SECTION 18

WATER RESOURCES

TABLE OF CONTENTS

SECTION 18

WATER RESOURCES

LIST OF TABLES

SECTION 18

WATER RESOURCES

LIST OF TABLES (CONTINUED)

SECTION 18

WATER RESOURCES

LIST OF TABLES (CONTINUED)

SECTION 18

WATER RESOURCES

LIST OF FIGURES

SECTION 18

WATER RESOURCES

LIST OF EXHIBITS

SECTION 18

WATER RESOURCES

LIST OF APPENDICES

SECTION 18

WATER RESOURCES

LIST OF REVISIONS DURING PERMIT TERM

REV. NUMBER	REVISION DESCRIPTION	DATE APPROVED

SECTION 18 WATER RESOURCES

The water resources baseline information and assessment provides a description of the pre-mine conditions of surface and groundwater flow and water quality within the permit area and adjacent areas. This baseline assessment is developed for the proposed Pinabete Mine Plan permit area (permit area). The proposed permit area will be within portions of the Area 4 North and Area 4 South resource areas of the BHP Navajo Coal Company (BNCC) mining lease, located on the western flank of the San Juan Structural Basin. The coal seams to be mined are associated with the Cretaceous Age Fruitland Formation (Section 17, Geologic Information). The baseline resource assessment for this permit application package establishes the foundation for the determination of probable hydrologic consequences for the proposed surface mine operation (Section 41, Probable Hydrologic Consequences) and for the design of water resources reclamation plans (Section 35, Hydrologic Reclamation Plan) that may be needed to protect surface and groundwater resources.

This baseline evaluation includes a review of reports and data concerning water resources of the region obtained from state and federal agencies, as well as the information developed for BNCC's Navajo Mine and by CONSOL Energy's (formerly Consolidated Coal) Burnham Mine. BNCC implemented a baseline hydrologic monitoring program to obtain additional site-specific information from four ephemeral stream monitoring sites, three surface water impoundment sites, 12 groundwater monitoring wells and piezometers, and 14 vibrating wire piezometers, located within BNCC mining lease Area 4 South and Area 5 that were installed in 1998 and 2007 to supplement the existing information.

18.1 Surface Water Resources

The Pinabete Mine Plan permit area is generally bounded by Pinabete Arroyo along the southwest side of the proposed permit area, by Navajo Mine permit area (Office of Surface Mining Reclamation and Enforcement (OSM) Permit No. NM-0003F) on the north, by the South Fork of Cottonwood Arroyo on the northeast, and the mining lease boundary on the east and west. The Pinabete mining area extends across approximately 8.75 square miles (sq mi) (5,569 acres) of the BNCC mining lease (Exhibit 18-1-1). Information pertaining to the No Name Arroyo, Brimhall Wash, and selected other regional drainages features are included in this Section to provide additional regional surface water information.

Pinabete Arroyo and the South Fork of the Cottonwood Arroyo are the primary surface water features within the permit area. Portions of the permit area also drain to the mainstem of the Cottonwood Arroyo and to an unnamed tributary to the Chaco River. The mainstem of the Cottonwood Arroyo and the Chaco River are outside of the permit area and will not be directly affected by proposed mining in the permit area. Cottonwood Arroyo, Pinabete Arroyo, and No Name Arroyo flow directly into the Chaco River. Cottonwood Arroyo has a watershed area of 79.8 sq mi. Pinabete Arroyo has a watershed of 60.3 sq mi, and No Name Arroyo has a watershed of 11.5 sq mi, (Table 18.1-1). The Chaco River flows north into the San Juan River and drains an area of approximately 4,350 sq mi.

Annual precipitation within the immediate area of the permit area is low, averaging 5.7 inches, and rainfall amounts vary considerably from year to year (Section 12, Climate). The average monthly precipitation varies from 0.1 to 1.2 inches per month, with the most precipitation occurring in July, August, and September (Section 12, Climate). The average annual evaporation rate for this area is about 55 inches per year (Section 12, Climate). Due to the great differential of excess evaporation over precipitation, surface water flow in streams in the permit area occurs only in response to major storm events and base flow is nonexistent.

18.1.1 Perennial and Intermittent Streams

Although the flow in Pinabete Arroyo and Cottonwood Arroyo is ephemeral, these streams are defined by OSM regulation 30 CFR 701.5 as intermittent because the drainage basin area is greater than 1 sq mi.

Cottonwood Arroyo has a drainage area of about 79.8 sq mi, including approximately 12.4 sq mi of the Chinde Wash that is diverted to the North Fork of the Cottonwood Arroyo by the Amarillo Canal. Slightly less than six percent of the Cottonwood Arroyo watershed lies within the permit area. The South Fork of the Cottonwood flows through the permit area. The drainage area of the South Fork of the Cottonwood upstream of the permit boundary is approximately 18.3 sq mi. An additional 2.7 sq mi are within the permit area, for a total drainage area of approximately 21.1 sq mi (Table 18.1-1 and Exhibit 18.1-2).

While the Pinabete Arroyo has a total drainage basin of approximately 60.3 sq mi, the size of the drainage basin area upstream of the point where Pinabete Arroyo exits the mine permit boundary is approximately 55.5 sq mi (Table 18.1-1 and Exhibit 18.1-2). BNCC has assembled baseline information on Pinabete Arroyo, Cottonwood Arroyo, and No Name Arroyo. BNCC has obtained baseline information on flow and water quality of Cottonwood Arroyo at three stations CNS-1, CS-1 and CN-1 as shown on Exhibit 18.1-2 and as described in Chapter 7 of Navajo Mine Permit Application Package (PAP) (OSM Permit No. NM-0003F) (BNCC 2009).

18.1.1.1 Stream Channel Characteristics

The stream channels of Pinabete Arroyo and the South Fork of the Cottonwood Arroyo will not be directly disturbed by proposed mining within the permit area. Culverts will be installed on these streams for the Burnham Road relocation. Construction of the Burnham road and culvert crossings may result in a temporary increase in sediment if storm runoff occurs during construction but, in the long-term, the crossings will be an improvement, due to the anticipated reduction in sediment loads, over the fords that currently exist where the Burnham Road crosses these streams. Stream buffer zones will be demarcated along these channels to prevent unauthorized disturbance of the designated channel reaches. Stream Buffer Zones are discussed further in Section 40.4.

The South Fork of the Cottonwood Arroyo is a major sand bed ephemeral drainage that passes through the northeastern portion of permit area. Exhibit 18.1-1 shows the watershed area and drainage configuration for Cottonwood Arroyo, including the South Fork of the Cottonwood Arroyo. Cottonwood Arroyo is characterized by a rapid increase in discharge from a dry channel to peak discharge, followed by a recession to low discharge over several hours. These rapidly varying flows can transport large of amounts of sediment and cause extensive change channel morphology, particularly noted at surface water station CNS-1. Total sediment and total dissolved solids concentrations are similar to regional values and average 97,989 mg/L and 656 mg/L, respectively.

The configuration of the sand bed channel of the segment of South Fork of the Cottonwood Arroyo, within the permit area, changes in response to the dynamics of sediment transport and deposition during the short duration high intensity flow events that naturally occur in the region. Exhibit 18.1-3 shows channel cross sections from monitoring stations in Cottonwood Arroyo before and after the large flow events that occurred in July and August 1999. The cross-sections, taken in early June 1999 and again in January 2000, show the amount of channel transformation due to large flow events. Only minor changes in channel cross section were observed at stations CS-1 and CN-1 while particularly large changes occurred at station CNS-1. At station CNS-1, the north bank (cut-bank) of the channel moved approximately 60-feet horizontally and channel bottom width increased from about 60 feet to 95 feet between the two survey events in June 1999 and January 2000. In addition to the loss of sediment on the cut-bank, some sediment was temporarily stored as evidenced by the formation of sand bars on the opposite bank and the sediment deposition on the flood plain from out of bank flows.

The main channel segments of Pinabete Arroyo and No Name Arroyo within BNCC's mining lease are similar to the sand bed channel characteristics of the South Fork of the Cottonwood Arroyo. These segments were inventoried in 1998 and 2007 to establish baseline characteristics. The results of the baseline channel inventory for Pinabete Arroyo and No Name Arroyo are included in Appendix 18.A. The purpose of this inventory was to document the channel conditions prior to mining, including bedrock outcrops, and indicators of channel instability such as knick points, channel cut banks, and channel scour or deposition. The channel bed and bank materials, cross sections, and vegetation characteristics were also noted. These properties provide an indication of the capacity of the stream channels to adjust and recover from potential changes in flows that may occur as a result of mining and reclamation.

Exhibits in Appendix 18.A display the channel profiles for Pinabete and No Name Arroyos and their tributaries within and adjacent to BNCC's mining lease. The channel cross sections for the corresponding segments of Pinabete Arroyo and No Name Arroyo at the stream monitoring stations are also provided on exhibits in Appendix 18.A.

Pinabete Arroyo is braided in many locations, reflecting the highly variable discharge rates, high bed load, limited vegetation, and high width to depth ratio. Channel depths range from 4 to 10 feet with widths varying from 20 to 80 feet. The main Pinabete Arroyo channel profile is mildly concave with slopes of 0.55% or higher at the upstream segment near the eastern permit boundary and decrease to about 0.33% downstream near the western permit boundary (Appendix 18.A). Sinuosity is relatively high downstream from Station P-1 for 1,500 feet, upstream and downstream of P-3 for 1,500 feet, and between P-5 and P-6 for 2,500 feet. No knick points, or convex segments, are present in the channel profile in the vicinity of the permit area. The channel maintains a slightly concave graded profile even though there may be continual reworking of sandy channel bed and bank materials. Minor changes in channel geometry and local slope may occur as a result of variation in the properties of channel materials and channel vegetation or in response to changing patterns of floods. Contributing tributaries are incised for as much as 300 feet upstream and exhibit head cuts ranging in height from 2 to 5 feet. Suspended sediment concentrations in storm runoff events are very high with TSS concentrations ranging from 10,200 to 521,000 mg/L in 26 baseline samples collected from Pinabete Arroyo (Table 18.1-13). For additional information refer to the 1998 and 2007 channel morphology reports in Appendix 18.A.

The main No Name Arroyo channel profile, plotted on exhibits in Appendix 18.A, was developed from 1-foot contour topography generated from aerial surveys conducted in 2008. It exhibits a variable slope with several knick points and convex segments, typical of an unstable channel. The knick point present in the channel profile near inventory location NNA-2 is associated with a 15-foot head cut and a deeply incised channel downstream of this location. Smaller head cuts were also found upstream of this point at locations just below the No Name Impoundment and at several points upstream of the No Name Impoundment. Sediment deposition is occurring at the impoundment where the Burnham Road (BIA Road No. 3005 and Navajo Road N-5082) crosses the No Name Arroyo. This deposition reduces sediment load in water that is released in outflows from the No Name Impoundment. The low sediment concentrations in impoundment outflows has accelerated erosion in the channel bed immediately downstream of the impoundment (Williams and Wolman 1984) and evidently contributes to the head cutting and channel incision observed in the reach further downstream of the impoundment. More detailed information on the channel morphology may be reviewed in the 1998 and 2007 channel morphology reports in Appendix 18.A.

18.1.1.2 Surface Water Flows

Between 1990 and 2000, BNCC performed baseline monitoring of surface water flows and water quality in Cottonwood Arroyo at three stations, CS-1 (South Fork), CN-1 (North Fork), and CNS-1 (main channel). Data collected during the ten years of baseline monitoring were submitted to OSM as part of the quarterly hydrologic reports and annual hydrologic reports for Navajo Mine (BNCC 2009). From 1990 through 1996, monitoring consisted of single stage sediment samplers in conjunction with crest gauges. From 1997 through 1999, monitoring consisted of automated samplers and ultrasonic water level sensors.

Storm runoff hydrographs for several flow events were generated from the measurements from ultrasonic water level sensors and are provided in Appendix 7-1 of the Navajo Mine PAP (BNCC 2009). These results indicate that for most flow events, runoff volumes (acre/feet) decrease from upstream to downstream. However, the two storm events in early August 1999 were an exception to this, in which runoff volumes increased from upstream to downstream. The loss of water from upstream to downstream is apparently the result of water infiltrating into the sand bed of the progressively widening channel downstream. The two flow events in early August 1999 that show a slight net increase in the total runoff volume from upstream to downstream were preceded by several flow events in late July 1999. These frequent flow and precipitation events would produce high antecedent moisture within the channel bottom, which in turn may limit channel bed infiltration. Also, intense precipitation between the monitoring stations, such as the 2.6 inches of precipitation recorded in August 1999 at MET II, may also account for the increase in flow at the downstream station during these events.

The hydrograph shape for most of the storm runoff events at the Cottonwood stations, particularly in the summer, is characterized by a very sharp rise or spike in the rising limb with a very short duration peak, followed by a gradual falling limb of the hydrograph (BNCC 2009). This hydrograph shape is characteristic of flash flows in ephemeral channels due to high intensity thunderstorms. The shape of the hydrograph and the duration and timing for an individual flow event is similar between stations (Appendix 7-1, Navajo Mine PAP, OSM Permit No. NM-0003F) (BNCC 2009).

Baseline surface water monitoring stations were established on No Name Arroyo and Pinabete Arroyo downstream of BNCC's mining lease in 1998 as shown on Exhibit 18.1-1. Prior to monitoring in year 2007, the lower Pinabete station was moved upstream approximately 6,000 feet from its 1998 location to provide a more suitable location closer to the mine permit boundary. Surface water monitoring stations were also installed on Pinabete Arroyo and No Name upstream of BNCC's mining lease. The monitoring stations were installed on relatively uniform straight channel segments and consisted of two or more single-stage samplers (Figure 18.1-1) and crest-stage gages (Figure 18.1-2) installed upstream and downstream of the single stage samplers to measure the slope of the water surface during the peak flow at the monitoring station.

Peak flow estimates (Q) reported in cubic feet per second (cfs) at each of the monitoring station locations (Table 18.1-2) were developed using Manning's equation as specified below:

$$Q(cfs) = 1.49 \times \frac{1}{n} \times A \times r^{\frac{2}{3}} \times S^{\frac{1}{2}}$$

The slope of the water surface (S) at each monitoring station location was determined from the measurements at the upstream and downstream crest-stage gages or from the slope of the channel when one of the crest stage gage readings was missing or erroneous. The cross-sectional area (A) and the hydraulic radius (r) corresponding to each measured crest-stage were digitized from the channel cross section at the monitoring station location.

The averages for the cross-sectional area (A) and the hydraulic radius (r) from the two crest stage gage locations at each station were used in Manning's equation to estimate flow except when one of the crest stage gage readings was missing or erroneous. In that case, the single value for A or r was used. The site-specific Manning roughness coefficient (n) was determined for each location during the stream channel inventory using the procedure for small channels as described in Gray (1970). Peak flows determined from crest-stage measurements during the 1997-1998 and 2007-2008 baseline monitoring period at the upstream and downstream sites on Pinabete Arroyo and No Name Arroyo are provided in Table 18.1-2.

Flows in the arroyos draining BNCC's mining lease are flashy and occur in response to short duration, high intensity precipitation events usually during the seasonal thunderstorm months of July through November. The thunderstorms are usually localized and the intense rainfall may not extend throughout the drainage area of the arroyo. Consequently, there may not be much consistency among flows measured upstream or downstream or in adjacent drainages as indicated in Table 18.1-2. Zero flow was recorded between November 1997 and June 1998 on both the Pinabete Arroyo and No Name Arroyo watersheds. Summer monsoonal rains in 1998 resulted in peak storm flows of 22.5 cfs at the upper Pinabete Arroyo site (Upper Pinabete), and 1,717 cfs at the downstream Pinabete Arroyo site (Lower Pinabete). The adjacent, but significantly smaller No Name Arroyo watershed exhibited a peak flow of 1.5 cfs at the upstream site (Upper No Name) in July, while no flow was reported at the No Name Arroyo downstream site (Lower No Name). The maximum peak flow of 2,307 cfs was observed in Pinabete Arroyo at the downstream site (Lower Pinabete) in August 1998, while the maximum peak flow observed in No Name Arroyo was 38.8 cfs at the downstream site (Lower No Name) in October 1998. Peak flow measured during 2007 and 2008 ranged from 0.2 to 7.5 cfs at the Pinabete Arroyo upstream site and from 0.4 to 46.6 cfs at the Pinabete Arroyo downstream site (Table 18.1-2). These peak flows are lower than the peak flows observed at the Pinabete Arroyo crest-stage gages in 1998. Peak flow measurements during 2007 and 2008 ranged from 0.7 to 19.1 cfs at the upstream No Name Arroyo site. The gages were damaged during a flow event in 2008 and were replaced. The peak flow estimates during 2007 and 2008 for the No Name Arroyo downstream site ranged from immeasurable to 111.1 cfs in 2007 and 2008 (Table 18.1-2). These peak flows at the lower No Name Arroyo location were higher than measured previously at this location during 1998. The 1998 water year appears to be an average water year, based on the examination of regional flows at two

U.S. Geological Survey (USGS) gages along the San Juan River in Farmington and Shiprock (Table 18.1-3).

SEDCAD™4 (SEDCAD) modeling was performed on Pinabete Arroyo, No Name Arroyo, and Cottonwood Arroyo to better characterize the flow and sediment regimes. Information used to develop the SEDCAD projections and modeling results are provided in Appendix 18.B. Table 18.1-4 provides a summary of the SEDCAD model results for peak flows and sediment yield for selected storm frequency events for the two surface water monitoring stations on Pinabete Arroyo, the two stations on No Name Arroyo, the South Fork Cottonwood Arroyo, Cottonwood Arroyo at Station CSN-1, and Cottonwood Arroyo at its confluence with the Chaco River.

About 48 percent of the Cottonwood Arroyo watershed is occupied by badlands which accounts for the high discharge and flow intensities observed in this stream. Peak flows from a 10-year, 6-hour (10yr-6hr) event on Cottonwood at Station CSN-1 located near the mining lease boundary are predicted to be about 2,879 cfs (Table 18.1-4). The Cottonwood Arroyo channel between the mining lease boundary and its mouth with the Chaco River has a uniform gradient. Suspended sediment concentrations are high during storm runoff events and the sandy channel bed and bank materials are reworked by the larger flood events.

The SEDCAD peak flow predictions for the Pinabete Arroyo, No Name Arroyo, and Cottonwood Arroyo are less than the predictions using USGS method for ungaged streams in northwestern New Mexico (Table 18.1-5). The USGS method was developed in cooperation with the Bureau of Indian Affairs to estimate the magnitude and frequency of peak discharges for ungaged streams within the Navajo Nation in Arizona, Utah, Colorado, and New Mexico (Waltemeyer 2006). Peak discharge estimates in Table 18.1-5 were calculated for Pinabete Arroyo, No Name Arroyo, and Cottonwood Arroyo using the regional equations developed in Waltemeyer (2006)

The SEDCAD predictions are thought to be more reliable, since the modeling incorporated detailed site-specific information on soils (e.g., K-factor and erodible particle size distributions) and cover values that were incorporated into subwatershed characterizations. In addition, the model accounts for the attenuation in flood flows associated with the No Name Impoundment on the No Name Arroyo.

Supplemental information is available from USGS regional sites located on Burnham Wash, a tributary to Brimhall Wash located southeast of the permit area (Site 9367936), the Teec-Ni-Di-Tso Wash, located within the region but further south from the Burnham Wash (Site 9367934), and the Chaco River gage (Site 9367938) (Exhibit 18.1-1). The first two sites have watersheds of 8.6 sq mi and 7.2 sq mi respectively, very similar in size to the 8.2 sq mi of the No Name Arroyo watershed above the mining lease boundary. The monthly average flow at Teec-Ni-Di-Tso Wash ranged from 0 to 2.2 cfs, with an average maximum daily flow of 3.6 cfs in January for the 5-year period between 1978 and 1982 (Table 18.1-6). This 5-year period had 2 years in the 25-50% quartile, 2 years in the 50-75% quartile, and 1 year, 1979, in the top quartile for daily flow (Table 18.1-3). Average zero daily flow days/month for the period of record ranged from 10 to 27 days, with the most days of flow in January and the fewest days of flow in June. The results for Burnham Wash, located southeast of the permit area on a tributary to Brimhall Wash, were similar (Table 18.1-7) to those reported for the Teec-Ni-Di-Tso Wash (Table 18.1-6). The monthly average flow in Burnham Wash ranged from 0.02 to 1.02 cfs, with an average maximum daily flow of 4.8 cfs in January for the 5-year period between 1978 and 1982. Average zero daily flow days/month for the period ranged from 7 to 26 days, with the most days of flow in January and February and the least days of flow in June and July.

Stream flow in the Chaco River is ephemeral upstream of the existing Four Corners Power Plant (FCPP) as indicated by observations and supported by the five years of flow monitoring on the Chaco River at the USGS Site 09367938 near Burnham, New Mexico (Exhibit 18.1-1). Measurable flows at this station occurred only in response to rainfall or snow melt events. Annual peak storm flows for the 1978 to 1982 (5-year) monitoring period ranged from 950 to 6,740 cfs. The number of flow days per month on the Chaco River is quite variable, with zero flow during many months and flow every day during April 1982 (Table 18.1-8). Average number of days of zero flow per month ranged from 27.6 days in June to 13.2 days in March (Table 18.1-8). The flow monitoring results at this station show that streamflow in the Chaco River occurs as discrete flow events that range from less than one day to more than several weeks that are separated by periods of zero flow that can range several days to several months.

Additional perspectives on flow in Pinabete Arroyo can be derived from monitoring performed at the CONSOL Energy's Burnham Mine on Brimhall Wash, located south of permit area (Exhibit 18.1-1). Part of the Brimhall Wash drainage lies immediately south and adjacent to Pinabete Arroyo. Both streams drain areas with similar landforms, soils, vegetation, and elevations. Brimhall Wash drainage is slightly larger at 85.2 sq mi as compared to Pinabete Arroyo with a 60.3-sq mi watershed. Brimhall Wash was monitored daily over a 3-year period, between October 1, 1977 and May 31, 1980, at two locations: Site M (downstream) and Site N (upstream) (Burnham Mine Permit Application Package on file at the OSM library in Denver, Colorado). Both sites experienced from 0 to 4 flow days/month for most months during the monitoring period, with a maximum of 10 flow days during August 1978 at Site N (Table 18.1-9). These results show that runoff from summer thunderstorms is localized and that channel conveyance losses can be considerable. For example, while 10 flow days were observed during August 1978 at the Site N, zero flow days were observed during August 1978 at Site M (Table 18.1-9). Runoff patterns on Pinabete Arroyo are expected to be similar to those observed at Brimhall Wash.

The No Name Impoundment is filled periodically by runoff from storm events. Water was first observed in the No Name Arroyo impoundment in November 1997 and remained in the impoundment until June 1998. A staff gage was installed in the impoundment during the spring of 1998. Staff gage levels were recorded on a monthly basis during year 1998 and as soon as possible after major precipitation events. These results are provided in Table 18.1-10. It appeared that water was lost from this impoundment by both seepage and evaporation. The impoundment was dry from late June until July 26, 1998, when it refilled to the spillway elevation during a storm runoff event. Water remained in the impoundment beyond December 1998. The invert of the spillway on the No Name Impoundment was surveyed in 2008 and was found to be 6 feet above the low point within the impoundment. The survey also showed that the storage capacity of the impoundment at the spillway invert elevation is 19.7 acre feet (ac-ft) and would cover an area of 8 acres. Spillway and elevation-area capacity details for the structure can be reviewed in the baseline SEDCAD runs on "No Name Watershed w/Impoundment", Structure 8, in Appendix 18.B.

18.1.1.3 Surface Water Quality

The Navajo Nation has adopted the Navajo Nation Surface Water Quality Standards (Navajo Nation Environmental Protection Agency [NNEPA] 2008) which established various surface water use quality standards. These standards apply to all Waters of the Navajo Nation which include, but are not limited to, ephemeral, intermittent, and perennial streams, springs, wetlands, and any natural or man-made depressions or basins that impound water within the border of the Navajo Nation. The standards associate specific uses with specific stream reaches including the Cottonwood Arroyo, Brimhall Wash, and the Chaco River. Specific uses have not been identified for No Name Arroyo and Pinabete Arroyo. It is likely that No Name and Pinabete Arroyos would share the standards with the Chaco River as they are nonperennial tributaries. Designated uses for Cottonwood Arroyo, Brimhall Wash, and the Chaco River include livestock watering (LW), aquatic & wildlife habitat (A&WHbt), fish consumption (FC), and secondary human contact (ScHC) standards (NNEPA 2008). The applicable standards for the designated uses have been identified on Table 18.1-11. The NNEPA has no water quality standard for total dissolved solids (TDS), sulfate, or fluoride but relevant livestock use criteria from Lardy, Stoltenow, and Johnson (2008) have been included in Table 18.1-11 to help assess the suitability of surface water for livestock use. The Navajo Nation surface water quality standard for suspended sediment applies only to surface water that is at or near base flow and does not apply to surface water during or soon after a precipitation event and is therefore not applicable to ephemeral flows (NNEPA 2008).

The USGS monitoring records indicate that sizeable peak flows periodically occur due to high intensity thunderstorm events. The duration of flow resulting from these events is extremely short and typical of ephemeral runoff events. Sampling of such short-duration stream flows with passive single-stage samplers ensures the collection of samples from episodic events. In addition, samplers can be located at several stages within the stream, thereby enabling collection of samples at different flow depths. Figure 18.1-1 shows the design for the single-stage sediment sampler and Figure 18.1-2 shows the crest stage gage design. The intake on the single-stage samplers points downstream to reduce plugging from debris that might be present in the stream flow. Each sample location along in Pinabete Arroyo and No Name Arroyo had three single-stage sediment samplers at different locations along the channel cross section. Single-stage sediment samplers were also used from 1990 through 1996 at the three Cottonwood Arroyo monitoring stations, CS-1 (South Fork), CN-1 (North Fork), and CNS-1 (main channel). These stations were replaced by automated samplers and ultrasonic water level sensors for the baseline monitoring period from 1997 through 1999.

Analytical results of water samples collected at these monitoring stations are summarized in Tables 18.1-12, 18.1-13, and 18.1-14 and are discussed below. Flows associated with the water quality samples from the single-stage samplers were inferred from the estimated peak flow for the crest-stage measurements obtained at the same time that the samples were collected.

Samples collected by the automated sampler on the Cottonwood stations CN-1, CS-1, and CNS-1 were analyzed for chemistry and total sediment. For each sample/flow event, only the first sample bottle collected was analyzed for chemistry from each station with the remaining samples analyzed for total sediment. A total of 314 water samples were collected from these stations between 1997-1999, with 255 of these samples analyzed for total sediment and 59 samples analyzed for chemistry. An additional 233 samples were obtained from 1990 to 1997 at these stations from the single stage samplers and from occasional grab samples.

Table 18.1-12 provides a summary of the median concentrations for water quality analysis results from samples collected at each of these Cottonwood baseline monitoring stations. These results show that for all three stations the dominant water type is a sodium sulfate. The median total dissolved solids concentration (TDS) for CN-1 is 780 mg/L with a range of 290-6,220 mg/L. The median TDS concentration for CS-1 is 675 mg/L with a range of 305-9,060 mg/L and for CNS-1 the median TDS concentration is 610 mg/L with a range of 315-15,600 mg/L. These values indicate a slight decrease in TDS concentration from upstream to downstream. More importantly, these values are typical of regional TDS concentrations for surface water quality. Station CN-1 has a slightly higher concentration of sulfate and TDS, which may reflect slightly different soil types in the watershed and possible Navajo Indian Irrigation Project (NIIP) impacts.

Surface water data were collected and analyzed for different parameters during the three years of water monitoring conducted between 1998 and 2008 at stations on Pinabete and No Name Arroyos. Samples were acquired from two sites in Pinabete Arroyo, Upper Pinabete (upstream), and Lower Pinabete (downstream). Samples were collected at the Upper Pinabete site on four dates in 1998, two dates in 2007, and two dates in 2008 (Table 18.1-13). Samples were collected at the Lower Pinabete site on five dates in

1998, four dates in 2007, and two dates in 2008 (Table 18.1-13). On some of the sample dates, samples were obtained from more than one of the single-stage sample containers at a sampling location. The surface water in Pinabete Arroyo is a sodium sulfate type (Figure 18.1-3 and Figure 18.1-4) and had a hardness ranging from 29 to 413 mg/L as calcium carbonate ($CaCO_3$), with a median value of hardness of 108 mg/L as $CaCO_3$. The conductivity ranged from 396 to 1,940 micro Siemens per centimeter (μS/cm), with a median value of 723 μS/cm. Dissolved aluminum values for all samples ranged from <0.1 to 2.3 mg/L, with a median value of 0.27 mg/L. The chronic aquatic standard for dissolved aluminum is 0.087 mg/L, so virtually all baseline background samples were elevated above that level. Total suspended solids (TSS) values ranged from 10,200 mg/L to 521,000 mg/L, with a median value of 79,200 mg/L. These high sediment loads are consistent with water quality from ephemeral drainages in arid regions. Boron concentrations ranged from 0.06 to 0.9 mg/L. Most of the cadmium results were less than the detection limit of 0.00055 mg/L but four samples detected cadmium at concentrations above the hardness dependent chronic aquatic and wildlife crition of 0.00026 mg/L. Copper concentrations ranged from 0.006 to 0.026 mg/L, with a median value of 0.009 mg/L and approximately half the samples above the hardness dependent chronic aquatic and wildlife crition of 0.00956 mg/L. Fluoride concentrations range from <0.20 to 1.19 mg/L. The Upper Pinabete station had dissolved iron concentrations which ranged from <0.05 to 7.00 mg/L while the Lower Pinabete station had values which ranged from <0.02 to 20.3 mg/L. Total iron values ranged from 125 to 1,940 mg/L at the upstream site and ranged from 6 to 1,220 mg/L at the downstream site. The NNEPA has no surface water quality standard associated with iron. For three events, mercury levels were detected at concentrations in excess of the chronic aquatic and wildlife habitat standard of 0.001 μg/L. For all other events, the mercury levels were less than the detection limit, but the method detection limit for mercury of 0.2 μg/L is higher than the chronic aquatic and wildlife habitat standard. Dissolved selenium concentrations range from <0.001 to 0.007 mg/L with some of the concentrations in excess of the chronic aquatic and wildlife habitat standard of 0.002 mg/L.

Samples were acquired from two sites in No Name Arroyo, Upper No Name (upstream) and Lower No Name (downstream), during the 3 years of water monitoring conducted between 1998 and 2008. Samples were collected at the Upper No Name site on two dates in 1998 and on three dates in 2008 (Table 18.1-14). Samples were collected at the Lower No Name site on three dates in 1998, one date in 2007, and one date in 2008 (Table 18.1-14). On some of the sample dates, samples were obtained from more than one of the single-stage sample containers at a sampling location. The water at the upstream site (Upper No Name 3) is a sodium-bicarbonate type, while the downstream site (Lower No Name 1) is a sodium sulfate type (Figure 18.1-4 and Figure 18.1-5). Hardness ranged from 32 to 558 mg/L, with a median value of 106 mg/L. Conductivity ranged from 150 to 1,330 μS/cm, with a median value of 314 μS/cm. The conductivity results are consistent with the TDS concentrations, which ranged from 100 mg/L to 1,030 mg/L, with a median value of 353 mg/L. Dissolved aluminum ranged from 0.15 to 1.65 mg/L. Eight of 13 dissolved aluminum values are elevated above the aquatic and wildlife habitat limit of 0.087 mg/L, but the detection limit of the other 5 samples exceeded the limit. This is often related to the high concentrations of some analytes that interfere with detection of other analytes at very low concentrations.

Total suspended solids (TSS) values ranged from 367 mg/L to 395,000 mg/L, with a median value of 16,300 mg/L. The two samples collected on August 13, 1998 at the Lower No Name station also show increasing suspended solids with increasing flow as the #2 sampler is set at a higher intake stage. These samples also exhibit considerable variation in major ion concentrations between samples collected at different intake stages during the same runoff event. Dissolved iron concentrations ranged from <0.05 mg/L to 3.31 mg/L on No Name Arroyo, while total iron concentrations ranged from 3 to 6,020 mg/L on sampling at Upper No Name and 1 to 419 mg/L for sampling on Lower No Name. Boron concentrations ranged from <0.05 to 0.5 mg/L, fluoride concentrations ranged from 0.19 to 0.89 mg/L, and dissolved selenium concentrations were less than 0.1 mg/L.

Analysis results of samples from two sites in Brimhall Wash were provided in the Burnham Mine Permit Application Package, on file in the Office of Surface Mining Library in Denver, Colorado. Seventeen samples were collected at the upstream site (Site N), and 19 samples were collected at the downstream site (Site M) between March 14, 1990 and January 8, 1995 (Table 18.1-15). Both sites exhibit sodium sulfate-type waters (Figure 18.1-6), with a median hardness of 113 mg/L $CaCO_3$. Specific conductance varies substantially, with recorded results ranging from 142 to 27,800 µS/cm. The highest value was recorded following a large storm event on July 23, 1990. Excluding that value, the average specific conductance was 1,277 µS/cm. Total dissolved solids ranged from 10 to 27,500 mg/L, with a median value of 940 mg/L. Three of 36 samples exhibited TDS levels above the relevant livestock use criterion of 3,000 mg/L (Lardy et.al. 2008). Flows at the sites were storm related and sediment laden. Total suspended solids at the two sites ranged from 11,800 to 128,420 mg/L, with a median value of 57,660 mg/L. Total iron values range from 0.27 to 7480 mg/L, with a median value of 202 mg/L. Boron concentrations ranged from 0.02 to 0.36 mg/L and fluoride concentrations ranged from 0.1 to 2.0 mg/L, with a median of 0.9 mg/L. Total selenium was analyzed three times and was always less than the method detection limit at <0.005 mg/L, although the method detection limit for selenium slightly exceeds the aquatic and wildlife habitat standard of 0.002 mg/L. Total mercury was detected in only one of four samples at a concentration of 0.0006 mg/L and was less than the method detection limit of 0.0005 mg/L in the other three samples. Both the detected value and the detection limit for total mercury exceed the chronic aquatic and wildlife habitat limit of 0.001 ug/L. This was also the case with total selenium, which had a detection limit of 0.005 mg/L, while the chronic aquatic and wildlife habitat criterion is 0.002 mg/L. Sulfate concentrations varied substantially, with results ranging from 29 to 18,100 mg/L and a median value of 356 mg/L. Six of 35 values for sulfate exceeded the relevant criterion for livestock use of 1,000 mg/L.

From a general water quality characterization perspective, the samples from the Pinabete Arroyo, No Name Arroyo, and Brimhall Wash monitoring locations (Table 18.1-13, Table 18.1-14, and Table 18.1-15, respectively) appeared to exhibit higher concentrations of major ions and TDS in the first major runoff event of the season as compared to subsequent events. The results from the Upper No Name monitoring station show lower levels of TSS, settleable solids, TDS, and major ion concentrations than were observed at the Lower No Name station or at either of the Pinabete Arroyo monitoring stations. The sodium adsorption ratios were also lower in the samples taken from the No Name Arroyo stations as compared to the Pinabete Arroyo stations.

Changes in TDS and TSS concentrations at upstream and downstream locations on Brimhall Wash were evaluated in the Burnham Mine Permit Application Package on file in the Office of Surface Mining Library in Denver, Colorado (Table 18.1-16 and Table 18.1-17). These results show median TDS concentrations of 845 mg/L at the upstream site (Site N) and 843 mg/L at the downstream site (Site M). Median TSS concentrations were 20,810 mg/L at the upstream site (Site N) and >20,000 mg/L at the downstream site (Site M). Exceptionally high TSS concentrations were often associated with elevated TDS concentrations.

The USGS monitored stream flow continuously over the period from November 1975 through September 1994 at Station 09367950 on the Chaco River near its mouth as shown on Exhibit 18.1-1. Suspended sediment concentrations were also monitored at this station over the period from October 1976 through September 1982. The stream-flow data show base flows ranging from 0 to 30 cfs during non-storm periods and annual peak storm flows ranging from 1,170 to 6,410 cfs. Discharges from Morgan Lake near the FCPP generate a perennial flow in this lower reach of the Chaco River. Suspended sediment concentrations vary with discharge and typically range from 300 to 5,000 mg/L, except during storm runoff events when concentrations typically range from 50,000 to 150,000 mg/L (USGS 2009).

18.1.2 Lakes, Reservoirs, Other Water Bodies

There are no lakes or reservoirs within the permit area. However, there are three small impoundments within the permit area, one on a tributary to Cottonwood Arroyo and two on tributaries to Pinabete Arroyo as shown on Exhibit 18.1-2. These are stock watering ponds that catch surface flows from some tributary drainages. These impoundments extend across less than 2 acres each and are often dry. The stock water ponds are not used for irrigation, consumption by humans, or purposes other than livestock watering.

The small pond, on a tributary to Cottonwood Arroyo in Area 4 North on the northwest side of the permit area shown as Pond 4N in Exhibit 18.1-2 has a limited drainage and is usually dry. The small stock impoundment on a tributary to Pinabete Arroyo designated as Stevenson's Well Pond provides a water source for local recharge of the alluvial well located immediately downgradient of the pond. The third pond, located on a tributary to Pinabete Arroyo at the boundary between Area 4 North and Area 4 South, is designated as the 4N/4S Pond as shown on Exhibit 18.1-2. Water samples were collected at both the 4N/4S Pond and at the Stevenson's Well Site pond. The analytical results from these ponds are summarized in Table 18.1-18. The concentration of dissolved aluminum in one sample at the 4N/4S Pond with a concentration of 0.38 mg/L exceeded the chronic aquatic and wildlife limit of 0.087 mg/L. The cadmium limit is hardness dependent. There is no data on the hardness of these samples, but using the median hardness along Pinabete of 108 mg/L, the dissolved cadmium chronic aquatic limit is 0.00026 mg/L (Table 18.1-11), which is exceeded by the concentration of 0.00107 mg/L at the 4N/4S Pond, and 0.01397 mg/L at the Stevenson's Well Site pond. Samples collected in 2007 and 2008 from these ponds were also analyzed for pesticides and polychlorinated biphenyls (PCBs). These results show that pesticides and PCB values were below detection limits (Appendix 18.C).

Other ponds are found within the study area but outside the permit area. The largest of these is the No Name Impoundment located on the No Name Arroyo channel at the intersection of Burnham Road (BIA Road 3005 and Navajo Road N-5082) and No Name Arroyo. This impoundment holds varying amounts of water depending upon the occurrence of storm runoff. Water containment is seasonal according to the monthly monitoring that occurred in 1997 and 1998. The No Name Impoundment contained water from December 1997 past June 11, 1998. When the water level in the impoundment was checked again on July 21, 1998, it was dry and appeared to have been dry from some time. Following storms on July 26, 1998, the impoundment refilled with water, reflecting the fact that storage in the impoundment is dependent on surface water inflow from storm events. Enhanced vegetation growth immediately downstream of the No Name Impoundment strongly suggests that localized groundwater is present due to seepage from the impoundment.

Water quality samples have been collected at No Name Impoundment. Grab samples were obtained monthly in 1998 from the No Name Impoundment when it contained water and was free of ice cover. The analytical results for the water quality samples from the impoundment are summarized in Table 18.1-18. Comparison of the monthly sample results shows higher concentrations of major ions, TDS, and Sodium Adsorption Ration (SAR) in April and May as the impoundment was drying up than in July and August after the impoundment was filled by major storm runoff events on July 26, 1998 and August 21, 1998. Based on these results, the water in the No Name Impoundment appears to be acceptable for livestock watering use even when concentrated by evaporation during storage. Data collected in 2007 and 2008 show PCB values were below detection limits (Appendix 18.C). There were elevated concentrations of dissolved aluminum above chronic aquatic and wildlife habitat standard. Cadmium chronic aquatic habitat standards are hardness dependent, and the No Name Impoundment had a median hardness of 117.5 mg/L $CaCO_3$ from 1998 sampling, which results in a standard of 0.00028 mg/L for cadmium. Dissolved cadmium concentrations were 0.00025 mg/L on April 10, 2008 and 0.01397 mg/L on August 12, 2008.

The median hardness of 117.5 generates a chronic aquatic habitat standard of 0.01028 for copper, and the dissolved copper concentrations were 0.0285 mg/L on April 10, 2008 and 0.0088 mg/L August 12, 2008.

18.1.3 Discharges into Surface Water Bodies

There are no springs, seeps, or man-made discharges into surface water bodies within or adjacent to the permit area.

18.1.4 Surface Water Resources Information Collection and Analysis

BNCC has obtained baseline information on flow and water quality of Cottonwood Arroyo at three stations CNS-1, CS-1 and CN-1 during the period from 1990 through 1999. BNCC also implemented a baseline hydrologic monitoring program on Pinabete and No Name Arroyos in 2007 and 2008 to supplement monthly data collected in 1998. Water quality and flow information was obtained during this baseline monitoring program from two stream monitoring sites located near the permit boundary on Pinabete Arroyo and from two monitoring stations on No Name Arroyo near the mining lease boundary. Samples were also collected and analyzed for water quality at two impoundments located within the permit area and at the No Name Impoundment located on No Name Arroyo south of the permit area.

A crest-stage gage and single-stage sediment sampler were installed near the upstream and downstream permit boundaries on Pinabete Arroyo and No Name Arroyo. The locations of the crest stage gages and sediment samplers are shown on Exhibit 18.1-1. The designs of the single-stage sediment sampler and crest stage gage are shown in Figure 18.1-1 and Figure 18.1-2, respectively. Surveyed channel profiles and cross sections were established at the crest-stage gage locations. All water samples included field measurements of pH, temperature, and specific conductance. Water quality parameters, consisting of total suspended solids, settleable solids and total dissolved solids, dissolved and total iron and manganese, major cations and anions, 12 trace metals, 3 minor anions, and 2 radium isotopes. The sampling suite and associated data for Pinabete Arroyo and No Name Arroyo samples are summarized on Table 18.1-12 and Table 18.1-13, respectively. Quality assurance and quality control information for the 2007-2008 surface water data is provided in Appendix 18.D.

Channel profiles and cross sections at the crest stage gage locations were surveyed in 2007 and compared to the survey performed in 1998. This comparison provided limited evidence of midterm morphological changes for the project area and provided insights into channel stability.

18.2 Groundwater Resources

The groundwater baseline assessment provides a description of the pre-mine conditions for each water-bearing stratum, including the coal seams and any potentially impacted strata below the lowest coal seam to be mined. The baseline assessment also establishes the foundation for the determination of probable hydrologic consequences for the surface coal mine operation (Section 41, Probable Hydrologic Consequences) and for the design of water monitoring and mitigation plans that may be needed to ensure that there is no material damage to groundwater resources.

A number of studies of the geology and groundwater hydrology have been conducted by the New Mexico Bureau of Mines and Geology and the USGS in the vicinity of the permit area. BNCC has also conducted extensive drilling and exploration within its mining lease, which, together with data from the nearby Navajo Mine, provide information about the geology and groundwater hydrology of the area to be mined. BNCC has also implemented a groundwater monitoring program (Section 42, Monitoring, Maintenance, Inspections, and Examinations) to obtain site-specific information on groundwater levels, aquifer characteristics, and groundwater quality to supplement the existing information.

18.2.1 Springs, Seeps, and Other Groundwater Discharges

Direct recharge of overburden is quite low due to the arid climate with average annual precipitation of less than 6 inches and annual evaporation rate of about 55 inches (Section 12, Climate). Recharge rates measured by chloride mass balance methods on undisturbed areas at the nearby Navajo Mine ranged from 0.002 to 0.09 in/yr (Stone 1987). Due to the very low rates of recharge, groundwater discharge rates are also quite low and insufficient to sustain base flow at any streams in the vicinity of the permit area, including the Chaco River.

Site reconnaissance and review of springs identified by the New Mexico Office of the State Engineer (NMOSE) (2010) Navajo Settlement Agreement found no springs within or adjacent to the permit area. Several springs were identified outside the adjacent area as shown on Exhibit 18.2-1. One spring, S-0846 (BIA NO. U-30), was identified about 2.5 miles north of the permit area, immediately west of Navajo Mine Area 3 on Lowe Arroyo. The use of this spring was listed as unknown and the spring was not found during site reconnaissance. Also, the Cottonwood Springs, BIA designations 13R-103 and 13R-104, are identified as spring S-0127 in the NMOSE (2010) Navajo Settlement Agreement. These springs are on upper Cottonwood Arroyo about 4.2 miles northeast of the permit area. Finally, two springs, #52 and #53, were identified in an inventory of wells and springs conducted by Billings and Associates, Inc (BAI) in 1985 for the Navajo Mine. The approximate locations for these springs from the BAI inventory are shown on Exhibit 18.2-1. It is possible that these springs may be the same as the Cottonwood Springs since a number of the springs and wells in the BAI inventory were not mapped accurately.

An intermittent artificial seep was also identified during the site reconnaissance at a location immediately below the surface impoundment on No Name Arroyo. Enhanced vegetation, consisting of dense salt cedar, brush, and grass, occurs for several hundred feet downstream of the No Name impoundment. This seep is the result of the surface impoundment and not a location of groundwater discharge and is not shown on

Exhibit 18.2-1. One location for potential groundwater discharge was identified during the site reconnaissance by enhanced vegetation growth and salt deposits along the on the channel bed and banks at a location on Pinabete Arroyo approximately 1,400 feet upstream of the Burnham Road crossing. These features suggest the presence of a groundwater discharge that is insufficient to sustain flow (Brown 1976). The groundwater source may be from the No. 8 coal seam, which outcrops in the vicinity of this location or it could be from the alluvium, which is known to be partially saturated upstream near the eastern permit boundary at alluvial well PA-1. It is unlikely that these salt deposits are due to evaporation of residual runoff because they occur along the channel bed and bank, not in depressions, and do not extend upstream or downstream of this isolated location.

Groundwater flow directions in the Pinabete alluvium follow the surface water down gradient towards the Chaco River. However, there are no indications of groundwater discharge along the Chaco River in the vicinity of Pinabete Arroyo. The only springs and seeps noted along the Chaco River are far to the north near the FCPP where Stone et.al. (1983) report that several short reaches of the Chaco River flow due to springs issuing from the alluvium. This surface water flow is discussed in Section 18.1.1.

Based on the potentiometric surfaces presented in Section 18.2.4, flow directions in the Fruitland coals are toward the north-northeast. Potentiometric gradients in the Pictured Cliffs Sandstone (PCS) are toward the north. The northerly gradients in these potentiometric surfaces are influenced by the topographic low along the San Juan River valley. There may also be some local influence of topographic lows along the Chaco River tributaries on potentiometric gradients in these units. Potential rates of discharge from these bedrock units are extremely low due to the low recharge rates and low hydraulic conductivity of these units.

18.2.2 Wells

An inventory of water supply wells located within and adjacent to the permit area was prepared from well information from a several sources. The sources include the water supply wells identified by the NMOSE (2010) Navajo Settlement Agreement, the inventory of wells conducted by BAI in 1985 for the Navajo Mine, wells identified in the “Groundwater Operations Manual and Well Survey for Navajo Mine and Vicinity” that was completed by Metric Corporation (1991), and wells found in review of permits on file at the Navajo Nation Water Resource Management office in Fort Defiance, Arizona.

The study area for the inventory presented in this section extends from Chaco River and its alluvium on the west to about four miles east of BNCC’s mining lease shown in Exhibit 18.2-1. Relevant information on the wells shown in Exhibit 18.2-1 is provided in Table 18.2-1. Wells that were installed for the sole purpose of monitoring are not shown on Exhibit 18.2-1. These monitoring wells, including the monitoring wells that have been abandoned, are depicted on Exhibit 18.2-2. Although the completion zone for some of the wells is not specified in the information sources, it is believed that almost all of the water wells located within the study area are completed within the alluvium of the Chaco River, Pinabete Arroyo, and Brimhall Wash due to their locations on Exhibit 18.2-1. Only four of the wells in Table 18.2-1 are believed to be completed in bedrock formations. Well 13-AW is a flowing artesian oil and gas well that was converted to stock water use that is sourced from bedrock below the PCS, most likely from the Menefee Formation. The completion zone for well W-606, located in Area 5 of the BNCC mining lease, is not specified. This well was capped and welded shut during the site reconnaissance and the well depth could not be measured. However, based on the depth reported by Metric Corporation (1991), this well may be completed within the PCS. Likewise, Tribal Well 13-7-2, located approximately 300-feet south of the Burnham Chapter House, is a PCS well that was originally installed for water supply for Burnham. It was replaced and abandoned due to poor yield and poor water quality. Finally, Well #90, located along the Chaco River north of Brimhall Wash, was identified as a PCS well in the BAI inventory for Navajo Mine. These water-bearing units are deeper than the PCS but it is possible that the uppermost screen interval in this well could be within the PCS.

The following three water wells were indicated to be within the permit area from one or more of the various sources of available information used for the well inventory:

- Well W-0345 (13R-48) is a dug alluvial well located on Pinabete Arroyo west of the Burnham Road. This well includes a hand pump and tank and is used for stock watering.
- Well #70 is identified in the 1985 BAI inventory for the Navajo Mine as a dug alluvial well. This well could not be found in the site reconnaissance and alluvium does not exist at the location identified by BAI.
- Well W-0343 (13-5-1) is an alluvial well located on a tributary to Pinabete Arroyo adjacent to the Burnham Road. This well is recharged by an adjacent man-made pond (Stevenson Well Pond) and is equipped with a hand pump. This well is also referred to as the Stevenson Well.

Well W-0344 (#93) identified as a Pinabete alluvial well several hundred feet south of the permit area at a location adjacent to the Burnham Road was not found in the site reconnaissance.

18.2.3 Aquifers and Other Groundwater Resources

The hydrogeologic units within and adjacent to the permit area that could potentially be affected by proposed mining and reclamation within permit area include:

- The alluvium of the Chaco River, Cottonwood Arroyo, and Pinabete Arroyo
- The coal seams of the Fruitland Formation
- The Pictured Cliffs Sandstone (PCS), located below the Fruitland Formation No. 2 coal seam

Alluvial fill deposits occur in the valley bottoms of the Cottonwood Arroyo and Pinabete Arroyo, within the permit area, along the Chaco River to the west of the permit area and along portions of No Name

Arroyo southwest of the permit area. However, these deposits are not considered Alluvial Valley Floors (AVF). Refer to Section 19 (Alluvial Valley Floors) for information on the negative determination for AVF within and adjacent to the permit area. Portions of the alluvium of Cottonwood Arroyo and Pinabete Arroyo are saturated and will yield water to wells, as evidenced by the dug wells completed in the alluvium of both the Cottonwood Arroyo and Pinabete Arroyo as indicated in Section 18.2.2 (Exhibit 18.2-1). The alluvium of the Chaco River also contains groundwater as indicated by the dug wells located adjacent to the Chaco River (Exhibit 18.2-1). As stated in Section 18.2.1, the groundwater is not sufficient for sustained base flow in any of these drainages.

The alluvium of No Name Arroyo was found to be dry based on alluvial monitoring well GM-23, which was installed in 1976 in association with a proposed coal gasification project and screened only in the alluvium of No Name Arroyo. This well was plugged and abandoned in 1994 by BNCC at the request of the OSM. Two new alluvial monitoring wells, NNA-1 and NNA-2, were installed in 1998 at locations upstream and downstream of the No Name Impoundment as shown in Exhibit 18.2-2. Water level monitoring data from these wells further support the dry character of the alluvium along No Name Arroyo. However, saturated conditions may occasionally occur within the alluvium of No Name Arroyo for a relatively short distance downstream of the No Name Impoundment due to seepage from the impoundment. The No Name Impoundment is discussed in Section 18.1.2.

Groundwater is also found in the coal units of the Fruitland Formation and in the PCS, which underlies the Fruitland Formation in the permit area. The geologic strata within the permit and adjacent area dip gently to the east toward the center of the San Juan Basin at an angle of 1 to 2 degrees. A more thorough description of the regional and localized geology of the permit area is provided in Section 17 (Geologic Information). Based on both regional and site-specific information, the Fruitland Formation and associated coal units, and the PCS are unsaturated or partially saturated near the outcrop of these units on the western side of the permit area but become saturated to the east and down dip of the outcrop.

Based on baseline information obtained from water level elevations measured in the wells and piezometers, the general groundwater flow directions in the Fruitland Formation within Area 3, Area 4 North, Area 4 South, and Area 5 of the BNCC mining lease are vertically downward through the interbedded shale and coal units of the Fruitland Formation and into the PCS and laterally within individual coal seams toward the north-northeast with some localized flow toward the topographic lows along the Cottonwood Arroyo and Pinabete Arroyo. Although the vertical hydraulic conductivities of the interbedded shales in the Fruitland Formation are quite low, recharge rates are lower still. Direct recharge rates measured by chloride mass balance methods on undisturbed areas at the Navajo Mine ranged from 0.002 to 0.09 in/yr (Stone 1987). The highest recharge rate of 0.09 in/yr was for valley terraces while the lowest recharge rate of 0.002 in/yr was for badland areas. Recharge from upland flats averaged 0.03 in/yr. Based on the research by Kearns and Hendrickx (1998), areal recharge is thought to occur during very large precipitation events and during extended wet periods with increasing soil moisture. Recharge is expected to be higher from saturated alluvium and surface impoundments. Although Stone's research (1986 and 1987) did not include recharge estimates for surface impoundments, it does provide an estimate of an average recharge rate of 0.16 in/yr from depressions within reclaimed mine areas at the Navajo Mine.

Based on BNCC's mining experience at Navajo Mine, the coals, overburden, and interburden in the Fruitland Formation are not expected to yield much water during mining. The saturated sands that occur in the Fruitland Formation are of limited extent and only yield significant water when recharged by water from the NIIP. NIIP influences do not extend into the drainages associated with the permit area, although the North Fork of the Cottonwood Arroyo does receive direct discharges of water from irrigation canals. The direct discharges occur when an over supply of water in the canal is released directly to the stream channel. Direct discharge is highly variable, occurs quickly, and can last up to 12 hours. However, usually there is no flow in Cottonwood Arroyo and it retains the characteristics of an ephemeral stream. The pre-mine groundwater in the Fruitland Formation throughout most of the BNCC mining lease will not support beneficial use because of the very low well yields and poor water quality. As indicated in Section 18.2.2, there are no known water supply wells completed in the Fruitland Formation within or adjacent to the permit area.

The PCS is a well-cemented, low-permeability, marine sand and is the first water-bearing unit below the lowest coal seam to be mined (No. 2 coal seam). Based on the information in Section 17 (Geologic Information), the PCS is approximately 110 to 120 feet thick and follows the structure of the Fruitland Formation, dipping to the east at approximately 2 degrees, although the structure varies locally. The PCS conformably overlies the Lewis Shale, with the contact marked by a zone of interbedded sandstones and mudstones in the lower part of the PCS (Stone et.al. 1983). It outcrops just west of the mine area and east of the Chaco River. Within and adjacent to the permit area, the general groundwater flow in the PCS is toward the north. The PCS is also a natural gas reservoir in the San Juan Basin. Stone et.al. (1983) state that the PCS cannot be considered a major aquifer and it is important only because it is the water-bearing horizon immediately underlying the coals in the Fruitland Formation.

Water yields from monitoring wells completed in the PCS at the BNCC's mining lease are quite low. Two of the PCS wells, KPC2007-2 and KPC2007-3, installed within the BNCC Navajo mining lease south of the permit area were quickly pumped or bailed dry during conventional sampling. The yield from PCS monitoring well KPC98-01, located west of the permit area wells was sufficient to sustain a rate of about 0.4 gallons per minute (gpm) during a constant rate pumping test. The fourth PCS monitoring well KPC2007-01 was installed within the permit area. This well was pumped dry after about 140 minutes during a constant-rate pumping test at a rate of about 0.95 gpm with most of the pumped water derived from well bore storage.

There are no known water supply wells completed in the PCS within or adjacent to the permit area. As indicated in Section 18.2.2, one water supply well, 13-7-2, was installed in the PCS south of the BNCC mining lease near the Burnham Chapter House as shown in Exhibit 18.2-1. This well was originally completed as a water supply for the Burnham Chapter House but was replaced and abandoned due to the poor yield and poor water quality. Another well, 13-15-1, located south of the permit area and within Area 5 of BNCC's mining lease could also be screened in the PCS as discussed in Section 18.2.2.

18.2.3.1 Groundwater Quantity

Monitoring wells and vibrating wire piezometers (VWPs) were installed in the Fruitland coal seams, in the alluvium of Pinabete Arroyo and No Name Arroyo, and in the PCS in 1998 and in 2007 for baseline hydrogeology characterization of Area 4 South and Area 5 of BNCCs mining lease. The No. 3 coal seam was the target for much of the characterization of the Fruitland Coal because the No 3 coal seam is continuous over most of Area 4 South and Area 5 of the BNCC mining lease. The No. 2 and No 3 coal seams are hydrologically connected and sometimes merge within the mining lease area. Three monitoring wells and three VWPs were installed in the No. 3 coal seam. Four VWPs were also installed within the No. 2 coal seam within Area 4 South and Area 5 of the BNCC mining lease.

The upper coal seams (Nos. 6, 7, and 8) do not exist over the entire lease area but outcrop toward the western limits of the mine lease and are washed out within portions of the drainages, particularly along Pinabete Arroyo. The No. 8 coal seam is typically the thickest coal seam and is believed to exhibit the highest hydraulic conductivity of the coals. All coal seams include splits and partings, although these are most extensive in the No. 8 coal seam as indicated in Section 17 (Geologic Information). The No. 8 coal seam depicted in the cross sections in Exhibit 18.2-2 includes splits and partings. The groundwater monitoring and hydrogeologic characterization program for Area 4 South and Area 5 of BNCC's mining lease also included the installation of one monitoring well and one VWP in the No. 8 coal seam, one VWP in the No. 7 coal seam and one VWP in the No. 6 coal seam.

Four monitoring wells and four VWPs were installed in the PCS within Areas 4 South and 5 of the BNCC mining lease. Well KPC2007-03 was installed to measure water levels within the PCS at the western boundary of the BNCC mining lease. The 2007 drilling program work plan called for installation of a No. 2 coal monitoring well at this location along the western boundary of the BNCC mining lease. However, the No. 2 coal seam was observed to be dry during drilling at this location so the well was completed in the upper part of the PCS to monitor water levels. The PCS well KPC2007-02 was installed to measure water levels and to characterize baseline water quality within the PCS up gradient of Area 4 South. Sampling of this well found high pH and elevated calcium, which is an indication of well-grout influence. Consequently, this well has been used only for water level monitoring in the baseline program. The PCS well KPC2007-01 was installed to measure water levels and to characterize baseline water quality within the PCS within the permit area. The VWPs were installed to measure potentiometric levels within the PCS and various coal units within the permit area. Completion diagrams for the monitoring wells installed in years 1998 and 2007 as well as VWPs installed in 2007 are provided in Appendix 18.E.

Historical water level data collected during the mid-1970s are also available for six wells that were completed in the PCS within or adjacent to the BNCC mining lease for a previously proposed project. The locations for these PCS monitoring wells are shown on Exhibit 18.2-2. Historical baseline water quality data were also obtained at five of these PCS wells. These PCS monitoring wells and piezometers were plugged and abandoned in 1994. Historic water level monitoring data and pumping test data are also available for the PCS well O-1, located at the Burnham Mine situated southeast of BNCC mining lease as shown on Exhibit 18.2-2. These data, together with data from the adjacent Navajo Mine and other regional sources, supplement the recent baseline groundwater information obtained for Area 4 South and Area 5 of BNCC's mining lease.

18.2.3.1.1 Alluvial Aquifer Information

Baseline monitoring of the alluvium of Cottonwood Arroyo was conducted at four alluvial well monitoring locations shown on Exhibit 18.2-2. Baseline water quality information obtained prior to year 1983 from the monitoring wells GM-17 and QACW-2 (GM-18) are included in Appendix 6-C of the Navajo Mine PAP (BNCC 2009). Well GM-17 is completed in the alluvium of North Fork of the Cottonwood Arroyo. A dug well, GM-18, completed in the alluvium of Cottonwood Arroyo west of the permit area, was converted for use as a monitoring well and is designated as QACW-2 in Exhibit 18.2-2. This well was included in the Navajo Mine quarterly monitoring program (OSM Permit No. NM-0003F) (BNCC 2009). However, the well is usually dry and relatively few samples have been obtained during baseline monitoring. Water quality samples could not be obtained from alluvial monitoring well QACW-1 because it was dry or had insufficient water for sampling during baseline monitoring from 1987 through 1998. The well was subsequently removed by the advance of mining operations in Area 3. BNCC has also performed baseline monitoring of well QACW–2B completed in the alluvium of Cottonwood Arroyo west of the permit area as shown in Exhibit 18.2-2. This well is a dug well that has been used for stock water supply and is not owned by BNCC.

Two alluvial monitoring wells, PA-1 and PA-2, were installed in 1998 within the alluvium of Pinabete Arroyo near dug water wells at the locations shown on Exhibit 18.2-2. Two alluvial monitoring wells, NNA-1 and NNA-2, were also installed in the alluvium of No Name Arroyo at locations upstream and downstream of the No Name Impoundment as shown on Exhibit 18.2-2.

Water levels were measured monthly at each of the alluvial monitoring wells. Table 18.2-2 summarizes the water level readings in each of the Pinabete alluvial monitoring wells during the baseline monitoring program. The water level readings in each of the Cottonwood alluvial monitoring wells during the monitoring period are summarized in Table 18.2-3. The No Name alluvial well NNA-2 has been dry during the entire baseline monitoring program. The No Name alluvial well NNA-1, located down gradient from the No Name Impoundment, has been dry except during the latter half of 1998 when seepage associated high water levels in the impoundment provided a source of water for the alluvium at this well. The data for the Pinabete alluvial wells show a decline in water levels during the spring and early summer of 1998 followed by a rise in water levels due to thunderstorm runoff events in late summer and fall of 1998. In 2007, water levels declined slightly from August through December.

Well completion and aquifer test results for the alluvial monitoring wells are summarized in Table 18.2-4. Well completion diagrams for the Pinabete and No Name alluvial wells are provided in Appendix 18.E. Well completion diagrams could not be found for the Cottonwood alluvial wells. Aquifer test data and interpretation results for the monitoring wells installed in year 1998 are provided in Appendix 18.F. The calculated or measured hydraulic conductivities for the Pinabete Arroyo alluvium of 51.3 feet per day (ft/day) (1.8×10^{-2} centimeter per second (cm/sec)) and 11.1 ft/day (4.1×10^{-3} cm/sec) are within the range expected for clean sand and are considerably higher than the bedrock values in the area. Well yields from the alluvium, however, are limited by a very low saturated thickness of about 5 feet or less. Saturated thickness in the No Name alluvial wells was insufficient to permit a pumping test or slug test. The hydraulic conductivity of the No Name alluvium is expected to be considerably lower than the Pinabete Arroyo alluvium due to the high percentage of fine-grained alluvial silts and clays, as evidenced by the well logs.

18.2.3.1.2 Fruitland Formation Information

Groundwater production from the Fruitland coal seams is quite limited. The majority of exploration drill holes through the Fruitland Formation within BNCC mining lease Area 4 South and Area 5 did not yield measurable groundwater during drilling. Measurable water was encountered at a few locations. Specifically, three boreholes located within the northeast portion of Area 4 South produced water at rates estimated at greater than 10 gpm. This groundwater is believed to be associated with the No. 6 and the No. 8 coal seams. Measurable water was also encountered in the No. 8 coal seam during completion of the No. 3 Coal seam well KF-98-03. At this location, groundwater was first encountered in the unconsolidated sand and gravel above the No. 8 coal seam at a depth of about 22 feet. The No. 8 coal seam was encountered in the depth interval from 24 to 38 feet. Water was produced at a rate of about 2 to 3 gpm from the coal and the overlying sand and gravel.

In 2007, well KF2007-01 was completed in the No. 8 coal seam to characterize the groundwater near the permit boundary to the east of the No. 3 coal seam well KF-98-03. Well KF2007-01 is the only coal seam well within BNCC mining lease Area 4 South and Area 5 with sufficient yield to permit the application of a constant rate pumping test to determine hydraulic characteristics of the coal. The water yields from wells KF-98-02, KF-98-03, and KF-98-04, completed in the No. 3 coal seam, are all very low and these wells are quickly pumped or bailed dry during conventional sampling. The locations for the four additional coal monitoring wells are shown on Exhibit 18.2-2, along with the wells previously installed for groundwater monitoring within Area 3 at the Navajo Mine. Completion diagrams and lithologic logs for these additional coal monitoring wells are provided in Appendix 18.E.

Potentiometric elevations measured at the monitoring wells and VWPs completed in the Fruitland coal seams within BNCC mining lease Area 4 North, Area 4 South, and Area 5 are provided in Table 18.2-5. Wide fluctuations in water levels in the No. 3 coal seam wells occurred during the 1998 monitoring period. These fluctuations were the result of well development, aquifer testing, and sampling. A considerable amount of time is required for water levels in these wells to approach equilibrium due to the low hydraulic conductivity of the coal. Quarterly sampling using micro-purge sampling techniques was performed for the sampling program starting in 2007 so that the magnitude of fluctuation resulting from sampling was limited.

Well KF-98-04 was designated to be screened in the first saturated bedrock unit adjacent to the alluvium of Pinabete Arroyo near alluvial well PA-1. The purpose of this well was to help evaluate the relationship between water levels in alluvium and water levels in the bedrock underlying the alluvium. The first saturated bedrock below the alluvium was at a depth of about 63 to 64 feet in the No. 3 coal seam, demonstrating that the saturated alluvium within the Pinabete Arroyo at this location is perched above the underlying unsaturated bedrock. Monitoring well KF-98-04 has remained dry throughout most of the 2007-2008 monitoring period, with only 0.1 foot of saturation recorded on October 4, 2007.

Static water level readings could not be obtained monthly at well KF-98-03 after October 4, 2007 because this well was being periodically purged and bailed as part of a program to remove influence from grout that may have penetrated portions of the sand pack surrounding the screened interval in this well. This well and two of the new PCS wells (KPC2007-02 and KPC2007-03) exhibited low yield and pH levels ≥12, indicating that the annular space cement grout may have penetrated the bentonite seal on top of the sand pack surrounding the screened interval in these wells during well completion. The grout penetration is believed to be the result of the low hydraulic heads in the coal combined with the high-pressure head of the grout seal placed in the annular space. The monitoring wells with the largest annular cement interval are also the wells with unusually high pH values that are indicative of grout intrusion. The low yield of the No. 3 coal seam at well KF98-03 has also limited the prospect of grout removal by well purging.

Consequently, in the fall of 2007, acid treatment was used to remediate cement contamination of the monitoring well sand pack materials. Due to the very low yield at these wells, bailing and purging of wells KF-98-03 and KPC2007-02 have continued, reducing the times when static water level measurements could be taken at these wells.

In 1998, a displacement (slug) test was performed at well KF-98-02 and bailed recovery tests were conducted at wells KF-98-03 and KF-98-04 to determine transmissivity and hydraulic conductivity in the No. 3 coal seam. Test results found very low transmissivity values ranging from 0.01 to 0.001 square feet per day (ft^2/day) and hydraulic conductivity values ranging from 0.002 to 0.00013 ft/day ($3.5x10^{-7}$ to $4.6x10^{-8}$ cm/sec) as summarized in Table 18.2-6. These values are consistent with the hydraulic conductivity values of 0.001, 0.002, 0.0014, and 0.003 ft/day estimated for the No. 2, No. 3, and No. 4-6 coal seam wells, respectively, at the KF84-22 well series located at the Navajo Mine Area 4 North (Table 18.2-6). Well KF84-22A was not tested at this location but hydraulic conductivity values ranging from 0.004 to 0.06 ft/day ($1.4x10^{-5}$ to $1.4x10^{-6}$ cm/sec) with a geometric mean of 0.033 ft/day ($1.16x10^{-5}$ cm/sec) were estimated from tests at three No. 8 seam coal wells (SJKF84#3, SJKF84#4, and SJKF84#5) located adjacent to the Navajo Mine. These results are comparable to the hydraulic conductivity value of 0.056 ft/day ($2x10^{-5}$ cm/sec) estimated for the No. 8 coal seam well KF2007-01 as described in Appendix 18.F and summarized in Table 18.2-6.

In a separate set of tests, the transmissivity and hydraulic conductivity values calculated from the observation well response during a pumping test of the No. 8 coal seam well, G-20, located at the San Juan Mine were 0.017 ft^2/day and 0.001 ft/day ($3.5x10^{-7}$ cm/sec), respectively (San Juan Coal Company 2009). These results for the hydraulic conductivity of No. 8 coal at the San Juan Mine are lower than the values from well tests at BNCC's mining lease. However, the observation well response from the pumping test for this well at the San Juan Mine is useful because it provides a reliable estimate for the storage coefficient of $4.2x10^{-4}$ for the No. 8 coal seam.

Potentiometric elevations in the saturated coal units and the underlying PCS were also measured using VWPs installed at five locations throughout BNCC's mining lease in Area 4 South and Area 5 as shown on Exhibit 18.2-2. VWP construction details are provided in Appendix 18.E. Potentiometric elevations measured at the VWPs completed in the coals are summarized in Table 18.2-5. The December 2007 measurements of potentiometric elevations in the coal wells and VWPs were used to estimate the potentiometric surface for the No. 3 and No. 8 coal seams at the site as presented in Exhibit 18.2-3 and Exhibit 18.2-4, respectively. The potentiometric levels measured on July 6, 1989 at the No. 2 and No. 3 coal seams at the KF84-22 well series located north of the permit area were also used in developing the potentiometric surfaces in these exhibits. The potentiometric gradients in both the No. 2 and No. 3 coal units indicate groundwater flow components toward the north-northeast in the vicinity of these monitoring wells and piezometers.

Potentiometric gradients in the upper coal seams in the vicinity of the permit area are expected to be generally toward the northeast, similar to the gradients observed in the No. 2 and No. 3 coals, although local gradients may be influenced by the lower elevations along Pinabete Arroyo, No Name Arroyo, and Cottonwood Arroyo. The No. 6, No. 7, and No. 8 coal seams outcrop along the valleys of Pinabete Arroyo, No Name Arroyo, and Cottonwood Arroyo within the mining lease area. Field observations of salt deposits and enhanced vegetation production suggest that local discharge may occur from the No. 8 coal at the coal subcrop beneath the Pinabete alluvium as discussed previously in Section 18.2.1.

Potentiometric elevations in the monitored coal units and in the underlying PCS were plotted for four of the nested VWP locations, to depict vertical gradients and possible seasonal patterns. Plots were not prepared for the VWP2007-4 location for the reason that only one VWP was installed in the PCS at this location because the overlying Fruitland coal units appeared to be dry during piezometer installation. Figure 18.2-1 shows consistent potentiometric elevations over time for the No. 2 coal seam and the PCS at location VWP2007-05. The slightly higher potentiometric elevation in the PCS indicates a slight upward gradient from the PCS to the Fruitland Formation at this location.

A plot of the potentiometric levels in the No. 2 and No. 3 coal seams and the PCS at well VWP2007-03 is provided in Figure 18.2-2. The results show consistent downward gradients from the No. 3 coal seam to the PCS. The wide fluctuation in potentiometric levels in well KPC2007-02 is due to the bailing and purging of this well. Figure 18.2-3 shows the potentiometric levels in the PCS and in the upper and lower coal units at the VWP2007-02 location. The results show high downward gradients from the No. 8 coal seam to the No. 3 coal seam and slight upward gradients from the PCS to the No. 3 coal seam.

A plot of potentiometric elevations in the PCS and in No. 6, No. 3, and No. 2 coal seams at well VWP2007-01 is provided in Figure 18.2-4. The results show consistent downward gradients from the No. 6 coal to the PCS, with the highest vertical gradients between the No. 6 and the No. 3 coal seams. The plot also includes water levels measured in the PCS well KPC2007-01 at the VWP2007-01 location. Measured water elevations in well KPC2007-01 are consistently about 6 feet lower than the potentiometric elevation measured in the PCS at VWP2007-01. The VWP in the PCS at this location is installed at the top of the PCS, while the well screen and filter pack extend through about 75 feet of the PCS. The difference between the two measurements suggests that hydrostatic heads are higher at the top of the PCS at this location and decline with depth. Thus, downward gradients are believed to continue through the PCS at this location.

18.2.3.1.3 Pictured Cliffs Sandstone Information

The PCS underlies the Fruitland Formation and follows the structure of the Fruitland coal seams. The PCS is a marginal water resource due to the low permeabilities, poor water quality, gas production, and low yields (Stone et.al. 1983). The PCS conformably overlies and intertongues with the Lewis Shale. As discussed previously, the PCS appears to be on the order of 110 to 120 feet thick within BNCC's mining lease Areas 4 North, Area 4 South, and Area 5.

Well KPC-98-01 was installed in 1998 west of the permit area near the PCS outcrop at the location shown in Exhibit 18.2-2. In 2007, wells KPC2007-01, KPC2007-02, and KPC2007-3 were completed in the PCS at the locations shown in Exhibit 18.2-2. Completion diagrams and lithologic logs for these PCS wells are provided in Appendix 18.E.

VWPs were installed in the PCS at four of the five VWP locations as shown on Exhibit 18.2-2. A VWP was not installed in the PCS at the VWP2007-03 location because monitoring well KPC2007-02 was installed in the PCS at this location. Construction diagrams and lithologic logs for these VWP installations are provided in Appendix 18.E. Potentiometric elevations measured at the PCS wells and the VWPs installed in the PCS are summarized in Table 18.2-7.

Historical water level data collected during the mid-1970s are also available in a report by Science Application, Inc. (1979) for six wells that were completed in the PCS within or adjacent to Area 4 North, Area 4 South, and Area 5 of BNCC's mining lease (Table 18.2-8). These abandoned PCS monitoring wells are designated as GM wells with water elevations shown on Exhibit 18.2-5. These PCS monitoring wells and piezometers were plugged and abandoned in 1994. Historic water level monitoring data are also available for the PCS monitoring well O-1 located at the Burnham Mine southeast of BNCC's mining lease as shown in Exhibit 18.2-2.

The December 2007 measurements of potentiometric elevations in the PCS wells and VWPs installed in the PCS were used to estimate the potentiometric surface presented in Exhibit 18.2-5. The potentiometric elevations measured during the 1970s at the abandoned PCS monitoring wells were also used to develop this potentiometric surface for the PCS. The potentiometric gradients in PCS indicate an overall northerly gradient. There is a slight easterly component in the gradients at the southern end of the site due to a structural high in the PCS along the southeast perimeter of Area 5 of BNCC's mining lease. There are also local gradients toward the topographic lows along No Name Arroyo, Pinabete Arroyo, and Cottonwood Arroyo.

An aquifer test was conducted in 1975 at well T4-1 installed in the PCS near the western side of Area 5 of BNCC's mining lease as shown in Exhibit 18.2-2. The drawdown and recovery measurements were recorded at the pumped well and at observation well GM30A, located 55.8 feet from the pumping well, and at observation well T4-2 located 12.5 feet from the pumping well. The top of the PCS is approximately 146 feet below ground surface at the test location while the static water level was at a depth of 134 feet, demonstrating confined conditions at the test location (Science Application Inc. 1979). The results of this aquifer test are summarized in Table 18.2-9, along with the results of tests performed at the PCS monitoring wells installed as part of this baseline monitoring program. The testing results and interpretations performed for the PCS baseline monitoring wells are provided in Appendix 18.F.

The hydraulic conductivity from the recovery response at well GM-30A from the pumping test at the PCS well T4-1 was 0.0016 ft/day ($5.6x10^{-7}$ cm/sec). The storage coefficient determined from the observation well response at GM-30A was $3.4x10^{-5}$. The highest hydraulic conductivity estimate for the PCS near the permit area was 0.02 ft/day ($7.0x10^{-6}$ cm/sec) obtained from the test at monitoring well KPC-98-01, located northwest of the mining lease as shown on Exhibit 18.2-2. The PCS is unconfined at this location. The results for this well are consistent with the aquifer test results of 0.032 ft/day ($1.1x10^{-5}$ cm/sec) from a slug test at Well O-1 completed in the PCS at the Burnham Mine but higher than the range from 0.01 to 0.0001 ft/day ($3.5x10^{-6}$ to $3.5\ 10^{-8}$ cm/sec) obtained from the slug tests at the three other PCS monitoring wells as summarized in Table 18.2-9.

Pumping test results for the PCS monitoring well O-1 in the Burnham Mine permit application package are on file in the library of the OSM in Denver, CO. In this well test, pumping at a relatively high rate of 18.3 gpm could be sustained for only 8.7 minutes when most of the well-bore storage water was removed and the test had to be terminated. Although the results were interpreted in the Burnham Mine permit application package as a pumping test, this approach is not correct due to the predominant influence of well-bore storage. Consequently, the well test results have been reinterpreted as a slug test in this report. Slug test results indicate a hydraulic conductivity of 0.032 ft/day ($1.1x10^{-5}$ cm/sec).

18.2.3.2 Groundwater Quality

The water quality characteristics of the Cottonwood, Pinabete and No Name alluvium, the Fruitland coal seams, and the underlying PCS have been determined from the baseline groundwater monitoring. The results are presented in the subsequent subsections and show that the groundwater within and adjacent to the permit area is poor and suitable only for marginal livestock use based on the relevant groundwater use criteria listed Table 18.2-10. The use criteria in Table 18.2-10 are not enforceable standards with respect to groundwater and are included only as a reference for the suitability of the groundwater quality for domestic water supply and for livestock use. These use criteria are mostly derived from the Navajo Nation surface water quality criteria (NNEPA 2008) for domestic water supply and for livestock watering use. Lardy, Stoltenow, and Johnson (2008) provide relevant livestock watering criteria for TDS, sulfate and fluoride but do not provide a livestock use criterion for chloride.

18.2.3.2.1 Alluvial Groundwater Quality

Quarterly samples were obtained from the two alluvial monitoring wells installed in Pinabete Arroyo and four alluvial wells within the Cottonwood Arroyo. No samples have been obtained from No Name well NNA-2 because the well was dry throughout the baseline monitoring program in 1998 and in 2007-2008. Saturated conditions occurred during the latter half of 1998 at the No Name alluvial monitoring well NNA-1, located below the No Name Impoundment. Two quarterly samples were obtained from this well during this period. At other times during the baseline monitoring period this well has been dry and no samples were obtained. QACW-2 is usually dry and relatively few samples have been obtained during baseline monitoring. Water quality samples could not be obtained from alluvial monitoring well QACW-1 because it was dry or had insufficient water for sampling during baseline monitoring from 1987 through 1998. The analytical results for the water quality samples from these wells are summarized below.

The baseline water quality monitoring results for the Cottonwood alluvial wells are summarized in Table 18-2-11. These results show the water quality of the alluvium of Cottonwood Arroyo to be a sodium-sulfate type of poor water quality with relatively high but variable TDS concentrations. TDS concentrations at monitoring well QACW-2B, located near the mouth of Cottonwood Arroyo, ranged from 2,590 to 3,615 mg/L. This monitoring well is a stock water well that was converted to a monitoring well and is referred to as well 13-R-28A in Exhibit 18.2-1. Median sulfate concentrations exceed recommended livestock use criteria at all the Cottonwood alluvial wells. Median concentrations of TDS and sulfate in the groundwater within the Cottonwood alluvial wells also exceeds the U.S. Environmental Protection Agency (USEPA) Secondary Drinking water use criteria listed Table 18.2-10. Fluoride concentrations fluctuate in the alluvial groundwater and are often above relevant criteria for livestock and drinking water use.

Water quality analytical results from quarterly monitoring at Pinabete alluvial wells, PA-1 and PA-2, are provided in Table 18.2-12 and Table 18.2-13, respectively. These results show the water quality of the alluvium of Pinabete Arroyo to be a sodium-sulfate type with TDS concentrations ranging from 1,500 to 4,300 mg/L. Water within the alluvium is unsuitable for drinking water use due to TDS, sulfate, fluoride, iron, and manganese concentrations above secondary drinking water standards. The quality of the alluvial groundwater varies although the TDS, sulfate, and fluoride concentrations usually exceed relevant criteria for livestock use.

Water quality analytical results in Table 18.2-14, from sampling of the No Name Arroyo alluvial well NNA-1, show the water to be a sodium-sulfate type similar to Pinabete Arroyo but with much higher sulfate, sodium, and TDS concentrations. Water quality within the alluvium downstream of the No Name Impoundment is unsuitable for either drinking water or livestock water use.

Some information on the baseline water quality in the Chaco River Alluvium is provided by Thorn (1993). These results show considerable variability in the alluvial water quality with TDS concentrations ranging from 742 to 11,900 mg/L, sulfate concentrations from 350 to 6,600 mg/L, and fluoride concentrations ranging from 0.4 to 1.7 mg/L. Additional water quality information for the Chaco River alluvium is included in the well inventory included in Appendix 6.E of the Navajo Mine PAP (OSM Permit No. NM-0003F) (BNCC 2009). The available water quality information from this well inventory show TDS concentrations ranging from 1,950 mg/L to 3,110 mg/L and sulfate concentrations ranging from 1,100 to 1,790 mg/L at wells located west of Areas 2, 3 and 4 at the Navajo Mine.

18.2.3.2.2 Fruitland Formation Groundwater Quality

The No. 3 coal seam well KF-98-04 has been essentially dry throughout the baseline monitoring period, with the exception of about 3 feet of initial saturation following well completion. Although a sample was obtained from this well in March 1998 following well completion, the well could not be purged and the water sample collected immediately following well completion cannot be considered to be representative of baseline conditions.

Water quality analytical results from the baseline sampling of the No. 3 coal seam well KF-98-02 are provided in Table 18.2-15. Results indicate some initial influence from drilling fluids or from the annular grout seal in the first two samples from this well. The reduction in both the pH and calcium concentrations with subsequent sampling suggests the reduction of any influence from drilling fluids or from the annular grout seal in subsequent samples from this well. The pH levels in this well have declined with time and the November 2007 results were within the range from 7 to 9 that is generally expected for the Fruitland coals within the San Juan Basin.

As shown in Table 18.2-15, water quality within the No. 3 coal seam at monitoring well KF-98-02 is unsuitable for drinking water use due to concentrations of TDS, chloride, and boron above the Navajo Nation water quality criteria for drinking water use. The TDS concentrations in water at this monitoring location also exceed the relevant criterion for livestock use. Based on the recent samples from the No. 3 coal seam well KF-98-02, the groundwater in the No. 3 coal seam at this location is a sodium-bicarbonate-chloride type, with TDS of about 3,300 mg/L (Table 18.2-15). The ion composition results are consistent with the baseline coal water quality monitoring data at the Navajo Mine, which show the coal seams to be of a sodium-bicarbonate-chloride type, although TDS concentrations are higher at the Navajo Mine wells as indicated in Table 18.2-16.

Table 18.2-16 provides median concentrations from baseline monitoring of coal wells at the Navajo Mine. Water quality monitoring data from the coal wells located within or adjacent to the Navajo Mine permit area show very high concentrations of TDS in the coal seam groundwater, with median concentrations at individual wells ranging from 2,770 mg/L to 13,400 mg/L. The concentrations of TDS, chloride, sodium, and bicarbonate are lower in the No. 3 coal seam monitoring well KF-98-02 in Table 18.2-15 in comparison to the median concentrations observed at the No. 3 coal seam monitoring well KF84-21A in Table 18.2-16. Lower concentrations of these constituents would be expected at well KF-98-02 because it is located up gradient from well KF84-21A and closer to the likely recharge source.

The coal seam water quality results in Table 18.2-16 show that TDS concentrations increase with depth and distance from the outcrop. Furthermore, TDS concentrations as high as 50,000 mg/L have been observed in the Fruitland coal units east and down dip of the Navajo Mine permit area (BNCC 2009). The TDS concentrations ranged from 43,035 to 50,810 mg/L at monitoring wells SJKF84#2 and SJKF84#3 installed in the No. 8 coal down dip of the Navajo Mine (Chapter 6, Navajo Mine Permit Application Package, BNCC 2009). The lower concentrations of TDS occur within close proximity to the coal outcrop, although concentrations of sulfate are higher near the outcrop and sulfate is generally absent down dip due to sulfate reduction.

Water quality analytical results from the baseline sampling of the No. 8 coal seam monitoring well KF2007-01 are provided in Table 18.2-17. There was considerable fluctuation in the pH and in the concentrations of TDS and major ions observed in samples from this well. These fluctuations are not uncommon after completion of wells with very low rates of water production because it is not possible to fully develop the well. Stabilization of water quality parameters is expected to occur over time, similar to what has occurred at well KF-98-02. Water quality within the No. 8 coal at this monitoring location is unsuitable for drinking water due to concentrations of TDS, chloride, fluoride, and sulfate that are above the USEPA secondary drinking water use criteria. The sulfate and TDS concentrations in coal water at this monitoring location often exceed relevant criteria for livestock use.

Baseline monitoring of coal wells located within and adjacent to the permit area indicated that well yields at most locations would not be sufficient to sustain use for livestock water supply. In limited locations where the coals may yield sufficient to occasionally fill a stock tank, the water could provide for marginal livestock use, although the recommended livestock criteria for TDS and sulfate are usually exceeded. The water quality would result in restrictions for use as a supply for young calves or as a long-term supply for cattle. Also, the water in the coal units would not be suitable for drinking water due to elevated TDS, chloride, boron, and sulfate concentrations. Based on the trends observed from sampling of coal wells at the BNCC mining lease, concentrations of TDS, bicarbonate, and chloride appear to increase with depth and distance from the outcrop but sulfate concentrations appear to decrease.

There is also an apparent trend of increasing TDS, chloride, and bicarbonate concentrations and decreasing sulfate concentrations toward the north-northeast in the direction of the potentiometric gradient. This trend appears in concentrations observed at the No. 8 coal seam well KF84-22A in comparison with the concentrations observed at the No. 8 coal seam well KF84-18B located north-northeast of well KF84-22A. A similar trend is also observed in the comparison of results for the No. 3 coal seam well KF-98-02 with the down gradient No. 3 coal seam well KF84-21A.

Groundwater chemistry changes or evolves along its flow path from the recharge area to the discharge area. Precipitation is low in TDS, is naturally weakly acidic, and contains bicarbonate due to the solution of carbon dioxide in the air. In this portion of the San Juan Basin, the precipitation reaching the ground is immediately neutralized and acquires sodium, sulfate, and other ions. Water that has only a short residence time in the ground is still typically high in TDS concentrations, with sodium, sulfate, and bicarbonate the dominant ions as indicated by both the surface water and alluvial groundwater samples. Calcium is also present due to dissolution of calcium carbonate, but at concentrations that are considerably lower than sodium. Chloride concentrations are typically lower near the recharge areas, although both chloride and TDS can vary with the spatial variation in recharge rates and frequency of leaching of salts from the unsaturated zone.

As groundwater migrates through the saturated zones it is no longer in contact with atmospheric carbon dioxide and its capacity to dissolve carbonates diminishes. The chemistry of the groundwater continues to evolve as other soluble minerals dissolve and cation exchange processes reduce the proportion of calcium and increase the proportion of sodium in solution. Sulfate reduction also occurs when groundwater transitions from oxidizing to reducing conditions, particularly within the coals.

18.2.3.2.3 Pictured Cliffs Sandstone Groundwater Quality

Water quality analytical results from the baseline sampling of PCS well KPC-98-01 are provided in Table 18.2-18. When the initial sample was collected from PCS monitoring well KPC-98-01 in 1998, it showed some influence of drilling fluids based on the low TDS, sulfate, and chloride and higher pH and nitrate observed in the initial well sample as shown in Table 18.2-18. It is suspected that the well was not fully developed due to low permeability and limited saturation. Sampling results starting in 2007 are more consistent and representative of baseline conditions within the PCS at this location. Based on the recent samples, the groundwater in the PCS at this location is a sodium-sulfate-bicarbonate type with TDS above 6,000 mg/L.

The ion composition results in water samples from well KPC-98-01 are consistent with the results from well KPC2007-01 (Table 18.2-19). TDS concentrations are quite similar at the two PCS wells with concentrations at well KPC2007-01 slightly below 6,000 mg/L and concentrations at well KPC-98-01 slightly above 6,000 mg/L. The groundwater in the PCS at these two locations is unsuitable for either domestic or livestock use due to the high TDS and sulfate concentrations.

Water quality monitoring data for the PCS were also available from samples collected during the mid-1970s from five wells that were completed in the PCS within or adjacent to Area 4 North, Area 4 South, and Area 5 of BNCC's mining lease. The locations for these PCS monitoring wells are shown on Exhibit 18.2-2.

Water quality analytical results of the baseline samples from PCS monitoring well GM-21, located within Area 5, are provided in Table 18.2-20. The water quality results are consistent with the results from wells KPC-98-01 and KPC2007-01. The groundwater is a sodium-sulfate-bicarbonate type with TDS above 6,000 mg/L.

Historic baseline water quality results from PCS monitoring well GM-20 are summarized in Table 18.2-21. This well was located within the center of Area 4 South of BNCC's Navajo mining lease. These results indicate TDS concentrations between 5,000 and 6,000 mg/L, which are comparable with results from the other PCS monitoring wells. The groundwater in the PCS at this location is a sodium-sulfate-chloride-bicarbonate type, with higher chloride concentrations than in the other nearby PCS monitoring wells. The earlier samples from this well also show an elevated groundwater pH. It is quite likely that this well also encountered some influence of grout intrusion that was not removed during well development or grout curing. The elevated pH influence does not appear in the later samples from this well.

Baseline water quality data for PCS monitoring well GM-19 are summarized in Table 18.2-22. This well was located within the proposed permit area. The resulting water type is similar to the water type from PCS monitoring well GM-20, although TDS concentrations are higher, ranging between 7,810 and 9,270 mg/L, with corresponding higher concentrations of sulfate, chloride, sodium, and bicarbonate.

Baseline water quality data for PCS monitoring well GM-30A are provided in Table 18.2-23. This well was located on the west side of Area 5 of BNCC's mining lease. The results indicate a sodium-sulfate-chloride type with TDS concentrations between 6,000 and 7,000 mg/L, and are comparable with the results from PCS monitoring wells within Areas 4 North, Area 4 South, and Area 5 of BNCC's mining lease. The ion balance in the first sample from this well was poor but improved in the second sample. Anion-cation balances greater than ± 0.10 are often an indicator of poor quantitative results. Sometimes, a lack of ion balance can be explained by the presence of high metals in acidic waters or soluble silica in alkaline waters that may not have been considered in calculating the ion balance. However, in this case, it appears that the lack of balance is the low sulfate concentration reported in the first sample, which appears to be erroneous. All the other major ions were consistent between the two samples.

The water sample results from well GM-28 are not included in this report because the ion balance was poor with 37% and 48% difference in the two samples. This well was located north of the permit area, as shown in Exhibit 18-2-2. Despite the poor ion balance, results for TDS are meaningful. The TDS concentrations in the samples from this well ranged from 4,334 to 6,580 mg/L. These results are consistent with the TDS concentrations observed at other PCS monitoring wells and slightly lower than the TDS concentration observed at well GM-19 located within the permit area.

In summary, groundwater quality data from monitoring wells located within and adjacent to the permit area indicate the groundwater in the PCS has high TDS concentrations, ranging from 5,000 mg/L to over 9,000 mg/L. Sulfate is the dominant anion, although the concentrations of chloride and bicarbonate are also relatively high. Sodium is the dominant cation. Magnesium and calcium concentrations are quite low and are typically less than the potassium concentrations, although potassium was not included in the samples from the GM wells that were collected during the 1970s. Generally, water quality changes are observed in the first few samples obtained from monitoring wells, apparently due to the difficulty in developing these low-yield wells. Thus, samples obtained after the initial two samples are believed to provide a better representation of baseline conditions.

The high concentrations of TDS, sulfate, chloride, and boron in the water from the PCS within and adjacent to the permit area preclude its use for domestic purposes. The PCS is also a poor source for livestock watering due to the very high TDS and sulfate concentrations, and low permeability and low yield, as stated in Section 18.2.3.1.3. The TDS and sulfate concentrations are lower in the water in the alluvium of Pinabete Arroyo, making it a better source for livestock use, although the TDS and sulfate concentrations in the alluvium are often above relevant criteria for livestock use.

18.2.4 Groundwater Resources Information Collection and Analysis

The baseline groundwater evaluation included a review of reports and data concerning groundwater resources of the region from New Mexico and federal agencies as well as the information provided in the permit application package and the groundwater monitoring reports for BNCC's Navajo Mine and CONSOL Energy's Burnham Mine (monitoring reports on file at the OSM Library in Denver, Colorado). BNCC has also conducted extensive drilling within the permit area which, together with data from the adjacent Navajo Mine and the nearby Burnham Mine, provide information about the geology and groundwater hydrology of the permit area and surrounding areas. BNCC also implemented a groundwater monitoring program in 1998 and in 2007 and 2008 to obtain site-specific information on groundwater levels, aquifer characteristics, and groundwater quality for the previously proposed Navajo Mine Extension Project. The baseline monitoring program and assessment were developed in accordance with the "Work Plan for Baseline Groundwater Hydrology for the Navajo Mine Extension Project" submitted to OSM on

May 23, 2007. The focus of this baseline monitoring program encompassed areas within and adjacent to the permit area.

An inventory of permitted wells and springs was conducted based on information from several sources, including the New Mexico Office of the State Engineer (NMOSE) (2010) Navajo Settlement Agreement, the inventory of wells and springs conducted by Billings and Associates, Inc (BAI) in 1985 for the Navajo Mine, wells identified in the "Groundwater Operations Manual and Well Survey for Navajo Mine and Vicinity" that was completed by Metric Corporation (1991), wells found in review of permits on file at the Navajo Nation Water Resource Management office in Fort Defiance, Arizona and a site reconnaissance for springs, seeps, and wells located within the permit area and adjacent area. Some of the data used in the discussion of baseline conditions were collected by other companies or organizations for other projects. As a result, the particular analytes considered and the associated detection limits may be slightly different from those included in BNCC's baseline monitoring in years 2007 and 2008. Efforts have been made to address these differences within the discussion of the data or in the tables used to report the results. Quality assurance and quality control information for the 2007-2008 groundwater data is provided in Appendix 18.G.

18.3 Hydrologic Model

Groundwater models are useful to support the interpretation of baseline hydrogeologic information. Furthermore, groundwater models are required for the predictive evaluations needed to prepare a probable hydrologic consequence (PHC) assessment of proposed mining and reclamation activities. Groundwater models used for a PHC assessment can range from simple empirical equations to complex numerical computer simulations of groundwater flow and chemistry.

Site-specific data or data representative of the site conditions are needed to apply groundwater models. Extrapolation of data from adjacent or nearby areas or using typical values for parameters from similar hydrogeologic environments is acceptable when the similarity of the areas is established. Numerical groundwater flow models can help to develop a better understanding of the hydrogeologic system, including the groundwater flow relationships between hydrogeologic units and between surface water and groundwater. Model calibration can also serve to revise the conceptual model of the groundwater system and provide a better assessment of the properties of hydrogeologic units on a regional scale that cannot be obtained solely from local pumping testing results.

The first step in developing a groundwater model is to establish the objectives of the study. Specific objectives of the groundwater model are as follows:

- The first objective is to provide a better understanding of the baseline groundwater flow systems within and adjacent to the proposed mining location.

- The second objective is to provide a better understanding of the likely groundwater changes that may occur during and after mining.

18.3.1 Groundwater Model Development

A multilayer, numerical, groundwater flow model has been developed to model the groundwater flow systems within and adjacent to the permit area. A detailed presentation of the numerical groundwater flow model is included in Appendix 41.B, in Section 41 (Probable Hydrologic Consequences). This report includes a description of the conceptual model of the groundwater flow system. A conceptual groundwater model is a complex hypothesis of the characteristics and functions of a hydrogeologic system, including recharge and discharge relationships, groundwater flow within and between hydrogeologic units, and the expected properties of these hydrogeologic units. An essential part of both the conceptual and numerical models is a graphical representation of the horizontal and vertical boundaries of the hydrogeologic system (the model domain) and the delineation of the hydrogeologic units within the model domain that are believed to have the primary controlling influence on groundwater flows. Another element of the conceptual model is to define, to the extent possible, the properties of these hydrogeologic units, including the thickness, hydraulic conductivities, and storage characteristics across the model domain. The conceptual model also includes the hydrogeologist's understanding of spatial relationships between and approximate rates of recharge and discharge, including the groundwater inflows and outflows from the model domain.

The delineation of the hydrogeologic units within and adjacent to permit area was based on the extensive geologic and groundwater information obtained from a variety of sources, including the baseline information presented in this baseline Section. Although the coal geology is complex with multiple coal bed splits and pinch outs, there is good correlation and spatial continuity for particular coal zones, or seams, at the Pinabete permit area and adjacent Navajo Mine. These coal seams may feature one coal bed, or they may include splits with multiple coal beds. For these reasons, the conceptual hydrogeologic model and the numerical groundwater model for the permit area and adjacent area handle the individual coal zones, or seams, as separate and distinct hydrogeologic units. The PCS, the first hydrogeologic unit below the Fruitland Formation, has been included in the groundwater flow model. The top of the Lewis Shale, below the PCS, has been included as the base of the model domain. The delineation of these hydrogeologic units within the permit area was created from the extensive geologic and groundwater information developed for the project. Information was also obtained from a variety of sources to help delineate the hydrogeologic units and define groundwater conditions for the portions of the model domain that are beyond the limits of the permit area.

18.3.2 Baseline Groundwater Model Results

The multilayer groundwater model was calibrated to obtain a good match with potentiometric surfaces and water levels established from the baseline groundwater studies at the permit area while maintaining consistency with the site-specific recharge estimates from Stone (1986) and the range of hydraulic conductivities associated with each hydrogeologic unit. During model calibration, hydraulic conductivities were applied only for the entire hydrogeologic unit and not spatially within a unit. Without a consistent geologic basis, spatial adjustments in hydrologic conductivities would lead to over-parameterization of the model to match modeled potentiometric levels with observed values. Although some of the differences between the modeled and observed potentiometric levels may be associated with spatial variation in hydrogeologic properties within a hydrogeologic unit, the chosen method for model calibration allows for the overall groundwater flow within each hydrogeologic unit and between units to be represented by the calibrated groundwater model.

Generally, a shale zone such as the Lewis Shale would be considered as an impermeable boundary. However, given the low recharge rates at the permit area, the overall low permeability of the Fruitland Formation shales and coals, and the relatively low permeability of the PCS, the flow conditions at the boundary between the PCS and Lewis Shale were found to be significant for calibrating the groundwater flow model. Providing for downward flow from the PCS into the Lewis Shale was required in order to reach an adequate calibration with recharge rates consistent with the measurements from Stone (1987). Downward flow and downward gradients are also indicated by hydrogeologic studies and tests of the Lewis Shale and the PCS immediately west of the permit area (Science Application, Inc. 1979).

Table 18.3-1 shows the relationship between the modeled recharge rates and the measurements by Stone (1987). Outside of the alluvial valleys, recharge rates were adjusted by slope within the range of estimates from Stone (1987) for badland areas and for upland flats. The modeled potentiometric surface for the PCS, the No. 3 coal seam, and the No. 8 coal seam are provided in Figure 18.3-1, Figure 18.3-2, and Figure 18.3-3, respectively. These results are consistent with the potentiometric surfaces developed from baseline monitoring in Section 18.2.4. However, the modeled potentiometric surfaces extend beyond the limits that could be depicted from well measurements. These potentiometric surfaces and flow patterns are consistent with the conceptual model and all the geologic and hydrogeologic information and the specified boundary conditions.

The results in Figure 18.3-1 show a component of groundwater flow from the PCS to the topographic lows along the west side of the model domain in the valleys of Brimhall Wash, No Name Arroyo, Pinabete Arroyo, and Cottonwood Arroyo. Although portions of the PCS along the western outcrop remain unsaturated, as indicated in Figure 18.3-1, the model estimates potentiometric elevations for these unsaturated zones.

The results for the No. 3 coal seam in Figure 18.3-2 also show a component of groundwater flow to the topographic lows along the west side of the model domain in the valleys of No Name Arroyo, Pinabete Arroyo, and Cottonwood Arroyo. The No. 3 coal seam is not present over a portion of the Brimhall Wash drainage or along the western portion of the model domain. Also, the No 3 coal seam is unsaturated in areas along the western outcrop and remains unsaturated in the modeled potentiometric surface as indicated in Figure 18.3-2. A similar pattern is observed in Figure 18.3-3 for the No. 8 coal seam, although this coal is not present over a large portion of the Brimhall drainage or within a large portion of the No Name Arroyo and Pinabete Arroyo valleys within the permit area. In addition to the flow toward the topographic lows, there is a component of flow down dip to the northeast. Portions of the No. 8 coal seam near the western outcrop are unsaturated, as shown in Figure 18.3-3. Not shown in these figures for individual hydrogeologic units are the overall downward gradients and downward flow between units. In fact, the model predicts perched groundwater conditions in the shallower coals along the western portion of the permit areas as depicted by the north-south section in Figure 18.3-4.

The calibrated numerical model helps confirm the conceptual model. The numerical model is well constrained and consistent with the recharge rates measured by Stone (1987) and with the hydraulic conductivities and heads measured within the various hydrogeologic units in the model domain.

Personnel

Persons or organizations responsible for data collection, analysis, and preparation of this permit application package section:

Kent Applegate Matt Owens BHP Navajo Coal Company	Norwest Corporation Denver, CO URS Corporation Albuquerque, NM

References

BHP Navajo Coal Company (BNCC). 2009. Navajo Mine Permit Application Package. OSM Permit No. NM-0003F. On file at Office of Surface Mining Reclamation and Enforcement- Western Region Technical Office. Denver, Colorado.

Billings and Associates Inc. 1987. Solutions to OSMRE Concerns and Deficiencies Related to the Ground Water Sections of the Navajo Mine Permit Application Package. OSM Permit NM-0003C, Chapter 12, Appendix 12-C. On file at Office of Surface Mining Reclamation and Enforcement- Western Region Technical Office. Denver, Colorado.

Brown, D.R. 1976. Hydrogeology and Water Resources of the Aztec Quadrangle, San Juan County, New Mexico. Unpublished Master's Thesis, New Mexico Institute of Mining and Technology, Socorro, New Mexico.

CONSOL Energy. 1984. Mine Permit Application for the Burnham Mine. Copy on File in the Office of Surface Mining Library in Denver, Colorado.

Gray, D.M. 1970. Handbook on the Principles of Hydrology. Water Information Center, Inc. Port Washington, New York.

Kearns A.K., and J.M.H. Hendrickx. 1998. Temporal Variability of Diffuse Ground Water Recharge in New Mexico. Technical Completion Rep 309. New Mexico Water Resources Research Institute, New Mexico State University, Las Cruces, New Mexico.

Lardy, G., C. Stoltenow, and R. Johnson 2008. AS-94 Livestock and Water. Acquired from the Internet 8-18-11 from www.ag.ndsu.edu/pubs/h2oqual/watanim/as954.pdf (Verified March 29, 2012).

Metric Corporation. 1991. Groundwater Operations Manual and Well Survey for the Navajo Mine and Vicinity, San Juan County, New Mexico. Prepared for BHP-Utah International, Inc., September, 1991.

Navajo Nation Environmental Protection Agency Water Quality Program (NNEPA WQP), 2008. Navajo Nation Surface Water Quality Standards 2007. Passed by Navajo Nation Resources Committee on May 13, 2008.

New Mexico Environment Department. 2006. 2006-2008 303D-305D List of Impaired Waters. http://www.nmenv.state.nm.us/swqb/303d-305b/2006-2008/2006-2008_303d-305bLIST.pdf (Verified March 29, 2012).

San Juan Coal Company. 2009. San Juan Mine Permit 09-01, page 804-9. On file at the New Mexico Energy, Minerals, and Natural Resources Department - Mining and Minerals Division Office Santa Fe, New Mexico

Science Application, Inc. 1979. Ground and Surface Water Hydrology of the Navajo Coal Mine and Adjacent Areas. Natural Resources Division of Science Application, Inc. Albuquerque, New Mexico.

Stone, W.J., F.P Lyford, P.F.Frenzel, N.H. Mizell, and E. T. Padgett. 1983. Hydrogeology and Water Resources of San Juan Basin, New Mexico. Hydrology Report 6. New Mexico Bureau of Mines & Mineral Resources, Socorro, New Mexico.

Stone, W.J. 1984. Preliminary Estimates of Recharge at the Navajo Mine Based on Chloride in the Unsaturated Zone. Open File Report 213. New Mexico Bureau of Mines & Mineral Resources, Socorro, New Mexico.

Stone, W.J. 1986. Phase II Recharge Study at the Navajo Mine Based on Chloride, Stable Isotopes, and Tritium in the Unsaturated Zone. Open File Report 216. New Mexico Bureau of Mines & Mineral Resources, Socorro, New Mexico.

Stone, W.J. 1987. Phase III Recharge Study at the Navajo Mine-Impact of Mining on Recharge. Open File Report 282. New Mexico Bureau of Mines & Mineral Resources, Socorro, New Mexico.

Thorn, Conde R. 1993. Water-Quality Data from the San Juan and Chaco Rivers and Selected Alluvial Aquifers, San Juan County, New Mexico. USGS Open-File Report 93-84. Available online at: http://pubs.er.usgs.gov/usgspubs/ofr/ofr9384 (Verified March 29, 2012).

United States Geological Survey (USGS). 2009. USGS Water Data for New Mexico. http://waterdata.usgs.gov/nm/nwis/nwis (Verified March 29, 2012).

Waltemeyer, S.D. 2006. Analysis of the Magnitude and Frequency of Peak Discharges for the Navajo Nation in Arizona, Utah, Colorado, and New Mexico. Scientific Investigations Report 2006-5306. United States Geological Survey, Reston, Virginia.

Williams, G.P. and M.G. Wolman. 1984. Downstream Effects of Dams on Alluvial Rivers. U.S. Geological Survey Professional Paper 1206. U.S. Government Printing Office, Washington, DC.

Table 18.1-1 Watershed Areas for Permit Area and nearby USGS Gages

Name of watershed / description of location	Watershed (sq miles)			USGS gage
	Upstream of Coal Permit Boundary	Upstream of exit from Coal Permit Boundary	Entire watershed	
Drainages intersecting permit area upstream and downstream				
South Fork of Cottonwood Arroyo	18.3	20.7	21.1	NA
Pinabete Arroyo	51.8	55.7	60.3	NA
Drainages outside of permit area				
No Name Arroyo			11.5	NA
Regional gages				
Teec-Ni-Di-Tso Wash	-	-	7.2	9367934
Burnham Wash	-	-	8.6	9367936
Chaco River	-	-	3,640	9367938
Chaco River	-	-	4,350	9367950
San Juan River at Farmington, NM	-	-	7,240	9365000
San Juan River at Shiprock, NM	-	-	12,900	9368000

Table 18.1-2 Baseline Peak Flow Measurements on Pinabete Arroyo and No Name Arroyo in 1997, 1998, 2007, and 2008

Monitoring period	Peak Flow Measurement - Q (cfs)			
	Pinabete Arroyo upstream (upper Pinabete)	Pinabete Arroyo downstream (lower Pinabete)	No Name Arroyo upstream (upper No Name)	No Name Arroyo downstream (lower No Name)
Nov. 1997	0	0	0	0
Dec. 1997	0	0	0	0
Jan. 1998	0	0	0	0
Feb. 1998	0	0	0	0
Mar. 1998	0	0	0	0
Apr. 1998	0	0	0	0
May 1998	0	0	0	0
June 1998	0	0	0	0
July 1998	22.5	1717	1.5	0
Aug. 1998	1079	2307	*	*
Sept. 1998	0	4.9	9.5	74
Oct. 1998	1073**	119**	17.7**	38.8**
Nov. 1998	308	145	3.9	9.9
Dec. 1998	0	0	0	0
Aug. 2007	0.68	-	-	111.06
Oct. 2007	2.04	16.41	0.73	5.66
Dec. 2007	2.04	36.32	0.73	2.62
Feb. 2008	4.46	24.05	19.14	10.19
July 2008	7.53	46.62	NA	11.64
Aug. 2008	0.44	NA	NA	0.00

Q - runoff rate
cfs - cubic feet per second
* Site could not be accessed on 26 Aug 1998. Measurement taken in September is likely due to the storm on 21 Aug 1998
**October flows determined from measurements taken on 7 Nov. 1998

Table 18.1-3 Comparison of Average Annual Flows at Five Regional USGS Gages for Selected Years Between 1978 and 2010

	Teec-Ni-Di-Tso Wash	Burnham Wash	Chaco River	Chaco River	San Juan at Farmington	San Juan at Shiprock	Flow distribution quartile
Area (sq miles)	7.2	85.2	3640	4350	7,240	12,900	
USGS ID	9367934	9367936	9367938	9367950	9365000	9368000	
Selected years (flows in cubic feet per second [cfs])							
1978	0.072	0.657	15.2	34.6	1303	1186	25%-50%
1979	0.207	0.333	77.7	85.1	3574	3706	75%-100%
1980	0.121	0.132	10.7	25.2	2475	2588	50%-75%
1981	0.029	0.058	7.35	20.8	1276	1309	25%-50%
1982	0.337	0.396	19.1	51.2	1967	1940	50%-75%
1998	ND	ND	ND	ND	2036	1760	50%-75%
2007	ND	ND	ND	ND	1782	1838	25%-50%
2008	ND	ND	ND	ND	2597	2574	50%-75%
2009	ND	ND	ND	ND	1298	1247	25%-50%
2010	ND	ND	ND	ND	1111	1031	0%-25%

Lowest Quartile	1990, 2010
25%-50%	1978, 1981, 1991, 2007, 2009
50-75%	1980, 1982, 1992, 1994, **1998 (close to average),** 2008
Top Quartile	**1979 (very high)**, 1993, 1995

ND - No data collected; gages not operated after 1983 water year
Source: USGS 2009

Table 18.1-4 SEDCAD™ 4 Estimated Peak Discharge and Sediment Yield

Watershed location	SEDCAD designation	2yr-6hr event (0.85 inches)		10yr-6hr event (1.28 inches)		25yr-6hr event (1.56 inches)		100yr-6hr event (2.04 inches)	
		Peak discharge (cfs)	Sediment yield (tons)	Peak dscharge (cfs)	Sediment yield (tons)	Peak discharge (cfs)	Sediment yield (tons)	Peak discharge (cfs)	Sediment yield (tons)
South Fork Cottonwood	Structure 21	729	4,561	1,588	11,292	2,220	16,455	3,439	26,631
Cottonwood at CSN-1	Structure 36	1,258	10,716	2,871	27,297	4,106	40,745	6,428	67,549
Pinabete upstream	Structure 6	406	2,251	1,124	8,093	1,715	13,703	2,879	25,544
Pinabete downstream	Structure 8	396	2,147	1,099	7,808	1,678	13,103	2,817	24,239
No Name upstream	Structure 2	54	69	231	302	297	461	523	868
No Name downstream	Structure 5	114	290	564	1,544	661	1,781	1,022	3,091
Cottonwood at Confluence	Structure 37	1,250	10,744	2,839	30,644	4,049	40,586	6,325	67,181
Unnamed Tributary to Chaco	Structure 1	50	158	137	497	205	788	334	1,380

cfs - cubic feet per second

Table 18.1-5 Peak Discharge Estimates for Watersheds Based on Drainage Area Using Regional Equations

	Discharge area (mi^2)	Average basin elevation (ft msl)	Average basin slope (%)	Peak discharge (cfs)						
	A	E	S	Q2	Q5	Q10	Q25	Q50	Q100	Q500
No Name Arroyo	11.5	5503.77	1.54	294	1,943	3,361	6,456	9,482	13,764	27,068
Pinabete Arroyo	58.4	5880	1.82	568	3,329	5,479	9,972	14,134	19,821	36,596
Cottonwood Arroyo	80.4	5588	10.6	700	7,786	13,591	26,257	38,900	55,889	108,738

Source: Waltemeyer 2006

mi^2 - square mile
ft msl - feet above mean sea level
cfs - cubic feet per second
Q - runoff rate

Table 18.1-6 Average Monthly Flow, Maximum Daily Flow, and Number of Zero Flow Days at USGS 09367934, Teec-Ni-Di-Tso Wash near Burnham, New Mexico

Year	Monthly mean discharge (cfs) (calculation period: October 1977 to September 1982)											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1977	-	-	-	-	-	-	-	-	-	0.046	0.088	0
1978	0	0	0	0.04	0.349	0	0	0.035	0.297	0.084	0.271	0.604
1979	1.41	0	0.008	0.004	0.019	0.024	0	0.023	0.003	0.071	0.173	0
1980	0.721	0.236	0	0	0.048	0	0	0.194	0.001	0	0	0
1981	0	0	0.115	0.077	0	0.007	0.12	0.006	0.026	0.081	0.064	0
1982	0	1.44	0.077	0.033	0.189	0	0.047	2.18	0.002	-	-	-
Mean of monthly discharge (cfs)	0.43	0.34	0.04	0.03	0.12	0.01	0.03	0.49	0.07	0.06	0.12	0.12
Avg. max daily flow (cfs)	3.6	2.2	0.58	0.24	1.2	0.13	0.36	10	0.66	0.48	0.76	1.3
Zero flow days	10	15	25	24	21	27	23	21	20	23	16	25

cfs - cubic feet per second

Source: http://waterdata.usgs.gov/nm/nwis/dvstat/?referred_module=sw&site_no=09367934&por_09367934_1=559352,00060,1,1977-10-01,1982-10-14&format=html_table&stat_cds=mean_va&date_format=YYYY-MM-DD&rdb_compression=file&submitted_form=parameter_selection_list

Table 18.1-7 Average Monthly Flow, Maximum Daily Flow, and Number of Zero Flow Days at USGS 09367936, Burnham Wash near Burnham, New Mexico

Year	Monthly mean discharge (cfs) (calculation period: October 1977 to September 1982)											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1977	-	-	-	-	-	-	-	-	-	0.292	0.325	0
1978	0.173	0.068	0.1	0.181	5.48	0	0	0.053	1.13	0.409	1.53	0.366
1979	1.54	0	0.012	0.005	0.029	0.036	0	0.035	0.005	0.071	0.225	0.039
1980	0.418	0.394	0.007	0.006	0.068	0	0.005	0.278	0.087	0.01	0	0
1981	0	0	0.248	0.067	0.009	0.053	0.16	0.004	0.141	0.232	0.059	0
1982	0	2.81	0.117	0.061	0.194	0	0	1.46	0.001	-	-	-
Mean of monthly discharge	0.43	0.65	0.1	0.06	1.2	0.02	0.03	0.37	0.27	0.2	0.43	0.08
Avg. max daily flow	4.8	1.9	0.91	0.8	14	0.2	0.4	5.1	3.6	2.3	2.8	1.4
Zero flow days	7	7	14	20	17	26	26	22	18	17	17	25

cfs - cubic feet per second

Source: http://waterdata.usgs.gov/nm/nwis/dvstat/?referred_module=sw&site_no=09367936&por_09367936_1=559353,00060,1,1977-10-01,1982-10-14&format=html_table&stat_cds=mean_va&date_format=YYYY-MM-DD&rdb_compression=file&submitted_form=parameter_selection_list

Table 18.1-8 Days with Flow and Average Monthly Zero Flow Days at at USGS 09367938, Chaco River near Burnham, New Mexico

Month/Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1977	-	-	-	-	-	-	-	-	-	0	8	0
1978	1	22	23	0	8	0	0	3	7	8	24	11
1979	13	15	22	12	14	6	5	10	0	7	6	0
1980	20	19	0	9	20	0	1	0	9	5	0	0
1981	0	0	15	2	0	6	17	0	11	3	1	0
1982	0	0	29	30	13	0	5	29	24			
Average zero flow days	24.2	17.0	13.2	19.4	20.0	27.6	25.4	22.6	19.8	26.4	22.2	28.8
Median zero flow days	1	15	22	9	13	0	5	3	9	5	6	0

Table 18.1-9 Days with Flow and Average Monthly Zero Flow Days at Site N (Upstream) and Site M (Downstream) on Burnham Wash between October 1, 1977 and May 31, 1980

Site N

Month/Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1977	-	-	-	-	-	-	-	-	-	0	3	0
1978	0	0	4	3	8	0	2	10	9	8	5	3
1979	4	0	0	0	2	2	1	1	0	1	0	0
1980	2	1	0	0	0	-	-	-	-	-	-	-
Average zero flow days	28	28	27	28	28	28	28	21	21	26	23	28

Site M

Month / Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1977	-	-	-	-	-	-	-	-	-	0	0	0
1978	0	0	0	0	4	0	0	0	3	3	3	0
1979	3	0	0	0	2	0	3	0	0	2	6	0
1980	0	5	0	0	0	-	-	-	-	-	-	-
Average zero flow days	28	24	29	30	20	30	28	28	22	23	20	31

Source:
Brimhall Watershed Flows from Hydrologic_Monitoring_Program_1978.pdf from CONSOL Energy's Burnham Mine SMCRA Permit (OSM permit number NM-005)

Table 18.1-10 No Name Impoundment Staff Gage Readings from 1998

Date	Staff gage reading (ft)
11/17/1997	Thin ice
5/12/1998	2
6/11/1998	1.04
7/21/1998	dry
7/29/1998	> 5.0
8/20/1998	> 5.0
8/26/1998	> 5.0
9/30/1998	5
10/15/1998	4.2
11/7/1998	3.8
12/17/1998	3.7

Table 18.1-11 Baseline Surface Water Quality Analytes with Applicable Water Quality Standards, Methodologies, and Minimum Detection Limits

Consituent (mg/L, unless specified)	Livestock	Aquatic & Wildlife Habitat (Acute)	Aquatic & Wildlife Habitat (Chronic)	Secondary Human Contact	Fish Consumption
Aluminum		0.75	0.087		
Arsenic	0.2	0.34	0.15	0.28	0.08
Barium				98	
Boron	5			126	
Cadmium[1]	0.05	0.00217	0.00026	0.47	0.008
Chromium (III+IV)	1				
III*		0.00035	0.0201	1400	75
IV		0.016	0.011	2.8	0.15
Copper[1]	0.5	0.01445	0.00956	9.33	
Fluoride	2*				
Lead[1]	0.1	0.07022	0.00274	0.015	
Mercury		0.0024	0.000001	0.28	0.00015
Nitrate	132			1493.33	
pH (standard units)	6.5-9.0	6.5-9.0	6.5-9.0	6.5-9.0	
Radium 226+228	30				
Selenium	0.05	0.033	0.002	4.67	0.67
Silver[1]		0.00367		0.00467	8
Sulfate	1000*				
TDS	3000*				
Zinc[1]	25	0.0214	0.0215	280	5.1

Note all values are NNEPA 2008 criterion unless otherwise specified

[1] Aquatic & Wildlife Criterion are hardness dependent and calculated for a hardness of 108 mg/L as CaCO3, which is the median for Pinabette and Cottonwood Arroyos

*Lardy, Stoltenow and Johnson 2008

Table 18.1-12 Median Concentrations at Cottonwood Baseline Monitoring Stations

Parameter [1]	CN-1	CS-1	CNS-1
Start Date	7/18/90	7/18/90	7/18/90
End Date	9/2/99	9/5/99	8/3/99
Max # of Observations	96	92	104
pH (S.U.)	7.95	8.4	8.3
Total Dissolved Solids (mg/l)	780	675	610
Total Suspended Solids (mg/l)	87500	59400	65300
Total Settleable Solids (mg/l)	59.45	114	37.55
Conductivity (µmhos/cm)	1035	817	760
Arsenic(mg/L)	<0.0015	<0.002	<0.002
Boron (mg/l)	0.08	0.12	0.13
Calcium (mg/l)	35	23	25
Cadmium (mg/L)	<0.0025	<0.0025	<0.0025
Chloride (mg/l)	16	12.8	13
Iron (mg/l)	2.03	1.66	2.37
Total Iron (mg/l)	174	225.5	203
Lead	<0.01	<0.01	<0.01
Magnesium (mg/l)	3.9	2.6	3.8
Manganese (uncharacterized, presumed dissolved) (mg/l)	<0.1	<0.1	<0.1
Total Manganese (mg/l)	10.15	4.2	5.128
Nitrate as N (mg/L	7	7.65	8
Potassium (mg/l)	5.2	5.04	4.7
Selenium (mg/l)	<0.0025	<0.0025	<0.0025
Sulfate (mg/l)	386	275	257
Sodium (mg/l)	205	175	160
Bicarbonate as $CaCO_3$(mg/l)	170	151	141
Carbonate as $CaCO_3$(mg/l)	1	2.4	2.2

[1]Medians calculated based on half of the detection limit. Less than symbols (<) associated with half value, for which actual value is not certain

Table 18.1-13 Water quality and flow data on Pinabete Arroyo between July 29, 1998 and July 21, 2008

Sample ID	Sample date	Flow (cfs)	Alkalinity as CaCO3 (mg/L)	Q	Aluminum, D (mg/L)	Q	Arsenic, D (mg/L)	Barium, D (mg/L)	Bicarbonate as CaCO3 (mg/L)	Q	Boron, D (mg/L)	Cation anion balance (CAB) (%)	Q	Cadmium, D (mg/L)	Calcium, D (mg/L)	Q	Carbonate as CaCO3 (mg/L)	Q	Chloride (mg/L)	Q	Chromium, D (mg/L)	Electrical conductivity (EC) (µS/cm)	Copper, D (mg/L)	Q	Fluoride (mg/L)
Upper Pinabete [1]	7/29/1998	22.50	-		-		-	-	207		0.06	-		-	39	<	1		9		-	930	-		0.78
Upper Pinabete [1]	8/26/1998	1079	-		-		-	-	178		0.09	-		-	73	<	1		32		-	1640	-		1.09
Upper Pinabete [1]	9/30/1998	-	-		-		-	-	269		0.09	-		-	65	<	1		24		-	1460	-		1.19
Upper Pinabete [1]	11/7/1998	308	-		-		-	-	156		0.07	-		-	24	<	1		10		-	880	-		0.90
Upper Pinabete #3	10/8/2007	2.04	116		0.28		0.0084	0.0313	114		0.30	0.19	<	0.00005	15	<	10		10	<	0.001	584	0.0080	<	0.2
Upper Pinabete #3	12/3/2007	2.07	119	<	0.10		0.015	0.0388	117	<	0.10	3.22	<	0.00005	22.1	<	10		10	<	0.001	962	0.0096	<	0.2
Upper Pinabete grab [2]	2/13/2008	4.46	53		0.42		0.0204	0.0433	53		0.9	4.43	<	0.00005	23.6	<	10		11		0.002	1520	0.0261	<	0.2
Upper Pinabete #2	8/12/2008	0.44	123	<	0.10		0.0009	0.0685	123		0.1	5.93		0.00014	94.2	<	10	<	10	<	0.001	1460	0.0115	<	0.2
Upper Pinabete #3	8/12/2008	0.44	228	<	0.10		0.0022	0.1120	228		0.1	5.35	<	0.00005	101	<	10		10	<	0.001	1810	0.0090	<	0.2
Lower Pinabete [1]	7/29/1998	1717	-		-		-	-	464		0.17	-		-	141	<	1		27		-	1940	-		0.40
Lower Pinabete [1]	8/26/1998	2307	-		-		-	-	307		0.11	-		-	71	<	1		34		-	1530	-		0.70
Lower Pinabete [1]	9/30/1998	4.90	-		-		-	-	132	<	0.05	-		-	50	<	1		6		-	410	-		0.45
Lower Pinabete [1]	11/7/1998	145	-		-		-	-	125		0.14	-		-	19	<	1		8		-	600	-		0.75
Lower Pinabete #1	11/18/1998	145	-		-		-	-	107		0.07	-		-	20		3		7		-	480	-		0.60
Lower Pinabete #2	11/18/1998	145	-		-		-	-	120		0.09	-		-	20		3		8		-	570	-		0.75
Lower Pinabete grab [2]	9/18/2007	-	102	<	0.10		0.0013	0.0366	102	<	0.10	0.07	<	0.00005	27.3	<	10	<	10	<	0.001	396	0.0072		0.2
Lower Pinabete #1	9/24/2007	-	134		0.21		0.0133	0.2193	134		0.2	1.05	<	0.00005	48.9	<	10		13	<	0.001	866	0.0109	<	0.2
Lower Pinabete #2	9/24/2007	-	139		0.12		0.0062	0.1359	139		0.1	6.57	<	0.00005	39.4	<	10		11	<	0.001	776	0.0104	<	0.2
Lower Pinabete #1	10/8/2007	16.41	147		0.21		0.0015	0.0528	147		0.30	2.11	<	0.00005	32.7	<	10		13		0.001	1020	0.0076	<	0.20
Lower Pinabete #2	10/8/2007	16.41	158		0.26		0.0100	0.0621	156		0.30	6.01	<	0.00005	34.4	<	10		15		0.001	1040	0.0095	<	0.20
Lower Pinabete #1 [4]	12/3/2007	36.32	-		-		-	-	-		-	-		-	-		-		-		-	708	-		-
Lower Pinabete #2	12/3/2007	36.32	138	<	0.1		0.0101	0.0247	138	<	0.10	4.03	<	0.00005	18.1	<	10	<	10	<	0.001	654	0.0117	<	0.20
Lower Pinabete #3 [4]	12/3/2007	36.30	-		-		-	-	-		-	-		-	-		-		-		-	655	-		-
Lower Pinabete #1	2/13/2008	24.05	145		2.30		0.0094	0.0344	125		0.9	5.05		0.00005	9.5		20	<	10		0.003	502	0.0171	<	0.2
Lower Pinabete #2	2/13/2008	24.05	124	<	0.10		0.0025	0.0421	124		0.5	4.50	<	0.00005	72.4	<	10		13		0.002	666	0.0070	<	0.2
Lower Pinabete #1	7/21/2008	46.62	212	<	0.10	<	0.005	0.076	212		0.1	2.86		0.0681	48.2	<	10	<	10	<	0.01	723	0.009	<	0.2
Lower Pinabete #2	7/21/2008	46.62	200	<	0.10	<	0.005	0.071	200	<	0.1	3.39		0.0037	42.8	<	10		10	<	0.01	641	0.006	<	0.2
Lower Pinabete #3	7/21/2008	46.62	170	<	0.10	<	0.005	0.050	170	<	0.1	4.25	<	0.0005	36.5	<	10	<	10	<	0.01	584	0.007	<	0.2

[1] Sampler designation was only provided if more than one sampler contained water
[2] If water was flowing when the samplers where visited, a grab sample was taken
[3] Very limited sample volume
[4] If water is present in all three samplers, full analysis was completed on one with abbreviated analyses on the other two
Q - Qualifier
D - Dissolved
T - Total
cfs - cubic feet per second
mg/L - milligrams per liter
µS/cm - microsiemens per centimeter
su - standard units
pCi/L - picocuries per liter

Table 18.1-13 (Continued)

Sample ID	Sample date	Hardness (calc)	Q	Hydroxide as CaCO3 (mg/L)	Q	Iron, D (mg/L)	Iron, T (mg/L)	Q	Lead, D (mg/L)	Magnesium, D (mg/L)	Q	Manganese, D (mg/L)	Manganese, T (mg/L)	Q	Mercury (mg/L)	Q	Nitrate/ Nitrite as N (mg/L)	pH (su)	Q	Phosphorous, T (mg/L)	Potassium, D (mg/L)	Radium 226 (pCi/L)	Radium 228 (pCi/L)	Sodium adsorption ratio (SAR)	Q
Upper Pinabete [1]	7/29/1998	110		-		7.00	118		-	2.9		0.357	12.80		-		-	8.10		-	5.5	-	-	6.3	<
Upper Pinabete [1]	8/26/1998	209		-		0.15	286		-	6.8		0.007	12.90		-		-	7.80		-	5.7	-	-	8.0	<
Upper Pinabete [1]	9/30/1998	186		-		1.17	1140		-	5.7		0.453	24.40		-		-	7.60		-	5.3	-	-	7.7	<
Upper Pinabete [1]	11/7/1998	87		-		0.05	6		-	6.8	<	0.01	2.20		-		-	8.20		-	8.6	-	-	8.0	<
Upper Pinabete #3	10/8/2007	41	<	10	<	0.05	1150		0.0002	0.9	<	0.005	22.80	<	0.0002		0.74	8.24		3.09	3.5	-	-	-	
Upper Pinabete #3	12/3/2007	62	<	10	<	0.05	1220	<	0.0001	1.7	<	0.005	24.1	<	0.0002		2.48	8.11		0.26	3.7	-	-	-	
Upper Pinabete grab [2]	2/13/2008	68	<	10		0.26	571		0.0005	2.2		0.005	8.09		0.0016		1.65	7.99		0.89	5.5	-	-	-	
Upper Pinabete #2	8/12/2008	262	<	10	<	0.05	(3)		0.0001	6.4	<	0.005	(3)		(3)		(3)	7.51		(3)	7.8	-	-	-	
Upper Pinabete #3	8/12/2008	281	<	10	<	0.05	59.0	<	0.0001	7.0	<	0.005	16.1	<	0.0002		0.06	7.48		0.09	8.0	-	-	-	
Lower Pinabete [1]	7/29/1998	413		-	<	0.02	155		-	14.7		3.76	28.40		-		-	7.00		-	10.7	-	-	5.1	<
Lower Pinabete [1]	8/26/1998	201		-		1.35	305		-	6.0		0.21	21.40		-		-	7.60		-	6.6	-	-	7.5	<
Lower Pinabete [1]	9/30/1998	147		-		1.66	216		-	5.3		0.125	4.07		-		-	8.10		-	9.1	-	-	1.9	<
Lower Pinabete [1]	11/7/1998	62		-		20.30	1490		-	3.4		2.11	52.00		-		-	8.20		-	5.4	-	-	6.0	<
Lower Pinabete #1	11/18/1998	59		-		0.03	472		-	2.1	<	0.01	7.80		-		-	8.40		-	4.6	-	-	4.8	<
Lower Pinabete #2	11/18/1998	61		-		3.50	844		-	2.6		0.11	13.40		-		-	8.30		-	3.8	-	-	5.8	<
Lower Pinabete grab [2]	9/18/2007	77	<	10		0.05	125		0.0002	2.1	<	0.005	5.86	<	0.0002		1.73	8.02		0.12	5.0	1.7 ± 0.6	3.0 ± 0.7	-	
Lower Pinabete #1	9/24/2007	137	<	10		0.07	(3)		0.0003	3.6	<	0.005	(3)	<	0.0002		1.93	7.64		0.26	4.8	-	-	-	
Lower Pinabete #2	9/24/2007	111	<	10		0.13	391	<	0.0002	3.1		0.006	20.2	<	0.0002		0.85	7.39		0.52	5.1	-	-	-	<
Lower Pinabete #1	10/8/2007	90	<	10		0.12	1550		0.0004	2.1		0.017	38.4	<	0.0002		0.31	8.07		2.06	5.0	-	-	-	
Lower Pinabete #2	10/8/2007	95	<	10		0.13	1940		0.0002	2.2		0.009	55.90	<	0.0002		0.31	8.01		0.64	5.1	-	-	-	
Lower Pinabete #1 [4]	12/3/2007	-		-		-	-		-	-		-	-		-		-	8.19		-	-	-	-	-	
Lower Pinabete #2	12/3/2007	51	<	10	<	0.05	775	<	0.0001	1.3	<	0.005	16.7	<	0.0002		3.40	8.16		0.17	4.10	-	-	-	
Lower Pinabete #3 [4]	12/3/2007	-		-		-	-		-	-		-	-		-		-	8.21		-	-	-	-	-	
Lower Pinabete #1	2/13/2008	29	<	10		1.04	1120		0.0011	1.2		0.012	22.5		0.0024		0.98	8.56		0.69	3.0	-	-	-	
Lower Pinabete #2	2/13/2008	248	<	10	<	0.05	1260	<	0.0001	16.4	<	0.005	25.5		0.0032		1.79	8.35		0.36	4.4	-	-	-	
Lower Pinabete #1	7/21/2008	139	<	10		0.30	1100	<	0.001	4.6		0.899	35.5		0.0015		0.04	7.49		0.89	6.2	-	-	-	<
Lower Pinabete #2	7/21/2008	125	<	10		0.06	574	<	0.001	4.3		0.645	19.6		0.0011		0.54	7.61		0.83	6.8	-	-	-	<
Lower Pinabete #3	7/21/2008	106	<	10		0.12	566		0.003	3.6		0.506	19.0		0.0010		0.46	7.66		0.58	6.2	-	-	-	<

[1] Sampler designation was only provided if more than one sampler contained water
[2] If water was flowing when the samplers where visited, a grab sample was taken
[3] Very limited sample volume
[4] If water is present in all three samplers, full analysis was completed on one with abbreviated analyses on the other two
Q - Qualifier
D - Dissolved
T - Total
cfs - cubic feet per second
mg/L - milligrams per liter
µS/cm - microsiemens per centimeter
su - standard units
pCi/L - picocuries per liter

Table 18.1-13 (Continued)

Sample ID	Sample date	Selenium, D (mg/L)	Q	Settleable solids (mL/L)	Q	Silver, D (mg/L)	Sodium, D (mg/L)	Q	Sulfate (mg/L)	Total dissolved solids (TDS) (mg/L)	Total suspended solids (TSS) (mg/L)	Q	Zinc, D (mg/L)
Upper Pinabete [1]	7/29/1998	0.005		705		-	151.0		319	610	109,000		-
Upper Pinabete [1]	8/26/1998	0.005		714		-	265.0		581	1,200			-
Upper Pinabete [1]	9/30/1998	0.005		800		-	242.0		360	1,060	178,000		-
Upper Pinabete [1]	11/7/1998	0.005		14.4		-	166.0		313	620	305,000		-
Upper Pinabete #3	10/8/2007	0.003		27.1	<	0.00005	115.0		180	660	64,200		0.001
Upper Pinabete #3	12/3/2007	0.002		3.9	<	0.00005	194.0		390	835	89,900		0.002
Upper Pinabete grab [2]	2/13/2008	0.005		9.6		0.00010	309		740	5,300	26,600		0.004
Upper Pinabete #2	8/12/2008	0.002		904	<	0.00005	278.0		840	1,270	521,000		0.002
Upper Pinabete #3	8/12/2008	0.001		658	<	0.00005	284.0		780	1,270	140,000		0.001
Lower Pinabete [1]	7/29/1998	0.005		850		-	238.0		684	1,410	279,000		-
Lower Pinabete [1]	8/26/1998	0.005		890		-	243.0		591	1,220	-		-
Lower Pinabete [1]	9/30/1998	0.005		4.5		-	52.8		130	350	24,200		-
Lower Pinabete [1]	11/7/1998	0.005		1.0		-	108.0		164	390	34,700		-
Lower Pinabete #1	11/18/1998	0.005		9.9		-	85.1		123	370	28,400		-
Lower Pinabete #2	11/18/1998	0.005		9.5		-	103.0		169	400	49,200		-
Lower Pinabete grab [2]	9/18/2007	0.002		31.4		0.00008	54.2		100	295	17,900		0.003
Lower Pinabete #1	9/24/2007	0.002		400	<	0.00005	138.0		295	570	89,600		0.016
Lower Pinabete #2	9/24/2007	0.001		184	<	0.00005	96.2		235	460	97,600		0.015
Lower Pinabete #1	10/8/2007	0.007		727	<	0.00005	180.0		360	600	132,000		0.002
Lower Pinabete #2	10/8/2007	0.007		766	<	0.00005	179.0		390	620	156,000		0.002
Lower Pinabete #1 [4]	12/3/2007	-		25.6		-	-		-	1,130	88,000		-
Lower Pinabete #2	12/3/2007	0.003		16.7		0.00006	137.0		190	935	51,800		0.006
Lower Pinabete #3 [4]	12/3/2007	-		17.9		-	-		-	1,270	68,000		-
Lower Pinabete #1	2/13/2008	0.003		111.0		0.00006	140		165	28,400	10,200		0.006
Lower Pinabete #2	2/13/2008	0.003		174.0	<	0.00005	30.2		170	13,600	70,400		0.004
Lower Pinabete #1	7/21/2008	0.01		290	<	0.0005	112.0		180	500	102,000		0.16
Lower Pinabete #2	7/21/2008	0.01		190	<	0.0005	98.5		140	430	50,300		0.01
Lower Pinabete #3	7/21/2008	0.01		190	<	0.0005	93.6		138	400	48,900	<	0.01

[1] Sampler designation was only provided if more than one sampler contained water
[2] If water was flowing when the samplers where visited, a grab sample was taken
[3] Very limited sample volume
[4] If water is present in all three samplers, full analysis was completed on one with abbreviated analyses on the other two
Q - Qualifier
D - Dissolved
T - Total
cfs - cubic feet per second
mg/L - milligrams per liter
µS/cm - microsiemens per centimeter
su - standard units
pCi/L - picocuries per liter

Table 18.1-14 Water quality and flow data on No Name Arroyo between July 29, 1998 and August 12, 2008

Sample ID	Sample date	Flow (cfs)	Alkalinity as CaCO3 (mg/L)	Q	Aluminum, D (mg/L)	Q	Arsenic, D (mg/L)	Barium, D (mg/L)	Bicarbonate as CaCO3 (mg/L)	Q	Boron, D (mg/L)	Cation anion balance (CAB) (%)	Q	Cadmium, D (mg/L)	Calcium, D (mg/L)	Q	Carbonate as CaCO3 (mg/L)	Q	Chloride (mg/L)	Q	Chromium, D (mg/L)
Upper No Name[1]	7/29/1998	2	-		-		-	-	132		<0.05	-		-	35	<	1		8		-
Upper No Name[1]	9/30/1998	10	-		-		-	-	180		<0.05	-		-	42		3		7		-
Upper No Name #2	2/13/2008	19	106		0.52		0.0027	0.0287	106		0.5	4.62	<	0.00005	11.5	<	10		19		0.002
Upper No Name #3	2/13/2008	19	122		1.65		0.0046	0.0468	122		0.4	12.4	<	0.00005	16.3	<	10	<	10		0.003
Upper No Name grab[2]	2/13/2008	19.14	132		0.56		0.0038	0.0361	132		0.3	2.28	<	0.00005	17.9	<	10	<	10		0.003
Upper No Name #2	7/21/2008	-	128	<	0.10	<	0.005	0.050	128	<	0.1	3.08		0.0099	17.0	<	10	<	10	<	0.01
Upper No Name #3	7/21/2008	-	133	<	0.10	<	0.005	0.053	133	<	0.1	4.53		0.0011	18.5	<	10	<	10	<	0.01
Upper No Name #1	8/12/2008	-	119	<	0.10		0.0032	0.0658	119	<	0.1	6.90		0.00025	23.8	<	10	<	10	<	0.001
Upper No Name #2	8/12/2008	-	121	<	0.10		0.0023	0.0606	121	<	0.1	3.63	<	0.00005	22.8	<	10	<	10	<	0.001
Upper No Name #3	8/12/2008	-	110		0.15		0.0019	0.0583	110	<	0.1	4.07		0.00062	20.3	<	10	<	10	<	0.001
Lower No Name #1	8/13/1998	-	-		-		-	-	417		0.2	-		-	92	<	1		11		-
Lower No Name #2	8/14/1998	-	-		-		-	-	232		0.2	-		-	121	<	1		17		-
Lower No Name[1]	9/30/1998	74.00	-		-		-	-	264		0.1	-		-	77	<	1		9		-
Lower No Name #1	8/28/2007	-	129	<	0.10		0.0011	0.0474	129	<	0.1	9.65	<	0.00005	45.6	<	10	<	10	<	0.001
Lower No Name #2	8/28/2007	-	158	<	0.10		0.0011	0.0500	158	<	0.1	14.2	<	0.00005	39.5	<	10	<	10	<	0.001
Lower No Name #1	8/12/2008	-	302	<	0.10		0.0051	0.122	302	<	0.1	3.80	<	0.00005	147	<	10	<	10	<	0.001
Lower No Name #2	8/12/2008	-	270	<	0.10		0.0045	0.111	270		0.2	1.19		0.00095	120	<	10	<	10	<	0.001
Lower No Name #3	8/12/2008	-	320	<	0.10		0.0058	0.138	320		0.2	9.71	<	0.00005	186	<	10	<	10	<	0.001

[1] Sampler designation was only provided if more than one sampler contained water

[2] If water was flowing when the samplers where visited, a grab sample was taken

Q - Qualifier

D - Dissolved

T - Total
cfs - cubic feet per second
mg/L - milligrams per liter

µs/cm - microsiemens per centimeter

su - standard units

Table 18.1-14 (Continued)

Sample ID	Sample date	Electrical conductivity (EC) (µs/cm)	Copper, D (mg/L)	Q	Fluoride (mg/L)	Q	Hydroxide as CaCO3 (mg/L)	Q	Iron, D (mg/L)	Iron, T (mg/L)	Q	Lead, D (mg/L)	Magnesium, D (mg/L)	Q	Manganese, D (mg/L)	Manganese, T (mg/L)	Q	Mercury (mg/L)	Q	Nitrate/Nitrite as N (mg/L)	pH (su)	Q
Upper No Name[1]	7/29/1998	150	-		0.19		-		0.58	6020		-	2.1		0.24	1.28		-		-	8.10	
Upper No Name[1]	9/30/1998	290	-		0.26		-		0.46	5		-	2.3		0.043	0.13		-		-	8.40	
Upper No Name #2	2/13/2008	197	0.0067		0.20	<	10		0.28	66		0.0002	0.9	<	0.005	1.27	<	0.0002		0.26	8.16	
Upper No Name #3	2/13/2008	217	0.0124		0.30	<	10		0.80	88		0.0006	1.4		0.008	1.96	<	0.0002		0.33	8.16	
Upper No Name grab[2]	2/13/2008	337	0.0099		0.30	<	10		0.41	35		0.0003	1.2	<	0.005	0.40	<	0.0002		0.40	8.12	
Upper No Name #2	7/21/2008	205	0.007		0.3	<	10		0.10	108	<	0.001	1.1		0.090	2.55		0.0003		0.04	8.07	
Upper No Name #3	7/21/2008	215	0.008		0.3	<	10		0.08	123	<	0.001	1.2		0.115	2.67		0.0003	<	0.02	8.02	
Upper No Name #1	8/12/2008	270	0.0044	<	0.2	<	10	<	0.05	7.07	<	0.0001	1.5		0.040	4.36	<	0.0002		0.06	7.83	<
Upper No Name #2	8/12/2008	286	0.0044	<	0.2	<	10	<	0.05	3.24	<	0.0001	1.4	<	0.005	1.56	<	0.0002		0.06	7.88	
Upper No Name #3	8/12/2008	241	0.0042	<	0.2	<	10		0.10	3.43		0.0002	1.2	<	0.005	2.17	<	0.0002		0.03	7.92	
Lower No Name #1	8/13/1998	1020	-		0.64		-		0.45	5		-	10.7		0.034	0.13		-		-	7.60	
Lower No Name #2	8/14/1998	1050	-		0.68		-		0.05	1		-	14.0	<	0.005	0.02		-		-	8.00	
Lower No Name[1]	9/30/1998	730	-		0.89		-		3.31	290		-	8.8		0.8	6.38		-		-	7.70	
Lower No Name #1	8/28/2007	612	0.0072		0.4	<	10	<	0.05	258	<	0.0001	4.5		0.007	5.79	<	0.0002		2.94	7.91	
Lower No Name #2	8/28/2007	498	0.0056		0.3	<	10	<	0.05	419	<	0.0001	3.9		0.010	10.3	<	0.0002		2.94	7.90	<
Lower No Name #1	8/12/2008	1170	0.0057	<	0.2	<	10		1.59	8.1		0.0092	17.7		0.233	13.1	<	0.0002		0.41	7.29	
Lower No Name #2	8/12/2008	1000	0.0063	<	0.2	<	10		0.08	16.4		0.0002	14.7		0.568	13.6	<	0.0002		0.06	7.33	
Lower No Name #3	8/12/2008	1330	0.0063	<	0.2	<	10		0.08	17.0		0.0002	22.6		0.206	25.5	<	0.0002		0.09	7.17	<

[1] Sampler designation was only provided if more than one sampler contained water

[2] If water was flowing when the samplers where visited, a grab sample was taken

Q - Qualifier

D - Dissolved

T - Total
cfs - cubic feet per second
mg/L - milligrams per liter

µs/cm - microsiemens per centimeter

su - standard units

Table 18.1-14 (Continued)

Sample ID	Sample date	Phosphorous, T (mg/L)	Potassium, D (mg/L)	Sodium adsorption ration (SAR)	Q	Selenium, D (mg/L)	Q	Settleable solids (mL/L)	Q	Silver, D (mg/L)	Sodium, D (mg/L)	Q	Sulfate (mg/L)	Total dissolved solids (TDS) (mg/L)	Total suspended solids (TSS) (mg/L)	Q	Zinc, D (mg/L)
Upper No Name[1]	7/29/1998	-	6.0	0.8	<	0.005		3		-	18.6		16	100	7,400		-
Upper No Name[1]	9/30/1998	-	8.2	0.7	<	0.005		0.1		-	17.3		7	190	1,520		-
Upper No Name #2	2/13/2008	0.26	3.7	-	<	0.001		1.6	<	0.00005	27.4	<	10	320	2,550		0.004
Upper No Name #3	2/13/2008	0.19	4.8	-	<	0.001		3.7		0.00024	35.3	<	10	160	5,520		0.005
Upper No Name grab[2]	2/13/2008	0.29	3.9	-	<	0.001	<	0.5		0.00007	44.9		30	490	367		0.007
Upper No Name #2	7/21/2008	0.12	3.3	0.7	<	0.01		8.4	<	0.0005	24.5	<	10	180	8,100		0.03
Upper No Name #3	7/21/2008	0.09	3.5	0.7	<	0.01		8.4	<	0.0005	25.2	<	10	135	6,780		0.03
Upper No Name #1	8/12/2008	0.05	4.5	-	<	0.001		27.9	<	0.00005	25.9	<	10	220	19,400		0.002
Upper No Name #2	8/12/2008	0.13	4.2	-	<	0.001		18.1	<	0.00005	28.8		16	195	15,900		0.001
Upper No Name #3	8/12/2008	0.79	4.0	-		-		12.3	<	0.00005	23.5	<	10	160	8,170		0.001
Lower No Name #1	8/13/1998	-	13.6	2.0	<	0.005		162		-	82.9		131	530	26,100		-
Lower No Name #2	8/14/1998	-	29.5	2.0	<	0.005		194		-	95.0		383	840	78,400		-
Lower No Name[1]	9/30/1998	-	9.6	1.7	<	0.0		251.0		-	60.6		142	520	36,800		-
Lower No Name #1	8/28/2007	0.12	7.7	-		0.001		121	<	0.00005	64.9		220	445	16,700		0.010
Lower No Name #2	8/28/2007	0.05	10.0	-		0.001		77.7	<	0.00005	44.7		152	385	31,500		0.002
Lower No Name #1	8/12/2008	0.13	11.3	-		0.001		571	<	0.00005	67.1		380	810	394,000		0.001
Lower No Name #2	8/12/2008	35.0	10.8	-		0.001		450	<	0.00005	55.1		265	670	246,000		0.004
Lower No Name #3	8/12/2008	0.05	11.0	-		0.001		670		0.00135	75.4		600	1030	395,000		0.004

[1] Sampler designation was only provided if more than one sampler contained water

[2] If water was flowing when the samplers where visited, a grab sample was taken

Q - Qualifier

D - Dissolved

T - Total
cfs - cubic feet per second
mg/L - milligrams per liter

μs/cm - microsiemens per centimeter

su - standard units

Table 18.1-15 Water Quality Data on Brimhall Wash for Site N (Upstream) and Site M (Downstream) Between March 14, 1990 and January 8, 1995

Sample date	Alkalinity as CaCO3 (mg/L)	Bicarb as CaCO3 (mg/L)	Q	Boron, T (mg/L)	Q	Cation anion balance (CAB) %	Q	Cadmium, T (mg/L)	Calcium, D (mg/L)	Q	Chloride (mg/L)	Electrical conductivity (EC) (µs/cm)	Q	Fluoride (mg/L)	Hardness as CaCO3 (calc)	Q	Iron, D (mg/L)	Iron, T (mg/L)	Q
Site M																			
3/14/1990		156	<	5					188		39.4	718		1.2	774		173	234	
5/14/1990		133	<	5					411		4.04	1280		0.295	1040		0.11	0.65	
7/23/1990		461	<	5					400		10.4	27800		0.656	1390		1.15	10.1	
8/24/1990		190	<	5					316		20.3	2550		0.398	823		0.21	0.58	
9/29/1990		89	<	5					480		4.47	222		0.23	1203		2.39	3.69	
10/22/1990		88.9	<	5			<	0.005	18		4.6	359		0.33	53		1.76	1.8	<
11/19/1990		135	<	5			<	0.005	16.7		13.4	489		0.65	53		20.9	23	<
1/20/1991		530	<	5					550		82.2	7360		0.93	1000		0.72	0.72	
6/21/1991		1170	<	2.5					28.3		47.1	1540		0.3	2650		3.66	9.71	
1/1/1992		330	<	2.5					633		21.1	912	<	0.1	1700		580	582	
7/14/1992	494	494			<	0.84			35		10	571		0.6	100		0.53	420	
8/31/1992	146	146				4.52			13		10	798		1.5	37		0.94	1520	
1/1/1993A	266	262			<	0.47			42		13	2180		2	126	<	0.02	5.36	
1/1/1993B	116	116			<	3.15			60		13	418		0.9	146		0.16	716	
3/11/1993	140	140				3.85			9		11	732		0.9	31		12	171	
9/6/1993	216	216			<	2.14			28		8	1040		0.9	78		0.14	1210	
7/10/1994	135	135			<	1.59			22		7			1.5	51		0.06	163	
10/2/1994	210	210							53		21			0.4	153		2.74	4.49	
1/8/1995	172	172							3.5		4			0.6	10		0.25	520	
Site N																			
5/14/1990		277	<	5					26		13.2	1210		1.1	80		0.18	0.8	
6/19/1990		299	<	5					38.7		15.3	1440		0.848	115		0.28	1.72	
8/24/1990		518	<	5					238		4.96	1332		0.942	599		2.1	2.6	
10/22/1990		221	<	5			<	0.005	22.2		7.2	1120		0.89	68		0.49	1.11	<
1/20/1991		588	<	5					354		360	1256	<	0.2	2200		25.7	398	
6/21/1991		268	<	2.5					22.2		7.94	676		1.1	84		1.13	2.31	
8/20/1991		407	<	2.5					43.7		4.2				2200		7.26	410	
9/26/1991		363	<	2.5					38	<	0.5	1420		0.77	120		0.17	0.27	
1/1/1992		290	<	2.5					123		32.3	996		0.2	150		97.8	388	
7/14/1992	192	192				1.59			26		24	1510		2	73	<	0.02	2860	
8/31/1992	250	250			<	5.24			49		46	1460		1.7	143		0.43	2080	
1/1/1993	88	88				1.26			38		14	1050		1.2	111		0.22	255	
3/11/1993	165	165			<	0.42			20		16	985		1.1	58		0.15	276	
9/29/1993									1246		15	142	<	0.1	4370		730	4510	
7/10/1994	260	260			<	4.49			27		17			1.4	63		0.33	3060	
10/2/1994	950	950							29		8			1.3	85		0.11	7480	
1/8/1995	182	182							3.5		10			1	14		0.05	1000	

Q - Qualifier
BDL - Below Detection Limit
D - Dissolved
T - Total
mg/L - milligrams per liter
µs/cm - microsiemens per centimeter
su - standard units

Table 18.1-15 (Continued)

Sample date	Lead, T (mg/L)	Q	Magnesium D (mg/L)	Q	Manganese D (mg/L)	Manganese, T (mg/L)	Q	Mercury, D (mg/L)	Q	Mercury, T (mg/L)	Q	Nitrate nitrogen	Nitrate/Nitrite as N (mg/L)	Q	Nitrite as N (mg/L)	Q	Nitrogen, total Kjeldahl	pH (su)	Potassium, D (mg/L)
Site M																			
3/14/1990			74			4.45						3.08						7.89	154
5/14/1990			3.28			0.37						0.383						7.49	5.08
7/23/1990			95			13.8						0.484						7.99	19.1
8/24/1990			8.2			1.59						0.373						8.58	5.22
9/29/1990			1.1			0.05						0.355						7.87	3.8
10/22/1990	0.05		1.9			0.02			<	0.0005		0.6						7.96	3.29
11/19/1990	0.05		2.76			0.16				0.0006		0.66						8.18	15.9
1/20/1991			73.9			0.04						0.06						7.16	8.7
6/21/1991			4.25			0.07						0.31						7.29	11.3
1/1/1992			83.5			5.94						1.63						8.13	164
7/14/1992			3		0.38							0.05	0.13		0.08			7.7	4
8/31/1992			1		0.02							0.7	0.7	<	0.01			8.1	4
1/1/1993A			5	<	0.01		<	0.0001				1.36	1.36	<	0.01			8.4	1
1/1/1993B		<	1	<	0.01							3.54	3.59		0.05			7.8	1
3/11/1993			2		7							1.22	1.24		0.02			8.3	3
9/6/1993			2		0.01							1.92	1.98		0.06		9.4	8	4
7/10/1994		<	1	<	0.01							0.67	1.3		0.63		2.4	7.6	4
10/2/1994			5		1.04							0.04	0.04	<	0.01	<	0.1	7.5	6
1/8/1995			0.3									7.7	7.8		0.11		3.7	8.3	1.7
Site N																			
5/14/1990			3.67			0.17						0.651						7.43	5.61
6/19/1990			4.57			1.4						0.289						7.21	4.94
8/24/1990			1.1			0.11						0.61						7.87	5.29
10/22/1990	0.05		3.03			0.1			<	0.0005		0.23						7.51	3.88
1/20/1991			172			5.05						1.83						7.57	17.6
6/21/1991			3.19			0.39					<	0.05						7.51	3.38
8/20/1991			6.7			7.21						0.39						7.98	0.81
9/26/1991			6.91			0.83					<	0.05						6.95	5
1/1/1992			44.5			2.97						0.11						7.98	4.72
7/14/1992			2	<	0.01							1.2	1.2	<	0.01			8.2	3
8/31/1992			5		0.08							0.25	0.31		0.06			8.1	5
1/1/1993			4	<	0.01							2.11	2.14		0.03			8.1	3
3/11/1993			2	<	0.01							1.81	1.81	<	0.01			8	3
9/29/1993			306		39							13498.4	13500		1.6			0.6	90
7/10/1994		<	1	<	0.01							0.58	0.86		0.28		2.5	7.8	4
10/2/1994			3		0.42							0.02	0.02	<	0.01	<	0.1	8	3
1/8/1995			1.2									3.2	3.2				5.7	8.2	1.7

Q - Qualifier
BDL - Below Detection Limit
D - Dissolved
T - Total
mg/L - milligrams per liter
µs/cm - microsiemens per centimeter
su - standard units

Table 18.1-15 (Continued)

Sample date	Sodium adsorption ratio (SAR)	Sodium adsorption ratio (SAR) Calc.	Selenium, D (mg/L)	Q	Selenium, T (mg/L)	Q	Silica	Sodium, D (mg/L)	Sulfate (mg/L)	Q	Total dissolved solids (TDS) (mg/L)	Total suspended solids (TSS) (mg/L)	Q	Vanadium, D (mg/L)	Q	Vanadium, T (mg/L)
Site M																
3/14/1990		18.30					71	1170	204		1980				<	0.5
5/14/1990		2.71				<	1	201	558		2500				<	0.05
7/23/1990		84.04					10.1	7200	18100		24600				<	0.5
8/24/1990		6.61					10.4	436	1091		1640				<	0.5
9/29/1990		0.93					26.2	74.2	108		360				<	0.5
10/22/1990		5.05		<	0.005	<	1	84.3	85		392				<	0.5
11/19/1990		8.30		<	0.005		3	139	166		404				<	0.5
1/20/1991		16.15					4.6	1520	3690		5760				<	0.1
6/21/1991		14.04					162	303	800		1350				<	0.5
1/1/1992		2.84					5050	286	757		2110					0.4
7/14/1992		8.41					13.5	193	29		480	61880	<	0.01		
8/31/1992		11.87					19.8	165	200		540	57660	<	0.01		
1/1/1993A		12.63	0.003				10.9	325	539		1062		<	0.01		
1/1/1993B		5.26					9.5	150	356		652	14400	<	0.01		
3/11/1993	12.63	12.49					141	159	191		456	45880		0.14		
9/6/1993		10.39					19.3	211	328		726	46200	<	0.01		
7/10/1994	13.57						16.2		393		744		<	0.01		
10/2/1994							19		490		924		<	0.01		
1/8/1995							8.4		140		370					
Site N																
5/14/1990		9.78					9.6	201	167		555				<	0.05
6/19/1990		15.07					13.3	372	135	<	720				<	0.05
8/24/1990		5.34					9.23	300	272		1000				<	0.5
10/22/1990		11.72		<	0.005		1.3	222	298		956				<	0.5
1/20/1991		1.89					5.3	173	3010		4381					0.38
6/21/1991		43.51					10.6	828	147		640				<	0.5
8/20/1991		21.40					38.2	575	1460		1010					1.87
9/26/1991		13.95					12.6	356	422		968				<	0.5
1/1/1992		3.54					16	180	1380		2150					0.26
7/14/1992		14.81					22.8	291	447		820	115800	<	0.01		
8/31/1992		9.94					18.7	273	494		1020	128420	<	0.01		
1/1/1993		11.75					14	285	587		960	11800	<	0.01		
3/11/1993	12.23	12.10					17.9	212	329		648	110120	<	0.01		
9/29/1993		2.96					311	450			2107		<	0.01		
7/10/1994	15.91						23.3		461		1050		<	0.01		
10/2/1994							16.1		140		520		<	0.01		
1/8/1995							13		220		440					

Q - Qualifier
BDL - Below Detection Limit
D - Dissolved
T - Total
mg/L - milligrams per liter
µs/cm - microsiemens per centimeter
su - standard units

Table 18.1-16 Comparison of Total Dissolved Solids and Total Suspended Solids at Site M (Downstream) on Brimhall Wash Between February 1979 and September 1982

Date	Grab sample	Single-stage sampler	No reference	Total solids (mg/L)	Total dissolved solids (mg/L)	Total suspended solids (mg/L)
07/01/79			X	78,820	11,520	67,300
02/01/79			X	39,327	37,489	1,838
04/16/81	X			78100	3400	74700
06/04/81	X			4,220	2,070	2,150
07/01/81	X			93,010	11,500	81,510
07/08/81	X			68,750	2,450	66,300
08/13/81	X			14,480	510	13,970
08/31/81	X			92,890	8,580	84,310
09/09/81		X		146,230	1,470	144,760
09/24/81		X		135,054	1,962	133,092
10/05/81		X		624	520	104
10/05/81		X		47,140	860	46,280
11/30/81		X		22,700	420	22,280
02/16/82	X			10,354	254	10,100
02/25/82	X			21,461	451	21,010
03/03/82	X			18,107	537	17,570
03/17/82	X			68,133	693	67,440
03/29/82	X			4,192	720	3,472
05/03/82	X			5,548	579	4,969
05/05/82	X			4,320	210	4,110
07/19/82	X			6,038	877	5,161
07/26/82	X			20,370	370	> 20,000
07/28/82		X		20,620	620	> 20,000
07/28/82	X			21,000	1,100	> 20,000
08/03/82	X			20,749	749	> 20,000
08/12/82			X	20,848	843	> 20,000
08/17/82			X	5,910	1,000	4,910
08/23/82	X			19183	863	18,320
08/25/82	X			20841	841	> 20,000
09/10/82			X	20873	873	> 20,000
09/13/82			X	20,570	570	> 20,000
Average				37,112	3,061	> 34,053
Median				20,841	843	> 20,000

mg/L - milligrams per liter

Table 18.1-17 Comparison of Total Dissolved Solids and Total Suspended Solids on at Site N (Upstream) on Brimhall Wash between February 1979 and September 1982

Date	Grab sample	Single-stage sampler	No reference	Total solids (mg/L)	Total dissolved solids (mg/L)	Total suspended solids (mg/L)
07/01/79			X	64,497	24,373	40,124
04/16/81	X			71,790	90	71,700
06/04/81		X		QNS		
07/01/81	X			55,730	10,280	45,450
07/08/81	X			69,550	4,220	65,330
07/10/81		X		126,720	1,844	124,876
08/12/81		X		149,080	2,110	146,970
08/31/81	X			35,470	9,050	26,420
09/09/81	X			172,938	1,910	171,028
09/24/81	X			24,568	2,404	22,164
10/05/81	X				QNS	77,780
11/30/81	X			89,850	690	89,160
02/16/82	X			7,430	220	7,210
02/25/82	X			31,310	380	30,930
03/03/82	X			21,210	400	20,810
03/17/82	X			20,341	391	19,950
03/29/82	X			4,046	600	3,446
05/03/82	X			4,729	389	4,340
05/05/82	X			4,413	420	3,993
07/28/82		X		21,062	1,062	> 20,000
08/03/82	X			20,890	890	> 20,000
08/12/82		X		20,820	820	> 20,000
08/17/82	X	X		5,169	449	4,720
08/23/82	X			19,900	900	19,000
09/10/82		X		20,800	800	> 20,000
09/13/82		X		20,870	870	> 20,000
Average				45,133	2,732	> 49,770
Median				21,136	845	20,810

mg/L - milligrams per liter
QNS - Quantity not sufficient

Table 18.1-18 Surface Water Quality for Other Bodies of Water Within and Adjacent to the NMEP Permit Area

Sample ID	Sample date	Alkalinity as CaCO3 (mg/L)	Aluminum, D (mg/L)	Aluminum, T (mg/L)	Arsenic, D (mg/L)	Arsenic, T (mg/L)	Barium, D (mg/L)	Barium, T (mg/L)	Bicarbonate as CaCO3 (mg/L)	Boron, D (mg/L)	Cation anion balance (CAB) (%)	Cadmium, D (mg/L)	Calcium, D (mg/L)	Carbonate as CaCO3 (mg/L)	Chloride (mg/L)	Chromium, D (mg/L)	Cobalt, D (mg/L)
Ponds within Pinabete watershed																	
4N/4S Pond (aka Mid Pinabete Pond or Pond East of Lower Pinabete)	4/10/08	-		19.9	-	0.0008	-	0.175	-	0.2	-	< 0.00005	-	-	-	0.006	0.00029
4N/4S Pond (aka Mid Pinabete Pond or Pond East of Lower Pinabete)	5/12/08	-	-	181	-	0.0051	-	0.905	-	0.4	-	< 0.00005	-	-	-	0.008	0.00257
4N/4S Pond (aka Mid Pinabete Pond or Pond East of Lower Pinabete)	7/21/08	248	0.38	-	< 0.005	-	0.124	-	248	0.2	3.92	0.0054	54.2	< 10	11	< 0.01	-
4N/4S Pond (aka Mid Pinabete Pond or Pond East of Lower Pinabete)	8/12/08	-	-	3.64	-	0.0020	-	0.2250	-	0.2	-	0.00107	-	-	-	< 0.001	0.00080
Stevenson's Well Site Pond (aka Well Site Pond)	7/21/08	312	< 0.10	-	< 0.005	-	0.208	-	312	0.2	2.29	0.0083	44.6	< 10	19	< 0.01	-
Stevenson's Well Site Pond (aka Well Site Pond)	8/12/08	-	-	1.83	-	< 0.0025	-	0.1550	-	< 0.1	-	0.01397	-	-	-	< 0.001	0.00030
Ponds within No Name watershed																	
No Name Impoundment (aka Mid No Name or Pond Along No Name)	4/30/98	-	-	-	-	-	-	-	129	0.10	-	-	17	1	17	-	-
No Name Impoundment (aka Mid No Name or Pond Along No Name)	5/15/98	-	-	-	-	-	-	-	162	0.12	-	-	15	< 1	19	-	-
No Name Impoundment (aka Mid No Name or Pond Along No Name)	7/29/98	-	-	-	-	-	-	-	109	< 0.05	-	-	24	< 1	4	-	-
No Name Impoundment (aka Mid No Name or Pond Along No Name)	8/20/98	-	-	-	-	-	-	-	170	0.06	-	-	42	< 1	7	-	-
No Name Impoundment (aka Mid No Name or Pond Along No Name)	8/26/98	-	-	-	-	-	-	-	135	< 0.05	-	-	41	< 1	6	-	-
No Name Impoundment (aka Mid No Name or Pond Along No Name)	9/30/98	-	-	-	-	-	-	-	195	0.07	-	-	46	< 1	6	-	-
No Name Impoundment (aka Mid No Name or Pond Along No Name)	11/7/98	-	-	-	-	-	-	-	204	0.08	-	-	43	< 1	6	-	-
No Name Impoundment (aka Mid No Name or Pond Along No Name)	12/1/98	-	-	-	-	-	-	-	165	0.08	-	-	45	< 1	67	-	-
No Name Impoundment (aka Mid No Name or Pond Along No Name)	4/10/08	-	-	32.4	-	0.0013	-	0.356	-	0.3	-	0.00025	-	-	-	0.004	0.00151
No Name Impoundment (aka Mid No Name or Pond Along No Name)	8/12/08	-	-	1.67	-	< 0.0025	-	0.1130	-	< 0.10	-	0.00010	-	-	-	< 0.001	0.00018
No Name Impoundment (aka Mid No Name or Pond Along No Name)	4/1/09	189	0.13	16.60	0.002	0.0028	0.124	0.2520	185	0.20	0.07	< 0.00005	26	< 10	18	0.006	0.00052

D - Dissolved
T - Total
mg/L - milligrams per liter
µs/cm - microsiemens per centimeter
su - standard units

Table 18.1-18 (Continued)

Sample ID	Electrical conductivity (EC) (µs/cm)	Copper, D (mg/L)	Fluoride (mg/L)	Hardness (calc)	Hydroxide as CaCO3 (mg/L)	Iron, D (mg/L)	Iron, T (mg/L)	Lead, D (mg/L)	Magnesium, D (mg/L)	Manganese, D (mg/L)	Manganese, T (mg/L)	Mercury, T (mg/L)	Nitrate/Nitrite as N (mg/L)	pH (su)	Phosphorous, T (mg/L)	Potassium, D (mg/L)	Sodium adsorption ratio (SAR)
Ponds within Pinabete watershed																	
4N/4S Pond (aka Mid Pinabete Pond or Pond East of Lower Pinabete)	-	0.0064	-	-	-	-	-	< 0.0001	-	-	-	< 0.0002	-	-	-	-	-
4N/4S Pond (aka Mid Pinabete Pond or Pond East of Lower Pinabete)	-	0.0356	-	-	-	-	-	0.0002	-	-	-	0.0008	-	-	-	-	-
4N/4S Pond (aka Mid Pinabete Pond or Pond East of Lower Pinabete)	673	0.016	0.9	162	< 10	0.39	19	0.007	6.4	0.377	0.910	0.0002	< 0.02	7.62	0.18	12.1	-
4N/4S Pond (aka Mid Pinabete Pond or Pond East of Lower Pinabete)	-	0.0068	-	-	-	-	-	0.0016	-	-	-	< 0.0002	-	-	-	-	-
Stevenson's Well Site Pond (aka Well Site Pond)	608	0.014	1.2	-	< 10	0.05	383	< 0.001	< 0.5	0.357	9.26	0.0008	0.03	7.80	< 0.05	7.5	0.7
Stevenson's Well Site Pond (aka Well Site Pond)	-	0.0068	-	-	-	-	-	0.0016	-	-	-	< 0.0002	-	-	-	-	-
Ponds within No Name watershed																	
No Name Impoundment (aka Mid No Name or Pond Along No Name)	430	-	0.70	55	-	1.07	-	-	3.9	0.315	-	-	-	8.60	-	11.1	3.4
No Name Impoundment (aka Mid No Name or Pond Along No Name)	470	-	0.85	46	-	0.39	-	-	3.6	0.026	-	-	-	8.90	-	8.9	4.4
No Name Impoundment (aka Mid No Name or Pond Along No Name)	250	-	0.51	40	-	0.15	-	-	2.3	0.056	-	-	-	7.70	-	8.3	1.3
No Name Impoundment (aka Mid No Name or Pond Along No Name)	370	-	0.44	43	-	<0.02	-	-	3.5	0.152	-	-	-	7.80	-	8.2	1.2
No Name Impoundment (aka Mid No Name or Pond Along No Name)	320	-	0.44	42	-	0.59	-	-	3.1	0.062	-	-	-	7.50	-	8.2	1.1
No Name Impoundment (aka Mid No Name or Pond Along No Name)	410	-	0.57	49	-	0.98	-	-	4.3	0.112	-	-	-	8.10	-	9.3	1.0
No Name Impoundment (aka Mid No Name or Pond Along No Name)	440	-	0.47	54	-	0.27	-	-	5.1	0.020	-	-	-	8.20	-	9.9	2.0
No Name Impoundment (aka Mid No Name or Pond Along No Name)	370	-	0.40	37	-	0.37	-	-	4.2	0.020	-	-	-	8.10	-	6.5	1.3
No Name Impoundment (aka Mid No Name or Pond Along No Name)	-	0.0285	-	-	-	-	-	0.0055	-	-	-	< 0.0002	-	-	-	-	-
No Name Impoundment (aka Mid No Name or Pond Along No Name)	-	0.0088	-	-	-	-	-	0.0006	-	-	-	< 0.0002	-	-	-	-	-
No Name Impoundment (aka Mid No Name or Pond Along No Name)	788	0.0151	1.2	83	< 10	0.08	11.6	< 0.0001	4.8	0.040	0.232	< 0.0002	< 0.020	8.23	0.07	7.5	6.4

D - Dissolved
T - Total
mg/L - milligrams per liter
µs/cm - microsiemens per centimeter
su - standard units

Table 18.1-18 (Continued)

Sample ID	Selenium, D (mg/L)	Selenium, T (mg/L)	Settleable solids (mL/L)	Silver, D (mg/L)	Sodium, D (mg/L)	Sulfate (mg/L)	Total dissolved solids (mg/L)	Total suspended solids (mg/L)	Vanadium, D (mg/L)	Zinc, D (mg/L)
Ponds within Pinabete watershed										
4N/4S Pond (aka Mid Pinabete Pond or Pond East of Lower Pinabete)	-	< 0.001	-	-	-	-	-	-	0.0032	< 0.001
4N/4S Pond (aka Mid Pinabete Pond or Pond East of Lower Pinabete)	-	0.001	-	-	-	-	-	-	0.0077	0.008
4N/4S Pond (aka Mid Pinabete Pond or Pond East of Lower Pinabete)	< 0.01	-	5.2	< 0.0005	90.0	122	415	727	-	0.02
4N/4S Pond (aka Mid Pinabete Pond or Pond East of Lower Pinabete)	-	< 0.001	-	-	-	-	-	-	0.0038	0.010
Stevenson's Well Site Pond (aka Well Site Pond)	< 0.01	-	37.9	< 0.0005	86.4	39	380	9200	-	0.02
Stevenson's Well Site Pond (aka Well Site Pond)	-	0.002	-	-	-	-	-	-	0.0064	0.006
Ponds within No Name watershed										
No Name Impoundment (aka Mid No Name or Pond Along No Name)	-	< 0.005	< 0.1	-	59.3	52	340	140	-	-
No Name Impoundment (aka Mid No Name or Pond Along No Name)	-	< 0.005	0.1	-	72.4	52	310	123	0.0048	0.037
No Name Impoundment (aka Mid No Name or Pond Along No Name)	-	< 0.005	< 0.1	-	25.8	25	140	51	0.007	< 0.003
No Name Impoundment (aka Mid No Name or Pond Along No Name)	-	< 0.005	< 0.1	-	30.2	33	270	183	-	-
No Name Impoundment (aka Mid No Name or Pond Along No Name)	-	< 0.005	< 0.1	-	26.2	30	260	-	-	-
No Name Impoundment (aka Mid No Name or Pond Along No Name)	-	< 0.005	< 0.1	-	27.7	29	290	32	-	-
No Name Impoundment (aka Mid No Name or Pond Along No Name)	-	< 0.005	< 0.1	-	39.1	40	270	22	-	-
No Name Impoundment (aka Mid No Name or Pond Along No Name)	-	< 0.005	< 0.2	-	33.6	< 5	220	19	-	-
No Name Impoundment (aka Mid No Name or Pond Along No Name)	-	< 0.001	-	-	-	-	-	-	0.0048	0.037
No Name Impoundment (aka Mid No Name or Pond Along No Name)	-	< 0.001	-	-	-	-	-	-	0.0070	0.003
No Name Impoundment (aka Mid No Name or Pond Along No Name)	< 0.001	< 0.001	< 0.5	< 0.00005	133	190	710	162	0.0024	0.002

D - Dissolved
T - Total
mg/L - milligrams per liter
µs/cm - microsiemens per centimeter
su - standard units

Table 18.2-1. Water Supply Wells in Study Area

Site Name	Type	Owner	Completion	Construction	Status	Primary Use	Water Quality Data	Depth to Water	Total Depth (ft)
45 (#34)	Well	Navajo	Pinabete/ Chaco Alluvium	NA		Unknown	see Myers and Villaneuva (1986) well 45	8	8
#46	Well	Navajo	Alluvium	Dug Well		Unknown	see BAI #46	7.3	9
#90	Well	Navajo	PCS	NA		Stock, Domestic	NA		131
13-15-4 (#60)	Well	Unknown	Chaco Alluvium	Concrete collar; wooden lid, bucket operated	Unpermitted	Unknown	NA	8	11
13-7-2	Well	Unknown	PCS	7" steel casing w/ windmill on 8'x8' concrete pad	Abandoned	Unknown	NA		198.8
13-7-4	Well	Navajo Trust	Unknown	Hand dug w/ hand pump	Permitted	Unknown	NA		Unknown
13-AW (13T-513, #58)	Well	Unknown	Alluvium - Artesian	NA	Unpermitted	OG well converted to Livestock	see BAI #58	11	530
GM-22 (13R-38)	Well	Unknown	Pinabete Alluvium	Dug well w/concrete pad & windmill	Permitted	Monitoring/ Livestock	NA	11	47
GM-32 (13-15-7)	Well	Unknown. Likely the same well as W-0202	Chaco Alluvium	Block & Concrete dug well, formerly hand pump operated; 10'x10' concrete pad	Unpermitted	Monitoring/ Livestock	NA	8	9
GM-35	Well	Unknown	Unknown	Dug well w/concrete pad operated by portable hand pump	Unpermitted	Unknown	NA		8.7
GM-36 (13-7-5)	Well	Unknown	Unknown	Dug well w concrete well head; bucket operated	Unpermitted	Livestock & Monitoring	NA		10.4
W-0148	Well	Navajo Trust	Unknown	NA		Stock Water	NA		Unknown
W-0202	Well	Navajo Trust	Chaco Alluvium	NA		Stock Water	NA		7
W-0203 (13-15-5)	Well	Navajo Trust	Chaco Alluvium	NA	Unpermitted	Stock Water	NA		8
W-0204 (13-15-6)	Well	Navajo Trust	Chaco Alluvium	Dug well; 8'x8' concrete pad; sides eroding into well	Unpermitted	Stock Water	NA		14
W-0314	Well	Navajo Trust	Unknown	NA		Stock Water	NA		Unknown
W-0342	Well	Navajo Trust	Unknown	NA		Stock Water	NA		Unknown
W-0343 (13-5-1, Stevenson, 13-15-2)	Well	Navajo Trust	Alluvium	5" steel casing; well cap welded shut	Permitted	Stock Water	NA		Unknown
W-0344 (#93)	Well	Navajo Trust	Pinabete Alluvium	NA		Stock Water	see BAI #93	7	9
W-0345 (13R-48, 13-15-3)	Well	Navajo Trust	Pinabete Alluvium	Dug well; concrete well head; wooden cover	Permitted	Stock Water	NA	7	10

Table 18.2-1. (Continued)

Site Name	Type	Owner	Completion	Construction	Status	Primary Use	Water Quality Data	Depth to Water	Total Depth (ft)
W-0346 (13R-37, 13-8-4)	Well	Navajo Trust	Pinabete Alluvium	Dug well w/ concrete pad over well; hand pump operable	Unpermitted	Stock Water, Use Unknown	NA	6	8
W-0348 (13-8-1)	Well	Navajo Trust	Pinabete Alluvium	Open well; concrete well head	Unpermitted	Stock Water	NA	9	13
W-0519 (13R-31 #17, G4, 13-14-7)	Well	Navajo Trust	Chaco Alluvium	NA	Unpermitted	Stock Water	see Thorn (1993) well G4	16	16
W-520	Well	Unknown	Unknown	NA		Stock Water	NA		Unknown
W-0537	Well	Navajo Trust	Unknown			Stock Water	NA		Unknown
W-0540	Well	Navajo Trust	Unknown			Stock Water	NA		Unknown
W-0545	Well	Navajo Trust	Unknown			Stock Water	NA		Unknown
G-3 (#36)	Well	Unknown	Unknown	NA		Stock Water	see Thorn (1993) well G3		Unknown
W-0606 (13-15-1)	Well	Navajo Trust	Unknown but likely PCS	5" steel casing w/ 8' x 8' concrete pad; Windmill	Unpermitted	Stock Water	NA		Unknown
W-0607	Well	Unknown	Alluvial	Windmill		Stock Water	NA	18	25
W-0618 (46,13R-28, #35)	Well	Navajo Trust	Cottonwood Alluvium	NA		Stock Water	see Myers and Villaneuva (1986) well 46	5	16
W-0624	Well	Navajo Trust	Unknown			Stock Water	NA		Unknown
W-0644 (13R-28A, QACW-2B, CWAP-1, #126)	Well	Navajo Trust	Cottonwood Alluvium	Hand dug w/ hand pump		Stock Water	see BAI #126	Unknown	11
W-0645 (13R-29, #61, 13-14-6)	Well	Navajo Trust	Chaco Alluvium	NA	Permitted	Stock Water	see BAI #61	12	16
W-0686	Well	Navajo Trust	Unknown	Windmill		Stock Water	NA		Unknown
W-0691 (13-15-8)	Well	Navajo Trust	Chaco Alluvium	Dug well, 5'x5' concrete pad; equipped w/hand pump	Unpermitted	Stock Water	NA		Unknown

PCS - Pictured Cliffs Sandstone

- BAI - Numbering System from Historic Addendum 12-D-A prepared by Billings and Associates, Inc. 1985

Source of Navajo Trust information - New Mexico Office of the State Engineer. 2010. Notice of Navajo Nation Expedited Inter Se Proceeding. Hydrographic Survey, Appendix M. Acquired from the Internet August 17, 2011 from http://www.ose.state.nm.us/water-info/NavajoSettlement/Notice2010/AppendixM.pdf

Table 18.2-2 Water Levels in Pinabete Alluvial Monitoring Wells

Well Name	PA-1		PA-2	
Measuring point elevation (ft msl)	5352.9		5431.43	
Date	Water level (ft)	Elevation (ft msl)	Water level (ft)	Elevation (ft msl)
3/26/1998	-	-	7.61	5423.82
3/29/1998	11.35	5341.55	7.69	5423.74
4/30/1998	11.42	5341.48	-	-
5/12/1998	11.46	5341.44	7.94	5423.49
6/11/1998	11.63	5341.27	8.16	5423.27
7/21/1998	12.04	5340.86	8.38	5423.05
8/20/1998	11.87	5341.03	8.24	5423.19
9/30/1998	11.7	5341.20	8.09	5423.34
11/8/1998	11.4	5341.50	7.88	5423.55
12/17/1998	11.18	5341.72	7.63	5423.8
8/22/2007	11.85	5341.05	8.78	5422.65
9/4/2007	11.95	5340.95	8.76	5422.67
10/4/2007	12.1	5340.80	NA	-
11/5/2007	12.14	5340.76	-	-
11/15/2007	-	-	8.76	5422.67
12/3/2007	12.09	5340.81	-	-
12/5/2007	-	-	8.7	5422.73
1/17/2008	12.0	5340.90	8.6	5422.83
2/19/2008	-	-	8.6	5422.83
2/21/2008	11.7	5341.20	-	-
3/20/2008	11.6	5341.30	8.3	5423.18
4/24/2008	11.5	5341.40	5.5	5425.93
5/27/2008	11.0	5341.90	5.0	5426.43
6/24/2008	12.0	5340.90	8.2	5423.23
7/24/2008	12.2	5340.70	9.0	5422.43
8/19/2008	-	-	9.2	5422.23
8/20/2008	11.2	5341.70	-	-
9/30/2008	11.0	5341.90	9.0	5422.4

ft msl - feet above mean sea level
(-) no measurement taken

Table 18.2-3 Water Levels in Cottonwood Alluvial Monitoring Wells

Well Name	QACW-1		QACW-2		QACW-2B		GM-17	
Measuring point elevation (ft msl)	5300.79		5201.64		5245		-	
Date	Water level (ft)	Elevation (ft msl)	Water level (ft)	Elevation (ft msl)	Water level (ft)	Elevation (ft msl)	Water level (ft)	Elevation (ft msl)
11/16/1974	-	-	9.90	-	-	-	-	-
6/27/1975	-	-	10.70	-	-	-	-	-
8/6/1975	-	-	9.80	-	-	-	-	-
10/14/1975	-	-	-	-	-	-	12.91	-
5/18/1976	-	-	-	-	-	-	12.81	-
9/24/1980	-	-	-	-	-	-	10.88	-
9/17/1981	-	-	-	-	-	-	15.65	-
12/15/1981	-	-	-	-	-	-	16.10	-
6/25/1982	-	-	-	-	-	-	18.15	-
9/29/1982	-	-	-	-	-	-	17.30	-
9/16/1985	-	-	Dry	-	-	-	-	-
12/16/1985	no reading	-	-	-	-	-	-	-
3/7/1986	19.11	-	-	-	-	-	-	-
3/18/1986	-	-	13.80	-	-	-	-	-
6/18/1986	no water	-	no water	-	9.10	-	-	-
9/15/1986	20.90	-						
12/9/1986	20.50	-	13.60	-	8.90	-	-	-
3/30/1987	Dry	-	Dry	-	8.11	-	-	-
6/17/1987	Dry	-						
6/18/1987	-	-	Dry	-	9.20	-	-	-
9/15/1987	-	-	Dry	-	-	-	-	-
9/16/1987	21.90	-	-	-	9.58	5235.42	-	-
3/24/1988	-	-	13.83	5187.81	-	-	-	-
6/30/1988	Dry	-	14.42	5187.22	9.25	5235.75	-	-
9/21/1988	Dry	-						
9/22/1988	-	-	14.00	5187.64		-	-	-
12/22/1988	Dry	-	14.25	5187.39	9.25	5235.75	-	-
3/22/1989	Dry	-						
3/23/1989	-	-	14.25	5187.39	9.17	5235.83	-	-
6/27/1989	Dry	-	Dry	-	-	-	-	-
12/19/1989	Dry	-	Dry	-	-	-	-	-
4/18/1990	Dry	-	Dry	-	-	-	-	-
6/20/1990	Dry	-	Dry	-	-	-	-	-
6/21/1990	-	-	-	-	9.33	5235.67	-	-
9/19/1990	-	-	-	-	9.08	5235.92	-	-
9/21/1990	21.25	5279.54	14.25	5187.39	-	-	-	-
12/12/1990	21.25	5279.54	14.42	5187.22	8.50	5236.5	-	-
12/13/1990	-	-	-	-	8.50	5236.5	-	-
3/14/1991	21.25	5279.54	14.42	5187.22	8.42	5236.58	-	-
3/31/1991	-	-	-	-	8.42	5236.58	-	-
6/11/1991	-	-	-	-	8.75	5236.25	-	-
6/12/1991	21.33	5279.46	14.08	5187.56	8.75	5236.25	-	-
9/12/1991	21.33	5279.39	9.25	5192.34	9.25	5235.75	-	-
12/9/1991	21.42	5279.29	19.50	5182.14	-	-	-	-
12/11/1991	-	-	-	-	8.92	5236.08	-	-
3/10/1992	21.42	5279.37	14.42	5187.22	-	-	-	-
3/11/1992	-	-	-	-	8.58	5236.42	-	-
6/9/1992	21.50	5279.29	19.50	5187.06	8.83	5236.17	-	-
9/21/1992	21.71	5279.08	21.71	5179.93	14.46	5230.54	-	-
9/22/1992	-	-	-	-	8.79	5236.21	-	-
12/16/1992	21.50	-	14.63	-	-	-	-	-
3/10/1993	21.54	-	14.58	-	-	-	-	-
6/8/1993	21.42	-	17.58	-	-	-	-	-
9/8/1993	21.33	5279.39	15.00	5180.24	15.00	5230	-	-
12/13/1993	21.25	-	15.00	-	-	-	-	-
6/14/1994	21.25	-	15.00	-	-	-	-	-
9/7/1994	21.25	5279.49	15.00	5180.34	15.00	5230	-	-
12/13/1994	21.25	-	15.00	-	-	-	-	-
3/28/1995	20.33	-	14.79	-	-	-	-	-
6/6/1995	20.42	5280.28	15.00	-	9.15	5235.85	-	-
9/26/1995	21.40	5279.39	15.00	5186.64	9.83	5235.17	-	-
12/12/1995	Dry	5280.79	Dry	Dry	-	-	-	-
12/13/1995	-	-	-	-	9.72	5235.28	-	-
3/12/1996	Dry	Dry	Dry	Dry	9.70	5235.3	-	-
6/25/1996	Dry	Dry	Dry	Dry	10.01	5234.99	-	-
9/30/1996	Dry	Dry	Dry	Dry	10.05	5234.95	-	-

Table 18.2-3 (Continued)

Well Name	QACW-1		QACW-2		QACW-2B		GM-17	
Measuring point elevation (ft msl)	5300.79		5201.64		5245		-	
Date	Water level (ft)	Elevation (ft msl)	Water level (ft)	Elevation (ft msl)	Water level (ft)	Elevation (ft msl)	Water level (ft)	Elevation (ft msl)
12/17/1996	Dry	Dry	Dry	Dry	9.50	5235.5	-	-
3/27/1997	Dry	Dry	Dry	Dry	9.29	5235.71	-	-
6/27/1997	Dry	Dry	Dry	Dry	9.61	5235.39	-	-
9/19/1997	Dry	Dry	Dry	Dry	9.75	5235.25	-	-
12/11/1997	Dry	Dry	dry	dry	9.60	5235.4	-	-
3/5/1998	-	-	Dry	Dry	8.36	5236.64	-	-
6/23/1998	20.80	5279.99	17.10	5184.54	10.08	5234.92	-	-
9/9/1998	dry	Dry	17.10	5184.54	10.01	5234.99	-	-
12/8/1998	dry	dry	Dry	dry	9.45	5235.55	-	-
12/21/2005	-	-	dry	-	-	-	-	-
9/27/2007	-	-	Dry	-	-	-	-	-
12/19/2007	-	-	Dry	-	-	-	-	-
3/26/2008	-	-	Dry	-	-	-	-	-
6/30/2008	-	-	Dry	-	-	-	-	-
9/23/2008	-	-	Dry	-	-	-	-	-
12/17/2008	-	-	Dry	-	-	-	-	-

ft msl - feet above mean sea level
(-) no measurement taken

Table 18.2-4 Alluvial Monitoring Well Summary and Aquifer Test Results

Well	Location (ft)		ID (in)	Elevation (ft)	Well depth (ft)	Test type	Transmissivity (ft^2/day)	Hydraulic conductivity		Saturated thickness
	Northing	Easting						(ft/day)	(cm/sec)	
GM-17	2013500	309800	4	NA	20.3	NA	NA	NA	NA	NA
QACW-2	2009420.7	287032.58	NA	5201.64	NA	NA	NA	NA	NA	NA
QACW-1	2010700	304050	2	5300.79	21.45	NA	NA	NA	NA	NA
QACW-2B	2008000	295200	dug well	5245	11	NA	NA	NA	NA	NA
PA-1	1990260.3	300409.2	2.1	5351.2	15.2	2.0 gpm pumping test	230.7	51.3	1.8E-02	4.5
PA-2	1980956.9	306702.8	2.1	5429.6	9.6	0.75 gpm pumping test	53.6	10.7	3.8E-03	5
NNA-1	1976857.2	296773.3	2.1	5430.5	24.8	NA	NA	NA	NA	0 to 11.5
NNA-2	1975404.9	299547.6	2.1	5454.7	22.1	NA	NA	NA	NA	0

ft^2/day - square feet per day
cm/sec - centimeter per second
NA - information not available
ID - inner diameter

Table 18.2-5. Potentiometric Elevations in Coal Monitoring Wells and Piezometers

Well/VWP Name	KF-98-02	KF-98-03	KF-98-04	KF2007-01	VWP 2007-01 (yellow)	VWP 2007-01 (green)	VWP 2007-01 S6 (white)	VWP 2007-02 (yellow)	VWP 2007-02 (white)	VWP 2007-02 (blue)	VWP 2007-02 (green)	VWP 2007-03 (yellow)	VWP 2007-03 (red)	VWP 2007-05 S2 (blue)
Coal Unit	S3	S3	S3	S8	S2a/S2b	S3	S6	S2	S3	S7	S8	S3	S2	S2
Date	Potentiometric Elevation (ft msl)													
4/30/1998	5325.75	5294.77	5289.62	-	-	-	-	-	-	-	-	-	-	-
5/12/1998	5331.00	5294.95	5289.59	-	-	-	-	-	-	-	-	-	-	-
6/11/1998	5340.83	5292.87	5289.03	-	-	-	-	-	-	-	-	-	-	-
7/21/1998	5349.56	5293.74	5289.07	-	-	-	-	-	-	-	-	-	-	-
11/8/1998		5293.78	5288.83	-	-	-	-	-	-	-	-	-	-	-
12/17/1998	5315.64	5292.75	5288.85	-	-	-	-	-	-	-	-	-	-	-
8/22/2007	-	5292.21	-	5392.33	5275.44	5278.48	5331.54	5292.06	5288.98	5372.05	5394.32	5366.22	5360.25	-
9/4/2007	5352.12	5292.37	-	5392.60	5273.72	5278.78	5331.85	5291.73	5288.58	5371.69	5394.47	5367.05	5357.72	-
10/4/2007	5354.47	-	5288.48	-	-	-	-	-	-	-	-	-	-	-
10/9/2007	-	-	-	5392.81	5273.44	5278.79	5330.39	5291.30	5287.63	5371.25	5393.71	5367.63	5357.26	-
11/5/2007	5356.16	-	-	-	-	-	-	-	-	-	-	5367.88	5357.23	5410.91
11/15/2007	-	-	-	5392.86	5273.37	5278.69	5329.97	5290.94	5288.21	5370.93	5393.77	-	-	-
12/3/2007	-	-	-	-	-	-	-	-	-	-	-	5367.74	5357.60	-
12/5/2007	5323.44	5291.94	-	5392.01	-	5278.56	5329.88	5291.09	5287.85	5370.81	5393.67	-	-	5410.61
1/17/2008	5329.14	5292.73	-	5393.06	-	-	-	-	-	-	-	-	-	-
1/31/2008	-	-	-	-	5273.42	5278.79	5329.84	5291.91	5288.15	5370.74	5393.81	5368.04	5357.83	5410.71
2/19/2008	5332.94	5291.73	-	5393.36	5273.05	5278.62	5330.05	5289.57	5287.20	5370.63	5393.56	5368.70	5357.74	-
3/20/2008	5328.04	5292.13	-	5392.96	5273.15	5278.39	5330.09	5289.18	5286.96	5370.63	5393.71	5366.44	5385.30	-
4/24/2008	5331.34	5292.83	-	5393.26	5273.23	5278.30	5330.11	5289.12	5286.86	5370.60	5393.67	5366.52	5385.50	5410.22
5/27/2008	-	-	-	5393.06	-	-	-	-	-	-	-	-	-	-
5/28/2008	5332.54	-	-	-	5273.42	5286.86	5330.11	5289.70	5286.86	5370.54	5390.11	5365.97	5385.40	5410.27
6/24/2008	5299.04	5291.73	-	5393.06	5273.47	5278.62	5330.15	5287.02	5287.02	5370.59	5390.11	5365.97	5385.40	5410.33
7/24/2008	5303.84	5293.43	-	5365.96	5273.30	5278.76	5330.17	5289.63	5286.89	5370.51	5390.05	5366.05	5385.50	5410.33
8/19/2008	5305.84	-	-	5392.96	5273.42	5278.56	5330.17	5286.99	5287.51	5370.45	5393.48	5366.19	5358.26	5410.33
8/20/2008	-	5293.03	-	-	-	-	-	-	-	-	-	-	-	-

Table 18.2-5. (Continued)

Well/VWP Name	KF-98-02	KF-98-03	KF-98-04	KF2007-01	VWP 2007-01 (yellow)	VWP 2007-01 (green)	VWP 2007-01 S6 (white)	VWP 2007-02 (yellow)	VWP 2007-02 (white)	VWP 2007-02 (blue)	VWP 2007-02 (green)	VWP 2007-03 (yellow)	VWP 2007-03 (red)	VWP 2007-05 S2 (blue)
Coal Unit	S3	S3	S3	S8	S2a/S2b	S3	S6	S2	S3	S7	S8	S3	S2	S2
Date	Potentiometric Elevation (ft msl)													
9/30/2008	5300.24	5292.73	-	5392.76	5273.45	5278.53	5330.42	5287.63	5287.42	5370.51	5393.36	5366.14	5358.11	5410.39

ft msl - feet above mean sea level
VWP - vibrating wire piezometer
(-) no measurement taken

Table 18.2-6 Coal Monitoring Well Summary and Aquifer Test Results

Well	Location (ft)[1] Northing	Easting	Coal seam	Elevation (ft)	Well depth (ft)	Test type	Transmissivity (ft^2/day)	Hydraulic conductivity (ft/day)	(cm/sec)	Saturated thickness
Kf-98-02	1974601.45	2526796.60	#3	5505.89	216.5	Displacement Test	0.0010	0.0001	4.6E-08	7.5
Kf-98-03	1984332.35	2527508.40	#3	5423.45	133.9	Bailed Recovery Test	0.010	0.002	7.1E-07	5
Kf-98-04	1990225.42	2523277.83	#3	5351.80	64.8	Bailed Recovery Test	0.010	0.001	3.5E-07	10
Kf84-22D	2009478.18	2530679.02	#3	5124.20	220	MCWhorter Recovery	0.01	0.002	7.1E-07	5.0
Kf2007-01	1995163.61	2525504.37	#8	5557.2	118	Papadopulos-Cooper Pumping Test	1.398	0.056	2.0E-05	25
SJKF84#3	2088296.86	2558656.03	#8	4990.18	120	MCWhorter Recovery	0.71	0.04	1.4E-05	18.0
SJKF84#4	2085218.97	2557197.37	#8	5046.67	71	MCWhorter Recovery	1.03	0.06	2.1E-05	18.0
SJKF84#5	2084335.75	2554186.41	#8	5092.00	180	MCWhorter Recovery	0.07	0.004	1.4E-06	18.0
KF84-20(d)	2017120.64	304307.65	#7	5213.92	190	MCWhorter Recovery	0.01	0.002	7.1E-07	5.0
Kf84-21C	2009797.60	2526457.46	#7	5219.66	75	MCWhorter Recovery	0.04	0.008	2.8E-06	5.0
Kf84-22B	2009478.18	2530679.02	#7	5204.10	140	MCWhorter Recovery	0.02	0.003	1.1E-06	5.0
Kf84-22C	2009478.18	2530679.02	#4-6	5142.50	202	MCWhorter Recovery	0.01	0.0014	4.9E-07	7.0
Kf84-20A	2017903.13	2526824.67	#2	5163.78	240	MCWhorter Recovery	0.009	0.001	3.5E-07	10.0
Kf84-22E	2009478.18	2530679.02	#2	5107.80	237	MCWhorter Recovery	0.01	0.001	3.5E-07	10.0

ft^2/day - square feet per day
cm/sec - centimeter per second
[1] Coordinate system - State Plane New Mexico West, NAD 1983

Table 18.2-7 Water Depths and Potentiometric Elevations in the Pictured Cliffs Sandstone

	Well or Piezometer Name											
	KPC-98-01		KPC2007-01		KPC2007-02		KPC2007-03		VWP 2007-01 Kpc (blue)	VWP 2007-02 Kpc (red)	VWP 2007-04 Kpc	VWP 2007-05 Kpc (red)
Measuring point elevation (ft msl)	5366.46		5355.71		5515.06		5470.23					
Date	Water depth (ft)	Elevation (ft msl)	Water depth (ft)	Elevation (ft msl)	Water depth (ft)	Elevation (ft msl)	Water depth (ft)	Elevation (ft msl)	Potentiometric elev (ft msl)	Potentiometric elev (ft-msl)	Potentiometric Elev. (ft-msl)	Potentiometric Elev. (ft-msl)
3/29/1998	91.31*	5275.15	-	-	-	-	-	-	-	-	-	-
4/30/1998	86.62	5279.84	-	-	-	-	-	-	-	-	-	-
5/12/1998	84.84	5281.62	-	-	-	-	-	-	-	-	-	-
6/11/1998	106.37	5260.09	-	-	-	-	-	-	-	-	-	-
7/21/1998	97.27	5269.19	-	-	-	-	-	-	-	-	-	-
11/8/1998	80.30	5286.16	-	-	-	-	-	-	-	-	-	-
12/17/1998	89.81	5276.65	-	-	-	-	-	-	-	-	-	-
8/22/2007	-	-	93.61	5262.10	217.55	5297.51	-	-	5270.44	-	-	-
8/23/2007	75.09	5291.37	-	-	-	-	128.66	5341.57	-	5298.44	-	-
9/4/2007	79.35	5287.11	93.68	5262.03	169.11	5345.95	128.03	5342.20	5268.35	5297.90	-	-
10/4/2007	77.56	5288.90	93.65	5262.06	-	-	-	-	-	5297.37	-	-
10/9/2007	-	-	-	-	-	-	-	-	5267.89	-	-	-
11/5/2007	76.51	5289.95	93.78	5261.93	183.30	5331.76	130.67	5339.56	-	-	5393.83	5411.60
11/15/2007	-	-	-	-	-	-	-	-	5268.14	-		
12/5/2007	78.15	5288.31	93.71	5262.00	163.16	5351.90	133.71	5336.52	5268.26	5296.81	5397.48	5411.26
1/31/2008	-	-	-	-	-	-	-	-	5268.09	5297.32	5393.68	5411.54
2/19/2008	-	-	-	-	-	-	-	-	5268.91	-	-	-
2/21/2008	-	-	-	-	-	-	-	-	-	5296.42	-	-
3/20/2008	89.80	5276.66	96.80	5258.91	158.80	5356.26	128.30	5341.93	5268.95	5296.48	5401.50	5410.79
4/24/2008	85.00	5281.46	94.10	5261.61	156.40	5358.66	123.50	5346.73	5268.78	5296.42	5401.82	5410.76
5/27/2008	81.50	5284.96	98.50	5257.21	155.90	5359.16	126.50	5343.73	-	-	-	-
5/28/2008	-	-	-	-	-	-	-	-	5269.01	5296.28	5402.20	5410.82
6/24/2008	79.90	5286.56	94.10	5261.61	157.10	5357.96	127.10	5343.13	5269.04	5296.48	5402.40	5410.88
7/24/2008	79.20	5287.26	94.00	5261.71	156.30	5358.76	126.70	5343.53	5268.76	5296.39	5402.86	5410.85

Table 18.2-7 (Continued)

	Well or Piezometer Name											
	KPC-98-01		KPC2007-01		KPC2007-02		KPC2007-03		VWP 2007-01 Kpc (blue)	VWP 2007-02 Kpc (red)	VWP 2007-04 Kpc	VWP 2007-05 Kpc (red)
Measuring point elevation (ft msl)	5366.46		5355.71		5515.06		5470.23					
Date	Water depth (ft)	Elevation (ft msl)	Water depth (ft)	Elevation (ft msl)	Water depth (ft)	Elevation (ft msl)	Water depth (ft)	Elevation (ft msl)	Potentiometric elev (ft msl)	Potentiometric elev (ft-msl)	Potentiometric Elev. (ft-msl)	Potentiometric Elev. (ft-msl)
8/19/2008	-	-	-	-	157.80	5357.26	-	-	5268.83	5296.14	5402.95	5410.85
8/20/2008	78.40	5288.06	94.10	5261.61	-	-	126.70	5343.53	-	-	-	-
9/30/2008	77.70	5288.76	94.40	5261.31	155.20	5359.86	126.80	5343.43	5268.66	5296.25	5403.30	5410.94

ft msl - feet above mean sea level
*1 day after well development
(-) no measurement taken

Table 18.2-8 Water Depths in the Pictured Cliffs Sandstone Monitoring Wells from 1970s and 1980s

Well name	GM-19		GM-20		GM-21		GM-28		GM-29		GM-30A	
	Water depth (ft)	Elevation (ft msl)	Water depth (ft)	Elevation (ft msl)	Water depth (ft)	Elevation (ft msl)	Water depth (ft)	Elevation (ft msl)	Water depth (ft)	Elevation (ft msl)	Water depth (ft)	Elevation (ft msl)
Measuring point elevation	NA	5385.0	NA	5470.0	NA	5610.0	NA	5320.0	NA	5380.0	NA	5520.0
11/16/1974	-	-	-	-	-	-	-	-	-	-	132.6	5387.4
3/27/1975	-	-	-	-	-	-	-	-	-	-	132.7	5387.3
11/19/1975	-	-	-	-	-	-	-	-	-	-	132.7	5387.3
12/9/1975	-	-	-	-	-	-	-	-	-	-	133.2	5386.8
9/26/1983	-	-	-	-	-	-	52.7	5267.4	-	-	-	-
9/27/1983	119.6	5265.5	137.5	5332.6	1892.0	5428.1	-	-	-	-	135.0	5385.0
4/17/1984	-	-	-	-	-	-	81.0	5239.0	-	-	-	-
7/7/1989	119.7	5265.3	-	-	-	-	54.6	5265.4	74.4	5305.6	-	-
7/26/1989	-	-	137.1	5332.9	181.7	5428.4	-	-	-	-	133.2	5386.8

ft msl - feet above mean sea level
NA - information not available
(-) no measurement taken

Table 18.2-9 Pictured Cliffs Sandstone Monitoring Well Summary and Aquifer Test Results

Well	Location (ft)[1]		Elevation (ft)	Well Depth (ft)	Test type	Transmissivity (ft^2/day)	Hydraulic conductivity		Saturated thickness (ft)	Storage coefficient
	Northing	Easting					(ft/day)	(cm/sec)		
KPC-98-01	1993802	290787	5366.46	125.7	0.4 gpm pumping test	0.79	0.020	7.1E-06	39	NA
KPC2007-01	1995103	302596	5355.71	208.84	NA	0.576	0.0074	2.6E-06	78	NA
KPC2007-02	1975119	303891	5515.06	320.98	NA	NA	0.0001	3.5E-08	NA	NA
KPC2007-03	1982885	295091	5470.23	138.4	NA	NA	0.0040	1.4E-06	NA	NA
Pumping test well T4-1	1976250	289850	5520	228	0.15 gpm pumping	0.1203	0.0014	4.9E-07	84	0.00032
Recovery test well GM-30A	1975811	290347	NA	191.6	NA	0.1337	0.0016	5.6E-07	84	0.00034
O-1					Cooper slug test	2.7300	0.0321	1.1E-05	85	NA
(18.3 gpm for 8.7 min)	1958366	320663	5520	414	Horslev slug test	3.7500	0.0441	1.6E-05	85	NA

[1] Coordinates State Plane New Mexico West NAD 1983

ft^2/day - square feet per day

cm/sec - centimeter per second

gpm - gallon per minute

NA - information not available or not determined

Table 18.2-10. Relevant Groundwater Quality Use Criteria

Parameter (units)	Livestock Watering Criteria [1]	Domestic Water Supply Criteria for Surface Water by 2007 Navajo Nation Standards	EPA Secondary Drinking Water Standards[2]
Arsenic (mg/L)	0.2	0.01	
Barium (mg/L)		1	
Boron (mg/L)	5	0.63	
Cadmium (mg/L)	0.05	0.005	
Chloride (mg/L)			250
Chromium (mg/L)	1	0.1	
Copper (mg/L)	0.5(D)	1.3	1
Fluoride (mg/L)	2*	4	2
Total iron (mg/L)	-		0.3
Lead (mg/L)	0.1	0.015	
Total manganese (mg/L)	-		0.05
Mercury (mg/L)	0.01	0.002	
Nitrate (mg/L-N)	0.132	10	
pH (su)	6.5-9.0	5.0-9.0	6.5-8.5
Potassium (mg/L)			
Radium-226 (pCi/L)	30**	5**	
Radium-228 (pCi/L)	30**	5**	
Selenium (mg/L)	0.05	0.05	
Silver (mg/L)		0.035	0.1
Sulfate (mg/L)	1000*		250
Total dissolved solids (TDS) (mg/L)	3000*		500
Uranium (mg/L)		0.03	
Zinc (mg/L)	25	2.1	5

[1] Based on Navajo Nation Environmental Protection Agency Water Quality Program, 2008, Navajo Nation Surface Water Quality Standards 2007, passed by Navajo Nation Resources Committee on May 13, 2008 and on other cirteria for livestock use as noted

[2] http://water.epa.gov/drink/contaminants/secondarystandards.cfm

* Although there are no Navajo Nation livestock watering criteria for TDS, sulfate and fluoride, TDS concentrations above 3,000 may adversely affect growing/young livestock and waters with sulfate concentrations above 1,000 mg/l and fluoride concentrations above 2 mg/l are not recommended for livestock use (Lardy, G., C.

** 30 pCi/L criteria for Ra-226 + Ra-228

mg/L - milligram per liter

µS/cm - microsiemens per centimeter

su - standard units

pCi/L - picocuries per liter

Table 18.2-11 Baseline Water Quality at Cottonwood Arroyo Alluvial Wells

		Cottonwood Alluvial Well		
Parameter		QACW-2	QACW-2B	GM-17
Baseline Monitoring Period		1974 - 1998	1986 - 1999	1975 - 1982
pH (SU)[1]	n	9	33	7
	median	7.9	7.8	6.9
TDS -180° (mg/L)	n	14	32	11
	median	2,305	3,015	15,210
Bicarbonate (as HCO3 mg/L)	n	9	32	2
	median	310	375.2	767
Carbonate (as CaCO3 mg/L)	n	2	15	0
	median	24	0.5	NA
Chloride (mg/L)	n	14	33	11
	median	28.2	138	113
Sulfate (mg/L)	n	14	32	11
	median	1,227	1,605	9,308
Calcium (mg/L)	n	9	33	8
	median	113	154	375
Magnesium (mg/L)	n	11	33	10
	median	16.2	22.7	145.0
Potassium (mg/L)	n	5	32	6
	median	2.0	6.5	25.5
Sodium (mg/L)	n	9	33	8
	median	451	778	4,510
Fluoride (mg/L)	n	14	33	11
	median	2.35	1.38	0.30
Nitrate as N (mg/L)	n	7	7	11
	median	0.18	0.09	1.03
Boron (mg/L)	n	13	32	11
	median	0.11	0.13	0.28
Iron, total (mg/L)	n	4	16	9
	median	0.03	1.04	0.62
Iron, diss.(mg/L)	n	14	33	11
	median	0.18	0.10	0.09
Manganese, total (mg/L)	n	3	16	8
	median	0.02	0.37	1.765
Manganese, diss. (mg/L)	n	14	33	11
	median	0.10	0.11	1.02
Selenium. (mg/L)	n	9	33	11
	median	0.0030	0.0025	0.0004

[1]Lab pH included in summary only when no field pH data are available for the well
QACW-2 includes 1974 through 1979 samples from GM-18

Table 18.2-12 Water Quality at Pinabete Arroyo Alluvial Well PA-1

Parameter (units)	3/29/1998	5/15/1998	8/20/1998	11/8/1998	6/15/2004	11/5/2007	2/21/2008	5/27/2008	8/20/2008	11/21/2008
Total Alkalinity as $CaCO_3$ (mg/L)	300	297	282	301	302	304	314	310	224	344
Arsenic (mg/L)	<0.005	<0.005	<0.005	<0.005	-	0.0008	<0.0005	0.0007	<0.0005	0.0008
Barium (mg/L)	0.05	0.03	0.9	0.03	-	0.0161	0.0144	0.0262	0.0164	0.0174
Bicarbonate as HCO_3 (mg/L)	365	362	344	367	368	371	383	378.2	273	420
Boron (mg/L)	0.17	0.2	0.2	0.22	-	0.787	0.2	0.2	0.2	0.2
Ion balance (%)	6.77	0.89	3.88	2.38	-	5.99	1.06	1.78	0.85	1.64
Cadmium (mg/L)	<0.001	<0.001	<0.001	<0.001	-	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Calcium (mg/L)	85.4	68.5	103	90.6	102	110	116	137	139	101
Carbonate (mg/L)	<1	<1	<1	<1	<10	<10	<10	<10	<10	<10
Chloride (mg/L)	25	22	29	16	14	14	17	36	25	18
Chromium (mg/L)	0.03* (total)	<0.01	<0.01	<0.01	-	0.005	0.004	0.004	<0.001	<0.001
Electrical conductivity (EC) (uS/cm)	2540	2410	2310	2150	2480	2380	2380	2680	3050	2520
Copper (mg/L)	<0.01	<0.01	<0.01	<0.01	-	0.0106	0.0151	0.0101	0.0094	0.0079
Fluoride (mg/L)	2.49	2.36	2.39	2.53	-	2.2	2.2	2.1	2.2	3
Hydroxide (mg/L)	<1	<1	<1	<1	<10	<10	<10	<10	<10	<10
Iron (mg/L)	0.99	0.06	<0.02	<0.02	-	<0.05	<0.05	<0.05	<0.05	<0.05
Total iron (mg/L)	41.9	3.07	4.43	0.25	-	16.7	17.5	53.2	1.39	3.88
Lead (mg/L)	<0.005	<0.005	<0.005	<0.005	-	<0.0001	<0.0001	0.0002	0.0002	0.0003
Magnesium (mg/L)	15.4	13.4	16.5	13.8	15.8	16.3	17.9	22.3	22.3	16.4
Manganese, D (mg/L)	0.138	0.005	0.017	<0.01	-	0.118	0.057	0.488	0.218	0.087
Manganese, T (mg/L)	1.31	0.843	0.37	0.03	-	0.487	0.302	3.56	0.350	0.142
Mercury (mg/L)	<0.001	<0.001	<0.001	<0.001	-	<0.0002	<0.0002	0.0002	<0.0002	<0.0002

Table 18.2-12 (Continued)

Parameter (units)	3/29/1998	5/15/1998	8/20/1998	11/8/1998	6/15/2004	11/5/2007	2/21/2008	5/27/2008	8/20/2008	11/21/2008
Nitrate (mg/L-N)	0.66	0.72	<0.05	NM	-	0.05	0.03	0.04	0.10	0.05
pH (su)	7.6	7.5	7.5	7.7	7.67	7.61	7.54	7.53	7.48	7.78
Potassium (mg/L)	9.8	1.8	1.7	2.9	1.4	1.4	1.3	2.7	1.7	1.7
Radium-226 (pCi/L)	<1.69	5.78	NM	0.91	-	2.9 ± 0.9	0.42 ± 0.34	1.3 ± 0.4	0.6 ± 0.42	0.10 ± 0.22
Radium-228 (pCi/L)	<1.9	5.77	NM	11.74	-	1.5 ± 0.7	0.60 ± 0.40	1.1 ± 0.6	0.53 ± 0.49	0.48 ± 0.38
Selenium (mg/L)	0.005	0.005	<0.005	<0.005	0.014	0.006	0.004	0.006	0.003	0.006
Silver (mg/L)	<0.01	<0.01	<0.01	<0.01	-	<0.00005	<0.00005	0.00006	<0.00005	<0.00005
Sodium (mg/L)	375	458	374	377	464	418	457	511	503	445
Sulfate (mg/L)	893	833	875	805	920	1040	1060	1140	1280	980
Total dissolved solids (TDS) (mg/L)	1610	1640	1730	1500	1660	1680	4310	1950	2030	1750
Uranium (mg/L)	-	-	-	-	-	0.01010	0.01080	0.01350	0.01620	0.01230
Zinc (mg/L)	0.053	0.037	<0.025	0.043	-	0.007	0.002	0.002	0.002	0.007

(-) s no analysis performed
mg/L - milligram per liter
µS/cm - microsiemens per centimeter
su - standard units
pCi/L - picocuries per liter

Table 18.2-13 Water Quality at Pinabete Arroyo Alluvial Well PA-2

Parameter (units)	3/30/1998	5/15/1998	8/20/1998	11/11/1998	6/15/2004	11/15/2007	2/21/2008	5/27/2008	8/19/2008	11/20/2008
Total alkalinity as $CaCO_3$ (mg/L)	293	281	315	327	286	410	308	328	405	430
Arsenic (mg/L)	<0.005	<0.005	<0.005	<0.005	-	0.0012	0.0007	0.0018	0.0008	0.0027
Barium (mg/L)	0.04	0.02	<0.2	0.02	-	0.0107	0.0129	0.0195	0.0143	0.0119
Bicarbonate as HCO_3 (mg/L)	357	342	384	398	349	451	376	400	494	525
Boron (mg/L)	0.19	0.2	0.22	0.31	-	0.2	2.1	0.2	0.3	0.2
Ion balance (%)	4.27	2.64	1.65	3.2	-	16	6.5	5.57	0.61	8.18
Cadmium (mg/L)	<0.001	<0.001	<0.001	<0.001	-	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Calcium (mg/L)	56.8	61	101	95	87.5	95	96.0	96.8	90.8	92.3
Carbonate (mg/L)	<1	<1	<1	<1	<10	24	<10	<10	<10	<10
Chloride (mg/L)	22	65	51	35	22	38	30	32	42	45
Chromium (mg/L)	0.03* (total)	<0.01	<0.01	<0.01	-	0.006	0.004	0.003	<0.001	0.009
Electrical conductivity (EC) (uS/cm)	4390	4510	4530	4520	4040	4600	4410	4110	5010	4860
Copper (mg/L)	<0.01	<0.01	<0.01	<0.01	-	0.0508	0.0116	0.0225	0.0226	0.0220
Fluoride (mg/L)	2.47	2.81	3.06	2.91	-	2.8	2.4	2.5	3.1	3.3
Hydroxide (mg/L)	<1	<1	<1	<1	<10	<10	<10	<10	<10	<10
Iron (mg/L)	0.11	<0.02	<0.02	0.04	-	<0.05	<0.05	<0.05	<0.05	<0.05
Total iron (mg/L)	63.9	2.88	6.55	0.13	-	1.86	5.61	3.03	1.86	3.19
Lead (mg/L)	<0.005	<0.005	<0.005	<0.005	-	<0.0001	<0.0001	0.0001	0.0002	0.0001
Magnesium (mg/L)	12	11	16	15	13.2	0.0277	15.5	16.7	15.5	16.7
Manganese (mg/L)	1.33	0.456	0.22	0.11	-	0.0277	0.090	0.141	0.128	0.135
Total manganese (mg/L)	3.71	0.525	0.88	0.24	-	0.552	1.27	0.599	0.551	0.748
Mercury (mg/L)	<0.001	<0.001	<0.001	<0.001	-	<0.0002	<0.0002	0.0002	<0.0002	<0.0002

Table 18.2-13 (Continued)

Parameter (units)	3/30/1998	5/15/1998	8/20/1998	11/11/1998	6/15/2004	11/15/2007	2/21/2008	5/27/2008	8/19/2008	11/20/2008
Nitrate (mg/L-N)	0.27	0.32	<0.05	NM	-	0.06	0.08	0.08	0.11	0.05
pH (su)	7.9	7.4	7.3	7.5	7.62	7.19	7.41	7.5	7.21	7.31
Potassium (mg/L)	5	2	3	5.4	1.8	2.1	2.0	2.4	3.3	3.2
Radium-226 (pCi/L)	<1.69	27.9	-	0.48	-	0.67 ± 0.43	0.40 ± 0.39	0.45 ± 0.34	0.60 ± 0.40	2.5 ± 0.7
Radium-228 (pCi/L)	<1.9	1.74	-	9.02	-	0.62 ± 0.48	1.4 ± 0.6	0.19 ± 0.56	1.2 ± 0.5	0.55 ± 0.37
Selenium (mg/L)	0.0007	0.006	<0.005	<0.005	0.012	0.012	0.009	0.014	0.010	0.018
Silver (mg/L)	<0.01	<0.01	<0.01	<0.01	-	<0.00005	<0.00005	0.00009	<0.00005	<0.00005
Sodium (mg/L)	781	981	872	891	839	809	850	907	966	1000
Sulfate (mg/L)	1670	1760	1690	1940	1550	2200	2100	2150	1950	2400
Total Dissolved Solids (TDS) (mg/L)	2990	3150	3600	3420	2780	3500	3070	3030	3540	3580
Uranium (mg/L)	-	-	-	-	-	0.01230	0.01120	0.01350	0.01160	0.01170
Zinc (mg/L)	0.051	0.025	<0.025	0.18	-	0.003	0.008	0.009	0.004	0.008

(-) no analysis performed

mg/L - milligram per liter

µS/cm - microsiemens per centimeter

su - standard units

pCi/L - picocuries per liter

Table 18.2-14 Water Quality at No Name Arroyo Alluvial Well NNA-1

Parameter (units)	8/20/1998	11/11/1998
Arsenic (mg/L)	<0.005	<0.005
Barium (mg/L)	0.9	0.02
Boron (mg/L)	2.4	0.84
Cadmium (mg/L)	<0.001	<0.001
Chromium (mg/L)	<0.01	<0.01
Copper (mg/L)	<0.01	<0.01
Iron (mg/L)	<0.02	0.04
Lead (mg/L)	<0.005	<0.005
Manganese (mg/L)	0.084	0.45
Mercury (mg/L)	<0.001	<0.001
Selenium (mg/L)	0.008	0.043
Silver (mg/L)	<0.01	<0.01
Zinc (mg/L)	<0.025	0.21
Total Iron (mg/L)	1.56	0.17
Total manganese (mg/L)	0.13	0.66
pH (su)	7.6	7.6
Electrical conductivity (EC) (uS/cm)	13100	20700
Total dissolved solids (TDS) (mg/L)	12600	13400
Fluoride (mg/L)	1.93	0.97
Bicarbonate (HCO3 mg/L)	639	719
Carbonate (CO3 mg/L)	<1	<1
Chloride (mg/L)	180	127
Sulfate (mg/L)	7150	10100
Calcium (mg/L)	333	293
Magnesium (mg/L)	249	205
Potassium (mg/L)	15	28.3
Sodium (mg/L)	2640	3220
Hydroxide (mg/L)	<1	NA
Total Alkalinity (mg/L)	524	589
Nitrate (mg/L-N)	5.26	NA
Ion balance (%)	3.9	13.45
Radium-226 (pCi/L)	NA	1.37
Radium-228 (pCi/L)	NA	2.81

*secondary standard

** Ra-226 + Ra-228

Table 18.2-15 Water Quality at No. 3 Coal Seam Well KF-98-02

(Samples collected on 3/291998 and on 11/8/1998 eliminated due to pH>11)

Parameter (units)	8/23/2007	11/5/2007	2/19/2008	5/28/2008	8/19/2008	11/20/2008
Total alkalinity (mg/L)	1530	1040	1320	1390	1620	1580
Arsenic (mg/L)	0.0055	0.0057	0.0058	0.0045	0.0028	0.0051
Barium (mg/L)	0.1399	0.0925	0.1230	0.175	0.3380	0.1420
Bicarbonate (HCO3 mg/L)	1037	1269	1464	1696	1928	1560
Boron (mg/L)	0.3	1.47	0.4	0.3	0.4	0.5
Ion balance (%)	3.04	8.77	0.51	1.21	4.89	2.63
Cadmium (mg/L)	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Calcium (mg/L)	1.6	16.2	5.5	9.1	6.7	4.6
Carbonate (CO3 mg/L)	408	<10	72	<10	24	12
Chloride (mg/L)	930	650	920	950	1210	1280
Chromium (mg/L)	0.029	0.02	0.033	0.017	0.002	0.069
Electrical conductivity (EC) (uS/cm)	5510	3790	4910	5440	7050	7090
Copper (mg/L)	0.0192	0.0124	0.0222	0.053	0.0305	0.0263
Fluoride (mg/L)	1.8	1.4	1.7	0.2	1.8	1.6
Hydroxide (mg/L)	<10	<10	<10	<10	<10	<10
Iron (mg/L)	<0.05	<0.05	<0.05	0.05	0.08	0.07
Total iron (mg/L)	0.14	0.891	0.53	0.52	0.42	1.01
Lead (mg/L)	0.0003	0.0003	0.0003	0.0002	0.0005	0.0001
Magnesium (mg/L)	0.6	<0.5	0.8	1.0	2.7	2.4
Total manganese (mg/L)	0.007	0.016	0.020	0.019	0.039	0.017
Manganese (mg/L)	<0.005	<0.005	0.025	0.011	0.044	0.045
Mercury (mg/L)[1]	<0.0002	<0.0002	<0.0002	0.0003	<0.0002	<0.0002
Nitrate (mg/L-N)	<0.02	0.06	<0.02	0.03	0.03	0.02
pH (su)	9.55	7.53	8.11	7.89	7.79	8.01
Potassium (mg/L)	12.1	8.5	11.5	12.1	13.3	13.0
Radium-226 (pCi/L)	0.13 ± 0.28	0.31 ± 0.32	0.77 ± 0.58	0.82 ± 0.72	0.50 ± 0.36	0.18 ± 0.28
Radium-228 (pCi/L)	-0.02 ± 0.46	0.34 ± 0.50	0.64 ± 0.70	0.74 ± 0.75	0.83 ± 0.49	0.51 ± 0.43
Selenium (mg/L)[2]	0.008	0.008	0.008	0.006	0.005	0.009
Silver (mg/L)	<0.00005	<0.00005	<0.00005	0.00033	<0.00005	0.00016
Sodium (mg/L)	1250	786	1170	1170	1310	1510
Sulfate (mg/L)	64	136	118	96	120	36
Total dissolved solids (TDS) (mg/L)	3180	2220	3050	3080	4040	4100
Uranium (mg/L)	-	0.00424	0.00595	0.00546	0.00532	0.00540
Zinc (mg/L)	<0.001	0.006	0.001	<0.001	0.008	0.010

Table 18.2-15 (Continued)

(Samples collected on 3/291998 and on 11/8/1998 eliminated due to pH>11)

Parameter (units)	8/23/2007	11/5/2007	2/19/2008	5/28/2008	8/19/2008	11/20/2008

*secondary standard

** Ra-226 + Ra-228

(-) no analysis performed

mg/L - milligram per liter

µS/cm - microsiemens per centimeter

su - standard units

pCi/L - picocuries per liter

Table 18.2-16. Baseline Water Quality in the Fruitland Coals at Navajo Mine

Well	Well Depth (feet)	Baseline Monitoring Period	pH (SU)		TDS -180° (mg/L)		Bicarbonate as HCO_3 (mg/L)		Carbonate as CO_3 (mg/L)		Chloride (mg/L)		Sulfate (mg/L)		Calcium (mg/L)		Magnesium (mg/L)		Potassium (mg/L)	
			n	median	n	median	n	median	n	median	n	median	n	median	n	median	n	median	n	median
KF84-21a (No 2)	118	1984-2001	30	7.9	30	8375	30	1197	17	<1	30	4445	30	63	30	13.3	30	14.9	30	13.3
KF84-21c (No 7)	75	1984	1	8.08	1	8505	1	919	1	68.4	1	3980	1	184	1	14.6	1	14.9	1	15.0
KF84-22a (No 8)	125	1984-2001	22	8.0	22	4650	22	1170	12	<1	22	290	22	2140	22	15.3	22	3.5	22	6.8
KF84-22b (No 7)	140	1984-2001	26	7.4	26	6115	25	854	15	<1	25	3220	26	<10	26	45.0	26	13.4	26	11.9
KF84-22d (No 3)	220	1984	1	7.94	1	8610	1	830	1	46.8	1	3420	1	<10	1	27.4	1	18.7	1	15.8
KF84-22e (No 2)	237	1984	2	7.98	2	8155	2	814	2	52.8	2	4185	2	24.5	2	35.6	2	17.5	2	16.3
KF84-20A (No 3)	190	1984-2001	26	7.93	26	7260	26	1090	23	<1	26	3715	26	<10	26	18.4	26	11.0	26	11.9
KF84-20C (No 7)	240	1984-2001	23	7.9	23	2770	23	1562	21	<1	23	715	23	7	23	9.6	23	2.8	23	5.9
KF84-18b (No 8)	133	1984-2001	25	7.1	25	9300	25	1030	13	<1	25	4900	25	<10	25	114.0	27	24.3	25	15.0
KF84-18a (No. 6)	181	1984-2001	26	7.47	26	13400	26	450	14	<1	26	7900	26	5.5	26	157.0	26	50.6	26	22.5

Well	Well Depth (feet)	Baseline Monitoring Period	Sodium (mg/L)		Fluoride (mg/L)		Nitrate as N (mg/L)		Boron (mg/L)		Iron, total (mg/L)		Iron, diss.(mg/L)		Manganese, total (mg/L)		Manganese, diss. (mg/L)		Selenium, diss. (mg/L)	
			n	median	n	median	n	median	n	median	n	median	n	median	n	median	n	median	n	median
KF84-21a (No 2)	118	1984-2001	30	3080	30	1.56	5	0.1	30	0.61	21	0.100	30	0.100	21	0.020	30	0.0255	29	<0.005
KF84-21c (No 7)	75	1984	1	2858	1	1.79	1	394	1	0.63	1	-	1	0.015	1	-	1	0.3800	1	<0.001
KF84-22a (No 8)	125	1984-2001	22	1600	22	2.19	3	0.53	22	0.27	19	0.420	22	0.080	19	0.020	22	0.0143	22	<0.005
KF84-22b (No 7)	140	1984-2001	26	2210	25	0.89	1	0.08	25	0.39	23	1.130	26	0.195	23	0.300	26	0.300	26	<0.005
KF84-22d (No 3)	220	1984	1	2866	1	1.28	1	-	1	0.5	1	-	1	0.006	1	-	1	0.016	1	<0.001
KF84-22e (No 2)	237	1984	2	2803	2	1.23	2	-	2	0.51	2	-	2	0.005	2	-	2	0.140	2	<0.001
KF84-20A (No 3)	190	1984-2001	26	2690	26	1.39	2	0.115	26	0.55	17	2.730	26	0.235	17	0.180	26	0.100	26	<0.005
KF84-20C (No 7)	240	1984-2001	23	1040	23	1.74	2	0.18	21	0.42	16	0.640	23	0.180	16	0.075	23	0.082	23	<0.005
KF84-18b (No 8)	133	1984-2001	25	3380	25	0.44	3	0.1	25	0.73	17	11.900	25	<0.5	16	0.380	25	0.380	25	<0.005
KF84-18a (No. 6)	181	1984-2001	26	4640	26	0.66	2	0.1	26	0.72	17	3.80	26	0.25	17	1.33	26	1.32	19	<0.005

Median calculation based on all but rejected sample results including field splits and non detected results
Rejected samples include: samples with no sampling or analysis date, samples with pH>11, samples that are clearly inconsistent with results of other damples
For less than detection limit, 1/2 the detection limit used for summary unles the median is a detection limit that is lower than any detected result
uncaracterized metals results included as dissolved metals in statistical summray

Table 18.2-17 Water Quality at No. 8 Coal Seam Well KF2007-01

Parameter (units)	8/16/2007	11/15/2007	5/27/2008	8/19/2008	11/20/2008
Total alkalinity (mg/L)	1800	1670	1478	1646	1670
Arsenic (mg/L)	0.0014	0.003	0.002	0.0017	0.0028
Barium (mg/L)	0.0297	0.0351	0.0344	0.0280	0.0293
Bicarbonate (HCO3 mg/L)	2098	1074	1190	1490	1550
Boron (mg/L)	0.2	0.329	0.3	0.4	0.4
Ion balance (%)	7.1	4.6	8.19	6.21	1.92
Cadmium (mg/L)	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Calcium (mg/L)	4.2	2.2	2.7	3.9	3.2
Carbonate (CO3 mg/L)	29	284	288	156	120
Chloride (mg/L)	278	364	362	338	320
Chromium (mg/L)	0.012	0.032	0.024	0.003	0.067
Electrical conductivity (EC) (uS/cm)	8240	7380	6330	5560	5170
Copper (mg/L)	0.0362	0.1180	0.0737	0.0349	0.0232
Fluoride (mg/L)	3.1	2.6	2.6	2.7	3.3
Hydroxide (mg/L)	<10.	<10	<10	<10	<10
Iron (mg/L)	<0.05	<0.05	<0.05	<0.05	<0.05
Total iron (mg/L)	<0.05	0.0847	0.33	1.20	0.29
Lead (mg/L)	<0.0001	0.0003	<0.0001	0.0004	0.0322
Magnesium (mg/L)	1.6	1.4	1.6	1.8	1.5

Table 18.2-17 (Continued)

Parameter (units)	8/16/2007	11/15/2007	5/27/2008	8/19/2008	11/20/2008
Manganese (mg/L)	0.008	<0.005	0.007	0.013	0.008
Total manganese (mg/L)	0.011	0.0168	0.023	0.052	0.017
Mercury (mg/L)	<0.0002	<0.0002	0.0004	<0.0002	<0.0002
Nitrate (mg/L-N)	<0.02	<0.02	0.29	0.43	0.25
pH (su)	8.12	9.56	9.09	8.64	8.75
Potassium (mg/L)	9	46.9	28.9	17.9	16.4
Radium-226 (pCi/L)	0.11 ± 0.27	0.51 ± 0.35	0.33 ± 0.42	0.50 ± 0.39	0.30 ± 0.30
Radium-228 (pCi/L)	0.32 ± 0.48	0.89 ± 0.46	0.58 ± 0.50	0.76 ± 0.53	0.55 ± 0.35
Selenium (mg/L)	0.006	0.004	0.005	0.004	0.005
Silver (mg/L)	<0.00005	<0.00005	0.00006	0.00007	<0.00005
Sodium (mg/L)	995	1780	1430	1160	1180
Sulfate (mg/L)	315	2050	1380	740	620
Total dissolved solids (TDS) (mg/L)	2750	5160	4130	3460	3250
Uranium (mg/L)	0.00060	0.00059	0.00044	0.00058	0.00037
Zinc (mg/L)	0.002	0.003	0.002	0.014	0.010

*secondary standard
** Ra-226 + Ra-228
mg/L - milligram per liter
µS/cm - microsiemens per centimeter
su - standard units
pCi/L - picocuries per liter

Table 18.2-18 Water Quality at Pictured Cliffs Sandstone Monitoring Well KPC-98-01

Parameter (units)	3/29/1998	11/8/1998	8/23/2007	11/5/2007	2/21/2008	5/27/2008	8/20/2008	11/21/2008
Total Alkalinity as $CaCO_3$ (mg/L)	131	581	750	930	900	870	740	850
Arsenic (mg/L)	<0.005	<0.005	0.0042	0.00193	0.0019	0.002	0.0017	0.0035
Barium (mg/L)	0.02	0.02	0.0138	0.0101	0.0123	0.0236	0.0132	0.0126
Bicarbonate as HCO_3 (mg/L)	132	709	891	1135	1098	1061	903	1037
Boron (mg/L)	0.12	0.61	0.6	1.11	0.7	0.7	0.6	0.7
Ion balance (%)	2.13	3.71	4.6	8.3	2.17	0.49	6.89	1.61
Cadmium (mg/L)	<0.001	<0.001	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Calcium (mg/L)	26.5	33.1	28	25.2	26.8	30.8	28.4	28.6
Carbonateas CO3 (mg/L)	14	<1	12	<10	<10	<10	<10	<10
Chloride (mg/L)	39	177	310	212	234	244	220	236
Chromium (mg/L)	<0.01* (total)	<0.01	0.018	0.124	0.012	0.004	0.001	0.021
Electrical conductivity (EC) (uS/cm)	1380	6550	5510	8250	8250	8250	8730	8700
Copper (mg/L)	<0.01	<0.01	0.0396	0.026	0.0571	0.43	0.0468	0.0807
Fluoride (mg/L)	2.29	1.13	1.3	1.4	1.4	1.3	1.5	1.5
Hydroxide (mg/L)	-	-	<10	<10	<10	<10	<10	<10
Iron (mg/L)	0.46	1.51	0.68	<0.05	<0.05	<0.05	<0.05	<0.05
Total iron (mg/L)	2.51	1.74	0.68	29.5	7.60	2.71	0.16	0.51
Lead (mg/L)	<0.005	0.005	0.0001	<0.0001	0.0003	0.0003	0.0002	0.0001
Magnesium (mg/L)	2.7	5.7	8.2	6.8	7.7	8	7.4	7.7
Manganese (mg/L)	0.013	0.08	0.063	0.0673	0.058	0.051	0.037	0.039
Total manganese (mg/L)	0.038	0.1	0.073	0.111	0.183	0.082	0.044	0.045

Table 18.2-18 (Continued)

Parameter (units)	3/29/1998	11/8/1998	8/23/2007	11/5/2007	2/21/2008	5/27/2008	8/20/2008	11/21/2008
Mercury (mg/L)	<0.001	<0.001	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Nitrate (mg/L-N)	1.54	-	<0.02	2.29	1.94	4.46	2.68	1.92
pH (su)	9.1	8	7.78	7.76	7.70	7.79	7.73	7.87
Potassium (mg/L)	8.2	17.3	9.2	7.1	8.6	10	8.5	8.1
Radium-226 (pCi/L)	<1.69	3.92	0.92 ± 0.49	1.0 ± 0.5	1.2 ± 0.5	1.5 ± 0.5	0.76 ± 0.44	0.61 ± 0.36
Radium-228 (pCi/L)	<1.9	5.42	1.2 ± 0.5	1.6 ± 0.6	1.1 ± 0.4	1.2 ± 0.5	1.2 ± 0.5	1.3 ± 0.4
Selenium (mg/L)	<0.005	<0.005	0.005	0.00346	0.006	0.005	0.005	0.011
Silver (mg/L)	<0.01	<0.01	<0.00005	0.00006	<0.00005	0.00007	<0.00005	<0.00005
Sodium (mg/L)	202	1490	2150	1790	1930	2270	1690	1980
Sulfate (mg/L)	350	2680	3900	3350	3300	3800	3300	3400
Total dissolved solids (TDS) (mg/L)	800	4830	6640	6060	6050	5900	5820	6360
Uranium (mg/L)	-	-	0.01901	0.01230	0.01220	0.00952	0.01000	0.01010
Zinc (mg/L)	0.093	0.365	0.002	0.201	0.018	0.022	0.019	0.027

(-) analysis not performed for parameter

mg/L - milligram per liter

μS/cm - microsiemens per centimeter

su - standard units

Table 18.2-19 Water Quality at Pictured Cliffs Sandstone Monitoring Well KPC2007-01

Parameter (units)	8/16/2007	11/15/2007	2/19/2008	5/28/2008	8/20/2008	11/20/2008
Total alkalinity (mg/L)	1480	1870	1900	1280	1600	1440
Arsenic (mg/L)	0.006	0.0058	0.0052	0.0234	0.0025	0.0051
Barium (mg/L)	0.0342	0.0096	0.0214	0.0341	0.0191	0.0173
Bicarbonate (HCO3 mg/L)	1732	866	415	1488	756	1293
Boron (mg/L)	0.3	0.429	0.5	0.6	0.4	0.5
Ion balance (%)	9	10.4	11.1	6.13	17.9	7.82
Cadmium (mg/L)	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Calcium (mg/L)	13.4	3.6	2.4	18.6	3	11.6
Carbonate (mg/L)	60	1160	1560	60	980	380
Chloride (mg/L)	320	304	292	374	365	580
Chromium (mg/L)	0.005	0.025	0.040	0.008	0.002	0.063
Electrical conductivity (EC) (uS/cm)	8240	8260	8070	7950	8560	9250
Copper (mg/L)	0.0934	0.104	0.0785	0.2470	0.0369	0.0412
Fluoride (mg/L)	1.7	1.5	1.5	1.8	1.6	1.6
Hydroxide (mg/L)	<10	<10	<10	<10	<10	<10
Iron (mg/L)	<0.05	<0.05	<0.05	0.13	<0.05	<0.05
Total iron (mg/L)	1.11	0.0892	0.93	533	0.17	1.57
Lead (mg/L)	<0.0001	<0.0001	<0.0001	0.0004	0.0002	0.0002
Magnesium(mg/L)	7.3	0.0056	4.2	9.4	4.4	7.1
Manganese (mg/L)	0.034	0.0244	<0.005	0.022	<0.005	0.0785
Total manganese (mg/L)	0.055	0.024	0.022	9.73	0.006	0.137
Mercury (mg/L)	<0.0002	<0.0002	<0.0002	0.001	<0.0002	<0.0002
Nitrate (mg/L-N)	<0.02	<0.02	0.03	0.05	0.65	0.07
pH (su)	8.19	9.82	10.3	8.35	9.85	9.14
Potassium (mg/L)	18.1	76.9	73.3	14.3	35.2	16.2
Radium-226 (pCi/L)	0.18 ± 0.28	0.61 ± 0.39	0.01 ± 0.28	2.0 ± 0.7	0.33 ± 0.32	0.10 ± 0.22
Radium-228 (pCi/L)	0.86 ± 0.57	0.19 ± 0.44	0.37 ± 0.57	0.42 ± 0.45	0.50 ± 0.47	0.37 ± 0.43
Selenium (mg/L)	0.008	0.003	0.004	0.006	0.004	0.008
Silver (mg/L)	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	0.0001
Sodium (mg/L)	1720	2020	1920	1840	1600	2020
Sulfate (mg/L)	2750	2500	2000	2900	2350	2800
Total disolved solids (TDS) (mg/L)	5820	5820	5650	6790	5640	6280
Uranium (mg/L)	0.00187	0.00149	0.00065	0.00472	0.00080	0.00089

Table 18.2-19 (Continued)

Parameter (units)	8/16/2007	11/15/2007	2/19/2008	5/28/2008	8/20/2008	11/20/2008
Zinc (mg/L)	0.006	0.004	0.001	0.012	0.003	0.008

*secondary standard
** Ra-226 + Ra-228
mg/L - milligram per liter
µS/cm - microsiemens per centimeter
su - standard units
pCi/L - picocuries per liter

Table 18.2-20 Water Quality at Pictured Cliffs Sandstone Monitoring Well GM-21

Parameter (units)	11/16/1974	8/4/1976	8/22/1977	9/10/1979
Arsenic (mg/L)	<0.5	<0.01	<0.01	<.0001
Barium (mg/L)	-	<0.1	<0.5	0.05
Boron (mg/L)	0.88	0.7	1.0	1.10
Cadmium (mg/L)	0.081	<0.001	<0.01	<.01
Chromium (mg/L)	-	0.005	<0.01	0.03
Copper (mg/L)	0.025	<0.001	0.01	<0.01
Iron (mg/L)	0.2	0.198	<0.05	0.04
Lead (mg/L)	<0.05	0.001	<0.05	0.26
Manganese (mg/L)	0.05	<0.039	0.07	0.03
Mercury (mg/L)	<0.0005	<0.0004	<0.001	-
Selenium (mg/L)	<0.05	<0.01	<0.01	0.001
Silver (mg/L)	-	<0.001	<0.05	<0.1
Zinc (mg/L)	0.447	0.045	0.06	0.62
Total iron (mg/L)	-	-	-	0.41
Total manganese (mg/L)	-	-	-	0.11
pH (su)	7.9	7.2	7.3	7
Electrical conductivity (EC) (uS/cm)	-	-	-	-
Total dissolved solids (TDS) (mg/L)	6923	6624	6370	6140

Table 18.2-20 (Continued)

Parameter (units)	11/16/1974	8/4/1976	8/22/1977	9/10/1979
Fluoride (mg/L)	0.4	0.2	-	-
Bicarbonate (mg/L)	585	-	-	-
Carbonate (mg/L)	-	-	-	-
Chloride (mg/L)	780	646	150	118
Sulfate (mg/L)	3600	2502	2625	3740
Calcium (mg/L)	423	155	414	-
Magnesium (mg/L)	65	148	62	-
Potassium (mg/L)	-	-	-	-
Sodium (mg/L)	1470	920	1440	-
Hydroxide (mg/L)	-	-	-	-
Total alkalinity (mg/L)	-	-	-	-
Nitrate (mg/L-N)	-	-	0.4	-
Ion balance (%)	8.2	-	-	-
Radium-226 (pCi/L)	-	-	-	0.11
Radium-228 (pCi/L)	-	-	-	-

(-) analysis not performed for parameter
mg/L - milligram per liter
µS/cm - microsiemens per centimeter
su - standard units
pCi/L - picocuries per liter

Table 18.2-21 Water Quality at Pictured Cliffs Sandstone Monitoring Well GM-20

(Sample collected on 11/16/1974 eliminated due to pH>11)

Parameter (units)	6/27/1975	5/18/1976	10/6/1976	8/22/1977	12/20/1977	9/10/1979
Arsenic (mg/L)	-	0.01	0.03	<0.01	<0.01	<0.001
Barium (mg/L)	-	0.24	<0.1	<0.5	<0.1	0.1
Boron (mg/L)	-	0.88	0.2	0.9	1.2	2.24
Cadmium (mg/L)	-	0.001	<0.001	<0.01	0.001	<0.1
Chromium (mg/L)	-	0.013	0.019	<0.01	0.012	0.01
Copper (mg/L)	-	0.016	0.006	0.01	0.008	0.03
Iron (mg/L)	-	0.64	0.066	<0.05	0.35	0.01
Lead (mg/L)	-	0.035	0.034	<0.05	<0.001	0.10
Manganese (mg/L)	-	0.026	0.008	<0.001	0.16	0.29
Mercury (mg/L)	-	<0.0004	<0.0004	<0.001	<0.0004	-
Selenium (mg/L)	-	<0.01	<0.01	<0.01	<0.01	0.001
Silver (mg/L)	-	<0.001	<0.001	<0.05	<0.01	<.01
Zinc (mg/L)	-	0.08	<0.001	<0.05	0.04	1.06
Total iron (mg/L)	-	-	-	-	-	0.03
Total manganese (mg/L)	-	-	-	-	-	0.29
pH (su)	10.8	9.3	8.6	8.7	7.3	7
Electrical conductivity (EC) (uS/cm)	8755	-	-	-	-	-
Total dissolved solids (TDS) (mg/L)	-	5711	5822	5880	5050	5260

Table 18.2-21 (Continued)

(Sample collected on 11/16/1974 eliminated due to pH>11)

Parameter (units)	6/27/1975	5/18/1976	10/6/1976	8/22/1977	12/20/1977	9/10/1979
Fluoride (mg/L)	-	-	-	-	-	-
Bicarbonate as HCO3 (mg/L)	290	475	-	462	269	-
Carbonate as CO3 (mg/L)	272	105	-	-	-	-
Chloride (mg/L)	-	2118	1280	1430	757	803
Sulfate (mg/L)	-	1725	1830	2050	2380	2250
Calcium (mg/L)	-	10.6	8.5	11	9.3	-
Magnesium (mg/L)	-	4.32	4.56	7	19	-
Potassium (mg/L)	-	-	-	-	-	-
Sodium (mg/L)	-	2000	1690	2020	1600	-
Hydroxide (mg/L)	-	-	-	-	-	-
Total alkalinity (mg/L)	-	-	-	-	-	-
Nitrate (mg/L-N)	-	-	0.08	0.6	0.2	-
Ion balance (%)	-	9.8	-	0.9	2.5	-

(-) analysis not performed for parameter

mg/L - milligram per liter

µS/cm - microsiemens per centimeter
su - standard units

Table 18.2-22 Water Quality at Pictured Cliffs Sandstone Monitoring Well GM-19

Parameter (units)	11/16/1974	8/5/1976	8/8/1977	9/10/1979
Arsenic (mg/L)	<0.5	<0.001	<0.05	0.33
Barium (mg/L)	-	<0.1	<0.5	0.08
Boron (mg/L)	1.03	0.3	1.0	0.88
Cadmium (mg/L)	0.016	<0.001	<0.01	<.01
Chromium (mg/L)	-	0.001	<0.01	<.01
Copper (mg/L)	0.015	0.001	0.02	0.02
Iron (mg/L)	0.4	0.005	<0.05	0.01
Lead (mg/L)	<0.05	0.001	<0.05	0.1
Manganese (mg/L)	0.245	0.088	0.06	0.11
Mercury (mg/L)	<0.0005	<0.0004	<0.001	-
Selenium (mg/L)	<0.05	<0.01	<0.01	0.002
Silver (mg/L)	-	<0.001	<0.05	<.01
Zinc (mg/L)	0.240	0.031	0.07	0.42
Total iron (mg/L)	-	-	-	0.01
Total manganese (mg/L)	-	-	-	0.12
pH (su)	8.1	7.83	7.9	7.5
Electrical conductivity (EC) (uS/cm)	-	-	-	-

Table 18.2-22 (Continued)

Parameter (units)	11/16/1974	8/5/1976	8/8/1977	9/10/1979
Total dissolved solids (TDS) (mg/L)	9172	8437	7810	9270
Fluoride (mg/L)	1.7	0.76	0.9	1.49
Bicarbonate as HCO3 (mg/L)	1000	-	-	-
Carbonate as CO3 (mg/L)	-	-	-	-
Chloride (mg/L)	1020	534.8	668	1077
Sulfate (mg/L)	4050	3685	4000	4535
Calcium (mg/L)	43	13.2	200	-
Magnesium (mg/L)	19	3.83	38	-
Potassium (mg/L)	-	-	-	-
Sodium (mg/L)	3040	1610	2200	-
Hydroxide (mg/L)	-	-	-	-
Total alkalinity (mg/L)	-	-	-	-
Nitrate (mg/L-N)	-	-	1.2	-
Ion balance (%)	2.4	-	-	-

(-) analysis not performed for parameter
mg/L - milligram per liter
µS/cm - microsiemens per centimeter
su - standard units

Table 18.2-23 Water Quality at Pictured Cliffs Sandstone Monitoring Well GM-30A

Parameter (units)	5/19/1976	8/22/1977	9/10/1979
Arsenic (mg/L)	<0.01	<0.01	0.0019
Barium (mg/L)	0.4	<0.5	0.03
Boron (mg/L)	0.46	0.6	0.96
Cadmium (mg/L)	<0.001	<0.01	<.01
Chromium (mg/L)	0.010	<0.01	0.01
Copper (mg/L)	0.007	0.01	<.01
Iron (mg/L)	0.49	<0.05	0.01
Lead (mg/L)	0.20	<0.05	0.13
Manganese (mg/L)	0.07	0.04	<.01
Mercury (mg/L)[1]	<0.0004	<0.001	-
Selenium (mg/L)[2]	<0.01	<0.01	0.002
Silver (mg/L)	<0.001	<0.05	<.01
Zinc (mg/L)	0.09	<0.05	0.16
Total iron (mg/L)	-	-	0.02
Total manganese (mg/L)	-	-	0.05
pH (su)	7.6	7.5	7.5
Electrical conductivity (EC) (uS/cm)	-	-	-

Table 18.2-23 (Continued)

Parameter (units)	5/19/1976	8/22/1977	9/10/1979
Total dissolved solids (TDS) (mg/L)	6573	6930	7070
Fluoride (mg/L)	-	-	-
Bicarbonate (mg/L)	171	210	-
Carbonate (mg/L)	-	-	-
Chloride (mg/L)	1215	1120	1203
Sulfate (mg/L)	422	3100	3105
Calcium (mg/L)	30.8	102	-
Magnesium (mg/L)	17.7	22	-
Potassium (mg/L)	-	-	-
Sodium (mg/L)	2070	2110	-
Hydroxide (mg/L)	-	-	-
Total alkalinity (mg/L)	-	-	-
Nitrate (mg/L-N)	0.51	0.4	-
Ion balance (%)	34	4.5	-

(-) analysis not performed for parameter
mg/L - milligram per liter
µS/cm - microsiemens per centimeter
su - standard units

Table 18.3-1 Measured and Modeled Recharge Rates

Surface characterization	Recharge range[1] (in/yr)	Mean recharge[1] (in/yr)	Modeled recharge (in/yr)
Badlands	0.002 to 0.01	0.006	
Slopes > 5%			0.002
Slopes: 2 to 5%			0.01
Upland flat	.02 to 0.05	0.03	
Upland flat (slope<1%)			0.03
Upland (slope 1 to 2%)			0.02
Alluvial valley	0.09	0.09	0.09

[1]From Stone 1987

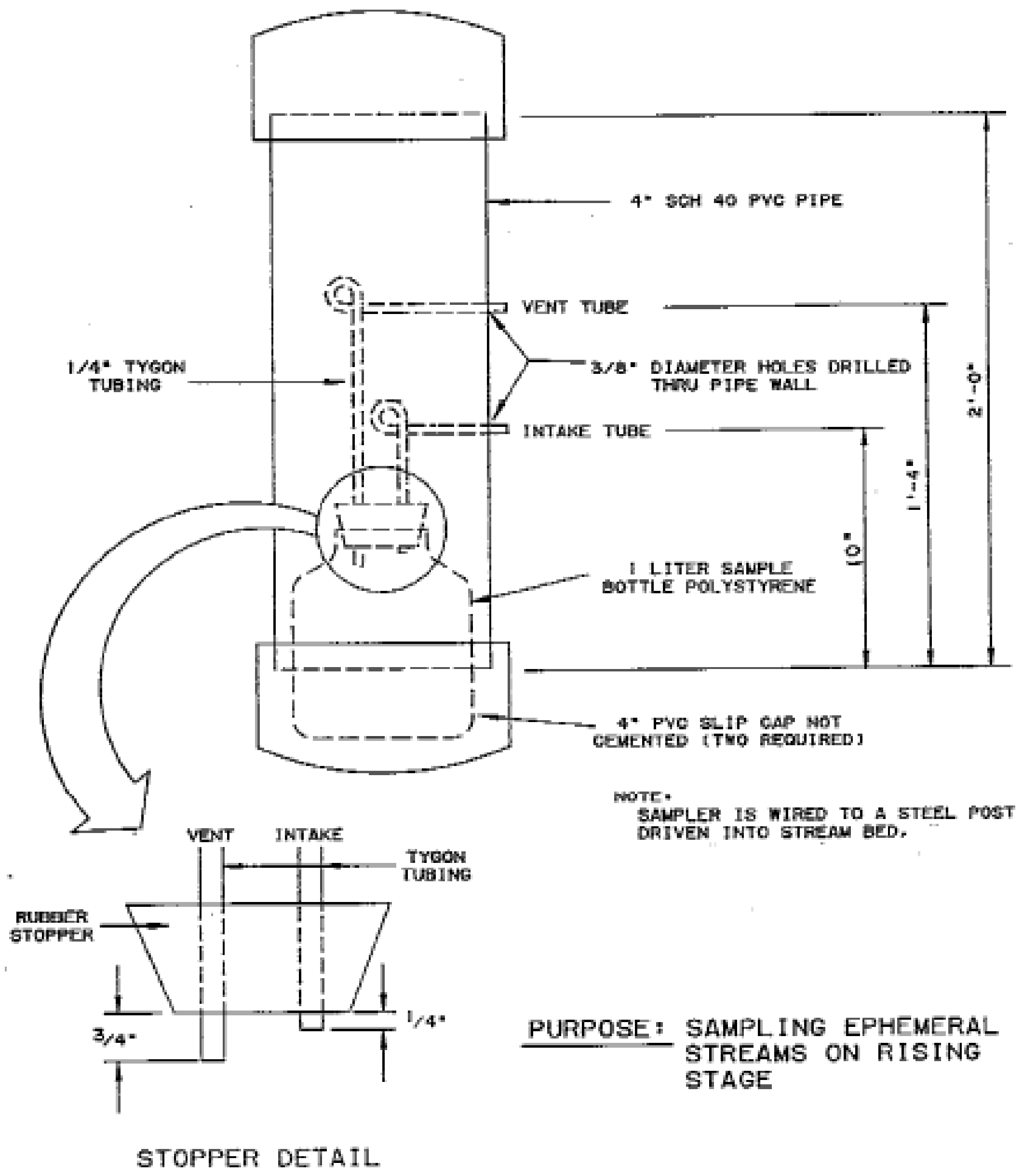


Figure 18.1-1 Schematic of Single-Stage Sediment Sampler

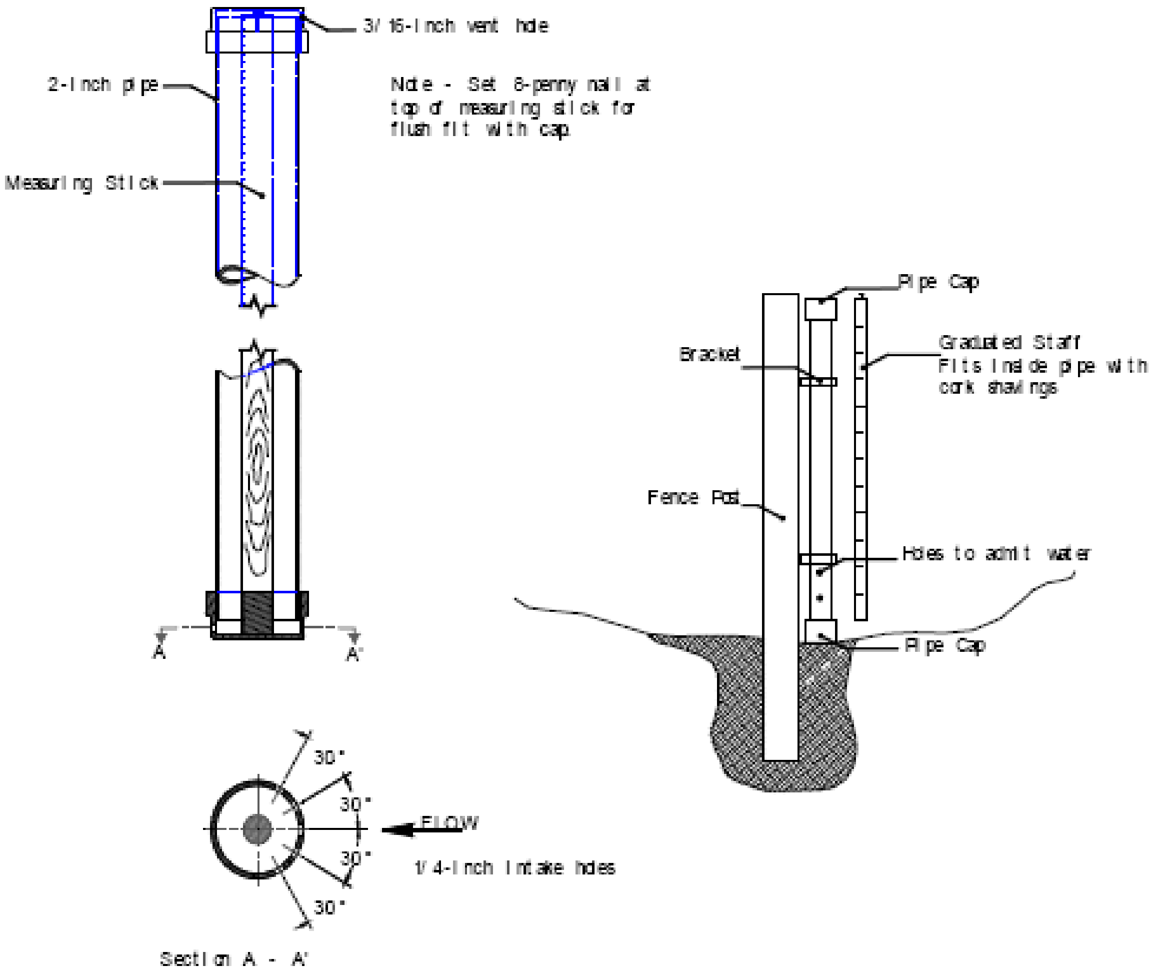
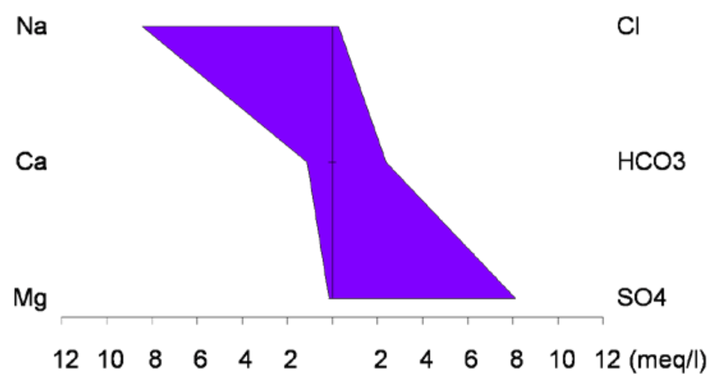


Figure 18.1-2 Schematic of Crest Stage Gage

Upper Pinabete 3, 12/3/2007



Lower Pinabete 2, 12/3/2007

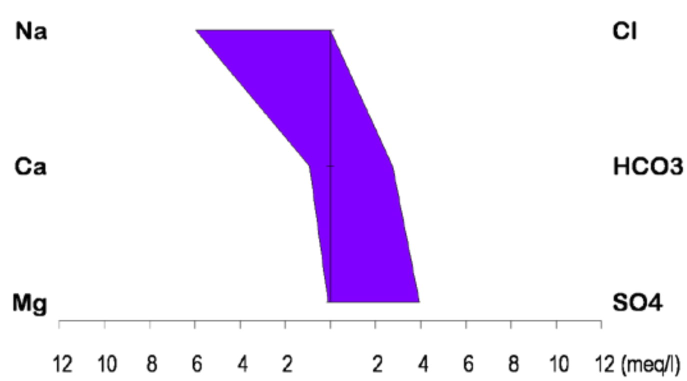


Figure 18.1-3 Pinabete Arroyo Stiff Diagrams

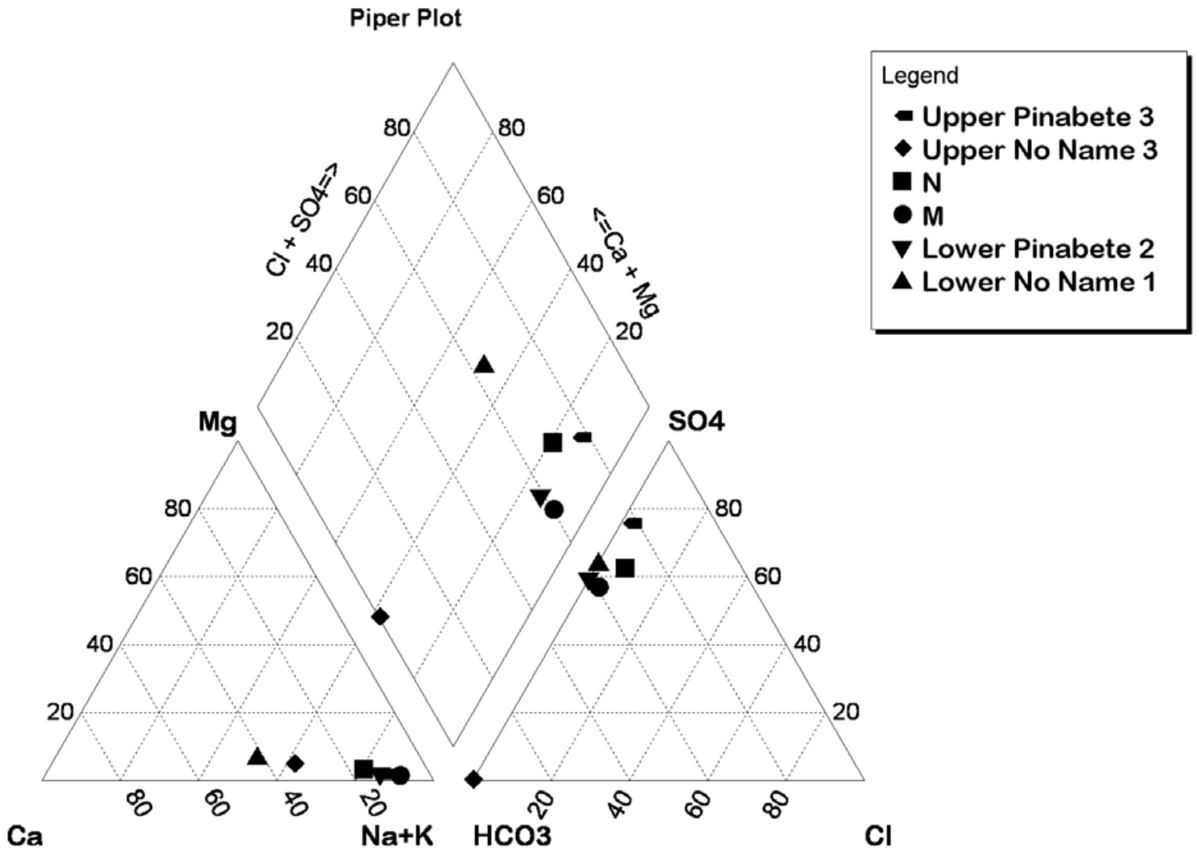


Figure 18.1-4 Piper Plot Diagram for Surface Water Samples from Pinabete Arroyo, No Name Arroyo, and Brimhall Wash

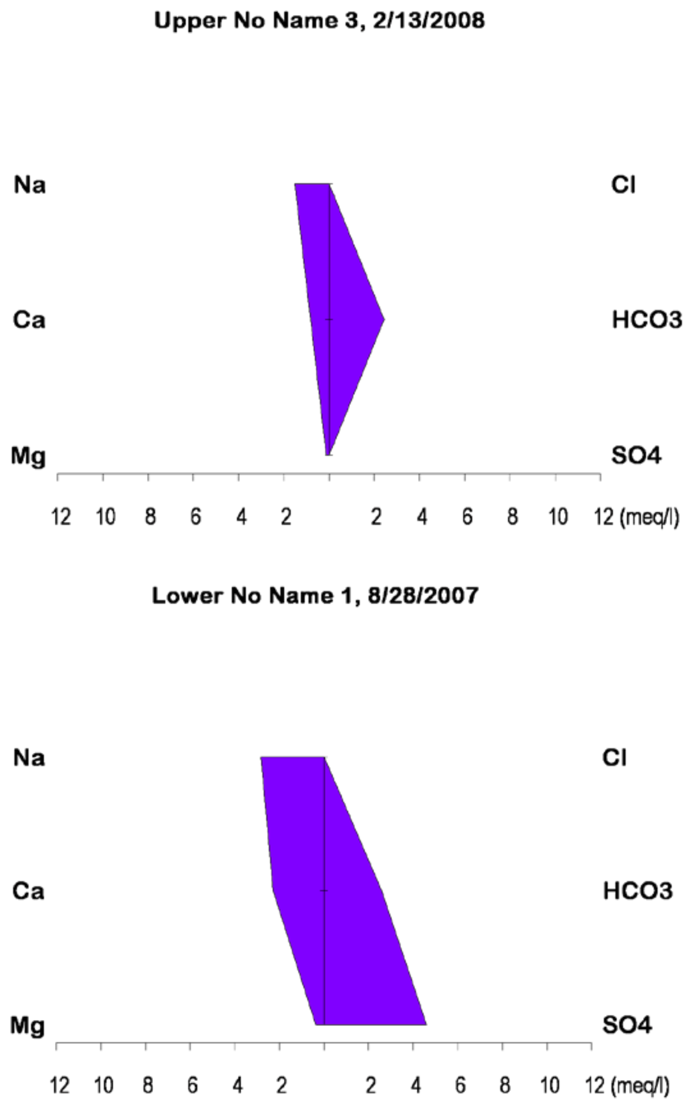


Figure 18.1-5 No Name Arroyo Stiff Diagrams

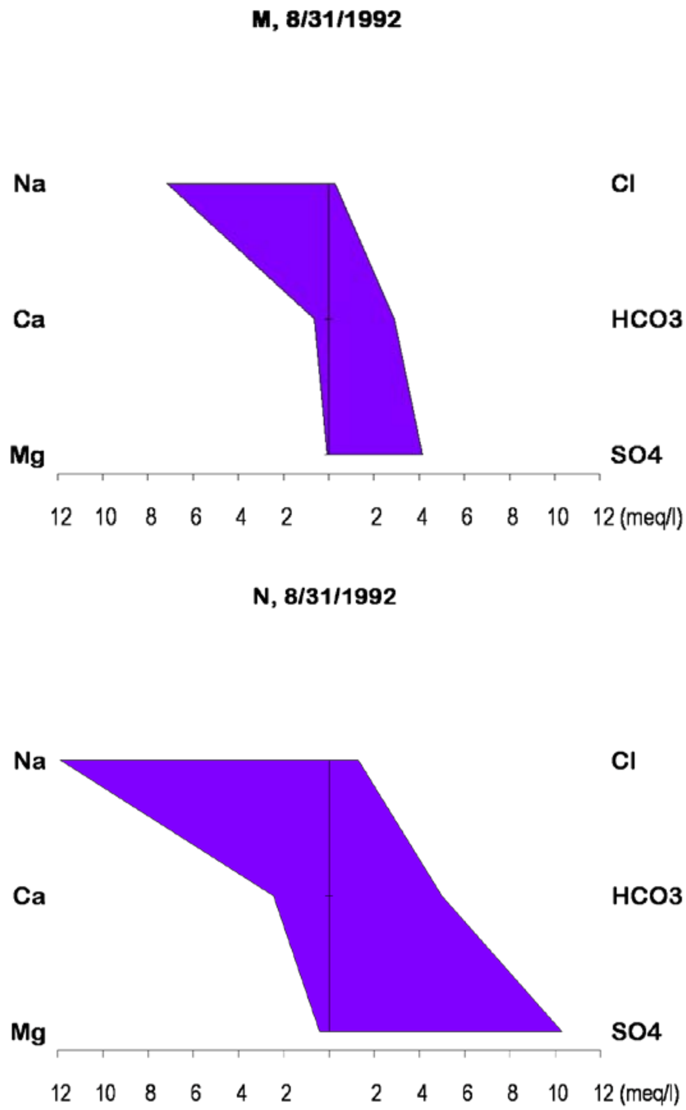


Figure 18.1-6 Brimhall Wash Stiff Diagrams – Upstream (Site N) and Downstream (Site M).

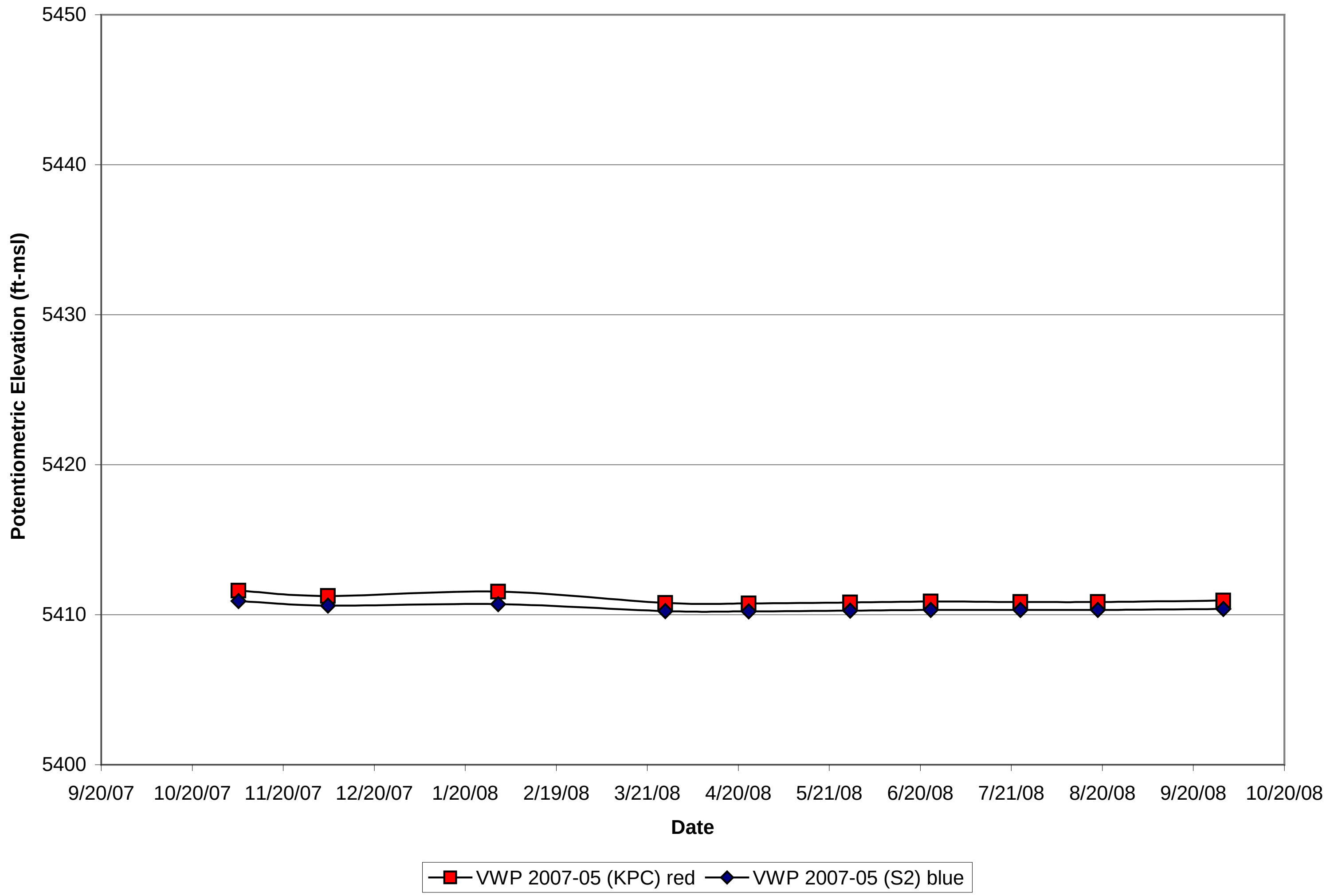


Figure 18.2-1 Baseline Potentiometric Elevations at Location VWP2007-05

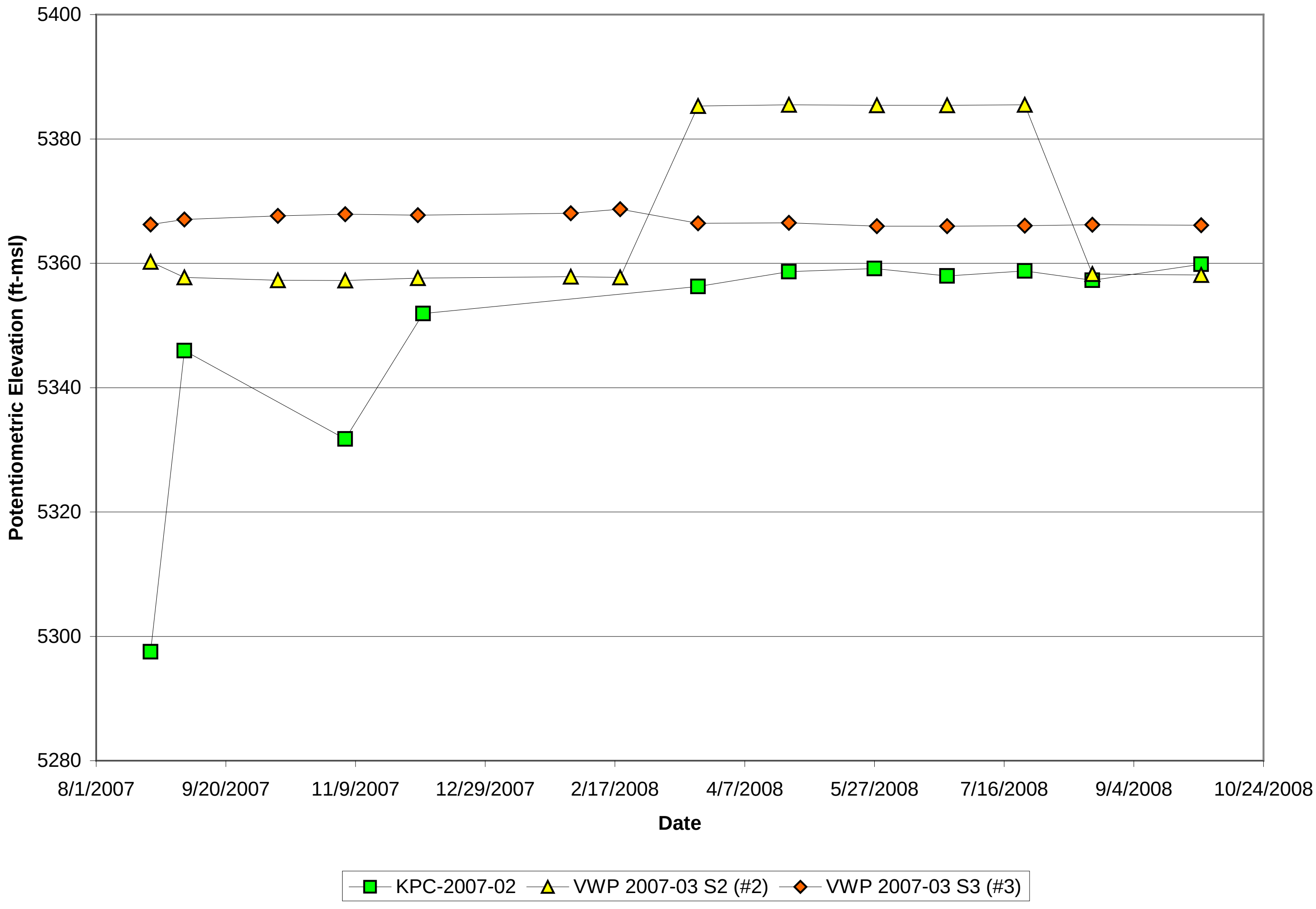


Figure 18.2-2 Baseline Potentiometric Elevations at Location VWP2007-03

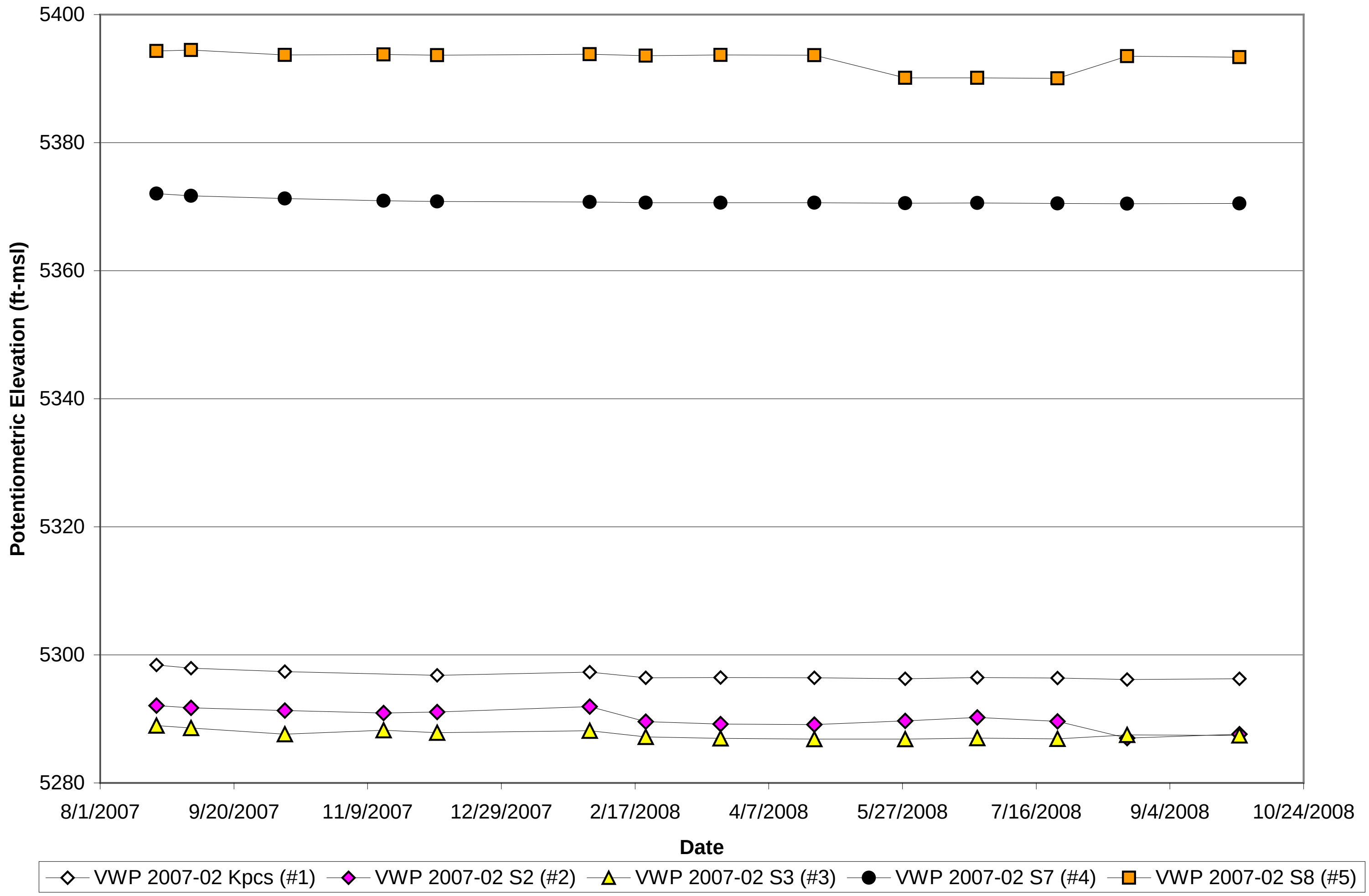


Figure 18.2-3 Baseline Potentiometric Elevations at Location VWP2007-02

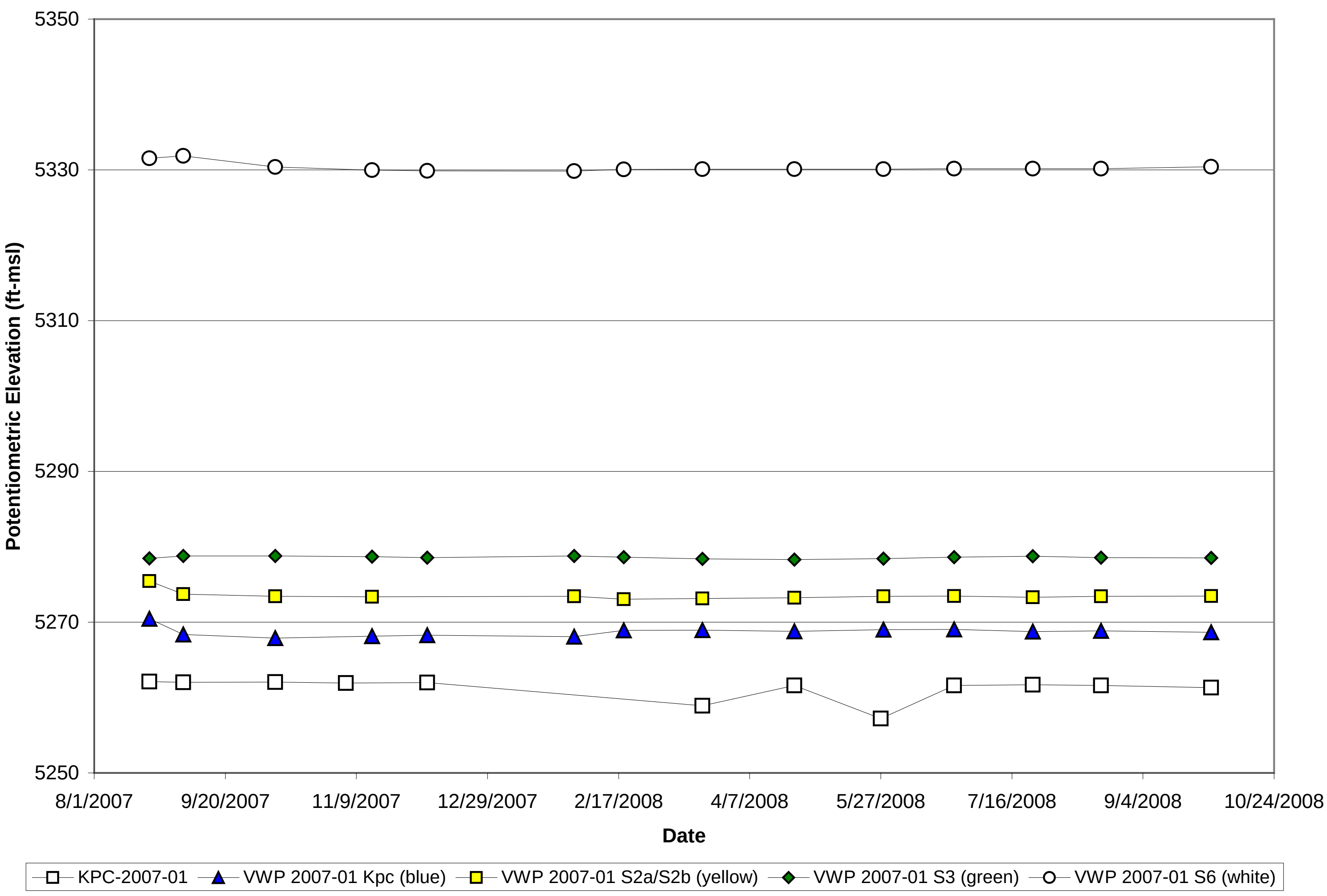


Figure 18.2-4 Baseline Potentiometric Elevations at Location VWP2007-01

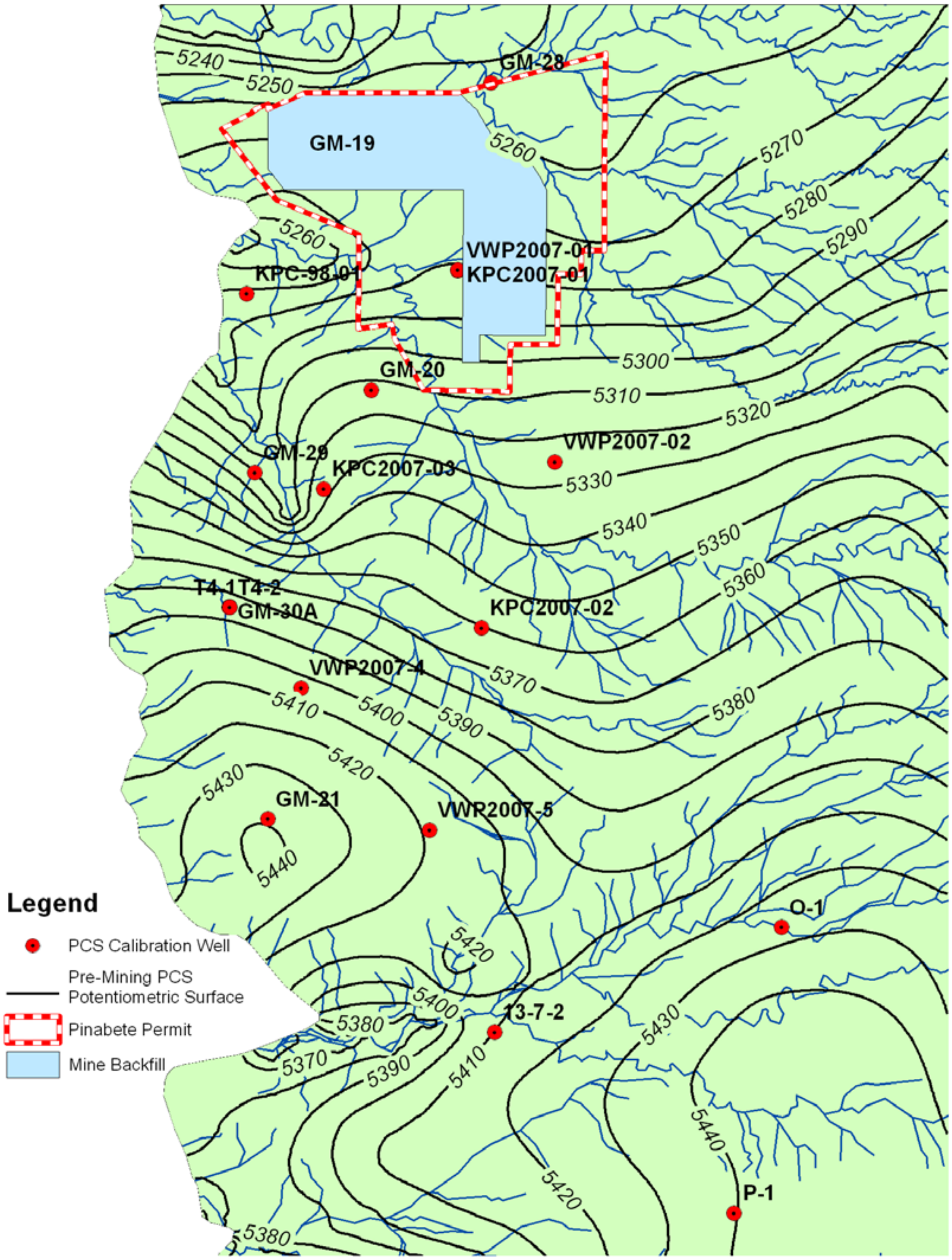


Figure 18.3-1 Modeled Baseline Potentiometric Surface for the Pictured Cliffs Sandstone

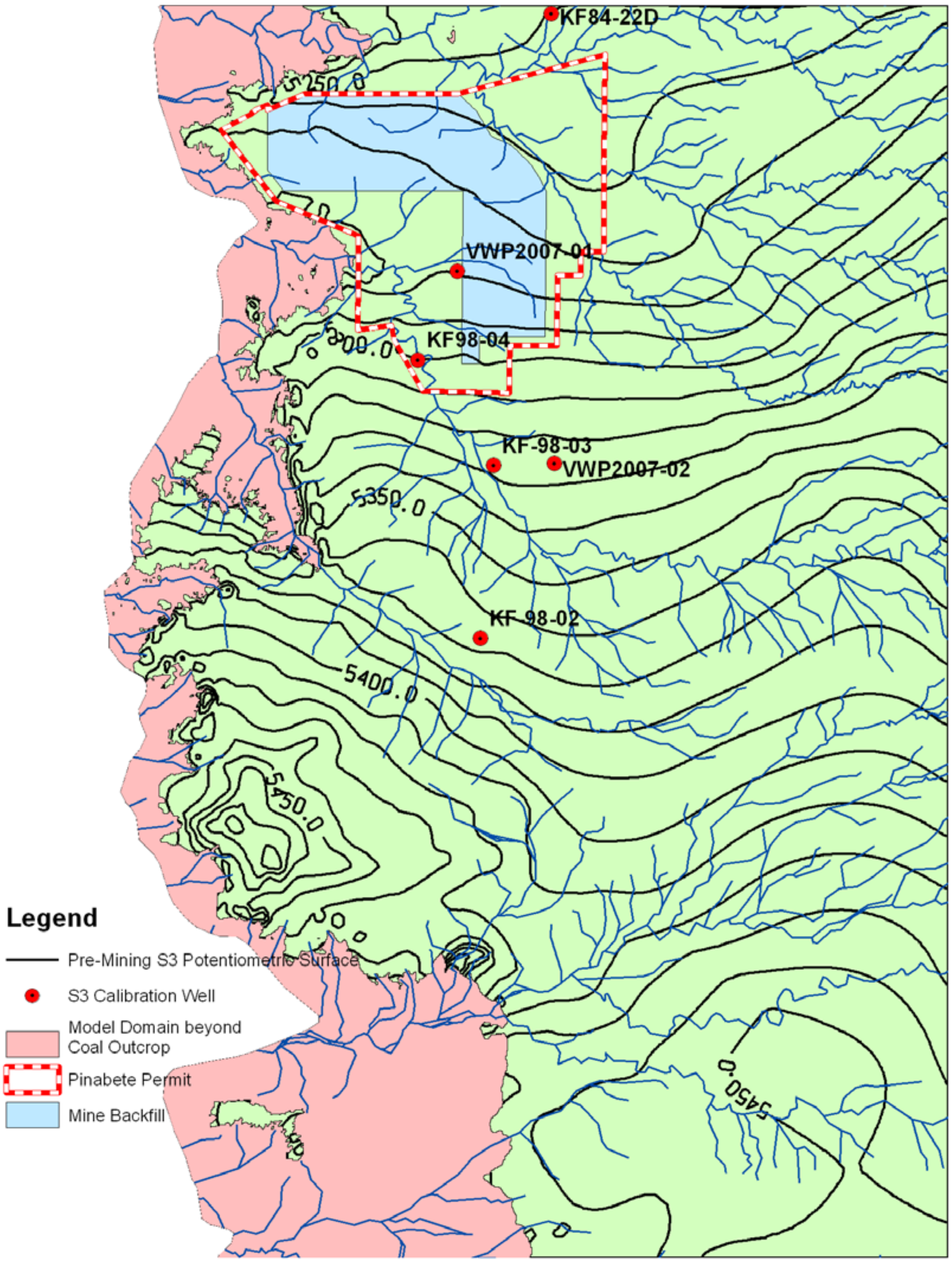


Figure 18.3-2 Modeled Baseline Potentiometric Surface for the No. 3 Coal Seam

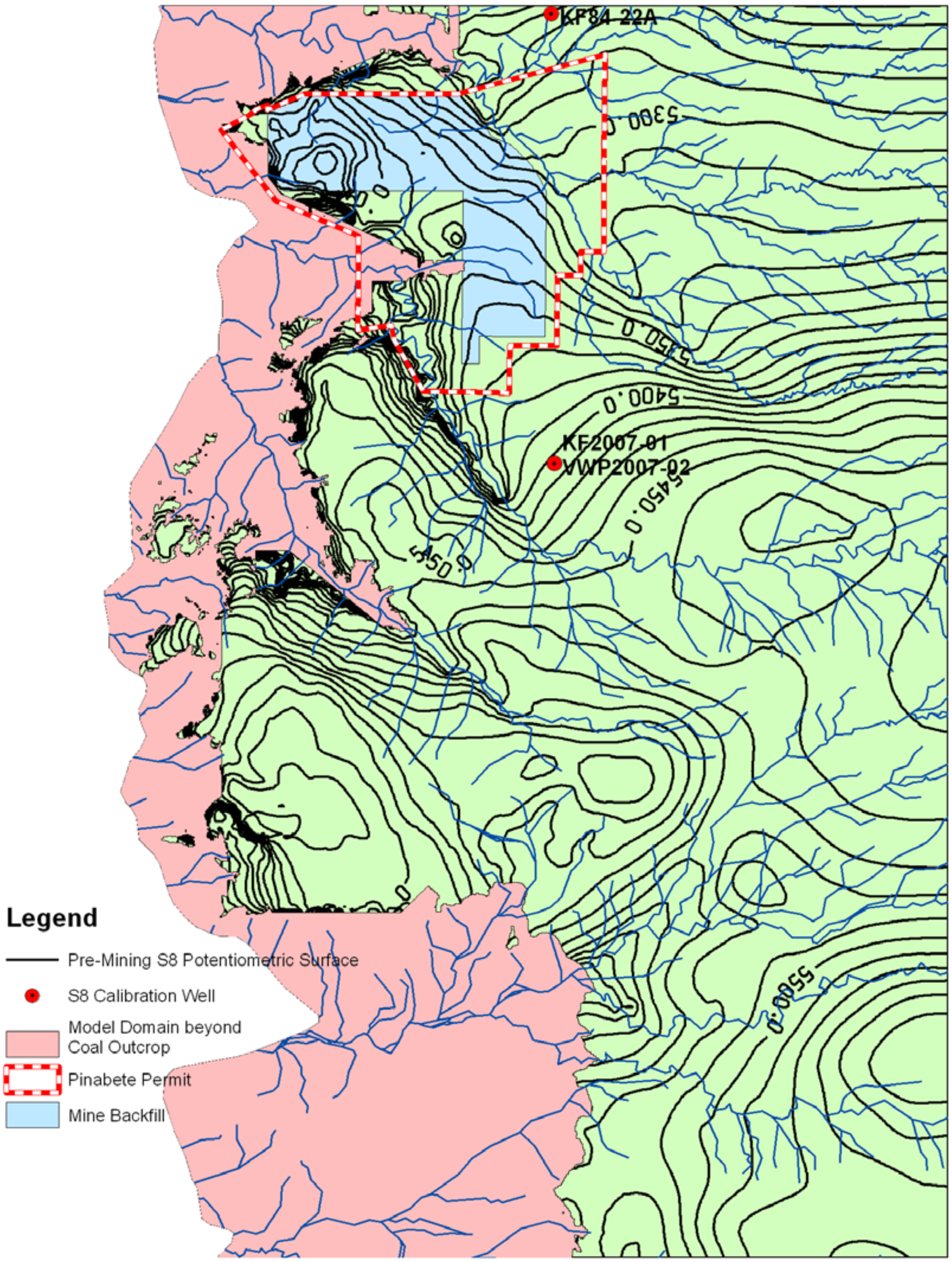


Figure 18.3-3 Modeled Baseline Potentiometric Surface for the No. 8 Coal Seam

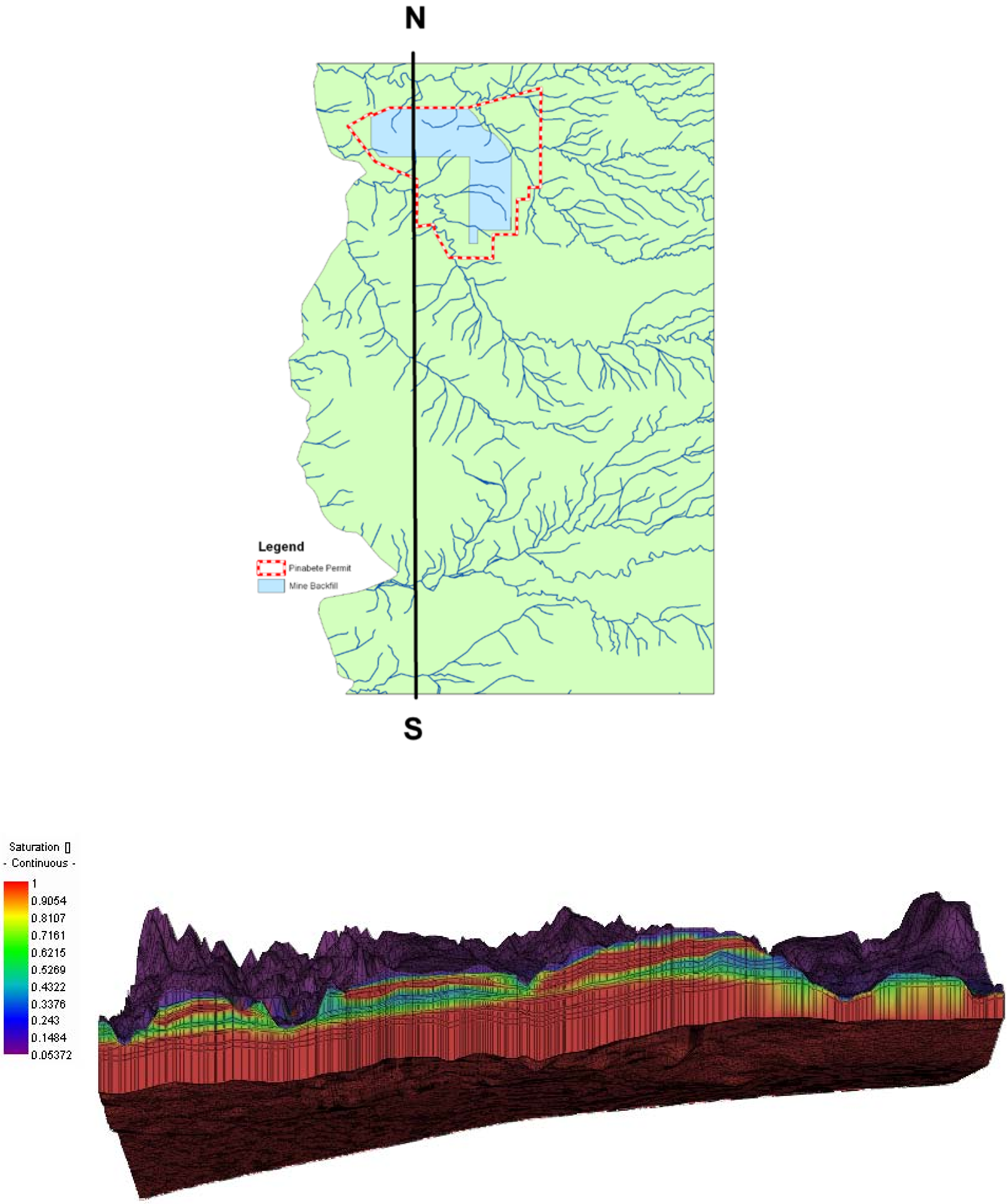
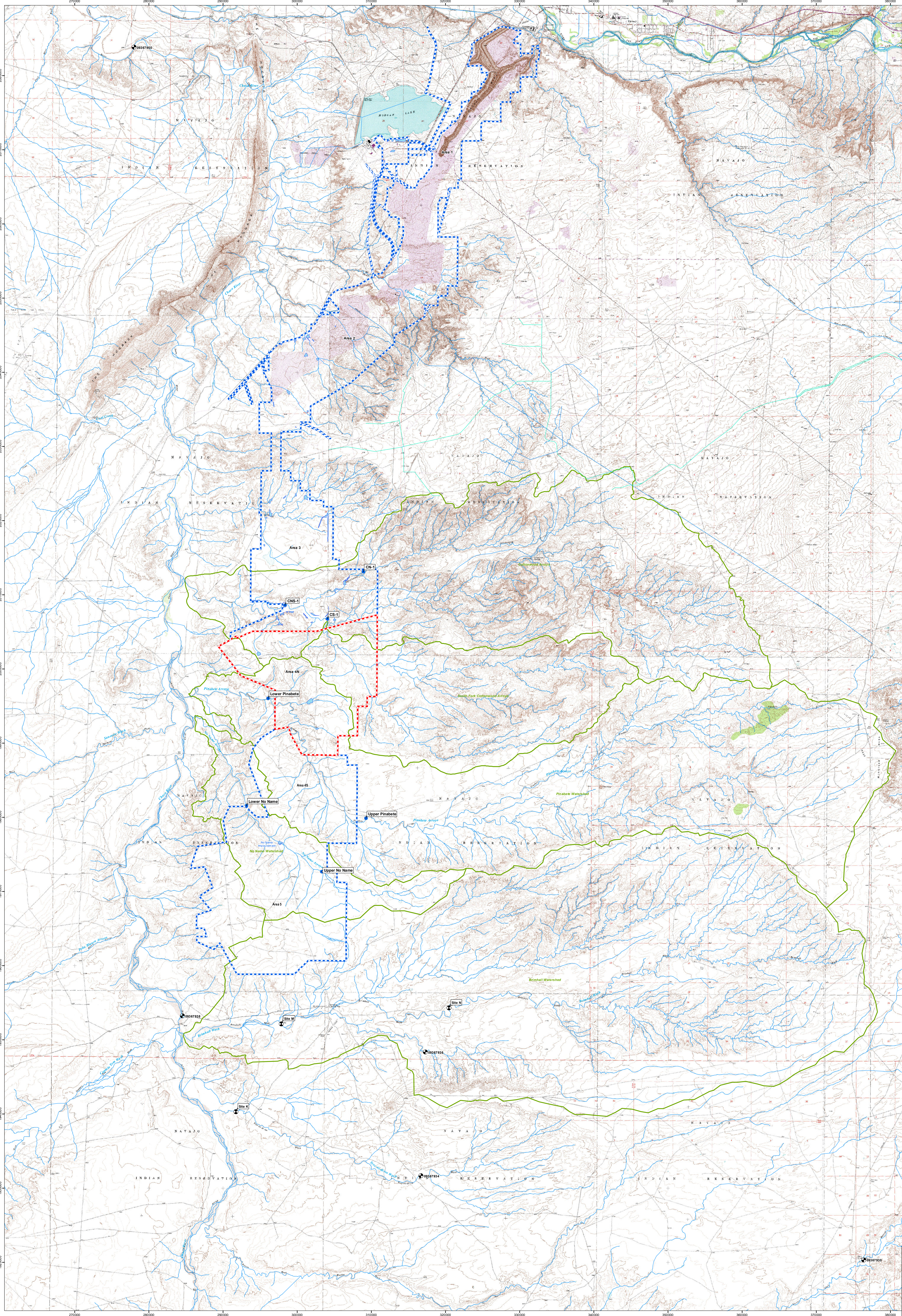


Figure 18.3-4 Modeled Baseline Saturation for a North-South Section at Pinabete Permit Area



12-A	2/21/12	MPO	Prepared for Submittal to OSM		CKA	
REV. No.	DATE	DRAFT BY	REVISION DESCRIPTION	ENG.	EQD.	PE
				APPROVALS		

Exhibit 18.1-1

bhpbilliton
resourcing the future

BHP NAVAJO COAL COMPANY

Regional Surface Water Features
and Monitoring Locations

PREPARED BY: MD	DRAWN BY: MPO	PAPER SIZE: ARCH E
APPROVED BY: CKA	DATE: 2/21/2012	

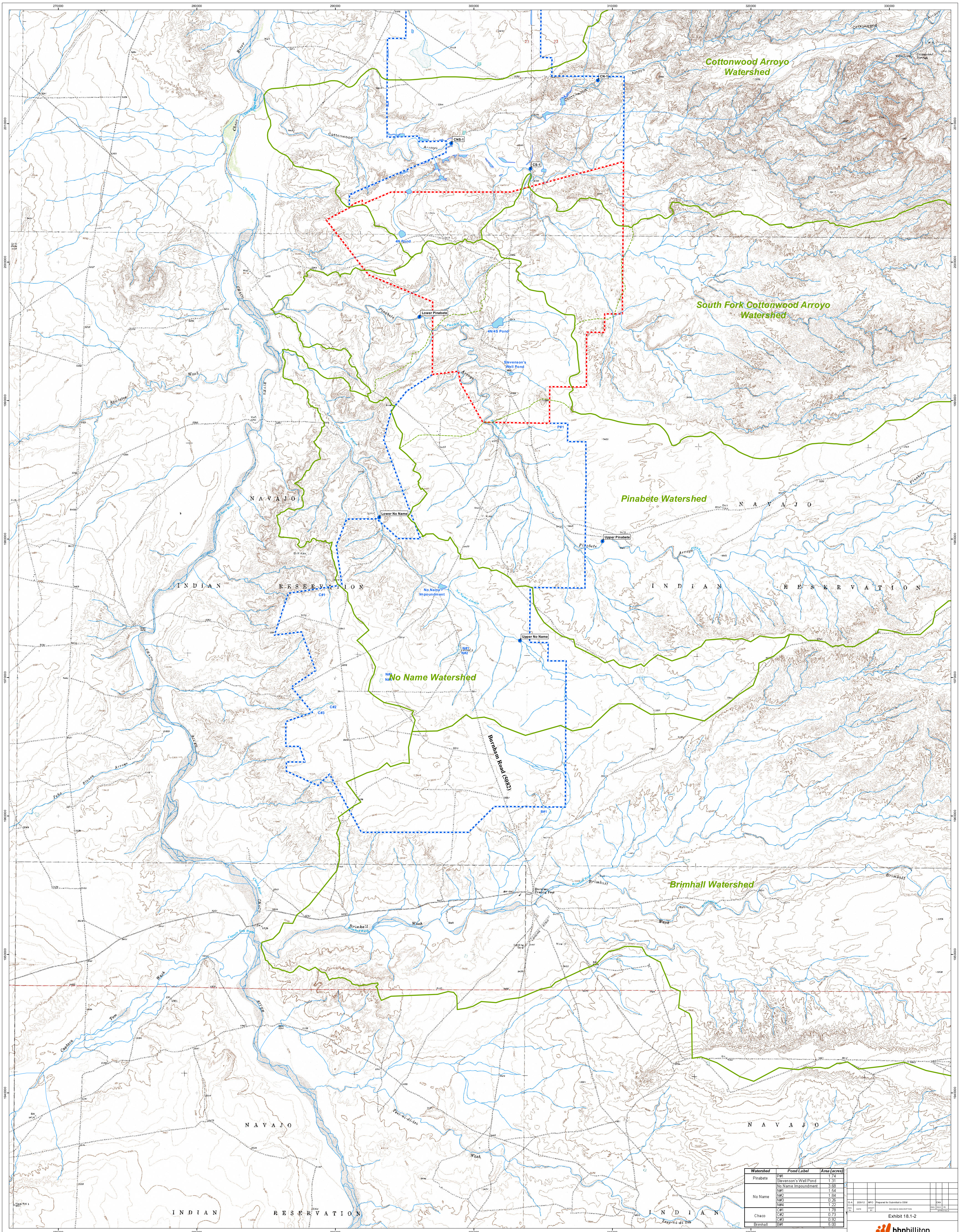
Coordinate System:
NAD 1927 State Plane New Mexico West FIPS 3003
Projection: Transverse Mercator
Datum: North American 1927

Units: Foot US

0 2,000 4,000 8,000 12,000 Feet
1:48,000

Legend

- BNCC Surface Water Monitoring Sites
- Regional Monitoring Sites
- USGS Monitoring Stations
- USGS Monitoring Station 9367938
- Streams
- Amarillo Canal
- Watersheds
- Ponds
- Pinabete SMCRA Permit Area
- Mining Lease Area



Watershed	Pond Label	Area (acres)
Pinabete	P#1	1.74
	Stevenson's Well Pond	1.31
No Name	No Name Impoundment	3.68
	N#1	1.54
	N#2	1.84
	N#3	0.26
	N#4	1.22
Chaco	C#1	1.78
	C#2	0.73
	C#3	0.92
Brimhall	B#1	5.00

REV. No.	DATE	DRAFT BY	REVISION DESCRIPTION	ENG.	EQD.	PE.
12-A	2/29/12	MPO	Prepared for Submittal to OSM		CKA	

Exhibit 18.1-2

bhpbilliton resourcing the future

BHP NAVAJO COAL COMPANY

Surface Water Features and Stream Monitoring Stations

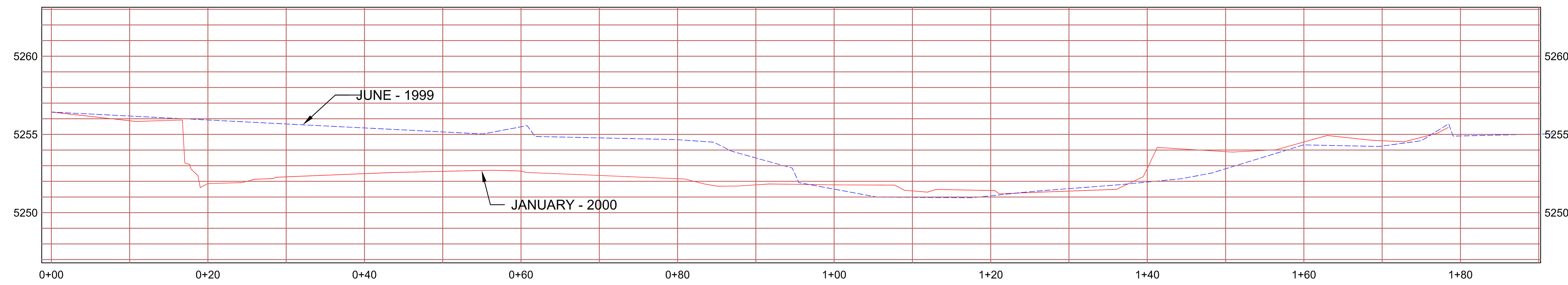
PREPARED BY: MD	DRAWN BY: MPO	PAPER SIZE: ARCH E
APPROVED BY: CKA	DATE: 2/21/12	

Coordinate System:
NAD 1927 StatePlane New Mexico West FIPS 3003
Projection: Transverse Mercator
Datum: North American 1927
Units: Foot US

Feet: 0, 1,000, 2,000, 4,000, 6,000
1:24,000

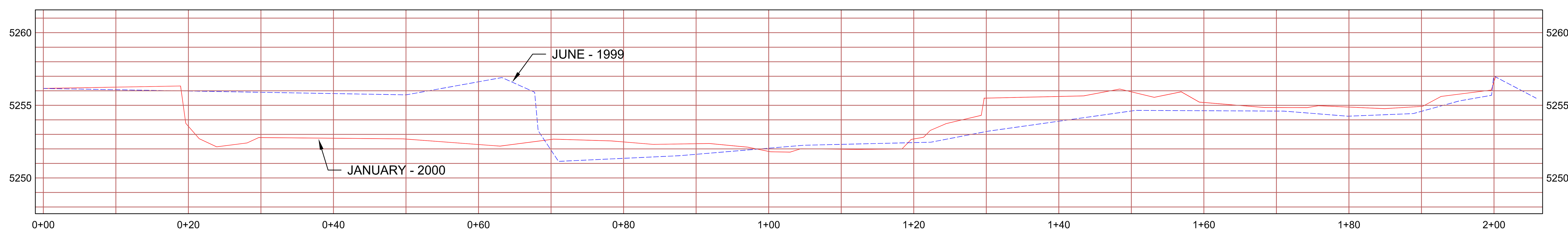
Legend

- Ponds
- BNCC Surface Water Monitoring Station
- Streams
- Watershed Boundaries
- Subwatershed Boundaries
- Pinabete SMCRA Permit Area
- Mining Lease Area



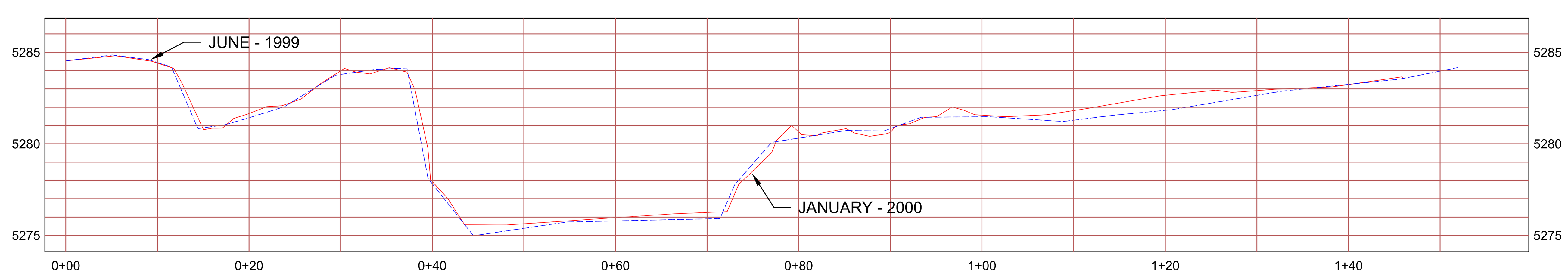
SURFACE WATER STATION CNS-1 SECTION 2 AND 2A

68 FT DOWNSTREAM FROM SECTION 3 AND 3A

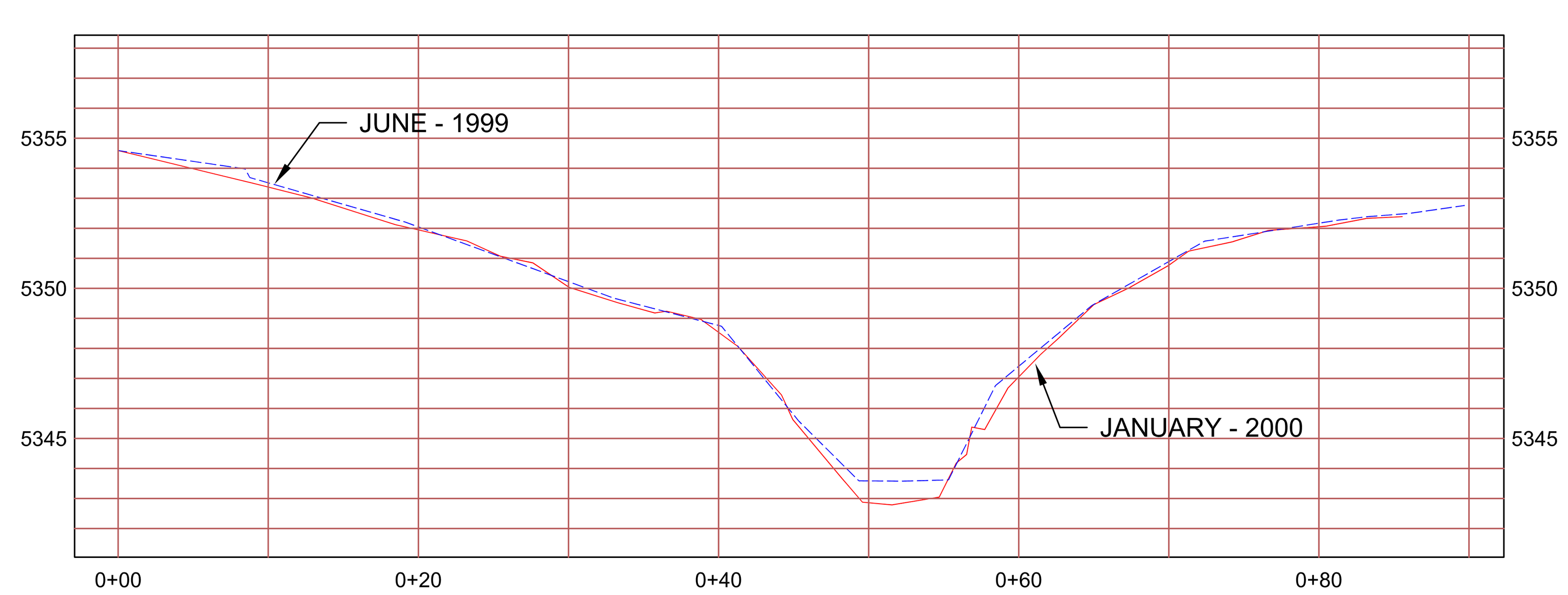


SURFACE WATER STATION CNS-1 SECTION 3 AND 3A

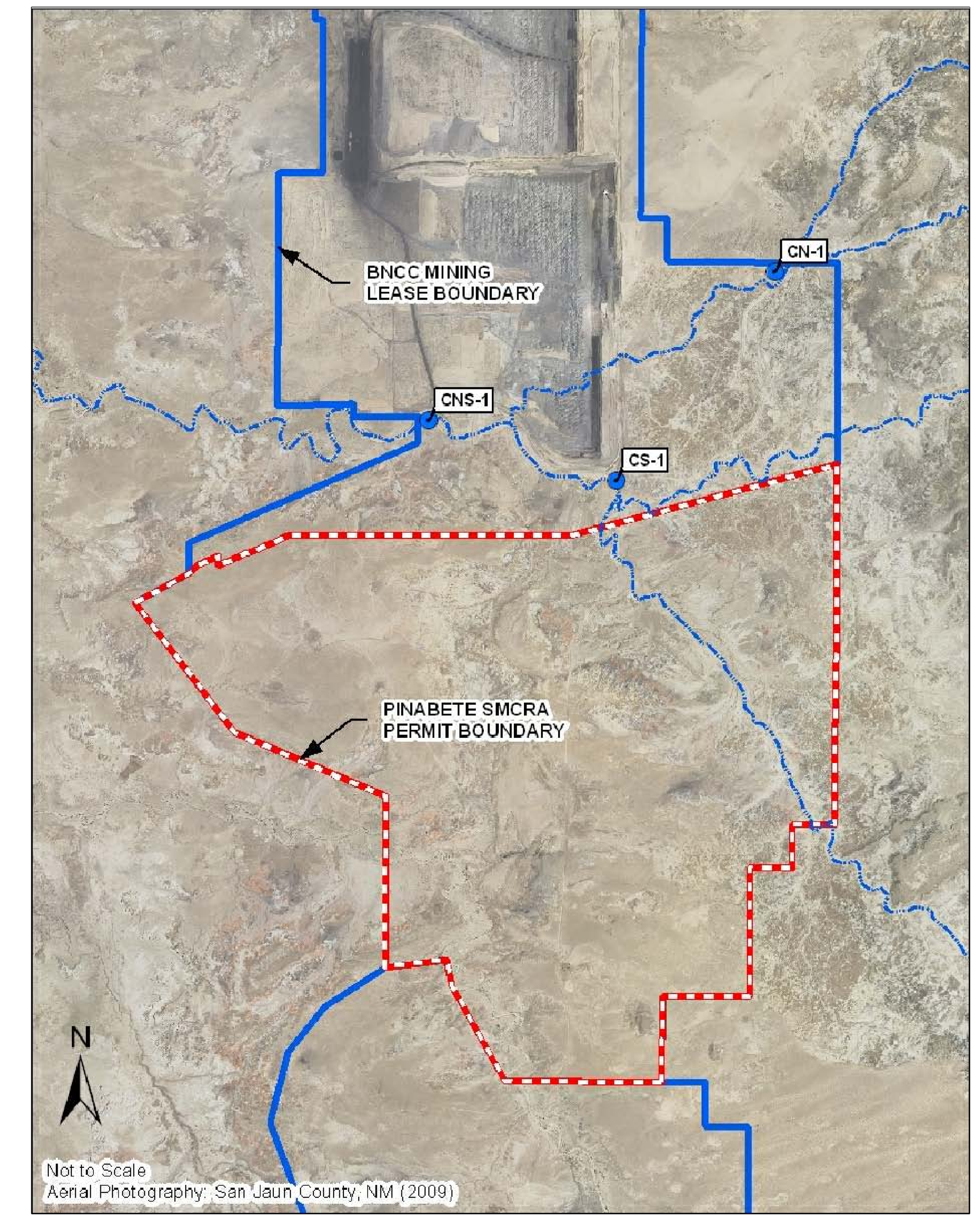
68 FT UPSTREAM FROM SECTION 2 AND 2A



SURFACE WATER STATION CS-1



SURFACE WATER STATION CN-1



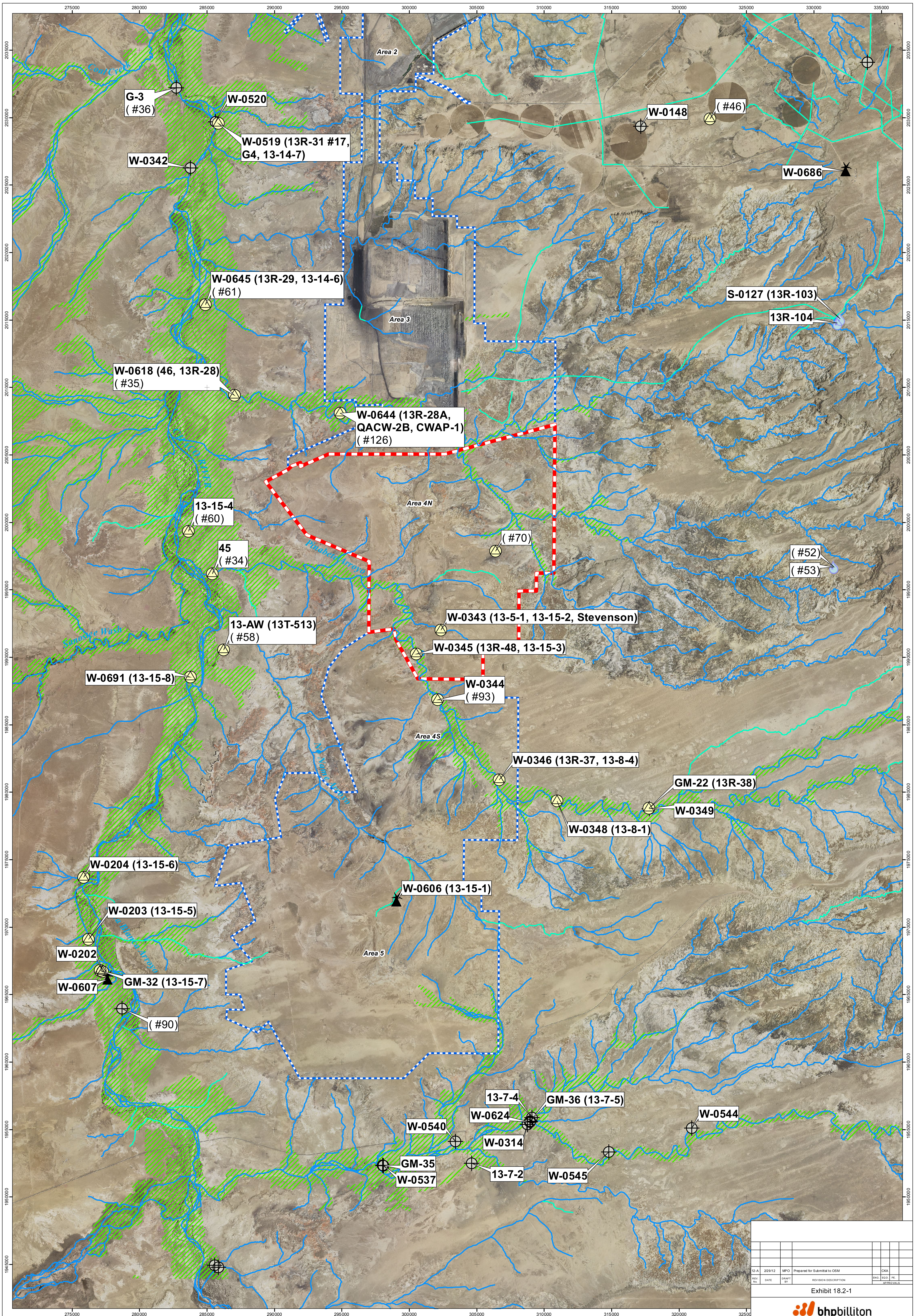
BHP NAVAJO COAL CO.
PINABETE PERMIT AREA
PO BOX 1717, FRUITLAND, NEW MEXICO, 87416

SURFACE WATER MONITORING
STATIONS CN-1, CS-1, CNS-1
JUNE 1999 AND JANUARY 2000
SURFACES

EXHIBIT 18.1-3
CROSS-SECTIONS
COTTONWOOD ARROYO

DRAWING

SHEET
OF 0



12-A	2/29/12	MPO	Prepared for Submittal to OSM		CKA		
REV. No.	DATE	DRAFT BY	REVISION DESCRIPTION	ENG.	EQD.	PE.	
				APPROVALS			

Exhibit 18.2-1

bhpbilliton
resourcing the future

BHP NAVAJO COAL COMPANY

Inventory of Water Supply Wells and Springs

PREPARED BY: MD	DRAWN BY: MPO	PAPER SIZE: ARCH D
APPROVED BY: CKA	DATE: 2/21/12	

Data Sources:
Aerial Photography (San Juan County) 2009
[1] Navajo Nation Hydrographic Survey (2010)
(http://www.ose.state.nm.us/legal_ose_proposed_settlements_sj_notice2010.html)
[2] USGS Geology Maps: MF-1026, MF-1076, MF-1077, MF-1080, MF-1092, MF-1093 & I-1978

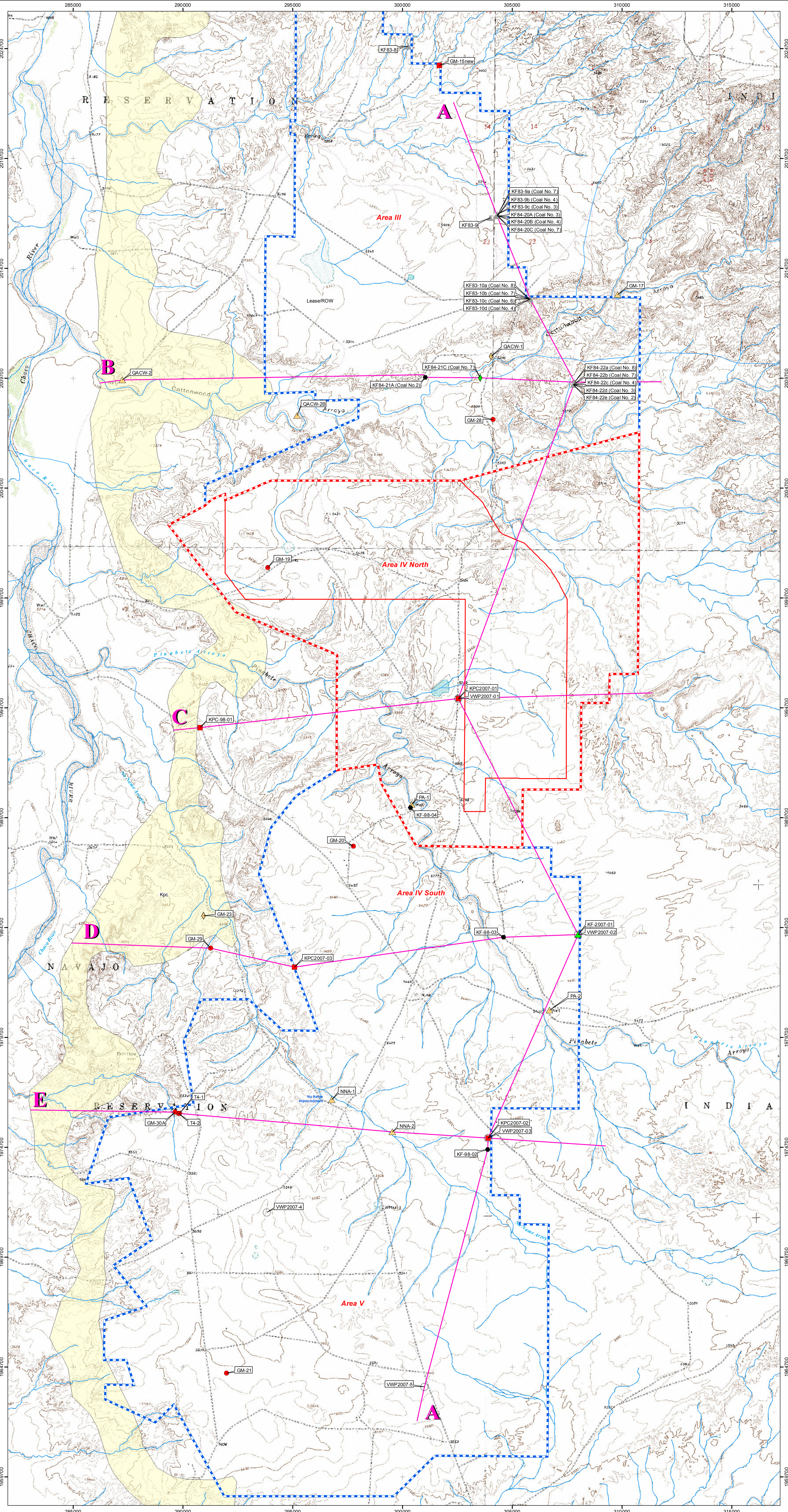
Coordinate System:
NAD 1927 State Plane New Mexico West FIPS 3003
Projection: Transverse Mercator
Datum: North American 1927

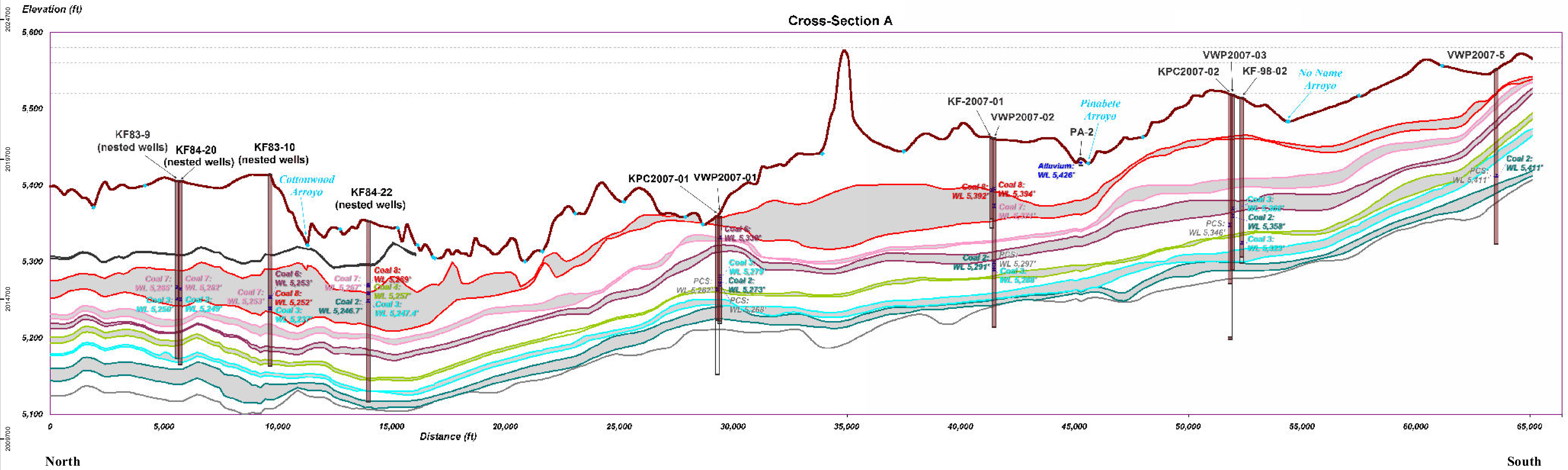
Units: Foot US

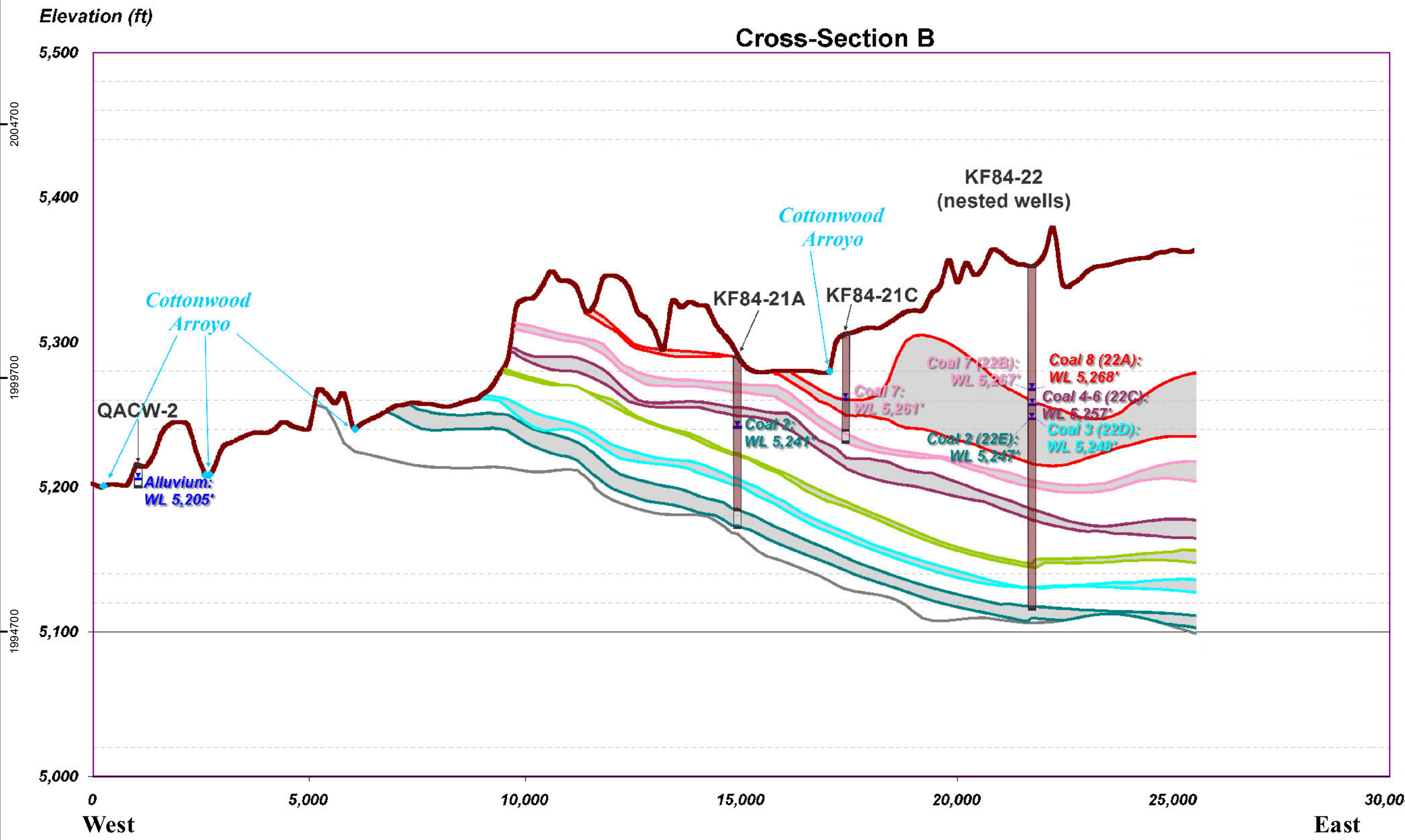
0 1,500 3,000 6,000 9,000 Feet
1:36,000

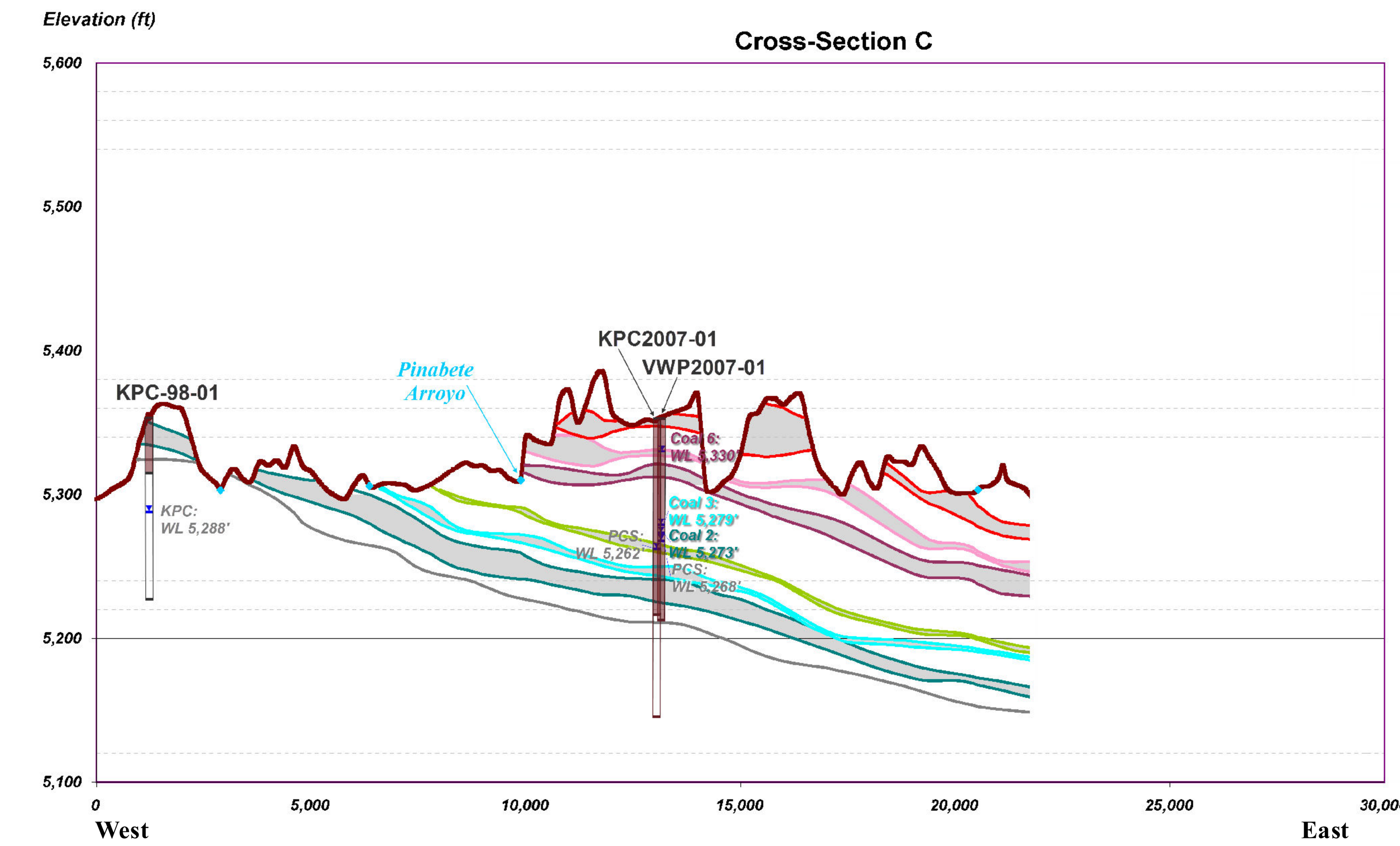
Legend

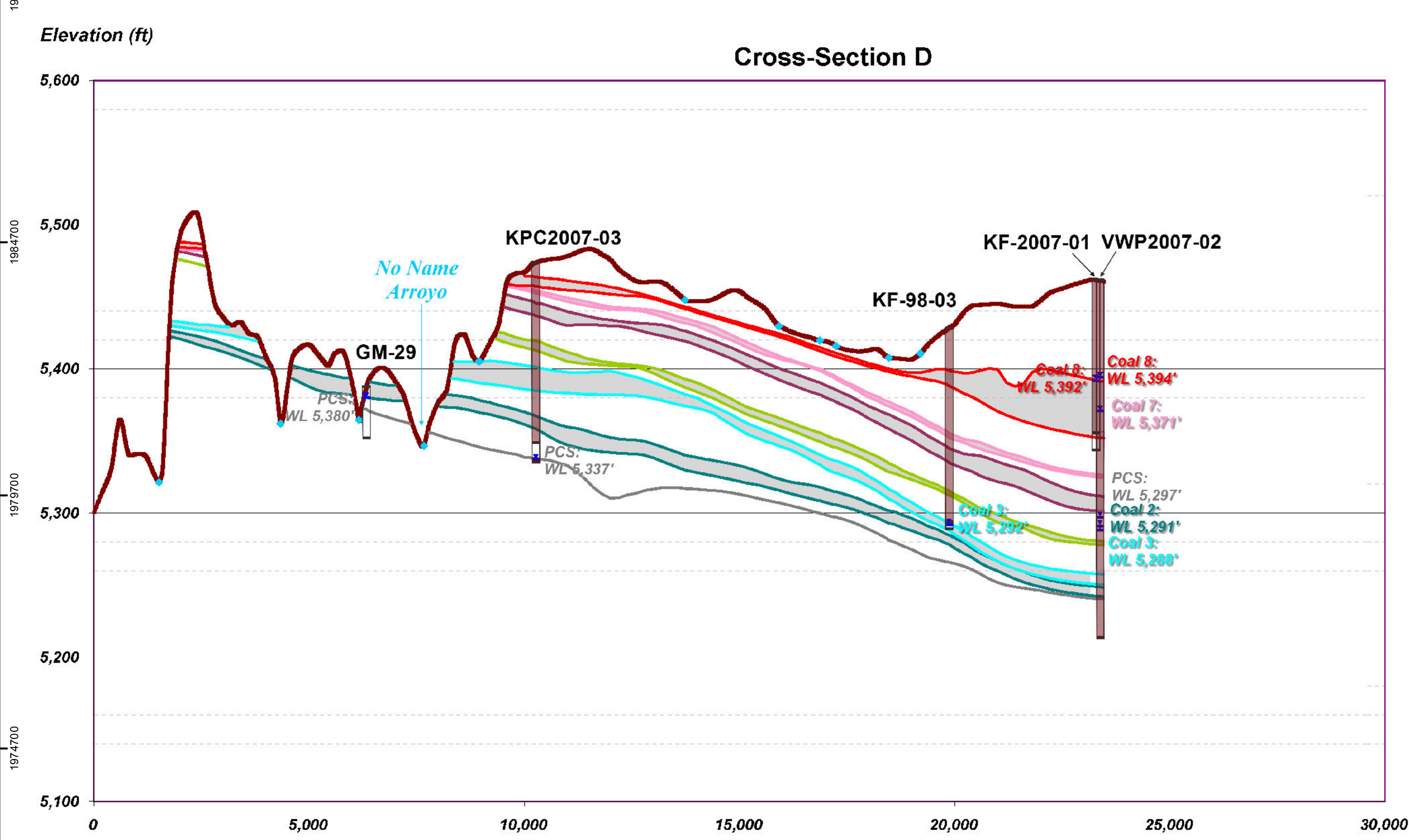
Water Supply Wells & Springs[1]
(#BAI Number)
Spring &Seep
Alluvial Well
Well
Windmill
Natural Stream
Artificial Path/Ditch
Alluvium[2]
Pinabete SMCRA Permit Area
Mining Lease Area

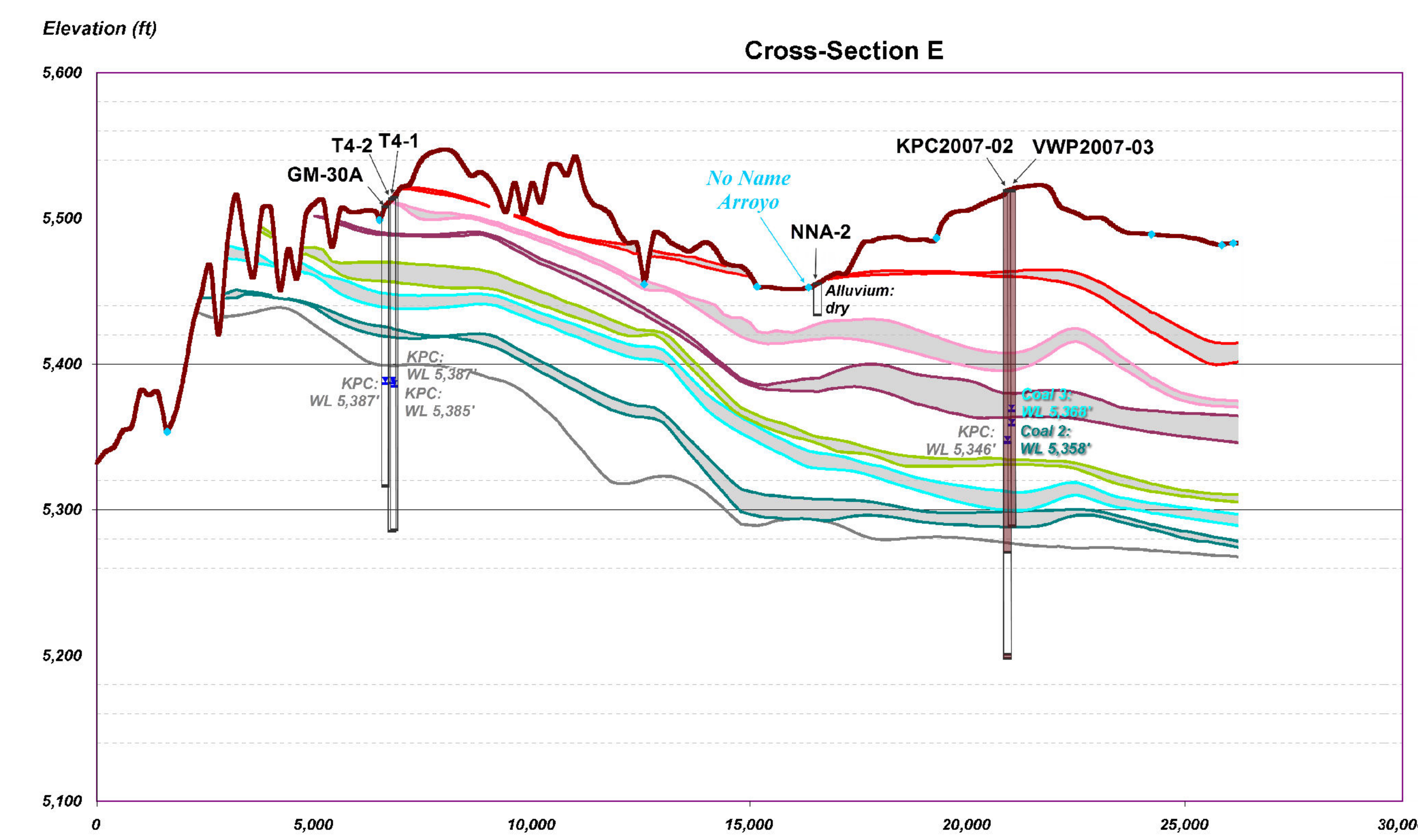












- Abandoned Alluvial Monitoring Well
- Abandoned Alluvial Monitoring Well
- Existing Alluvial Monitoring Well
- Well, Coal No. 2, Existing
- No 3. Coal Monitoring Well
- Well, Coal No. 4, Existing
- No 6. Coal Monitoring Well
- No 7. Coal Monitoring Well
- No 8. Coal Monitoring Well
- Fruitland Well or Nested Wells
- Abandoned PCS Monitoring Well
- Existing PCS Monitoring Well
- Nested Vibrating Wire Piezometer
- Pinabete SMCRA Permit Area
- Mining Lease Area
- Proposed Mine Block
- Streams
- Pictured Cliffs Formation (Kpc)

Cross-Sections :

- Pictured Cliffs Top
- S2 Coal
- S3 Coal
- S4 Coal
- S6 Coal
- S7 Coal
- S8 Coal
- S9 Coal
- Topo (2000)
- Wells
- Water Levels
- Streams

N

1:24,000

0 1,750 3,500 7,000 Feet

Projection Information:
State Plane New Mexico West
North American Datum 1927
FIPS 3003
feet

REV. No.	DATE	DRAFT BY	REVISION DESCRIPTION	ENG.	EQD.	PE.
12-A	3/9/12	MPO	Prepared for Submittal to OSM		CKA	

APPROVALS

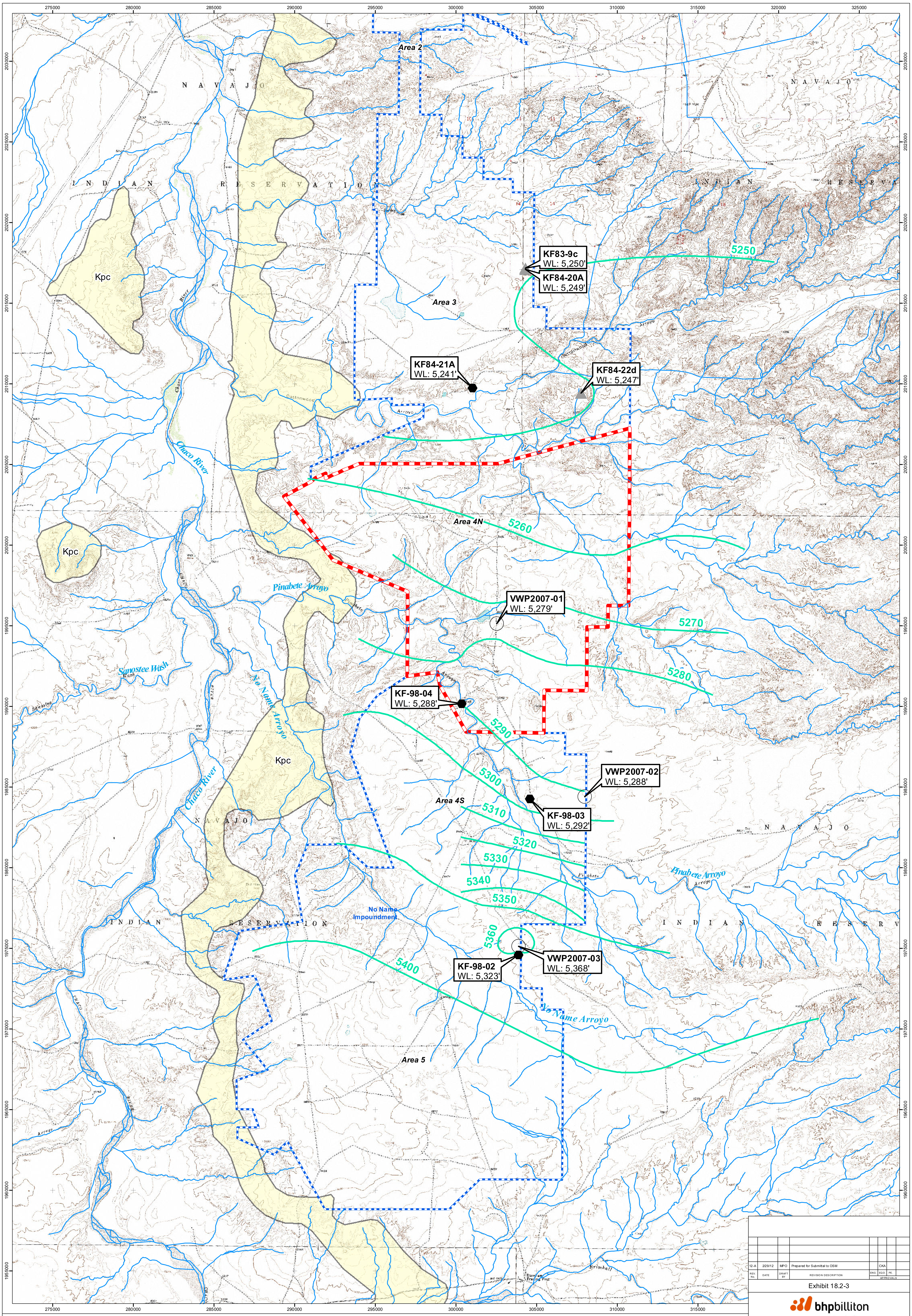
Exhibit 18.2-2

bhpbilliton
resourcing the future

BHP NAVAJO COAL COMPANY

Hydrogeologic Cross-Sections,
Monitoring Wells, & Piezometers

PREPARED BY: MD	DRAWN BY: MO	PAPER SIZE: ARCH D
APPROVED BY: CKA	DATE: 3/9/12	



12-A	2/29/12	MPO	Prepared for Submittal to OSM		CKA		
REV. No.	DATE	DRAFT BY	REVISION DESCRIPTION	ENG.	EQD.	PE.	
				APPROVALS			

Exhibit 18.2-3

bhpbilliton resourcing the future

BHP NAVAJO COAL COMPANY

No. 3 Coal Seam Potentiometric Surface

PREPARED BY: MD	DRAWN BY: MPO	PAPER SIZE: ARCH D
APPROVED BY: CKA	DATE: 2/12/12	

Coordinate System:
NAD 1927 State Plane New Mexico West FIPS 3003
Projection: Transverse Mercator
Datum: North American 1927

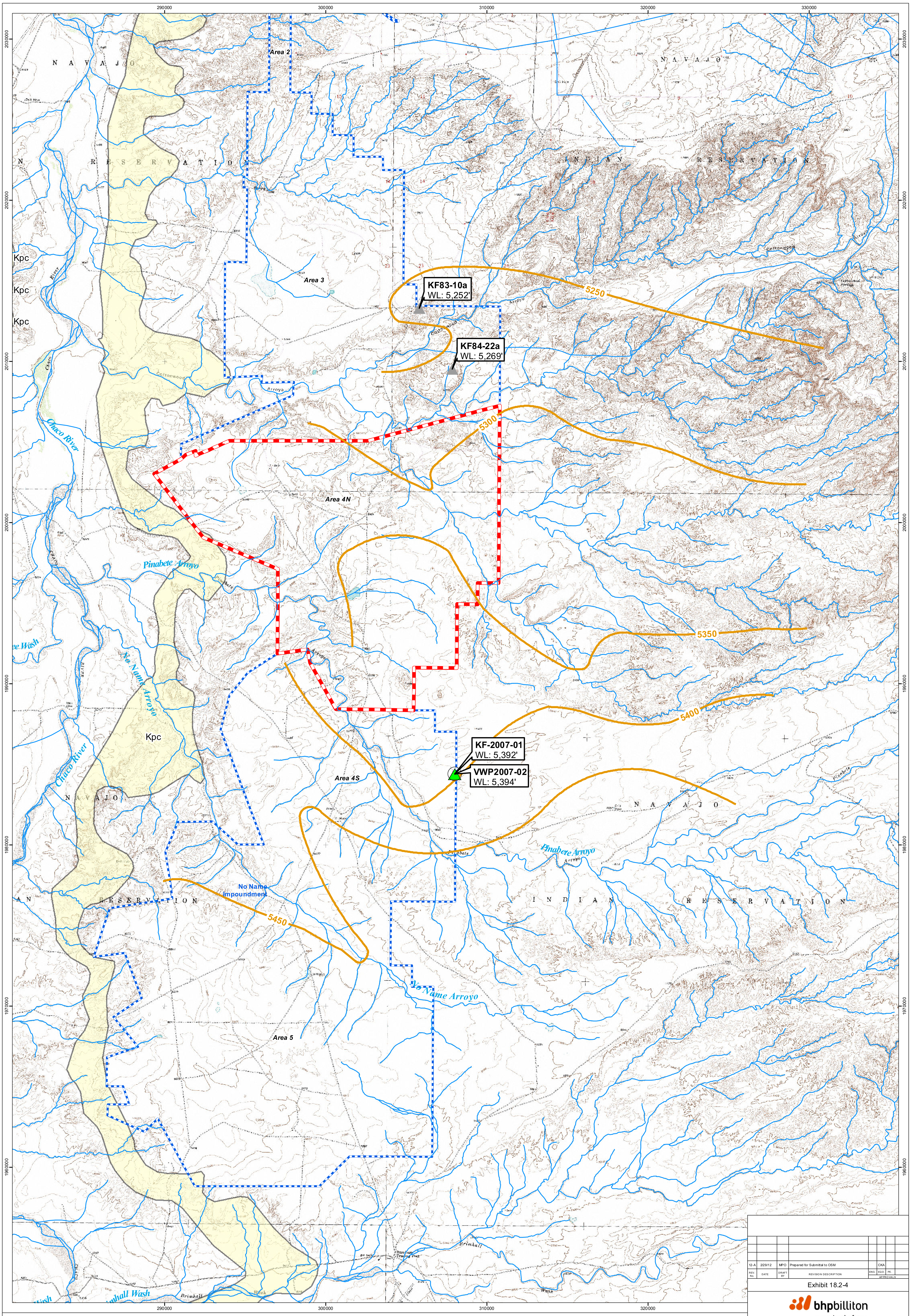
Units: Foot US

0 1,250 2,500 5,000 7,500 Feet
1:30,000

Legend

Well Type, Completion, Status
- No 3. Coal Monitoring Well
- Fruitland Nested Wells
- Nested Vibrating Wire Piezometer

- Coal Seam No. 3 Potentiometric Contours
- Streams
- Pictured Cliffs Formation (Kpc)
- Pinabete SMCRA Permit Area
- Mining Lease Area



Coordinate System:
NAD 1927 StatePlane New Mexico West FIPS 3003
Projection: Transverse Mercator
Datum: North American 1927
Units: Foot US

0 1,250 2,500 5,000 7,500 Feet
1:30,000

Legend

- Well Type, Completion, Status
- No 8. Coal Monitoring Well
- Fruitland Nested Well
- Nested Vibrating Wire Piezometer
- Coal No.8 Potentiometric Contours
- Streams
- Pictured Cliffs Formation (Kpc)
- Pinabete SMCRA Permit Area
- Mining Lease Area

REV. No.	DATE	DRAFT BY	REVISION DESCRIPTION	ENG	ECO	PE
12-A	2/29/12	MPO	Prepared for Submittal to OSM		CKA	

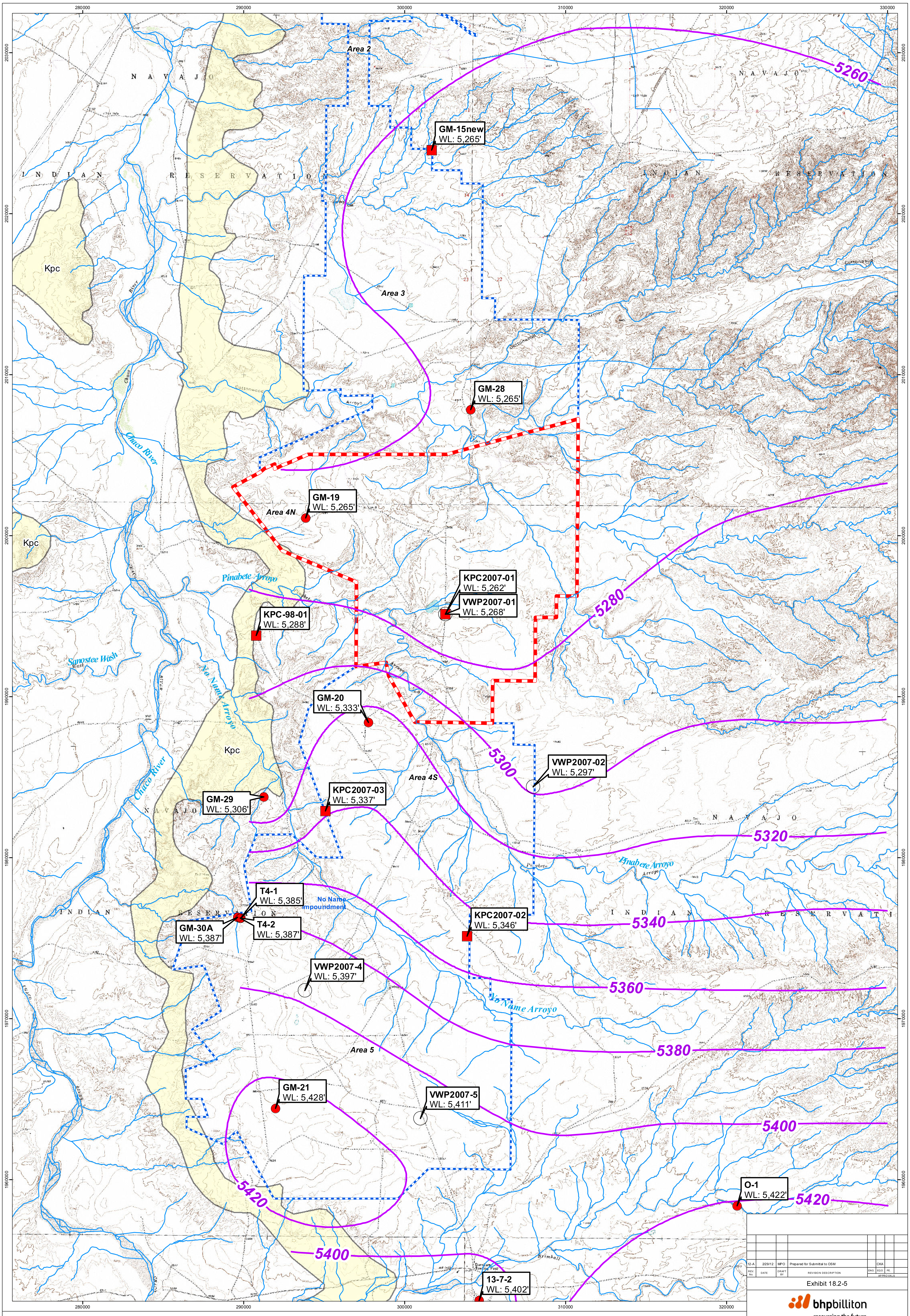
Exhibit 18.2-4

bhpbilliton
resourcing the future

BHP NAVAJO COAL COMPANY

No. 8 Coal Seam Potentiometric Surface

PREPARED BY: MD	DRAWN BY: MPO	PAPER SIZE: ARCH D
APPROVED BY: CKA	DATE: 2/21/12	



Coordinate System:
NAD 1927 State Plane New Mexico West FIPS 3003
Projection: Transverse Mercator
Datum: North American 1927

Units: Foot US

0 1,250 2,500 5,000 7,500 Feet
1:30,000

Legend

- Abandoned PCS Monitoring Well
- Existing PCS Monitoring Well
- Nested Vibrating Wire Piezometer
- PCS Potentiometric Contour
- Streams
- Pictured Cliffs Formation (Kpc)
- Pinabete SMCRA Permit Area
- Mining Lease Area

REV. No.	DATE	DRAFT BY	REVISION DESCRIPTION	ENG.	EQD.	PE.
12-A	2/29/12	MPO	Prepared for Submittal to OSM		CKA	

APPROVALS

Exhibit 18.2-5

bhpbilliton
resourcing the future

BHP NAVAJO COAL COMPANY

Pictured Cliffs Sandstone (PCS)
Potentiometric Elevations

PREPARED BY: MD	DRAWN BY: MPO	PAPER SIZE: ARCH D
APPROVED BY: CKA	DATE: 2/21/12	

Appendix 18.A

Baseline Channel Inventories of Pinabete Arroyo and No Name Arroyo

from 1998 and 2007 (Edited 2012)

Appendix 18.A

BASELINE CHANNEL INVENTORIES OF PINABETE ARROYO AND NO NAME ARROYO FROM 1998 AND 2007 (EDITED 2012)

TABLE OF CONTENTS

Appendix 18.A

BASELINE CHANNEL INVENTORIES OF PINABETE ARROYO AND NO NAME ARROYO FROM 1998 AND 2007 (EDITED 2012)

LIST OF FIGURES

FIGURE NUMBER **FIGURE TITLE**

Appendix 18.A

BASELINE CHANNEL INVENTORIES OF PINABETE ARROYO AND NO NAME ARROYO FROM 1998 AND 2007 (EDITED 2012)

LIST OF FIGURES (Continued)

FIGURE NUMBER	FIGURE TITLE

Appendix 18.A

BASELINE CHANNEL INVENTORIES OF PINABETE ARROYO AND NO NAME ARROYO FROM 1998 AND 2007 (EDITED 2012)

LIST OF EXHIBITS

INTRODUCTION

Appendix 18.A includes two channel reconnaissance memos from 1998 and 2007 (edited 2012) on Pinabete and No Name Arroyos, and five exhibits with cross-section and profile information. Exhibit 18.A-1 is the 1998 survey of Pinabete Arroyo with cross-sections at the upstream and downstream monitoring locations and a channel profile which was drawn between the six channel characterization sites' elevation data. The cross-sections shown on Exhibit 18.A-2 documented the 2007 return to the channel characterization sites on Pinabete and re-survey of cross-sections. Two of the Pinabete Arroyo channel characterization sites, Upper Pinabete Station- B (MID) and P-6B (MID), were also resurveyed in 2008 and are presented on Exhibit 18.A-2. Exhibit 18.A-3 is the 1998 survey of No Name Arroyo with cross-sections at the upstream and downstream monitoring locations and a channel profile which was drawn from one mile upstream of the uppermost site, NN-7, to the confluence with the Chaco River, using elevations acquired at the seven channel characterization sites. Exhibit 18.A-4 is a channel profile of lower No Name between channel characterization site NN-3 and the confluence of No Name with the Chaco River developed from aerial survey with ground truth performed to depict topography with and near the channel at a 1-foot contour interval. Exhibit 18.A-5 shows cross-sections developed during the 2007 channel reconnaissance on the No Name stations.

The 1998 channel reconnaissance survey established six stations on Pinabete and seven stations on No Name to assess channel geomorphology conditions. As noted in the section titled "Channel Inventory and Evaluation for No Name Arroyo and Pinabete Arroyo 1998, Edited 2012", the survey consisted of walking one thousand-foot segments of the channel in the vicinity of the stations to generally characterize the channel. The, extent of scouring and deposition along the stream, the occurrence of bedrock outcrops, bank stability and vegetative stabilization features were documented. A channel cross section was then chosen which most closely characterized the channel reach. Measurements of channel bottom width, top width and channel depth were made at the cross section using a surveyor's tape and staff gage. The upper and lower sites of each channel became established surface water monitoring locations.

The 2007 Channel Inventory and Evaluation for No Name Arroyo and Pinabete Arroyo were performed to acquire more recent geomorphologic data on Pinabete and No Name Arroyos to reflect pre-mine conditions. The evaluation included a channel stability assessment, a sinuosity evaluation, conceptual classification of bed and bank soils and the subsequent Manning's n values, and a drainage density appraisal. The survey generally returned to the 1998 stations, but many of the original survey posts were not found. A GPS unit was utilized to develop the cross-section information. A new site was established on the lower end of Pinabete (P-6) to better reflect conditions near the northwest lease boundary.

The 1998 profiles and cross sections for Pinabete and No Name (Exhibit 18.A-1 and Exhibit 18.A-3, respectively) include three cross sections at the uppermost and lower most channel geomorphology stations. The locations of the crest stage gages and single stage sampler were also documented, as these stations became the surface monitoring locations.

The 2007 cross sections for the Pinabete and No Name are presented in Exhibit 18.A-2 and Exhibit 18.A-5, respectively. When cross sectional information for 1998 was available at the station, it was plotted on the cross section. The 1998 data appeared to be between 0.5 and 6 feet lower in elevation than the 2007 data. Rather than interpreting this as an expression of significant aggradation during the 1998-2007 time interval, best characterized as a drought, it is thought that any gross elevation differences are better described as a shift in the original datum. Substantially better channel information was acquired in 2008, when BHP Navajo Coal Company (BNCC) had the lower 4.3 miles of No Name flown for mapping at a 1-foot contour interval. The topographic map showing a 500-foot average coverage on either side of the channel is displayed on Exhibit 18.A-4. A channel profile was developed from this survey which clearly identifies knickpoints at eight locations as the arroyo passes through badland topography. The largest change is seen at 18,450 feet upstream of the confluence, with a 10-foot drop in elevation. A comparison was made between the cross sections surveyed in 2007 and the ones generated by the 1-foot contour map at the Lower No Name monitoring station and NN-3, and the 2008 elevations averaged 3.5 feet higher than the cross-section information developed in 2007. Again, these differences may be the result of differences in the datum used for the surveys. The general shape of the cross sections is very similar, leading us to believe that the surveys were at approximately the same location. However, the difficulty in comparing channel surveys between the two time periods is the result of obtaining consistent information from different groups of surveyors and establishing accurate datum and permanent channel survey monuments in remote locations.

CHANNEL INVENTORY AND EVALUATION FOR NO NAME ARROYO AND PINABETE ARROYO 1998, EDITED 2012

Introduction

A stream channel inventory and evaluation was conducted to describe the pre-mining conditions for the main channels of Pinabete Arroyo and No Name Arroyo in 1998. The purpose of this work was to document the channel conditions prior to mining, including the presence of bedrock outcrops, and indicators of channel instabilities such as knickpoints, channel cutbanks, and channel scour or deposition. The composition of the channel bed and bank materials, cross section dimensions, and vegetation type and density were also noted. These characteristics provide indications of the capacity of the stream channels to adjust and recover from potential changes due to mining and reclamation. This inventory also included surveys of channel cross sections and slopes and estimation of Manning roughness coefficients at surface water monitoring locations.

Methods

A stream channel inventory describes the spatial variability in a stream's characteristics at a specific point in time. Prior to the field visit, main channel profiles were plotted from topographic maps featuring 10-feet contour intervals. Locations of convex segments in the channel profile, channel knickpoints, monitoring station locations, and surface water impoundments were identified on the map. Channel inventory locations were selected to include these channel features. Inventory locations were spaced about every mile through the permit area and at a farther spacing downstream of the permit area. There is no defined channel on No Name Arroyo upstream of the permit area and the inventory did not extend beyond the upstream monitoring station on Pinabete Arroyo.

During the field inventory, a 1,000-feet segment of the channel was walked at each location to roughly characterize the channel. Features including the vegetation conditions on the channel bottom and banks, the occurrence of steep bank slopes and evidence of bank failure, extent of scouring and deposition along the stream, and the occurrence of bedrock outcrops were documented. A channel cross section was then chosen which most closely characterized the channel reach. Measurements of channel bottom width, top width and channel depth were made at the cross section using a surveyor's tape and staff gage. The composition of the channel bottom and bank were field classified in accordance with the Unified Soil Classification (USC) system. Photographs were taken to document channel conditions at each channel inventory location.

At each of the monitoring station locations, channel cross sections, crest stage gages, and single stage sediment samplers were surveyed and estimates of Manning's roughness coefficients were determined using the procedure for small channels as described in Gray (1970). Using this procedure the value of Manning's roughness coefficient, n, is estimated from table values for component conditions which affect hydraulic roughness and resistance to flow. These conditions include channel materials, channel vegetation, surface irregularities, variations in channel shape, obstructions, and channel meandering.

The survey of channel cross-sections at the stream monitoring stations was completed on June 2, 1998, before the start of the thunderstorm runoff season, and again on November 30, 1998, at the end of the season. The surveyed sections for both dates are provided in Exhibit 18.A-1 and Exhibit 18.A-3. The channel profiles did not change significantly between the two survey dates but the channel cross sections at the Pinabete Arroyo stations changed due to floods redistributing sediment deposits within the channel. The change in channel cross sections at the No Name Arroyo stations were much less than at the Pinabete station locations.

Pinabete Arroyo Inventory

The main Pinabete Arroyo channel profile shown in Exhibit 18.A-1 exhibits a slightly concave channel profile with channel slopes of 0.55 % or higher at the upstream segment near the eastern permit boundary and decrease to about 0.43 % downstream at the western permit boundary. No knickpoints, or convex segments, are present in the channel profile in the vicinity of the Navajo Mine Extension permit area. Road crossings and monitoring station locations within or near Pinabete Arroyo are also shown on Exhibit 18.A-1. No surface water impoundments are located within the main channel of Pinabete Arroyo within the permit area.

The inventory of channel conditions was conducted at six cross section locations along the main stem of Pinabete Arroyo within or near the permit area. The inventory is presented below. The location descriptions begin with the upstream location and proceed downstream at distances measured along the channel. The cross section locations are shown on Exhibit 18.A-2.

Location P1

This location is at the upstream monitoring station of Pinabete Arroyo. The channel at this location is incised with a trapezoidal shape featuring a bottom width of 24.5 feet, a top width of 42.5 feet, and a depth of 3 feet. Channel bottom materials are sands (SP) with pebbles and stones. Channel banks consist of medium sand (SP) with semi-consolidated sands and gravels that form steep near vertical banks. Bedrock outcrops occur in the channel banks upstream of location P1. Sandstone slabs and fragments have sloughed into the channel from the erosion of the embankments on meander bends as shown in Figure 18.A-1. No vegetation is found on the channel bottom and sparse shrubs grass and tamarisk occur on the channel banks and sand bars as shown in Figure 18.A-2. The channel appears to be in a state of dynamic equilibrium along this reach. The erosion of the channel banks on meander bends is compensated by sand deposition on the inside of the meanders. The channel slope at this location is about 0.56% and the valley slope about 0.8%.

The value of Manning's roughness coefficient, n, was estimated to be 0.032 using the procedure for small channels described in Gray (1970). The estimated contribution to roughness from component conditions includes:

Channel materials,	0.022
Channel vegetation, negligible	0.000
Surface irregularities,	0.005
Variations in channel section,	0.005
Obstructions, and meandering,	0.000

Figure 18.A-1 Pinabete Arroyo upstream of location P1, looking upstream

Figure 18.A-2 Pinabete Arroyo location P1, looking downstream

Location P2

This location is approximately 7,700 feet down the channel from location P1. The channel at this location is trapezoidal but wider and shallower than P1 with a bottom width of 40 feet, a top width of 58 feet, and a depth of about 2.1 feet. The channel bottom is comprised of fine sand (SP) with sparse coal and rock fragments. The channel banks consist of sand with negligible fines (SW). Salt deposits occur on bed and bank materials due to evaporation of ground water seepage as shown in Figure 18.A-3. The rate of seepage is insufficient to cause surface flow. The No. 8 coal seam outcrop occurs near this cross section location as shown in Figure 18.A-4 and may be the source of seepage. No vegetation occurs on the channel bottom. Dense shrubs and forbs occur on the channel banks and overbanks. The channel slope at this location is about 0.51% and the valley slope about 0.6%.

Figure 18.A-3 Pinabete Arroyo location P2, looking upstream

Figure 18.A-4 Coal outcrop on channel bank at Pinabete Arroyo location P2

Location P3

This location is approximately 5,530 feet down channel from location P2. This location is on a meander bend immediately upstream of the Burnham Road crossing as shown in Figure 18.A-5. The channel at this location is approximately trapezoidal with a 48-foot wide sand bar and the inside of the meander bend. The bottom width is 24 feet and top width, excluding the sand bar, is 40 feet. The channel is about 2.8 feet deep. The channel bottom and sand bar are comprised of sand with gravel (SW), with a greater gravel fraction on the sand bar. The channel banks are comprised of sand with a higher fine fraction (SP) and are cohesive enough to form steep banks in places. The channel banks are sparsely vegetated and the sand bar and channel bottom are devoid of vegetation as shown in Figure 18.A-5. Shrubs occur on the overbanks. The channel slope at this location is about 0.51% and the valley slope about 0.7%

Figure 18.A-5 Pinabete Arroyo location P3, looking upstream

Location P4

This location is at the road crossing to the dug alluvial well and monitoring well PA-1 and is approximately 5,750 feet down the channel from location P3. The channel at this location exhibits considerable meandering with bedrock outcrops common on the outside of meander bends. The channel at this location is approximately trapezoidal with a bottom width of 54 feet and top width of 65 feet. The channel is about 2.0 feet deep. The channel bed and banks are comprised of medium to coarse sand (SW), with a higher gravel fraction on the sand bars located on the inside of meander bends. The channel banks and overbanks are vegetated with grasses and shrubs while channel bottom is devoid of vegetation as shown in Figure 18.A-6. The channel slope at this location is about 0.51% and the valley slope about 0.9%

Figure 18.A-6 Pinabete Arroyo location P4, looking upstream

Location P5

This location is approximately 6,600 feet down the channel from location P4. The channel at this location exhibits considerable meandering with steep cutbanks on the outside of meander bends. The channel at this location is slightly narrower than at location P4 with a bottom width of 33 feet. The channel is about 3.0 feet deep. The channel bends and banks on the inside of meander beds are comprised of medium sand (SW) with pebbles. The channel banks on the outside of meander bends are comprised of cohesive sand with fines (SP). The channel banks and overbanks are vegetated with grasses and shrubs while channel bottom is devoid of vegetation as shown in Figure 18.A-7. The channel slope at this location is about 0.51% and the valley slope about 1.2%.

Figure 18.A-7 Pinabete Arroyo location P5, looking downstream

Location P6

Location P6 is approximately 16,600 feet downstream of location P5. This location is downstream of the western permit boundary and includes stage crest gages and single stage samplers for the Lower Pinabete Arroyo surface water monitoring station. The channel is approximately trapezoidal in shape with a top width of approximately 115 feet, a bottom width of about 70 to 80 feet, and a channel depth of 4 feet. Channel cross sections associated with the crest stage gages are included on Exhibit 18.A-1. Bottom sediments consist of sand with sparse gravel and rock fragments (SW). Channel banks are sand (SW). A sandstone outcrop occurs on the south bank of the location as shown in Figure 18.A-8. There is no vegetation on the channel bottom and the channel banks are steep with sparse shrub cover. The overbanks have a variable cover of grasses and shrubs. The channel slope at this location is about 0.33 % and the valley slope is about 0.6%.

Manning roughness coefficient for the channel is estimated to be 0.032 using the procedure for small channels described in Gray (1970). The estimated contribution to roughness from component conditions includes:

Channel materials,	0.022
Channel vegetation, negligible	0.000
Surface irregularities,	0.005
Variations in channel section,	0.005
Obstructions, and meandering,	0.000

Figure 18-A.8 Pinabete Arroyo location P6, looking upstream

No Name Arroyo Inventory

An inventory of channel conditions was conducted at nine locations along the main stem of No Name Arroyo within the permit area. The inventory location descriptions begin with the No Name Arroyo downstream monitoring station location (NN-1) and proceed up the channel to the No Name Arroyo upstream monitoring station location (NN-7) (Exhibit 18.A-3). The No Name surface water impoundment is located on the channel just upstream of location NN-4 at the Burnham road crossing as shown on Exhibit 18.A-3. The water quality monitoring station locations within No Name Arroyo are also shown on Exhibit 18.A-3. The main No Name Arroyo channel profile is shown in Exhibit 18.A-3. Knickpoints are present in the channel profile near inventory locations NN-2 and NN-4 as shown on Exhibit 18.A-3. A small knickpoint also occurs at the bedrock outcrop below location NN-1, although this does not show up on the longitudinal profile.

Location NN-1

This location is at the No Name Arroyo downstream monitoring station which is downstream of the western permit boundary. The channel is incised and is approximately trapezoidal in shape with a bottom width of 12 to 15 feet, a top width of 35 to 50 feet and a depth of about 8 feet. Bottom materials are medium to coarse sand with rock fragments (SW). Bank materials are comprised of cohesive silt (MH). No vegetation is found on the channel bottom although the channel is at times partially filled with tumbleweeds as shown in Figure 18-A.9. Shrubs, grass and forbs occur on the channel overbank while the channel banks are steep and support sparse vegetation. Sandstone bedrock outcrops in the channel just below the monitoring station as shown in Figure 18.A-9. The channel slope at this location is about 1.4% and the valley slope about 1.4%. Manning roughness coefficient for the channel is estimated to be about 0.037 using the procedure for small channels described in Gray (1970). The estimated contribution to roughness from component conditions includes:

Channel materials,	0.022
Channel vegetation, low	0.000
Surface irregularities,	0.010
Variations in channel section,	0.005
Obstructions, and meandering,	0.000

Figure 18.A-9 No Name Arroyo location NN-1, looking upstream

Location NN-2

This location is immediately above a 15-foot head cut on No Name Arroyo approximately 3,000 feet upstream of the location NN-1. The channel upstream of the head cut is approximately parabolic in shape with a bottom width of about feet, a top width 15 feet, and a depth of about 1 to 1.5 feet. Channel bed and bank materials are comprised cohesive silts (MH) with dense shrubs and grass as shown in Figure 18-A.10. A relatively broad, well-vegetated floodplain occurs on either side of the channel. Downstream of the head cut, the channel is deeply incised with near vertical banks that slough readily as seen in Figure 18-A.11. Bank materials are cohesive silts (MH). The channel bottom and banks are devoid of vegetation and the channel is partially filled with tumbleweeds as shown in Figure 18.A-11. The channel slope at this location is about 0.71% and the valley slope about 1.3%.

Figure 18.A-10 No Name Arroyo location NN-2, looking upstream

Figure 18.A-11 Headcut below No Name Arroyo Location NN-2, looking downstream

Location NN-3

This location is approximately 3,100 feet upstream of the No Name Arroyo location NN-2. The channel is approximately trapezoidal in shape with a bottom width of 5 feet, a top width of approximately 20 feet, and a depth of about 5 feet. The channel bed is composed of medium sand with fine gravel and rock fragments (SP). The channel banks are composed of cohesive silty sand (SM). No vegetation is found on channel bottom but shrubs and grasses are abundant on the channel banks and overbanks as shown in Figure 18-A.12. The channel was partially filled with tumbleweeds as shown in Figure 18.A-12. The channel slope and valley slope at this location are both approximately 0.72%.

Figure 18.A-12 No Name Arroyo location NN-3, looking upstream

Location NN-4

This location is immediately below the No Name impoundment approximately 3,350 feet upstream of the No Name Arroyo location NN-3. A channel section was not measured at this location because of the significant variation in channel conditions. The spillway overflow from the impoundment crosses the Burnham road on the south side and flows down a bedrock lined channel to the valley floor below the impoundment as shown in Figure 18-A.13. A very dense growth of shrubs and tamarisk is present in the valley below the impoundment with channel headcuts occurring at a number of places within the valley floor as shown in Figure 18.A-14. The valley floor soils consist of silt and very fine sand (MH). The valley slope just below the No Name impoundment is about 1.0%.

Figure 18.A-13 Spillway channel below No Name Impoundment, location NN-4, looking upstream

Figure 18.A-14 No Name Arroyo location NN-4, looking upstream

Location NN-5

This location is upstream of the No Name Impoundment and approximately 3,300 feet upstream of location NN-4. The channel is incised 2 to 3 feet and is irregular in shape with several channels terminating in headcuts upstream of NN-5. Channel top widths vary from several feet to approximately 20 feet on the main channel below location NN-5. No distinct channel occurs in the valley bottom for a distance of about 1,000 feet upstream of the headcuts. Channel bed and bank materials consist of cohesive silt and fine sand

(MH). No vegetation is found on the near vertical banks where they occur but dense shrubs and grasses are abundant on the overbank but less dense on the channel bottom. The dimensions of the channel section were not measured at this location because of the widely varying sections. Tumbleweeds were found at numerous places within the channel as shown in Figure 18.A-15. The valley and channel slope at this location are about 0.78%.

Figure 18.A-15 No Name Arroyo location NN-5, looking downstream

Location NN-6

This location is approximately 5,060 feet upstream of the location NN-5. The channel is incised about 2 feet and is irregular in shape as shown in Figure 18-A.16. Small channel headcuts and soil pipes were common around location NN-6. The channel above and below this location occurs intermittently within the valley bottom and is typically associated with channel incision with headcuts and soil pipes. Channel bed and bank materials consist of cohesive silts (MH). Vegetation in these areas is sparse due to the presence of limiting soil conditions. The density of vegetation is greatest in minor depressions where water and windblown soils accumulate but channel erosion or scouring does not occur. A channel section was not measured at this location because of the widely varying sections. Tumbleweeds were found at numerous places within the channel as shown in Figure 18.A-16. The channel and valley slope at this location is about 0.82%.

Figure 18.A-16 No Name location NN-6, looking upstream

Location NN-7

This location is at the upstream monitoring station on No Name Arroyo located just west of the eastern lease boundary approximately 400 feet upstream of location NN-6. The surface water monitoring station includes one stage crest gage and one single stage sampler. The channel is approximately parabolic in shape with a top width of less than 6 feet and a depth of less than 1 foot and but varies along the channel. The channel does not extend upstream of this location and occurs intermittently downstream. Channel rills are found within the broad flat valley of No Name Arroyo both upstream and downstream of the eastern lease boundary. Channel cross-sections associated with the stage crest gage and sediment sampler are included on Exhibit 18.A-3. Channel bed sediments at this location are fine sands (SM). Channel banks are comprised of cohesive silty sand (ML). Vegetation occurs on the channel bank and overbank but is very sparse on the channel bed as shown in Figure 18.A-17. The channel and valley slope at this location are about 0.82%. The Manning roughness coefficient for the channel is estimated to be about 0.055 using the procedure for small channels described in Gray (1970). The estimated contribution to roughness from component conditions includes:

Channel materials,	0.020
Channel vegetation, moderate	0.010

Surface irregularities,	0.010
Variations in channel section,	0.015
Obstructions, and meandering,	0.000

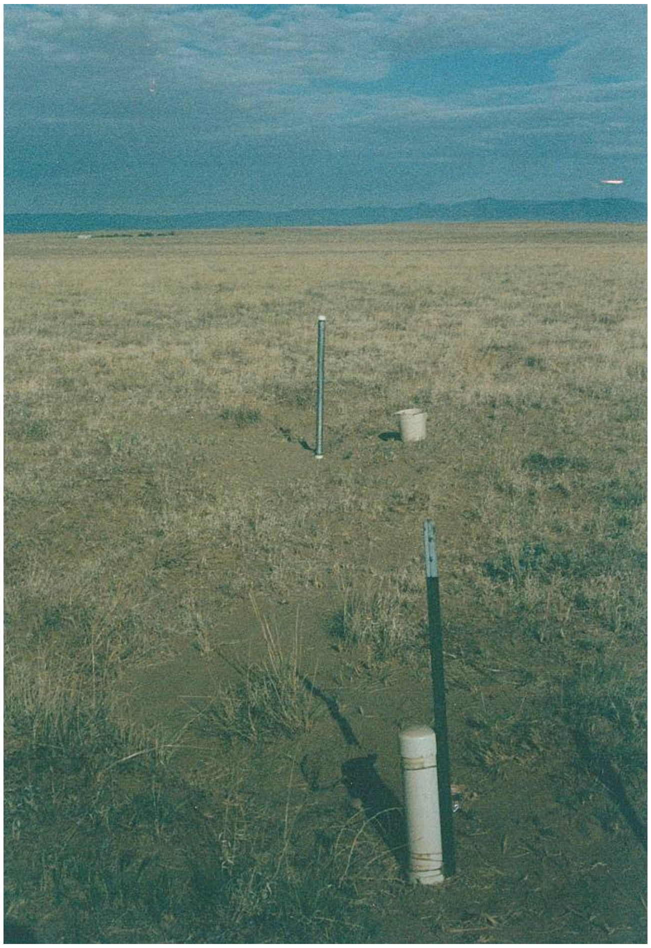


Figure 18.A-17 No Name Arroyo location NN-7, looking downstream

References

Gray, D.M. 1970. Handbook on the Principles of Hydrology. Water Information Center, Inc.

CHANNEL INVENTORY AND EVALUATION FOR
NO NAME ARROYO AND PINABETE ARROYO
2007, EDITED 2012

Introduction

From August 27 to August 29, 2007, two URS teams independently conducted a baseline channel inventory survey and a drainage density survey on the Pinabete and No Name Arroyos within Area IV South and Area V. The Pinabete Arroyo is the main drainage path for Area IV South, bisecting the lease by flowing from the southeast corner to the northwest corner. The No Name Arroyo is the main drainage path for Area V, and flows from east to west along its northern boundary, just south of Area IV South. The Pinabete Arroyo is proposed to be diverted into the No Name Arroyo during the mining operation of Area IV South. Exhibit 18.A-6 is a map of the study area.

The baseline channel inventory was performed by the team of Bud Brock and Samrat Mohanty as part of the effort to obtain hydrologic information necessary for evaluation of Probable Hydrologic Consequences (PHC) of the previously proposed mining operations in Area IV South. The drainage density survey was completed by the team of Briana Gunn and Bill Sabatka to estimate input parameters for the development of the Approximate Original Contours (AOC) for Area IV South.

Baseline Channel Inventory

The specific objectives of the Baseline Channel Inventory effort are:

- Perform reconnaissance of Pinabete Arroyo and No Name Arroyo, including their major tributaries and associated floodplains to describe pre-mining conditions.
- Evaluate channel stability for both the major arroyos.
- Estimate channel characteristics, such as sinuosity and Manning's n values, for use in later modeling efforts.
- Perform limited conceptual classification of bed and bank soils.

Field Reconnaissance Methodology

The URS team performed reconnaissance of the Pinabete Arroyo between the Upper Pinabete Monitoring Station, P-1, and Lower Pinabete Monitoring Station, P-6, and of the No Name Arroyo between Upper No Name Monitoring Station, NN-7, and Lower No Name Monitoring Station, NN-1, as well as their major tributaries and floodplains.

Key channel features identified included road crossings, culverts, dams, tributary junctions, bedrock outcrops, head cuts, bend points, and locations of convex segments within the channel flow path. The conditions of the channels along each course were described, including vegetative conditions in the channel and on the overbanks, the occurrence of steep bank slopes, evidence of bank failure, extent of scouring and deposition along the stream, and the classification of stream bed sediments. Photographs of the channel conditions were taken as part of the channel baseline survey for future reference during the Surface Water PHC project. A representative sample of the photos is presented in the text.

Limited soil classifications were performed on the channel bed and bank soils. Physical characteristics such as gradation, texture, moisture, plasticity, and density were noted for soils at selected locations. Locations were chosen based on their proximity to the monitoring stations, survey cross-sections, and any location with a perceived change in soil type.

Observations on No Name Arroyo

The No Name Arroyo is a fairly “young” arroyo, currently undergoing significant evolution. Overall, the No Name Arroyo is fairly straight for the reach located within the BNCC mining lease and flows in a general northwesterly direction. There are numerous small bends and turns in the channel, but they are minor and have little effect on the overall direction of the stream. The exception is the last major bend in the channel, approximately 900 feet upstream of NN-2. At this location, the channel takes a bend of approximately 30-degrees to the north. From here the channel continues on a north-by-northwesterly direction until the confluence point with Chaco River.

The stream characteristics for No Name Arroyo can be divided into two distinct sections, upstream (east) of Burnham Road and downstream (west) of Burnham Road. For the majority of the stream reach upstream of the Burnham Road, there is a narrow, shallow, and discontinuous low flow channel with the capacity to convey runoff from the frequent storm events (1 to 5 year storm events). The low flow channel varies from 1 to 4 feet in dept and 2 to 10 feet in width. Bends in the channel are up to, and in a few locations exceed, 90-degrees. Flows resultant from the larger storm events overtop the low flow channel and are conveyed in a wide “U” shaped shallow concentrated flow area. The shallow concentrated flow area ranges from approximately 50 to 100 feet wide, with some locations approaching 200 feet. The soil has minimal alluvial deposits consisting primarily of a clayey loam. Vegetation in the shallow concentrated flow area consists of low to medium grass with scattered low to medium brush for an effective ground cover of 60% to 80%. The Manning’s n value for the channel is estimated to be 0.04. The two areas where the channel does not conform to these general statements are described below.

Figure 18.A-18 No Name Arroyo low flow channel upstream of Burnham Road

The area from NN-7 to approximately 500 feet downstream, the channel is incised at a depth of 2 to 4 feet and a width of 10 to 20 feet and has significant braiding. With the exception of the rare major storm events, flow is confined to the channel. The vegetation in the channel is consistent with the downstream section; however, the effective ground cover is approximately 50% in the channel resulting in an estimated Manning's n value of 0.035.

Figure 18.A-19 No Name Arroyo shallow concentrated flow area upstream of Burnham Road

Immediately upstream of Burnham Road is the other location where the No Name Arroyo characteristics deviate from the typical channel section described above. Burnham Road acts as a retention structure creating a ponding area on the upstream side of the road. No crossing culverts were found. The gradient of the road slopes downward from north to south with a small dip in the road just south of the effective ponding area before the gradient of the road starts in an upward slope. This dip in the road acts as an overflow location for the ponding area and corresponds to a sandstone outcrop that limits the erosion of the roadway. The ponding area has an effective ponding depth of approximately 4 to 6 feet before flow will inundate the overflow location. It is assumed this ponding area was intentionally created to serve as a cattle watering pond. The bottom of ponding area is covered with clayey soil. There is little to no vegetation in the bottom of the ponding area; however, heavy brush is present on the upstream half of the pond overbanks. This heavy brush extends into and up the channel feeding the pond for approximately 500 feet creating an effective ground cover of almost 100% resulting in an estimated Manning's n value for this part of the channel of 0.15.

Figure 18.A-20 No Name Arroyo upstream of NN-7

Figure 18.A-21 No Name Arroyo ponding area upstream of Burnham Road looking upstream

Vegetation in the overbank area is fairly consistent along the stream reach and is composed primarily of low grass with interspersed low brush covering approximately 5% to 30% of the ground. The soil in the overbank area is fairly consistent with that in the channel, with the exception of the presence of more gravel. There are few medium to large size rocks in the channel or overbank area. The Manning's n value is estimated to be approximately 0.035 for the overbank area.

The overbank areas consist of a gently sloping floodplain area leading to widely spaced rolling hills. The hills range up to approximately 100 feet high and are composed primarily of fractured sandstone gravel intermixed with loose soils. Tributaries in the area are typically shallow concentrated or sheet flow with only a few of the tributaries having incising at the main channel with a head cut depth of 1 to 3 feet. Upstream of the tributary head cut, the flow regime consists of shallow concentrated and sheet flow.

For the majority of the stream reach downstream of Burnham Road, the channel is well defined with incised depths up to 15 feet, steep to vertical side slopes, and bends ranging from 10 to 45-degrees. The soils in the channel banks are collapsible clayey silt. There is a significant amount of fractured sandstone in the bottom of the channel that has washed into the arroyo from the outcroppings to the north or from discrete outcroppings in the channel banks. There are a few scattered locations where fractured sandstone outcroppings are present in the channel banks, almost always on the north side. Sandstone outcroppings were noted in the channel bottom at two locations, approximately 200 feet upstream of NN-2 and approximately 1,500 feet downstream of NN-4. Vegetation in the overbank area is fairly consistent along the stream reach and is composed primarily of low grass with interspersed low brush covering approximately 5% to 30% of the ground surface. The soil in the overbank area is fairly consistent with that in the channel, with the exception of the presence of more gravel. There are few medium to large size rocks in the channel and overbank areas. The Manning's n value is estimated to be approximately 0.035 for this overbank area. Vegetation and Manning's n values in the channel varies from upstream to downstream and are discussed per section below.

Figure 18.A-22 No Name Arroyo sandstone outcropping upstream of NN-2

Immediately downstream of Burnham Road, the channel is difficult to discern due to the thick vegetation consisting of dense salt cedar, brush, and grass constituting an effective ground cover of approximately 100%. Approximately 500 feet downstream of Burnham Road, the channel flairs out and becomes visible. The channel cross section in this area displays a benched condition. From the channel bank, it drops approximately 8 to 15 feet where it hits a small bench, roughly 5 feet wide. It then drops another 2 to 5 feet to the low flow portion of the channel, which is generally 2 to 5 feet wide. Overall, the channel width varies from approximately 15 to 40 feet wide. This general channel configuration continues downstream for approximately 500 feet to near the location of NN-4. The channel is fairly straight in the area with bends not exceeding 10 to 20 degrees. Due to the thick vegetation, the Manning's n for this portion of the channel is estimated to be 0.15.

From NN-4 to downstream approximately 1,000 feet, the channel is 10 to 12 feet deep and 10 to 20 feet wide. Vegetation in the channel is very thick constituting a ground cover of approximately 80%. Bends are more pronounced and frequent but do not exceed approximately 45 degrees. Due to the thick vegetation, the Manning's n value for this portion of the channel is estimated to be 0.10.

Figure 18.A-23 No Name Arroyo at approximately NN-4

From approximately 1,000 feet downstream of NN-4 to approximately 500 feet downstream of NN-3, the channel is 8 to 10 feet deep and 10 to 20 feet wide. Vegetation in the channel still consists of salt cedar, brush, and low to medium grasses, but the density has decreased to an effective ground cover of approximately 50%. Bends are still fairly frequent but do not exceed approximately 45 degrees. The Manning's n value for this portion of the channel is estimated to be 0.05.

At approximately 500 feet downstream of NN-3, the channel dissipates over the course of approximately 200 feet as it exits a tight meander. The flow regime reverts to shallow concentrated and overland flow for a stretch of approximately 2,000 feet. Where a defined channel exists for this stretch of the arroyo, it is heavily braided, no more than 3 feet deep, and in excess of 30 feet wide. There are stretches where a definitive channel is not present and runoff reverts to sheet flow conditions. Vegetation in the channel and overland flow area is thicker than the downstream channel reaches, consisting of low to medium grasses and weeds, brush, and some salt cedar constituting a ground cover of approximately 50%. The Manning's n value for this portion of the channel is estimated to be 0.04. The overland flow terminates at a major head cut in the channel located approximately 1,000 feet upstream of NN-2. The head cut is approximately 30 feet wide and 12 feet deep. Downstream of the head cut, there is a definable channel as described in the following paragraph.

From the head cut to NN-2, braiding is frequent and the side slopes are vertical. The channel is approximately 8 to 12 feet deep and approximately 10 to 30 feet wide. The top edge of the channel banks tend to be sharp, indicating the channel is relatively new. Bends are fairly minor and range from less than

10 degrees to a maximum of 45 degrees. Vegetation in the channel consists primarily of low grass with some salt cedar and low brush constituting a ground cover of approximately 30%. The Manning's n value for this portion of the channel is estimated to be 0.03.

Figure 18.A-24 No Name Arroyo headcut approximately 1,000 feet upstream of NN-2

Figure 18.A-25 No Name Arroyo from NN-2 to NN-1

From NN-2 to NN-1, the channel banks are vertical or nearly vertical in most locations. In the locations where the channel banks are not vertical, they range to a side slope of approximately 3h:1v. The top edge of the channel banks have been rounded over by erosion, indicating the incision has been in place for a few years. There is little to no braiding in the channel. Channel depths, widths, vegetative cover, Manning's n value, and bends are consistent with the preceding section.

The overbank areas consist of a gently sloping floodplain area with a varied width from 50 to 200 feet leading to a fairly dense clustering of steep hills. The hills are generally up to approximately 100 feet high and are composed primarily of fractured sandstone overlain by loose soils. The majority of the hills have at least one side consisting of a vertical face of fractured sandstone. Tributaries in the area are typically incised at the main channel and upstream for up to 200 feet with a head cut depth of 2 to 5 feet. Upstream of the tributary head cut, the flow regime consists of shallow concentrated and sheet flow.

Observations on Pinabete Arroyo

The Pinabete Arroyo is a well defined and established channel. The overall trend of the channel is fairly straight through the BNCC mining lease area flowing in a general north by northwesterly direction. Right before the channel exits the mining lease area, there are a series of bends that result in an almost 90 degree change in the overall direction of the channel leaving it flowing in a west-by-northwesterly direction until its confluence with the Chaco River.

The stream characteristics for the Pinabete Arroyo are fairly consistent through the study area. The slope of the channel upstream of the BNCC mining lease boundary is 0.65% and downstream of the lease boundary in0.31%. Typically, the channel is 4 to 10 feet deep and 20 to 80 feet wide with side slopes in the range of 4h:1v to 10h:1v. At the bend points, the side slopes on the outside of the bend transition to vertical. Vegetation in the channel is almost solely confined to the channel banks and consists of low grass, some small brush, and the occasional salt cedar clump. The soil in the channel is primarily silty sand with very little to no clay content. There are a couple of locations where bedrock is exposed in the channel. These are at Burnham Road and approximately half way between P-1 and P-2. Otherwise, the channel is basically devoid of rock of any size, with the exception of the sandstone outcroppings at the bend points. The estimated Manning's n value for the channel is 0.022.

Although the general trend of the arroyo is fairly straight, the sinuosity of the channel is relatively high. There are numerous bend points with angles greater than 90 degrees, with a large percent of the bends approaching 180 degrees. Typically, between the major bend points the channel is fairly straight or has a gentle meander. There are a few locations on the stream reach where the sinuosity is very high, as one bend ties directly into the next and the bends approach or are in excess of 90 degrees. These areas are from P-1 downstream for 1,500 feet, upstream and downstream of P-3 for approximately 1,500 feet, and a 2,500 stretch of the channel centered approximately half way between P-5 and P-6.

Figure 18.A-26 Pinabete Arroyo typical channel

Figure 18.A-27 Pinabete Arroyo exposed bedrock between P-1 and P-2

Figure 18.A-28 Pinabete Arroyo typical bend point upstream of Burnham Road

Tributaries to the Pinabete Arroyo are typically incised near the confluence point to the main channel. The incising extends up the tributary for no more than approximately 300 feet where it terminates in a small head cut of 2 to 5 feet deep. The overbank area can be divided into two sections, upstream (east) and downstream (west) of Burnham Road. As with the No Name Arroyo, the overbank area upstream of Burnham Road consists primarily of gently rolling hills up to approximately 100 feet high composed primarily of fractured sandstone gravel intermixed with loose soils. The soil in the overbank area is fairly consistent with that in the channel, with the exception of the presence of more gravel. Vegetation is composed primarily of low grass with interspersed low brush covering approximately 5% to 30% of the ground. There are few medium to large size rocks in overbank area. The Manning's n value is estimated to be approximately 0.035 for the overbank area.

Figure 18.A-28 Pinabete Arroyo typical bend point upstream of Burnham Road

Downstream of Burnham Road, the overbank area is also similar to that of the No Name Arroyo. Typically, a gently sloping floodplain area up to 200 feet wide leads to steep hills up to approximately 100 feet high. The hills generally have at least one vertical face of exposed sandstone with the other sides composed of fractured sandstone and soil. The soil in the overbank area is fairly consistent with that in the channel, with the exception of the presence of more gravel. Vegetation is composed primarily of low grass with interspersed low brush covering approximately 5% to 50% of the ground. There are numerous medium to large size rocks in overbank area consisting of sandstone that has eroded off the nearby hills. The Manning's n value is estimated to be approximately 0.05 for this overbank area.

Drainage Density Survey

This 3-day effort included field reconnaissance of the Pinabete and No Name Arroyos and their major tributaries, developing drainage density data by measuring tributary lengths and areas, measurement of A-channel lengths, and head to ridge lengths.

Several drainage areas for the Pinabete and No Name Arroyos were identified prior to field survey where drainage parameters could be estimated. These locations were selected based on identified hydrologic features and soil types, as well as recommendations from environmental staff of BNCC. Pinabete Drainage Basins 18 and 21, and No Name Basin 1 were selected for reconnaissance. Drainage basin designations are based on a SedCAD model developed by BNCC, and are shown on Exhibit 18.A-6.

Figure 18.A-29 Pinabete Arroyo near confluence of main tributary channel from Drainage Basin 18

Day - 1

The URS team performed an overall reconnaissance of the area was performed by driving through the project area from north to south over the watersheds of both the arroyos. The first basin explored was Drainage Basin 18. This drainage basin is located immediately downstream of Burnham Road and drains to the Pinabete Arroyo directly downstream of cross section P-3. A GPS receiver was used to mark the drainage features of the tributary channels within Drainage Basin 18.

The tributary channels within Drainage Basin 18 are fairly flat and narrow, rectangular in shape, have a bottom width varying from less than 1 foot to over 10 feet, and side slopes from 1h:1v to 3h:1v. The main tributary channel within Drainage Basin 18 extends approximately 5,000 feet to the southwest from the confluence with the Pinabete Arroyo. The total length of all the tributary channels within the Drainage Basin 18 is 18,400 feet. The contributing drainage area is estimated to be 322 acres. The estimated drainage density is 60 feet per acre (ft/acre).

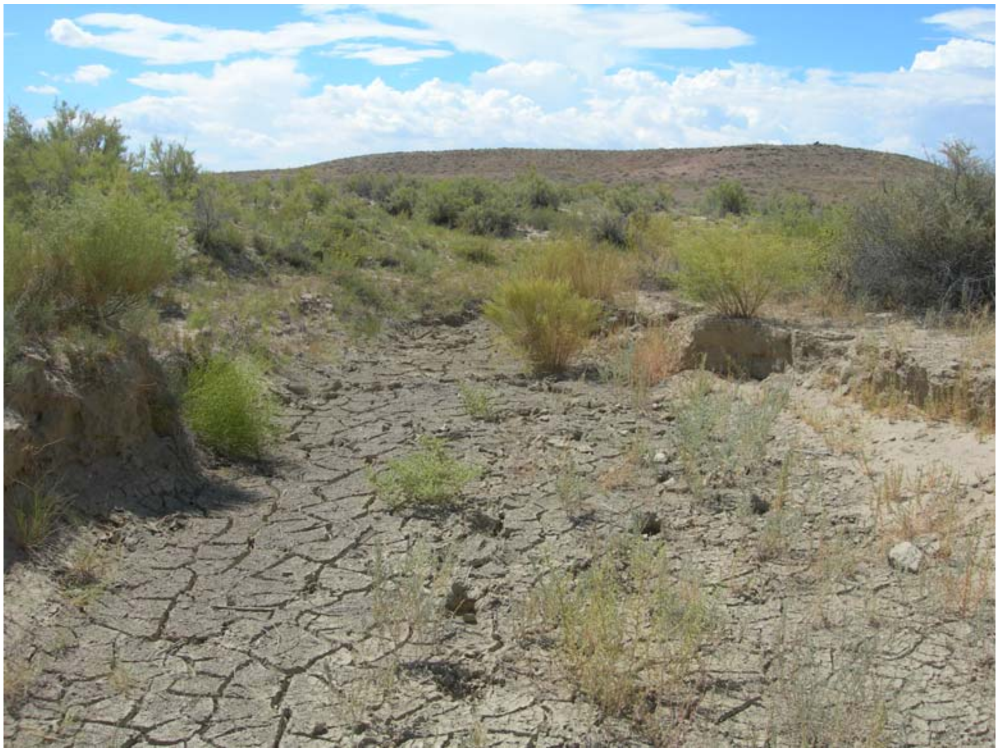


Figure 18.A-30 Main tributary channel from Drainage Basin 18 near confluence with Pinabete Arroyo

Figure 18.A-31 Top segment of Drainage Basin 18 main tributary channel

Figure 18.A-32 Top ridge within Drainage Basin 18 - note increased gravel content

During the field investigation, the team observed that there were very few channels that could be classified as type A or B, with the majority of the channels consistent with type C. For this reason, only a few A-channel lengths were measured within Drainage Basin 18. However, due to the flatness of the area and the small changes in grade between channels, none of the measured head to crest lengths were considered representative of the project area.

The soil within the tributaries is alluvial deposits with very few bedrock outcrops. The channel contains small to large fractured sandstone fragments along the channel bottom, extending into the channel side slopes. The channel bank is unstable, resulting in sustained erosion except for the areas with high rock concentrations.

Day - 2

During the second day, Drainage Basin 22 and the north end of Drainage Basin 21 were identified to have distinct ridges and valleys containing concave to convex channels where A-channel lengths could be evaluated, and the overall terrain contained a greater amount of elevation change.

In these areas, the tributary channel lengths were measured and coordinates were recorded along the tributary alignments to estimate elevation change and A-channel lengths. Within these areas a soil type that was slightly different than that within Drainage Basin 18 was identified. The soil type has less alluvial sands and a greater volume of gravel. These areas have a more stable channel configuration, which is narrower with a reduced amount of riling. The estimated average A-channel length and head to ridge length are approximately 30 feet and 150 feet, respectively; with one outlying head to ridge length of approximately 650 feet.

Figure 18.A-33 Center of tributary channel 18R1 in Drainage Basin 18

Figure 18.A-34 Channel 18 on south bank of Pinabete Arroyo

Figure 18.A-35 Bedrock outcrop within main tributary channel of Drainage Basin 18 after rainfall event

Towards the end of the second day, the southern portion of Pinabete Drainage Basin 21 and No Name Drainage Basin 1 were examined. Both these areas have fairly flat topography with no measurable ridges and valleys, and were therefore not further evaluated.

An attempt was made to identify additional contributing drainage areas in the Pinabete watershed that would be representative of the surface generated by the Natural Regrade model. During this process, Drainage Basin 28 was identified. This basin is approximately 1 mile downstream of Drainage Basin 18.

Day - 3

On the third day, measurements of the lengths of the tributaries within Drainage Basin 28 were conducted. The tributaries within this basin have slopes varying from 2 to 20 percent, which is steeper than tributaries measured in the preceding basins. The tributaries are narrower in comparison to those within Drainage Basin 18. The tributary channels generally have a trapezoidal shape, a bottom width varying from 0.5 to 4 feet, and 1h:1v to 2h:1v side slopes. The main tributary channel extends approximately 1,080 feet to the confluence with the Pinabete Arroyo. The total length of all tributaries within Drainage Basin 28 is 2,350 feet. The contributing drainage area is approximately 16.8 acres. The estimated drainage density is 140 ft/acre.

Figure 18.A-36 Typical upstream channel segment in Drainage Basin 28

Figure 18.A-37 Typical A-channel in Drainage Basin 28

Figure 18.A-38 Typical A-channel in Drainage Basin 18

The majority of the tributaries were found to contain an A-channel reach with a measurable head to ridge length. Measurements were taken along the tributary channels. The estimated average A-channel length and head to ridge length are approximately 20 and 100 feet, respectively.

The soil type within Drainage Basin 28 is similar to Drainage Basin 22 with a lower amount of alluvial deposits and a large amount of gravel. For the majority of the tributaries, gravel is present at the transition between the concave to convex areas. Overall, this basin appears to be more stable than Drainage Basin 18.

GPS data were recorded at the estimated upstream and downstream elevation of the Pinabete Arroyo in the NMEP to be used as input in the Natural Regrade model. The upstream and downstream elevations are estimated to be 5,440 feet and 5,310 feet (Mean Sea Level), respectively.

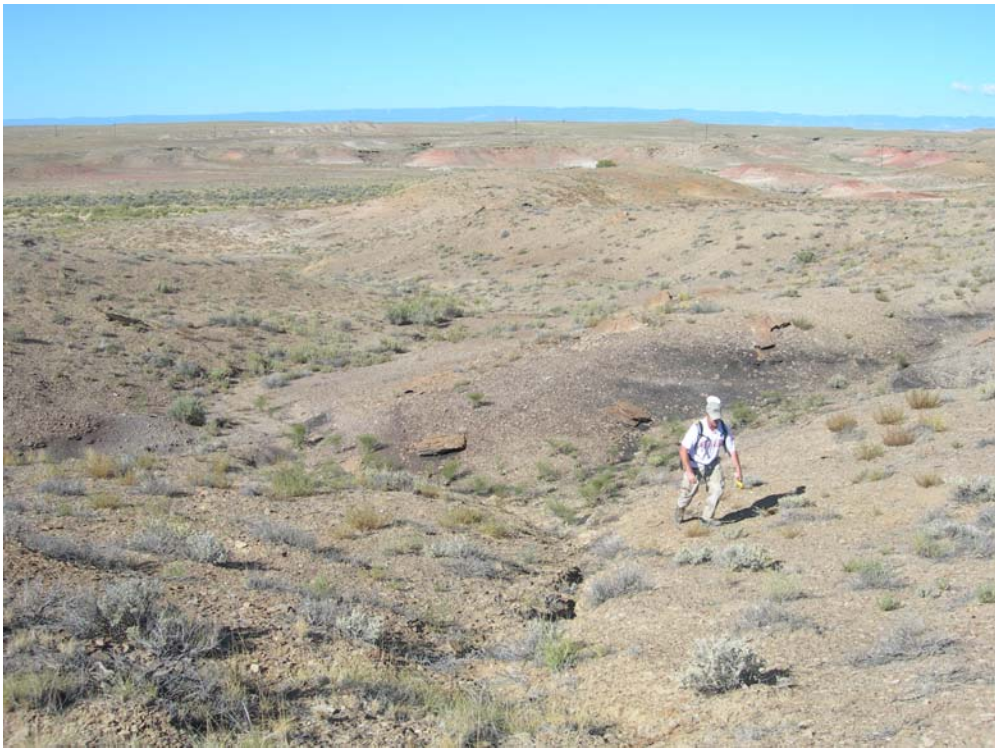
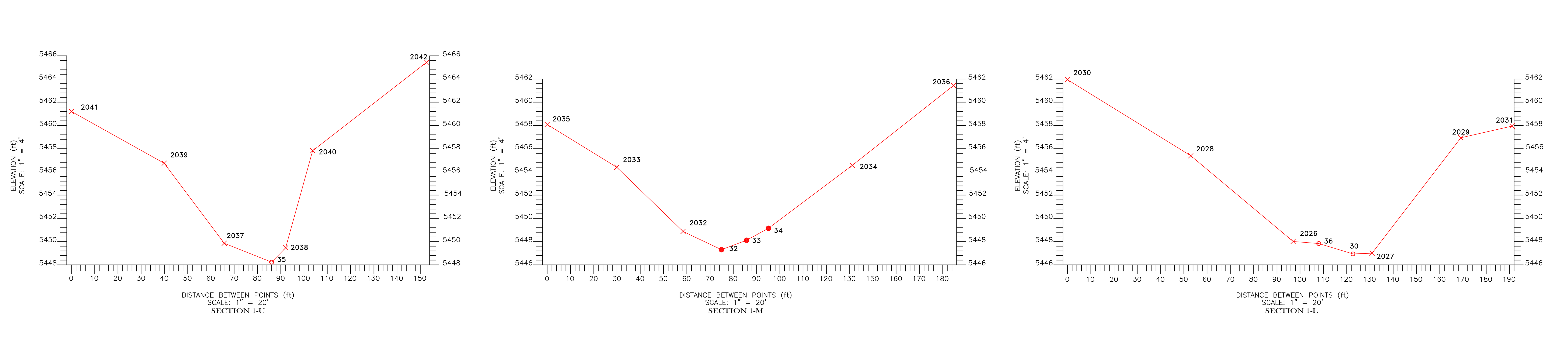
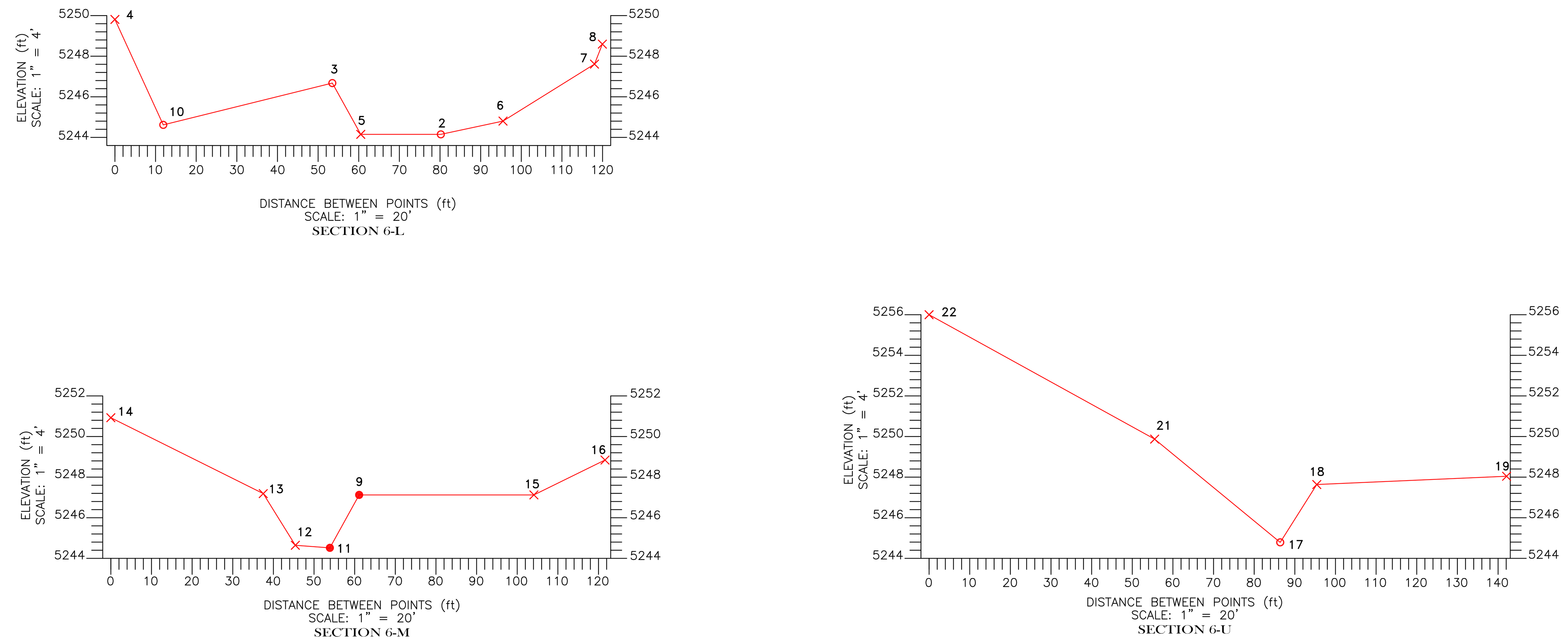


Figure 18.A-39 Typical geomorphologic formations within Drainage Basin 28

Figure 18.A-40 Southern boundary of the permit area looking north



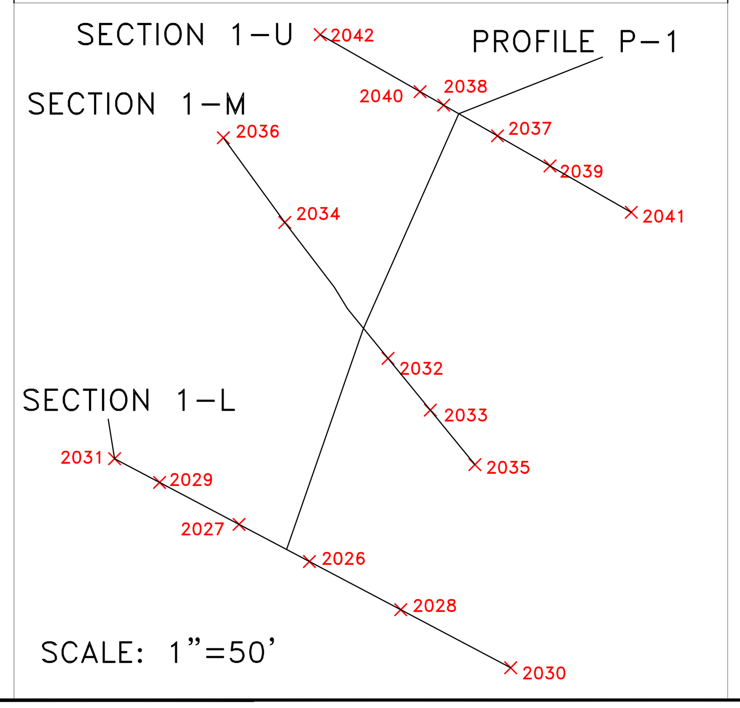
UPSTREAM



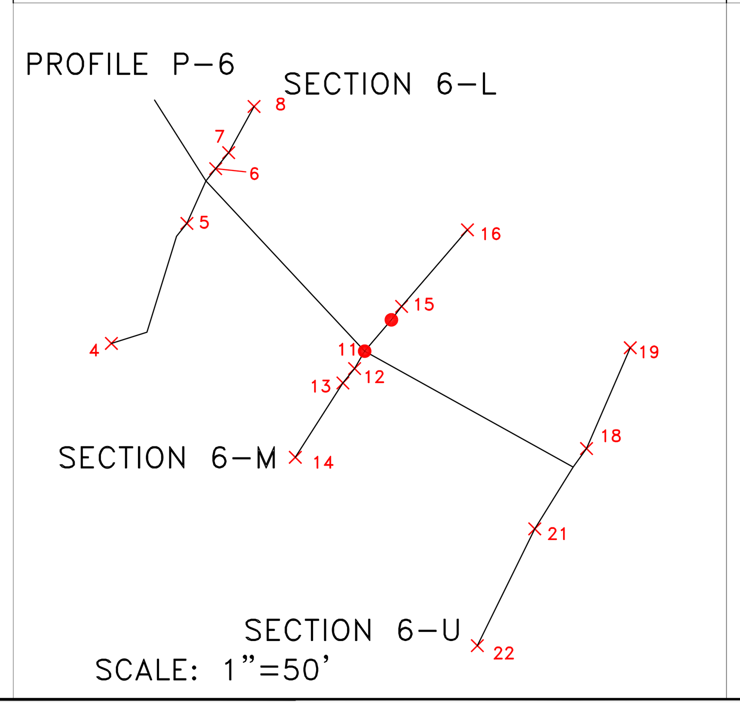
DOWNSTREAM

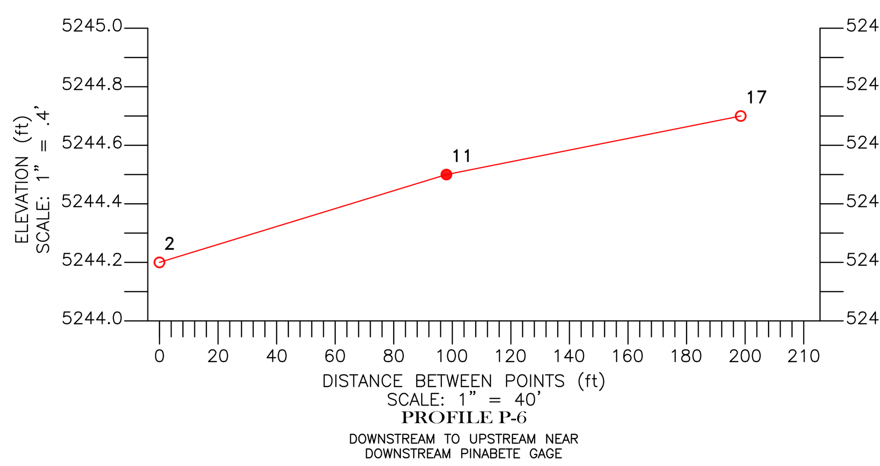
Longitudinal Profile for Pinabete Arroyo

SECTIONS AND PROFILE LOCATIONS AT
PINABETE ARROYO
UPSTREAM MONITORING STATION P-1

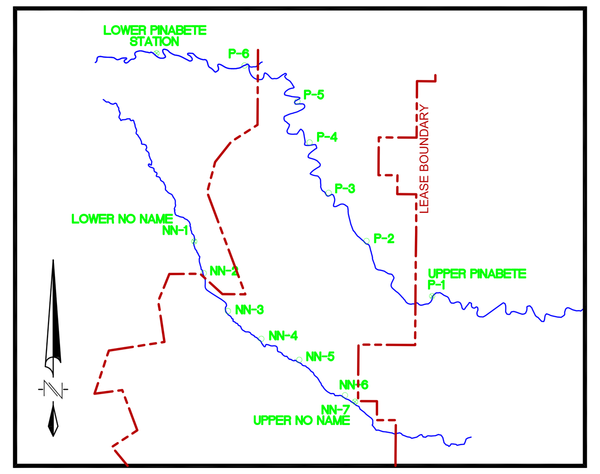


SECTIONS AND PROFILE LOCATIONS AT
PINABETE ARROYO
DOWNSTREAM MONITORING STATION P-6





Site Map



LEGEND

P-7	CHANNEL INVENTORY LOCATION
×	SURVEY POINT
○	CREST STAGE GAGE
●	SINGLE STAGE SAMPLER

REV. No.	DATE	DRAFT. BY	REVISION DESCRIPTION	PRE'D BY	E.Q.	P.E.	APPROVED DATE
12-A	3/16/12	MPO	Submitted to OSM for Approval		CKA		

NORWEST
Applied Hydrology

EXHIBIT 18.A-1

BHP NAVAJO COAL COMPANY

bhpbilliton

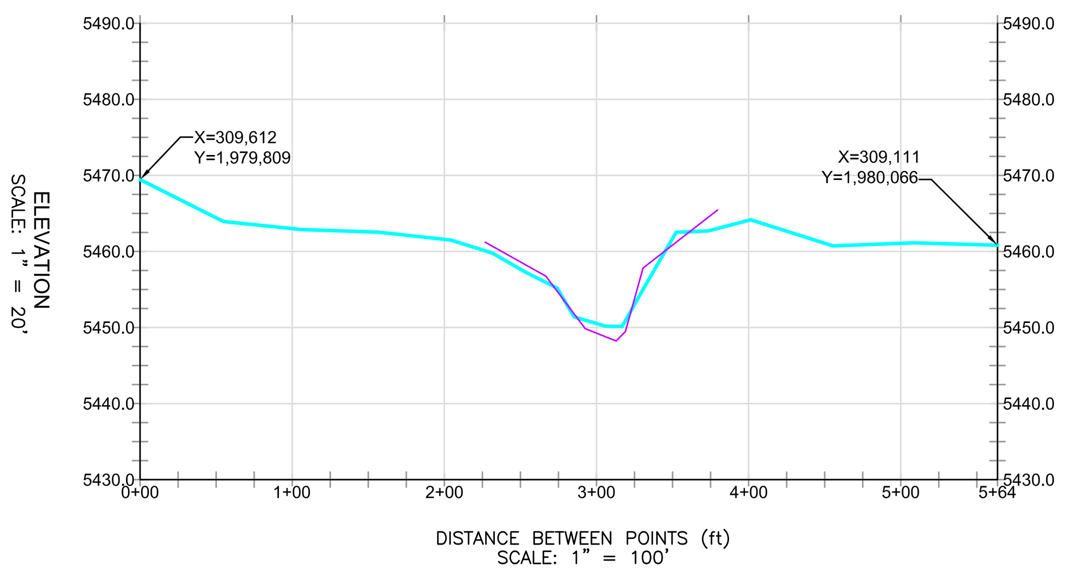
P.O. BOX 1717
FRUITLAND, NEW MEXICO 87416
PHONE(505)598-4200
Fax(505)598-4229

PINABETE PERMIT

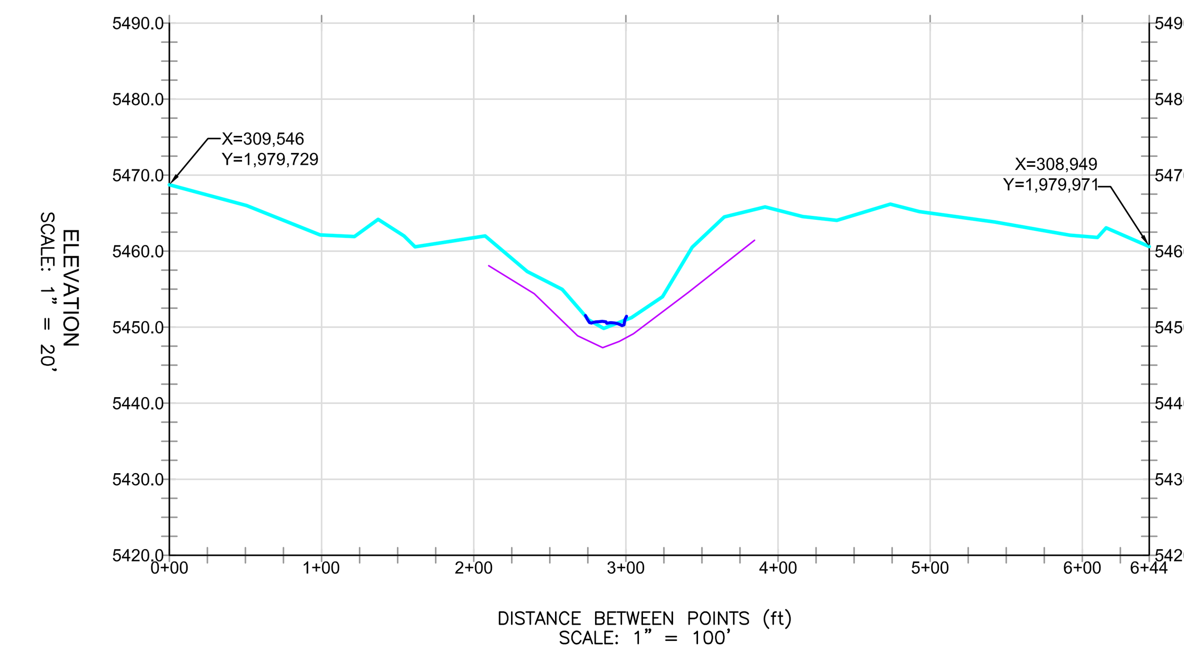
PINABETE ARROYO MONITORING STATION INFORMATION AND CHANNEL CHARACTERIZATION 1998

PREPARED BY APO	DRAWN BY JLS	SCALE: AS SHOWN
APPROVED BY	DATE Mar 16, 2012	

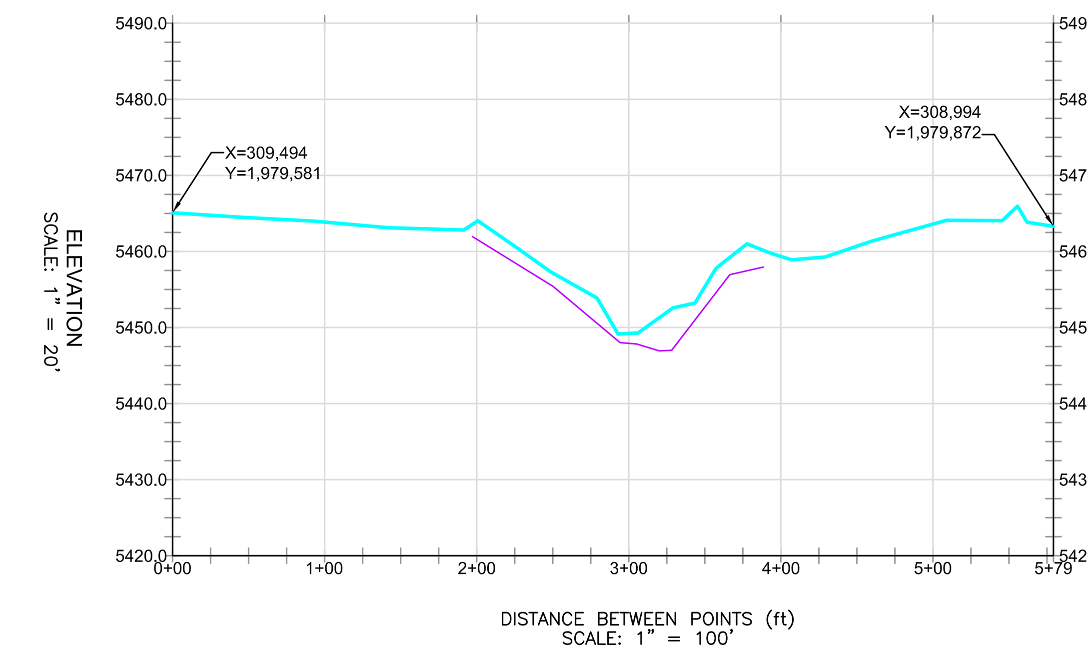
UPPER PINABETE STATION -A (UPPER)



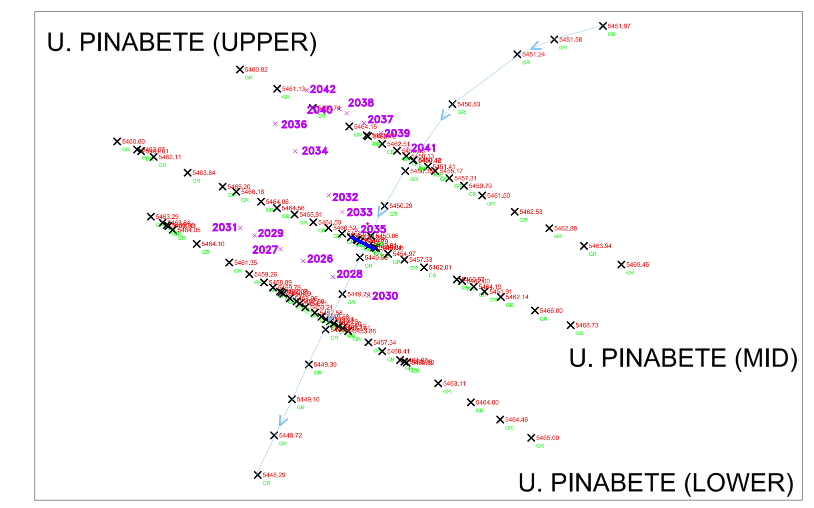
UPPER PINABETE STATION -B (MID)



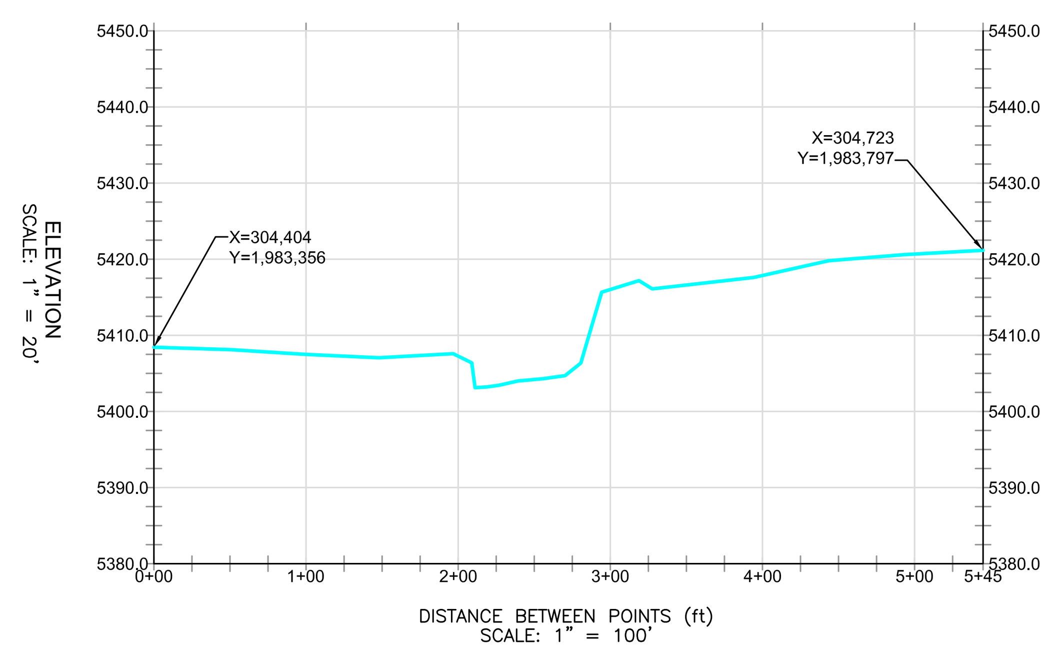
UPPER PINABETE STATION -C (LOWER)



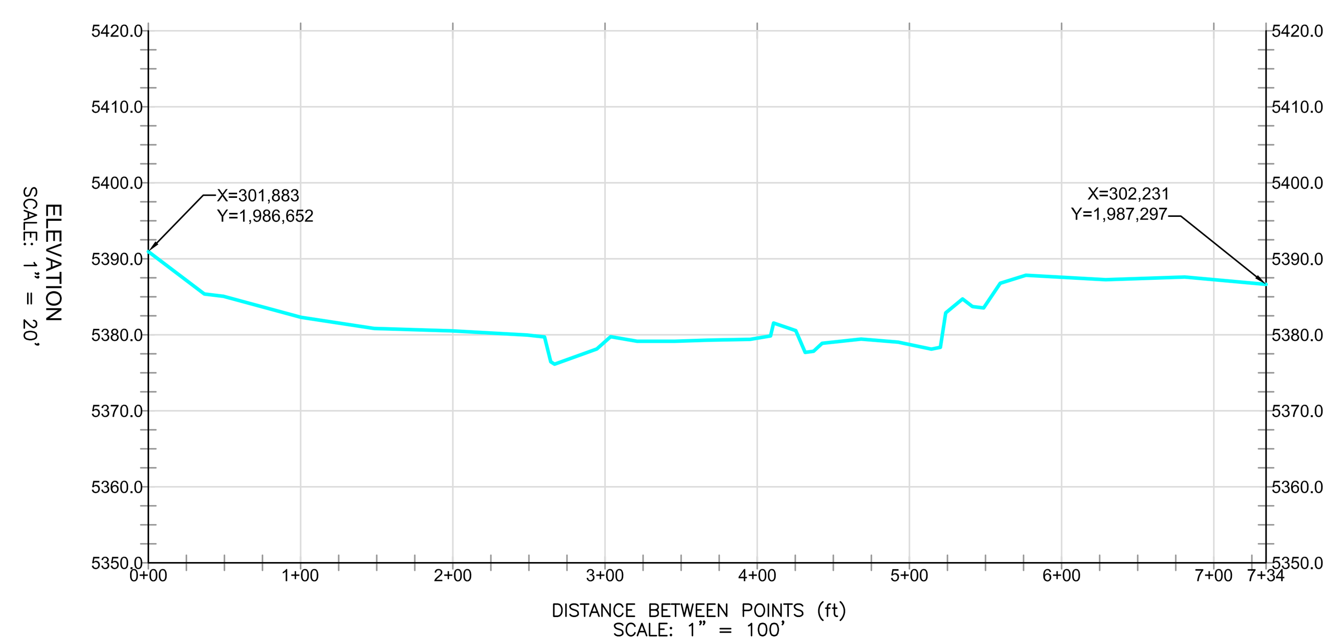
SECTIONS LOCATIONS AT
PINABETE ARROYO UPSTREAM
MONITORING STATIONS



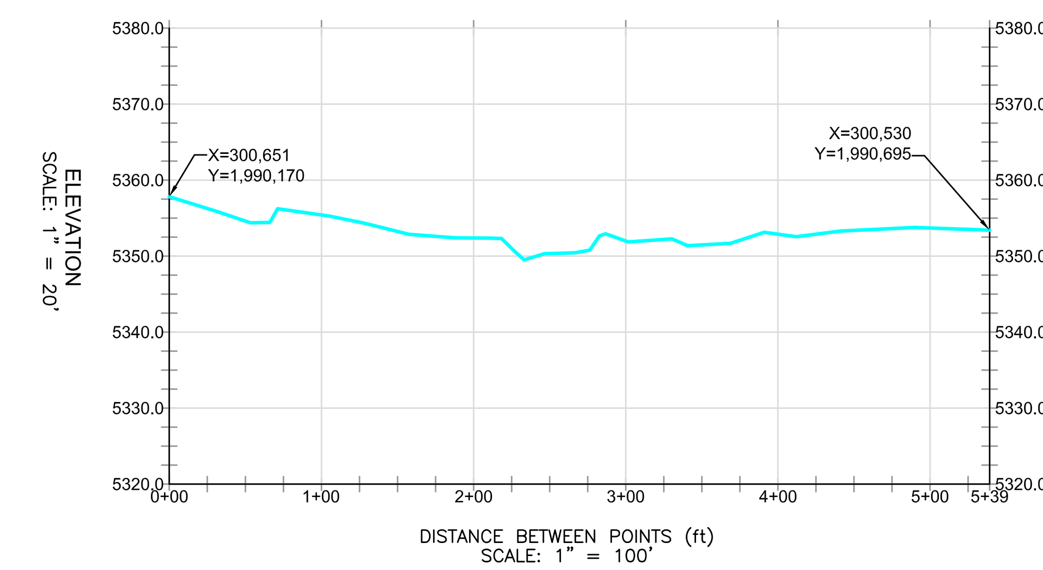
P-2



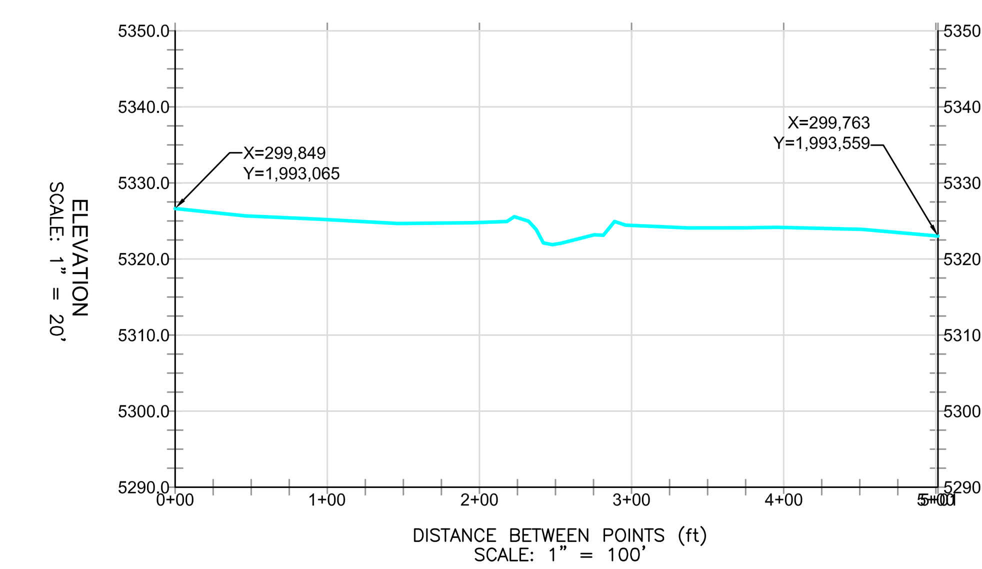
P-3



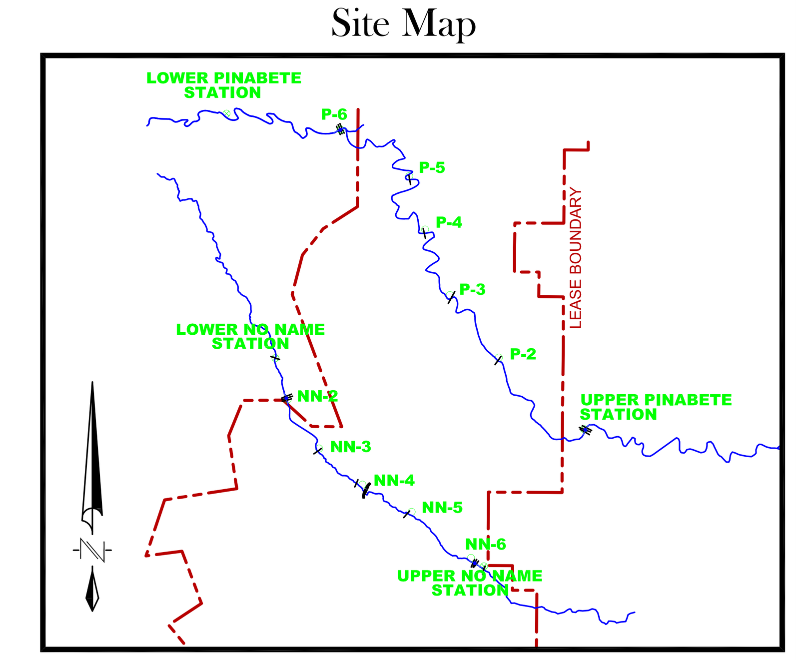
P-4



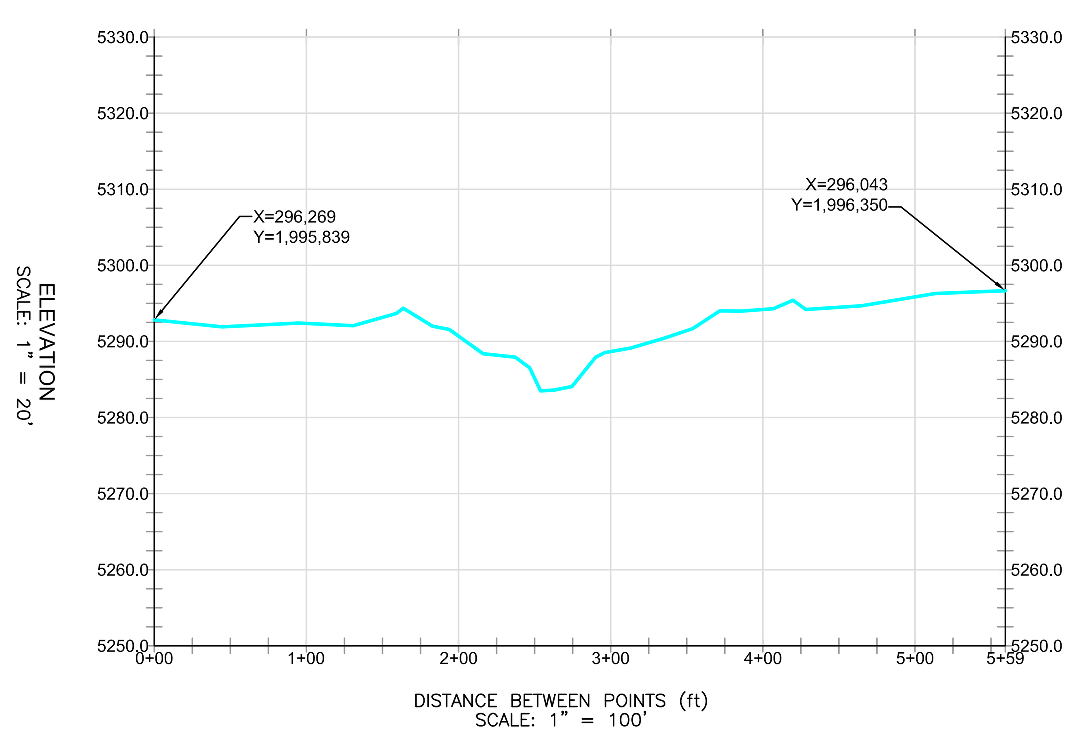
P-5



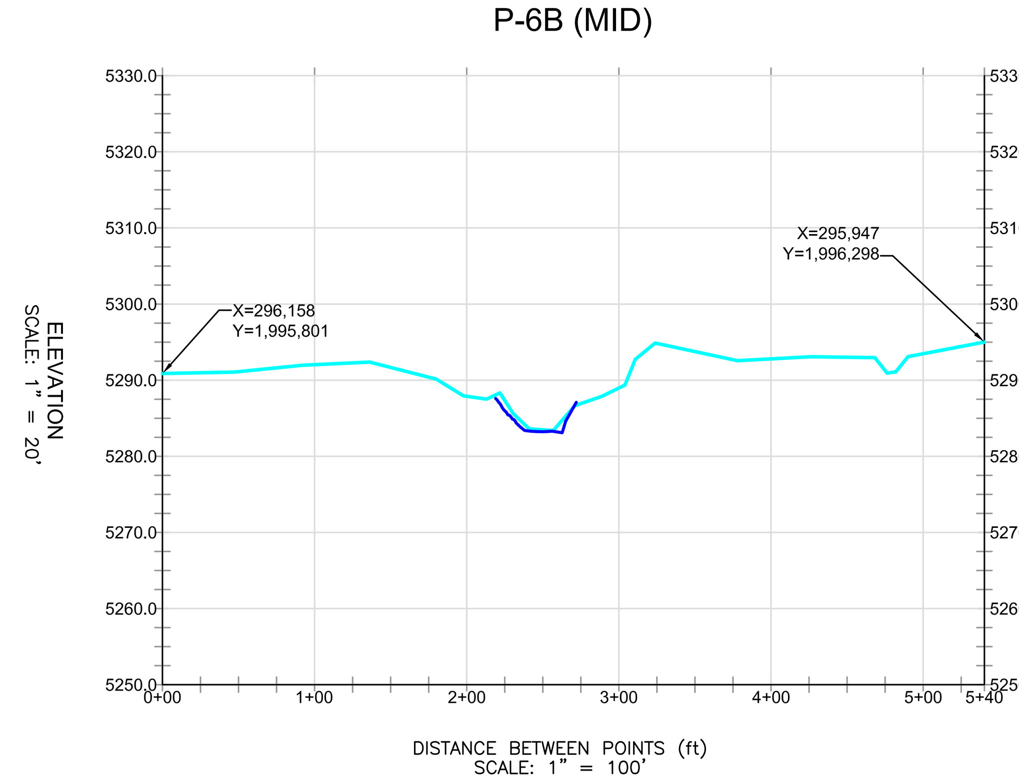
Site Map



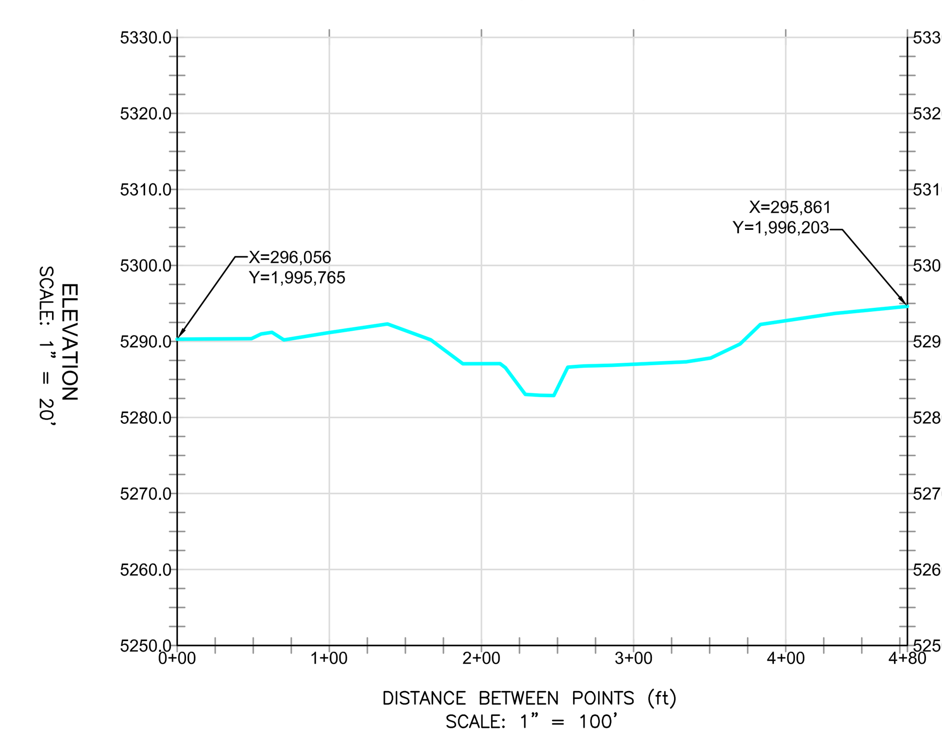
P-6A (UPPER)



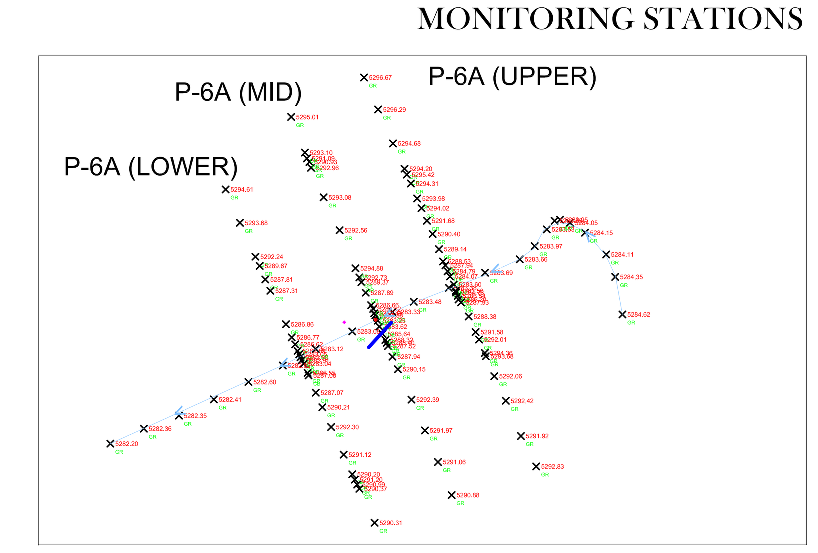
P-6B (MID)



P-6C (LOWER)



SECTIONS LOCATIONS AT
PINABETE ARROYO P-6
MONITORING STATIONS



LEGEND

- 2008 SURVEYED SECTION
- 2007 SURVEYED SECTION
- 1998 SURVEYED SECTION

NOTES
- COORDINATE DATUM IS NEW MEXICO STATE PLANE NAD 27 FEET WEST ZONE
- CROSS SECTIONS LOOKING DOWNSTREAM

REV. No.	DATE	DRAFT BY	REVISION DESCRIPTION	PRE'D BY	E.G.	P.E.	APPROVED DATE
12-A	3/16/12	MPO	Submitted to OSM for Approval	CKA			

APPROVALS

NORWEST
Applied Hydrology

EXHIBIT 18.A-2

BHP NAVAJO COAL COMPANY

bhpbilliton

P.O. BOX 1717
FRUITLAND, NEW MEXICO 87416

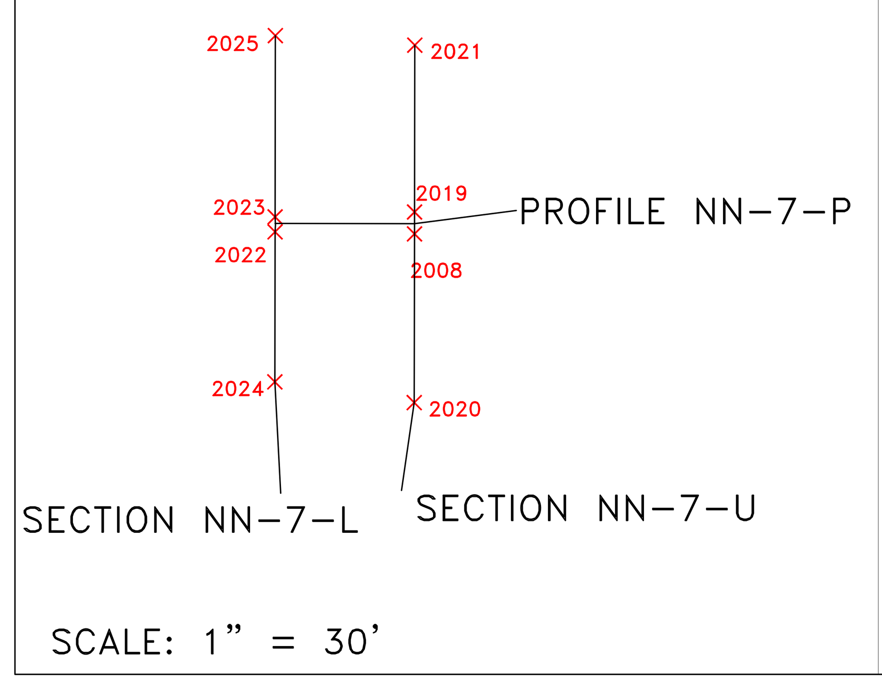
PHONE(505)598-4200
Fax(505)598-4229

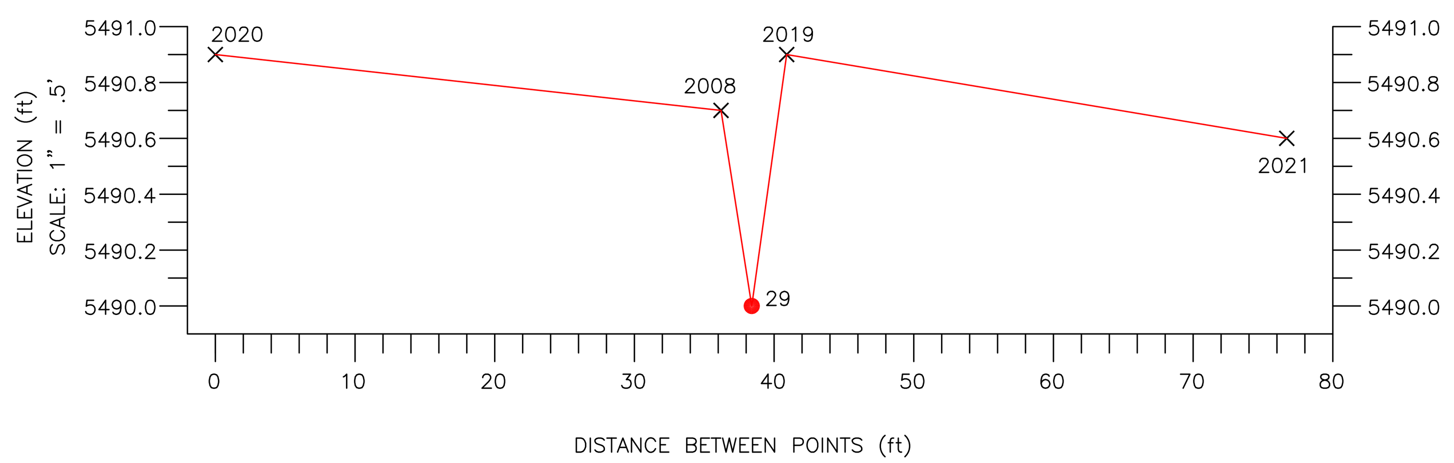
PINABETE PERMIT

PINABETE ARROYO
CROSS SECTIONS

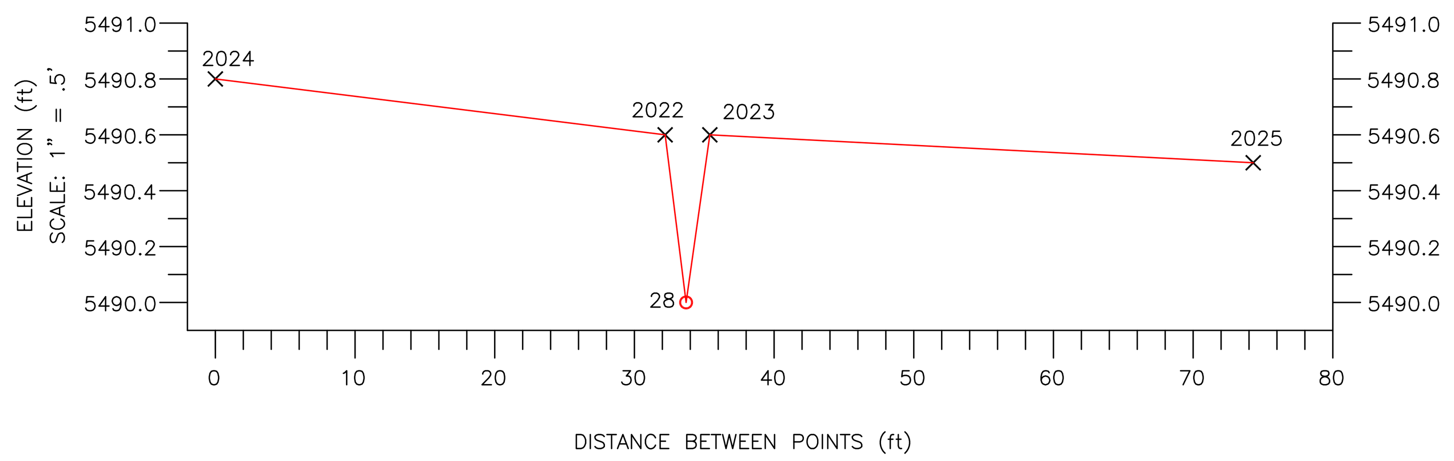
PREPARED BY APO	DRAWN BY JLS	SCALE: AS SHOWN
APPROVED BY	DATE Mar 16, 2012	

SECTIONS AND PROFILE LOCATIONS AT
NO NAME ARROYO
UPSTREAM MONITORING STATION NN-7

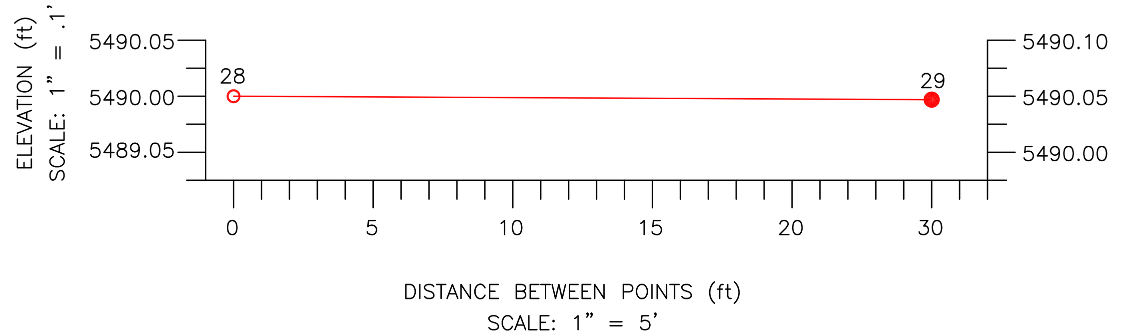




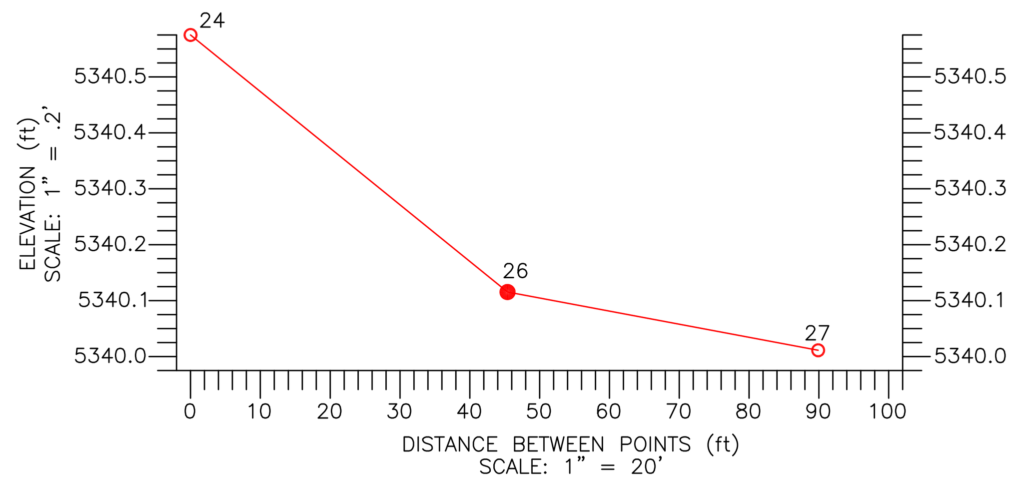
SECTION NN-7-U



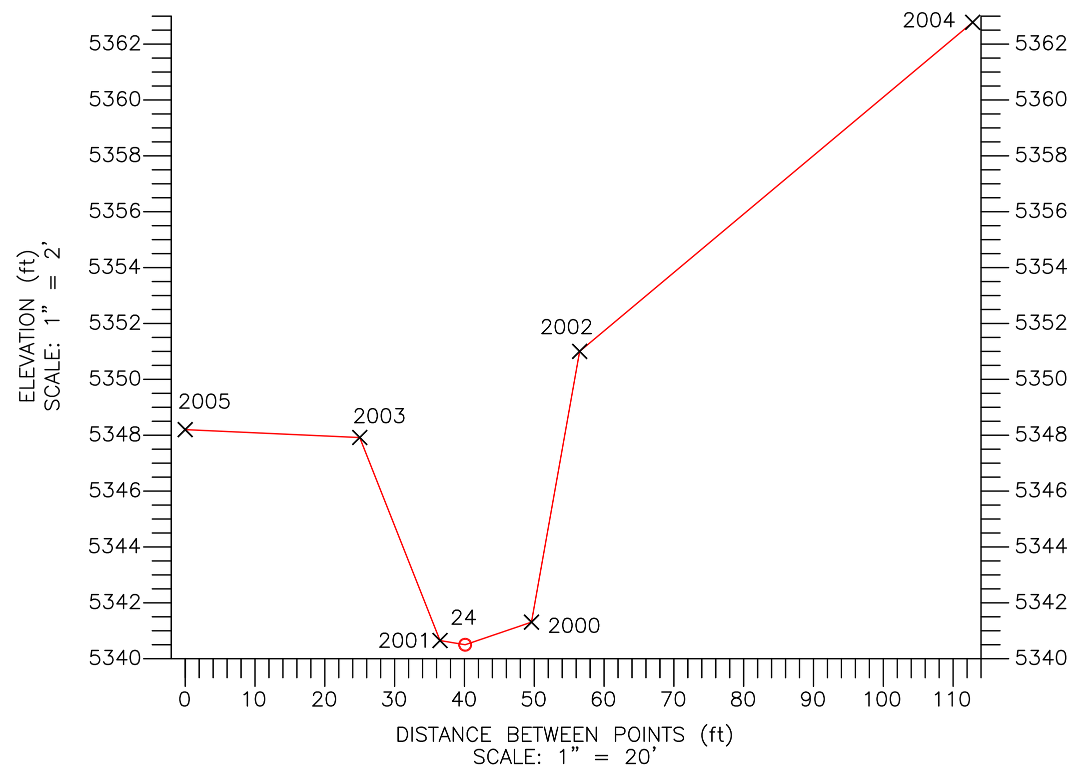
SECTION NN-7-L



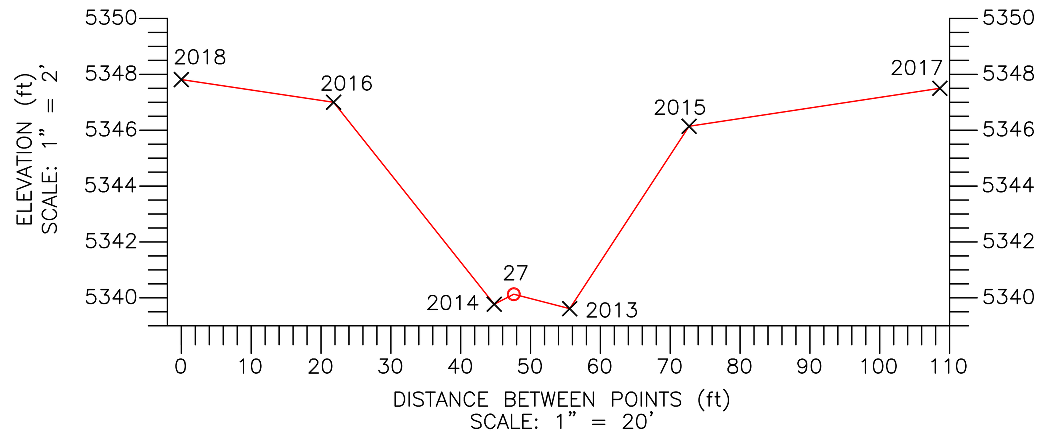
PROFILE NN-7-P



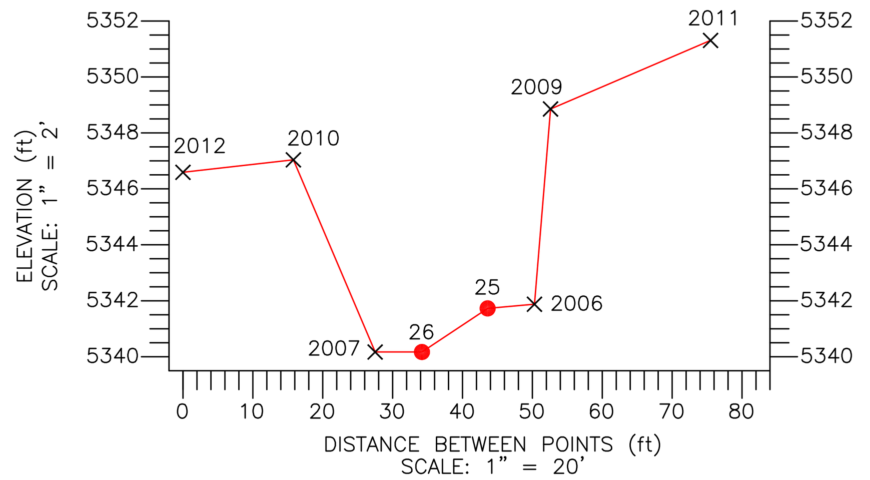
PROFILE NN-1-P



SECTION NN-1-U

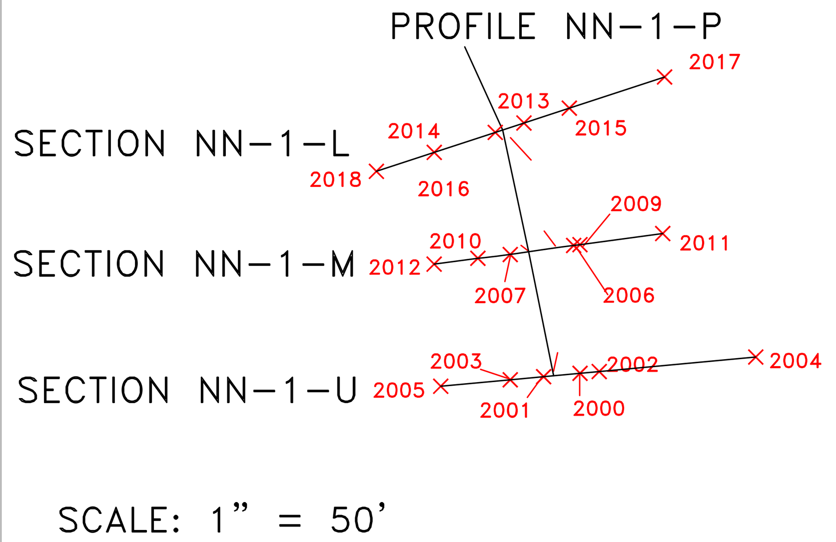


SECTION NN-1-L



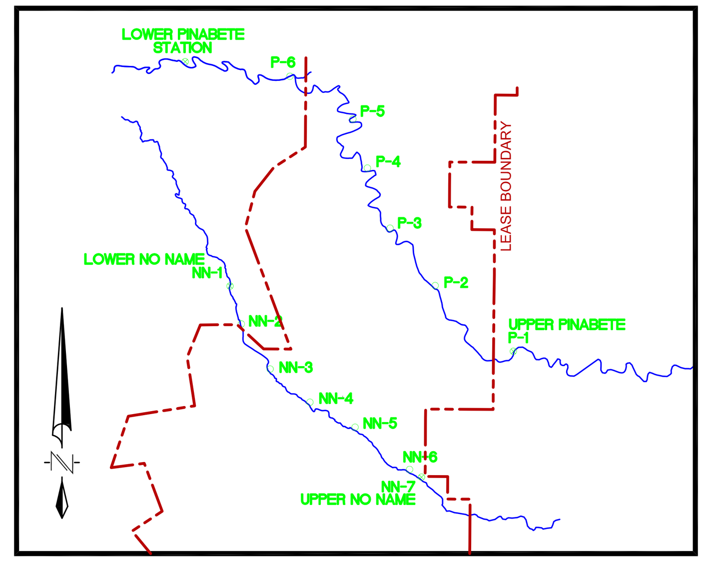
SECTION NN-1-M

SECTIONS AND PROFILE LOCATIONS AT
NO NAME ARROYO
DOWNSTREAM MONITORING STATION NN-1



Longitudinal Profile for No Name Arroyo

Site Map



LEGEND

NN-7	CHANNEL INVENTORY LOCATION
×	SURVEY POINT
○	CREST STAGE GAGE
●	SINGLE STAGE SAMPLER

REV. No.	DATE	DRAFT BY	REVISION DESCRIPTION	PREP. BY	APPROVALS
12-A	3/16/12	MPO	Submitted to OSM for Approval		CKA

NORWEST

EXHIBIT 18.A-3

BHP NAVAJO COAL COMPANY

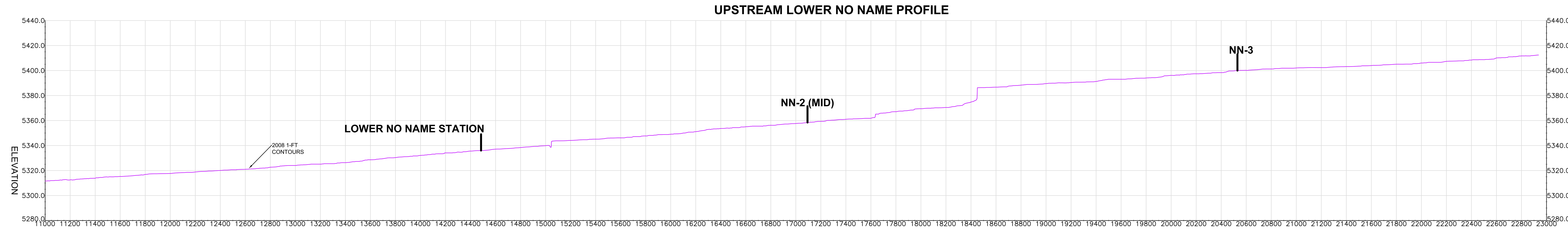
bhpbilliton

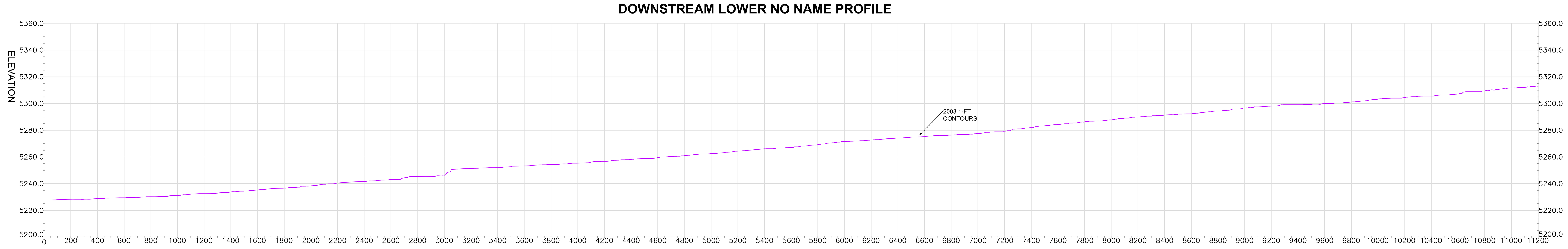
P.O. BOX 1717
FRUITLAND, NEW MEXICO 87416
PHONE(505)598-4200
Fax(505)598-4229

PINABETE PERMIT

NO NAME ARROYO MONITORING STATION
INFORMATION AND CHANNEL
CHARACTERIZATION 1998

PREPARED BY	APO	DRAWN BY	JLS	SCALE:	AS SHOWN
APPROVED BY		DATE	Mar 16, 2012		





12-A	3/16/12	MPO	Submitted to OSM for Approval	CKA			
REV. No.	DATE	DRAFT BY	REVISION DESCRIPTION	PREP'D BY	E.G.	P.E.	APPROVED DATE

NORWEST

EXHIBIT 18.A-4

BHP NAVAJO COAL COMPANY

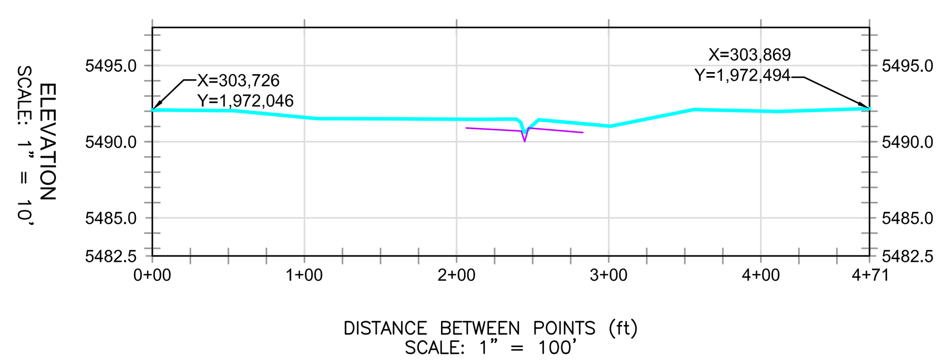
bhpbilliton

P.O. BOX 1717
FRUITLAND, NEW MEXICO 87416
PHONE(505)598-4200
Fax(505)598-4229

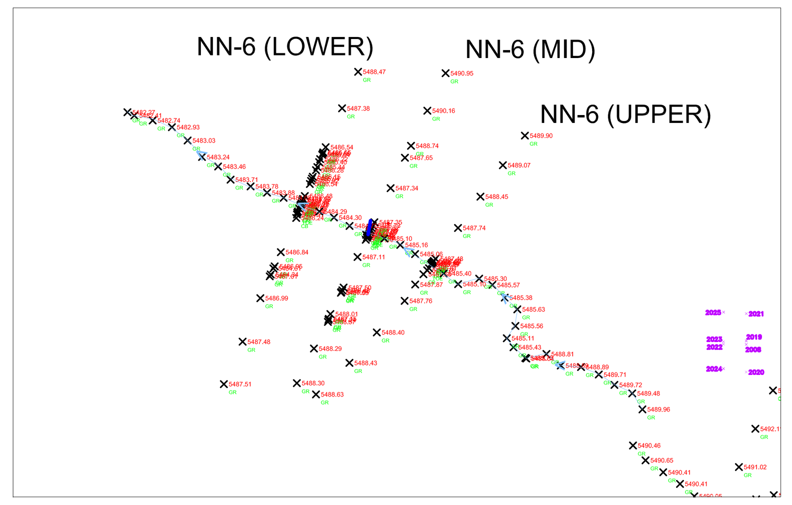
PINABETE PERMIT
LOWER NO NAME ARROYO

PREPARED BY	APO	DRAWN BY	JLS	SCALE:	1" = 2000'
APPROVED BY		DATE	Mar 16, 2012		

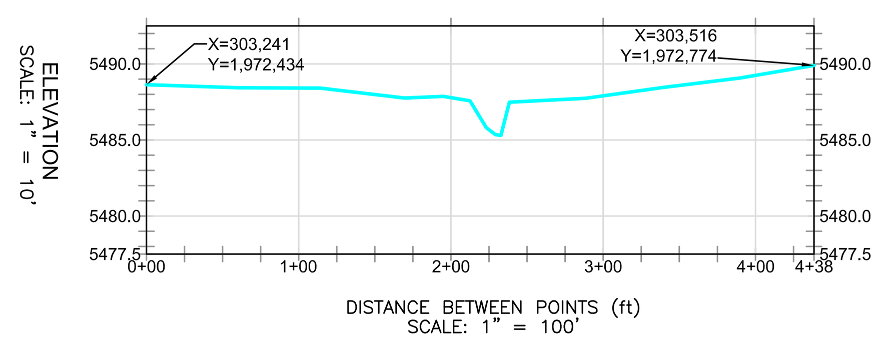
UPPER NO NAME STATION



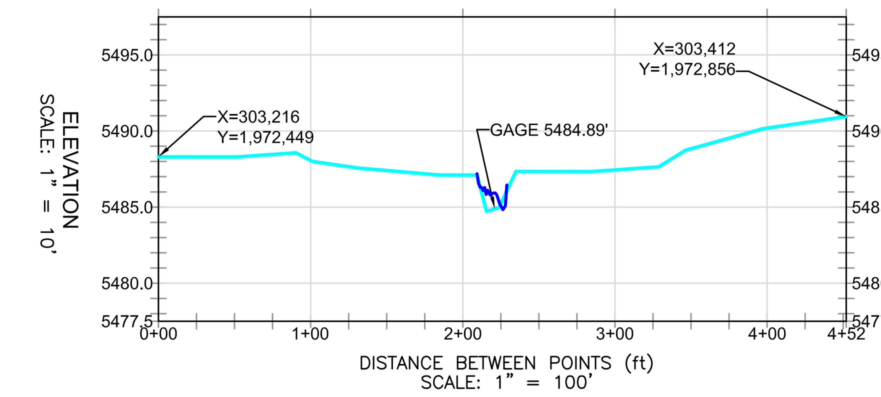
SECTIONS LOCATIONS AT NO NAME ARROYO NN-6 MONITORING STATIONS



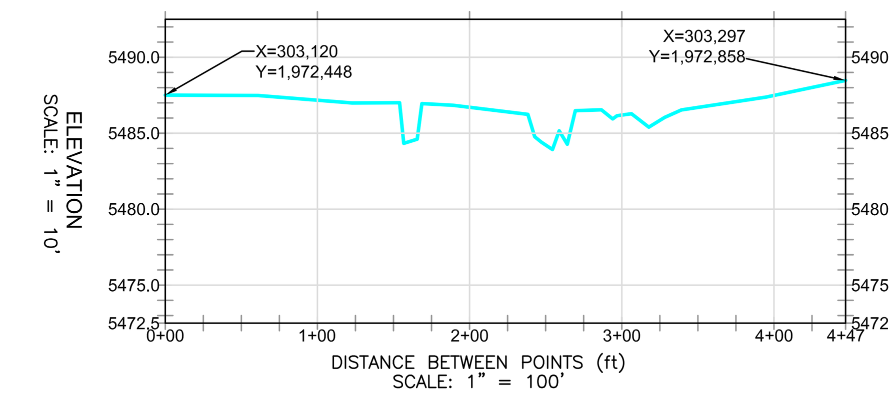
NN-6A (UPPER)



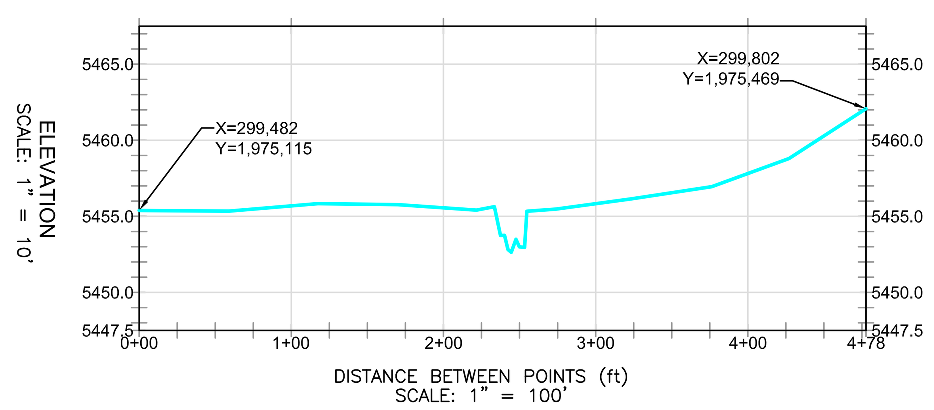
NN-6B (MID)



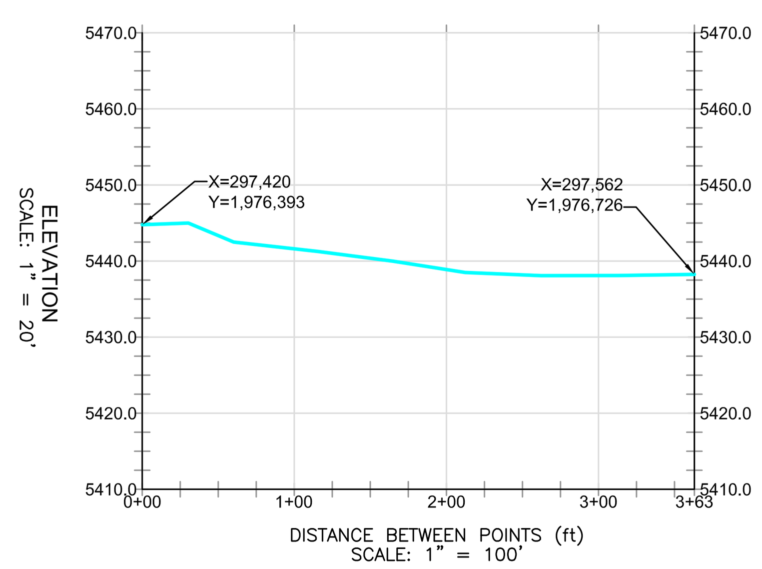
NN-6C (LOWER)



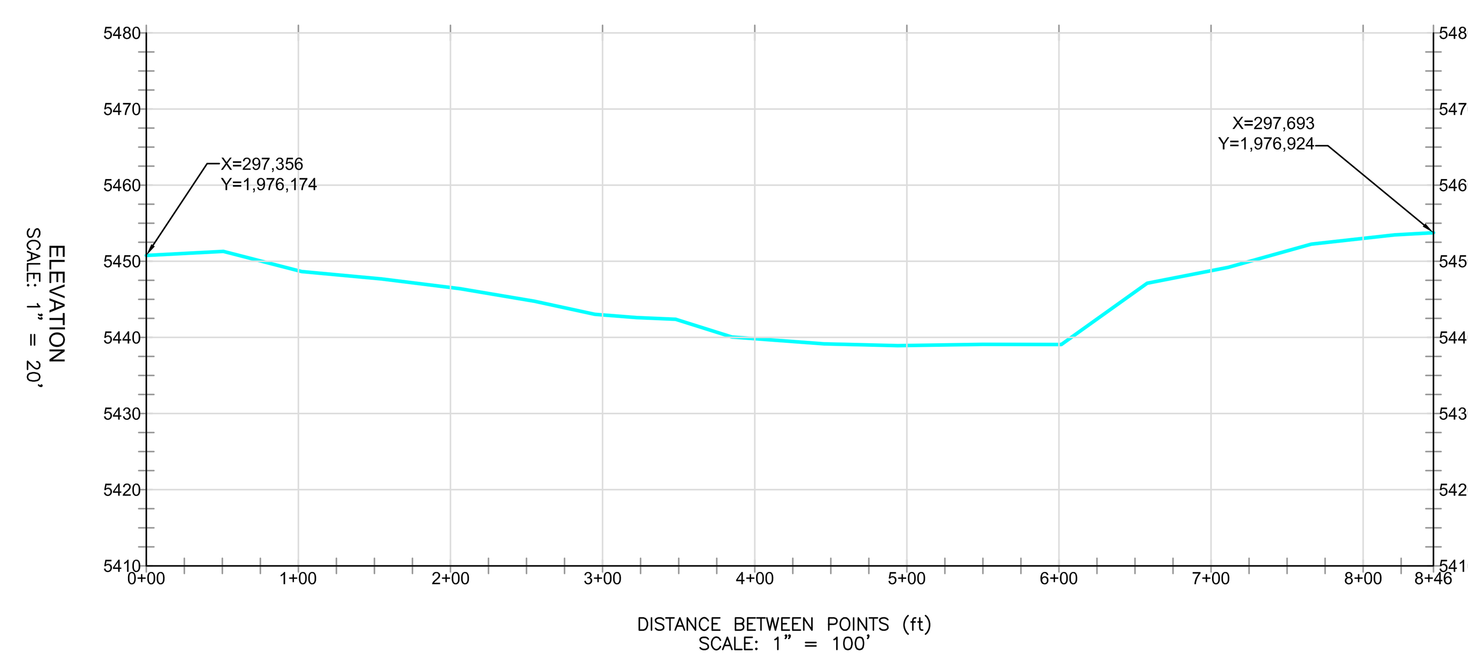
NN-5



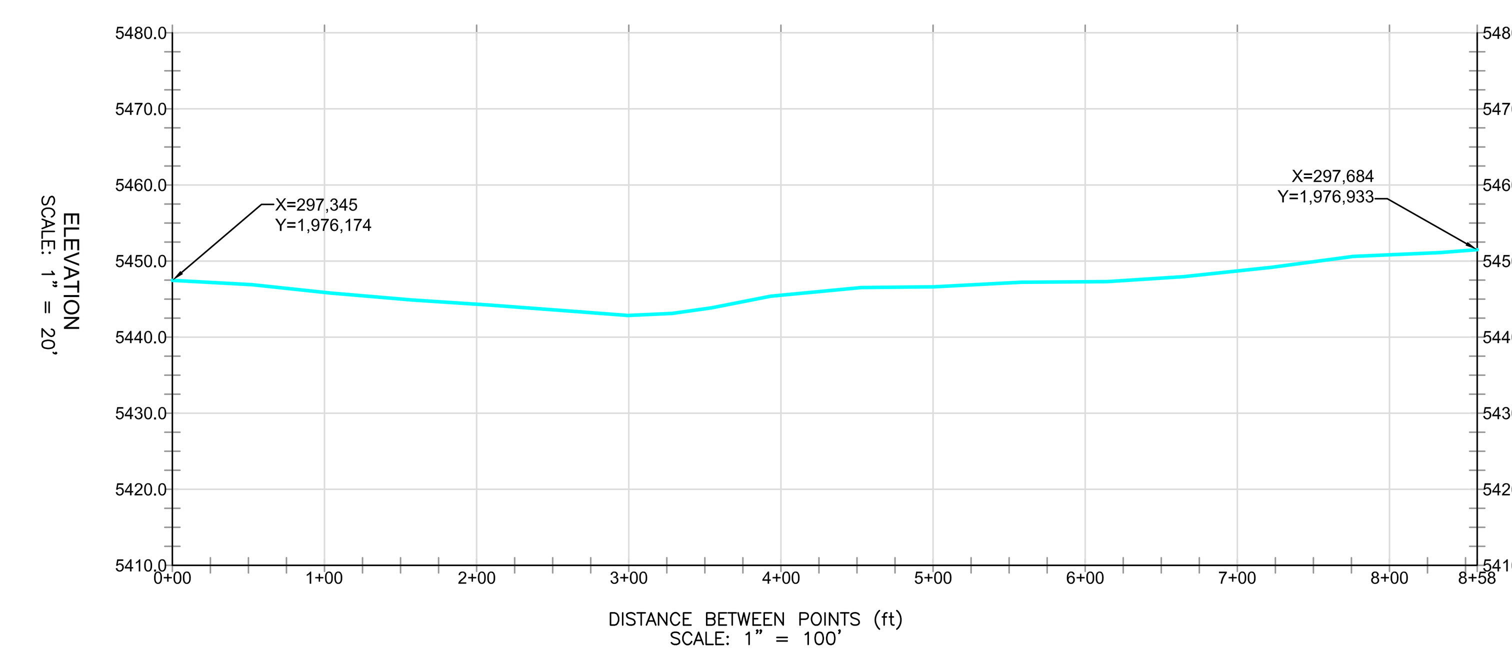
NN-4A (UPPER)



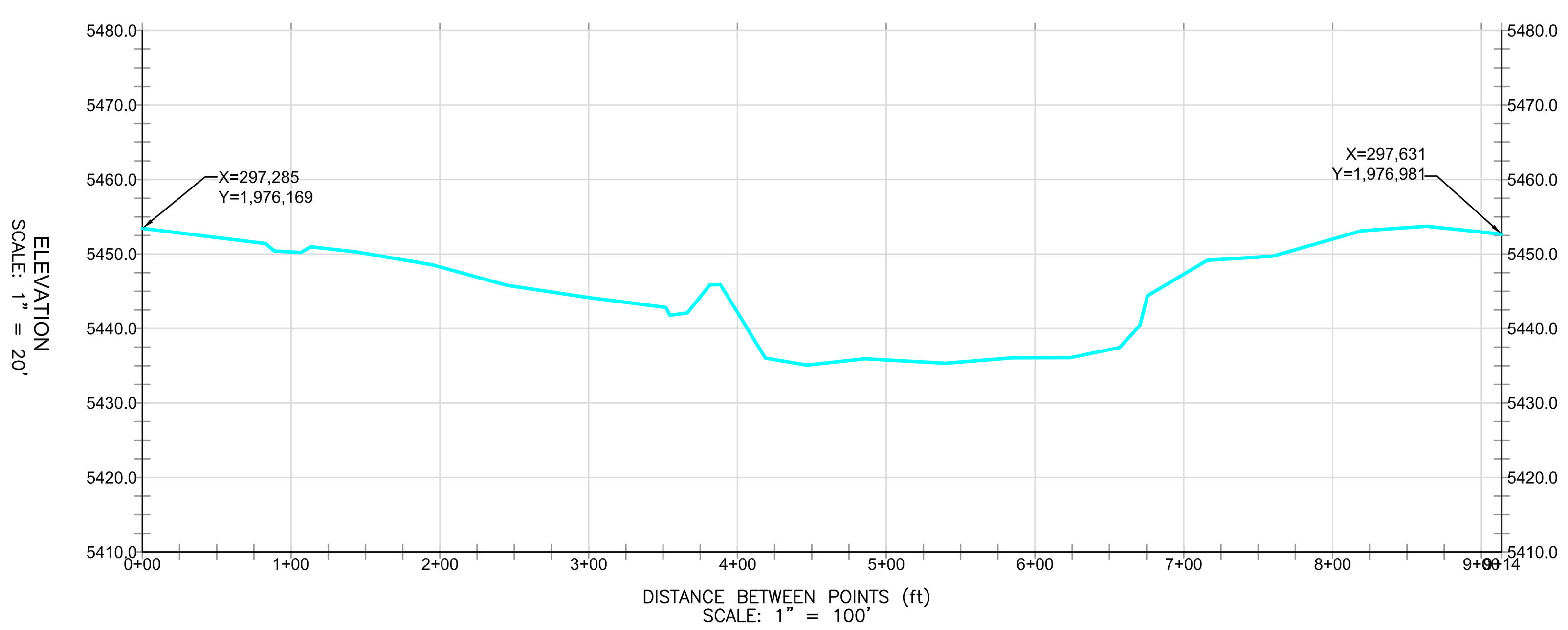
NN-4B (MID)



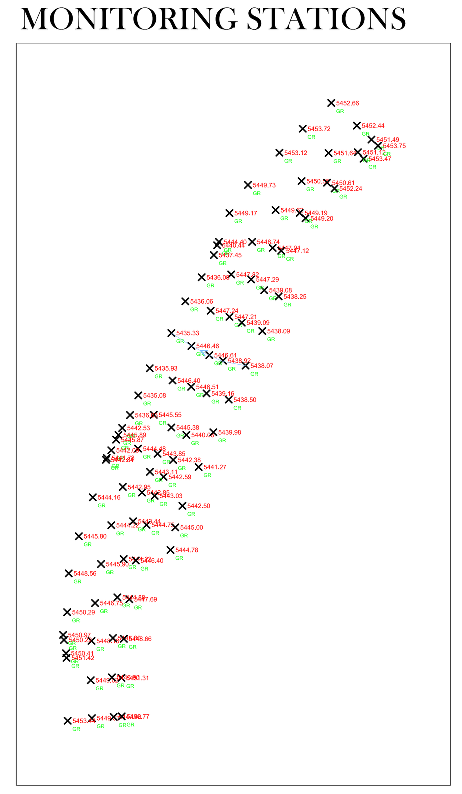
NN-4C (LOWER)



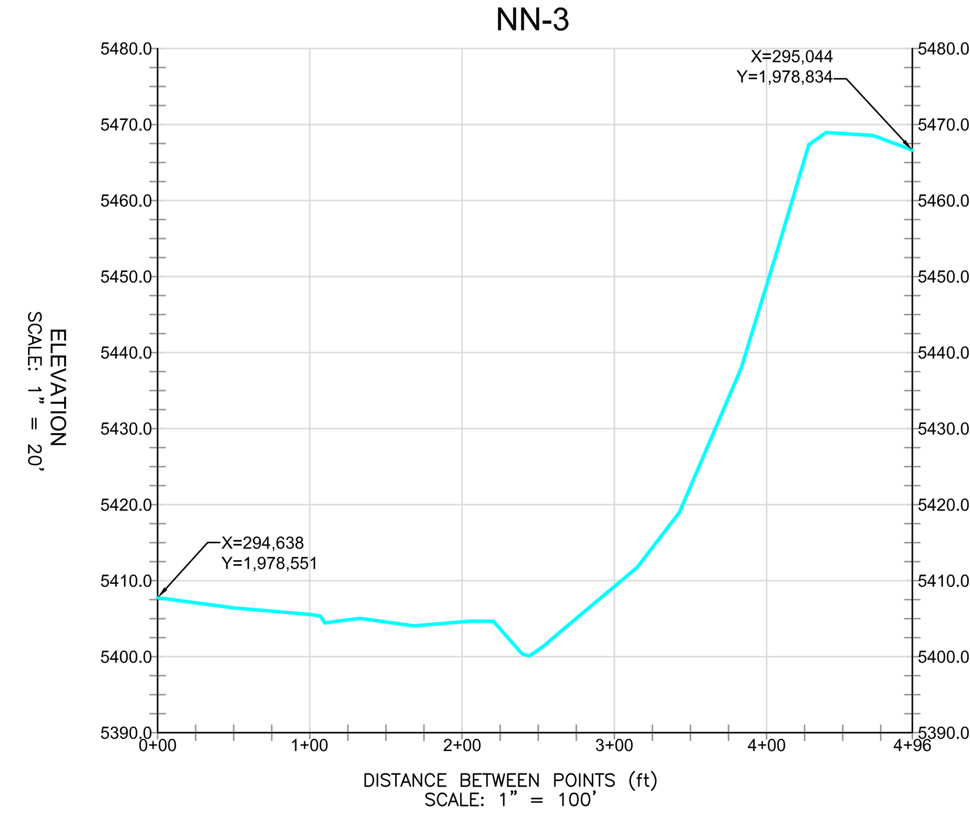
NN-4D (LOWEST)



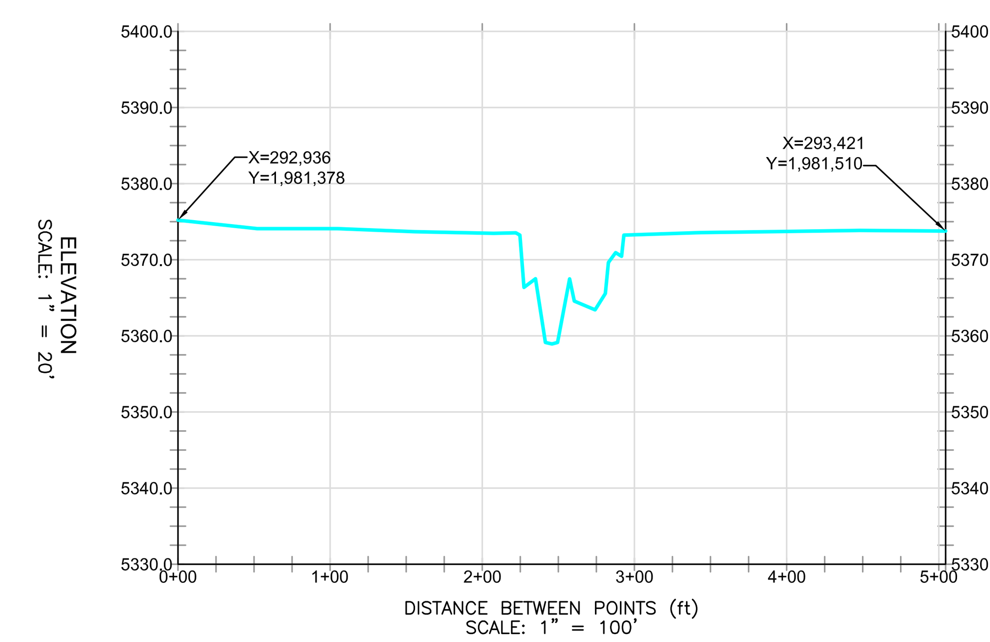
SECTIONS LOCATIONS AT NO NAME ARROYO NN-4 MONITORING STATIONS



NN-3



NN-2A (UPPER)



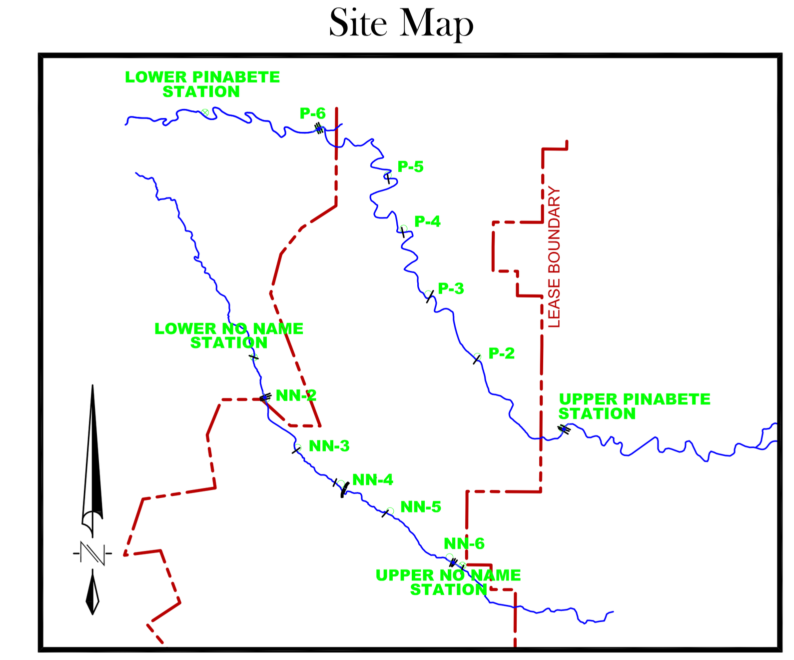
LEGEND

- 2008 SURVEYED SECTION
- 2007 SURVEYED SECTION
- 1998 SURVEYED SECTION

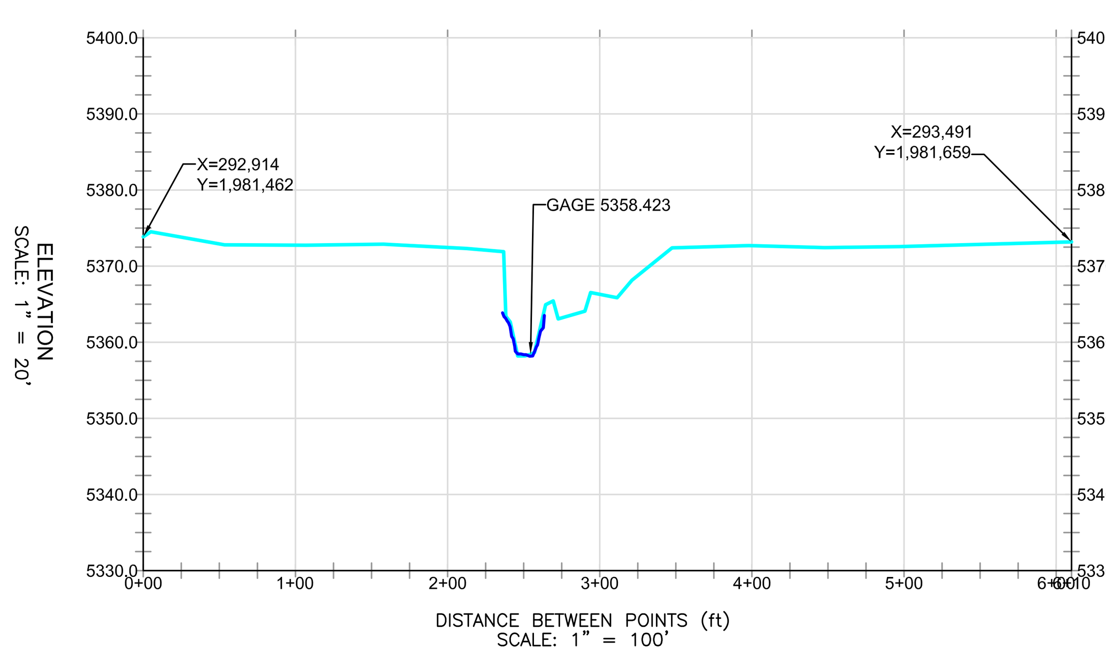
NOTES

- COORDINATE DATUM IS NEW MEXICO STATE PLANE NAD 27 FEET WEST ZONE
- CROSS SECTIONS LOOKING DOWNSTREAM

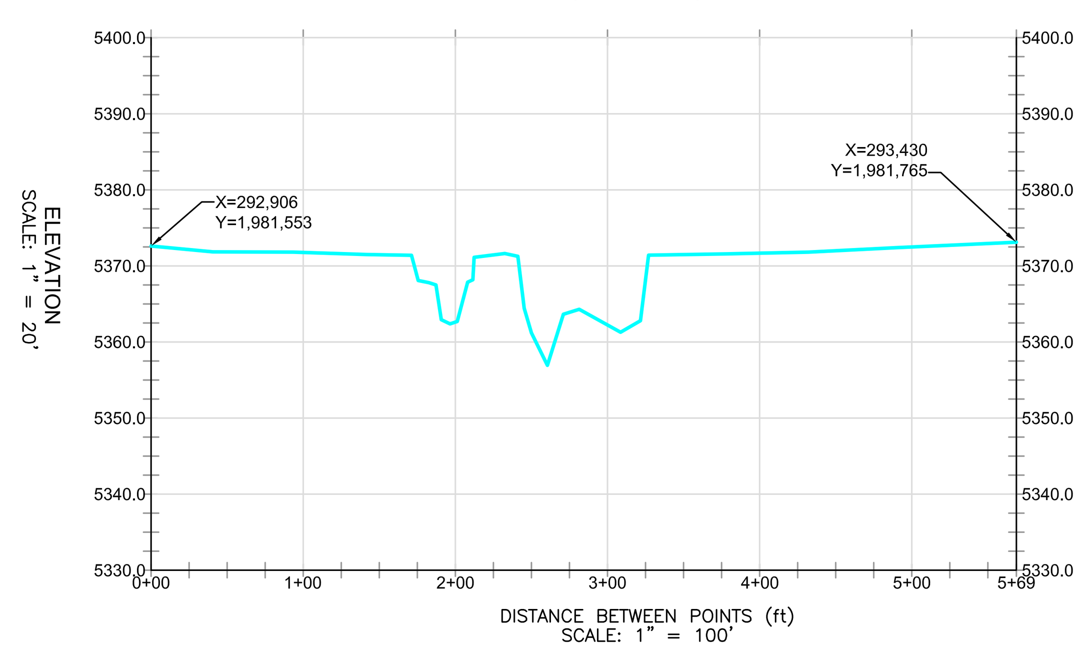
Site Map



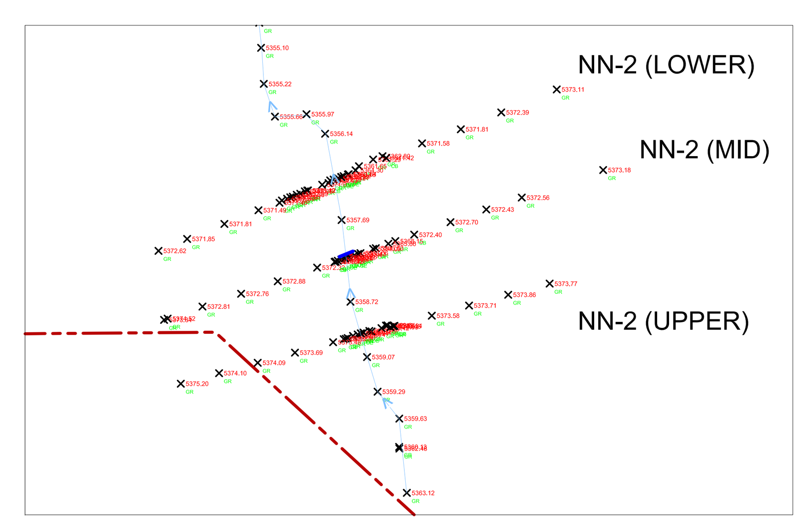
NN-2B (MID)



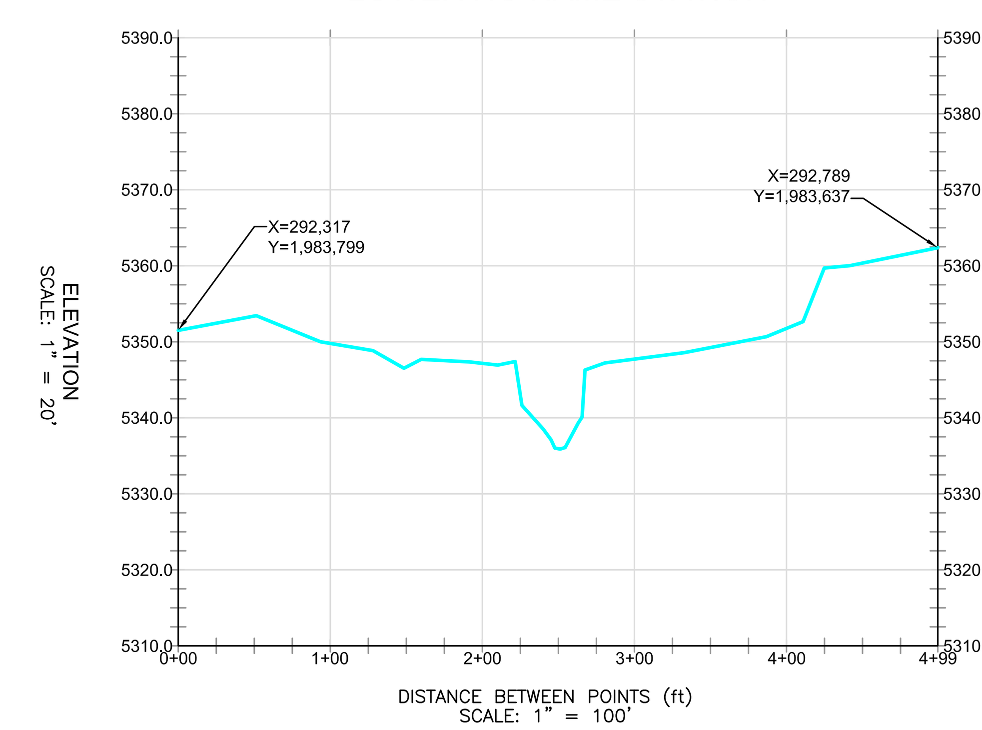
NN-2C (LOWER)



SECTIONS LOCATIONS AT NO NAME ARROYO NN-2 MONITORING STATIONS



LOWER NO NAME STATION



REV. No.	DATE	DRAFT BY	REVISION DESCRIPTION	PREP'D BY	E.G.	P.E.	APPROVED DATE
12-A	3/16/12	MPO	Submitted to OSM for Approval	CKA			

NORWEST

EXHIBIT 18.A-5

BHP NAVAJO COAL COMPANY

bhpbilliton

P.O. BOX 1717
FRUITLAND, NEW MEXICO 87416
PHONE(505)598-4200
Fax(505)598-4229

PINABETE PERMIT

NO NAME ARROYO CROSS SECTIONS

PREPARED BY	APO	DRAWN BY	JLS	SCALE:	AS SHOWN
APPROVED BY		DATE	Mar 16, 2012		

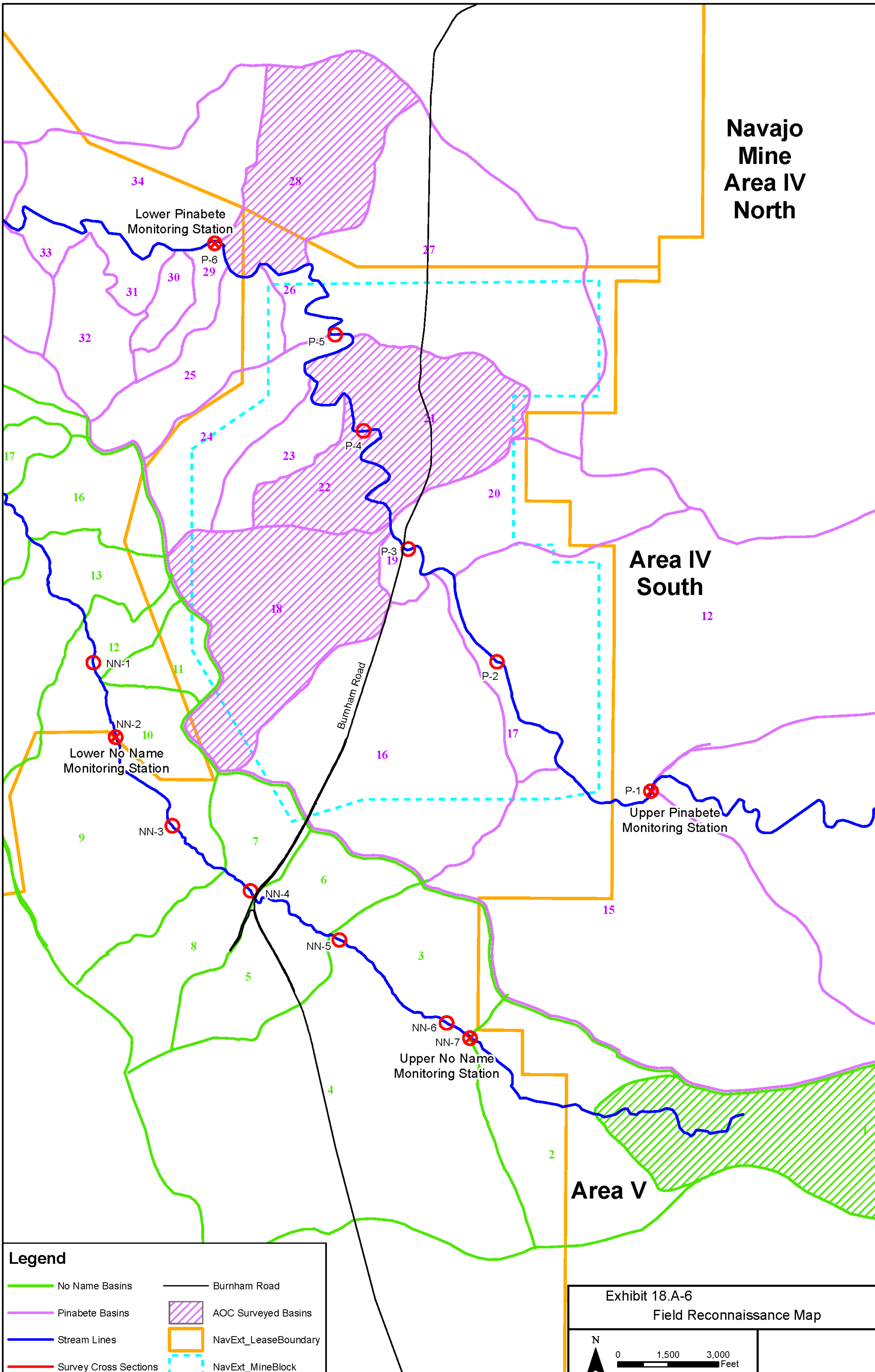


Exhibit 18.A-6
Field Reconnaissance Map

Appendix 18.B

SEDCAD™4 Modeling of Baseline Flood Flows and Sediment Yields

APPENDIX 18.B

SEDCAD™4 MODELING OF BASELINE FLOOD FLOWS AND SEDIMENT YIELDS

TABLE OF CONTENTS

APPENDIX 18.B

SEDCAD™4 MODELING OF BASELINE FLOOD FLOWS AND SEDIMENT YIELDS

LIST OF TABLES

APPENDIX 18.B

SEDCAD™4 MODELING OF BASELINE FLOOD FLOWS AND SEDIMENT YIELDS

LIST OF EXHIBITS

APPENDIX 18.B

SEDCAD™4 MODELING OF BASELINE FLOOD FLOWS AND SEDIMENT YIELDS

LIST OF ATTACHMENTS

SEDCAD™4 MODELING OF BASELINE FLOOD FLOWS AND SEDIMENT YIELDS

The SEDCAD™4 (SEDCAD) hydrology model has been used to determine flood flows and sediment yields for the pre-mine baseline watersheds of Pinabete Arroyo, No Name Arroyo, and Cottonwood Arroyos. Application of the SEDCAD program involves subdividing the drainage area into subwatersheds. Designation of subwatersheds with relatively uniform soil and vegetation characteristics helps in the estimation of model parameters required by SEDCAD. Information is required for physical structures located along the channel that may affect flow and sediment routing within the stream channels. SEDCAD null structures are also established at appropriate locations along the channel network where flow and sedimentology predictions are needed.

The SEDCAD input parameters and output results for the 6-hour rainfall event at the 2-year, 10-year, 25-year, 50-year, and 100-year frequencies and the 10-year 24-hour (10yr-24hr) precipitation event for Pinabete Arroyo is provided as Attachment 18.B-1 to this appendix. There are two models for pre-mine conditions on No Name Arroyo. The Burnham Road crosses No Name Arroyo in Area 4 South. The road embankment created the No Name Impoundment. As discussed in Section 18 (Water Resources), this impoundment has been used as a livestock pond. As part of this baseline evaluation, two SEDCAD models were developed for No Name Arroyo, one with the impoundment is provided as Attachment 18.B-2 and one without the impoundment is provided as Attachment 18.B-3. These attachments include the SEDCAD results for the 6-hour rainfall event at the 2-year, 10-year, 25-year, 50-year, and 100-year frequencies and the 10yr-24hr precipitation event. The No Name Arroyo model with the impoundment reflects current existing baseline conditions. The SEDCAD input parameters and output results are provided in Attachment 18.B-4 to this appendix for Cottonwood Arroyo and in Attachment 18.B-5 to this appendix for the Unnamed Tributary to Chaco River. The results for the 6-hour rainfall event at the 2-year, 10-year, 25-year, and 100-year frequencies are provided in these Appendices.

Soil erosion by water for a specific watershed is usually calculated using the well known empirical Revised Universal Soil Loss Equation (RUSLE) (Renard et al. 1997) and is given by the following expression:

$$A = RKLSCP$$

A is the average soil loss per unit area, expressed in units selected for K and the time period specified by R. Normal English units are tons/acre/year.

R is the rainfall/runoff factor, which is the number of rainfall units for rainfall energy and runoff, plus the factor for runoff from snowmelt.

K is the soil erodibility factor, which is the rate of soil loss per unit of R for a given soil on a slope of 9% with slope length of 72.6 feet (22.1 meters).

L is the slope length factor, which is the ratio of soil loss from a defined slope length relative to that from a slope length of 72.6 feet (22.1 meters).

S is the slope steepness factor, which is the ratio of soil loss from a slope with a given steepness relative to that from a 9% slope.

C is the cover and management factor, which is the ratio of soil loss from an area with a known cover and management. And,

P is the supporting conservation practice factor.

SEDCAD requires these types of inputs be developed for each watershed being analyzed. To follow is a discussion on how the necessary parameter inputs were developed and calculated for the Pinabete Mine Plan.

Runoff Modeling

Subwatershed Designation and Slopes

The SEDCAD subwatershed designations and drainage configuration for the watersheds of interest are shown on Exhibit 18.B-1. The subwatershed information was developed using Carlson Civil Suite 2008, AutoCAD®, and ArcGIS® software. The base mapping used to develop these subwatersheds is a combination of 10-feet contoured aerial flight and digital elevation model (DEM) data. The DEM images were based on digital raster graphics, representing U.S. Geologic Survey (USGS) 7.5 minute topographic quadrangle maps (NMRGIS 2009 and USGS 2009). All DEM analysis was performed utilizing the Spatial Analyst extension for ArcGIS® on DEM images projected to the North American Datum of 1927- State Plane New Mexico West coordinate system and in standard units (feet) of measure.

A more detailed analysis was prepared for subwatesheds within the lease boundary because they will be influenced by mining and reclamation activities. The 11.5-square mile (sq mi) No Name Arroyo was divided into 19 subwatersheds. The 60.3-sq mi Pinabete Arroyo watershed was divided into 52 subwatersheds as shown on Exhibit 18.B-1. The 79.8-sq mi drainage of Cottonwood Arroyo was divided into 113 subwatersheds (Exhibit 18.B-1). Subwatershed parameters required by the SEDCAD program were determined as described below. The unnamed tributary to the Chaco River having a watershed area of only 0.45 sq mi was divided into one subwatershed (Exhibit 18.B-1).

Time of Concentration

The time of concentration for each subwatershed was calculated by the SEDCAD program from the length and slope of the longest flow path that was input from the topographic map using AutoCAD® software.

Rainfall Duration, Frequency, and Distribution

For evaluation purposes, peak flows were estimated for the 6-hour rainfall event at the 2-year, 10-year, 25-year, 50-year, and 100-year frequencies and the 10yr-24hr storm event. Storm precipitation values provided in Section 18 (Water Resources) for the various return periods were obtained from the National Oceanic and Atmospheric Administration (NOAA) online frequency estimates (Bonnin et al. 2006) for the location of Area 4 South from Atlas 14, New Mexico to represent precipitation conditions within the Cottonwood Arroyo, No Name Arroyo and Pinabete Arroyo watersheds. A Soil Conservation Service (SCS) Type II-70 rainfall distribution was applied to all storms, which is consistent with the rainfall distribution used by Navajo Mine.

Curve Number

Hydrologic group for the various soil types within each watershed was obtained from the Soil Survey of San Juan County, Eastern Part (Keetch 1980) for lands outside the BNCC lease area and from the baseline soils study (Section 14, Soil) for lands inside the BNCC lease area. These soil surveys classified soil types into four hydrologic group ratings: A, B, C, and D. Runoff curve numbers were developed from the "SEDCAD™4 User Manual" and software (Warner et al. 1998) and from SCS Engineering Division Technical Release Urban Hydrology for Small Watersheds, Table 2-2d, page 2-8, "Runoff curve numbers for arid and semiarid rangelands" (USDA 1986), for each hydrologic soil group assuming a land use/condition between "Herbaceous" and "Desert Shrub" each with a poor cover condition. From this information, runoff curve numbers were derived for each of the four surface texture types. The curve numbers derived for each texture type are summarized in Table 18.B-1. The runoff curve number for a subwatershed was calculated as a weighted average based on the overall surface texture proportions determined for that watershed.

Hydrologic Response Class

A medium hydrologic response class was applied to all subwatersheds. The hydrologic response class determines the shape of the unit hydrograph used in the SEDCAD model. The medium class is typical of agricultural and semiarid rangeland conditions and was determined to be representative of site conditions.

Sedimentology Evaluation

The SEDCAD sedimentology analysis relies on a rainfall factor, erodible particle size data, a soil's erodibility factor, the watershed's topography and the resulting distance of overland flow, cover values and cultural practices at the site. Data for all of these parameters are entered for each subwatershed within the model.

Erodible Particle Size Distributions

BHP Navajo Coal Company (BNCC) obtained information about soils within and adjacent to the Pinabete Mine Plan permit area (permit area) as part of the rigorous baseline soils investigation. This information came from site-specific studies (Section 14, Soil) and regional soil survey data (Keetch 1980). Soil mapping units were categorized into four surface textures to provide a basis for developing values for sedimentology parameters used in the SEDCAD model. These surface texture classes included: fine, fine loamy, coarse loamy, and sandy. ArcGIS® software was used to overlay the pre-mine subwatersheds with the baseline soils information to produce a database file that contained the areas corresponding to each soil type within each subwatershed. Textures were linked to the soil types, and an evaluation of the percentage of each texture within each watershed was calculated as a function of area. This surface texture distribution was used to calculate the remaining factors needed for SEDCAD modeling.

Erodible particle size distributions (EPSD) were developed for each of the four surface texture classes in a study conducted by Dr. Richard Warner of the Biosystems and Agricultural Engineering Department at the University of Kentucky (Attachment 18.B-6). The SEDCAD modeling software has a maximum of 20 ESPD per watershed model. For some watershed models, there were more subwatersheds than the number of ESPDs allowed by SEDCAD. In these cases, average or representative EPSDs were used. This data was entered into the model, and the specific particle size distribution referenced for each structure. These particle size distributions are specific to each watershed model and are uniquely numbered. Due to formatting difficulties with the SEDCAD output, BNCC has reproduced the particle size distributions for the major model runs in supplemental tables to completely document the assumptions incorporated by the sedimentology analysis. Twenty particle size distributions were utilized to represent Pinabete Arroyo subwatershed conditions as summarized on Table 18.B-2. The 15 particle size distributions for No Name Arroyo are summarized on Table 18.B-3. The five 5 particle size distributions for tributaries to Cottonwood Arroyo are summarized on Table 18.B-4.

Erodibiltiy Factor (K)

The RUSLE K-factor is a measure of a soil's resistance to erosive powers of rainfall energy and runoff. Practically, soil erodibility is an integration of the impacts of rainfall and runoff on soil loss for a given soil. Experimentally, soil loss erodibility is the soil loss per unit rainfall index on a standard erosion plot. K-factor can be obtained through three different sources: published data, the Wischmeier nomograph developed from data collected on 55 different Midwestern USA agricultural soils, or the analytical approximation of the Wischmeier nomograph (Renard et al. 1997). Inter-Mountain Labs (IML) determined the K-factor for the four soil texture types using the analytical approximation of the Wischmeier nomograph, which is given by the following relationship:

$$K = \frac{2.1 \times 10^{-4}(12 - OM)M^{1.14} + 3.25(S_1 - 2) + 2.5(P_1 - 3)}{100}$$

K is the soil erodibility factor in tons per acre per unit rainfall index (ton/ac/unit rainfall)

Unit rainfall index is in hundreds of feet · tons-force · inches per hour (100s ft tonsf in/hr)

OM is the percentage organic matter,

P_1 is the permeability index (1 to 4),

S_1 is the soil structure index (1 to 6)

M is a parameter that depends on the parent particle size distribution and is given by the following and is valid for values of $\%MS + \%VFS$ less than 70:

$$M = (\%MS + \%VFS)(100 - \%CL)$$

$\%CL$ is percentage clay (size < 0.002 mm in diameter),

$\%MS$ is percentage silt (0.002 – 0.05 mm) and

$\%VFS$ is percentage very fine sand (0.05 – 0.1 mm).

The percentages clay, silt, and very fine sand are obtained directly from the parent particle size distribution, using American Society for Testing and Materials (ASTM) D422 – “Standard Test Method for Particle-Size Analysis of Soils” (ASTM 2000). The percentage of organic matter (*OM*) was determined using the Wakley-Black (WB) method (Nelson and Sommers 1982). IML also determined *OM* using the loss on ignition (LOI) described by Nelson and Sommers (1996). The results of these analyses are provided in Attachment 18.B-7. The K-factors for each texture type are summarized in Table 18.B-1. The K-factor for a subwatershed was then calculated as a weighted average based on overall the surface texture distribution determined for that watershed.

Cover Factor (C)

Representative vegetative cover and surface cover information was derived for each of the EPSD texture classes from baseline vegetation surveys (Section 15, Vegetation). This information was integrated with the EPSD texture class information using ArcGIS® to generate canopy cover and surface cover values for each of the four soil textures. Between 104 and 131 transects were used to determine the mean percent total vegetative cover (canopy cover) and mean percent surface cover for each of the four EPSD texture classes. The canopy cover and surface cover derived for each texture type are summarized in Table 18.B-1. The canopy cover versus surface cover tables for rangeland contained within SEDCAD were expanded through linear interpolation to provide cover factors for subwatersheds based on the surface texture distribution. The average cover values were calculated for subwatersheds as a weighted average based on area. These values were used to determine the cover factor through interpolation in Table 18.B-1.

Results

The results of the hydrology and sedimentology models for each of the watersheds are provided as attachments. Each attachment contains the summary output from SEDCAD including: storm information, structure networking, structure routing details, EPSD for each structure, subwatershed hydrology details, subwatershed sedimentology details, subwatershed time of concentration details, subwatershed Muskingum routing details. The subwatershed structure networking is shown on Exhibit 18.B-1. The attachments also contain structure summaries for the following storm events: 10-year 24-hour (10yr-24hr), 2yr-6hr, 10yr-6hr, 25yr-6hr, 50yr-6hr, and 100yr-6hr.

The Pinabete Arroyo summary is presented in Attachment 18.B-1. The No Name Arroyo summary without the impoundment is presented in Attachment 18.B-3. The summary for No Name Arroyo with the impoundment, the current baseline condition, is presented in Attachment 18.B-2. The Cottonwood Arroyo results are presented in Attachment 18.B-4. The summary for Chaco River unnamed tributary is presented in Attachment 18.B-5.

Peak flows and sediment yields calculated from the aforementioned SEDCAD models for the 6-hour rainfall events on 2-year, 10-year, 25-year and 100-year frequencies are reported in Section 18.1 (Surface Water Resources) for each of the surface water monitoring stations on Pinabete and No Name Arroyos, for the South Fork of Cottonwood Arroyo, Cottonwood Arroyo at monitoring station CNS-1, Cottonwood Arroyo at the confluence and the unnamed tributaries to Chaco just downstream of the permit boundary.

Personnel

Persons or organizations responsible for data collection, analysis, and preparation of this appendix:

Kent Applegate
Daphne Place
Leonard Raymond
Matt Owens
BHP Navajo Coal Company

Dr. Richard Warner
University of Kentucky

Norwest Corporation
Denver, CO

Inter-Mountain Labs, Inc.
Sheridan, WY

References

American Society for Testing and Materials (ASTM). 2000. Standard Test Method for Particle-size Analysis of Soils. D 422–63 (1998). 2000 Annual Book of ASTM Standards 04.08:10–17., American Society for Testing and Materials, Philadelphia, Pennsylvania.

Bonnin, G. M., D. Martin, B. Lin, T. Parzybok, M. Yekta, and D. Riley. 2006. Precipitation-Frequency Atlas of the United States. NOAA Atlas 14, Volume 1, Version 4. National Weather Service, Silver Spring, Maryland.

Keetch, C. Wesley. 1980. Soil Survey of San Juan County, New Mexico, Eastern Part. United States Department of Agriculture, Soil Conservation Service, Washington, D.C.

Nelson, D. W. and L. E. Sommers. 1982. Total Carbon, Organic Carbon and Organic Matter. In Methods of Soil Analysis: Part 2 Chemical and Microbiological Properties edited by A. L. Page et al., pp. 539-579. ASA Monograph Number 9.American Society of Agronomy, Madison, Wisconsin.

Nelson, D.W., and L.E. Sommers. 1996. Total Carbon, Organic Carbon, and Organic Matter. In *Methods of Soil Analysis: Part 3. Chemical Methods*, edited by D.L. Sparks, A.L. Page, P.A. Helmke, R.H. Loeppert, P.N. Soltanpour, M.A. Tabatabai, C.T. Johnson, and M.E. Sumner. pp. 961-1010. SSSA Book Series No. 5. Soil Science Society of America and American Society of Agronomy, Madison, Wisconsin.

New Mexico Resource Geographic Information System (NMRGIS). 2009. RGIS ftp site. http://rgis.unm.edu/loader_div.cfm?theme=Elevation (verified 18 Mar 2009). New Mexico Resource Geographic Information System (NMGIS), Earth Data Analysis Center, Albuquerque, New Mexico.

Renard, K.G., G.R. Foster, G.A. Weesies, D.K. McCool, D.C. and Yoder (coordinators). 1997. Predicting Soil Erosion by Water: A Guide to Conservation Planning with the Revised Soil Loss Equation (RUSLE). Agriculture Handbook No. 703. U.S. Dept. of Agriculture, Washington, D.C.

U.S. Dept. of Agriculture (USDA). 1986. Urban Hydrology for Small Watersheds. Technical Release 55. U.S. Department of Agriculture, Soils Conservation Service (SCS). Washington, D.C.

United States Geological Survey (USGS). 2009. The National Map Seamless Server. http://seamless.usgs.gov (verified 18 Mar 2009). United States Department of the Interior- United States Geologic Survey. Reston, Virginia.

Warner, R.C., P.J. Schwab, and D.J. Marshall. 1998. SEDCAD™ 4 for Windows 95/98/NT/2000/Me/XP Design Manual and User’s Guide. Civil Software Design, Lexington, Kentucky.

Table 18.B-1 SEDCAD™ Model Input Factors Based on Erodible Particle Size Distribution Texture Class

EPSD texture	K-factor	Run-off curve number	Canopy cover	Surface cover
Fine	0.20	93.0	4.7	30.8
Fine loamy	0.27	92.4	9.2	18.1
Coarse loamy	0.10	81.9	14.5	7.9
Sandy	0.20	65.6	13.9	1.6

Table 18.B-2 Pinabete Arroyo SEDCAD™ Model Erodible Particle Size Distribution Input

EPSD Designation / Diameter (mm)	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10
0.450	100.000	100.000	100.000	100.000	100.000	100.000	100.000	100.000	100.000	100.000
0.250	85.529	83.954	83.494	79.684	74.336	71.800	68.824	73.040	66.130	59.234
0.150	72.267	70.070	68.714	64.718	55.514	53.158	47.671	50.320	47.750	40.272
0.075	58.134	56.187	54.477	51.673	42.977	40.816	35.579	35.798	36.084	33.795
0.01585	49.962	48.376	46.844	44.689	37.721	35.600	31.445	31.104	31.122	31.492
0.01000	38.953	37.808	36.471	35.083	30.403	28.065	25.380	24.310	23.407	28.022
0.005012	9.675	9.683	9.177	10.018	9.205	9.529	8.929	6.708	10.343	13.538
0.001995	6.279	6.204	5.875	6.237	5.303	5.591	4.938	3.770	6.209	7.108
0.001000	6.010	5.917	5.567	5.908	4.905	5.155	4.462	3.276	5.698	6.676
0.000398	4.942	4.914	4.659	5.035	4.387	4.686	4.216	3.184	5.329	6.156

Note: Values reported as percent of sample passing through sieve with corresponding diameter
EPSD- erodible particle size distribution

Table 18.B-2 (Continued)

EPSD Designation Diameter (mm)	P11	P12	P13	P14	P15	P16	P17	P18	P19	P20
0.450	100.000	100.000	100.000	100.000	100.000	100.000	100.000	100.000	100.000	100.000
0.250	71.599	65.531	66.688	69.479	71.446	76.546	69.115	68.866	61.049	69.805
0.150	57.036	45.088	46.416	50.980	55.482	60.175	48.743	45.562	42.198	50.039
0.075	47.507	34.380	34.657	38.320	44.594	46.743	36.650	33.437	33.563	36.737
0.01585	42.049	30.640	30.363	32.920	39.040	40.133	32.221	30.098	30.211	31.517
0.01000	34.448	25.007	23.816	24.755	31.086	30.717	25.703	25.355	24.943	23.611
0.005012	12.666	10.180	9.557	9.532	11.375	9.459	9.189	8.126	12.221	8.675
0.001995	7.405	5.608	5.458	5.794	6.757	5.929	5.194	4.149	6.769	5.233
0.001000	7.069	5.126	4.956	5.304	6.368	5.532	4.723	3.674	6.286	4.726
0.000398	6.144	4.829	4.693	4.918	5.635	4.866	4.420	3.561	5.868	4.456

Note: Values reported as percent of sample passing through sieve with corresponding diameter
EPSD- erodible particle size distribution

Table 18.B-3 No Name Arroyo SEDCAD™ Model Erodible Particle Size Distribution Input

EPSD Designation Diameter (mm)	N1	N2	N3	N4	N5	N6	N7	N8	N9	N10
0.450	100.000	100.000	100.000	100.000	100.000	100.000	100.000	100.000	100.000	100.000
0.250	67.238	70.939	74.655	74.155	77.281	75.578	77.393	77.993	77.038	78.922
0.150	49.361	52.171	54.870	54.074	57.254	54.286	57.877	59.294	57.936	60.447
0.075	37.563	37.728	38.718	39.358	43.405	40.591	43.197	45.545	44.741	46.776
0.01585	32.342	31.597	32.157	33.572	37.974	35.722	37.191	39.656	39.265	40.830
0.01000	24.314	22.169	22.246	25.073	30.556	29.049	28.724	31.575	31.827	32.779
0.005012	10.387	8.316	6.741	7.496	7.842	7.567	7.539	8.344	8.573	8.418
0.001995	6.291	5.386	4.536	4.624	4.493	4.182	4.580	4.932	4.921	4.949
0.001000	5.795	4.854	4.004	4.140	4.097	3.764	4.153	4.551	4.545	4.587
0.000398	5.371	4.575	3.806	3.867	3.665	3.448	3.748	4.009	4.014	3.998

Note: Values reported as percent of sample passing through sieve with corresponding diameter
EPSD- erodible particle size distribution

Table 18.B-3 (Continued)

EPSD Designation Diameter (mm)	N11	N12	N13	N14	N15
0.450	100.000	100.000	100.000	100.000	100.000
0.250	76.892	78.922	76.672	68.115	77.333
0.150	57.043	60.447	56.704	49.351	57.313
0.075	43.798	46.776	42.929	37.400	44.056
0.01585	38.581	40.830	37.514	32.436	38.895
0.01000	31.549	32.779	30.059	24.922	32.007
0.005012	8.280	8.418	7.941	9.925	8.186
0.001995	4.655	4.949	4.571	5.882	4.556
0.001000	4.275	4.587	4.167	5.396	4.184
0.000398	3.798	3.998	3.743	5.013	3.706

Note: Values reported as percent of sample passing through sieve with corresponding diameter
EPSD- erodible particle size distribution

Table 18.B-4 Cottonwood Arroyo Unnamed Tributary SEDCAD™ Model Erodible Particle Size Distribution Input

EPSD Designation	CW1	CW2	CW3	CW4	CW5
Diameter (mm)					
0.450	100.000	100.000	100.000	100.000	100.000
0.250	71.002	79.759	73.724	79.290	83.334
0.150	52.517	62.156	54.007	60.839	68.417
0.075	40.991	48.658	41.754	47.304	53.993
0.01585	36.096	42.458	36.968	41.409	46.327
0.01000	29.101	34.107	30.394	33.504	35.855
0.005012	10.110	8.789	9.084	8.485	9.027
0.001995	5.803	5.220	5.060	4.944	5.817
0.001000	5.384	4.878	4.663	4.594	5.499
0.000398	4.868	4.198	4.196	3.982	4.619

Note: Values reported as percent of sample passing through sieve with corresponding diameter
EPSD- erodible particle size distribution

Attachment 18.B-1

Pinabete Arroyo Baseline Hydrology and Sedimentology SEDCAD™ Model Output

Copyright 1998 -2007 Pamela J. Schwab

General Information

Storm Information:

Storm Type:	Type II-70
Design Storm:	10 yr - 24 hr
Rainfall Depth:	1.700 inches

Copyright 1998 -2007 Pamela J. Schwab

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Null	#1	==>	#2	1.674	0.331	
Null	#2	==>	#5	4.188	0.295	
Null	#3	==>	#4	1.961	0.319	
Null	#4	==>	#5	3.103	0.304	
Null	#5	==>	#6	1.300	0.273	
Null	#6	==>	#7	0.995	0.281	EAST LEASE BNDY
Null	#7	==>	#8	2.793	0.277	
Null	#8	==>	#9	2.630	0.259	WEST LEASE BNDY
Null	#9	==>	End	0.000	0.000	

Structure Routing Details:

Stru #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	8. Large gullies, diversions, and low flowing streams	1.24	250.00	20,136.00	3.34	1.674
#1	**Muskingum K:**					**1.674**
#2	8. Large gullies, diversions, and low flowing streams	0.67	245.00	36,791.00	2.44	4.188
#2	**Muskingum K:**					**4.188**

Stru #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#3	8. Large gullies, diversions, and low flowing streams	0.99	210.00	21,118.00	2.99	1.961
#3	**Muskingum K:**					**1.961**
#4	8. Large gullies, diversions, and low flowing streams	0.77	227.00	29,388.00	2.63	3.103
#4	**Muskingum K:**					**3.103**
#5	8. Large gullies, diversions, and low flowing streams	0.47	45.00	9,601.00	2.05	1.300
#5	**Muskingum K:**					**1.300**
#6	8. Large gullies, diversions, and low flowing streams	0.54	42.00	7,845.00	2.19	0.995
#6	**Muskingum K:**					**0.995**
#7	8. Large gullies, diversions, and low flowing streams	0.49	105.00	21,218.00	2.11	2.793
#7	**Muskingum K:**					**2.793**
#8	8. Large gullies, diversions, and low flowing streams	0.37	64.00	17,238.00	1.82	2.630
#8	**Muskingum K:**					**2.630**

Copyright 1998 -2007 Pamela J. Schwab

Particle Size Distribution(s) at Each Structure

Structure #3:

Size (mm)	In/Out
0.4250	100.000%
0.2500	100.000%
0.1500	99.259%
0.0750	91.911%
0.0159	88.676%
0.0100	74.957%
0.0050	29.096%
0.0020	16.176%
0.0010	14.669%
0.0004	13.838%

Structure #4:

Size (mm)	In/Out
0.4250	100.000%
0.2500	100.000%
0.1500	100.000%
0.0750	97.132%
0.0159	92.310%
0.0100	80.309%
0.0050	32.210%
0.0020	18.271%
0.0010	16.676%
0.0004	15.488%

Structure #1:

Size (mm)	In/Out
0.4250	100.000%
0.2500	100.000%
0.1500	100.000%
0.0750	99.764%
0.0159	92.546%

Copyright 1998 -2007 Pamela J. Schwab

Size (mm)	In/Out
0.0100	78.308%
0.0050	26.859%
0.0020	15.680%
0.0010	14.425%
0.0004	13.154%

Structure #2:

Size (mm)	In/Out
0.4250	100.000%
0.2500	100.000%
0.1500	100.000%
0.0750	100.000%
0.0159	96.270%
0.0100	86.845%
0.0050	31.346%
0.0020	18.868%
0.0010	17.610%
0.0004	15.515%

Structure #5:

Size (mm)	In/Out
0.4250	100.000%
0.2500	100.000%
0.1500	100.000%
0.0750	98.899%
0.0159	97.137%
0.0100	86.893%
0.0050	30.817%
0.0020	18.355%
0.0010	17.054%
0.0004	15.188%

Structure #6 (EAST LEASE BNDY):

Size (mm)	In/Out
0.4250	100.000%
0.2500	100.000%
0.1500	100.000%
0.0750	100.000%
0.0159	100.000%
0.0100	98.333%

Size (mm)	In/Out
0.0050	35.089%
0.0020	20.966%
0.0010	19.497%
0.0004	17.329%

Structure #7:

Size (mm)	In/Out
0.4250	100.000%
0.2500	100.000%
0.1500	100.000%
0.0750	100.000%
0.0159	99.658%
0.0100	99.268%
0.0050	36.673%
0.0020	21.873%
0.0010	20.339%
0.0004	18.093%

Structure #8 (WEST LEASE BNDY):

Size (mm)	In/Out
0.4250	100.000%
0.2500	100.000%
0.1500	99.583%
0.0750	97.493%
0.0159	96.053%
0.0100	93.300%
0.0050	41.006%
0.0020	24.427%
0.0010	22.693%
0.0004	20.240%

Structure #9:

Size (mm)	In/Out
0.4250	100.000%
0.2500	100.000%
0.1500	100.000%
0.0750	97.786%
0.0159	95.993%
0.0100	93.435%
0.0050	41.510%

Copyright 1998 -2007 Pamela J. Schwab

Size (mm)	In/Out
0.0020	24.717%
0.0010	22.955%
0.0004	20.486%

Copyright 1998 -2007 Pamela J. Schwab

Structure Detail:

Structure #3 (Null)

Structure #4 (Null)

Structure #1 (Null)

Structure #2 (Null)

Structure #5 (Null)

Structure #6 (Null)

EAST LEASE BNDY

Structure #7 (Null)

Structure #8 (Null)

WEST LEASE BNDY

Structure #9 (Null)

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#3	1	791.300	1.145	1.181	0.350	80.800	M	137.26	21.870
	2	1,079.100	0.915	0.596	0.351	80.800	M	223.54	29.835
	3	450.300	0.571	0.319	0.355	81.300	M	138.88	12.992
	4	742.600	0.625	0.000	0.000	78.500	M	162.13	16.799
	5	915.400	1.119	0.000	0.000	78.800	M	131.60	21.280
	Σ	**3,978.700**						**440.83**	**102.777**
#4	1	546.400	0.726	1.710	0.319	81.700	M	147.20	16.285
	2	441.200	0.503	1.429	0.318	86.000	M	224.45	18.445
	3	889.400	0.815	0.998	0.318	82.100	M	228.19	27.379
	4	1,339.100	0.919	0.000	0.000	84.000	M	373.16	47.965
	Σ	**7,194.800**						**603.73**	**212.850**
#1	1	1,242.300	1.349	1.345	0.354	80.800	M	188.55	34.327
	2	1,662.000	1.465	0.849	0.360	80.300	M	224.08	44.015
	3	1,434.000	1.573	1.241	0.357	81.100	M	197.43	40.634
	4	842.700	1.102	0.977	0.364	81.000	M	153.76	23.683
	5	676.100	1.067	1.113	0.365	81.600	M	134.22	19.974
	6	1,223.200	0.778	0.596	0.352	81.800	M	315.94	36.750
	7	743.100	0.745	0.530	0.354	83.600	M	233.83	25.797
	8	654.500	0.801	0.000	0.000	92.200	M	397.48	42.811
	Σ	**8,477.900**						**932.74**	**267.991**
#2	1	609.500	0.668	1.219	0.340	85.700	M	249.70	24.903
	2	537.100	0.610	1.436	0.329	91.600	M	374.99	33.711
	3	455.000	0.546	1.288	0.324	82.000	M	154.39	13.898
	4	627.000	0.634	0.852	0.324	87.900	M	320.25	30.151
	5	653.100	0.452	0.453	0.315	91.200	M	527.57	39.848
	6	957.200	0.984	0.000	0.000	89.600	M	407.82	52.057
	Σ	**12,316.800**						**1,096.38**	**462.559**
#5	1	763.100	0.682	3.507	0.293	84.100	M	267.48	27.555
	2	983.300	1.117	2.231	0.289	89.200	M	367.53	51.945
	3	1,022.000	0.996	1.587	0.291	92.000	M	521.33	65.927
	4	688.700	1.908	1.255	0.291	80.800	M	78.28	19.028
	5	754.300	2.307	1.084	0.287	86.200	M	119.98	31.953
	6	628.400	0.538	0.595	0.301	93.000	M	524.05	43.517
	7	654.500	0.560	0.000	0.000	91.500	M	478.48	40.785
	Σ	**25,005.900**						**1,684.50**	**956.120**
#6	1	901.400	1.151	1.896	0.315	81.100	M	160.40	25.547
	2	1,011.200	1.871	0.166	0.287	83.500	M	151.23	34.801

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
	3	1,166.700	1.126	0.000	0.000	92.800	M	575.99	79.576
	Σ	**28,085.200**						**1,694.12**	**1,096.044**
#7	1	963.500	0.819	0.665	0.285	82.900	M	265.26	31.644
	2	1,513.200	2.587	0.000	0.000	75.000	M	69.93	24.541
	3	194.900	0.596	0.000	0.000	72.600	M	21.05	2.452
	Σ	**30,756.800**						**1,698.39**	**1,154.681**
#8	1	386.400	0.538	2.912	0.280	93.000	M	322.23	26.759
	2	569.700	0.734	2.659	0.279	92.400	M	373.20	37.816
	3	647.700	0.853	2.311	0.280	87.600	M	260.78	30.470
	4	754.800	1.690	2.328	0.277	76.200	M	57.58	13.788
	5	532.600	0.740	1.423	0.277	79.500	M	113.85	13.178
	6	309.700	0.436	1.168	0.285	85.600	M	166.21	12.570
	7	158.300	0.448	0.938	0.279	83.800	M	71.65	5.586
	8	304.300	0.648	0.566	0.296	80.600	M	80.17	8.278
	9	211.900	0.480	0.921	0.320	83.000	M	85.52	7.027
	10	711.200	0.890	0.436	0.300	83.300	M	190.68	24.108
	11	168.200	0.283	0.000	0.000	83.300	M	92.56	5.727
	Σ	**35,511.600**						**1,701.48**	**1,339.988**
#9	1	466.200	0.574	2.401	0.265	89.000	M	277.79	24.314
	2	427.200	0.633	2.204	0.256	84.900	M	169.55	16.405
	3	361.200	0.686	1.864	0.256	84.900	M	135.39	13.872
	4	573.300	0.655	0.983	0.255	85.800	M	240.22	23.605
	5	473.100	0.668	0.000	0.000	84.600	M	176.01	17.771
	Σ	**37,812.600**						**1,693.81**	**1,435.955**

Subwatershed Sedimentology Detail:

Stru #	SWS #	Soil K	L (ft)	S (%)	C	P	PS #	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc (ml/l)	24VW (ml/l)
#3	1	0.150	100.00	9.10	0.3050	1.0000	18	517.9	28,671	8.11	4.88
	2	0.181	100.00	10.10	0.3050	1.0000	13	1,178.3	48,541	17.28	10.19
	3	0.151	200.00	5.50	0.3050	1.0000	18	316.4	31,264	13.05	7.40
	4	0.183	130.00	7.60	0.3160	1.0000	12	550.1	42,933	16.42	9.09
	5	0.185	100.00	8.30	0.2760	1.0000	6	481.0	28,197	6.04	3.53
	Σ							**2,338.6**	**27,282**	**6.12**	**3.73**
#4	1	0.173	130.00	7.00	0.2850	1.0000	7	403.2	30,444	11.52	6.82
	2	0.148	100.00	12.00	0.2220	1.0000	5	682.7	44,554	17.59	10.60
	3	0.185	75.00	13.60	0.2740	1.0000	17	1,316.9	58,425	20.84	12.39

Stru #	SWS #	Soil K	L (ft)	S (%)	C	P	PS #	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc (ml/l)	24VW (ml/l)
	4	0.213	100.00	10.60	0.2330	1.0000	6	1,973.6	49,931	15.56	9.28
	Σ							**4,860.9**	**43,257**	**7.92**	**3.05**
#1	1	0.220	280.00	2.20	0.2960	1.0000	13	354.5	12,409	3.41	2.08
	2	0.202	240.00	3.30	0.2960	1.0000	13	568.5	15,494	3.87	2.36
	3	0.206	280.00	2.60	0.2960	1.0000	13	434.9	12,696	3.05	1.90
	4	0.188	200.00	5.10	0.2960	1.0000	13	527.8	27,112	8.72	5.22
	5	0.124	240.00	3.60	0.3130	1.0000	18	192.8	11,797	3.62	2.17
	6	0.178	130.00	7.90	0.2850	1.0000	7	1,127.3	38,034	13.98	8.19
	7	0.191	100.00	9.20	0.2540	1.0000	6	825.2	39,345	13.70	8.09
	8	0.199	75.00	15.10	0.1510	1.0000	2	1,562.1	42,372	11.59	7.24
	Σ							**4,565.8**	**34,225**	**6.95**	**2.52**
#2	1	0.188	130.00	7.30	0.2120	1.0000	5	578.5	28,165	9.86	5.93
	2	0.199	75.00	12.60	0.1510	1.0000	2	1,048.1	36,015	11.47	7.19
	3	0.200	100.00	8.60	0.2020	1.0000	11	346.9	31,127	9.19	5.37
	4	0.193	75.00	12.30	0.1730	1.0000	4	970.3	38,511	12.11	7.35
	5	0.187	75.00	14.00	0.1590	1.0000	3	1,581.0	46,771	17.49	10.75
	6	0.198	75.00	13.70	0.1680	1.0000	4	1,730.8	38,951	9.35	5.80
	Σ							**7,497.7**	**34,701**	**4.87**	**1.66**
#5	1	0.213	130.00	6.30	0.2330	1.0000	6	688.3	29,563	10.84	6.67
	2	0.209	130.00	7.10	0.1680	1.0000	4	930.8	20,627	4.23	2.68
	3	0.191	100.00	8.40	0.1500	1.0000	2	1,120.2	19,452	4.36	2.78
	4	0.235	200.00	4.90	0.2870	1.0000	9	373.4	22,778	4.39	2.78
	5	0.220	240.00	3.70	0.1900	1.0000	16	260.3	9,212	0.56	0.37
	6	0.200	130.00	7.30	0.1410	1.0000	1	847.6	22,769	7.65	4.77
	7	0.204	200.00	4.70	0.1560	1.0000	2	714.9	20,930	6.93	4.24
	Σ							**16,003.7**	**27,738**	**3.87**	**1.72**
#6	1	0.228	280.00	2.70	0.2870	1.0000	9	331.5	15,627	4.99	3.03
	2	0.226	280.00	2.40	0.2330	1.0000	6	276.0	9,268	1.14	0.72
	3	0.200	200.00	4.20	0.1460	1.0000	1	952.6	13,808	2.56	1.63
	Σ							**15,104.2**	**23,367**	**1.56**	**0.68**
#7	1	0.197	280.00	2.70	0.2330	1.0000	5	347.3	13,550	3.91	2.32
	2	0.204	420.00	1.80	0.3270	1.0000	19	163.4	7,759	0.31	0.20
	3	0.171	280.00	2.40	0.3380	1.0000	10	22.7	13,087	3.58	1.86
	Σ							**14,905.2**	**22,598**	**1.37**	**0.58**
#8	1	0.200	280.00	2.70	0.1410	1.0000	1	216.6	9,168	3.08	1.99
	2	0.204	280.00	2.30	0.1550	1.0000	3	277.0	8,371	2.60	1.67
	3	0.173	280.00	3.00	0.2220	1.0000	6	310.3	11,965	4.25	2.65
	4	0.204	280.00	3.00	0.3180	1.0000	19	144.3	12,459	1.51	0.93
	5	0.187	200.00	5.90	0.2960	1.0000	12	366.8	34,625	12.51	7.31

Stru #	SWS #	Soil K	L (ft)	S (%)	C	P	PS #	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc (ml/l)	24VW (ml/l)
	6	0.167	200.00	4.20	0.2740	1.0000	8	264.4	25,618	12.49	7.48
	7	0.215	100.00	9.40	0.2650	1.0000	20	219.1	48,298	23.28	13.69
	8	0.201	100.00	8.10	0.2960	1.0000	13	240.3	36,721	15.14	8.70
	9	0.208	280.00	2.70	0.2120	1.0000	15	76.1	13,686	5.07	2.94
	10	0.225	200.00	4.50	0.2540	1.0000	14	548.6	27,795	10.17	6.07
	11	0.198	100.00	9.20	0.2450	1.0000	6	210.9	47,825	22.37	12.48
	Σ							**14,698.1**	**47,845**	**4.55**	**0.79**
#9	1	0.206	130.00	7.80	0.1800	1.0000	16	600.7	28,616	11.28	7.10
	2	0.189	100.00	11.10	0.2450	1.0000	6	692.7	49,867	19.18	11.75
	3	0.177	100.00	8.30	0.2330	1.0000	6	310.5	26,790	9.96	6.07
	4	0.161	100.00	10.00	0.2220	1.0000	5	664.6	33,921	12.01	7.25
	5	0.175	200.00	5.90	0.2450	1.0000	6	428.6	29,984	11.21	6.57
	Σ							**15,678.9**	**32,341**	**3.04**	**0.79**

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	5. Nearly bare and untilled, and alluvial valley fans	2.99	22.00	736.00	1.720	0.118
		8. Large gullies, diversions, and low flowing streams	0.63	66.00	10,511.00	2.370	1.231
#1	**1**	**Time of Concentration:**					**1.349**
#1	2	5. Nearly bare and untilled, and alluvial valley fans	1.02	8.00	785.00	1.000	0.218
		8. Large gullies, diversions, and low flowing streams	1.48	242.00	16,353.00	3.640	1.247
#1	**2**	**Time of Concentration:**					**1.465**
#1	3	5. Nearly bare and untilled, and alluvial valley fans	0.88	10.00	1,136.10	0.930	0.339
		8. Large gullies, diversions, and low flowing streams	1.31	200.00	15,244.00	3.430	1.234
#1	**3**	**Time of Concentration:**					**1.573**
#1	4	5. Nearly bare and untilled, and alluvial valley fans	1.85	10.00	542.00	1.350	0.111
		8. Large gullies, diversions, and low flowing streams	1.62	220.00	13,595.00	3.810	0.991
#1	**4**	**Time of Concentration:**					**1.102**
#1	5	5. Nearly bare and untilled, and alluvial valley fans	1.23	10.00	812.00	1.100	0.205
		8. Large gullies, diversions, and low flowing streams	1.41	156.00	11,049.00	3.560	0.862
#1	**5**	**Time of Concentration:**					**1.067**
#1	6	5. Nearly bare and untilled, and alluvial valley fans	3.12	22.00	706.00	1.760	0.111

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
		8. Large gullies, diversions, and low flowing streams	2.85	346.00	12,152.00	5.060	0.667
#1	**6**	**Time of Concentration:**					**0.778**
#1	7	5. Nearly bare and untilled, and alluvial valley fans	4.66	43.00	922.01	2.150	0.119
		8. Large gullies, diversions, and low flowing streams	2.67	295.00	11,057.38	4.900	0.626
#1	**7**	**Time of Concentration:**					**0.745**
#1	8	5. Nearly bare and untilled, and alluvial valley fans	7.46	65.00	871.00	2.730	0.088
		8. Large gullies, diversions, and low flowing streams	2.61	324.00	12,433.00	4.840	0.713
#1	**8**	**Time of Concentration:**					**0.801**
#2	1	5. Nearly bare and untilled, and alluvial valley fans	6.24	30.00	481.00	2.490	0.053
		8. Large gullies, diversions, and low flowing streams	3.34	406.00	12,141.00	5.480	0.615
#2	**1**	**Time of Concentration:**					**0.668**
#2	2	5. Nearly bare and untilled, and alluvial valley fans	3.16	30.00	950.00	1.770	0.149
		8. Large gullies, diversions, and low flowing streams	4.22	432.00	10,229.00	6.160	0.461
#2	**2**	**Time of Concentration:**					**0.610**
#2	3	5. Nearly bare and untilled, and alluvial valley fans	2.65	10.00	378.00	1.620	0.064
		8. Large gullies, diversions, and low flowing streams	2.72	234.00	8,592.00	4.950	0.482
#2	**3**	**Time of Concentration:**					**0.546**
#2	4	5. Nearly bare and untilled, and alluvial valley fans	3.07	25.00	815.00	1.750	0.129
		8. Large gullies, diversions, and low flowing streams	3.32	330.00	9,931.00	5.460	0.505
#2	**4**	**Time of Concentration:**					**0.634**
#2	5	5. Nearly bare and untilled, and alluvial valley fans	7.45	45.00	604.00	2.720	0.061
		8. Large gullies, diversions, and low flowing streams	3.78	310.00	8,210.00	5.820	0.391
#2	**5**	**Time of Concentration:**					**0.452**
#2	6	5. Nearly bare and untilled, and alluvial valley fans	9.10	80.00	879.00	3.010	0.081
		8. Large gullies, diversions, and low flowing streams	2.32	344.00	14,831.00	4.560	0.903
#2	**6**	**Time of Concentration:**					**0.984**
#3	1	5. Nearly bare and untilled, and alluvial valley fans	1.29	15.00	1,163.00	1.130	0.285
		8. Large gullies, diversions, and low flowing streams	2.37	338.00	14,280.00	4.610	0.860
#3	**1**	**Time of Concentration:**					**1.145**
#3	2	5. Nearly bare and untilled, and alluvial valley fans	3.04	33.00	1,087.00	1.740	0.173

Copyright 1998 -2007 Pamela J. Schwab

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
		8. Large gullies, diversions, and low flowing streams	2.06	238.00	11,527.00	4.310	0.742
#3	**2**	**Time of Concentration:**					**0.915**
#3	3	5. Nearly bare and untilled, and alluvial valley fans	5.02	45.00	897.00	2.230	0.111
		8. Large gullies, diversions, and low flowing streams	3.09	270.00	8,741.00	5.270	0.460
#3	**3**	**Time of Concentration:**					**0.571**
#3	4	5. Nearly bare and untilled, and alluvial valley fans	7.41	28.00	378.00	2.720	0.038
		8. Large gullies, diversions, and low flowing streams	3.43	402.00	11,736.00	5.550	0.587
#3	**4**	**Time of Concentration:**					**0.625**
#3	5	5. Nearly bare and untilled, and alluvial valley fans	3.39	30.00	885.00	1.840	0.133
		8. Large gullies, diversions, and low flowing streams	2.58	442.00	17,121.00	4.820	0.986
#3	**5**	**Time of Concentration:**					**1.119**
#4	1	5. Nearly bare and untilled, and alluvial valley fans	3.59	62.00	1,729.00	1.890	0.254
		8. Large gullies, diversions, and low flowing streams	2.09	154.00	7,372.00	4.330	0.472
#4	**1**	**Time of Concentration:**					**0.726**
#4	2	5. Nearly bare and untilled, and alluvial valley fans	6.83	25.00	366.00	2.610	0.038
		8. Large gullies, diversions, and low flowing streams	2.36	182.00	7,708.00	4.600	0.465
#4	**2**	**Time of Concentration:**					**0.503**
#4	3	5. Nearly bare and untilled, and alluvial valley fans	19.03	47.00	247.00	4.360	0.015
		8. Large gullies, diversions, and low flowing streams	2.13	268.00	12,586.00	4.370	0.800
#4	**3**	**Time of Concentration:**					**0.815**
#4	4	5. Nearly bare and untilled, and alluvial valley fans	14.08	50.00	355.00	3.750	0.026
		8. Large gullies, diversions, and low flowing streams	2.46	372.00	15,119.00	4.700	0.893
#4	**4**	**Time of Concentration:**					**0.919**
#5	1	5. Nearly bare and untilled, and alluvial valley fans	12.55	65.00	518.00	3.540	0.040
		8. Large gullies, diversions, and low flowing streams	1.92	184.00	9,592.00	4.150	0.642
#5	**1**	**Time of Concentration:**					**0.682**
#5	2	5. Nearly bare and untilled, and alluvial valley fans	5.10	30.00	588.00	2.250	0.072
		8. Large gullies, diversions, and low flowing streams	1.77	266.00	15,016.00	3.990	1.045
#5	**2**	**Time of Concentration:**					**1.117**
#5	3	5. Nearly bare and untilled, and alluvial valley fans	1.90	20.00	1,050.00	1.380	0.211

Copyright 1998 -2007 Pamela J. Schwab

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
		8. Large gullies, diversions, and low flowing streams	2.19	274.00	12,532.00	4.430	0.785
#5	**3**	**Time of Concentration:**					**0.996**
#5	4	5. Nearly bare and untilled, and alluvial valley fans	2.78	32.00	1,152.00	1.660	0.192
		8. Large gullies, diversions, and low flowing streams	0.99	182.00	18,415.00	2.980	1.716
#5	**4**	**Time of Concentration:**					**1.908**
#5	5	5. Nearly bare and untilled, and alluvial valley fans	2.52	23.00	911.00	1.580	0.160
		8. Large gullies, diversions, and low flowing streams	1.07	256.00	23,965.00	3.100	2.147
#5	**5**	**Time of Concentration:**					**2.307**
#5	6	5. Nearly bare and untilled, and alluvial valley fans	6.36	25.00	393.00	2.520	0.043
		8. Large gullies, diversions, and low flowing streams	2.39	198.00	8,272.00	4.640	0.495
#5	**6**	**Time of Concentration:**					**0.538**
#5	7	5. Nearly bare and untilled, and alluvial valley fans	9.66	28.00	290.00	3.100	0.025
		8. Large gullies, diversions, and low flowing streams	2.12	179.00	8,427.00	4.370	0.535
#5	**7**	**Time of Concentration:**					**0.560**
#6	1	5. Nearly bare and untilled, and alluvial valley fans	31.83	120.00	377.00	5.640	0.018
		8. Large gullies, diversions, and low flowing streams	1.38	198.00	14,361.00	3.520	1.133
#6	**1**	**Time of Concentration:**					**1.151**
#6	2	5. Nearly bare and untilled, and alluvial valley fans	4.25	40.00	941.00	2.060	0.126
		8. Large gullies, diversions, and low flowing streams	0.96	176.00	18,407.00	2.930	1.745
#6	**2**	**Time of Concentration:**					**1.871**
#6	3	5. Nearly bare and untilled, and alluvial valley fans	4.35	25.00	575.00	2.080	0.076
		8. Large gullies, diversions, and low flowing streams	1.57	224.00	14,223.00	3.760	1.050
#6	**3**	**Time of Concentration:**					**1.126**
#7	1	5. Nearly bare and untilled, and alluvial valley fans	2.51	10.00	399.00	1.580	0.070
		8. Large gullies, diversions, and low flowing streams	1.11	95.00	8,524.00	3.160	0.749
#7	**1**	**Time of Concentration:**					**0.819**
#7	3	5. Nearly bare and untilled, and alluvial valley fans	2.14	14.00	655.00	1.460	0.124
		8. Large gullies, diversions, and low flowing streams	1.07	56.00	5,255.00	3.090	0.472
#7	**3**	**Time of Concentration:**					**0.596**
#8	1	5. Nearly bare and untilled, and alluvial valley fans	1.97	5.00	254.00	1.400	0.050

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
		8. Large gullies, diversions, and low flowing streams	1.64	111.00	6,755.00	3.840	0.488
#8	**1**	**Time of Concentration:**					**0.538**
#8	2	5. Nearly bare and untilled, and alluvial valley fans	2.49	8.00	321.00	1.570	0.056
		8. Large gullies, diversions, and low flowing streams	1.16	91.00	7,866.00	3.220	0.678
#8	**2**	**Time of Concentration:**					**0.734**
#8	3	5. Nearly bare and untilled, and alluvial valley fans	3.58	25.00	698.00	1.890	0.102
		8. Large gullies, diversions, and low flowing streams	1.12	96.00	8,579.00	3.170	0.751
#8	**3**	**Time of Concentration:**					**0.853**
#8	4	5. Nearly bare and untilled, and alluvial valley fans	0.85	10.00	1,181.00	0.920	0.356
		8. Large gullies, diversions, and low flowing streams	0.90	123.00	13,645.00	2.840	1.334
#8	**4**	**Time of Concentration:**					**1.690**
#8	5	5. Nearly bare and untilled, and alluvial valley fans	6.53	39.00	597.00	2.550	0.065
		8. Large gullies, diversions, and low flowing streams	1.42	123.00	8,678.00	3.570	0.675
#8	**5**	**Time of Concentration:**					**0.740**
#8	6	5. Nearly bare and untilled, and alluvial valley fans	1.45	5.00	344.00	1.200	0.079
		8. Large gullies, diversions, and low flowing streams	2.21	127.00	5,746.00	4.460	0.357
#8	**6**	**Time of Concentration:**					**0.436**
#8	7	5. Nearly bare and untilled, and alluvial valley fans	2.98	12.00	403.00	1.720	0.065
		8. Large gullies, diversions, and low flowing streams	1.97	114.00	5,796.00	4.200	0.383
#8	**7**	**Time of Concentration:**					**0.448**
#8	8	5. Nearly bare and untilled, and alluvial valley fans	20.11	105.00	522.00	4.480	0.032
		8. Large gullies, diversions, and low flowing streams	1.77	157.00	8,849.00	3.990	0.616
#8	**8**	**Time of Concentration:**					**0.648**
#8	9	5. Nearly bare and untilled, and alluvial valley fans	43.35	75.00	173.00	6.580	0.007
		8. Large gullies, diversions, and low flowing streams	1.57	100.00	6,387.00	3.750	0.473
#8	**9**	**Time of Concentration:**					**0.480**
#8	10	5. Nearly bare and untilled, and alluvial valley fans	1.85	40.00	2,159.00	1.360	0.440
		8. Large gullies, diversions, and low flowing streams	1.53	92.00	6,011.00	3.710	0.450
#8	**10**	**Time of Concentration:**					**0.890**
#8	11	5. Nearly bare and untilled, and alluvial valley fans	4.84	24.00	496.00	2.190	0.062

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
		8. Large gullies, diversions, and low flowing streams	2.79	111.00	3,980.20	5.000	0.221
#8	**11**	**Time of Concentration:**					**0.283**
#9	1	5. Nearly bare and untilled, and alluvial valley fans	7.42	25.00	337.00	2.720	0.034
		8. Large gullies, diversions, and low flowing streams	1.50	107.00	7,136.00	3.670	0.540
#9	**1**	**Time of Concentration:**					**0.574**
#9	2	5. Nearly bare and untilled, and alluvial valley fans	11.19	15.00	134.00	3.340	0.011
		8. Large gullies, diversions, and low flowing streams	1.96	184.00	9,391.00	4.190	0.622
#9	**2**	**Time of Concentration:**					**0.633**
#9	3	5. Nearly bare and untilled, and alluvial valley fans	3.14	25.00	796.00	1.770	0.124
		8. Large gullies, diversions, and low flowing streams	1.68	132.00	7,862.00	3.880	0.562
#9	**3**	**Time of Concentration:**					**0.686**
#9	4	5. Nearly bare and untilled, and alluvial valley fans	12.82	35.00	273.00	3.580	0.021
		8. Large gullies, diversions, and low flowing streams	1.93	183.00	9,495.00	4.160	0.634
#9	**4**	**Time of Concentration:**					**0.655**
#9	5	5. Nearly bare and untilled, and alluvial valley fans	2.66	15.00	564.00	1.630	0.096
		8. Large gullies, diversions, and low flowing streams	1.68	135.00	8,020.00	3.890	0.572
#9	**5**	**Time of Concentration:**					**0.668**

Subwatershed Muskingum Routing Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	8. Large gullies, diversions, and low flowing streams	1.89	378.00	19,958.00	4.120	1.345
#1	**1**	**Muskingum K:**					**1.345**
#1	2	8. Large gullies, diversions, and low flowing streams	2.11	282.00	13,337.00	4.360	0.849
#1	**2**	**Muskingum K:**					**0.849**
#1	3	8. Large gullies, diversions, and low flowing streams	2.02	384.00	19,036.00	4.260	1.241
#1	**3**	**Muskingum K:**					**1.241**
#1	4	8. Large gullies, diversions, and low flowing streams	2.28	364.00	15,948.82	4.530	0.977
#1	**4**	**Muskingum K:**					**0.977**
#1	5	8. Large gullies, diversions, and low flowing streams	2.33	428.00	18,360.00	4.580	1.113
#1	**5**	**Muskingum K:**					**1.113**

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	6	8. Large gullies, diversions, and low flowing streams	1.82	158.00	8,675.00	4.040	0.596
#1	**6**	**Muskingum K:**					**0.596**
#1	7	8. Large gullies, diversions, and low flowing streams	1.89	149.00	7,868.00	4.120	0.530
#1	**7**	**Muskingum K:**					**0.530**
#2	1	8. Large gullies, diversions, and low flowing streams	1.44	228.00	15,800.00	3.600	1.219
#2	**1**	**Muskingum K:**					**1.219**
#2	2	8. Large gullies, diversions, and low flowing streams	1.19	202.00	16,912.00	3.270	1.436
#2	**2**	**Muskingum K:**					**1.436**
#2	3	8. Large gullies, diversions, and low flowing streams	1.10	160.00	14,568.00	3.140	1.288
#2	**3**	**Muskingum K:**					**1.288**
#2	4	8. Large gullies, diversions, and low flowing streams	1.09	104.00	9,576.00	3.120	0.852
#2	**4**	**Muskingum K:**					**0.852**
#2	5	8. Large gullies, diversions, and low flowing streams	0.93	44.00	4,715.00	2.890	0.453
#2	**5**	**Muskingum K:**					**0.453**
#3	1	8. Large gullies, diversions, and low flowing streams	1.75	294.00	16,845.00	3.960	1.181
#3	**1**	**Muskingum K:**					**1.181**
#3	2	8. Large gullies, diversions, and low flowing streams	1.79	154.00	8,609.00	4.010	0.596
#3	**2**	**Muskingum K:**					**0.596**
#3	3	8. Large gullies, diversions, and low flowing streams	1.93	92.00	4,778.00	4.160	0.319
#3	**3**	**Muskingum K:**					**0.319**
#4	1	8. Large gullies, diversions, and low flowing streams	1.01	186.00	18,477.00	3.000	1.710
#4	**1**	**Muskingum K:**					**1.710**
#4	2	8. Large gullies, diversions, and low flowing streams	0.98	150.00	15,281.00	2.970	1.429
#4	**2**	**Muskingum K:**					**1.429**
#4	3	8. Large gullies, diversions, and low flowing streams	0.98	104.00	10,645.00	2.960	0.998
#4	**3**	**Muskingum K:**					**0.998**
#5	1	8. Large gullies, diversions, and low flowing streams	0.64	195.00	30,309.00	2.400	3.507
#5	**1**	**Muskingum K:**					**3.507**
#5	2	8. Large gullies, diversions, and low flowing streams	0.60	113.00	18,717.00	2.330	2.231
#5	**2**	**Muskingum K:**					**2.231**
#5	3	8. Large gullies, diversions, and low flowing streams	0.63	85.00	13,541.00	2.370	1.587
#5	**3**	**Muskingum K:**					**1.587**
#5	4	8. Large gullies, diversions, and low flowing streams	0.63	67.00	10,710.00	2.370	1.255

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#5	**4**	**Muskingum K:**					**1.255**
#5	5	8. Large gullies, diversions, and low flowing streams	0.59	53.00	8,978.00	2.300	1.084
#5	**5**	**Muskingum K:**					**1.084**
#5	6	8. Large gullies, diversions, and low flowing streams	0.74	41.00	5,528.00	2.580	0.595
#5	**6**	**Muskingum K:**					**0.595**
#6	1	8. Large gullies, diversions, and low flowing streams	0.94	186.00	19,797.00	2.900	1.896
#6	**1**	**Muskingum K:**					**1.896**
#6	2	8. Large gullies, diversions, and low flowing streams	0.58	8.00	1,372.00	2.290	0.166
#6	**2**	**Muskingum K:**					**0.166**
#7	1	8. Large gullies, diversions, and low flowing streams	0.57	31.00	5,417.00	2.260	0.665
#7	**1**	**Muskingum K:**					**0.665**
#8	1	8. Large gullies, diversions, and low flowing streams	0.53	120.00	22,753.13	2.170	2.912
#8	**1**	**Muskingum K:**					**2.912**
#8	2	8. Large gullies, diversions, and low flowing streams	0.51	106.00	20,587.00	2.150	2.659
#8	**2**	**Muskingum K:**					**2.659**
#8	3	8. Large gullies, diversions, and low flowing streams	0.53	95.00	18,060.00	2.170	2.311
#8	**3**	**Muskingum K:**					**2.311**
#8	4	8. Large gullies, diversions, and low flowing streams	0.50	88.00	17,689.00	2.110	2.328
#8	**4**	**Muskingum K:**					**2.328**
#8	5	8. Large gullies, diversions, and low flowing streams	0.50	54.00	10,815.00	2.110	1.423
#8	**5**	**Muskingum K:**					**1.423**
#8	6	8. Large gullies, diversions, and low flowing streams	0.57	54.00	9,503.00	2.260	1.168
#8	**6**	**Muskingum K:**					**1.168**
#8	7	8. Large gullies, diversions, and low flowing streams	0.51	37.00	7,229.00	2.140	0.938
#8	**7**	**Muskingum K:**					**0.938**
#8	8	8. Large gullies, diversions, and low flowing streams	0.68	34.00	5,017.00	2.460	0.566
#8	**8**	**Muskingum K:**					**0.566**
#8	9	8. Large gullies, diversions, and low flowing streams	1.01	101.00	9,985.00	3.010	0.921
#8	**9**	**Muskingum K:**					**0.921**
#8	10	8. Large gullies, diversions, and low flowing streams	0.72	29.00	4,009.00	2.550	0.436
#8	**10**	**Muskingum K:**					**0.436**
#9	1	8. Large gullies, diversions, and low flowing streams	0.41	68.00	16,597.51	1.920	2.401
#9	**1**	**Muskingum K:**					**2.401**

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#9	2	8. Large gullies, diversions, and low flowing streams	0.36	51.00	14,207.00	1.790	2.204
#9	**2**	**Muskingum K:**					**2.204**
#9	3	8. Large gullies, diversions, and low flowing streams	0.36	43.00	12,015.00	1.790	1.864
#9	**3**	**Muskingum K:**					**1.864**
#9	4	8. Large gullies, diversions, and low flowing streams	0.35	22.00	6,269.00	1.770	0.983
#9	**4**	**Muskingum K:**					**0.983**

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc. (ml/l)	24VW (ml/l)
#3	3,978.700	3,978.700	440.83	102.78	2,338.6	27,282	6.12	3.73
#4	3,216.100	7,194.800	603.73	212.85	4,860.9	43,257	7.92	3.05
#1	8,477.900	8,477.900	932.74	267.99	4,565.8	34,225	6.95	2.52
#2	3,838.900	12,316.800	1,096.38	462.56	7,497.7	34,701	4.87	1.66
#5	5,494.300	25,005.900	1,684.50	956.12	16,003.7	27,738	3.87	1.72
#6	3,079.300	28,085.200	1,694.12	1,096.04	15,104.2	23,367	1.56	0.68
#7	2,671.600	30,756.800	1,698.39	1,154.68	14,905.2	22,598	1.37	0.58
#8	4,754.800	35,511.600	1,701.48	1,339.99	14,698.1	47,845	4.55	0.79
#9	2,301.000	37,812.600	1,693.81	1,435.96	15,678.9	32,341	3.04	0.79

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc. (ml/l)	24VW (ml/l)
#3	3,978.700	3,978.700	54.16	11.47	213.2	19,166	1.80	1.28
#4	3,216.100	7,194.800	98.76	29.58	588.8	31,016	3.41	1.60
#1	8,477.900	8,477.900	154.53	42.61	702.9	27,435	3.84	1.69
#2	3,838.900	12,316.800	330.94	91.74	1,663.8	30,443	3.50	1.52
#5	5,494.300	25,005.900	410.43	194.41	2,430.5	16,075	1.29	0.74
#6	3,079.300	28,085.200	406.03	228.76	2,250.6	13,061	0.63	0.35
#7	2,671.600	30,756.800	402.61	234.65	2,227.6	14,438	0.62	0.30
#8	4,754.800	35,511.600	395.69	274.47	2,146.9	38,785	2.40	0.36
#9	2,301.000	37,812.600	391.10	294.15	2,361.0	24,665	1.71	0.41

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc. (ml/l)	24VW (ml/l)
#3	3,978.700	3,978.700	265.53	49.06	1,165.5	23,780	4.29	3.13
#4	3,216.100	7,194.800	377.17	107.10	2,542.2	37,709	5.84	2.68
#1	8,477.900	8,477.900	592.57	139.16	2,551.3	31,257	5.38	2.30
#2	3,838.900	12,316.800	789.79	255.55	4,558.0	31,911	4.07	1.66
#5	5,494.300	25,005.900	1,134.22	531.95	8,678.6	22,705	2.22	1.17
#6	3,079.300	28,085.200	1,124.25	614.41	8,093.3	18,945	1.13	0.58
#7	2,671.600	30,756.800	1,117.71	641.23	7,966.0	18,866	1.03	0.50
#8	4,754.800	35,511.600	1,099.20	745.76	7,808.1	43,083	3.70	0.66
#9	2,301.000	37,812.600	1,085.26	799.67	8,366.3	28,502	2.47	0.66

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc. (ml/l)	24VW (ml/l)
#3	3,978.700	3,978.700	466.46	83.38	2,147.3	25,470	5.50	4.05
#4	3,216.100	7,194.800	639.40	175.00	4,501.6	40,588	7.18	3.31
#1	8,477.900	8,477.900	985.54	222.07	4,256.2	32,523	6.32	2.72
#2	3,838.900	12,316.800	1,143.70	389.57	6,994.1	32,748	4.40	1.76
#5	5,494.300	25,005.900	1,730.17	806.73	14,677.0	25,793	3.17	1.63
#6	3,079.300	28,085.200	1,714.72	926.63	13,702.7	21,689	1.39	0.70
#7	2,671.600	30,756.800	1,705.83	973.65	13,442.9	20,981	1.23	0.59
#8	4,754.800	35,511.600	1,677.53	1,130.54	13,103.4	44,100	4.07	0.78
#9	2,301.000	37,812.600	1,655.79	1,211.78	13,932.0	29,937	2.73	0.77

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc. (ml/l)	24VW (ml/l)
#3	3,978.700	3,978.700	658.49	115.93	3,130.7	26,537	6.27	4.65
#4	3,216.100	7,194.800	888.09	238.37	6,403.9	42,242	8.00	3.70
#1	8,477.900	8,477.900	1,354.95	298.86	5,899.3	33,228	7.05	3.06
#2	3,838.900	12,316.800	1,488.15	511.26	9,343.7	33,523	4.68	1.86
#5	5,494.300	25,005.900	2,272.37	1,055.73	20,386.0	27,512	4.04	2.07
#6	3,079.300	28,085.200	2,252.50	1,208.91	19,063.8	23,337	1.56	0.77
#7	2,671.600	30,756.800	2,241.50	1,275.49	18,665.9	22,547	1.37	0.65
#8	4,754.800	35,511.600	2,203.65	1,479.73	18,151.3	44,954	4.31	0.86
#9	2,301.000	37,812.600	2,174.95	1,585.49	19,233.8	30,979	2.92	0.84

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc. (ml/l)	24VW (ml/l)
#3	3,978.700	3,978.700	890.75	154.95	4,359.5	27,516	6.97	5.19
#4	3,216.100	7,194.800	1,185.76	313.49	8,748.1	43,827	8.76	4.06
#1	8,477.900	8,477.900	1,795.71	389.46	7,899.2	33,914	7.74	3.38
#2	3,838.900	12,316.800	1,954.05	652.91	12,353.8	34,587	5.03	2.01
#5	5,494.300	25,005.900	2,905.07	1,345.19	27,274.7	28,823	4.66	2.39
#6	3,079.300	28,085.200	2,879.25	1,536.56	25,543.8	24,483	1.88	0.93
#7	2,671.600	30,756.800	2,865.67	1,626.91	24,968.3	23,757	1.49	0.70
#8	4,754.800	35,511.600	2,816.87	1,886.12	24,239.3	45,637	4.52	0.93
#9	2,301.000	37,812.600	2,780.20	2,020.17	25,625.9	31,941	3.08	0.90

Attachment 18.B-2

No Name Arroyo Baseline Hydrology and Sedimentology SEDCAD™ Model Output with Impoundment

General Information

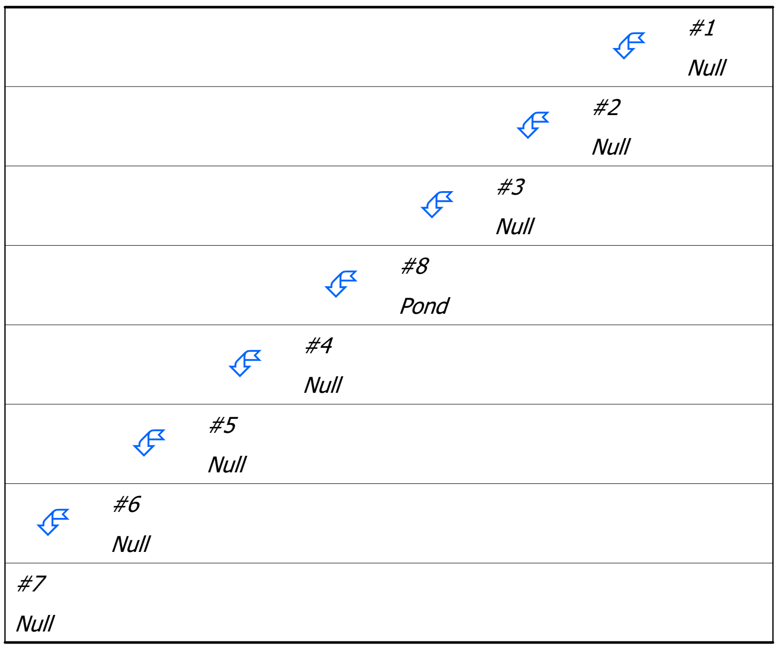
Storm Information:

Storm Type:	NRCS TYPE II-70
Design Storm:	10 yr - 24 hr
Rainfall Depth:	1.700 inches

Copyright 1998 -2007 Pamela J. Schwab

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Null	#1	==>	#2	0.814	0.291	SWS01
Null	#2	==>	#3	0.656	0.345	SWS02
Null	#3	==>	#8	0.000	0.000	SWS03, 04, 05
Null	#4	==>	#5	0.096	0.358	SWS06, 07
Null	#5	==>	#6	0.681	0.307	SWS08
Null	#6	==>	#7	1.027	0.307	SWS09, 10, 11, 12, 13, 14
Null	#7	==>	End	0.000	0.000	SWS15, 16, 17, 18, 19
Pond	#8	==>	#4	0.604	0.309	S03 Impoundment Area



Structure Routing Details:

Stru #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	8. Large gullies, diversions, and low flowing streams	0.62	43.00	6,923.00	2.36	0.814
#1	**Muskingum K:**					**0.814**
#2	8. Large gullies, diversions, and low flowing streams	1.59	142.00	8,936.00	3.78	0.656
#2	**Muskingum K:**					**0.656**
#4	8. Large gullies, diversions, and low flowing streams	2.03	30.00	1,480.00	4.27	0.096
#4	**Muskingum K:**					**0.096**

Stru #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#5	8. Large gullies, diversions, and low flowing streams	0.82	54.00	6,623.00	2.70	0.681
#5	**Muskingum K:**					**0.681**
#6	8. Large gullies, diversions, and low flowing streams	0.82	82.00	10,027.00	2.71	1.027
#6	**Muskingum K:**					**1.027**

Particle Size Distribution(s) at Each Structure

Structure #1 (SWS01):

Size (mm)	In/Out
0.4250	100.000%
0.2500	100.000%
0.1500	100.000%
0.0750	100.000%
0.0159	87.633%
0.0100	65.880%
0.0050	28.144%
0.0020	17.046%
0.0010	15.702%
0.0004	14.553%

Structure #2 (SWS02):

Size (mm)	In/Out
0.4250	100.000%
0.2500	100.000%
0.1500	100.000%
0.0750	100.000%
0.0159	94.592%
0.0100	70.816%
0.0050	28.706%
0.0020	17.854%
0.0010	16.303%
0.0004	15.212%

Structure #3 (SWS03, 04, 05):

Size (mm)	In/Out
0.4250	100.000%
0.2500	100.000%
0.1500	100.000%
0.0750	97.877%
0.0159	92.230%

Size (mm)	In/Out
0.0100	76.761%
0.0050	25.622%
0.0020	16.083%
0.0010	14.500%
0.0004	13.543%

Structure #8 (S03 Impoundment Area):

Size (mm)	In	Out
0.4250	100.000%	100.000%
0.2500	100.000%	100.000%
0.1500	100.000%	100.000%
0.0750	97.877%	100.000%
0.0159	92.230%	100.000%
0.0100	76.761%	100.000%
0.0050	25.622%	34.158%
0.0020	16.083%	21.441%
0.0010	14.500%	19.331%
0.0004	13.543%	18.055%

Structure #4 (SWS06, 07):

Size (mm)	In/Out
0.4250	100.000%
0.2500	100.000%
0.1500	100.000%
0.0750	90.443%
0.0159	84.645%
0.0100	75.204%
0.0050	28.223%
0.0020	17.306%
0.0010	15.616%
0.0004	14.459%

Structure #5 (SWS08):

Size (mm)	In/Out
0.4250	100.000%
0.2500	100.000%
0.1500	99.774%
0.0750	92.709%
0.0159	85.990%
0.0100	75.443%

Size (mm)	In/Out
0.0050	27.397%
0.0020	16.752%
0.0010	15.142%
0.0004	13.966%

Structure #6 (SWS09, 10, 11, 12, 13, 14):

Size (mm)	In/Out
0.4250	100.000%
0.2500	100.000%
0.1500	99.349%
0.0750	90.724%
0.0159	85.928%
0.0100	79.191%
0.0050	25.810%
0.0020	15.481%
0.0010	14.068%
0.0004	12.817%

Structure #7:

Size (mm)	In/Out
0.4250	100.000%
0.2500	100.000%
0.1500	97.978%
0.0750	93.104%
0.0159	88.810%
0.0100	79.800%
0.0050	25.172%
0.0020	14.985%
0.0010	13.630%
0.0004	12.388%

Structure Detail:

Structure #1 (Null)

SWS01

Structure #2 (Null)

SWS02

Structure #3 (Null)

SWS03, 04, 05

Structure #8 (Pond)

S03 Impoundment Area

Pond Inputs:

Initial Pool Elev:	5,441.01 ft
Initial Pool:	0.00 ac-ft
*Sediment Storage:	0.00 ac-ft
Dead Space:	5.00 %

**No sediment capacity defined*

Pond Results:

Peak Elevation:	5,448.48 ft
H'graph Detention Time:	1.10 hrs
Pond Model:	CSTRS
Dewater Time:	1.31 days
Trap Efficiency:	24.99 %

Dewatering time is calculated from peak stage to lowest spillway

Elevation-Capacity-Discharge Table

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)	
5,441.00	0.000	0.000	0.000		Top of Sed. Storage
5,441.01	0.011	0.000	0.000		
5,442.00	1.075	0.394	0.001		
5,443.00	2.094	1.950	0.001		
5,444.00	2.823	4.399	0.001		
5,445.00	4.127	7.854	0.001		
5,446.00	5.827	12.807	0.001		
5,447.00	7.996	19.691	55.000	26.25	

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)	
5,448.00	10.478	28.900	300.000	3.95	
5,448.48	12.103	34.593	571.922	1.35	Peak Stage
5,449.00	13.565	40.888	872.600		
5,450.00	16.428	55.862	1,000.000		

Detailed Discharge Table

Elevation (ft)	User-input discharge (cfs)	Combined Total Discharge (cfs)
5,441.00	0.000	0.000
5,441.01	0.000	0.000
5,442.00	0.001	0.001
5,443.00	0.001	0.001
5,444.00	0.001	0.001
5,445.00	0.001	0.001
5,446.00	0.001	0.001
5,447.00	55.000	55.000
5,448.00	300.000	300.000
5,449.00	872.600	872.600
5,450.00	1,000.000	1,000.000

Structure #4 (Null)

SWS06, 07

Structure #5 (Null)

SWS08

Structure #6 (Null)

SWS09, 10, 11, 12, 13, 14

Structure #7 (Null)

SWS15, 16, 17, 18, 19

Copyright 1998 -2007 Pamela J. Schwab

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#1	1	999.370	1.261	0.000	0.000	81.700	M	162.56	29.766
	Σ	**999.370**						**162.56**	**29.766**
#2	1	856.430	1.610	0.000	0.000	85.700	M	167.83	34.941
	Σ	**1,855.800**						**280.33**	**64.707**
#3	1	925.920	1.675	0.409	0.297	88.800	M	230.14	47.520
	2	1,019.220	1.106	0.193	0.261	87.000	M	299.75	45.846
	3	428.940	0.766	0.000	0.000	87.400	M	169.66	19.891
	Σ	**4,229.880**						**611.92**	**177.964**
#8	Σ	**4,229.880**						**611.92**	**177.964**
#4	1	551.860	0.790	0.364	0.292	86.200	M	192.60	23.387
	2	516.780	0.565	0.000	0.000	88.400	M	271.74	25.785
	Σ	**5,298.520**						**620.07**	**214.321**
#5	1	233.280	0.469	0.000	0.000	87.900	M	131.66	11.232
	Σ	**5,531.800**						**624.80**	**225.554**
#6	1	126.980	0.164	0.545	0.308	86.900	M	101.83	5.787
	2	235.630	0.327	0.427	0.341	86.700	M	144.93	10.409
	3	258.380	0.416	0.365	0.294	88.300	M	161.17	12.840
	4	180.930	0.449	0.176	0.301	86.700	M	94.53	7.968
	5	189.850	0.326	0.146	0.330	86.800	M	117.89	8.448
	6	172.360	0.753	0.000	0.000	88.300	M	74.40	8.537
	Σ	**6,695.930**						**642.03**	**279.543**
#7	1	91.450	0.220	0.854	0.310	86.800	M	65.92	4.081
	2	286.490	0.566	0.642	0.312	87.100	M	134.68	12.994
	3	75.280	0.179	0.610	0.308	86.800	M	58.49	3.393
	4	128.700	0.157	0.270	0.325	86.800	M	102.47	5.822
	5	67.060	0.333	0.000	0.000	82.000	M	27.39	2.057
	Σ	**7,344.910**						**652.74**	**307.890**

Subwatershed Sedimentology Detail:

Stru #	SWS #	Soil K	L (ft)	S (%)	C	P	PS #	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc (ml/l)	24VW (ml/l)
#1	1	0.233	280.00	2.40	0.2650	1.0000	1	308.7	12,523	3.66	2.22
	Σ							**308.7**	**12,523**	**3.66**	**2.22**
#2	1	0.245	420.00	1.40	0.2450	1.0000	2	236.1	7,888	2.53	1.60
	Σ							**494.6**	**8,847**	**2.26**	**1.44**
#3	1	0.235	280.00	2.20	0.2330	1.0000	3	399.8	9,626	3.28	2.12
	2	0.204	280.00	2.30	0.2330	1.0000	4	410.4	10,604	3.76	2.33
	3	0.158	240.00	3.80	0.2110	1.0000	5	198.1	12,102	4.07	2.45
	Σ							**1,239.2**	**8,405**	**1.82**	**1.10**
#8	Σ							**1,239.2**	**8,405**	**1.82**	**1.10**
#4	1	0.150	200.00	6.00	0.2320	1.0000	6	433.9	22,402	7.69	4.65
	2	0.183	100.00	9.10	0.1990	1.0000	7	662.4	31,375	12.99	7.74
	Σ							**1,675.7**	**26,789**	**6.05**	**1.29**
#5	1	0.170	100.00	10.10	0.1890	1.0000	8	294.8	32,531	12.94	7.60
	Σ							**1,875.5**	**27,699**	**6.19**	**1.36**
#6	1	0.160	100.00	11.50	0.1990	1.0000	9	207.4	44,285	21.06	12.35
	2	0.145	100.00	12.00	0.2110	1.0000	15	360.7	43,171	18.39	10.71
	3	0.171	100.00	8.20	0.1850	1.0000	10	246.1	23,504	9.41	5.60
	4	0.150	75.00	12.10	0.2110	1.0000	11	215.6	33,725	13.34	7.79
	5	0.143	75.00	13.30	0.2110	1.0000	15	271.8	40,504	17.28	9.97
	6	0.164	75.00	13.90	0.1850	1.0000	12	225.3	31,654	9.95	6.04
	Σ							**2,775.0**	**27,766**	**5.64**	**1.48**
#7	1	0.143	100.00	10.40	0.2110	1.0000	15	110.9	33,271	15.18	9.02
	2	0.162	75.00	15.20	0.2220	1.0000	13	527.1	48,820	18.88	11.36
	3	0.143	75.00	20.10	0.2110	1.0000	15	180.8	64,982	30.56	18.04
	4	0.143	100.00	8.10	0.2110	1.0000	15	113.6	24,801	11.77	6.76
	5	0.215	100.00	8.20	0.2760	1.0000	14	61.3	39,773	19.09	10.40
	Σ							**3,362.1**	**34,942**	**6.86**	**1.57**

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	5. Nearly bare and untilled, and alluvial valley fans	1.30	9.00	692.00	1.140	0.168
		8. Large gullies, diversions, and low flowing streams	1.35	186.00	13,736.00	3.490	1.093
#1	**1**	**Time of Concentration:**					**1.261**
#2	1	5. Nearly bare and untilled, and alluvial valley fans	1.06	11.00	1,041.00	1.020	0.283

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
		8. Large gullies, diversions, and low flowing streams	0.41	37.00	9,125.00	1.910	1.327
#2	**1**	**Time of Concentration:**					**1.610**
#3	1	5. Nearly bare and untilled, and alluvial valley fans	0.13	1.00	743.49	0.360	0.573
		8. Large gullies, diversions, and low flowing streams	0.79	84.00	10,596.69	2.670	1.102
#3	**1**	**Time of Concentration:**					**1.675**
#3	2	5. Nearly bare and untilled, and alluvial valley fans	3.79	40.00	1,056.00	1.940	0.151
		8. Large gullies, diversions, and low flowing streams	1.20	135.00	11,282.00	3.280	0.955
#3	**2**	**Time of Concentration:**					**1.106**
#3	3	5. Nearly bare and untilled, and alluvial valley fans	1.48	14.00	945.00	1.210	0.216
		8. Large gullies, diversions, and low flowing streams	1.68	129.00	7,691.00	3.880	0.550
#3	**3**	**Time of Concentration:**					**0.766**
#4	1	5. Nearly bare and untilled, and alluvial valley fans	0.96	7.00	731.00	0.970	0.209
		8. Large gullies, diversions, and low flowing streams	1.94	169.00	8,725.00	4.170	0.581
#4	**1**	**Time of Concentration:**					**0.790**
#4	2	5. Nearly bare and untilled, and alluvial valley fans	4.40	43.00	978.00	2.090	0.129
		8. Large gullies, diversions, and low flowing streams	2.35	170.00	7,224.00	4.600	0.436
#4	**2**	**Time of Concentration:**					**0.565**
#5	1	5. Nearly bare and untilled, and alluvial valley fans	2.11	22.00	1,044.00	1.450	0.200
		8. Large gullies, diversions, and low flowing streams	3.14	162.00	5,158.00	5.310	0.269
#5	**1**	**Time of Concentration:**					**0.469**
#6	1	5. Nearly bare and untilled, and alluvial valley fans	4.94	12.00	243.00	2.220	0.030
		8. Large gullies, diversions, and low flowing streams	4.62	144.00	3,117.00	6.440	0.134
#6	**1**	**Time of Concentration:**					**0.164**
#6	2	5. Nearly bare and untilled, and alluvial valley fans	4.52	46.00	1,017.00	2.120	0.133
		8. Large gullies, diversions, and low flowing streams	3.40	132.00	3,879.00	5.530	0.194
#6	**2**	**Time of Concentration:**					**0.327**
#6	3	5. Nearly bare and untilled, and alluvial valley fans	2.83	23.00	813.00	1.680	0.134
		8. Large gullies, diversions, and low flowing streams	2.68	134.00	4,999.00	4.910	0.282
#6	**3**	**Time of Concentration:**					**0.416**
#6	4	5. Nearly bare and untilled, and alluvial valley fans	4.43	28.00	632.00	2.100	0.083

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
		8. Large gullies, diversions, and low flowing streams	2.77	182.00	6,575.00	4.990	0.366
#6	**4**	**Time of Concentration:**					**0.449**
#6	5	5. Nearly bare and untilled, and alluvial valley fans	6.63	41.00	618.00	2.570	0.066
		8. Large gullies, diversions, and low flowing streams	2.36	102.00	4,321.00	4.600	0.260
#6	**5**	**Time of Concentration:**					**0.326**
#6	6	5. Nearly bare and untilled, and alluvial valley fans	0.41	4.00	979.00	0.630	0.431
		8. Large gullies, diversions, and low flowing streams	2.88	170.00	5,907.00	5.080	0.322
#6	**6**	**Time of Concentration:**					**0.753**
#7	1	5. Nearly bare and untilled, and alluvial valley fans	18.35	60.00	327.00	4.280	0.021
		8. Large gullies, diversions, and low flowing streams	3.36	133.00	3,954.00	5.500	0.199
#7	**1**	**Time of Concentration:**					**0.220**
#7	2	5. Nearly bare and untilled, and alluvial valley fans	2.42	20.00	826.00	1.550	0.148
		8. Large gullies, diversions, and low flowing streams	2.59	188.00	7,257.00	4.820	0.418
#7	**2**	**Time of Concentration:**					**0.566**
#7	3	5. Nearly bare and untilled, and alluvial valley fans	10.34	74.00	716.00	3.210	0.061
		8. Large gullies, diversions, and low flowing streams	4.74	132.00	2,785.00	6.530	0.118
#7	**3**	**Time of Concentration:**					**0.179**
#7	4	5. Nearly bare and untilled, and alluvial valley fans	17.05	37.00	217.00	4.120	0.014
		8. Large gullies, diversions, and low flowing streams	3.52	102.00	2,899.00	5.620	0.143
#7	**4**	**Time of Concentration:**					**0.157**
#7	5	5. Nearly bare and untilled, and alluvial valley fans	0.95	2.00	211.00	0.970	0.060
		8. Large gullies, diversions, and low flowing streams	1.06	32.00	3,028.00	3.080	0.273
#7	**5**	**Time of Concentration:**					**0.333**

Subwatershed Muskingum Routing Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#3	1	8. Large gullies, diversions, and low flowing streams	0.68	25.00	3,656.00	2.480	0.409
#3	**1**	**Muskingum K:**					**0.409**
#3	2	8. Large gullies, diversions, and low flowing streams	0.39	5.00	1,298.00	1.860	0.193
#3	**2**	**Muskingum K:**					**0.193**

Copyright 1998 -2007 Pamela J. Schwab

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#4	1	8. Large gullies, diversions, and low flowing streams	0.64	20.00	3,139.00	2.390	0.364
#4	**1**	**Muskingum K:**					**0.364**
#6	1	8. Large gullies, diversions, and low flowing streams	0.82	44.00	5,337.00	2.720	0.545
#6	**1**	**Muskingum K:**					**0.545**
#6	2	8. Large gullies, diversions, and low flowing streams	1.47	82.00	5,593.07	3.630	0.427
#6	**2**	**Muskingum K:**					**0.427**
#6	3	8. Large gullies, diversions, and low flowing streams	0.66	21.00	3,199.00	2.430	0.365
#6	**3**	**Muskingum K:**					**0.365**
#6	4	8. Large gullies, diversions, and low flowing streams	0.74	12.00	1,631.00	2.570	0.176
#6	**4**	**Muskingum K:**					**0.176**
#6	6	8. Large gullies, diversions, and low flowing streams	0.00	0.00	0.00	0.000	0.000
#6	**6**	**Muskingum K:**					**0.000**
#7	1	8. Large gullies, diversions, and low flowing streams	0.86	73.00	8,524.00	2.770	0.854
#7	**1**	**Muskingum K:**					**0.854**
#7	2	8. Large gullies, diversions, and low flowing streams	0.89	58.00	6,527.00	2.820	0.642
#7	**2**	**Muskingum K:**					**0.642**
#7	3	8. Large gullies, diversions, and low flowing streams	0.83	50.00	5,997.00	2.730	0.610
#7	**3**	**Muskingum K:**					**0.610**
#7	4	8. Large gullies, diversions, and low flowing streams	1.11	34.00	3,071.00	3.150	0.270
#7	**4**	**Muskingum K:**					**0.270**
#7	5	8. Large gullies, diversions, and low flowing streams	0.00	0.00	0.00	0.000	0.000
#7	**5**	**Muskingum K:**					**0.000**

Structure Summary:

		Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc. (ml/l)	24VW (ml/l)
#1		999.370	999.370	162.56	29.77	308.7	12,523	3.66	2.22
#2		856.430	1,855.800	280.33	64.71	494.6	8,847	2.26	1.44
#3		2,374.080	4,229.880	611.92	177.96	1,239.2	8,405	1.82	1.10
#8	In	0.000	4,229.880	611.92	177.96	1,239.2	8,405	1.82	1.10
	Out			571.92	165.15	929.5	6,960	0.41	0.24
#4		1,068.640	5,298.520	620.07	214.32	1,675.7	26,789	6.05	1.29
#5		233.280	5,531.800	624.80	225.55	1,875.5	27,699	6.19	1.36
#6		1,164.130	6,695.930	642.03	279.54	2,775.0	27,766	5.64	1.48
#7		648.980	7,344.910	652.74	307.89	3,362.1	34,942	6.86	1.57

Structure Summary:

		Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc. (ml/l)	24VW (ml/l)
#1		999.370	999.370	24.54	4.06	35.1	8,569	1.37	1.01
#2		856.430	1,855.800	54.18	10.99	68.8	5,906	0.91	0.70
#3		2,374.080	4,229.880	162.83	37.32	242.2	6,598	1.12	0.81
#8	In	0.000	4,229.880	162.83	37.32	242.2	6,598	1.12	0.81
	Out			93.21	24.51	115.9	5,833	0.21	0.12
#4		1,068.640	5,298.520	101.16	35.56	234.9	19,908	4.55	1.10
#5		233.280	5,531.800	113.85	38.19	290.0	21,442	5.04	1.31
#6		1,164.130	6,695.930	163.52	50.34	537.0	23,458	5.41	1.80
#7		648.980	7,344.910	173.96	56.37	664.8	28,570	6.13	1.85

Structure Summary:

		Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc. (ml/l)	24VW (ml/l)
#1		999.370	999.370	102.78	14.94	162.3	10,997	2.81	2.03
#2		856.430	1,855.800	184.74	34.40	271.1	7,706	1.69	1.26
#3		2,374.080	4,229.880	431.44	100.54	736.4	7,513	1.50	1.07
#8	In	0.000	4,229.880	431.44	100.54	736.4	7,513	1.50	1.07
	Out			382.13	87.73	532.0	6,367	0.36	0.25
#4		1,068.640	5,298.520	411.91	116.15	958.8	23,926	5.10	1.29
#5		233.280	5,531.800	415.11	122.72	1,080.4	24,656	5.14	1.34
#6		1,164.130	6,695.930	436.61	153.94	1,634.7	24,988	4.84	1.50
#7		648.980	7,344.910	459.56	170.04	2,019.5	31,828	6.13	1.67

Structure Summary:

		Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc. (ml/l)	24VW (ml/l)
#1		999.370	999.370	172.71	24.46	286.1	11,847	3.37	2.44
#2		856.430	1,855.800	297.02	53.97	461.0	8,420	2.09	1.56
#3		2,374.080	4,229.880	643.53	150.86	1,161.2	7,904	1.65	1.18
#8	In	0.000	4,229.880	643.53	150.86	1,161.2	7,904	1.65	1.18
	Out			603.72	138.05	901.9	6,632	0.39	0.29
#4		1,068.640	5,298.520	655.72	179.99	1,593.4	25,101	5.51	1.42
#5		233.280	5,531.800	660.92	189.61	1,781.2	25,958	5.63	1.49
#6		1,164.130	6,695.930	679.87	235.67	2,626.8	26,001	5.16	1.62
#7		648.980	7,344.910	684.67	259.74	3,161.3	32,691	6.12	1.67

Copyright 1998 -2007 Pamela J. Schwab

Structure Summary:

		Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc. (ml/l)	24VW (ml/l)
#1		999.370	999.370	238.50	33.34	407.6	12,383	3.74	2.70
#2		856.430	1,855.800	400.79	71.89	644.6	8,870	2.36	1.75
#3		2,374.080	4,229.880	833.00	195.96	1,557.5	8,153	1.78	1.27
#8	In	0.000	4,229.880	833.00	195.96	1,557.5	8,153	1.78	1.27
	Out			794.10	183.15	1,247.6	6,840	0.58	0.43
#4		1,068.640	5,298.520	863.16	237.10	2,179.5	25,893	5.80	1.50
#5		233.280	5,531.800	870.11	249.40	2,427.5	26,767	5.95	1.58
#6		1,164.130	6,695.930	894.70	308.63	3,552.4	26,816	5.48	1.72
#7		648.980	7,344.910	894.21	339.81	4,251.4	33,481	6.45	1.76

Structure Summary:

		Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc. (ml/l)	24VW (ml/l)
#1		999.370	999.370	317.38	43.86	557.8	12,883	4.07	2.94
#2		856.430	1,855.800	522.95	92.86	868.3	9,277	2.60	1.92
#3		2,374.080	4,229.880	1,050.99	247.96	2,028.7	8,385	1.92	1.37
#8	In	0.000	4,229.880	1,050.99	247.96	2,028.7	8,385	1.92	1.37
	Out			934.11	235.15	1,646.4	7,047	0.73	0.53
#4		1,068.640	5,298.520	1,010.93	302.85	2,775.0	26,217	5.95	1.52
#5		233.280	5,531.800	1,021.67	318.22	3,091.3	27,184	6.14	1.60
#6		1,164.130	6,695.930	1,068.25	392.52	4,543.6	27,354	5.75	1.78
#7		648.980	7,344.910	1,114.89	431.90	5,564.1	34,562	7.33	1.99

Attachment 18.B-3

No Name Arroyo Baseline Hydrology and Sedimentology SEDCAD™ Model Output without Impoundment

General Information

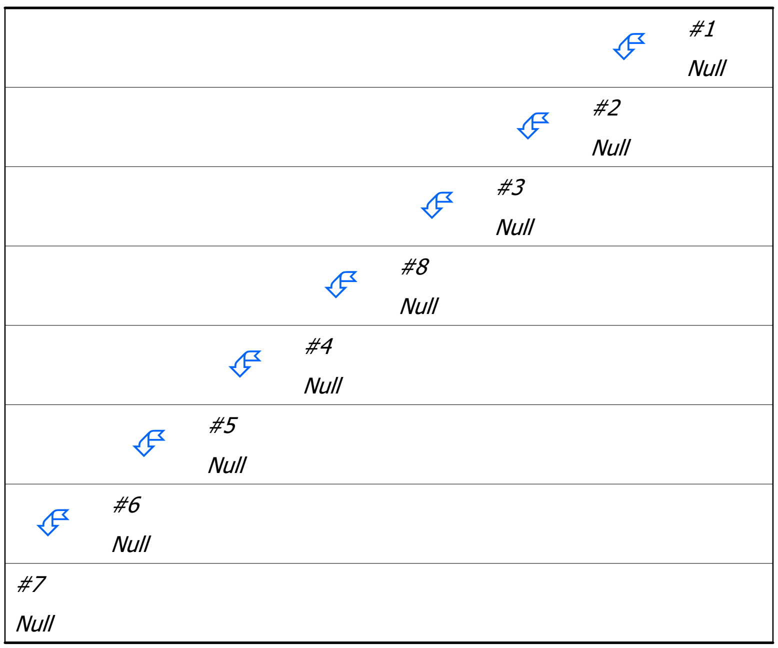
Storm Information:

Storm Type:	NRCS TYPE II-70
Design Storm:	10 yr - 24 hr
Rainfall Depth:	1.700 inches

Copyright 1998 -2007 Pamela J. Schwab

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Null	#1	==>	#2	0.814	0.291	SWS01
Null	#2	==>	#3	0.656	0.345	SWS02
Null	#3	==>	#8	0.000	0.000	SWS03, 04, 05
Null	#4	==>	#5	0.096	0.358	SWS06, 07
Null	#5	==>	#6	0.681	0.307	SWS08
Null	#6	==>	#7	1.027	0.307	SWS09, 10, 11, 12, 13, 14
Null	#7	==>	End	0.000	0.000	SWS15, 16, 17, 18, 19
Null	#8	==>	#4	0.604	0.309	S03 Impoundment Area



Structure Routing Details:

Stru #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	8. Large gullies, diversions, and low flowing streams	0.62	43.00	6,923.00	2.36	0.814
#1	**Muskingum K:**					**0.814**
#2	8. Large gullies, diversions, and low flowing streams	1.59	142.00	8,936.00	3.78	0.656
#2	**Muskingum K:**					**0.656**
#4	8. Large gullies, diversions, and low flowing streams	2.03	30.00	1,480.00	4.27	0.096
#4	**Muskingum K:**					**0.096**

Copyright 1998 -2007 Pamela J. Schwab

Stru #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#5	8. Large gullies, diversions, and low flowing streams	0.82	54.00	6,623.00	2.70	0.681
#5	**Muskingum K:**					**0.681**
#6	8. Large gullies, diversions, and low flowing streams	0.82	82.00	10,027.00	2.71	1.027
#6	**Muskingum K:**					**1.027**

Copyright 1998 -2007 Pamela J. Schwab

Particle Size Distribution(s) at Each Structure

Structure #1 (SWS01):

Size (mm)	In/Out
0.4250	100.000%
0.2500	100.000%
0.1500	100.000%
0.0750	100.000%
0.0159	87.633%
0.0100	65.880%
0.0050	28.144%
0.0020	17.046%
0.0010	15.702%
0.0004	14.553%

Structure #2 (SWS02):

Size (mm)	In/Out
0.4250	100.000%
0.2500	100.000%
0.1500	100.000%
0.0750	100.000%
0.0159	94.592%
0.0100	70.816%
0.0050	28.706%
0.0020	17.854%
0.0010	16.303%
0.0004	15.212%

Structure #3 (SWS03, 04, 05):

Size (mm)	In/Out
0.4250	100.000%
0.2500	100.000%
0.1500	100.000%
0.0750	97.877%
0.0159	92.230%

Size (mm)	In/Out
0.0100	76.761%
0.0050	25.622%
0.0020	16.083%
0.0010	14.500%
0.0004	13.543%

Structure #8 (S03 Impoundment Area):

Size (mm)	In/Out
0.4250	100.000%
0.2500	100.000%
0.1500	100.000%
0.0750	97.877%
0.0159	92.230%
0.0100	76.761%
0.0050	25.622%
0.0020	16.083%
0.0010	14.500%
0.0004	13.543%

Structure #4 (SWS06, 07):

Size (mm)	In/Out
0.4250	100.000%
0.2500	100.000%
0.1500	100.000%
0.0750	91.615%
0.0159	86.011%
0.0100	76.336%
0.0050	23.361%
0.0020	14.325%
0.0010	12.926%
0.0004	11.968%

Structure #5 (SWS08):

Size (mm)	In/Out
0.4250	100.000%
0.2500	100.000%
0.1500	99.810%
0.0750	93.331%
0.0159	86.940%
0.0100	76.363%

Size (mm)	In/Out
0.0050	23.079%
0.0020	14.112%
0.0010	12.756%
0.0004	11.765%

Structure #6 (SWS09, 10, 11, 12, 13, 14):

Size (mm)	In/Out
0.4250	100.000%
0.2500	100.000%
0.1500	99.151%
0.0750	90.981%
0.0159	86.749%
0.0100	78.947%
0.0050	22.775%
0.0020	13.661%
0.0010	12.414%
0.0004	11.310%

Structure #7:

Size (mm)	In/Out
0.4250	100.000%
0.2500	100.000%
0.1500	98.085%
0.0750	93.580%
0.0159	89.264%
0.0100	79.577%
0.0050	22.691%
0.0020	13.507%
0.0010	12.286%
0.0004	11.166%

Structure Detail:

Structure #1 (Null)

SWS01

Structure #2 (Null)

SWS02

Structure #3 (Null)

SWS03, 04, 05

Structure #8 (Null)

S03 Impoundment Area

Structure #4 (Null)

SWS06, 07

Structure #5 (Null)

SWS08

Structure #6 (Null)

SWS09, 10, 11, 12, 13, 14

Structure #7 (Null)

SWS15, 16, 17, 18, 19

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#1	1	999.370	1.261	0.000	0.000	81.700	M	162.56	29.766
	Σ	**999.370**						**162.56**	**29.766**
#2	1	856.430	1.610	0.000	0.000	85.700	M	167.83	34.941
	Σ	**1,855.800**						**280.33**	**64.707**
#3	1	925.920	1.675	0.409	0.297	88.800	M	230.14	47.520
	2	1,019.220	1.106	0.193	0.261	87.000	M	299.75	45.846
	3	428.940	0.766	0.000	0.000	87.400	M	169.66	19.891
	Σ	**4,229.880**						**611.92**	**177.964**
#8	Σ	**4,229.880**						**611.92**	**177.964**
#4	1	551.860	0.790	0.364	0.292	86.200	M	192.60	23.387
	2	516.780	0.565	0.000	0.000	88.400	M	271.74	25.785
	Σ	**5,298.520**						**681.43**	**227.135**
#5	1	233.280	0.469	0.000	0.000	87.900	M	131.66	11.232
	Σ	**5,531.800**						**693.15**	**238.368**
#6	1	126.980	0.164	0.545	0.308	86.900	M	101.83	5.787
	2	235.630	0.327	0.427	0.341	86.700	M	144.93	10.409
	3	258.380	0.416	0.365	0.294	88.300	M	161.17	12.840
	4	180.930	0.449	0.176	0.301	86.700	M	94.53	7.968
	5	189.850	0.326	0.146	0.330	86.800	M	117.89	8.448
	6	172.360	0.753	0.000	0.000	88.300	M	74.40	8.537
	Σ	**6,695.930**						**729.05**	**292.357**
#7	1	91.450	0.220	0.854	0.310	86.800	M	65.92	4.081
	2	286.490	0.566	0.642	0.312	87.100	M	134.68	12.994
	3	75.280	0.179	0.610	0.308	86.800	M	58.49	3.393
	4	128.700	0.157	0.270	0.325	86.800	M	102.47	5.822
	5	67.060	0.333	0.000	0.000	82.000	M	27.39	2.057
	Σ	**7,344.910**						**737.87**	**320.705**

Subwatershed Sedimentology Detail:

Stru #	SWS #	Soil K	L (ft)	S (%)	C	P	PS #	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc (ml/l)	24VW (ml/l)
#1	1	0.233	280.00	2.40	0.2650	1.0000	1	308.7	12,523	3.66	2.22
	Σ							**308.7**	**12,523**	**3.66**	**2.22**
#2	1	0.245	420.00	1.40	0.2450	1.0000	2	236.1	7,888	2.53	1.60
	Σ							**494.6**	**8,847**	**2.26**	**1.44**
#3	1	0.235	280.00	2.20	0.2330	1.0000	3	399.8	9,626	3.28	2.12
	2	0.204	280.00	2.30	0.2330	1.0000	4	410.4	10,604	3.76	2.33
	3	0.158	240.00	3.80	0.2110	1.0000	5	198.1	12,102	4.07	2.45
	Σ							**1,239.2**	**8,405**	**1.82**	**1.10**
#8	Σ							**1,239.2**	**8,405**	**1.82**	**1.10**
#4	1	0.150	200.00	6.00	0.2320	1.0000	6	433.9	22,402	7.69	4.65
	2	0.183	100.00	9.10	0.1990	1.0000	7	662.4	31,375	12.99	7.74
	Σ							**2,024.4**	**27,253**	**6.05**	**1.45**
#5	1	0.170	100.00	10.10	0.1890	1.0000	8	294.8	32,531	12.94	7.60
	Σ							**2,226.3**	**28,294**	**6.25**	**1.51**
#6	1	0.160	100.00	11.50	0.1990	1.0000	9	207.4	44,285	21.06	12.35
	2	0.145	100.00	12.00	0.2110	1.0000	15	360.7	43,171	18.39	10.71
	3	0.171	100.00	8.20	0.1850	1.0000	10	246.1	23,504	9.41	5.60
	4	0.150	75.00	12.10	0.2110	1.0000	11	215.6	33,725	13.34	7.79
	5	0.143	75.00	13.30	0.2110	1.0000	15	271.8	40,504	17.28	9.97
	6	0.164	75.00	13.90	0.1850	1.0000	12	225.3	31,654	9.95	6.04
	Σ							**3,144.8**	**28,310**	**5.83**	**1.62**
#7	1	0.143	100.00	10.40	0.2110	1.0000	15	110.9	33,271	15.18	9.02
	2	0.162	75.00	15.20	0.2220	1.0000	13	527.1	48,820	18.88	11.36
	3	0.143	75.00	20.10	0.2110	1.0000	15	180.8	64,982	30.56	18.04
	4	0.143	100.00	8.10	0.2110	1.0000	15	113.6	24,801	11.77	6.76
	5	0.215	100.00	8.20	0.2760	1.0000	14	61.3	39,773	19.09	10.40
	Σ							**3,729.9**	**35,233**	**7.02**	**1.69**

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	5. Nearly bare and untilled, and alluvial valley fans	1.30	9.00	692.00	1.140	0.168
		8. Large gullies, diversions, and low flowing streams	1.35	186.00	13,736.00	3.490	1.093
#1	**1**	**Time of Concentration:**					**1.261**
#2	1	5. Nearly bare and untilled, and alluvial valley fans	1.06	11.00	1,041.00	1.020	0.283

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
		8. Large gullies, diversions, and low flowing streams	0.41	37.00	9,125.00	1.910	1.327
#2	**1**	**Time of Concentration:**					**1.610**
#3	1	5. Nearly bare and untilled, and alluvial valley fans	0.13	1.00	743.49	0.360	0.573
		8. Large gullies, diversions, and low flowing streams	0.79	84.00	10,596.69	2.670	1.102
#3	**1**	**Time of Concentration:**					**1.675**
#3	2	5. Nearly bare and untilled, and alluvial valley fans	3.79	40.00	1,056.00	1.940	0.151
		8. Large gullies, diversions, and low flowing streams	1.20	135.00	11,282.00	3.280	0.955
#3	**2**	**Time of Concentration:**					**1.106**
#3	3	5. Nearly bare and untilled, and alluvial valley fans	1.48	14.00	945.00	1.210	0.216
		8. Large gullies, diversions, and low flowing streams	1.68	129.00	7,691.00	3.880	0.550
#3	**3**	**Time of Concentration:**					**0.766**
#4	1	5. Nearly bare and untilled, and alluvial valley fans	0.96	7.00	731.00	0.970	0.209
		8. Large gullies, diversions, and low flowing streams	1.94	169.00	8,725.00	4.170	0.581
#4	**1**	**Time of Concentration:**					**0.790**
#4	2	5. Nearly bare and untilled, and alluvial valley fans	4.40	43.00	978.00	2.090	0.129
		8. Large gullies, diversions, and low flowing streams	2.35	170.00	7,224.00	4.600	0.436
#4	**2**	**Time of Concentration:**					**0.565**
#5	1	5. Nearly bare and untilled, and alluvial valley fans	2.11	22.00	1,044.00	1.450	0.200
		8. Large gullies, diversions, and low flowing streams	3.14	162.00	5,158.00	5.310	0.269
#5	**1**	**Time of Concentration:**					**0.469**
#6	1	5. Nearly bare and untilled, and alluvial valley fans	4.94	12.00	243.00	2.220	0.030
		8. Large gullies, diversions, and low flowing streams	4.62	144.00	3,117.00	6.440	0.134
#6	**1**	**Time of Concentration:**					**0.164**
#6	2	5. Nearly bare and untilled, and alluvial valley fans	4.52	46.00	1,017.00	2.120	0.133
		8. Large gullies, diversions, and low flowing streams	3.40	132.00	3,879.00	5.530	0.194
#6	**2**	**Time of Concentration:**					**0.327**
#6	3	5. Nearly bare and untilled, and alluvial valley fans	2.83	23.00	813.00	1.680	0.134
		8. Large gullies, diversions, and low flowing streams	2.68	134.00	4,999.00	4.910	0.282
#6	**3**	**Time of Concentration:**					**0.416**
#6	4	5. Nearly bare and untilled, and alluvial valley fans	4.43	28.00	632.00	2.100	0.083

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
		8. Large gullies, diversions, and low flowing streams	2.77	182.00	6,575.00	4.990	0.366
#6	**4**	**Time of Concentration:**					**0.449**
#6	5	5. Nearly bare and untilled, and alluvial valley fans	6.63	41.00	618.00	2.570	0.066
		8. Large gullies, diversions, and low flowing streams	2.36	102.00	4,321.00	4.600	0.260
#6	**5**	**Time of Concentration:**					**0.326**
#6	6	5. Nearly bare and untilled, and alluvial valley fans	0.41	4.00	979.00	0.630	0.431
		8. Large gullies, diversions, and low flowing streams	2.88	170.00	5,907.00	5.080	0.322
#6	**6**	**Time of Concentration:**					**0.753**
#7	1	5. Nearly bare and untilled, and alluvial valley fans	18.35	60.00	327.00	4.280	0.021
		8. Large gullies, diversions, and low flowing streams	3.36	133.00	3,954.00	5.500	0.199
#7	**1**	**Time of Concentration:**					**0.220**
#7	2	5. Nearly bare and untilled, and alluvial valley fans	2.42	20.00	826.00	1.550	0.148
		8. Large gullies, diversions, and low flowing streams	2.59	188.00	7,257.00	4.820	0.418
#7	**2**	**Time of Concentration:**					**0.566**
#7	3	5. Nearly bare and untilled, and alluvial valley fans	10.34	74.00	716.00	3.210	0.061
		8. Large gullies, diversions, and low flowing streams	4.74	132.00	2,785.00	6.530	0.118
#7	**3**	**Time of Concentration:**					**0.179**
#7	4	5. Nearly bare and untilled, and alluvial valley fans	17.05	37.00	217.00	4.120	0.014
		8. Large gullies, diversions, and low flowing streams	3.52	102.00	2,899.00	5.620	0.143
#7	**4**	**Time of Concentration:**					**0.157**
#7	5	5. Nearly bare and untilled, and alluvial valley fans	0.95	2.00	211.00	0.970	0.060
		8. Large gullies, diversions, and low flowing streams	1.06	32.00	3,028.00	3.080	0.273
#7	**5**	**Time of Concentration:**					**0.333**

Subwatershed Muskingum Routing Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#3	1	8. Large gullies, diversions, and low flowing streams	0.68	25.00	3,656.00	2.480	0.409
#3	**1**	**Muskingum K:**					**0.409**
#3	2	8. Large gullies, diversions, and low flowing streams	0.39	5.00	1,298.00	1.860	0.193
#3	**2**	**Muskingum K:**					**0.193**

Copyright 1998 -2007 Pamela J. Schwab

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#4	1	8. Large gullies, diversions, and low flowing streams	0.64	20.00	3,139.00	2.390	0.364
#4	**1**	**Muskingum K:**					**0.364**
#6	1	8. Large gullies, diversions, and low flowing streams	0.82	44.00	5,337.00	2.720	0.545
#6	**1**	**Muskingum K:**					**0.545**
#6	2	8. Large gullies, diversions, and low flowing streams	1.47	82.00	5,593.07	3.630	0.427
#6	**2**	**Muskingum K:**					**0.427**
#6	3	8. Large gullies, diversions, and low flowing streams	0.66	21.00	3,199.00	2.430	0.365
#6	**3**	**Muskingum K:**					**0.365**
#6	4	8. Large gullies, diversions, and low flowing streams	0.74	12.00	1,631.00	2.570	0.176
#6	**4**	**Muskingum K:**					**0.176**
#6	6	8. Large gullies, diversions, and low flowing streams	0.00	0.00	0.00	0.000	0.000
#6	**6**	**Muskingum K:**					**0.000**
#7	1	8. Large gullies, diversions, and low flowing streams	0.86	73.00	8,524.00	2.770	0.854
#7	**1**	**Muskingum K:**					**0.854**
#7	2	8. Large gullies, diversions, and low flowing streams	0.89	58.00	6,527.00	2.820	0.642
#7	**2**	**Muskingum K:**					**0.642**
#7	3	8. Large gullies, diversions, and low flowing streams	0.83	50.00	5,997.00	2.730	0.610
#7	**3**	**Muskingum K:**					**0.610**
#7	4	8. Large gullies, diversions, and low flowing streams	1.11	34.00	3,071.00	3.150	0.270
#7	**4**	**Muskingum K:**					**0.270**
#7	5	8. Large gullies, diversions, and low flowing streams	0.00	0.00	0.00	0.000	0.000
#7	**5**	**Muskingum K:**					**0.000**

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc. (ml/l)	24VW (ml/l)
#1	999.370	999.370	162.56	29.77	308.7	12,523	3.66	2.22
#2	856.430	1,855.800	280.33	64.71	494.6	8,847	2.26	1.44
#3	2,374.080	4,229.880	611.92	177.96	1,239.2	8,405	1.82	1.10
#8	0.000	4,229.880	611.92	177.96	1,239.2	8,405	1.82	1.10
#4	1,068.640	5,298.520	681.43	227.14	2,024.4	27,253	6.05	1.45
#5	233.280	5,531.800	693.15	238.37	2,226.3	28,294	6.25	1.51
#6	1,164.130	6,695.930	729.05	292.36	3,144.8	28,310	5.83	1.62
#7	648.980	7,344.910	737.87	320.70	3,729.9	35,233	7.02	1.69

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc. (ml/l)	24VW (ml/l)
#1	999.370	999.370	24.54	4.06	35.1	8,569	1.37	1.01
#2	856.430	1,855.800	54.18	10.99	68.8	5,906	0.91	0.70
#3	2,374.080	4,229.880	162.83	37.32	242.2	6,598	1.12	0.81
#8	0.000	4,229.880	162.83	37.32	242.2	6,598	1.12	0.81
#4	1,068.640	5,298.520	184.02	48.38	413.6	22,630	4.06	1.12
#5	233.280	5,531.800	187.35	51.00	457.2	23,063	4.00	1.14
#6	1,164.130	6,695.930	198.53	63.15	649.4	22,914	3.78	1.24
#7	648.980	7,344.910	201.76	69.18	767.4	28,608	4.36	1.24

Civil Software Design, LLC

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc. (ml/l)	24VW (ml/l)
#1	999.370	999.370	102.78	14.94	162.3	10,997	2.81	2.03
#2	856.430	1,855.800	184.74	34.40	271.1	7,706	1.69	1.26
#3	2,374.080	4,229.880	431.44	100.54	736.4	7,513	1.50	1.07
#8	0.000	4,229.880	431.44	100.54	736.4	7,513	1.50	1.07
#4	1,068.640	5,298.520	482.25	128.96	1,216.8	24,685	5.00	1.40
#5	233.280	5,531.800	489.89	135.53	1,339.9	25,479	5.10	1.45
#6	1,164.130	6,695.930	516.87	166.75	1,900.8	25,548	4.74	1.54
#7	648.980	7,344.910	523.87	182.85	2,253.7	31,814	5.63	1.59

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc. (ml/l)	24VW (ml/l)
#1	999.370	999.370	172.71	24.46	286.1	11,847	3.37	2.44
#2	856.430	1,855.800	297.02	53.97	461.0	8,420	2.09	1.56
#3	2,374.080	4,229.880	643.53	150.86	1,161.2	7,904	1.65	1.18
#8	0.000	4,229.880	643.53	150.86	1,161.2	7,904	1.65	1.18
#4	1,068.640	5,298.520	716.55	192.81	1,900.8	25,592	5.50	1.55
#5	233.280	5,531.800	727.98	202.42	2,090.1	26,518	5.66	1.61
#6	1,164.130	6,695.930	766.65	248.48	2,957.5	26,507	5.28	1.73
#7	648.980	7,344.910	776.05	272.55	3,508.0	33,080	6.35	1.80

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc. (ml/l)	24VW (ml/l)
#1	999.370	999.370	238.50	33.34	407.6	12,383	3.74	2.70
#2	856.430	1,855.800	400.79	71.89	644.6	8,870	2.36	1.75
#3	2,374.080	4,229.880	833.00	195.96	1,557.5	8,153	1.78	1.27
#8	0.000	4,229.880	833.00	195.96	1,557.5	8,153	1.78	1.27
#4	1,068.640	5,298.520	925.53	249.91	2,536.1	26,223	5.88	1.66
#5	233.280	5,531.800	941.08	262.21	2,787.4	27,237	6.08	1.74
#6	1,164.130	6,695.930	988.90	321.44	3,935.3	27,254	5.69	1.87
#7	648.980	7,344.910	1,000.26	352.63	4,668.1	33,908	6.85	1.95

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc. (ml/l)	24VW (ml/l)
#1	999.370	999.370	317.38	43.86	557.8	12,883	4.07	2.94
#2	856.430	1,855.800	522.95	92.86	868.3	9,277	2.60	1.92
#3	2,374.080	4,229.880	1,050.99	247.96	2,028.7	8,385	1.92	1.37
#8	0.000	4,229.880	1,050.99	247.96	2,028.7	8,385	1.92	1.37
#4	1,068.640	5,298.520	1,165.55	315.66	3,287.9	26,769	6.25	1.78
#5	233.280	5,531.800	1,185.81	331.03	3,612.0	27,859	6.49	1.86
#6	1,164.130	6,695.930	1,244.10	405.34	5,090.3	27,832	6.08	2.00
#7	648.980	7,344.910	1,257.44	444.71	6,038.5	34,529	7.32	2.10

Attachment 18.B-4

Cottonwood Arroyo Baseline Hydrology and Sedimentology SEDCAD™ Model Output

Cottonwood Arroyo Pre-mine Hydrology and Sedimentology

The drainage subdivisions used to model the hydrology is shown on Exhibit 18.B.

Revised Febuary 2012

Art O'Hayre

Copyright 1998 -2007 Pamela J. Schwab

General Information

Storm Information:

Storm Type:	Type II-70
Design Storm:	10 yr - 6 hr
Rainfall Depth:	1.280 inches

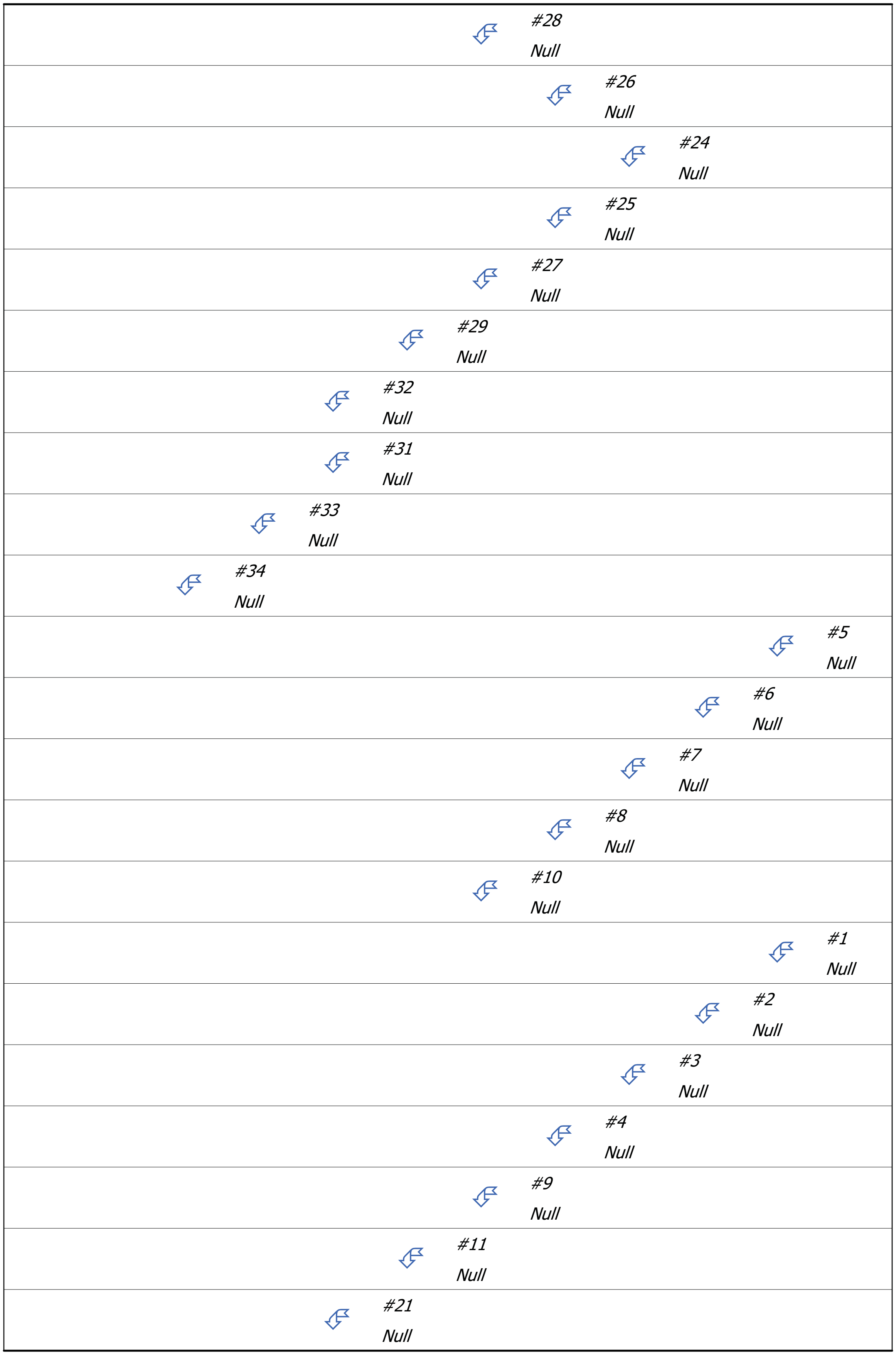
Particle Size Distribution:

Size (mm)	PostMine-LoamySand	PreMine-LoamySand	PreMine-Badlands	LoamySand Postmining
2.0000	100.000%	100.000%	100.000%	0.000%
0.1000	26.500%	30.000%	83.500%	0.000%
0.0500	14.000%	17.000%	77.000%	0.000%
0.0020	11.000%	11.000%	56.000%	0.000%
0.0010	0.000%	0.000%	0.000%	0.000%

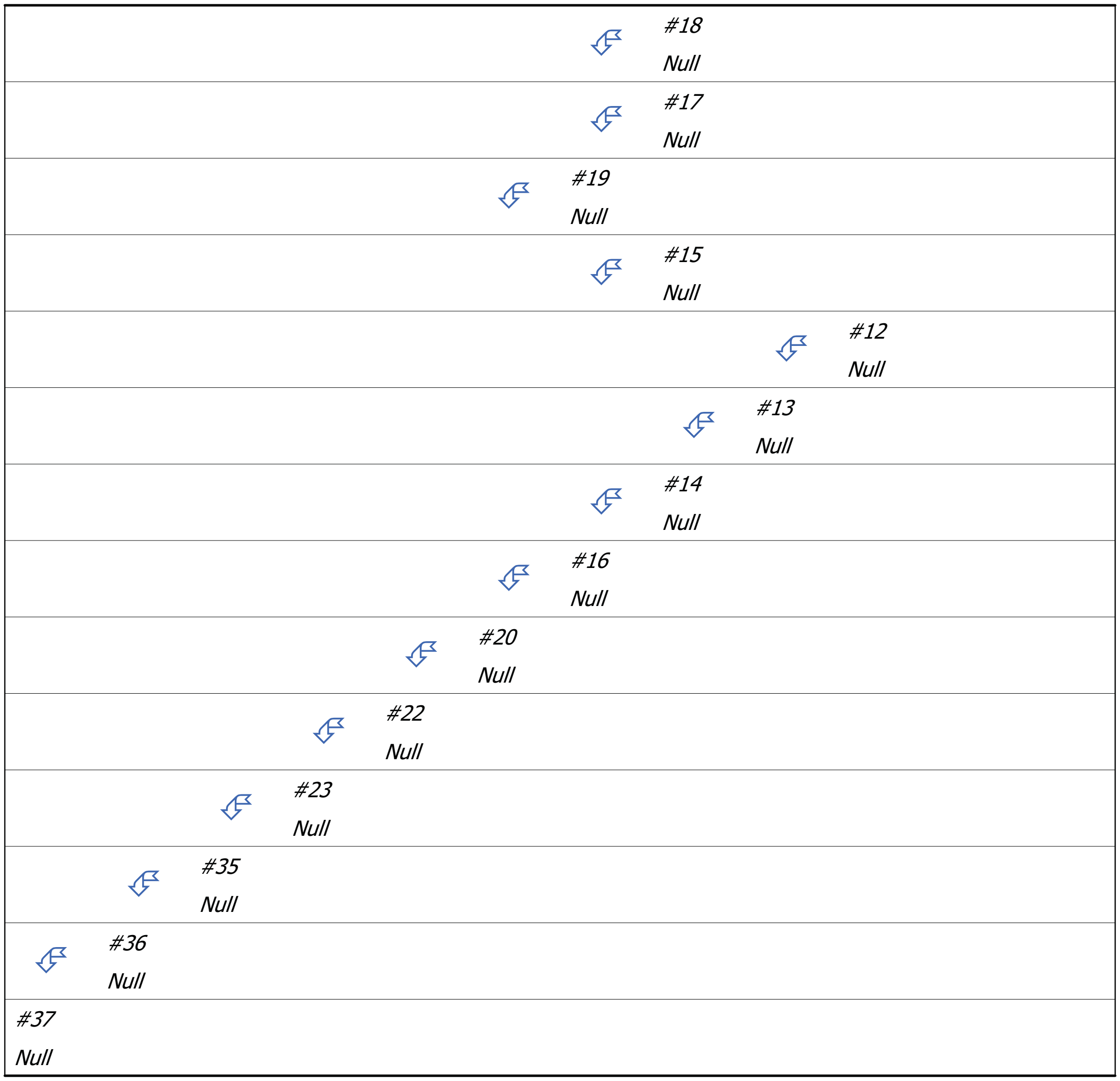
Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Null	#1	==>	#2	0.961	0.307	
Null	#2	==>	#3	0.068	0.331	
Null	#3	==>	#4	0.000	0.000	
Null	#4	==>	#9	0.718	0.281	
Null	#5	==>	#6	1.205	0.328	
Null	#6	==>	#7	0.189	0.304	
Null	#7	==>	#8	0.000	0.000	
Null	#8	==>	#10	0.989	0.300	
Null	#9	==>	#11	0.000	0.000	
Null	#10	==>	#11	0.000	0.000	
Null	#11	==>	#21	0.495	0.453	
Null	#12	==>	#13	0.076	0.330	
Null	#13	==>	#14	3.790	0.314	
Null	#14	==>	#16	1.198	0.286	
Null	#15	==>	#16	1.198	0.286	
Null	#16	==>	#20	0.911	0.280	
Null	#17	==>	#19	0.000	0.000	
Null	#18	==>	#19	0.000	0.000	
Null	#19	==>	#20	0.915	0.252	
Null	#20	==>	#22	0.000	0.000	
Null	#21	==>	#22	0.000	0.000	
Null	#22	==>	#23	0.811	0.247	
Null	#23	==>	#35	0.000	0.000	
Null	#24	==>	#25	0.964	0.340	
Null	#25	==>	#27	1.454	0.333	
Null	#26	==>	#27	1.454	0.333	
Null	#27	==>	#29	0.800	0.323	
Null	#28	==>	#29	0.800	0.323	
Null	#29	==>	#32	0.479	0.298	
Null	#30	==>	#32	0.479	0.298	
Null	#31	==>	#33	0.000	0.000	
Null	#32	==>	#33	0.000	0.000	
Null	#33	==>	#34	1.372	0.293	Inlet to North Fork Diversion
Null	#34	==>	#35	0.000	0.000	
Null	#35	==>	#36	0.735	0.251	
Null	#36	==>	#37	3.388	0.246	
Null	#37	==>	End	0.000	0.000	

#30
Null


#28
Null
#26
Null
#24
Null
#25
Null
#27
Null
#29
Null
#32
Null
#31
Null
#33
Null
#34
Null
#5
Null
#6
Null
#7
Null
#8
Null
#10
Null
#1
Null
#2
Null
#3
Null
#4
Null
#9
Null
#11
Null
#21
Null

Copyright 1998 -2007 Pamela J. Schwab



Structure Routing Details:

Stru #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	8. Large gullies, diversions, and low flowing streams	0.81	76.00	9,347.00	2.70	0.961
#1	**Muskingum K:**					**0.961**
#2	8. Large gullies, diversions, and low flowing streams	1.23	10.00	814.00	3.32	0.068
#2	**Muskingum K:**					**0.068**
#3	8. Large gullies, diversions, and low flowing streams	0.00	0.00	0.00	0.00	0.000
#3	**Muskingum K:**					**0.000**
#4	8. Large gullies, diversions, and low flowing streams	0.53	30.00	5,637.00	2.18	0.718
#4	**Muskingum K:**					**0.718**

Stru #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#5	8. Large gullies, diversions, and low flowing streams	1.17	165.00	14,065.00	3.24	1.205
#5	**Muskingum K:**					**1.205**
#6	8. Large gullies, diversions, and low flowing streams	0.78	14.00	1,799.25	2.64	0.189
#6	**Muskingum K:**					**0.189**
#8	8. Large gullies, diversions, and low flowing streams	0.72	65.00	9,046.00	2.54	0.989
#8	**Muskingum K:**					**0.989**
#11	8. Large gullies, diversions, and low flowing streams	30.00	8,801.00	29,336.66	16.43	0.495
#11	**Muskingum K:**					**0.495**
#12	8. Large gullies, diversions, and low flowing streams	1.21	11.00	906.00	3.30	0.076
#12	**Muskingum K:**					**0.076**
#13	8. Large gullies, diversions, and low flowing streams	0.92	363.00	39,301.00	2.88	3.790
#13	**Muskingum K:**					**3.790**
#14	8. Large gullies, diversions, and low flowing streams	0.58	57.00	9,834.00	2.28	1.198
#14	**Muskingum K:**					**1.198**
#15	8. Large gullies, diversions, and low flowing streams	0.58	57.00	9,834.00	2.28	1.198
#15	**Muskingum K:**					**1.198**
#16	8. Large gullies, diversions, and low flowing streams	0.52	37.00	7,084.00	2.16	0.911
#16	**Muskingum K:**					**0.911**
#19	8. Large gullies, diversions, and low flowing streams	0.33	19.00	5,699.00	1.73	0.915
#19	**Muskingum K:**					**0.915**
#22	8. Large gullies, diversions, and low flowing streams	0.31	15.00	4,852.00	1.66	0.811
#22	**Muskingum K:**					**0.811**
#24	8. Large gullies, diversions, and low flowing streams	1.46	184.00	12,568.00	3.62	0.964
#24	**Muskingum K:**					**0.964**
#25	8. Large gullies, diversions, and low flowing streams	1.28	228.00	17,755.00	3.39	1.454
#25	**Muskingum K:**					**1.454**
#26	8. Large gullies, diversions, and low flowing streams	1.28	228.00	17,755.62	3.39	1.454
#26	**Muskingum K:**					**1.454**
#27	8. Large gullies, diversions, and low flowing streams	1.07	96.00	8,938.00	3.10	0.800
#27	**Muskingum K:**					**0.800**
#28	8. Large gullies, diversions, and low flowing streams	1.07	96.00	8,938.00	3.10	0.800
#28	**Muskingum K:**					**0.800**
#29	8. Large gullies, diversions, and low flowing streams	0.70	30.00	4,313.00	2.50	0.479

Stru #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#29	**Muskingum K:**					**0.479**
#30	8. Large gullies, diversions, and low flowing streams	0.70	30.00	4,313.00	2.50	0.479
#30	**Muskingum K:**					**0.479**
#33	8. Large gullies, diversions, and low flowing streams	0.65	77.00	11,910.00	2.41	1.372
#33	**Muskingum K:**					**1.372**
#35	8. Large gullies, diversions, and low flowing streams	0.33	15.00	4,554.00	1.72	0.735
#35	**Muskingum K:**					**0.735**
#36	8. Large gullies, diversions, and low flowing streams	0.30	60.00	20,005.00	1.64	3.388
#36	**Muskingum K:**					**3.388**

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc. (ml/l)	24VW (ml/l)
#30	476.400	476.400	15.70	2.21	15.3	7,167	2.78	1.97
#28	1,217.900	1,217.900	382.70	43.31	2,332.2	55,472	0.03	0.02
#26	2,486.400	2,486.400	68.99	19.67	120.6	6,040	1.43	1.06
#24	8,061.800	8,061.800	94.96	55.80	195.1	4,045	0.42	0.27
#25	1,015.700	9,077.500	129.82	70.58	314.3	15,722	4.37	0.91
#27	1,783.700	13,347.600	257.18	116.43	1,049.3	28,391	12.11	2.82
#29	966.000	15,531.500	568.72	193.37	5,788.0	69,501	6.28	1.96
#32	293.700	16,301.600	577.68	208.81	6,156.3	61,380	1.79	0.63
#31	957.100	957.100	385.29	40.58	1,766.9	40,461	0.55	0.43
#33	0.000	17,258.700	689.75	249.39	7,923.2	52,770	1.36	0.59
#34	932.500	18,191.200	700.01	280.79	7,357.0	43,693	0.08	0.03
#5	2,023.000	2,023.000	569.83	57.97	1,713.8	40,068	2.73	1.47
#6	1,743.200	3,766.200	653.56	112.46	3,143.8	35,092	0.20	0.12
#7	2,395.300	6,161.500	1,113.99	216.70	8,725.2	44,676	0.00	0.00
#8	0.000	6,161.500	1,113.99	216.70	8,725.2	44,676	0.00	0.00
#10	1,053.200	7,214.700	1,133.41	254.36	8,518.5	40,724	0.09	0.05
#1	2,411.100	2,411.100	392.20	53.71	1,765.4	36,630	4.79	3.12
#2	1,497.000	3,908.100	470.12	113.29	2,441.9	23,797	0.18	0.12
#3	862.700	4,770.800	595.07	141.33	2,727.8	18,782	0.05	0.04
#4	0.000	4,770.800	595.07	141.33	2,727.8	18,782	0.05	0.04
#9	425.500	5,196.300	607.92	156.87	2,731.1	16,538	0.00	0.00
#11	0.000	12,411.000	1,534.59	411.23	11,249.6	33,725	0.05	0.03
#21	1,080.800	13,491.800	1,588.44	441.92	11,292.1	32,718	0.02	0.01
#18	848.500	848.500	183.01	26.77	311.1	14,117	0.05	0.03
#17	182.200	182.200	129.55	8.20	119.5	15,200	0.69	0.49
#19	0.000	1,030.700	301.05	34.98	430.6	13,250	0.20	0.14
#15	1,992.700	1,992.700	432.94	58.72	2,203.9	44,481	1.26	0.77
#12	3,494.500	3,494.500	233.63	38.33	558.4	16,053	6.71	4.46
#13	2,720.700	6,215.200	410.93	68.61	1,149.1	17,747	8.09	5.58
#14	5,096.800	11,312.000	521.22	201.24	4,552.2	78,723	1.23	0.25
#16	876.500	14,181.200	881.07	298.76	8,200.5	55,106	1.30	0.47
#20	681.900	15,893.800	909.02	362.94	8,814.8	42,311	0.37	0.15
#22	0.000	29,385.600	2,359.66	804.86	20,106.9	33,948	0.14	0.08
#23	752.900	30,138.500	2,337.19	824.67	19,890.7	32,983	0.00	0.00
#35	0.000	48,329.700	2,883.99	1,105.46	27,247.8	30,808	0.01	0.01
#36	730.590	49,060.290	2,870.74	1,119.67	27,292.6	36,689	0.01	0.01
#37	2,208.500	51,268.790	2,839.00	1,165.01	27,242.5	31,579	0.24	0.13

Particle Size Distribution(s) at Each Structure

Structure #30:

Size (mm)	In/Out
2.0000	100.000%
0.1000	100.000%
0.0500	61.212%
0.0020	39.608%
0.0010	0.000%

Structure #28:

Size (mm)	In/Out
2.0000	100.000%
0.1000	100.000%
0.0500	100.000%
0.0020	99.873%
0.0010	0.000%

Structure #26:

Size (mm)	In/Out
2.0000	100.000%
0.1000	100.000%
0.0500	84.182%
0.0020	54.471%
0.0010	0.000%

Structure #24:

Size (mm)	In/Out
2.0000	100.000%
0.1000	100.000%
0.0500	93.900%
0.0020	78.509%
0.0010	0.000%

Copyright 1998 -2007 Pamela J. Schwab

Structure #25:

Size (mm)	In/Out
2.0000	100.000%
0.1000	80.595%
0.0500	68.505%
0.0020	61.192%
0.0010	0.000%

Structure #27:

Size (mm)	In/Out
2.0000	100.000%
0.1000	75.314%
0.0500	52.685%
0.0020	39.141%
0.0010	0.000%

Structure #29:

Size (mm)	In/Out
2.0000	100.000%
0.1000	95.562%
0.0500	91.459%
0.0020	85.259%
0.0010	0.000%

Structure #32:

Size (mm)	In/Out
2.0000	100.000%
0.1000	100.000%
0.0500	99.317%
0.0020	92.618%
0.0010	0.000%

Structure #31:

Size (mm)	In/Out
2.0000	100.000%
0.1000	100.000%
0.0500	100.000%
0.0020	96.135%
0.0010	0.000%

Structure #33 (Inlet to North Fork Diversion):

Size (mm)	In/Out
2.0000	100.000%
0.1000	100.000%
0.0500	99.470%
0.0020	93.402%
0.0010	0.000%

Structure #34:

Size (mm)	In/Out
2.0000	100.000%
0.1000	100.000%
0.0500	100.000%
0.0020	99.500%
0.0010	0.000%

Structure #5:

Size (mm)	In/Out
2.0000	100.000%
0.1000	100.000%
0.0500	93.455%
0.0020	88.980%
0.0010	0.000%

Structure #6:

Size (mm)	In/Out
2.0000	100.000%
0.1000	100.000%
0.0500	100.000%
0.0020	98.356%
0.0010	0.000%

Structure #7:

Size (mm)	In/Out
2.0000	100.000%
0.1000	100.000%
0.0500	100.000%
0.0020	100.000%
0.0010	0.000%

Structure #8:

Size (mm)	In/Out
2.0000	100.000%
0.1000	100.000%
0.0500	100.000%
0.0020	100.000%
0.0010	0.000%

Structure #10:

Size (mm)	In/Out
2.0000	100.000%
0.1000	100.000%
0.0500	99.796%
0.0020	99.658%
0.0010	0.000%

Structure #1:

Size (mm)	In/Out
2.0000	100.000%
0.1000	95.498%
0.0500	85.914%
0.0020	80.819%
0.0010	0.000%

Structure #2:

Size (mm)	In/Out
2.0000	100.000%
0.1000	100.000%
0.0500	100.000%
0.0020	97.866%
0.0010	0.000%

Structure #3:

Size (mm)	In/Out
2.0000	100.000%
0.1000	100.000%
0.0500	100.000%
0.0020	99.192%
0.0010	0.000%

Structure #4:

Size (mm)	In/Out
2.0000	100.000%
0.1000	100.000%
0.0500	100.000%
0.0020	99.192%
0.0010	0.000%

Structure #9:

Size (mm)	In/Out
2.0000	100.000%
0.1000	100.000%
0.0500	100.000%
0.0020	100.000%
0.0010	0.000%

Structure #11:

Size (mm)	In/Out
2.0000	100.000%
0.1000	100.000%
0.0500	99.845%
0.0020	99.741%
0.0010	0.000%

Structure #21:

Size (mm)	In/Out
2.0000	100.000%
0.1000	100.000%
0.0500	100.000%
0.0020	99.791%
0.0010	0.000%

Structure #18:

Size (mm)	In/Out
2.0000	100.000%
0.1000	100.000%
0.0500	100.000%
0.0020	99.022%
0.0010	0.000%

Copyright 1998 -2007 Pamela J. Schwab

Structure #17:

Size (mm)	In/Out
2.0000	100.000%
0.1000	100.000%
0.0500	100.000%
0.0020	87.184%
0.0010	0.000%

Structure #19:

Size (mm)	In/Out
2.0000	100.000%
0.1000	100.000%
0.0500	100.000%
0.0020	95.736%
0.0010	0.000%

Structure #15:

Size (mm)	In/Out
2.0000	100.000%
0.1000	100.000%
0.0500	98.087%
0.0020	94.423%
0.0010	0.000%

Structure #12:

Size (mm)	In/Out
2.0000	100.000%
0.1000	83.026%
0.0500	56.746%
0.0020	36.718%
0.0010	0.000%

Structure #13:

Size (mm)	In/Out
2.0000	100.000%
0.1000	80.507%
0.0500	51.093%
0.0020	33.060%
0.0010	0.000%

Structure #14:

Size (mm)	In/Out
2.0000	100.000%
0.1000	100.000%
0.0500	100.000%
0.0020	95.609%
0.0010	0.000%

Structure #16:

Size (mm)	In/Out
2.0000	100.000%
0.1000	100.000%
0.0500	99.498%
0.0020	93.958%
0.0010	0.000%

Structure #20:

Size (mm)	In/Out
2.0000	100.000%
0.1000	100.000%
0.0500	100.000%
0.0020	97.546%
0.0010	0.000%

Structure #22:

Size (mm)	In/Out
2.0000	100.000%
0.1000	100.000%
0.0500	100.000%
0.0020	98.807%
0.0010	0.000%

Structure #23:

Size (mm)	In/Out
2.0000	100.000%
0.1000	100.000%
0.0500	100.000%
0.0020	100.000%
0.0010	0.000%

Structure #35:

Size (mm)	In/Out
2.0000	100.000%
0.1000	100.000%
0.0500	100.000%
0.0020	99.865%
0.0010	0.000%

Structure #36:

Size (mm)	In/Out
2.0000	100.000%
0.1000	100.000%
0.0500	100.000%
0.0020	99.890%
0.0010	0.000%

Structure #37:

Size (mm)	In/Out
2.0000	100.000%
0.1000	100.000%
0.0500	99.235%
0.0020	98.796%
0.0010	0.000%

Structure Detail:

Structure #30 (Null)

Structure #28 (Null)

Structure #26 (Null)

Structure #24 (Null)

Structure #25 (Null)

Structure #27 (Null)

Structure #29 (Null)

Structure #32 (Null)

Structure #31 (Null)

Structure #33 (Null)

Inlet to North Fork Diversion

Structure #34 (Null)

Structure #5 (Null)

Structure #6 (Null)

Structure #7 (Null)

Structure #8 (Null)

Structure #10 (Null)

Structure #1 (Null)

Structure #2 (Null)

Structure #3 (Null)

Structure #4 (Null)

Structure #9 (Null)

Structure #11 (Null)

Structure #21 (Null)

Structure #18 (Null)

Structure #17 (Null)

Structure #19 (Null)

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#30	1	476.400	1.131	0.000	0.000	73.100	M	15.70	2.214
	Σ	**476.400**						**15.70**	**2.214**
#28	1	772.300	0.657	0.523	0.334	90.400	M	348.71	27.461
	2	445.600	0.587	0.000	0.000	90.400	M	217.35	15.851
	Σ	**1,217.900**						**382.70**	**43.312**
#26	1	447.600	2.192	0.000	0.000	74.200	M	10.72	2.498
	2	2,038.800	3.000	0.000	0.000	77.000	M	59.31	17.168
	Σ	**2,486.400**						**68.99**	**19.666**
#24	1	2,607.500	5.367	2.377	0.305	75.200	M	35.68	16.987
	2	2,331.900	4.813	2.431	0.304	74.700	M	32.19	14.077
	3	1,758.500	2.231	1.788	0.297	76.200	M	57.92	13.255
	4	1,363.900	2.618	0.000	0.000	77.000	M	44.42	11.485
	Σ	**8,061.800**						**94.96**	**55.804**
#25	1	515.200	0.990	0.342	0.357	78.200	M	44.10	5.083
	2	130.500	0.787	0.342	0.357	78.100	M	13.16	1.271
	3	370.000	0.516	0.000	0.000	85.700	M	125.08	8.421
	Σ	**9,077.500**						**129.82**	**70.579**
#27	1	354.400	0.612	1.233	0.337	83.100	M	81.00	6.173
	2	305.200	0.529	1.054	0.328	84.000	M	85.27	5.846
	3	289.800	0.692	0.551	0.328	75.500	M	21.73	1.976
	4	253.000	0.361	0.551	0.328	79.400	M	53.79	2.908
	5	581.300	0.980	0.000	0.000	82.300	M	84.68	9.284
	Σ	**13,347.600**						**257.18**	**116.433**
#29	1	508.800	0.409	0.416	0.312	89.500	M	285.47	16.691
	2	233.200	0.521	0.291	0.312	91.600	M	136.95	9.256
	3	224.000	0.467	0.000	0.000	90.000	M	121.81	7.678
	Σ	**15,531.500**						**568.72**	**193.370**
#32	1	293.700	0.576	0.000	0.000	93.000	M	183.24	13.227
	Σ	**16,301.600**						**577.68**	**208.811**
#31	1	431.100	0.588	0.450	0.336	91.500	M	232.24	16.956
	2	325.800	0.432	0.149	0.327	93.000	M	240.11	14.690
	3	200.200	0.373	0.000	0.000	92.900	M	157.01	8.931
	Σ	**957.100**						**385.29**	**40.576**
#33	Σ	**17,258.700**						**689.75**	**249.387**

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#34	1	91.700	0.244	0.965	0.300	92.300	M	80.75	3.907
	2	105.200	0.256	0.965	0.300	93.000	M	96.06	4.763
	3	735.600	0.885	0.000	0.000	88.900	M	231.14	22.735
	Σ	**18,191.200**						**700.01**	**280.792**
#5	1	503.600	0.618	0.000	0.000	87.600	M	181.32	13.768
	2	406.500	0.388	0.501	0.350	84.800	M	150.41	8.450
	3	439.600	0.342	0.681	0.347	87.800	M	231.97	12.313
	4	162.600	0.280	0.681	0.347	86.000	M	79.58	3.825
	5	294.100	0.375	1.021	0.348	92.000	M	213.88	12.088
	6	216.600	0.272	1.018	0.348	90.100	M	154.07	7.526
	Σ	**2,023.000**						**569.83**	**57.970**
#6	1	149.100	0.331	0.000	0.000	92.600	M	120.20	6.499
	2	245.000	0.529	0.192	0.328	88.100	M	103.04	7.033
	3	276.200	0.450	0.461	0.319	89.500	M	146.70	9.035
	4	158.400	0.380	1.385	0.185	93.000	M	124.15	7.126
	5	206.200	0.402	0.796	0.320	89.400	M	115.74	6.701
	6	414.000	0.430	1.066	0.323	87.200	M	181.89	10.921
	7	294.300	0.535	1.066	0.323	86.400	M	104.00	7.171
	Σ	**3,766.200**						**653.56**	**112.457**
#7	1	731.700	1.274	0.000	0.000	93.000	M	255.12	32.900
	2	445.800	1.043	0.000	0.000	93.000	M	182.08	20.038
	3	270.800	0.804	0.000	0.000	93.000	M	134.47	12.176
	4	78.900	0.267	1.035	0.328	93.000	M	71.04	3.568
	5	154.900	0.310	1.071	0.326	93.000	M	132.26	6.996
	6	101.400	0.288	1.164	0.328	92.900	M	88.35	4.536
	7	117.700	0.298	1.344	0.329	92.200	M	95.91	4.942
	8	494.100	0.518	1.344	0.329	91.300	M	283.54	19.084
	Σ	**6,161.500**						**1,113.99**	**216.697**
#8	1	0.000	0.000	0.000	0.000	1.000	0.00	0.000	
	Σ	**6,161.500**						**1,113.99**	**216.697**
#10	1	355.500	1.286	0.000	0.000	93.000	M	123.01	15.981
	2	307.100	1.282	0.668	0.305	83.200	M	39.93	5.401
	3	147.300	1.245	0.517	0.303	90.600	M	41.73	5.327
	4	126.400	0.585	0.517	0.303	93.000	M	78.09	5.694
	5	116.900	1.179	0.621	0.305	93.000	M	43.37	5.257
	Σ	**7,214.700**						**1,133.41**	**254.357**
#1	1	557.400	0.941	0.000	0.000	83.600	M	97.16	10.228
	2	169.600	1.616	0.677	0.333	93.000	M	48.64	7.624
	3	636.400	1.842	0.729	0.333	81.000	M	47.29	8.792
	4	223.400	0.846	1.005	0.336	84.100	M	44.68	4.320

Copyright 1998 -2007 Pamela J. Schwab

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
	5	77.700	0.330	1.392	0.341	81.400	M	22.18	1.129
	6	746.600	0.678	1.392	0.341	88.200	M	267.03	21.621
	Σ	**2,411.100**						**392.20**	**53.715**
#2	1	257.000	0.423	0.000	0.000	93.000	M	191.46	11.596
	2	180.500	0.562	0.478	0.281	91.800	M	102.88	7.288
	3	200.700	0.687	0.574	0.283	93.000	M	111.40	9.029
	4	438.600	0.811	0.574	0.283	93.000	M	216.42	19.727
	5	420.200	1.247	0.801	0.293	88.000	M	92.44	11.930
	Σ	**3,908.100**						**470.12**	**113.285**
#3	1	172.600	0.443	0.000	0.000	93.000	M	125.54	7.770
	2	311.200	0.890	0.000	0.000	88.900	M	97.37	9.620
	3	378.900	0.632	0.209	0.314	87.900	M	138.33	10.658
	Σ	**4,770.800**						**595.07**	**141.332**
#4	Σ	**4,770.800**						**595.07**	**141.332**
#9	1	425.500	0.830	0.000	0.000	90.700	M	166.84	15.542
	Σ	**5,196.300**						**607.92**	**156.874**
#11	Σ	**12,411.000**						**1,534.59**	**411.231**
#21	1	272.800	0.819	0.000	0.000	86.900	M	74.74	6.974
	2	230.500	0.388	0.694	0.266	89.200	M	129.51	7.335
	3	181.100	0.289	0.877	0.256	91.300	M	138.97	7.007
	4	396.400	0.939	0.877	0.256	86.100	M	90.27	9.371
	Σ	**13,491.800**						**1,588.44**	**441.918**
#18	1	301.700	0.652	0.000	0.000	93.000	M	173.54	13.585
	2	546.800	0.768	0.561	0.320	86.300	M	148.05	13.189
	Σ	**848.500**						**183.01**	**26.774**
#17	1	182.200	0.462	0.000	0.000	93.000	M	129.55	8.202
	Σ	**182.200**						**129.55**	**8.202**
#19	Σ	**1,030.700**						**301.05**	**34.976**
#15	1	437.400	0.803	0.000	0.000	91.300	M	185.92	16.863
	2	549.000	0.637	0.654	0.327	91.300	M	275.19	21.177
	3	1,006.300	1.023	0.768	0.331	84.700	M	185.11	20.683
	Σ	**1,992.700**						**432.94**	**58.723**
#12	1	517.800	0.791	0.000	0.000	81.900	M	85.06	7.915
	2	229.000	0.571	0.043	0.418	80.100	M	38.64	2.855
	3	592.700	0.706	0.044	0.417	81.500	M	101.30	8.668
	4	1,806.900	1.542	0.487	0.362	76.700	M	86.99	14.604
	5	348.100	0.618	0.487	0.362	80.000	54.66	4.285	

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
	Σ	**3,494.500**						**233.63**	**38.327**
#13	1	411.600	0.725	0.000	0.000	79.700	M	55.06	4.891
	2	636.400	0.774	0.322	0.336	80.700	M	91.95	8.503
	3	319.000	0.575	0.685	0.318	85.500	M	98.20	7.115
	4	231.700	0.314	0.923	0.328	80.400	M	60.73	3.000
	5	1,122.000	1.308	0.923	0.328	74.700	M	44.53	6.775
	Σ	**6,215.200**						**410.93**	**68.612**
#14	1	405.900	0.384	0.000	0.000	90.800	M	263.85	14.961
	2	411.100	0.452	0.707	0.308	90.700	M	242.63	15.020
	3	787.400	0.658	0.975	0.307	91.400	M	389.56	30.676
	4	144.200	0.341	1.716	0.310	86.200	M	65.46	3.461
	5	343.800	0.289	1.970	0.312	86.500	M	173.76	8.480
	6	392.800	0.806	2.107	0.316	81.900	M	63.61	6.004
	7	528.200	0.518	2.544	0.316	87.200	M	206.25	13.918
	8	890.900	1.253	2.544	0.316	83.500	M	122.07	16.175
	9	741.400	1.076	3.047	0.316	84.800	M	132.42	15.394
	10	451.100	0.916	3.354	0.316	83.900	M	83.00	8.542
	Σ	**11,312.000**						**521.22**	**201.243**
#16	1	329.600	0.641	0.000	0.000	93.000	M	191.76	14.834
	2	348.400	0.542	0.509	0.286	92.500	M	216.12	14.980
	3	198.500	0.266	0.943	0.279	93.000	M	178.92	8.977
	Σ	**14,181.200**						**881.07**	**298.756**
#20	1	296.300	0.667	0.000	0.000	91.700	M	149.26	11.862
	2	385.600	0.713	0.476	0.440	93.000	M	208.57	17.345
	Σ	**15,893.800**						**909.02**	**362.939**
#22	Σ	**29,385.600**						**2,359.66**	**804.857**
#23	1	442.400	0.960	0.000	0.000	85.300	M	91.16	9.657
	2	310.500	0.538	0.559	0.291	89.500	M	147.54	10.156
	Σ	**30,138.500**						**2,337.19**	**824.670**
#35	Σ	**48,329.700**						**2,883.99**	**1,105.461**
#36	1	298.200	0.987	0.000	0.000	85.000	M	58.26	6.317
	2	196.800	0.441	0.000	0.000	87.900	M	91.10	5.542
	3	235.590	0.885	0.166	0.372	78.300	M	22.32	2.354
	Σ	**49,060.290**						**2,870.74**	**1,119.675**
#37	1	744.000	1.756	0.000	0.000	84.800	M	88.80	15.442
	2	296.000	0.439	1.780	0.243	87.800	M	136.09	8.260
	3	237.700	0.333	1.649	0.246	85.500	M	102.26	5.321
	4	561.400	1.502	1.780	0.243	84.100	M	70.78	10.848

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
	5	369.400	0.817	2.236	0.284	81.600	M	57.12	5.464
	Σ	**51,268.790**						**2,839.00**	**1,165.010**

Subwatershed Sedimentology Detail:

Stru #	SWS #	Soil K	L (ft)	S (%)	C	P	PS #	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc (ml/l)	24VW (ml/l)
#30	1	0.095	200.00	3.80	0.3720	1.0000	2	15.3	7,167	2.78	1.97
	Σ							**15.3**	**7,167**	**2.78**	**1.97**
#28	1	0.187	100.00	10.10	0.3750	1.0000	3	1,831.9	67,442	0.00	0.00
	2	0.196	100.00	10.20	0.3930	1.0000	3	1,151.2	74,204	0.07	0.05
	Σ							**2,332.2**	**55,472**	**0.03**	**0.02**
#26	1	0.155	400.00	1.40	0.3480	1.0000	2	10.2	4,082	1.09	0.81
	2	0.155	300.00	2.40	0.3340	1.0000	2	110.4	6,393	1.49	1.10
	Σ							**120.6**	**6,040**	**1.43**	**1.06**
#24	1	0.128	300.00	2.30	0.3360	1.0000	2	66.0	3,840	0.35	0.26
	2	0.136	300.00	2.70	0.3440	1.0000	2	70.5	4,930	0.50	0.37
	3	0.107	300.00	2.30	0.3330	1.0000	2	62.4	4,664	1.37	1.02
	4	0.163	400.00	1.60	0.3210	1.0000	2	57.9	5,031	1.35	0.99
	Σ							**195.1**	**4,045**	**0.42**	**0.27**
#25	1	0.125	400.00	1.90	0.3440	1.0000	2	34.8	7,104	3.32	2.35
	2	0.124	300.00	2.60	0.3280	1.0000	2	9.3	7,737	3.85	2.68
	3	0.122	175.00	4.90	0.2660	1.0000	2	138.2	17,512	10.27	7.04
	Σ							**314.3**	**15,722**	**4.37**	**0.91**
#27	1	0.127	175.00	5.90	0.3160	1.0000	2	134.4	22,614	12.66	8.90
	2	0.122	150.00	7.50	0.2920	1.0000	2	138.7	24,759	14.29	9.99
	3	0.070	125.00	8.40	0.3270	1.0000	2	23.7	12,704	6.26	4.32
	4	0.097	125.00	9.60	0.3170	1.0000	2	80.5	30,075	17.67	11.85
	5	0.126	125.00	8.90	0.3290	1.0000	2	239.4	26,689	13.37	9.42
	Σ							**1,049.3**	**28,391**	**12.11**	**2.82**
#29	1	0.190	125.00	9.80	0.3930	1.0000	3	1,365.3	83,318	3.07	2.16
	2	0.203	125.00	8.90	0.3940	1.0000	3	603.0	66,304	1.59	1.12
	3	0.193	125.00	8.40	0.3940	1.0000	3	441.4	59,660	1.55	1.08
	Σ							**5,788.0**	**69,501**	**6.28**	**1.96**
#32	1	0.210	150.00	7.70	0.3990	1.0000	3	811.1	62,434	1.37	0.97
	Σ							**6,156.3**	**61,380**	**1.79**	**0.63**

Stru #	SWS #	Soil K	L (ft)	S (%)	C	P	PS #	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc (ml/l)	24VW (ml/l)
#31	1	0.204	125.00	8.70	0.3620	1.0000	3	1,013.7	60,814	0.53	0.37
	2	0.210	150.00	7.30	0.3990	1.0000	3	950.2	65,819	3.41	2.41
	3	0.210	175.00	4.50	0.3980	1.0000	3	385.8	44,601	2.82	1.98
	Σ							**1,766.9**	**40,461**	**0.55**	**0.43**
#33	Σ							**7,923.2**	**52,770**	**1.36**	**0.59**
#34	1	0.189	175.00	4.60	0.2250	1.0000	3	86.5	22,344	1.96	1.42
	2	0.206	175.00	5.10	0.3620	1.0000	3	206.3	43,231	3.80	2.76
	3	0.176	175.00	4.20	0.2510	1.0000	3	400.7	18,159	0.00	0.00
	Σ							**7,357.0**	**43,693**	**0.08**	**0.03**
#5	1	0.149	75.00	12.50	0.3230	1.0000	3	670.0	50,428	0.00	0.00
	2	0.133	75.00	15.80	0.3190	1.0000	2	545.2	67,505	40.75	28.02
	3	0.103	100.00	11.00	0.2030	1.0000	3	312.6	26,590	1.17	0.81
	4	0.093	75.00	13.80	0.2130	1.0000	2	96.3	26,589	16.60	11.46
	5	0.123	100.00	11.00	0.1370	1.0000	3	238.9	20,258	1.18	0.84
	6	0.149	75.00	14.70	0.1990	1.0000	3	330.1	44,599	3.21	2.28
	Σ							**1,713.8**	**40,068**	**2.73**	**1.47**
#6	1	0.208	175.00	4.30	0.3980	1.0000	3	263.3	41,902	2.95	2.07
	2	0.183	175.00	5.40	0.3910	1.0000	3	271.1	40,223	0.00	0.00
	3	0.188	150.00	7.60	0.3900	1.0000	3	500.1	56,955	1.53	1.07
	4	0.210	150.00	6.30	0.3990	1.0000	3	380.9	52,378	3.26	2.41
	5	0.185	125.00	8.10	0.3860	1.0000	3	351.4	53,638	2.03	1.44
	6	0.104	100.00	11.30	0.2240	1.0000	3	295.4	27,989	0.49	0.34
	7	0.164	100.00	11.20	0.3740	1.0000	3	444.3	63,189	0.00	0.00
	Σ							**3,143.8**	**35,092**	**0.20**	**0.12**
#7	1	0.208	150.00	7.80	0.3780	1.0000	3	1,546.4	47,076	0.00	0.00
	2	0.209	100.00	10.20	0.3940	1.0000	3	1,272.4	63,450	0.00	0.00
	3	0.210	150.00	6.70	0.3990	1.0000	3	570.4	47,474	0.00	0.00
	4	0.210	100.00	11.50	0.3990	1.0000	3	343.1	94,143	8.06	5.87
	5	0.210	150.00	7.10	0.3990	1.0000	3	436.9	62,203	4.78	3.45
	6	0.209	150.00	7.90	0.3990	1.0000	3	301.6	65,955	5.34	3.87
	7	0.206	75.00	15.50	0.3990	1.0000	3	593.0	116,344	8.81	6.42
	8	0.202	75.00	14.50	0.3980	1.0000	3	2,089.2	107,811	2.44	1.76
	Σ							**8,725.2**	**44,676**	**0.00**	**0.00**
#8	1	0.000	0.00	0.00	0.0000	1.0000	0	0.0	1	0.00	0.00
	Σ							**8,725.2**	**44,676**	**0.00**	**0.00**
#10	1	0.190	300.00	2.70	0.1930	1.0000	3	125.7	8,003	0.00	0.00
	2	0.153	200.00	3.50	0.3610	1.0000	2	61.7	11,607	5.45	3.93
	3	0.189	200.00	3.70	0.3190	1.0000	3	72.2	13,712	0.00	0.00
	4	0.190	300.00	2.10	0.1940	1.0000	3	43.8	7,943	0.16	0.11

Stru #	SWS #	Soil K	L (ft)	S (%)	C	P	PS #	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc (ml/l)	24VW (ml/l)
	5	0.201	300.00	2.00	0.3030	1.0000	3	47.8	9,191	0.00	0.00
	Σ							**8,518.5**	**40,724**	**0.09**	**0.05**
#1	1	0.157	150.00	6.80	0.3830	1.0000	2	313.9	31,708	16.32	11.49
	2	0.210	150.00	6.60	0.3990	1.0000	3	244.8	32,032	0.00	0.00
	3	0.149	200.00	3.90	0.3870	1.0000	2	102.9	11,753	4.57	3.34
	4	0.169	175.00	4.70	0.3950	1.0000	2	105.8	25,092	13.31	9.47
	5	0.157	100.00	10.10	0.3940	1.0000	2	57.7	53,203	32.06	22.27
	6	0.175	75.00	12.60	0.2840	1.0000	3	1,117.8	52,264	0.00	0.00
	Σ							**1,765.4**	**36,630**	**4.79**	**3.12**
#2	1	0.190	150.00	7.90	0.1930	1.0000	3	346.0	30,942	1.66	1.16
	2	0.184	175.00	4.80	0.2010	1.0000	3	127.8	18,066	0.30	0.21
	3	0.202	200.00	3.90	0.3220	1.0000	3	190.3	21,517	0.00	0.00
	4	0.203	150.00	7.40	0.3220	1.0000	3	837.0	42,735	0.00	0.00
	5	0.181	175.00	5.10	0.3710	1.0000	3	305.1	25,752	0.00	0.00
	Σ							**2,441.9**	**23,797**	**0.18**	**0.12**
#3	1	0.190	175.00	5.20	0.1930	1.0000	3	158.4	21,221	1.05	0.74
	2	0.177	175.00	4.20	0.2560	1.0000	3	156.5	16,762	0.00	0.00
	3	0.166	175.00	4.30	0.2290	1.0000	3	173.0	16,953	0.00	0.00
	Σ							**2,727.8**	**18,782**	**0.05**	**0.04**
#4	Σ							**2,727.8**	**18,782**	**0.05**	**0.04**
#9	1	0.189	175.00	4.44	0.1970	1.0000	3	239.5	15,887	0.00	0.00
	Σ							**2,731.1**	**16,538**	**0.00**	**0.00**
#11	Σ							**11,249.6**	**33,725**	**0.05**	**0.03**
#21	1	0.177	175.00	4.44	0.2560	1.0000	3	118.7	17,681	0.00	0.00
	2	0.184	175.00	5.81	0.2210	1.0000	3	192.2	27,033	1.09	0.77
	3	0.185	300.00	2.70	0.2180	1.0000	3	93.1	13,510	0.99	0.72
	4	0.175	300.00	2.66	0.2690	1.0000	3	99.3	10,803	0.00	0.00
	Σ							**11,292.1**	**32,718**	**0.02**	**0.01**
#18	1	0.193	300.00	2.80	0.2200	1.0000	3	166.4	12,680	0.08	0.06
	2	0.173	175.00	4.70	0.3880	1.0000	3	388.7	30,310	0.00	0.00
	Σ							**311.1**	**14,117**	**0.05**	**0.03**
#17	1	0.196	300.00	2.60	0.2600	1.0000	3	119.5	15,200	0.69	0.49
	Σ							**119.5**	**15,200**	**0.69**	**0.49**
#19	Σ							**430.6**	**13,250**	**0.20**	**0.14**
#15	1	0.201	125.00	8.20	0.3960	1.0000	3	875.5	52,729	0.00	0.00
	2	0.161	100.00	11.40	0.3060	1.0000	3	1,156.8	55,407	0.00	0.00
	3	0.118	100.00	10.20	0.2850	1.0000	2	533.7	26,236	13.40	9.61

Stru #	SWS #	Soil K	L (ft)	S (%)	C	P	PS #	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc (ml/l)	24VW (ml/l)
	Σ							**2,203.9**	**44,481**	**1.26**	**0.77**
#12	1	0.124	150.00	6.30	0.3070	1.0000	2	148.5	19,741	10.37	7.20
	2	0.132	200.00	3.60	0.3500	1.0000	2	36.4	13,817	7.60	5.13
	3	0.136	175.00	5.00	0.3330	1.0000	2	177.8	21,738	11.65	8.02
	4	0.188	200.00	3.40	0.3570	1.0000	2	197.1	13,622	5.15	3.73
	5	0.228	175.00	4.10	0.3640	1.0000	2	128.9	31,777	17.19	11.85
	Σ							**558.4**	**16,053**	**6.71**	**4.46**
#13	1	0.128	150.00	6.90	0.3390	1.0000	2	110.5	23,979	12.49	8.59
	2	0.130	175.00	5.70	0.3300	1.0000	2	178.6	21,951	11.41	7.97
	3	0.191	175.00	6.00	0.2890	1.0000	2	226.5	33,049	19.05	13.35
	4	0.122	175.00	5.10	0.3460	1.0000	2	69.8	24,833	14.95	10.22
	5	0.137	175.00	4.20	0.3530	1.0000	2	88.6	13,184	5.06	3.67
	Σ							**1,149.1**	**17,747**	**8.09**	**5.58**
#14	1	0.196	100.00	10.20	0.3980	1.0000	3	1,259.0	86,487	4.31	3.00
	2	0.193	150.00	6.70	0.4020	1.0000	3	826.2	56,062	1.89	1.34
	3	0.169	75.00	13.80	0.3240	1.0000	3	2,082.9	67,952	0.00	0.00
	4	0.114	100.00	11.00	0.2980	1.0000	3	122.8	36,090	1.27	0.91
	5	0.078	100.00	10.10	0.1830	1.0000	3	130.6	15,659	0.79	0.57
	6	0.084	150.00	7.10	0.2700	1.0000	2	72.2	12,296	6.43	4.61
	7	0.087	100.00	10.00	0.1840	1.0000	3	203.3	14,793	0.00	0.00
	8	0.126	150.00	6.70	0.2740	1.0000	2	261.0	16,178	7.68	5.60
	9	0.117	150.00	7.30	0.2600	1.0000	2	254.1	16,557	8.36	6.10
	10	0.115	125.00	8.50	0.2610	1.0000	2	152.1	17,901	9.30	6.77
	Σ							**4,552.2**	**78,723**	**1.23**	**0.25**
#16	1	0.200	200.00	3.30	0.3000	1.0000	3	269.1	18,736	0.16	0.12
	2	0.204	150.00	6.00	0.3630	1.0000	3	664.4	45,187	1.15	0.82
	3	0.210	150.00	6.10	0.3990	1.0000	3	514.2	56,689	4.87	3.55
	Σ							**8,200.5**	**55,106**	**1.30**	**0.47**
#20	1	0.186	175.00	4.80	0.2130	1.0000	3	221.4	19,337	0.00	0.00
	2	0.194	200.00	3.80	0.2330	1.0000	3	264.4	15,676	0.00	0.00
	Σ							**8,814.8**	**42,311**	**0.37**	**0.15**
#22	Σ							**20,106.9**	**33,948**	**0.14**	**0.08**
#23	1	0.172	175.00	4.20	0.2810	1.0000	3	161.2	17,281	0.00	0.00
	2	0.185	150.00	6.00	0.2160	1.0000	3	232.8	23,728	0.14	0.10
	Σ							**19,890.7**	**32,983**	**0.00**	**0.00**
#35	Σ							**27,247.8**	**30,808**	**0.01**	**0.01**
#36	1	0.190	175.00	5.94	0.2830	1.0000	3	152.8	24,939	0.00	0.00
	2	0.180	125.00	9.92	0.2410	1.0000	3	230.0	43,767	0.83	0.57

Stru #	SWS #	Soil K	L (ft)	S (%)	C	P	PS #	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc (ml/l)	24VW (ml/l)
	3	0.151	300.00	2.63	0.3890	1.0000	2	25.9	11,526	5.58	3.90
	Σ							**27,292.6**	**36,689**	**0.01**	**0.01**
#37	1	0.196	200.00	3.80	0.3980	1.0000	2	265.1	17,384	7.49	5.41
	2	0.193	175.00	5.40	0.4020	1.0000	3	375.9	45,440	0.86	0.62
	3	0.173	150.00	7.11	0.2770	1.0000	3	185.8	35,144	1.19	0.86
	4	0.171	150.00	6.52	0.2990	1.0000	2	221.9	20,384	9.20	6.74
	5	0.078	400.00	1.20	0.1830	1.0000	2	9.4	1,760	0.91	0.66
	Σ							**27,242.5**	**31,579**	**0.24**	**0.13**

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	5. Nearly bare and untilled, and alluvial valley fans	3.65	50.00	1,369.00	1.910	0.199
		8. Large gullies, diversions, and low flowing streams	1.57	157.00	10,030.00	3.750	0.742
#1	**1**	**Time of Concentration:**					**0.941**
#1	2	5. Nearly bare and untilled, and alluvial valley fans	6.63	70.00	1,056.00	2.570	0.114
		5. Nearly bare and untilled, and alluvial valley fans	1.98	150.00	7,573.00	1.400	1.502
#1	**2**	**Time of Concentration:**					**1.616**
#1	3	5. Nearly bare and untilled, and alluvial valley fans	1.65	117.00	7,070.00	1.280	1.534
		8. Large gullies, diversions, and low flowing streams	2.43	126.00	5,188.00	4.670	0.308
#1	**3**	**Time of Concentration:**					**1.842**
#1	4	5. Nearly bare and untilled, and alluvial valley fans	5.77	260.00	4,506.00	2.400	0.521
		8. Large gullies, diversions, and low flowing streams	2.84	168.00	5,924.00	5.050	0.325
#1	**4**	**Time of Concentration:**					**0.846**
#1	5	5. Nearly bare and untilled, and alluvial valley fans	19.93	180.00	903.00	4.460	0.056
		8. Large gullies, diversions, and low flowing streams	3.30	178.00	5,393.00	5.450	0.274
#1	**5**	**Time of Concentration:**					**0.330**
#1	6	5. Nearly bare and untilled, and alluvial valley fans	13.43	105.00	782.00	3.660	0.059
		8. Large gullies, diversions, and low flowing streams	2.62	283.00	10,822.00	4.850	0.619
#1	**6**	**Time of Concentration:**					**0.678**
#2	1	5. Nearly bare and untilled, and alluvial valley fans	6.84	70.00	1,024.00	2.610	0.108

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
		8. Large gullies, diversions, and low flowing streams	1.62	70.00	4,325.00	3.810	0.315
#2	**1**	**Time of Concentration:**					**0.423**
#2	2	5. Nearly bare and untilled, and alluvial valley fans	5.56	45.00	810.00	2.350	0.095
		8. Large gullies, diversions, and low flowing streams	0.86	40.00	4,663.00	2.770	0.467
#2	**2**	**Time of Concentration:**					**0.562**
#2	3	5. Nearly bare and untilled, and alluvial valley fans	5.89	50.00	849.00	2.420	0.097
		8. Large gullies, diversions, and low flowing streams	1.17	80.00	6,862.00	3.230	0.590
#2	**3**	**Time of Concentration:**					**0.687**
#2	4	5. Nearly bare and untilled, and alluvial valley fans	12.63	95.00	752.00	3.550	0.058
		8. Large gullies, diversions, and low flowing streams	1.40	135.00	9,630.00	3.550	0.753
#2	**4**	**Time of Concentration:**					**0.811**
#2	5	5. Nearly bare and untilled, and alluvial valley fans	11.02	70.00	635.00	3.320	0.053
		8. Large gullies, diversions, and low flowing streams	0.46	40.00	8,732.00	2.030	1.194
#2	**5**	**Time of Concentration:**					**1.247**
#3	1	5. Nearly bare and untilled, and alluvial valley fans	1.24	10.00	805.00	1.110	0.201
		8. Large gullies, diversions, and low flowing streams	1.33	40.00	3,017.00	3.450	0.242
#3	**1**	**Time of Concentration:**					**0.443**
#3	2	5. Nearly bare and untilled, and alluvial valley fans	0.68	10.00	1,478.00	0.820	0.500
		8. Large gullies, diversions, and low flowing streams	1.78	100.00	5,622.00	4.000	0.390
#3	**2**	**Time of Concentration:**					**0.890**
#3	3	5. Nearly bare and untilled, and alluvial valley fans	4.66	70.00	1,501.00	2.150	0.193
		8. Large gullies, diversions, and low flowing streams	1.17	60.00	5,126.00	3.240	0.439
#3	**3**	**Time of Concentration:**					**0.632**
#5	1	5. Nearly bare and untilled, and alluvial valley fans	19.06	285.00	1,495.00	4.360	0.095
		8. Large gullies, diversions, and low flowing streams	2.64	242.00	9,174.00	4.870	0.523
#5	**1**	**Time of Concentration:**					**0.618**
#5	2	5. Nearly bare and untilled, and alluvial valley fans	14.27	105.00	736.00	3.770	0.054
		8. Large gullies, diversions, and low flowing streams	4.08	297.00	7,279.00	6.050	0.334
#5	**2**	**Time of Concentration:**					**0.388**
#5	3	5. Nearly bare and untilled, and alluvial valley fans	8.27	35.00	423.00	2.870	0.040

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
		8. Large gullies, diversions, and low flowing streams	3.44	208.00	6,049.00	5.560	0.302
#5	**3**	**Time of Concentration:**					**0.342**
#5	4	5. Nearly bare and untilled, and alluvial valley fans	14.58	85.00	583.00	3.810	0.042
		8. Large gullies, diversions, and low flowing streams	4.53	248.00	5,473.00	6.380	0.238
#5	**4**	**Time of Concentration:**					**0.280**
#5	5	5. Nearly bare and untilled, and alluvial valley fans	5.07	70.00	1,382.00	2.250	0.170
		8. Large gullies, diversions, and low flowing streams	3.89	170.00	4,375.00	5.910	0.205
#5	**5**	**Time of Concentration:**					**0.375**
#5	6	5. Nearly bare and untilled, and alluvial valley fans	12.48	90.00	721.00	3.530	0.056
		8. Large gullies, diversions, and low flowing streams	5.16	274.00	5,308.02	6.810	0.216
#5	**6**	**Time of Concentration:**					**0.272**
#6	1	5. Nearly bare and untilled, and alluvial valley fans	5.36	75.00	1,399.00	2.310	0.168
		8. Large gullies, diversions, and low flowing streams	2.41	66.00	2,742.00	4.650	0.163
#6	**1**	**Time of Concentration:**					**0.331**
#6	2	5. Nearly bare and untilled, and alluvial valley fans	3.39	80.00	2,359.00	1.840	0.356
		8. Large gullies, diversions, and low flowing streams	2.63	80.00	3,039.00	4.860	0.173
#6	**2**	**Time of Concentration:**					**0.529**
#6	3	5. Nearly bare and untilled, and alluvial valley fans	4.60	34.00	739.00	2.140	0.095
		8. Large gullies, diversions, and low flowing streams	2.33	136.00	5,845.00	4.570	0.355
#6	**3**	**Time of Concentration:**					**0.450**
#6	4	5. Nearly bare and untilled, and alluvial valley fans	6.06	85.00	1,402.00	2.460	0.158
		8. Large gullies, diversions, and low flowing streams	2.52	96.00	3,810.00	4.760	0.222
#6	**4**	**Time of Concentration:**					**0.380**
#6	5	5. Nearly bare and untilled, and alluvial valley fans	7.24	70.00	967.00	2.690	0.099
		8. Large gullies, diversions, and low flowing streams	2.34	117.00	5,003.00	4.580	0.303
#6	**5**	**Time of Concentration:**					**0.402**
#6	6	5. Nearly bare and untilled, and alluvial valley fans	31.83	183.00	575.00	5.640	0.028
		8. Large gullies, diversions, and low flowing streams	3.38	270.00	7,990.00	5.510	0.402
#6	**6**	**Time of Concentration:**					**0.430**
#6	7	5. Nearly bare and untilled, and alluvial valley fans	23.08	325.00	1,408.00	4.800	0.081

Copyright 1998 -2007 Pamela J. Schwab

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
		8. Large gullies, diversions, and low flowing streams	2.88	240.00	8,327.00	5.090	0.454
#6	**7**	**Time of Concentration:**					**0.535**
#7	1	5. Nearly bare and untilled, and alluvial valley fans	11.42	90.00	788.00	3.370	0.064
		8. Large gullies, diversions, and low flowing streams	1.46	230.00	15,769.00	3.620	1.210
#7	**1**	**Time of Concentration:**					**1.274**
#7	2	5. Nearly bare and untilled, and alluvial valley fans	10.97	60.00	547.00	3.310	0.045
		8. Large gullies, diversions, and low flowing streams	1.61	220.00	13,660.00	3.800	0.998
#7	**2**	**Time of Concentration:**					**1.043**
#7	3	5. Nearly bare and untilled, and alluvial valley fans	6.40	60.00	938.00	2.520	0.103
		8. Large gullies, diversions, and low flowing streams	1.72	171.00	9,931.00	3.930	0.701
#7	**3**	**Time of Concentration:**					**0.804**
#7	4	5. Nearly bare and untilled, and alluvial valley fans	19.23	80.00	416.00	4.380	0.026
		8. Large gullies, diversions, and low flowing streams	2.45	100.00	4,083.00	4.690	0.241
#7	**4**	**Time of Concentration:**					**0.267**
#7	5	5. Nearly bare and untilled, and alluvial valley fans	6.09	67.00	1,101.00	2.460	0.124
		8. Large gullies, diversions, and low flowing streams	2.51	80.00	3,184.00	4.750	0.186
#7	**5**	**Time of Concentration:**					**0.310**
#7	6	5. Nearly bare and untilled, and alluvial valley fans	5.93	63.00	1,062.00	2.430	0.121
		8. Large gullies, diversions, and low flowing streams	2.74	82.00	2,993.00	4.960	0.167
#7	**6**	**Time of Concentration:**					**0.288**
#7	7	5. Nearly bare and untilled, and alluvial valley fans	7.97	65.00	816.00	2.820	0.080
		8. Large gullies, diversions, and low flowing streams	3.48	153.00	4,400.00	5.590	0.218
#7	**7**	**Time of Concentration:**					**0.298**
#7	8	5. Nearly bare and untilled, and alluvial valley fans	6.60	50.00	758.00	2.560	0.082
		8. Large gullies, diversions, and low flowing streams	4.66	473.00	10,157.00	6.470	0.436
#7	**8**	**Time of Concentration:**					**0.518**
#9	1	5. Nearly bare and untilled, and alluvial valley fans	3.35	90.00	2,687.00	1.830	0.407
		8. Large gullies, diversions, and low flowing streams	0.58	20.00	3,463.00	2.270	0.423
#9	**1**	**Time of Concentration:**					**0.830**
#10	1	5. Nearly bare and untilled, and alluvial valley fans	1.24	41.00	3,317.00	1.110	0.830

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
		8. Large gullies, diversions, and low flowing streams	0.70	29.00	4,125.00	2.510	0.456
#10	**1**	**Time of Concentration:**					**1.286**
#10	2	5. Nearly bare and untilled, and alluvial valley fans	2.25	125.00	5,554.00	1.500	1.028
		8. Large gullies, diversions, and low flowing streams	2.13	85.00	3,997.00	4.370	0.254
#10	**2**	**Time of Concentration:**					**1.282**
#10	3	5. Nearly bare and untilled, and alluvial valley fans	1.39	68.00	4,904.00	1.170	1.164
		8. Large gullies, diversions, and low flowing streams	4.73	90.00	1,904.00	6.520	0.081
#10	**3**	**Time of Concentration:**					**1.245**
#10	4	5. Nearly bare and untilled, and alluvial valley fans	3.76	51.00	1,357.00	1.930	0.195
		8. Large gullies, diversions, and low flowing streams	0.65	22.00	3,385.00	2.410	0.390
#10	**4**	**Time of Concentration:**					**0.585**
#10	5	5. Nearly bare and untilled, and alluvial valley fans	1.63	88.00	5,391.16	1.270	1.179
#10	**5**	**Time of Concentration:**					**1.179**
#12	1	5. Nearly bare and untilled, and alluvial valley fans	4.50	75.00	1,667.00	2.120	0.218
		8. Large gullies, diversions, and low flowing streams	1.85	155.00	8,400.00	4.070	0.573
#12	**1**	**Time of Concentration:**					**0.791**
#12	2	5. Nearly bare and untilled, and alluvial valley fans	2.99	50.00	1,674.03	1.720	0.270
		8. Large gullies, diversions, and low flowing streams	1.67	70.00	4,201.17	3.870	0.301
#12	**2**	**Time of Concentration:**					**0.571**
#12	3	5. Nearly bare and untilled, and alluvial valley fans	4.04	57.00	1,411.00	2.000	0.195
		8. Large gullies, diversions, and low flowing streams	1.55	107.00	6,884.00	3.740	0.511
#12	**3**	**Time of Concentration:**					**0.706**
#12	4	5. Nearly bare and untilled, and alluvial valley fans	2.23	84.00	3,771.04	1.490	0.703
		8. Large gullies, diversions, and low flowing streams	1.62	186.00	11,515.60	3.810	0.839
#12	**4**	**Time of Concentration:**					**1.542**
#12	5	5. Nearly bare and untilled, and alluvial valley fans	3.68	53.00	1,442.00	1.910	0.209
		8. Large gullies, diversions, and low flowing streams	1.95	120.00	6,155.00	4.180	0.409
#12	**5**	**Time of Concentration:**					**0.618**
#13	1	5. Nearly bare and untilled, and alluvial valley fans	4.62	62.00	1,342.00	2.140	0.174
		8. Large gullies, diversions, and low flowing streams	1.91	157.00	8,225.00	4.140	0.551
#13	**1**	**Time of Concentration:**					**0.725**

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#13	2	5. Nearly bare and untilled, and alluvial valley fans	2.91	50.00	1,717.00	1.700	0.280
		8. Large gullies, diversions, and low flowing streams	2.28	183.00	8,039.00	4.520	0.494
#13	**2**	**Time of Concentration:**					**0.774**
#13	3	5. Nearly bare and untilled, and alluvial valley fans	6.18	95.00	1,537.00	2.480	0.172
		8. Large gullies, diversions, and low flowing streams	2.13	135.00	6,347.00	4.370	0.403
#13	**3**	**Time of Concentration:**					**0.575**
#13	4	5. Nearly bare and untilled, and alluvial valley fans	3.17	10.00	315.00	1.780	0.049
		8. Large gullies, diversions, and low flowing streams	2.30	100.00	4,344.00	4.550	0.265
#13	**4**	**Time of Concentration:**					**0.314**
#13	5	5. Nearly bare and untilled, and alluvial valley fans	3.10	70.00	2,255.00	1.760	0.355
		8. Large gullies, diversions, and low flowing streams	1.23	140.00	11,392.00	3.320	0.953
#13	**5**	**Time of Concentration:**					**1.308**
#14	1	5. Nearly bare and untilled, and alluvial valley fans	10.59	63.00	595.00	3.250	0.050
		8. Large gullies, diversions, and low flowing streams	2.60	151.00	5,808.00	4.830	0.334
#14	**1**	**Time of Concentration:**					**0.384**
#14	2	5. Nearly bare and untilled, and alluvial valley fans	7.28	67.00	920.00	2.690	0.095
		8. Large gullies, diversions, and low flowing streams	2.17	123.00	5,670.00	4.410	0.357
#14	**2**	**Time of Concentration:**					**0.452**
#14	3	5. Nearly bare and untilled, and alluvial valley fans	21.46	150.00	699.00	4.630	0.041
		8. Large gullies, diversions, and low flowing streams	3.10	364.00	11,728.00	5.280	0.617
#14	**3**	**Time of Concentration:**					**0.658**
#14	4	5. Nearly bare and untilled, and alluvial valley fans	3.39	35.00	1,032.00	1.840	0.155
		8. Large gullies, diversions, and low flowing streams	2.97	103.00	3,470.00	5.160	0.186
#14	**4**	**Time of Concentration:**					**0.341**
#14	5	5. Nearly bare and untilled, and alluvial valley fans	28.15	125.00	444.00	5.300	0.023
		8. Large gullies, diversions, and low flowing streams	4.18	246.00	5,886.00	6.130	0.266
#14	**5**	**Time of Concentration:**					**0.289**
#14	6	5. Nearly bare and untilled, and alluvial valley fans	3.18	40.00	1,257.00	1.780	0.196
		8. Large gullies, diversions, and low flowing streams	2.29	228.00	9,963.00	4.530	0.610
#14	**6**	**Time of Concentration:**					**0.806**

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#14	7	5. Nearly bare and untilled, and alluvial valley fans	16.72	100.00	598.00	4.080	0.040
		8. Large gullies, diversions, and low flowing streams	2.81	243.00	8,649.00	5.020	0.478
#14	**7**	**Time of Concentration:**					**0.518**
#14	8	5. Nearly bare and untilled, and alluvial valley fans	1.70	47.00	2,765.00	1.300	0.590
		8. Large gullies, diversions, and low flowing streams	2.44	274.00	11,208.00	4.690	0.663
#14	**8**	**Time of Concentration:**					**1.253**
#14	9	5. Nearly bare and untilled, and alluvial valley fans	2.87	105.00	3,657.00	1.690	0.601
		8. Large gullies, diversions, and low flowing streams	2.43	194.00	7,991.00	4.670	0.475
#14	**9**	**Time of Concentration:**					**1.076**
#14	10	5. Nearly bare and untilled, and alluvial valley fans	2.75	80.00	2,907.00	1.650	0.489
		8. Large gullies, diversions, and low flowing streams	2.41	172.00	7,149.00	4.650	0.427
#14	**10**	**Time of Concentration:**					**0.916**
#15	1	5. Nearly bare and untilled, and alluvial valley fans	12.80	54.00	422.00	3.570	0.032
		8. Large gullies, diversions, and low flowing streams	1.68	181.00	10,781.00	3.880	0.771
#15	**1**	**Time of Concentration:**					**0.803**
#15	2	5. Nearly bare and untilled, and alluvial valley fans	44.22	260.00	588.00	6.640	0.024
		8. Large gullies, diversions, and low flowing streams	2.45	254.00	10,354.00	4.690	0.613
#15	**2**	**Time of Concentration:**					**0.637**
#15	3	5. Nearly bare and untilled, and alluvial valley fans	10.04	85.00	847.00	3.160	0.074
		8. Large gullies, diversions, and low flowing streams	2.34	366.00	15,663.00	4.580	0.949
#15	**3**	**Time of Concentration:**					**1.023**
#16	1	5. Nearly bare and untilled, and alluvial valley fans	4.17	15.00	360.00	2.040	0.049
		8. Large gullies, diversions, and low flowing streams	1.42	108.00	7,618.00	3.570	0.592
#16	**1**	**Time of Concentration:**					**0.641**
#16	2	5. Nearly bare and untilled, and alluvial valley fans	8.70	62.00	713.00	2.940	0.067
		8. Large gullies, diversions, and low flowing streams	1.99	144.00	7,241.00	4.230	0.475
#16	**2**	**Time of Concentration:**					**0.542**
#16	3	5. Nearly bare and untilled, and alluvial valley fans	6.88	32.00	465.00	2.620	0.049
		8. Large gullies, diversions, and low flowing streams	2.29	81.00	3,543.00	4.530	0.217
#16	**3**	**Time of Concentration:**					**0.266**

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#17	1	5. Nearly bare and untilled, and alluvial valley fans	9.37	65.00	694.00	3.060	0.062
		8. Large gullies, diversions, and low flowing streams	1.19	56.00	4,712.00	3.270	0.400
#17	**1**	**Time of Concentration:**					**0.462**
#18	1	5. Nearly bare and untilled, and alluvial valley fans	9.00	60.00	667.00	2.990	0.061
		8. Large gullies, diversions, and low flowing streams	0.97	61.00	6,287.00	2.950	0.591
#18	**1**	**Time of Concentration:**					**0.652**
#18	2	5. Nearly bare and untilled, and alluvial valley fans	2.47	33.00	1,336.00	1.570	0.236
		8. Large gullies, diversions, and low flowing streams	2.01	164.00	8,154.00	4.250	0.532
#18	**2**	**Time of Concentration:**					**0.768**
#20	1	5. Nearly bare and untilled, and alluvial valley fans	11.87	45.00	379.00	3.440	0.030
		8. Large gullies, diversions, and low flowing streams	0.75	45.00	5,969.00	2.600	0.637
#20	**1**	**Time of Concentration:**					**0.667**
#20	2	5. Nearly bare and untilled, and alluvial valley fans	5.40	45.00	833.00	2.320	0.099
		8. Large gullies, diversions, and low flowing streams	1.30	98.00	7,547.00	3.410	0.614
#20	**2**	**Time of Concentration:**					**0.713**
#21	1	5. Nearly bare and untilled, and alluvial valley fans	4.09	60.00	1,467.00	2.020	0.201
		8. Large gullies, diversions, and low flowing streams	0.93	60.00	6,433.00	2.890	0.618
#21	**1**	**Time of Concentration:**					**0.819**
#21	2	5. Nearly bare and untilled, and alluvial valley fans	3.50	50.00	1,430.00	1.860	0.213
		8. Large gullies, diversions, and low flowing streams	2.15	60.00	2,785.00	4.400	0.175
#21	**2**	**Time of Concentration:**					**0.388**
#21	3	5. Nearly bare and untilled, and alluvial valley fans	1.70	15.00	881.00	1.300	0.188
		9. Small streams flowing bankfull	1.49	60.00	4,014.00	11.000	0.101
#21	**3**	**Time of Concentration:**					**0.289**
#21	4	5. Nearly bare and untilled, and alluvial valley fans	2.21	40.00	1,811.02	1.480	0.339
		8. Large gullies, diversions, and low flowing streams	0.84	50.00	5,949.54	2.750	0.600
#21	**4**	**Time of Concentration:**					**0.939**
#23	1	5. Nearly bare and untilled, and alluvial valley fans	2.44	65.00	2,660.01	1.560	0.473
		8. Large gullies, diversions, and low flowing streams	0.33	10.00	3,017.50	1.720	0.487
#23	**1**	**Time of Concentration:**					**0.960**
#23	2	5. Nearly bare and untilled, and alluvial valley fans	3.49	60.00	1,718.01	1.860	0.256

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
		8. Large gullies, diversions, and low flowing streams	1.66	65.00	3,926.06	3.860	0.282
#23	**2**	**Time of Concentration:**					**0.538**
#24	1	5. Nearly bare and untilled, and alluvial valley fans	1.71	430.00	25,118.00	1.300	5.367
#24	**1**	**Time of Concentration:**					**5.367**
#24	2	5. Nearly bare and untilled, and alluvial valley fans	1.84	430.00	23,393.00	1.350	4.813
#24	**2**	**Time of Concentration:**					**4.813**
#24	3	5. Nearly bare and untilled, and alluvial valley fans	1.82	155.00	8,498.00	1.350	1.748
		8. Large gullies, diversions, and low flowing streams	0.84	40.00	4,771.00	2.740	0.483
#24	**3**	**Time of Concentration:**					**2.231**
#24	4	5. Nearly bare and untilled, and alluvial valley fans	1.24	50.00	4,042.00	1.110	1.011
		8. Large gullies, diversions, and low flowing streams	0.49	60.00	12,150.00	2.100	1.607
#24	**4**	**Time of Concentration:**					**2.618**
#25	1	5. Nearly bare and untilled, and alluvial valley fans	0.51	10.00	1,950.00	0.710	0.762
		8. Large gullies, diversions, and low flowing streams	1.81	60.00	3,322.00	4.030	0.228
#25	**1**	**Time of Concentration:**					**0.990**
#25	2	5. Nearly bare and untilled, and alluvial valley fans	1.11	25.00	2,254.00	1.050	0.596
		8. Large gullies, diversions, and low flowing streams	2.36	75.00	3,178.00	4.600	0.191
#25	**2**	**Time of Concentration:**					**0.787**
#25	3	5. Nearly bare and untilled, and alluvial valley fans	3.23	30.00	929.00	1.790	0.144
		8. Large gullies, diversions, and low flowing streams	2.45	154.00	6,297.00	4.690	0.372
#25	**3**	**Time of Concentration:**					**0.516**
#26	1	5. Nearly bare and untilled, and alluvial valley fans	1.20	103.00	8,602.00	1.090	2.192
#26	**1**	**Time of Concentration:**					**2.192**
#26	2	5. Nearly bare and untilled, and alluvial valley fans	1.23	120.00	9,780.00	1.100	2.469
		8. Large gullies, diversions, and low flowing streams	2.18	184.00	8,454.00	4.420	0.531
#26	**2**	**Time of Concentration:**					**3.000**
#27	1	5. Nearly bare and untilled, and alluvial valley fans	4.32	50.00	1,158.02	2.070	0.155
		8. Large gullies, diversions, and low flowing streams	2.53	198.00	7,838.16	4.760	0.457
#27	**1**	**Time of Concentration:**					**0.612**
#27	2	5. Nearly bare and untilled, and alluvial valley fans	5.26	30.00	570.00	2.290	0.069
		8. Large gullies, diversions, and low flowing streams	3.15	278.00	8,822.00	5.320	0.460

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#27	**2**	**Time of Concentration:**					**0.529**
#27	3	5. Nearly bare and untilled, and alluvial valley fans	16.33	80.00	490.00	4.040	0.033
		8. Large gullies, diversions, and low flowing streams	2.15	225.00	10,443.00	4.400	0.659
#27	**3**	**Time of Concentration:**					**0.692**
#27	4	5. Nearly bare and untilled, and alluvial valley fans	12.43	65.00	523.00	3.520	0.041
		8. Large gullies, diversions, and low flowing streams	3.49	225.00	6,454.00	5.600	0.320
#27	**4**	**Time of Concentration:**					**0.361**
#27	5	5. Nearly bare and untilled, and alluvial valley fans	9.40	25.00	266.00	3.060	0.024
		8. Large gullies, diversions, and low flowing streams	2.32	364.00	15,700.00	4.560	0.956
#27	**5**	**Time of Concentration:**					**0.980**
#28	1	5. Nearly bare and untilled, and alluvial valley fans	5.25	40.00	762.00	2.290	0.092
		8. Large gullies, diversions, and low flowing streams	2.96	310.00	10,479.34	5.150	0.565
#28	**1**	**Time of Concentration:**					**0.657**
#28	2	5. Nearly bare and untilled, and alluvial valley fans	25.86	105.00	406.00	5.080	0.022
		8. Large gullies, diversions, and low flowing streams	2.96	310.00	10,479.34	5.150	0.565
#28	**2**	**Time of Concentration:**					**0.587**
#29	1	5. Nearly bare and untilled, and alluvial valley fans	11.58	30.00	259.00	3.400	0.021
		8. Large gullies, diversions, and low flowing streams	3.61	288.00	7,976.00	5.700	0.388
#29	**1**	**Time of Concentration:**					**0.409**
#29	2	5. Nearly bare and untilled, and alluvial valley fans	8.06	40.00	496.00	2.830	0.048
		8. Large gullies, diversions, and low flowing streams	2.90	252.00	8,693.55	5.100	0.473
#29	**2**	**Time of Concentration:**					**0.521**
#29	3	5. Nearly bare and untilled, and alluvial valley fans	7.25	25.00	345.00	2.690	0.035
		8. Large gullies, diversions, and low flowing streams	2.26	158.00	7,001.00	4.500	0.432
#29	**3**	**Time of Concentration:**					**0.467**
#30	1	5. Nearly bare and untilled, and alluvial valley fans	4.93	35.00	710.00	2.220	0.088
		8. Large gullies, diversions, and low flowing streams	1.67	243.00	14,540.00	3.870	1.043
#30	**1**	**Time of Concentration:**					**1.131**
#31	1	5. Nearly bare and untilled, and alluvial valley fans	2.91	15.00	515.00	1.700	0.084
		8. Large gullies, diversions, and low flowing streams	2.74	247.00	9,006.00	4.960	0.504
#31	**1**	**Time of Concentration:**					**0.588**

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#31	2	5. Nearly bare and untilled, and alluvial valley fans	7.46	25.00	335.00	2.730	0.034
		8. Large gullies, diversions, and low flowing streams	2.18	138.00	6,335.00	4.420	0.398
#31	**2**	**Time of Concentration:**					**0.432**
#31	3	5. Nearly bare and untilled, and alluvial valley fans	3.84	20.00	521.00	1.950	0.074
		8. Large gullies, diversions, and low flowing streams	2.24	108.00	4,826.00	4.480	0.299
#31	**3**	**Time of Concentration:**					**0.373**
#32	1	5. Nearly bare and untilled, and alluvial valley fans	3.48	22.00	632.00	1.860	0.094
		8. Large gullies, diversions, and low flowing streams	1.56	101.00	6,494.00	3.740	0.482
#32	**1**	**Time of Concentration:**					**0.576**
#34	1	5. Nearly bare and untilled, and alluvial valley fans	3.21	25.00	779.00	1.790	0.120
		8. Large gullies, diversions, and low flowing streams	2.80	63.00	2,251.00	5.010	0.124
#34	**1**	**Time of Concentration:**					**0.244**
#34	2	5. Nearly bare and untilled, and alluvial valley fans	5.75	40.00	696.00	2.390	0.080
		8. Large gullies, diversions, and low flowing streams	23.00	2,100.00	9,130.43	14.380	0.176
#34	**2**	**Time of Concentration:**					**0.256**
#34	3	5. Nearly bare and untilled, and alluvial valley fans	2.67	40.00	1,500.00	1.630	0.255
		8. Large gullies, diversions, and low flowing streams	1.28	98.00	7,675.00	3.380	0.630
#34	**3**	**Time of Concentration:**					**0.885**
#36	1	5. Nearly bare and untilled, and alluvial valley fans	3.21	105.00	3,274.00	1.790	0.508
		8. Large gullies, diversions, and low flowing streams	0.21	5.00	2,367.00	1.370	0.479
#36	**1**	**Time of Concentration:**					**0.987**
#36	2	5. Nearly bare and untilled, and alluvial valley fans	5.50	140.00	2,547.00	2.340	0.302
		8. Large gullies, diversions, and low flowing streams	1.58	30.00	1,897.00	3.770	0.139
#36	**2**	**Time of Concentration:**					**0.441**
#36	3	5. Nearly bare and untilled, and alluvial valley fans	2.03	80.00	3,938.62	1.420	0.770
		8. Large gullies, diversions, and low flowing streams	2.52	50.00	1,981.86	4.760	0.115
#36	**3**	**Time of Concentration:**					**0.885**
#37	1	5. Nearly bare and untilled, and alluvial valley fans	4.68	129.00	2,754.05	2.160	0.354
		8. Large gullies, diversions, and low flowing streams	0.16	10.00	6,108.73	1.210	1.402
#37	**1**	**Time of Concentration:**					**1.756**

Copyright 1998 -2007 Pamela J. Schwab

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#37	2	5. Nearly bare and untilled, and alluvial valley fans	7.32	90.00	1,229.00	2.700	0.126
		8. Large gullies, diversions, and low flowing streams	1.62	70.00	4,309.01	3.820	0.313
#37	**2**	**Time of Concentration:**					**0.439**
#37	3	5. Nearly bare and untilled, and alluvial valley fans	8.10	100.00	1,234.00	2.840	0.120
		8. Large gullies, diversions, and low flowing streams	2.66	100.00	3,763.21	4.890	0.213
#37	**3**	**Time of Concentration:**					**0.333**
#37	4	5. Nearly bare and untilled, and alluvial valley fans	5.09	90.00	1,768.03	2.250	0.218
		8. Large gullies, diversions, and low flowing streams	0.36	30.00	8,326.39	1.800	1.284
#37	**4**	**Time of Concentration:**					**1.502**
#37	5	5. Nearly bare and untilled, and alluvial valley fans	0.81	20.00	2,466.09	0.900	0.761
		8. Large gullies, diversions, and low flowing streams	4.06	50.00	1,231.01	6.040	0.056
#37	**5**	**Time of Concentration:**					**0.817**

Subwatershed Muskingum Routing Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	2	8. Large gullies, diversions, and low flowing streams	1.29	107.00	8,294.00	3.400	0.677
#1	**2**	**Muskingum K:**					**0.677**
#1	3	8. Large gullies, diversions, and low flowing streams	1.27	113.00	8,880.00	3.380	0.729
#1	**3**	**Muskingum K:**					**0.729**
#1	4	8. Large gullies, diversions, and low flowing streams	1.35	171.00	12,634.00	3.490	1.005
#1	**4**	**Muskingum K:**					**1.005**
#1	5	8. Large gullies, diversions, and low flowing streams	1.49	274.00	18,349.00	3.660	1.392
#1	**5**	**Muskingum K:**					**1.392**
#1	6	8. Large gullies, diversions, and low flowing streams	1.49	274.00	18,349.00	3.660	1.392
#1	**6**	**Muskingum K:**					**1.392**
#2	2	8. Large gullies, diversions, and low flowing streams	0.53	20.00	3,756.00	2.180	0.478
#2	**2**	**Muskingum K:**					**0.478**
#2	3	8. Large gullies, diversions, and low flowing streams	0.55	25.00	4,570.00	2.210	0.574
#2	**3**	**Muskingum K:**					**0.574**
#2	4	8. Large gullies, diversions, and low flowing streams	0.55	25.00	4,570.00	2.210	0.574
#2	**4**	**Muskingum K:**					**0.574**

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#2	5	8. Large gullies, diversions, and low flowing streams	0.65	45.00	6,955.00	2.410	0.801
#2	**5**	**Muskingum K:**					**0.801**
#3	3	8. Large gullies, diversions, and low flowing streams	0.92	20.00	2,168.00	2.880	0.209
#3	**3**	**Muskingum K:**					**0.209**
#5	1	8. Large gullies, diversions, and low flowing streams	0.00	0.00	0.00	0.000	0.000
#5	**1**	**Muskingum K:**					**0.000**
#5	2	8. Large gullies, diversions, and low flowing streams	1.75	125.00	7,149.00	3.960	0.501
#5	**2**	**Muskingum K:**					**0.501**
#5	3	8. Large gullies, diversions, and low flowing streams	1.65	155.00	9,418.00	3.840	0.681
#5	**3**	**Muskingum K:**					**0.681**
#5	4	8. Large gullies, diversions, and low flowing streams	1.65	155.00	9,418.00	3.840	0.681
#5	**4**	**Muskingum K:**					**0.681**
#5	5	8. Large gullies, diversions, and low flowing streams	1.67	239.00	14,273.00	3.880	1.021
#5	**5**	**Muskingum K:**					**1.021**
#5	6	8. Large gullies, diversions, and low flowing streams	1.68	239.00	14,223.00	3.880	1.018
#5	**6**	**Muskingum K:**					**1.018**
#6	2	8. Large gullies, diversions, and low flowing streams	1.16	26.00	2,241.00	3.230	0.192
#6	**2**	**Muskingum K:**					**0.192**
#6	3	8. Large gullies, diversions, and low flowing streams	1.00	50.00	4,987.00	3.000	0.461
#6	**3**	**Muskingum K:**					**0.461**
#6	4	5. Nearly bare and untilled, and alluvial valley fans	1.00	50.00	4,987.00	1.000	1.385
#6	**4**	**Muskingum K:**					**1.385**
#6	5	8. Large gullies, diversions, and low flowing streams	1.02	89.00	8,685.00	3.030	0.796
#6	**5**	**Muskingum K:**					**0.796**
#6	6	8. Large gullies, diversions, and low flowing streams	1.06	126.00	11,860.00	3.090	1.066
#6	**6**	**Muskingum K:**					**1.066**
#6	7	8. Large gullies, diversions, and low flowing streams	1.06	126.00	11,860.00	3.090	1.066
#6	**7**	**Muskingum K:**					**1.066**
#7	1	8. Large gullies, diversions, and low flowing streams	0.00	0.00	0.00	0.000	0.000
#7	**1**	**Muskingum K:**					**0.000**
#7	2	8. Large gullies, diversions, and low flowing streams	0.00	0.00	0.00	0.000	0.000
#7	**2**	**Muskingum K:**					**0.000**
#7	4	8. Large gullies, diversions, and low flowing streams	1.16	140.00	12,037.00	3.230	1.035

Copyright 1998 -2007 Pamela J. Schwab

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#7	**4**	**Muskingum K:**					**1.035**
#7	5	8. Large gullies, diversions, and low flowing streams	1.14	140.00	12,307.69	3.190	1.071
#7	**5**	**Muskingum K:**					**1.071**
#7	6	8. Large gullies, diversions, and low flowing streams	1.17	158.00	13,546.00	3.230	1.164
#7	**6**	**Muskingum K:**					**1.164**
#7	7	8. Large gullies, diversions, and low flowing streams	1.18	187.00	15,784.00	3.260	1.344
#7	**7**	**Muskingum K:**					**1.344**
#7	8	8. Large gullies, diversions, and low flowing streams	1.18	187.00	15,784.00	3.260	1.344
#7	**8**	**Muskingum K:**					**1.344**
#10	3	8. Large gullies, diversions, and low flowing streams	0.76	37.00	4,861.00	2.610	0.517
#10	**3**	**Muskingum K:**					**0.517**
#10	4	8. Large gullies, diversions, and low flowing streams	0.76	37.00	4,861.00	2.610	0.517
#10	**4**	**Muskingum K:**					**0.517**
#10	5	8. Large gullies, diversions, and low flowing streams	0.79	47.00	5,956.00	2.660	0.621
#10	**5**	**Muskingum K:**					**0.621**
#12	2	8. Large gullies, diversions, and low flowing streams	8.24	111.00	1,347.00	8.610	0.043
#12	**2**	**Muskingum K:**					**0.043**
#12	3	8. Large gullies, diversions, and low flowing streams	8.01	109.00	1,360.00	8.490	0.044
#12	**3**	**Muskingum K:**					**0.044**
#12	4	8. Large gullies, diversions, and low flowing streams	2.24	176.00	7,866.00	4.480	0.487
#12	**4**	**Muskingum K:**					**0.487**
#12	5	8. Large gullies, diversions, and low flowing streams	2.24	176.00	7,866.00	4.480	0.487
#12	**5**	**Muskingum K:**					**0.487**
#13	2	8. Large gullies, diversions, and low flowing streams	1.34	54.00	4,025.00	3.470	0.322
#13	**2**	**Muskingum K:**					**0.322**
#13	3	8. Large gullies, diversions, and low flowing streams	0.98	72.00	7,333.00	2.970	0.685
#13	**3**	**Muskingum K:**					**0.685**
#13	4	8. Large gullies, diversions, and low flowing streams	1.18	127.00	10,806.00	3.250	0.923
#13	**4**	**Muskingum K:**					**0.923**
#13	5	8. Large gullies, diversions, and low flowing streams	1.18	127.00	10,806.00	3.250	0.923
#13	**5**	**Muskingum K:**					**0.923**
#14	1	8. Large gullies, diversions, and low flowing streams	0.00	0.00	0.00	0.000	0.000
#14	**1**	**Muskingum K:**					**0.000**

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#14	2	8. Large gullies, diversions, and low flowing streams	0.83	58.00	6,957.00	2.730	0.707
#14	**2**	**Muskingum K:**					**0.707**
#14	3	8. Large gullies, diversions, and low flowing streams	0.81	77.00	9,480.00	2.700	0.975
#14	**3**	**Muskingum K:**					**0.975**
#14	4	8. Large gullies, diversions, and low flowing streams	0.86	147.00	17,117.00	2.770	1.716
#14	**4**	**Muskingum K:**					**1.716**
#14	5	8. Large gullies, diversions, and low flowing streams	0.88	175.00	19,934.00	2.810	1.970
#14	**5**	**Muskingum K:**					**1.970**
#14	6	8. Large gullies, diversions, and low flowing streams	0.95	211.00	22,155.00	2.920	2.107
#14	**6**	**Muskingum K:**					**2.107**
#14	7	8. Large gullies, diversions, and low flowing streams	0.96	257.00	26,835.00	2.930	2.544
#14	**7**	**Muskingum K:**					**2.544**
#14	8	8. Large gullies, diversions, and low flowing streams	0.96	257.00	26,835.00	2.930	2.544
#14	**8**	**Muskingum K:**					**2.544**
#14	9	8. Large gullies, diversions, and low flowing streams	0.95	307.00	32,146.59	2.930	3.047
#14	**9**	**Muskingum K:**					**3.047**
#14	10	8. Large gullies, diversions, and low flowing streams	0.96	339.00	35,382.00	2.930	3.354
#14	**10**	**Muskingum K:**					**3.354**
#15	1	8. Large gullies, diversions, and low flowing streams	0.00	0.00	0.00	0.000	0.000
#15	**1**	**Muskingum K:**					**0.000**
#15	2	8. Large gullies, diversions, and low flowing streams	1.14	86.00	7,535.00	3.200	0.654
#15	**2**	**Muskingum K:**					**0.654**
#15	3	8. Large gullies, diversions, and low flowing streams	1.25	115.00	9,236.00	3.340	0.768
#15	**3**	**Muskingum K:**					**0.768**
#16	2	8. Large gullies, diversions, and low flowing streams	0.58	24.00	4,161.00	2.270	0.509
#16	**2**	**Muskingum K:**					**0.509**
#16	3	8. Large gullies, diversions, and low flowing streams	0.51	37.00	7,269.00	2.140	0.943
#16	**3**	**Muskingum K:**					**0.943**
#17	1	8. Large gullies, diversions, and low flowing streams	0.00	0.00	0.00	0.000	0.000
#17	**1**	**Muskingum K:**					**0.000**
#18	1	8. Large gullies, diversions, and low flowing streams	0.00	0.00	0.00	0.000	0.000
#18	**1**	**Muskingum K:**					**0.000**
#18	2	8. Large gullies, diversions, and low flowing streams	1.02	62.00	6,103.00	3.020	0.561

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#18	**2**	**Muskingum K:**					**0.561**
#20	2	8. Large gullies, diversions, and low flowing streams	17.00	3,605.00	21,205.88	12.360	0.476
#20	**2**	**Muskingum K:**					**0.476**
#21	1	8. Large gullies, diversions, and low flowing streams	0.00	0.00	0.00	0.000	0.000
#21	**1**	**Muskingum K:**					**0.000**
#21	2	8. Large gullies, diversions, and low flowing streams	0.41	20.00	4,824.00	1.930	0.694
#21	**2**	**Muskingum K:**					**0.694**
#21	3	8. Large gullies, diversions, and low flowing streams	0.36	20.00	5,626.00	1.780	0.877
#21	**3**	**Muskingum K:**					**0.877**
#21	4	8. Large gullies, diversions, and low flowing streams	0.36	20.00	5,626.00	1.780	0.877
#21	**4**	**Muskingum K:**					**0.877**
#23	1	8. Large gullies, diversions, and low flowing streams	0.00	0.00	0.00	0.000	0.000
#23	**1**	**Muskingum K:**					**0.000**
#23	2	8. Large gullies, diversions, and low flowing streams	0.63	30.00	4,771.75	2.370	0.559
#23	**2**	**Muskingum K:**					**0.559**
#24	1	8. Large gullies, diversions, and low flowing streams	0.79	180.00	22,769.00	2.660	2.377
#24	**1**	**Muskingum K:**					**2.377**
#24	2	8. Large gullies, diversions, and low flowing streams	0.78	180.00	23,111.00	2.640	2.431
#24	**2**	**Muskingum K:**					**2.431**
#24	4	8. Large gullies, diversions, and low flowing streams	0.00	0.00	0.00	0.000	0.000
#24	**4**	**Muskingum K:**					**0.000**
#25	1	8. Large gullies, diversions, and low flowing streams	1.99	104.00	5,220.00	4.230	0.342
#25	**1**	**Muskingum K:**					**0.342**
#25	2	8. Large gullies, diversions, and low flowing streams	1.99	104.00	5,220.00	4.230	0.342
#25	**2**	**Muskingum K:**					**0.342**
#25	3	8. Large gullies, diversions, and low flowing streams	0.00	0.00	0.00	0.000	0.000
#25	**3**	**Muskingum K:**					**0.000**
#27	1	8. Large gullies, diversions, and low flowing streams	1.38	216.00	15,629.00	3.520	1.233
#27	**1**	**Muskingum K:**					**1.233**
#27	2	8. Large gullies, diversions, and low flowing streams	1.17	144.00	12,301.00	3.240	1.054
#27	**2**	**Muskingum K:**					**1.054**
#27	3	8. Large gullies, diversions, and low flowing streams	1.18	76.00	6,454.00	3.250	0.551
#27	**3**	**Muskingum K:**					**0.551**

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#27	4	8. Large gullies, diversions, and low flowing streams	1.18	76.00	6,454.00	3.250	0.551
#27	**4**	**Muskingum K:**					**0.551**
#28	1	8. Large gullies, diversions, and low flowing streams	1.30	84.00	6,445.17	3.420	0.523
#28	**1**	**Muskingum K:**					**0.523**
#29	1	8. Large gullies, diversions, and low flowing streams	0.88	37.00	4,210.00	2.810	0.416
#29	**1**	**Muskingum K:**					**0.416**
#29	2	8. Large gullies, diversions, and low flowing streams	0.88	26.00	2,949.00	2.810	0.291
#29	**2**	**Muskingum K:**					**0.291**
#31	1	8. Large gullies, diversions, and low flowing streams	1.35	76.00	5,639.00	3.480	0.450
#31	**1**	**Muskingum K:**					**0.450**
#31	2	8. Large gullies, diversions, and low flowing streams	1.15	20.00	1,734.00	3.220	0.149
#31	**2**	**Muskingum K:**					**0.149**
#34	1	8. Large gullies, diversions, and low flowing streams	0.73	65.00	8,900.00	2.560	0.965
#34	**1**	**Muskingum K:**					**0.965**
#34	2	8. Large gullies, diversions, and low flowing streams	0.73	65.00	8,900.00	2.560	0.965
#34	**2**	**Muskingum K:**					**0.965**
#36	3	8. Large gullies, diversions, and low flowing streams	2.71	80.00	2,957.00	4.930	0.166
#36	**3**	**Muskingum K:**					**0.166**
#37	2	8. Large gullies, diversions, and low flowing streams	0.29	30.00	10,319.91	1.610	1.780
#37	**2**	**Muskingum K:**					**1.780**
#37	3	8. Large gullies, diversions, and low flowing streams	0.31	30.00	9,800.71	1.650	1.649
#37	**3**	**Muskingum K:**					**1.649**
#37	4	8. Large gullies, diversions, and low flowing streams	0.29	30.00	10,319.91	1.610	1.780
#37	**4**	**Muskingum K:**					**1.780**
#37	5	8. Large gullies, diversions, and low flowing streams	0.56	100.00	17,956.54	2.230	2.236
#37	**5**	**Muskingum K:**					**2.236**

Cottonwood Arroyo Pre-mine Hydrology and Sedimentology

The drainage subdivisions used to model the hydrology is shown on Exhibit 18.B

Revised Febuary 2012

Art O'Hayre

Copyright 1998 -2007 Pamela J. Schwab

General Information

Storm Information:

Storm Type:	Type II-70
Design Storm:	2 yr - 6 hr
Rainfall Depth:	0.850 inches

Particle Size Distribution:

Size (mm)	PostMine-LoamySand	PreMine-LoamySand	PreMine-Badlands	LoamySand Postmining
2.0000	100.000%	100.000%	100.000%	0.000%
0.1000	26.500%	30.000%	83.500%	0.000%
0.0500	14.000%	17.000%	77.000%	0.000%
0.0020	11.000%	11.000%	56.000%	0.000%
0.0010	0.000%	0.000%	0.000%	0.000%

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc. (ml/l)	24VW (ml/l)
#30	476.400	476.400	0.42	0.11	0.4	2,965	1.82	1.55
#28	1,217.900	1,217.900	168.77	19.36	939.7	51,228	0.00	0.00
#26	2,486.400	2,486.400	8.59	2.86	13.1	4,375	0.55	0.42
#24	8,061.800	8,061.800	11.17	6.64	17.5	2,885	0.18	0.12
#25	1,015.700	9,077.500	43.84	10.83	64.9	15,537	6.38	1.81
#27	1,783.700	13,347.600	76.77	20.93	211.6	23,433	10.13	3.20
#29	966.000	15,531.500	221.98	55.19	2,116.8	64,602	2.94	1.26
#32	293.700	16,301.600	225.12	61.87	2,217.3	56,165	0.00	0.00
#31	957.100	957.100	186.43	19.66	773.0	37,599	0.40	0.30
#33	0.000	17,258.700	306.26	81.53	2,990.3	46,265	0.13	0.07
#34	932.500	18,191.200	312.79	95.29	2,757.0	37,581	0.05	0.03
#5	2,023.000	2,023.000	229.14	23.65	597.2	35,964	1.23	0.63
#6	1,743.200	3,766.200	265.00	46.82	1,150.6	31,888	0.18	0.10
#7	2,395.300	6,161.500	489.93	97.92	3,549.5	40,575	0.00	0.00
#8	0.000	6,161.500	489.93	97.92	3,549.5	40,575	0.00	0.00
#10	1,053.200	7,214.700	502.27	115.36	3,451.8	36,547	0.05	0.03
#1	2,411.100	2,411.100	145.59	19.69	601.9	34,411	2.97	1.92
#2	1,497.000	3,908.100	219.24	47.99	977.7	22,730	0.13	0.09
#3	862.700	4,770.800	274.62	60.13	1,092.3	18,273	0.04	0.03
#4	0.000	4,770.800	274.62	60.13	1,092.3	18,273	0.04	0.03
#9	425.500	5,196.300	278.73	67.17	1,092.8	15,772	0.00	0.00
#11	0.000	12,411.000	706.54	182.52	4,544.5	30,480	0.02	0.01
#21	1,080.800	13,491.800	728.86	194.95	4,561.0	29,762	0.00	0.00
#18	848.500	848.500	87.84	11.61	118.2	12,305	0.00	0.00
#17	182.200	182.200	65.14	4.08	55.0	14,274	0.37	0.26
#19	0.000	1,030.700	148.60	15.69	173.2	11,407	0.09	0.07
#15	1,992.700	1,992.700	180.77	24.60	857.0	40,282	0.20	0.12
#12	3,494.500	3,494.500	54.37	8.31	106.0	14,291	5.52	3.61
#13	2,720.700	6,215.200	99.03	15.37	232.3	16,747	7.21	4.76
#14	5,096.800	11,312.000	214.75	67.68	1,686.3	69,407	0.58	0.15
#16	876.500	14,181.200	384.91	111.41	3,202.2	48,003	0.53	0.23
#20	681.900	15,893.800	399.88	141.32	3,473.7	36,837	0.00	0.00
#22	0.000	29,385.600	1,034.13	336.26	8,034.7	30,529	0.00	0.00
#23	752.900	30,138.500	1,025.65	343.99	7,929.8	29,707	0.00	0.00
#35	0.000	48,329.700	1,260.70	439.29	10,686.8	27,942	0.01	0.01
#36	730.590	49,060.290	1,258.12	444.11	10,716.3	34,997	0.00	0.00
#37	2,208.500	51,268.790	1,249.70	459.47	10,744.2	29,250	0.14	0.08

Copyright 1998 -2007 Pamela J. Schwab

Particle Size Distribution(s) at Each Structure

Structure #30:

Size (mm)	In/Out
2.0000	100.000%
0.1000	48.542%
0.0500	27.507%
0.0020	17.799%
0.0010	0.000%

Structure #28:

Size (mm)	In/Out
2.0000	100.000%
0.1000	100.000%
0.0500	100.000%
0.0020	100.000%
0.0010	0.000%

Structure #26:

Size (mm)	In/Out
2.0000	100.000%
0.1000	100.000%
0.0500	98.959%
0.0020	67.283%
0.0010	0.000%

Structure #24:

Size (mm)	In/Out
2.0000	100.000%
0.1000	100.000%
0.0500	100.000%
0.0020	82.732%
0.0010	0.000%

Structure #25:

Size (mm)	In/Out
2.0000	100.000%
0.1000	75.475%
0.0500	54.531%
0.0020	41.368%
0.0010	0.000%

Structure #27:

Size (mm)	In/Out
2.0000	100.000%
0.1000	83.117%
0.0500	53.429%
0.0020	36.645%
0.0010	0.000%

Structure #29:

Size (mm)	In/Out
2.0000	100.000%
0.1000	98.330%
0.0500	95.362%
0.0020	92.997%
0.0010	0.000%

Structure #32:

Size (mm)	In/Out
2.0000	100.000%
0.1000	100.000%
0.0500	100.000%
0.0020	100.000%
0.0010	0.000%

Structure #31:

Size (mm)	In/Out
2.0000	100.000%
0.1000	100.000%
0.0500	100.000%
0.0020	96.996%
0.0010	0.000%

Copyright 1998 -2007 Pamela J. Schwab

Structure #33 (Inlet to North Fork Diversion):

Size (mm)	In/Out
2.0000	100.000%
0.1000	100.000%
0.0500	100.000%
0.0020	99.224%
0.0010	0.000%

Structure #34:

Size (mm)	In/Out
2.0000	100.000%
0.1000	100.000%
0.0500	100.000%
0.0020	99.610%
0.0010	0.000%

Structure #5:

Size (mm)	In/Out
2.0000	100.000%
0.1000	100.000%
0.0500	97.321%
0.0020	93.713%
0.0010	0.000%

Structure #6:

Size (mm)	In/Out
2.0000	100.000%
0.1000	100.000%
0.0500	100.000%
0.0020	98.412%
0.0010	0.000%

Structure #7:

Size (mm)	In/Out
2.0000	100.000%
0.1000	100.000%
0.0500	100.000%
0.0020	100.000%
0.0010	0.000%

Structure #8:

Size (mm)	In/Out
2.0000	100.000%
0.1000	100.000%
0.0500	100.000%
0.0020	100.000%
0.0010	0.000%

Structure #10:

Size (mm)	In/Out
2.0000	100.000%
0.1000	100.000%
0.0500	99.871%
0.0020	99.779%
0.0010	0.000%

Structure #1:

Size (mm)	In/Out
2.0000	100.000%
0.1000	98.279%
0.0500	91.147%
0.0020	86.784%
0.0010	0.000%

Structure #2:

Size (mm)	In/Out
2.0000	100.000%
0.1000	100.000%
0.0500	100.000%
0.0020	98.374%
0.0010	0.000%

Structure #3:

Size (mm)	In/Out
2.0000	100.000%
0.1000	100.000%
0.0500	100.000%
0.0020	99.425%
0.0010	0.000%

Structure #4:

Size (mm)	In/Out
2.0000	100.000%
0.1000	100.000%
0.0500	100.000%
0.0020	99.425%
0.0010	0.000%

Structure #9:

Size (mm)	In/Out
2.0000	100.000%
0.1000	100.000%
0.0500	100.000%
0.0020	100.000%
0.0010	0.000%

Structure #11:

Size (mm)	In/Out
2.0000	100.000%
0.1000	100.000%
0.0500	100.000%
0.0020	99.832%
0.0010	0.000%

Structure #21:

Size (mm)	In/Out
2.0000	100.000%
0.1000	100.000%
0.0500	100.000%
0.0020	100.000%
0.0010	0.000%

Structure #18:

Size (mm)	In/Out
2.0000	100.000%
0.1000	100.000%
0.0500	100.000%
0.0020	100.000%
0.0010	0.000%

Structure #17:

Size (mm)	In/Out
2.0000	100.000%
0.1000	100.000%
0.0500	100.000%
0.0020	92.667%
0.0010	0.000%

Structure #19:

Size (mm)	In/Out
2.0000	100.000%
0.1000	100.000%
0.0500	100.000%
0.0020	97.672%
0.0010	0.000%

Structure #15:

Size (mm)	In/Out
2.0000	100.000%
0.1000	100.000%
0.0500	100.000%
0.0020	98.619%
0.0010	0.000%

Structure #12:

Size (mm)	In/Out
2.0000	100.000%
0.1000	91.000%
0.0500	61.522%
0.0020	39.808%
0.0010	0.000%

Structure #13:

Size (mm)	In/Out
2.0000	100.000%
0.1000	88.147%
0.0500	54.905%
0.0020	35.527%
0.0010	0.000%

Structure #14:

Size (mm)	In/Out
2.0000	100.000%
0.1000	100.000%
0.0500	100.000%
0.0020	97.648%
0.0010	0.000%

Structure #16:

Size (mm)	In/Out
2.0000	100.000%
0.1000	100.000%
0.0500	100.000%
0.0020	96.875%
0.0010	0.000%

Structure #20:

Size (mm)	In/Out
2.0000	100.000%
0.1000	100.000%
0.0500	100.000%
0.0020	100.000%
0.0010	0.000%

Structure #22:

Size (mm)	In/Out
2.0000	100.000%
0.1000	100.000%
0.0500	100.000%
0.0020	100.000%
0.0010	0.000%

Structure #23:

Size (mm)	In/Out
2.0000	100.000%
0.1000	100.000%
0.0500	100.000%
0.0020	100.000%
0.0010	0.000%

Structure #35:

Size (mm)	In/Out
2.0000	100.000%
0.1000	100.000%
0.0500	100.000%
0.0020	99.899%
0.0010	0.000%

Structure #36:

Size (mm)	In/Out
2.0000	100.000%
0.1000	100.000%
0.0500	100.000%
0.0020	100.000%
0.0010	0.000%

Structure #37:

Size (mm)	In/Out
2.0000	100.000%
0.1000	100.000%
0.0500	99.526%
0.0020	99.244%
0.0010	0.000%

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#30	1	476.400	1.131	0.000	0.000	73.100	M	0.42	0.108
	Σ	**476.400**						**0.42**	**0.108**
#28	1	772.300	0.657	0.523	0.334	90.400	M	154.33	12.273
	2	445.600	0.587	0.000	0.000	90.400	M	96.41	7.084
	Σ	**1,217.900**						**168.77**	**19.357**
#26	1	447.600	2.192	0.000	0.000	74.200	M	0.63	0.195
	2	2,038.800	3.000	0.000	0.000	77.000	M	7.95	2.663
	Σ	**2,486.400**						**8.59**	**2.858**
#24	1	2,607.500	5.367	2.377	0.305	75.200	M	3.53	1.798
	2	2,331.900	4.813	2.431	0.304	74.700	M	2.75	1.295
	3	1,758.500	2.231	1.788	0.297	76.200	M	6.20	1.768
	4	1,363.900	2.618	0.000	0.000	77.000	M	5.82	1.781
	Σ	**8,061.800**						**11.17**	**6.642**
#25	1	515.200	0.990	0.342	0.357	78.200	M	6.68	0.949
	2	130.500	0.787	0.342	0.357	78.100	M	1.94	0.234
	3	370.000	0.516	0.000	0.000	85.700	M	43.63	3.000
	Σ	**9,077.500**						**43.84**	**10.825**
#27	1	354.400	0.612	1.233	0.337	83.100	M	22.90	1.867
	2	305.200	0.529	1.054	0.328	84.000	M	26.16	1.879
	3	289.800	0.692	0.551	0.328	75.500	M	1.46	0.226
	4	253.000	0.361	0.551	0.328	79.400	M	10.21	0.631
	5	581.300	0.980	0.000	0.000	82.300	M	22.25	2.645
	Σ	**13,347.600**						**76.77**	**20.932**
#29	1	508.800	0.409	0.416	0.312	89.500	M	123.40	7.174
	2	233.200	0.521	0.291	0.312	91.600	M	64.31	4.349
	3	224.000	0.467	0.000	0.000	90.000	M	53.48	3.373
	Σ	**15,531.500**						**221.98**	**55.186**
#32	1	293.700	0.576	0.000	0.000	93.000	M	91.29	6.575
	Σ	**16,301.600**						**225.12**	**61.868**
#31	1	431.100	0.588	0.450	0.336	91.500	M	108.09	7.934
	2	325.800	0.432	0.149	0.327	93.000	M	121.15	7.302
	3	200.200	0.373	0.000	0.000	92.900	M	79.56	4.422
	Σ	**957.100**						**186.43**	**19.658**
#33	Σ	**17,258.700**						**306.26**	**81.526**

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#34	1	91.700	0.244	0.965	0.300	92.300	M	40.53	1.889
	2	105.200	0.256	0.965	0.300	93.000	M	49.60	2.367
	3	735.600	0.885	0.000	0.000	88.900	M	95.10	9.513
	Σ	**18,191.200**						**312.79**	**95.295**
#5	1	503.600	0.618	0.000	0.000	87.600	M	70.38	5.418
	2	406.500	0.388	0.501	0.350	84.800	M	50.23	2.856
	3	439.600	0.342	0.681	0.347	87.800	M	93.95	4.893
	4	162.600	0.280	0.681	0.347	86.000	M	29.90	1.385
	5	294.100	0.375	1.021	0.348	92.000	M	104.07	5.773
	6	216.600	0.272	1.018	0.348	90.100	M	70.08	3.321
	Σ	**2,023.000**						**229.14**	**23.646**
#6	1	149.100	0.331	0.000	0.000	92.600	M	60.49	3.180
	2	245.000	0.529	0.192	0.328	88.100	M	41.26	2.835
	3	276.200	0.450	0.461	0.319	89.500	M	63.13	3.884
	4	158.400	0.380	1.385	0.185	93.000	M	63.13	3.542
	5	206.200	0.402	0.796	0.320	89.400	M	49.86	2.867
	6	414.000	0.430	1.066	0.323	87.200	M	70.28	4.213
	7	294.300	0.535	1.066	0.323	86.400	M	37.89	2.654
	Σ	**3,766.200**						**265.00**	**46.822**
#7	1	731.700	1.274	0.000	0.000	93.000	M	125.32	16.354
	2	445.800	1.043	0.000	0.000	93.000	M	89.59	9.961
	3	270.800	0.804	0.000	0.000	93.000	M	66.41	6.053
	4	78.900	0.267	1.035	0.328	93.000	M	36.64	1.774
	5	154.900	0.310	1.071	0.326	93.000	M	67.89	3.478
	6	101.400	0.288	1.164	0.328	92.900	M	45.26	2.246
	7	117.700	0.298	1.344	0.329	92.200	M	47.63	2.379
	8	494.100	0.518	1.344	0.329	91.300	M	131.34	8.857
	Σ	**6,161.500**						**489.93**	**97.922**
#8	1	0.000	0.000	0.000	0.000	1.000	0.00	0.000	
	Σ	**6,161.500**						**489.93**	**97.922**
#10	1	355.500	1.286	0.000	0.000	93.000	M	60.42	7.944
	2	307.100	1.282	0.668	0.305	83.200	M	11.38	1.645
	3	147.300	1.245	0.517	0.303	90.600	M	18.52	2.401
	4	126.400	0.585	0.517	0.303	93.000	M	38.88	2.830
	5	116.900	1.179	0.621	0.305	93.000	M	21.32	2.613
	Σ	**7,214.700**						**502.27**	**115.355**
#1	1	557.400	0.941	0.000	0.000	83.600	M	28.55	3.202
	2	169.600	1.616	0.677	0.333	93.000	M	23.89	3.790
	3	636.400	1.842	0.729	0.333	81.000	M	11.02	2.246
	4	223.400	0.846	1.005	0.336	84.100	M	13.64	1.398

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
	5	77.700	0.330	1.392	0.341	81.400	M	5.49	0.299
	6	746.600	0.678	1.392	0.341	88.200	M	106.62	8.758
	Σ	**2,411.100**						**145.59**	**19.692**
#2	1	257.000	0.423	0.000	0.000	93.000	M	96.72	5.764
	2	180.500	0.562	0.478	0.281	91.800	M	48.62	3.452
	3	200.700	0.687	0.574	0.283	93.000	M	55.21	4.488
	4	438.600	0.811	0.574	0.283	93.000	M	106.86	9.806
	5	420.200	1.247	0.801	0.293	88.000	M	36.13	4.787
	Σ	**3,908.100**						**219.24**	**47.989**
#3	1	172.600	0.443	0.000	0.000	93.000	M	63.26	3.862
	2	311.200	0.890	0.000	0.000	88.900	M	40.06	4.025
	3	378.900	0.632	0.209	0.314	87.900	M	54.50	4.256
	Σ	**4,770.800**						**274.62**	**60.132**
#4	Σ	**4,770.800**						**274.62**	**60.132**
#9	1	425.500	0.830	0.000	0.000	90.700	M	74.57	7.035
	Σ	**5,196.300**						**278.73**	**67.167**
#11	Σ	**12,411.000**						**706.54**	**182.522**
#21	1	272.800	0.819	0.000	0.000	86.900	M	27.62	2.650
	2	230.500	0.388	0.694	0.266	89.200	M	55.42	3.111
	3	181.100	0.289	0.877	0.256	91.300	M	66.39	3.252
	4	396.400	0.939	0.877	0.256	86.100	M	31.67	3.413
	Σ	**13,491.800**						**728.86**	**194.947**
#18	1	301.700	0.652	0.000	0.000	93.000	M	86.12	6.753
	2	546.800	0.768	0.561	0.320	86.300	M	52.82	4.856
	Σ	**848.500**						**87.84**	**11.608**
#17	1	182.200	0.462	0.000	0.000	93.000	M	65.14	4.077
	Σ	**182.200**						**65.14**	**4.077**
#19	Σ	**1,030.700**						**148.60**	**15.685**
#15	1	437.400	0.803	0.000	0.000	91.300	M	85.27	7.826
	2	549.000	0.637	0.654	0.327	91.300	M	126.59	9.828
	3	1,006.300	1.023	0.768	0.331	84.700	M	59.01	6.949
	Σ	**1,992.700**						**180.77**	**24.603**
#12	1	517.800	0.791	0.000	0.000	81.900	M	21.49	2.184
	2	229.000	0.571	0.043	0.418	80.100	M	7.95	0.669
	3	592.700	0.706	0.044	0.417	81.500	M	24.57	2.314
	4	1,806.900	1.542	0.487	0.362	76.700	M	9.77	2.147
	5	348.100	0.618	0.487	0.362	80.000	11.07	0.993	

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
	Σ	**3,494.500**						**54.37**	**8.307**
#13	1	411.600	0.725	0.000	0.000	79.700	M	10.68	1.098
	2	636.400	0.774	0.322	0.336	80.700	M	20.37	2.112
	3	319.000	0.575	0.685	0.318	85.500	M	33.59	2.506
	4	231.700	0.314	0.923	0.328	80.400	M	13.44	0.724
	5	1,122.000	1.308	0.923	0.328	74.700	M	2.63	0.623
	Σ	**6,215.200**						**99.03**	**15.370**
#14	1	405.900	0.384	0.000	0.000	90.800	M	121.19	6.801
	2	411.100	0.452	0.707	0.308	90.700	M	109.89	6.798
	3	787.400	0.658	0.975	0.307	91.400	M	179.88	14.295
	4	144.200	0.341	1.716	0.310	86.200	M	24.38	1.267
	5	343.800	0.289	1.970	0.312	86.500	M	66.96	3.155
	6	392.800	0.806	2.107	0.316	81.900	M	16.07	1.657
	7	528.200	0.518	2.544	0.316	87.200	M	78.91	5.369
	8	890.900	1.253	2.544	0.316	83.500	M	35.63	5.030
	9	741.400	1.076	3.047	0.316	84.800	M	42.51	5.204
	10	451.100	0.916	3.354	0.316	83.900	M	24.97	2.728
	Σ	**11,312.000**						**214.75**	**67.675**
#16	1	329.600	0.641	0.000	0.000	93.000	M	95.21	7.374
	2	348.400	0.542	0.509	0.286	92.500	M	105.55	7.299
	3	198.500	0.266	0.943	0.279	93.000	M	92.31	4.462
	Σ	**14,181.200**						**384.91**	**111.413**
#20	1	296.300	0.667	0.000	0.000	91.700	M	69.85	5.596
	2	385.600	0.713	0.476	0.440	93.000	M	103.27	8.622
	Σ	**15,893.800**						**399.88**	**141.317**
#22	**Σ**	**29,385.600**						**1,034.13**	**336.264**
#23	1	442.400	0.960	0.000	0.000	85.300	M	30.32	3.363
	2	310.500	0.538	0.559	0.291	89.500	M	63.07	4.365
	Σ	**30,138.500**						**1,025.65**	**343.992**
#35	**Σ**	**48,329.700**						**1,260.70**	**439.287**
#36	1	298.200	0.987	0.000	0.000	85.000	M	18.97	2.161
	2	196.800	0.441	0.000	0.000	87.900	M	36.43	2.213
	3	235.590	0.885	0.166	0.372	78.300	M	3.44	0.446
	Σ	**49,060.290**						**1,258.12**	**444.107**
#37	1	744.000	1.756	0.000	0.000	84.800	M	28.64	5.220
	2	296.000	0.439	1.780	0.243	87.800	M	54.17	3.282
	3	237.700	0.333	1.649	0.246	85.500	M	36.50	1.874
	4	561.400	1.502	1.780	0.243	84.100	M	21.68	3.510

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
	5	369.400	0.817	2.236	0.284	81.600	M	14.00	1.471
	Σ	**51,268.790**						**1,249.70**	**459.465**

Subwatershed Sedimentology Detail:

Stru #	SWS #	Soil K	L (ft)	S (%)	C	P	PS #	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc (ml/l)	24VW (ml/l)
#30	1	0.095	200.00	3.80	0.3720	1.0000	2	0.4	2,965	1.82	1.55
	Σ							**0.4**	**2,965**	**1.82**	**1.55**
#28	1	0.187	100.00	10.10	0.3750	1.0000	3	739.2	61,682	0.00	0.00
	2	0.196	100.00	10.20	0.3930	1.0000	3	465.2	68,043	0.00	0.00
	Σ							**939.7**	**51,228**	**0.00**	**0.00**
#26	1	0.155	400.00	1.40	0.3480	1.0000	2	0.5	2,388	0.74	0.59
	2	0.155	300.00	2.40	0.3340	1.0000	2	12.6	4,534	0.54	0.41
	Σ							**13.1**	**4,375**	**0.55**	**0.42**
#24	1	0.128	300.00	2.30	0.3360	1.0000	2	5.1	2,784	0.20	0.15
	2	0.136	300.00	2.70	0.3440	1.0000	2	4.7	3,502	0.38	0.29
	3	0.107	300.00	2.30	0.3330	1.0000	2	5.8	3,108	0.51	0.39
	4	0.163	400.00	1.60	0.3210	1.0000	2	6.5	3,508	0.46	0.36
	Σ							**17.5**	**2,885**	**0.18**	**0.12**
#25	1	0.125	400.00	1.90	0.3440	1.0000	2	4.7	5,072	1.86	1.34
	2	0.124	300.00	2.60	0.3280	1.0000	2	1.2	5,507	2.23	1.57
	3	0.122	175.00	4.90	0.2660	1.0000	2	43.0	15,659	8.76	5.86
	Σ							**64.9**	**15,537**	**6.38**	**1.81**
#27	1	0.127	175.00	5.90	0.3160	1.0000	2	33.9	19,102	9.87	6.86
	2	0.122	150.00	7.50	0.2920	1.0000	2	37.9	21,382	11.60	7.99
	3	0.070	125.00	8.40	0.3270	1.0000	2	1.5	6,752	2.44	1.82
	4	0.097	125.00	9.60	0.3170	1.0000	2	13.5	23,951	12.80	8.34
	5	0.126	125.00	8.90	0.3290	1.0000	2	56.1	22,130	9.81	6.86
	Σ							**211.6**	**23,433**	**10.13**	**3.20**
#29	1	0.190	125.00	9.80	0.3930	1.0000	3	532.0	77,172	0.75	0.52
	2	0.203	125.00	8.90	0.3940	1.0000	3	258.7	61,430	0.00	0.00
	3	0.193	125.00	8.40	0.3940	1.0000	3	175.6	54,954	0.00	0.00
	Σ							**2,116.8**	**64,602**	**2.94**	**1.26**
#32	1	0.210	150.00	7.70	0.3990	1.0000	3	371.2	58,211	0.00	0.00
	Σ							**2,217.3**	**56,165**	**0.00**	**0.00**

Copyright 1998 -2007 Pamela J. Schwab

Stru #	SWS #	Soil K	L (ft)	S (%)	C	P	PS #	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc (ml/l)	24VW (ml/l)
#31	1	0.204	125.00	8.70	0.3620	1.0000	3	431.7	55,950	0.00	0.00
	2	0.210	150.00	7.30	0.3990	1.0000	3	438.0	62,096	2.06	1.43
	3	0.210	175.00	4.50	0.3980	1.0000	3	177.9	42,351	1.96	1.35
	Σ							**773.0**	**37,599**	**0.40**	**0.30**
#33	Σ							**2,990.3**	**46,265**	**0.13**	**0.07**
#34	1	0.189	175.00	4.60	0.2250	1.0000	3	39.1	21,215	1.55	1.10
	2	0.206	175.00	5.10	0.3620	1.0000	3	96.3	41,216	3.06	2.19
	3	0.176	175.00	4.20	0.2510	1.0000	3	149.6	16,385	0.00	0.00
	Σ							**2,757.0**	**37,581**	**0.05**	**0.03**
#5	1	0.149	75.00	12.50	0.3230	1.0000	3	233.9	45,624	0.00	0.00
	2	0.133	75.00	15.80	0.3190	1.0000	2	160.7	60,621	35.07	23.47
	3	0.103	100.00	11.00	0.2030	1.0000	3	112.4	24,558	0.41	0.28
	4	0.093	75.00	13.80	0.2130	1.0000	2	31.5	24,650	15.01	10.10
	5	0.123	100.00	11.00	0.1370	1.0000	3	105.5	18,986	0.74	0.52
	6	0.149	75.00	14.70	0.1990	1.0000	3	134.3	42,024	2.19	1.53
	Σ							**597.2**	**35,964**	**1.23**	**0.63**
#6	1	0.208	175.00	4.30	0.3980	1.0000	3	120.1	39,925	2.16	1.49
	2	0.183	175.00	5.40	0.3910	1.0000	3	97.6	36,476	0.00	0.00
	3	0.188	150.00	7.60	0.3900	1.0000	3	194.4	52,428	0.00	0.00
	4	0.210	150.00	6.30	0.3990	1.0000	3	176.3	49,309	2.24	1.64
	5	0.185	125.00	8.10	0.3860	1.0000	3	136.3	49,341	0.54	0.38
	6	0.104	100.00	11.30	0.2240	1.0000	3	101.7	25,411	0.00	0.00
	7	0.164	100.00	11.20	0.3740	1.0000	3	144.7	56,415	0.00	0.00
	Σ							**1,150.6**	**31,888**	**0.18**	**0.10**
#7	1	0.208	150.00	7.80	0.3780	1.0000	3	702.2	43,218	0.00	0.00
	2	0.209	100.00	10.20	0.3940	1.0000	3	578.3	58,417	0.00	0.00
	3	0.210	150.00	6.70	0.3990	1.0000	3	259.8	43,870	0.00	0.00
	4	0.210	100.00	11.50	0.3990	1.0000	3	160.1	89,864	6.44	4.62
	5	0.210	150.00	7.10	0.3990	1.0000	3	203.3	58,980	3.65	2.61
	6	0.209	150.00	7.90	0.3990	1.0000	3	139.9	62,665	4.16	2.98
	7	0.206	75.00	15.50	0.3990	1.0000	3	266.1	110,381	6.55	4.71
	8	0.202	75.00	14.50	0.3980	1.0000	3	883.3	99,436	0.00	0.00
	Σ							**3,549.5**	**40,575**	**0.00**	**0.00**
#8	1	0.000	0.00	0.00	0.0000	1.0000	0	0.0	1	0.00	0.00
	Σ							**3,549.5**	**40,575**	**0.00**	**0.00**
#10	1	0.190	300.00	2.70	0.1930	1.0000	3	57.1	7,337	0.00	0.00
	2	0.153	200.00	3.50	0.3610	1.0000	2	15.7	9,695	3.99	2.88
	3	0.189	200.00	3.70	0.3190	1.0000	3	29.3	12,402	0.00	0.00
	4	0.190	300.00	2.10	0.1940	1.0000	3	20.0	7,361	0.00	0.00

Stru #	SWS #	Soil K	L (ft)	S (%)	C	P	PS #	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc (ml/l)	24VW (ml/l)
	5	0.201	300.00	2.00	0.3030	1.0000	3	21.7	8,433	0.00	0.00
	Σ							**3,451.8**	**36,547**	**0.05**	**0.03**
#1	1	0.157	150.00	6.80	0.3830	1.0000	2	82.5	26,888	12.53	8.75
	2	0.210	150.00	6.60	0.3990	1.0000	3	111.1	29,342	0.00	0.00
	3	0.149	200.00	3.90	0.3870	1.0000	2	21.2	9,384	2.84	2.10
	4	0.169	175.00	4.70	0.3950	1.0000	2	28.9	21,381	10.40	7.35
	5	0.157	100.00	10.10	0.3940	1.0000	2	12.5	44,935	25.37	17.19
	6	0.175	75.00	12.60	0.2840	1.0000	3	403.0	47,055	0.00	0.00
	Σ							**601.9**	**34,411**	**2.97**	**1.92**
#2	1	0.190	150.00	7.90	0.1930	1.0000	3	159.6	29,198	1.03	0.71
	2	0.184	175.00	4.80	0.2010	1.0000	3	55.3	16,688	0.00	0.00
	3	0.202	200.00	3.90	0.3220	1.0000	3	86.9	19,896	0.00	0.00
	4	0.203	150.00	7.40	0.3220	1.0000	3	381.1	39,430	0.00	0.00
	5	0.181	175.00	5.10	0.3710	1.0000	3	108.1	22,816	0.00	0.00
	Σ							**977.7**	**22,730**	**0.13**	**0.09**
#3	1	0.190	175.00	5.20	0.1930	1.0000	3	72.9	19,971	0.61	0.42
	2	0.177	175.00	4.20	0.2560	1.0000	3	58.4	15,122	0.00	0.00
	3	0.166	175.00	4.30	0.2290	1.0000	3	61.4	15,297	0.00	0.00
	Σ							**1,092.3**	**18,273**	**0.04**	**0.03**
#4	Σ							**1,092.3**	**18,273**	**0.04**	**0.03**
#9	1	0.189	175.00	4.44	0.1970	1.0000	3	97.9	14,473	0.00	0.00
	Σ							**1,092.8**	**15,772**	**0.00**	**0.00**
#11	Σ							**4,544.5**	**30,480**	**0.02**	**0.01**
#21	1	0.177	175.00	4.44	0.2560	1.0000	3	39.5	15,701	0.00	0.00
	2	0.184	175.00	5.81	0.2210	1.0000	3	73.9	24,858	0.33	0.23
	3	0.185	300.00	2.70	0.2180	1.0000	3	40.0	12,731	0.71	0.50
	4	0.175	300.00	2.66	0.2690	1.0000	3	31.4	9,428	0.00	0.00
	Σ							**4,561.0**	**29,762**	**0.00**	**0.00**
#18	1	0.193	300.00	2.80	0.2200	1.0000	3	76.0	11,763	0.00	0.00
	2	0.173	175.00	4.70	0.3880	1.0000	3	124.7	26,650	0.00	0.00
	Σ							**118.2**	**12,305**	**0.00**	**0.00**
#17	1	0.196	300.00	2.60	0.2600	1.0000	3	55.0	14,274	0.37	0.26
	Σ							**55.0**	**14,274**	**0.37**	**0.26**
#19	Σ							**173.2**	**11,407**	**0.09**	**0.07**
#15	1	0.201	125.00	8.20	0.3960	1.0000	3	368.1	48,226	0.00	0.00
	2	0.161	100.00	11.40	0.3060	1.0000	3	487.2	50,739	0.00	0.00
	3	0.118	100.00	10.20	0.2850	1.0000	2	152.8	22,483	10.48	7.48

Stru #	SWS #	Soil K	L (ft)	S (%)	C	P	PS #	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc (ml/l)	24VW (ml/l)
	Σ							**857.0**	**40,282**	**0.20**	**0.12**
#12	1	0.124	150.00	6.30	0.3070	1.0000	2	33.4	16,317	7.66	5.26
	2	0.132	200.00	3.60	0.3500	1.0000	2	6.7	11,058	5.41	3.57
	3	0.136	175.00	5.00	0.3330	1.0000	2	38.4	17,881	8.59	5.82
	4	0.188	200.00	3.40	0.3570	1.0000	2	19.8	8,880	2.17	1.65
	5	0.228	175.00	4.10	0.3640	1.0000	2	23.2	25,014	11.93	8.15
	Σ							**106.0**	**14,291**	**5.52**	**3.61**
#13	1	0.128	150.00	6.90	0.3390	1.0000	2	19.1	18,713	8.41	5.72
	2	0.130	175.00	5.70	0.3300	1.0000	2	35.2	17,524	7.99	5.56
	3	0.191	175.00	6.00	0.2890	1.0000	2	69.3	29,144	15.93	11.00
	4	0.122	175.00	5.10	0.3460	1.0000	2	13.5	20,608	11.54	7.65
	5	0.137	175.00	4.20	0.3530	1.0000	2	4.8	7,061	2.12	1.69
	Σ							**232.3**	**16,747**	**7.21**	**4.76**
#14	1	0.196	100.00	10.20	0.3980	1.0000	3	523.7	80,672	2.17	1.48
	2	0.193	150.00	6.70	0.4020	1.0000	3	340.2	51,669	0.39	0.28
	3	0.169	75.00	13.80	0.3240	1.0000	3	881.1	62,374	0.00	0.00
	4	0.114	100.00	11.00	0.2980	1.0000	3	40.3	32,851	0.11	0.08
	5	0.078	100.00	10.10	0.1830	1.0000	3	44.0	14,425	0.35	0.25
	6	0.084	150.00	7.10	0.2700	1.0000	2	16.3	10,073	4.71	3.36
	7	0.087	100.00	10.00	0.1840	1.0000	3	69.6	13,279	0.00	0.00
	8	0.126	150.00	6.70	0.2740	1.0000	2	68.1	13,578	5.70	4.16
	9	0.117	150.00	7.30	0.2600	1.0000	2	73.3	14,162	6.51	4.74
	10	0.115	125.00	8.50	0.2610	1.0000	2	41.0	15,152	7.17	5.20
	Σ							**1,686.3**	**69,407**	**0.58**	**0.15**
#16	1	0.200	200.00	3.30	0.3000	1.0000	3	122.9	17,391	0.00	0.00
	2	0.204	150.00	6.00	0.3630	1.0000	3	297.4	41,912	0.09	0.06
	3	0.210	150.00	6.10	0.3990	1.0000	3	240.0	54,115	3.89	2.79
	Σ							**3,202.2**	**48,003**	**0.53**	**0.23**
#20	1	0.186	175.00	4.80	0.2130	1.0000	3	95.0	17,756	0.00	0.00
	2	0.194	200.00	3.80	0.2330	1.0000	3	120.6	14,509	0.00	0.00
	Σ							**3,473.7**	**36,837**	**0.00**	**0.00**
#22	Σ							**8,034.7**	**30,529**	**0.00**	**0.00**
#23	1	0.172	175.00	4.20	0.2810	1.0000	3	48.2	14,969	0.00	0.00
	2	0.185	150.00	6.00	0.2160	1.0000	3	90.2	21,665	0.00	0.00
	Σ							**7,929.8**	**29,707**	**0.00**	**0.00**
#35	Σ							**10,686.8**	**27,942**	**0.01**	**0.01**
#36	1	0.190	175.00	5.94	0.2830	1.0000	3	44.7	21,503	0.00	0.00
	2	0.180	125.00	9.92	0.2410	1.0000	3	82.3	40,194	0.00	0.00

Stru #	SWS #	Soil K	L (ft)	S (%)	C	P	PS #	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc (ml/l)	24VW (ml/l)
	3	0.151	300.00	2.63	0.3890	1.0000	2	3.6	8,290	3.23	2.29
	Σ							**10,716.3**	**34,997**	**0.00**	**0.00**
#37	1	0.196	200.00	3.80	0.3980	1.0000	2	76.7	14,865	5.59	4.04
	2	0.193	175.00	5.40	0.4020	1.0000	3	133.8	41,249	0.00	0.00
	3	0.173	150.00	7.11	0.2770	1.0000	3	58.2	31,798	0.00	0.00
	4	0.171	150.00	6.52	0.2990	1.0000	2	60.8	17,257	6.83	5.01
	5	0.078	400.00	1.20	0.1830	1.0000	2	2.1	1,430	0.66	0.47
	Σ							**10,744.2**	**29,250**	**0.14**	**0.08**

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	5. Nearly bare and untilled, and alluvial valley fans	3.65	50.00	1,369.00	1.910	0.199
		8. Large gullies, diversions, and low flowing streams	1.57	157.00	10,030.00	3.750	0.742
#1	**1**	**Time of Concentration:**					**0.941**
#1	2	5. Nearly bare and untilled, and alluvial valley fans	6.63	70.00	1,056.00	2.570	0.114
		5. Nearly bare and untilled, and alluvial valley fans	1.98	150.00	7,573.00	1.400	1.502
#1	**2**	**Time of Concentration:**					**1.616**
#1	3	5. Nearly bare and untilled, and alluvial valley fans	1.65	117.00	7,070.00	1.280	1.534
		8. Large gullies, diversions, and low flowing streams	2.43	126.00	5,188.00	4.670	0.308
#1	**3**	**Time of Concentration:**					**1.842**
#1	4	5. Nearly bare and untilled, and alluvial valley fans	5.77	260.00	4,506.00	2.400	0.521
		8. Large gullies, diversions, and low flowing streams	2.84	168.00	5,924.00	5.050	0.325
#1	**4**	**Time of Concentration:**					**0.846**
#1	5	5. Nearly bare and untilled, and alluvial valley fans	19.93	180.00	903.00	4.460	0.056
		8. Large gullies, diversions, and low flowing streams	3.30	178.00	5,393.00	5.450	0.274
#1	**5**	**Time of Concentration:**					**0.330**
#1	6	5. Nearly bare and untilled, and alluvial valley fans	13.43	105.00	782.00	3.660	0.059
		8. Large gullies, diversions, and low flowing streams	2.62	283.00	10,822.00	4.850	0.619
#1	**6**	**Time of Concentration:**					**0.678**
#2	1	5. Nearly bare and untilled, and alluvial valley fans	6.84	70.00	1,024.00	2.610	0.108

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
		8. Large gullies, diversions, and low flowing streams	1.62	70.00	4,325.00	3.810	0.315
#2	**1**	**Time of Concentration:**					**0.423**
#2	2	5. Nearly bare and untilled, and alluvial valley fans	5.56	45.00	810.00	2.350	0.095
		8. Large gullies, diversions, and low flowing streams	0.86	40.00	4,663.00	2.770	0.467
#2	**2**	**Time of Concentration:**					**0.562**
#2	3	5. Nearly bare and untilled, and alluvial valley fans	5.89	50.00	849.00	2.420	0.097
		8. Large gullies, diversions, and low flowing streams	1.17	80.00	6,862.00	3.230	0.590
#2	**3**	**Time of Concentration:**					**0.687**
#2	4	5. Nearly bare and untilled, and alluvial valley fans	12.63	95.00	752.00	3.550	0.058
		8. Large gullies, diversions, and low flowing streams	1.40	135.00	9,630.00	3.550	0.753
#2	**4**	**Time of Concentration:**					**0.811**
#2	5	5. Nearly bare and untilled, and alluvial valley fans	11.02	70.00	635.00	3.320	0.053
		8. Large gullies, diversions, and low flowing streams	0.46	40.00	8,732.00	2.030	1.194
#2	**5**	**Time of Concentration:**					**1.247**
#3	1	5. Nearly bare and untilled, and alluvial valley fans	1.24	10.00	805.00	1.110	0.201
		8. Large gullies, diversions, and low flowing streams	1.33	40.00	3,017.00	3.450	0.242
#3	**1**	**Time of Concentration:**					**0.443**
#3	2	5. Nearly bare and untilled, and alluvial valley fans	0.68	10.00	1,478.00	0.820	0.500
		8. Large gullies, diversions, and low flowing streams	1.78	100.00	5,622.00	4.000	0.390
#3	**2**	**Time of Concentration:**					**0.890**
#3	3	5. Nearly bare and untilled, and alluvial valley fans	4.66	70.00	1,501.00	2.150	0.193
		8. Large gullies, diversions, and low flowing streams	1.17	60.00	5,126.00	3.240	0.439
#3	**3**	**Time of Concentration:**					**0.632**
#5	1	5. Nearly bare and untilled, and alluvial valley fans	19.06	285.00	1,495.00	4.360	0.095
		8. Large gullies, diversions, and low flowing streams	2.64	242.00	9,174.00	4.870	0.523
#5	**1**	**Time of Concentration:**					**0.618**
#5	2	5. Nearly bare and untilled, and alluvial valley fans	14.27	105.00	736.00	3.770	0.054
		8. Large gullies, diversions, and low flowing streams	4.08	297.00	7,279.00	6.050	0.334
#5	**2**	**Time of Concentration:**					**0.388**
#5	3	5. Nearly bare and untilled, and alluvial valley fans	8.27	35.00	423.00	2.870	0.040

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
		8. Large gullies, diversions, and low flowing streams	3.44	208.00	6,049.00	5.560	0.302
#5	**3**	**Time of Concentration:**					**0.342**
#5	4	5. Nearly bare and untilled, and alluvial valley fans	14.58	85.00	583.00	3.810	0.042
		8. Large gullies, diversions, and low flowing streams	4.53	248.00	5,473.00	6.380	0.238
#5	**4**	**Time of Concentration:**					**0.280**
#5	5	5. Nearly bare and untilled, and alluvial valley fans	5.07	70.00	1,382.00	2.250	0.170
		8. Large gullies, diversions, and low flowing streams	3.89	170.00	4,375.00	5.910	0.205
#5	**5**	**Time of Concentration:**					**0.375**
#5	6	5. Nearly bare and untilled, and alluvial valley fans	12.48	90.00	721.00	3.530	0.056
		8. Large gullies, diversions, and low flowing streams	5.16	274.00	5,308.02	6.810	0.216
#5	**6**	**Time of Concentration:**					**0.272**
#6	1	5. Nearly bare and untilled, and alluvial valley fans	5.36	75.00	1,399.00	2.310	0.168
		8. Large gullies, diversions, and low flowing streams	2.41	66.00	2,742.00	4.650	0.163
#6	**1**	**Time of Concentration:**					**0.331**
#6	2	5. Nearly bare and untilled, and alluvial valley fans	3.39	80.00	2,359.00	1.840	0.356
		8. Large gullies, diversions, and low flowing streams	2.63	80.00	3,039.00	4.860	0.173
#6	**2**	**Time of Concentration:**					**0.529**
#6	3	5. Nearly bare and untilled, and alluvial valley fans	4.60	34.00	739.00	2.140	0.095
		8. Large gullies, diversions, and low flowing streams	2.33	136.00	5,845.00	4.570	0.355
#6	**3**	**Time of Concentration:**					**0.450**
#6	4	5. Nearly bare and untilled, and alluvial valley fans	6.06	85.00	1,402.00	2.460	0.158
		8. Large gullies, diversions, and low flowing streams	2.52	96.00	3,810.00	4.760	0.222
#6	**4**	**Time of Concentration:**					**0.380**
#6	5	5. Nearly bare and untilled, and alluvial valley fans	7.24	70.00	967.00	2.690	0.099
		8. Large gullies, diversions, and low flowing streams	2.34	117.00	5,003.00	4.580	0.303
#6	**5**	**Time of Concentration:**					**0.402**
#6	6	5. Nearly bare and untilled, and alluvial valley fans	31.83	183.00	575.00	5.640	0.028
		8. Large gullies, diversions, and low flowing streams	3.38	270.00	7,990.00	5.510	0.402
#6	**6**	**Time of Concentration:**					**0.430**
#6	7	5. Nearly bare and untilled, and alluvial valley fans	23.08	325.00	1,408.00	4.800	0.081

Copyright 1998 -2007 Pamela J. Schwab

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
		8. Large gullies, diversions, and low flowing streams	2.88	240.00	8,327.00	5.090	0.454
#6	**7**	**Time of Concentration:**					**0.535**
#7	1	5. Nearly bare and untilled, and alluvial valley fans	11.42	90.00	788.00	3.370	0.064
		8. Large gullies, diversions, and low flowing streams	1.46	230.00	15,769.00	3.620	1.210
#7	**1**	**Time of Concentration:**					**1.274**
#7	2	5. Nearly bare and untilled, and alluvial valley fans	10.97	60.00	547.00	3.310	0.045
		8. Large gullies, diversions, and low flowing streams	1.61	220.00	13,660.00	3.800	0.998
#7	**2**	**Time of Concentration:**					**1.043**
#7	3	5. Nearly bare and untilled, and alluvial valley fans	6.40	60.00	938.00	2.520	0.103
		8. Large gullies, diversions, and low flowing streams	1.72	171.00	9,931.00	3.930	0.701
#7	**3**	**Time of Concentration:**					**0.804**
#7	4	5. Nearly bare and untilled, and alluvial valley fans	19.23	80.00	416.00	4.380	0.026
		8. Large gullies, diversions, and low flowing streams	2.45	100.00	4,083.00	4.690	0.241
#7	**4**	**Time of Concentration:**					**0.267**
#7	5	5. Nearly bare and untilled, and alluvial valley fans	6.09	67.00	1,101.00	2.460	0.124
		8. Large gullies, diversions, and low flowing streams	2.51	80.00	3,184.00	4.750	0.186
#7	**5**	**Time of Concentration:**					**0.310**
#7	6	5. Nearly bare and untilled, and alluvial valley fans	5.93	63.00	1,062.00	2.430	0.121
		8. Large gullies, diversions, and low flowing streams	2.74	82.00	2,993.00	4.960	0.167
#7	**6**	**Time of Concentration:**					**0.288**
#7	7	5. Nearly bare and untilled, and alluvial valley fans	7.97	65.00	816.00	2.820	0.080
		8. Large gullies, diversions, and low flowing streams	3.48	153.00	4,400.00	5.590	0.218
#7	**7**	**Time of Concentration:**					**0.298**
#7	8	5. Nearly bare and untilled, and alluvial valley fans	6.60	50.00	758.00	2.560	0.082
		8. Large gullies, diversions, and low flowing streams	4.66	473.00	10,157.00	6.470	0.436
#7	**8**	**Time of Concentration:**					**0.518**
#9	1	5. Nearly bare and untilled, and alluvial valley fans	3.35	90.00	2,687.00	1.830	0.407
		8. Large gullies, diversions, and low flowing streams	0.58	20.00	3,463.00	2.270	0.423
#9	**1**	**Time of Concentration:**					**0.830**
#10	1	5. Nearly bare and untilled, and alluvial valley fans	1.24	41.00	3,317.00	1.110	0.830

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
		8. Large gullies, diversions, and low flowing streams	0.70	29.00	4,125.00	2.510	0.456
#10	**1**	**Time of Concentration:**					**1.286**
#10	2	5. Nearly bare and untilled, and alluvial valley fans	2.25	125.00	5,554.00	1.500	1.028
		8. Large gullies, diversions, and low flowing streams	2.13	85.00	3,997.00	4.370	0.254
#10	**2**	**Time of Concentration:**					**1.282**
#10	3	5. Nearly bare and untilled, and alluvial valley fans	1.39	68.00	4,904.00	1.170	1.164
		8. Large gullies, diversions, and low flowing streams	4.73	90.00	1,904.00	6.520	0.081
#10	**3**	**Time of Concentration:**					**1.245**
#10	4	5. Nearly bare and untilled, and alluvial valley fans	3.76	51.00	1,357.00	1.930	0.195
		8. Large gullies, diversions, and low flowing streams	0.65	22.00	3,385.00	2.410	0.390
#10	**4**	**Time of Concentration:**					**0.585**
#10	5	5. Nearly bare and untilled, and alluvial valley fans	1.63	88.00	5,391.16	1.270	1.179
#10	**5**	**Time of Concentration:**					**1.179**
#12	1	5. Nearly bare and untilled, and alluvial valley fans	4.50	75.00	1,667.00	2.120	0.218
		8. Large gullies, diversions, and low flowing streams	1.85	155.00	8,400.00	4.070	0.573
#12	**1**	**Time of Concentration:**					**0.791**
#12	2	5. Nearly bare and untilled, and alluvial valley fans	2.99	50.00	1,674.03	1.720	0.270
		8. Large gullies, diversions, and low flowing streams	1.67	70.00	4,201.17	3.870	0.301
#12	**2**	**Time of Concentration:**					**0.571**
#12	3	5. Nearly bare and untilled, and alluvial valley fans	4.04	57.00	1,411.00	2.000	0.195
		8. Large gullies, diversions, and low flowing streams	1.55	107.00	6,884.00	3.740	0.511
#12	**3**	**Time of Concentration:**					**0.706**
#12	4	5. Nearly bare and untilled, and alluvial valley fans	2.23	84.00	3,771.04	1.490	0.703
		8. Large gullies, diversions, and low flowing streams	1.62	186.00	11,515.60	3.810	0.839
#12	**4**	**Time of Concentration:**					**1.542**
#12	5	5. Nearly bare and untilled, and alluvial valley fans	3.68	53.00	1,442.00	1.910	0.209
		8. Large gullies, diversions, and low flowing streams	1.95	120.00	6,155.00	4.180	0.409
#12	**5**	**Time of Concentration:**					**0.618**
#13	1	5. Nearly bare and untilled, and alluvial valley fans	4.62	62.00	1,342.00	2.140	0.174
		8. Large gullies, diversions, and low flowing streams	1.91	157.00	8,225.00	4.140	0.551
#13	**1**	**Time of Concentration:**					**0.725**

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#13	2	5. Nearly bare and untilled, and alluvial valley fans	2.91	50.00	1,717.00	1.700	0.280
		8. Large gullies, diversions, and low flowing streams	2.28	183.00	8,039.00	4.520	0.494
#13	**2**	**Time of Concentration:**					**0.774**
#13	3	5. Nearly bare and untilled, and alluvial valley fans	6.18	95.00	1,537.00	2.480	0.172
		8. Large gullies, diversions, and low flowing streams	2.13	135.00	6,347.00	4.370	0.403
#13	**3**	**Time of Concentration:**					**0.575**
#13	4	5. Nearly bare and untilled, and alluvial valley fans	3.17	10.00	315.00	1.780	0.049
		8. Large gullies, diversions, and low flowing streams	2.30	100.00	4,344.00	4.550	0.265
#13	**4**	**Time of Concentration:**					**0.314**
#13	5	5. Nearly bare and untilled, and alluvial valley fans	3.10	70.00	2,255.00	1.760	0.355
		8. Large gullies, diversions, and low flowing streams	1.23	140.00	11,392.00	3.320	0.953
#13	**5**	**Time of Concentration:**					**1.308**
#14	1	5. Nearly bare and untilled, and alluvial valley fans	10.59	63.00	595.00	3.250	0.050
		8. Large gullies, diversions, and low flowing streams	2.60	151.00	5,808.00	4.830	0.334
#14	**1**	**Time of Concentration:**					**0.384**
#14	2	5. Nearly bare and untilled, and alluvial valley fans	7.28	67.00	920.00	2.690	0.095
		8. Large gullies, diversions, and low flowing streams	2.17	123.00	5,670.00	4.410	0.357
#14	**2**	**Time of Concentration:**					**0.452**
#14	3	5. Nearly bare and untilled, and alluvial valley fans	21.46	150.00	699.00	4.630	0.041
		8. Large gullies, diversions, and low flowing streams	3.10	364.00	11,728.00	5.280	0.617
#14	**3**	**Time of Concentration:**					**0.658**
#14	4	5. Nearly bare and untilled, and alluvial valley fans	3.39	35.00	1,032.00	1.840	0.155
		8. Large gullies, diversions, and low flowing streams	2.97	103.00	3,470.00	5.160	0.186
#14	**4**	**Time of Concentration:**					**0.341**
#14	5	5. Nearly bare and untilled, and alluvial valley fans	28.15	125.00	444.00	5.300	0.023
		8. Large gullies, diversions, and low flowing streams	4.18	246.00	5,886.00	6.130	0.266
#14	**5**	**Time of Concentration:**					**0.289**
#14	6	5. Nearly bare and untilled, and alluvial valley fans	3.18	40.00	1,257.00	1.780	0.196
		8. Large gullies, diversions, and low flowing streams	2.29	228.00	9,963.00	4.530	0.610
#14	**6**	**Time of Concentration:**					**0.806**

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#14	7	5. Nearly bare and untilled, and alluvial valley fans	16.72	100.00	598.00	4.080	0.040
		8. Large gullies, diversions, and low flowing streams	2.81	243.00	8,649.00	5.020	0.478
#14	**7**	**Time of Concentration:**					**0.518**
#14	8	5. Nearly bare and untilled, and alluvial valley fans	1.70	47.00	2,765.00	1.300	0.590
		8. Large gullies, diversions, and low flowing streams	2.44	274.00	11,208.00	4.690	0.663
#14	**8**	**Time of Concentration:**					**1.253**
#14	9	5. Nearly bare and untilled, and alluvial valley fans	2.87	105.00	3,657.00	1.690	0.601
		8. Large gullies, diversions, and low flowing streams	2.43	194.00	7,991.00	4.670	0.475
#14	**9**	**Time of Concentration:**					**1.076**
#14	10	5. Nearly bare and untilled, and alluvial valley fans	2.75	80.00	2,907.00	1.650	0.489
		8. Large gullies, diversions, and low flowing streams	2.41	172.00	7,149.00	4.650	0.427
#14	**10**	**Time of Concentration:**					**0.916**
#15	1	5. Nearly bare and untilled, and alluvial valley fans	12.80	54.00	422.00	3.570	0.032
		8. Large gullies, diversions, and low flowing streams	1.68	181.00	10,781.00	3.880	0.771
#15	**1**	**Time of Concentration:**					**0.803**
#15	2	5. Nearly bare and untilled, and alluvial valley fans	44.22	260.00	588.00	6.640	0.024
		8. Large gullies, diversions, and low flowing streams	2.45	254.00	10,354.00	4.690	0.613
#15	**2**	**Time of Concentration:**					**0.637**
#15	3	5. Nearly bare and untilled, and alluvial valley fans	10.04	85.00	847.00	3.160	0.074
		8. Large gullies, diversions, and low flowing streams	2.34	366.00	15,663.00	4.580	0.949
#15	**3**	**Time of Concentration:**					**1.023**
#16	1	5. Nearly bare and untilled, and alluvial valley fans	4.17	15.00	360.00	2.040	0.049
		8. Large gullies, diversions, and low flowing streams	1.42	108.00	7,618.00	3.570	0.592
#16	**1**	**Time of Concentration:**					**0.641**
#16	2	5. Nearly bare and untilled, and alluvial valley fans	8.70	62.00	713.00	2.940	0.067
		8. Large gullies, diversions, and low flowing streams	1.99	144.00	7,241.00	4.230	0.475
#16	**2**	**Time of Concentration:**					**0.542**
#16	3	5. Nearly bare and untilled, and alluvial valley fans	6.88	32.00	465.00	2.620	0.049
		8. Large gullies, diversions, and low flowing streams	2.29	81.00	3,543.00	4.530	0.217
#16	**3**	**Time of Concentration:**					**0.266**

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#17	1	5. Nearly bare and untilled, and alluvial valley fans	9.37	65.00	694.00	3.060	0.062
		8. Large gullies, diversions, and low flowing streams	1.19	56.00	4,712.00	3.270	0.400
#17	**1**	**Time of Concentration:**					**0.462**
#18	1	5. Nearly bare and untilled, and alluvial valley fans	9.00	60.00	667.00	2.990	0.061
		8. Large gullies, diversions, and low flowing streams	0.97	61.00	6,287.00	2.950	0.591
#18	**1**	**Time of Concentration:**					**0.652**
#18	2	5. Nearly bare and untilled, and alluvial valley fans	2.47	33.00	1,336.00	1.570	0.236
		8. Large gullies, diversions, and low flowing streams	2.01	164.00	8,154.00	4.250	0.532
#18	**2**	**Time of Concentration:**					**0.768**
#20	1	5. Nearly bare and untilled, and alluvial valley fans	11.87	45.00	379.00	3.440	0.030
		8. Large gullies, diversions, and low flowing streams	0.75	45.00	5,969.00	2.600	0.637
#20	**1**	**Time of Concentration:**					**0.667**
#20	2	5. Nearly bare and untilled, and alluvial valley fans	5.40	45.00	833.00	2.320	0.099
		8. Large gullies, diversions, and low flowing streams	1.30	98.00	7,547.00	3.410	0.614
#20	**2**	**Time of Concentration:**					**0.713**
#21	1	5. Nearly bare and untilled, and alluvial valley fans	4.09	60.00	1,467.00	2.020	0.201
		8. Large gullies, diversions, and low flowing streams	0.93	60.00	6,433.00	2.890	0.618
#21	**1**	**Time of Concentration:**					**0.819**
#21	2	5. Nearly bare and untilled, and alluvial valley fans	3.50	50.00	1,430.00	1.860	0.213
		8. Large gullies, diversions, and low flowing streams	2.15	60.00	2,785.00	4.400	0.175
#21	**2**	**Time of Concentration:**					**0.388**
#21	3	5. Nearly bare and untilled, and alluvial valley fans	1.70	15.00	881.00	1.300	0.188
		9. Small streams flowing bankfull	1.49	60.00	4,014.00	11.000	0.101
#21	**3**	**Time of Concentration:**					**0.289**
#21	4	5. Nearly bare and untilled, and alluvial valley fans	2.21	40.00	1,811.02	1.480	0.339
		8. Large gullies, diversions, and low flowing streams	0.84	50.00	5,949.54	2.750	0.600
#21	**4**	**Time of Concentration:**					**0.939**
#23	1	5. Nearly bare and untilled, and alluvial valley fans	2.44	65.00	2,660.01	1.560	0.473
		8. Large gullies, diversions, and low flowing streams	0.33	10.00	3,017.50	1.720	0.487
#23	**1**	**Time of Concentration:**					**0.960**
#23	2	5. Nearly bare and untilled, and alluvial valley fans	3.49	60.00	1,718.01	1.860	0.256

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
		8. Large gullies, diversions, and low flowing streams	1.66	65.00	3,926.06	3.860	0.282
#23	**2**	**Time of Concentration:**					**0.538**
#24	1	5. Nearly bare and untilled, and alluvial valley fans	1.71	430.00	25,118.00	1.300	5.367
#24	**1**	**Time of Concentration:**					**5.367**
#24	2	5. Nearly bare and untilled, and alluvial valley fans	1.84	430.00	23,393.00	1.350	4.813
#24	**2**	**Time of Concentration:**					**4.813**
#24	3	5. Nearly bare and untilled, and alluvial valley fans	1.82	155.00	8,498.00	1.350	1.748
		8. Large gullies, diversions, and low flowing streams	0.84	40.00	4,771.00	2.740	0.483
#24	**3**	**Time of Concentration:**					**2.231**
#24	4	5. Nearly bare and untilled, and alluvial valley fans	1.24	50.00	4,042.00	1.110	1.011
		8. Large gullies, diversions, and low flowing streams	0.49	60.00	12,150.00	2.100	1.607
#24	**4**	**Time of Concentration:**					**2.618**
#25	1	5. Nearly bare and untilled, and alluvial valley fans	0.51	10.00	1,950.00	0.710	0.762
		8. Large gullies, diversions, and low flowing streams	1.81	60.00	3,322.00	4.030	0.228
#25	**1**	**Time of Concentration:**					**0.990**
#25	2	5. Nearly bare and untilled, and alluvial valley fans	1.11	25.00	2,254.00	1.050	0.596
		8. Large gullies, diversions, and low flowing streams	2.36	75.00	3,178.00	4.600	0.191
#25	**2**	**Time of Concentration:**					**0.787**
#25	3	5. Nearly bare and untilled, and alluvial valley fans	3.23	30.00	929.00	1.790	0.144
		8. Large gullies, diversions, and low flowing streams	2.45	154.00	6,297.00	4.690	0.372
#25	**3**	**Time of Concentration:**					**0.516**
#26	1	5. Nearly bare and untilled, and alluvial valley fans	1.20	103.00	8,602.00	1.090	2.192
#26	**1**	**Time of Concentration:**					**2.192**
#26	2	5. Nearly bare and untilled, and alluvial valley fans	1.23	120.00	9,780.00	1.100	2.469
		8. Large gullies, diversions, and low flowing streams	2.18	184.00	8,454.00	4.420	0.531
#26	**2**	**Time of Concentration:**					**3.000**
#27	1	5. Nearly bare and untilled, and alluvial valley fans	4.32	50.00	1,158.02	2.070	0.155
		8. Large gullies, diversions, and low flowing streams	2.53	198.00	7,838.16	4.760	0.457
#27	**1**	**Time of Concentration:**					**0.612**
#27	2	5. Nearly bare and untilled, and alluvial valley fans	5.26	30.00	570.00	2.290	0.069
		8. Large gullies, diversions, and low flowing streams	3.15	278.00	8,822.00	5.320	0.460

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#27	**2**	**Time of Concentration:**					**0.529**
#27	3	5. Nearly bare and untilled, and alluvial valley fans	16.33	80.00	490.00	4.040	0.033
		8. Large gullies, diversions, and low flowing streams	2.15	225.00	10,443.00	4.400	0.659
#27	**3**	**Time of Concentration:**					**0.692**
#27	4	5. Nearly bare and untilled, and alluvial valley fans	12.43	65.00	523.00	3.520	0.041
		8. Large gullies, diversions, and low flowing streams	3.49	225.00	6,454.00	5.600	0.320
#27	**4**	**Time of Concentration:**					**0.361**
#27	5	5. Nearly bare and untilled, and alluvial valley fans	9.40	25.00	266.00	3.060	0.024
		8. Large gullies, diversions, and low flowing streams	2.32	364.00	15,700.00	4.560	0.956
#27	**5**	**Time of Concentration:**					**0.980**
#28	1	5. Nearly bare and untilled, and alluvial valley fans	5.25	40.00	762.00	2.290	0.092
		8. Large gullies, diversions, and low flowing streams	2.96	310.00	10,479.34	5.150	0.565
#28	**1**	**Time of Concentration:**					**0.657**
#28	2	5. Nearly bare and untilled, and alluvial valley fans	25.86	105.00	406.00	5.080	0.022
		8. Large gullies, diversions, and low flowing streams	2.96	310.00	10,479.34	5.150	0.565
#28	**2**	**Time of Concentration:**					**0.587**
#29	1	5. Nearly bare and untilled, and alluvial valley fans	11.58	30.00	259.00	3.400	0.021
		8. Large gullies, diversions, and low flowing streams	3.61	288.00	7,976.00	5.700	0.388
#29	**1**	**Time of Concentration:**					**0.409**
#29	2	5. Nearly bare and untilled, and alluvial valley fans	8.06	40.00	496.00	2.830	0.048
		8. Large gullies, diversions, and low flowing streams	2.90	252.00	8,693.55	5.100	0.473
#29	**2**	**Time of Concentration:**					**0.521**
#29	3	5. Nearly bare and untilled, and alluvial valley fans	7.25	25.00	345.00	2.690	0.035
		8. Large gullies, diversions, and low flowing streams	2.26	158.00	7,001.00	4.500	0.432
#29	**3**	**Time of Concentration:**					**0.467**
#30	1	5. Nearly bare and untilled, and alluvial valley fans	4.93	35.00	710.00	2.220	0.088
		8. Large gullies, diversions, and low flowing streams	1.67	243.00	14,540.00	3.870	1.043
#30	**1**	**Time of Concentration:**					**1.131**
#31	1	5. Nearly bare and untilled, and alluvial valley fans	2.91	15.00	515.00	1.700	0.084
		8. Large gullies, diversions, and low flowing streams	2.74	247.00	9,006.00	4.960	0.504
#31	**1**	**Time of Concentration:**					**0.588**

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#31	2	5. Nearly bare and untilled, and alluvial valley fans	7.46	25.00	335.00	2.730	0.034
		8. Large gullies, diversions, and low flowing streams	2.18	138.00	6,335.00	4.420	0.398
#31	**2**	**Time of Concentration:**					**0.432**
#31	3	5. Nearly bare and untilled, and alluvial valley fans	3.84	20.00	521.00	1.950	0.074
		8. Large gullies, diversions, and low flowing streams	2.24	108.00	4,826.00	4.480	0.299
#31	**3**	**Time of Concentration:**					**0.373**
#32	1	5. Nearly bare and untilled, and alluvial valley fans	3.48	22.00	632.00	1.860	0.094
		8. Large gullies, diversions, and low flowing streams	1.56	101.00	6,494.00	3.740	0.482
#32	**1**	**Time of Concentration:**					**0.576**
#34	1	5. Nearly bare and untilled, and alluvial valley fans	3.21	25.00	779.00	1.790	0.120
		8. Large gullies, diversions, and low flowing streams	2.80	63.00	2,251.00	5.010	0.124
#34	**1**	**Time of Concentration:**					**0.244**
#34	2	5. Nearly bare and untilled, and alluvial valley fans	5.75	40.00	696.00	2.390	0.080
		8. Large gullies, diversions, and low flowing streams	23.00	2,100.00	9,130.43	14.380	0.176
#34	**2**	**Time of Concentration:**					**0.256**
#34	3	5. Nearly bare and untilled, and alluvial valley fans	2.67	40.00	1,500.00	1.630	0.255
		8. Large gullies, diversions, and low flowing streams	1.28	98.00	7,675.00	3.380	0.630
#34	**3**	**Time of Concentration:**					**0.885**
#36	1	5. Nearly bare and untilled, and alluvial valley fans	3.21	105.00	3,274.00	1.790	0.508
		8. Large gullies, diversions, and low flowing streams	0.21	5.00	2,367.00	1.370	0.479
#36	**1**	**Time of Concentration:**					**0.987**
#36	2	5. Nearly bare and untilled, and alluvial valley fans	5.50	140.00	2,547.00	2.340	0.302
		8. Large gullies, diversions, and low flowing streams	1.58	30.00	1,897.00	3.770	0.139
#36	**2**	**Time of Concentration:**					**0.441**
#36	3	5. Nearly bare and untilled, and alluvial valley fans	2.03	80.00	3,938.62	1.420	0.770
		8. Large gullies, diversions, and low flowing streams	2.52	50.00	1,981.86	4.760	0.115
#36	**3**	**Time of Concentration:**					**0.885**
#37	1	5. Nearly bare and untilled, and alluvial valley fans	4.68	129.00	2,754.05	2.160	0.354
		8. Large gullies, diversions, and low flowing streams	0.16	10.00	6,108.73	1.210	1.402
#37	**1**	**Time of Concentration:**					**1.756**

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#37	2	5. Nearly bare and untilled, and alluvial valley fans	7.32	90.00	1,229.00	2.700	0.126
		8. Large gullies, diversions, and low flowing streams	1.62	70.00	4,309.01	3.820	0.313
#37	**2**	**Time of Concentration:**					**0.439**
#37	3	5. Nearly bare and untilled, and alluvial valley fans	8.10	100.00	1,234.00	2.840	0.120
		8. Large gullies, diversions, and low flowing streams	2.66	100.00	3,763.21	4.890	0.213
#37	**3**	**Time of Concentration:**					**0.333**
#37	4	5. Nearly bare and untilled, and alluvial valley fans	5.09	90.00	1,768.03	2.250	0.218
		8. Large gullies, diversions, and low flowing streams	0.36	30.00	8,326.39	1.800	1.284
#37	**4**	**Time of Concentration:**					**1.502**
#37	5	5. Nearly bare and untilled, and alluvial valley fans	0.81	20.00	2,466.09	0.900	0.761
		8. Large gullies, diversions, and low flowing streams	4.06	50.00	1,231.01	6.040	0.056
#37	**5**	**Time of Concentration:**					**0.817**

Subwatershed Muskingum Routing Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	2	8. Large gullies, diversions, and low flowing streams	1.29	107.00	8,294.00	3.400	0.677
#1	**2**	**Muskingum K:**					**0.677**
#1	3	8. Large gullies, diversions, and low flowing streams	1.27	113.00	8,880.00	3.380	0.729
#1	**3**	**Muskingum K:**					**0.729**
#1	4	8. Large gullies, diversions, and low flowing streams	1.35	171.00	12,634.00	3.490	1.005
#1	**4**	**Muskingum K:**					**1.005**
#1	5	8. Large gullies, diversions, and low flowing streams	1.49	274.00	18,349.00	3.660	1.392
#1	**5**	**Muskingum K:**					**1.392**
#1	6	8. Large gullies, diversions, and low flowing streams	1.49	274.00	18,349.00	3.660	1.392
#1	**6**	**Muskingum K:**					**1.392**
#2	2	8. Large gullies, diversions, and low flowing streams	0.53	20.00	3,756.00	2.180	0.478
#2	**2**	**Muskingum K:**					**0.478**
#2	3	8. Large gullies, diversions, and low flowing streams	0.55	25.00	4,570.00	2.210	0.574
#2	**3**	**Muskingum K:**					**0.574**
#2	4	8. Large gullies, diversions, and low flowing streams	0.55	25.00	4,570.00	2.210	0.574
#2	**4**	**Muskingum K:**					**0.574**

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#2	5	8. Large gullies, diversions, and low flowing streams	0.65	45.00	6,955.00	2.410	0.801
#2	**5**	**Muskingum K:**					**0.801**
#3	3	8. Large gullies, diversions, and low flowing streams	0.92	20.00	2,168.00	2.880	0.209
#3	**3**	**Muskingum K:**					**0.209**
#5	1	8. Large gullies, diversions, and low flowing streams	0.00	0.00	0.00	0.000	0.000
#5	**1**	**Muskingum K:**					**0.000**
#5	2	8. Large gullies, diversions, and low flowing streams	1.75	125.00	7,149.00	3.960	0.501
#5	**2**	**Muskingum K:**					**0.501**
#5	3	8. Large gullies, diversions, and low flowing streams	1.65	155.00	9,418.00	3.840	0.681
#5	**3**	**Muskingum K:**					**0.681**
#5	4	8. Large gullies, diversions, and low flowing streams	1.65	155.00	9,418.00	3.840	0.681
#5	**4**	**Muskingum K:**					**0.681**
#5	5	8. Large gullies, diversions, and low flowing streams	1.67	239.00	14,273.00	3.880	1.021
#5	**5**	**Muskingum K:**					**1.021**
#5	6	8. Large gullies, diversions, and low flowing streams	1.68	239.00	14,223.00	3.880	1.018
#5	**6**	**Muskingum K:**					**1.018**
#6	2	8. Large gullies, diversions, and low flowing streams	1.16	26.00	2,241.00	3.230	0.192
#6	**2**	**Muskingum K:**					**0.192**
#6	3	8. Large gullies, diversions, and low flowing streams	1.00	50.00	4,987.00	3.000	0.461
#6	**3**	**Muskingum K:**					**0.461**
#6	4	5. Nearly bare and untilled, and alluvial valley fans	1.00	50.00	4,987.00	1.000	1.385
#6	**4**	**Muskingum K:**					**1.385**
#6	5	8. Large gullies, diversions, and low flowing streams	1.02	89.00	8,685.00	3.030	0.796
#6	**5**	**Muskingum K:**					**0.796**
#6	6	8. Large gullies, diversions, and low flowing streams	1.06	126.00	11,860.00	3.090	1.066
#6	**6**	**Muskingum K:**					**1.066**
#6	7	8. Large gullies, diversions, and low flowing streams	1.06	126.00	11,860.00	3.090	1.066
#6	**7**	**Muskingum K:**					**1.066**
#7	1	8. Large gullies, diversions, and low flowing streams	0.00	0.00	0.00	0.000	0.000
#7	**1**	**Muskingum K:**					**0.000**
#7	2	8. Large gullies, diversions, and low flowing streams	0.00	0.00	0.00	0.000	0.000
#7	**2**	**Muskingum K:**					**0.000**
#7	4	8. Large gullies, diversions, and low flowing streams	1.16	140.00	12,037.00	3.230	1.035

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#7	**4**	**Muskingum K:**					**1.035**
#7	5	8. Large gullies, diversions, and low flowing streams	1.14	140.00	12,307.69	3.190	1.071
#7	**5**	**Muskingum K:**					**1.071**
#7	6	8. Large gullies, diversions, and low flowing streams	1.17	158.00	13,546.00	3.230	1.164
#7	**6**	**Muskingum K:**					**1.164**
#7	7	8. Large gullies, diversions, and low flowing streams	1.18	187.00	15,784.00	3.260	1.344
#7	**7**	**Muskingum K:**					**1.344**
#7	8	8. Large gullies, diversions, and low flowing streams	1.18	187.00	15,784.00	3.260	1.344
#7	**8**	**Muskingum K:**					**1.344**
#10	3	8. Large gullies, diversions, and low flowing streams	0.76	37.00	4,861.00	2.610	0.517
#10	**3**	**Muskingum K:**					**0.517**
#10	4	8. Large gullies, diversions, and low flowing streams	0.76	37.00	4,861.00	2.610	0.517
#10	**4**	**Muskingum K:**					**0.517**
#10	5	8. Large gullies, diversions, and low flowing streams	0.79	47.00	5,956.00	2.660	0.621
#10	**5**	**Muskingum K:**					**0.621**
#12	2	8. Large gullies, diversions, and low flowing streams	8.24	111.00	1,347.00	8.610	0.043
#12	**2**	**Muskingum K:**					**0.043**
#12	3	8. Large gullies, diversions, and low flowing streams	8.01	109.00	1,360.00	8.490	0.044
#12	**3**	**Muskingum K:**					**0.044**
#12	4	8. Large gullies, diversions, and low flowing streams	2.24	176.00	7,866.00	4.480	0.487
#12	**4**	**Muskingum K:**					**0.487**
#12	5	8. Large gullies, diversions, and low flowing streams	2.24	176.00	7,866.00	4.480	0.487
#12	**5**	**Muskingum K:**					**0.487**
#13	2	8. Large gullies, diversions, and low flowing streams	1.34	54.00	4,025.00	3.470	0.322
#13	**2**	**Muskingum K:**					**0.322**
#13	3	8. Large gullies, diversions, and low flowing streams	0.98	72.00	7,333.00	2.970	0.685
#13	**3**	**Muskingum K:**					**0.685**
#13	4	8. Large gullies, diversions, and low flowing streams	1.18	127.00	10,806.00	3.250	0.923
#13	**4**	**Muskingum K:**					**0.923**
#13	5	8. Large gullies, diversions, and low flowing streams	1.18	127.00	10,806.00	3.250	0.923
#13	**5**	**Muskingum K:**					**0.923**
#14	1	8. Large gullies, diversions, and low flowing streams	0.00	0.00	0.00	0.000	0.000
#14	**1**	**Muskingum K:**					**0.000**

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#14	2	8. Large gullies, diversions, and low flowing streams	0.83	58.00	6,957.00	2.730	0.707
#14	**2**	**Muskingum K:**					**0.707**
#14	3	8. Large gullies, diversions, and low flowing streams	0.81	77.00	9,480.00	2.700	0.975
#14	**3**	**Muskingum K:**					**0.975**
#14	4	8. Large gullies, diversions, and low flowing streams	0.86	147.00	17,117.00	2.770	1.716
#14	**4**	**Muskingum K:**					**1.716**
#14	5	8. Large gullies, diversions, and low flowing streams	0.88	175.00	19,934.00	2.810	1.970
#14	**5**	**Muskingum K:**					**1.970**
#14	6	8. Large gullies, diversions, and low flowing streams	0.95	211.00	22,155.00	2.920	2.107
#14	**6**	**Muskingum K:**					**2.107**
#14	7	8. Large gullies, diversions, and low flowing streams	0.96	257.00	26,835.00	2.930	2.544
#14	**7**	**Muskingum K:**					**2.544**
#14	8	8. Large gullies, diversions, and low flowing streams	0.96	257.00	26,835.00	2.930	2.544
#14	**8**	**Muskingum K:**					**2.544**
#14	9	8. Large gullies, diversions, and low flowing streams	0.95	307.00	32,146.59	2.930	3.047
#14	**9**	**Muskingum K:**					**3.047**
#14	10	8. Large gullies, diversions, and low flowing streams	0.96	339.00	35,382.00	2.930	3.354
#14	**10**	**Muskingum K:**					**3.354**
#15	1	8. Large gullies, diversions, and low flowing streams	0.00	0.00	0.00	0.000	0.000
#15	**1**	**Muskingum K:**					**0.000**
#15	2	8. Large gullies, diversions, and low flowing streams	1.14	86.00	7,535.00	3.200	0.654
#15	**2**	**Muskingum K:**					**0.654**
#15	3	8. Large gullies, diversions, and low flowing streams	1.25	115.00	9,236.00	3.340	0.768
#15	**3**	**Muskingum K:**					**0.768**
#16	2	8. Large gullies, diversions, and low flowing streams	0.58	24.00	4,161.00	2.270	0.509
#16	**2**	**Muskingum K:**					**0.509**
#16	3	8. Large gullies, diversions, and low flowing streams	0.51	37.00	7,269.00	2.140	0.943
#16	**3**	**Muskingum K:**					**0.943**
#17	1	8. Large gullies, diversions, and low flowing streams	0.00	0.00	0.00	0.000	0.000
#17	**1**	**Muskingum K:**					**0.000**
#18	1	8. Large gullies, diversions, and low flowing streams	0.00	0.00	0.00	0.000	0.000
#18	**1**	**Muskingum K:**					**0.000**
#18	2	8. Large gullies, diversions, and low flowing streams	1.02	62.00	6,103.00	3.020	0.561

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#18	**2**	**Muskingum K:**					**0.561**
#20	2	8. Large gullies, diversions, and low flowing streams	17.00	3,605.00	21,205.88	12.360	0.476
#20	**2**	**Muskingum K:**					**0.476**
#21	1	8. Large gullies, diversions, and low flowing streams	0.00	0.00	0.00	0.000	0.000
#21	**1**	**Muskingum K:**					**0.000**
#21	2	8. Large gullies, diversions, and low flowing streams	0.41	20.00	4,824.00	1.930	0.694
#21	**2**	**Muskingum K:**					**0.694**
#21	3	8. Large gullies, diversions, and low flowing streams	0.36	20.00	5,626.00	1.780	0.877
#21	**3**	**Muskingum K:**					**0.877**
#21	4	8. Large gullies, diversions, and low flowing streams	0.36	20.00	5,626.00	1.780	0.877
#21	**4**	**Muskingum K:**					**0.877**
#23	1	8. Large gullies, diversions, and low flowing streams	0.00	0.00	0.00	0.000	0.000
#23	**1**	**Muskingum K:**					**0.000**
#23	2	8. Large gullies, diversions, and low flowing streams	0.63	30.00	4,771.75	2.370	0.559
#23	**2**	**Muskingum K:**					**0.559**
#24	1	8. Large gullies, diversions, and low flowing streams	0.79	180.00	22,769.00	2.660	2.377
#24	**1**	**Muskingum K:**					**2.377**
#24	2	8. Large gullies, diversions, and low flowing streams	0.78	180.00	23,111.00	2.640	2.431
#24	**2**	**Muskingum K:**					**2.431**
#24	4	8. Large gullies, diversions, and low flowing streams	0.00	0.00	0.00	0.000	0.000
#24	**4**	**Muskingum K:**					**0.000**
#25	1	8. Large gullies, diversions, and low flowing streams	1.99	104.00	5,220.00	4.230	0.342
#25	**1**	**Muskingum K:**					**0.342**
#25	2	8. Large gullies, diversions, and low flowing streams	1.99	104.00	5,220.00	4.230	0.342
#25	**2**	**Muskingum K:**					**0.342**
#25	3	8. Large gullies, diversions, and low flowing streams	0.00	0.00	0.00	0.000	0.000
#25	**3**	**Muskingum K:**					**0.000**
#27	1	8. Large gullies, diversions, and low flowing streams	1.38	216.00	15,629.00	3.520	1.233
#27	**1**	**Muskingum K:**					**1.233**
#27	2	8. Large gullies, diversions, and low flowing streams	1.17	144.00	12,301.00	3.240	1.054
#27	**2**	**Muskingum K:**					**1.054**
#27	3	8. Large gullies, diversions, and low flowing streams	1.18	76.00	6,454.00	3.250	0.551
#27	**3**	**Muskingum K:**					**0.551**

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#27	4	8. Large gullies, diversions, and low flowing streams	1.18	76.00	6,454.00	3.250	0.551
#27	**4**	**Muskingum K:**					**0.551**
#28	1	8. Large gullies, diversions, and low flowing streams	1.30	84.00	6,445.17	3.420	0.523
#28	**1**	**Muskingum K:**					**0.523**
#29	1	8. Large gullies, diversions, and low flowing streams	0.88	37.00	4,210.00	2.810	0.416
#29	**1**	**Muskingum K:**					**0.416**
#29	2	8. Large gullies, diversions, and low flowing streams	0.88	26.00	2,949.00	2.810	0.291
#29	**2**	**Muskingum K:**					**0.291**
#31	1	8. Large gullies, diversions, and low flowing streams	1.35	76.00	5,639.00	3.480	0.450
#31	**1**	**Muskingum K:**					**0.450**
#31	2	8. Large gullies, diversions, and low flowing streams	1.15	20.00	1,734.00	3.220	0.149
#31	**2**	**Muskingum K:**					**0.149**
#34	1	8. Large gullies, diversions, and low flowing streams	0.73	65.00	8,900.00	2.560	0.965
#34	**1**	**Muskingum K:**					**0.965**
#34	2	8. Large gullies, diversions, and low flowing streams	0.73	65.00	8,900.00	2.560	0.965
#34	**2**	**Muskingum K:**					**0.965**
#36	3	8. Large gullies, diversions, and low flowing streams	2.71	80.00	2,957.00	4.930	0.166
#36	**3**	**Muskingum K:**					**0.166**
#37	2	8. Large gullies, diversions, and low flowing streams	0.29	30.00	10,319.91	1.610	1.780
#37	**2**	**Muskingum K:**					**1.780**
#37	3	8. Large gullies, diversions, and low flowing streams	0.31	30.00	9,800.71	1.650	1.649
#37	**3**	**Muskingum K:**					**1.649**
#37	4	8. Large gullies, diversions, and low flowing streams	0.29	30.00	10,319.91	1.610	1.780
#37	**4**	**Muskingum K:**					**1.780**
#37	5	8. Large gullies, diversions, and low flowing streams	0.56	100.00	17,956.54	2.230	2.236
#37	**5**	**Muskingum K:**					**2.236**

Cottonwood Arroyo Pre-mine Hydrology and Sedimentology

The drainage subdivisions used to model the hydrology is shown on Exhibit 18.B.

Revised Febuary 2012

Art O'Hayre

Copyright 1998 -2007 Pamela J. Schwab

General Information

Storm Information:

Storm Type:	Type II-70
Design Storm:	25 yr - 6 hr
Rainfall Depth:	1.560 inches

Particle Size Distribution:

Size (mm)	PostMine-LoamySand	PreMine-LoamySand	PreMine-Badlands	LoamySand Postmining
2.0000	100.000%	100.000%	100.000%	0.000%
0.1000	26.500%	30.000%	83.500%	0.000%
0.0500	14.000%	17.000%	77.000%	0.000%
0.0020	11.000%	11.000%	56.000%	0.000%
0.0010	0.000%	0.000%	0.000%	0.000%

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc. (ml/l)	24VW (ml/l)
#30	476.400	476.400	36.53	4.76	37.8	8,241	3.58	2.53
#28	1,217.900	1,217.900	540.05	60.99	3,425.4	57,102	0.35	0.25
#26	2,486.400	2,486.400	132.85	36.83	246.5	6,616	1.86	1.38
#24	8,061.800	8,061.800	184.75	107.97	413.0	4,459	0.52	0.33
#25	1,015.700	9,077.500	200.88	132.08	560.2	15,558	3.88	0.78
#27	1,783.700	13,347.600	411.67	211.75	1,872.8	29,782	12.72	2.77
#29	966.000	15,531.500	846.18	320.24	8,834.4	71,508	7.80	2.18
#32	293.700	16,301.600	861.61	342.94	9,448.4	63,077	3.77	1.20
#31	957.100	957.100	527.85	55.53	2,515.1	41,599	0.63	0.49
#33	0.000	17,258.700	979.82	398.47	11,963.5	54,725	2.76	1.10
#34	932.500	18,191.200	992.63	443.02	11,159.6	45,924	0.09	0.03
#5	2,023.000	2,023.000	837.11	84.35	2,651.8	41,867	3.61	1.97
#6	1,743.200	3,766.200	956.02	162.51	4,790.3	36,533	0.21	0.12
#7	2,395.300	6,161.500	1,580.25	304.55	12,734.9	46,225	0.00	0.00
#8	0.000	6,161.500	1,580.25	304.55	12,734.9	46,225	0.00	0.00
#10	1,053.200	7,214.700	1,604.48	357.12	12,452.2	42,273	0.11	0.07
#1	2,411.100	2,411.100	588.72	81.15	2,757.0	37,715	5.52	3.62
#2	1,497.000	3,908.100	655.37	163.33	3,619.6	24,206	0.19	0.13
#3	862.700	4,770.800	829.77	203.32	4,035.6	18,997	0.06	0.04
#4	0.000	4,770.800	829.77	203.32	4,035.6	18,997	0.06	0.04
#9	425.500	5,196.300	849.71	225.11	4,042.0	16,916	0.00	0.00
#11	0.000	12,411.000	2,175.32	582.22	16,494.3	34,910	0.07	0.04
#21	1,080.800	13,491.800	2,220.17	626.96	16,455.3	33,282	0.03	0.02
#18	848.500	848.500	268.00	38.22	496.6	15,750	0.12	0.07
#17	182.200	182.200	174.08	11.12	167.2	15,582	0.82	0.58
#19	0.000	1,030.700	409.10	49.34	663.8	14,808	0.28	0.18
#15	1,992.700	1,992.700	627.55	84.79	3,281.0	46,290	1.92	1.17
#12	3,494.500	3,494.500	397.28	66.53	1,024.9	16,872	7.34	4.90
#13	2,720.700	6,215.200	697.21	118.62	2,079.9	18,344	8.61	6.01
#14	5,096.800	11,312.000	857.46	314.10	7,172.5	83,385	1.80	0.36
#16	876.500	14,181.200	1,254.01	451.62	12,480.7	57,021	1.79	0.63
#20	681.900	15,893.800	1,290.99	540.86	13,372.2	43,852	0.63	0.26
#22	0.000	29,385.600	3,356.18	1,167.82	29,827.5	35,065	0.24	0.13
#23	752.900	30,138.500	3,323.41	1,197.06	29,527.9	34,065	0.00	0.00
#35	0.000	48,329.700	4,127.57	1,640.09	40,687.5	31,691	0.02	0.01
#36	730.590	49,060.290	4,106.02	1,662.08	40,745.8	37,462	0.02	0.01
#37	2,208.500	51,268.790	4,049.05	1,731.98	40,586.1	32,624	0.29	0.15

Particle Size Distribution(s) at Each Structure

Structure #30:

Size (mm)	In/Out
2.0000	100.000%
0.1000	95.919%
0.0500	54.354%
0.0020	35.170%
0.0010	0.000%

Structure #28:

Size (mm)	In/Out
2.0000	100.000%
0.1000	100.000%
0.0500	100.000%
0.0020	98.281%
0.0010	0.000%

Structure #26:

Size (mm)	In/Out
2.0000	100.000%
0.1000	100.000%
0.0500	77.468%
0.0020	50.127%
0.0010	0.000%

Structure #24:

Size (mm)	In/Out
2.0000	100.000%
0.1000	100.000%
0.0500	92.408%
0.0020	76.427%
0.0010	0.000%

Structure #25:

Size (mm)	In/Out
2.0000	100.000%
0.1000	81.685%
0.0500	71.766%
0.0020	65.129%
0.0010	0.000%

Structure #27:

Size (mm)	In/Out
2.0000	100.000%
0.1000	74.075%
0.0500	52.339%
0.0020	39.457%
0.0010	0.000%

Structure #29:

Size (mm)	In/Out
2.0000	100.000%
0.1000	94.549%
0.0500	89.941%
0.0020	81.885%
0.0010	0.000%

Structure #32:

Size (mm)	In/Out
2.0000	100.000%
0.1000	100.000%
0.0500	96.353%
0.0020	87.711%
0.0010	0.000%

Structure #31:

Size (mm)	In/Out
2.0000	100.000%
0.1000	100.000%
0.0500	100.000%
0.0020	95.759%
0.0010	0.000%

Structure #33 (Inlet to North Fork Diversion):

Size (mm)	In/Out
2.0000	100.000%
0.1000	100.000%
0.0500	97.119%
0.0020	89.403%
0.0010	0.000%

Structure #34:

Size (mm)	In/Out
2.0000	100.000%
0.1000	100.000%
0.0500	100.000%
0.0020	99.472%
0.0010	0.000%

Structure #5:

Size (mm)	In/Out
2.0000	100.000%
0.1000	99.651%
0.0500	91.884%
0.0020	85.871%
0.0010	0.000%

Structure #6:

Size (mm)	In/Out
2.0000	100.000%
0.1000	100.000%
0.0500	100.000%
0.0020	98.363%
0.0010	0.000%

Structure #7:

Size (mm)	In/Out
2.0000	100.000%
0.1000	100.000%
0.0500	100.000%
0.0020	100.000%
0.0010	0.000%

Structure #8:

Size (mm)	In/Out
2.0000	100.000%
0.1000	100.000%
0.0500	100.000%
0.0020	100.000%
0.0010	0.000%

Structure #10:

Size (mm)	In/Out
2.0000	100.000%
0.1000	100.000%
0.0500	99.741%
0.0020	99.580%
0.0010	0.000%

Structure #1:

Size (mm)	In/Out
2.0000	100.000%
0.1000	94.414%
0.0500	84.026%
0.0020	78.767%
0.0010	0.000%

Structure #2:

Size (mm)	In/Out
2.0000	100.000%
0.1000	100.000%
0.0500	100.000%
0.0020	97.739%
0.0010	0.000%

Structure #3:

Size (mm)	In/Out
2.0000	100.000%
0.1000	100.000%
0.0500	100.000%
0.0020	99.130%
0.0010	0.000%

Structure #4:

Size (mm)	In/Out
2.0000	100.000%
0.1000	100.000%
0.0500	100.000%
0.0020	99.130%
0.0010	0.000%

Structure #9:

Size (mm)	In/Out
2.0000	100.000%
0.1000	100.000%
0.0500	100.000%
0.0020	100.000%
0.0010	0.000%

Structure #11:

Size (mm)	In/Out
2.0000	100.000%
0.1000	100.000%
0.0500	99.805%
0.0020	99.683%
0.0010	0.000%

Structure #21:

Size (mm)	In/Out
2.0000	100.000%
0.1000	100.000%
0.0500	100.000%
0.0020	99.759%
0.0010	0.000%

Structure #18:

Size (mm)	In/Out
2.0000	100.000%
0.1000	100.000%
0.0500	100.000%
0.0020	97.922%
0.0010	0.000%

Structure #17:

Size (mm)	In/Out
2.0000	100.000%
0.1000	100.000%
0.0500	100.000%
0.0020	85.172%
0.0010	0.000%

Structure #19:

Size (mm)	In/Out
2.0000	100.000%
0.1000	100.000%
0.0500	100.000%
0.0020	94.709%
0.0010	0.000%

Structure #15:

Size (mm)	In/Out
2.0000	100.000%
0.1000	100.000%
0.0500	96.507%
0.0020	92.676%
0.0010	0.000%

Structure #12:

Size (mm)	In/Out
2.0000	100.000%
0.1000	80.910%
0.0500	54.212%
0.0020	35.079%
0.0010	0.000%

Structure #13:

Size (mm)	In/Out
2.0000	100.000%
0.1000	78.331%
0.0500	49.080%
0.0020	31.758%
0.0010	0.000%

Structure #14:

Size (mm)	In/Out
2.0000	100.000%
0.1000	100.000%
0.0500	100.000%
0.0020	93.915%
0.0010	0.000%

Structure #16:

Size (mm)	In/Out
2.0000	100.000%
0.1000	100.000%
0.0500	99.094%
0.0020	92.311%
0.0010	0.000%

Structure #20:

Size (mm)	In/Out
2.0000	100.000%
0.1000	100.000%
0.0500	100.000%
0.0020	95.936%
0.0010	0.000%

Structure #22:

Size (mm)	In/Out
2.0000	100.000%
0.1000	100.000%
0.0500	100.000%
0.0020	98.045%
0.0010	0.000%

Structure #23:

Size (mm)	In/Out
2.0000	100.000%
0.1000	100.000%
0.0500	100.000%
0.0020	100.000%
0.0010	0.000%

Structure #35:

Size (mm)	In/Out
2.0000	100.000%
0.1000	100.000%
0.0500	100.000%
0.0020	99.855%
0.0010	0.000%

Structure #36:

Size (mm)	In/Out
2.0000	100.000%
0.1000	100.000%
0.0500	100.000%
0.0020	99.838%
0.0010	0.000%

Structure #37:

Size (mm)	In/Out
2.0000	100.000%
0.1000	100.000%
0.0500	99.126%
0.0020	98.596%
0.0010	0.000%

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#30	1	476.400	1.131	0.000	0.000	73.100	M	36.53	4.764
	Σ	**476.400**						**36.53**	**4.764**
#28	1	772.300	0.657	0.523	0.334	90.400	M	491.68	38.669
	2	445.600	0.587	0.000	0.000	90.400	M	305.95	22.321
	Σ	**1,217.900**						**540.05**	**60.991**
#26	1	447.600	2.192	0.000	0.000	74.200	M	23.11	5.111
	2	2,038.800	3.000	0.000	0.000	77.000	M	112.68	31.721
	Σ	**2,486.400**						**132.85**	**36.832**
#24	1	2,607.500	5.367	2.377	0.305	75.200	M	71.74	33.393
	2	2,331.900	4.813	2.431	0.304	74.700	M	66.31	28.216
	3	1,758.500	2.231	1.788	0.297	76.200	M	113.95	25.140
	4	1,363.900	2.618	0.000	0.000	77.000	M	84.58	21.220
	Σ	**8,061.800**						**184.75**	**107.969**
#25	1	515.200	0.990	0.342	0.357	78.200	M	81.39	9.063
	2	130.500	0.787	0.342	0.357	78.100	M	24.40	2.273
	3	370.000	0.516	0.000	0.000	85.700	M	190.15	12.775
	Σ	**9,077.500**						**200.88**	**132.080**
#27	1	354.400	0.612	1.233	0.337	83.100	M	129.85	9.820
	2	305.200	0.529	1.054	0.328	84.000	M	133.52	9.142
	3	289.800	0.692	0.551	0.328	75.500	M	44.45	3.841
	4	253.000	0.361	0.551	0.328	79.400	M	93.60	5.022
	5	581.300	0.980	0.000	0.000	82.300	M	139.19	15.009
	Σ	**13,347.600**						**411.67**	**211.747**
#29	1	508.800	0.409	0.416	0.312	89.500	M	404.67	23.823
	2	233.200	0.521	0.291	0.312	91.600	M	188.69	12.806
	3	224.000	0.467	0.000	0.000	90.000	M	171.82	10.877
	Σ	**15,531.500**						**846.18**	**320.244**
#32	1	293.700	0.576	0.000	0.000	93.000	M	247.25	17.930
	Σ	**16,301.600**						**861.61**	**342.938**
#31	1	431.100	0.588	0.450	0.336	91.500	M	321.18	23.493
	2	325.800	0.432	0.149	0.327	93.000	M	322.14	19.913
	3	200.200	0.373	0.000	0.000	92.900	M	210.22	12.124
	Σ	**957.100**						**527.85**	**55.530**
#33	Σ	**17,258.700**						**979.82**	**398.468**

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#34	1	91.700	0.244	0.965	0.300	92.300	M	108.45	5.351
	2	105.200	0.256	0.965	0.300	93.000	M	127.71	6.456
	3	735.600	0.885	0.000	0.000	88.900	M	335.17	32.747
	Σ	**18,191.200**						**992.63**	**443.022**
#5	1	503.600	0.618	0.000	0.000	87.600	M	268.07	20.239
	2	406.500	0.388	0.501	0.350	84.800	M	230.58	13.021
	3	439.600	0.342	0.681	0.347	87.800	M	336.99	18.042
	4	162.600	0.280	0.681	0.347	86.000	M	118.70	5.772
	5	294.100	0.375	1.021	0.348	92.000	M	290.40	16.627
	6	216.600	0.272	1.018	0.348	90.100	M	214.22	10.646
	Σ	**2,023.000**						**837.11**	**84.347**
#6	1	149.100	0.331	0.000	0.000	92.600	M	161.30	8.862
	2	245.000	0.529	0.192	0.328	88.100	M	150.59	10.257
	3	276.200	0.450	0.461	0.319	89.500	M	208.50	12.896
	4	158.400	0.380	1.385	0.185	93.000	M	166.02	9.660
	5	206.200	0.402	0.796	0.320	89.400	M	164.26	9.578
	6	414.000	0.430	1.066	0.323	87.200	M	269.04	16.158
	7	294.300	0.535	1.066	0.323	86.400	M	156.53	10.750
	Σ	**3,766.200**						**956.02**	**162.509**
#7	1	731.700	1.274	0.000	0.000	93.000	M	346.80	44.600
	2	445.800	1.043	0.000	0.000	93.000	M	247.27	27.164
	3	270.800	0.804	0.000	0.000	93.000	M	182.24	16.506
	4	78.900	0.267	1.035	0.328	93.000	M	94.49	4.837
	5	154.900	0.310	1.071	0.326	93.000	M	176.25	9.484
	6	101.400	0.288	1.164	0.328	92.900	M	117.81	6.157
	7	117.700	0.298	1.344	0.329	92.200	M	129.29	6.777
	8	494.100	0.518	1.344	0.329	91.300	M	392.49	26.519
	Σ	**6,161.500**						**1,580.25**	**304.553**
#8	1	0.000	0.000	0.000	0.000	1.000	0.00	0.000	
	Σ	**6,161.500**						**1,580.25**	**304.553**
#10	1	355.500	1.286	0.000	0.000	93.000	M	167.23	21.664
	2	307.100	1.282	0.668	0.305	83.200	M	64.37	8.575
	3	147.300	1.245	0.517	0.303	90.600	M	58.93	7.480
	4	126.400	0.585	0.517	0.303	93.000	M	105.39	7.719
	5	116.900	1.179	0.621	0.305	93.000	M	58.93	7.126
	Σ	**7,214.700**						**1,604.48**	**357.116**
#1	1	557.400	0.941	0.000	0.000	83.600	M	155.00	16.115
	2	169.600	1.616	0.677	0.333	93.000	M	66.17	10.336
	3	636.400	1.842	0.729	0.333	81.000	M	80.29	14.616
	4	223.400	0.846	1.005	0.336	84.100	M	70.44	6.742

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
	5	77.700	0.330	1.392	0.341	81.400	M	36.23	1.860
	6	746.600	0.678	1.392	0.341	88.200	M	391.01	31.484
	Σ	**2,411.100**						**588.72**	**81.153**
#2	1	257.000	0.423	0.000	0.000	93.000	M	256.73	15.720
	2	180.500	0.562	0.478	0.281	91.800	M	141.48	10.054
	3	200.700	0.687	0.574	0.283	93.000	M	150.71	12.240
	4	438.600	0.811	0.574	0.283	93.000	M	293.34	26.741
	5	420.200	1.247	0.801	0.293	88.000	M	135.94	17.427
	Σ	**3,908.100**						**655.37**	**163.335**
#3	1	172.600	0.443	0.000	0.000	93.000	M	168.52	10.532
	2	311.200	0.890	0.000	0.000	88.900	M	141.19	13.857
	3	378.900	0.632	0.209	0.314	87.900	M	203.46	15.593
	Σ	**4,770.800**						**829.77**	**203.316**
#4	Σ	**4,770.800**						**829.77**	**203.316**
#9	1	425.500	0.830	0.000	0.000	90.700	M	234.68	21.789
	Σ	**5,196.300**						**849.71**	**225.105**
#11	Σ	**12,411.000**						**2,175.32**	**582.221**
#21	1	272.800	0.819	0.000	0.000	86.900	M	111.80	10.369
	2	230.500	0.388	0.694	0.266	89.200	M	184.23	10.517
	3	181.100	0.289	0.877	0.256	91.300	M	189.85	9.736
	4	396.400	0.939	0.877	0.256	86.100	M	136.92	14.118
	Σ	**13,491.800**						**2,220.17**	**626.962**
#18	1	301.700	0.652	0.000	0.000	93.000	M	234.61	18.415
	2	546.800	0.768	0.561	0.320	86.300	M	223.53	19.804
	Σ	**848.500**						**268.00**	**38.220**
#17	1	182.200	0.462	0.000	0.000	93.000	M	174.08	11.118
	Σ	**182.200**						**174.08**	**11.118**
#19	Σ	**1,030.700**						**409.10**	**49.338**
#15	1	437.400	0.803	0.000	0.000	91.300	M	258.94	23.432
	2	549.000	0.637	0.654	0.327	91.300	M	382.26	29.427
	3	1,006.300	1.023	0.768	0.331	84.700	M	288.75	31.930
	Σ	**1,992.700**						**627.55**	**84.789**
#12	1	517.800	0.791	0.000	0.000	81.900	M	140.91	12.902
	2	229.000	0.571	0.043	0.418	80.100	M	66.83	4.847
	3	592.700	0.706	0.044	0.417	81.500	M	169.25	14.252
	4	1,806.900	1.542	0.487	0.362	76.700	M	168.42	27.242
	5	348.100	0.618	0.487	0.362	80.000	94.98	7.291	

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
	Σ	**3,494.500**						**397.28**	**66.533**
#13	1	411.600	0.725	0.000	0.000	79.700	M	96.79	8.384
	2	636.400	0.774	0.322	0.336	80.700	M	157.14	14.233
	3	319.000	0.575	0.685	0.318	85.500	M	149.91	10.830
	4	231.700	0.314	0.923	0.328	80.400	M	101.73	5.057
	5	1,122.000	1.308	0.923	0.328	74.700	M	94.33	13.581
	Σ	**6,215.200**						**697.21**	**118.618**
#14	1	405.900	0.384	0.000	0.000	90.800	M	365.33	20.943
	2	411.100	0.452	0.707	0.308	90.700	M	338.08	21.056
	3	787.400	0.658	0.975	0.307	91.400	M	540.50	42.565
	4	144.200	0.341	1.716	0.310	86.200	M	98.01	5.205
	5	343.800	0.289	1.970	0.312	86.500	M	257.38	12.690
	6	392.800	0.806	2.107	0.316	81.900	M	105.39	9.788
	7	528.200	0.518	2.544	0.316	87.200	M	306.31	20.592
	8	890.900	1.253	2.544	0.316	83.500	M	195.49	25.534
	9	741.400	1.076	3.047	0.316	84.800	M	206.21	23.723
	10	451.100	0.916	3.354	0.316	83.900	M	131.53	13.383
	Σ	**11,312.000**						**857.46**	**314.097**
#16	1	329.600	0.641	0.000	0.000	93.000	M	259.17	20.109
	2	348.400	0.542	0.509	0.286	92.500	M	293.69	20.454
	3	198.500	0.266	0.943	0.279	93.000	M	237.98	12.169
	Σ	**14,181.200**						**1,254.01**	**451.619**
#20	1	296.300	0.667	0.000	0.000	91.700	M	206.13	16.387
	2	385.600	0.713	0.476	0.440	93.000	M	282.30	23.513
	Σ	**15,893.800**						**1,290.99**	**540.857**
#22	**Σ**	**29,385.600**						**3,356.18**	**1,167.818**
#23	1	442.400	0.960	0.000	0.000	85.300	M	140.43	14.750
	2	310.500	0.538	0.559	0.291	89.500	M	210.50	14.496
	Σ	**30,138.500**						**3,323.41**	**1,197.064**
#35	**Σ**	**48,329.700**						**4,127.57**	**1,640.087**
#36	1	298.200	0.987	0.000	0.000	85.000	M	90.30	9.700
	2	196.800	0.441	0.000	0.000	87.900	M	133.11	8.109
	3	235.590	0.885	0.166	0.372	78.300	M	41.09	4.186
	Σ	**49,060.290**						**4,106.02**	**1,662.082**
#37	1	744.000	1.756	0.000	0.000	84.800	M	138.50	23.796
	2	296.000	0.439	1.780	0.243	87.800	M	199.18	12.104
	3	237.700	0.333	1.649	0.246	85.500	M	154.65	8.100
	4	561.400	1.502	1.780	0.243	84.100	M	111.96	16.932

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
	5	369.400	0.817	2.236	0.284	81.600	M	95.38	8.964
	Σ	**51,268.790**						**4,049.05**	**1,731.978**

Subwatershed Sedimentology Detail:

Stru #	SWS #	Soil K	L (ft)	S (%)	C	P	PS #	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc (ml/l)	24VW (ml/l)
#30	1	0.095	200.00	3.80	0.3720	1.0000	2	37.8	8,241	3.58	2.53
	Σ							**37.8**	**8,241**	**3.58**	**2.53**
#28	1	0.187	100.00	10.10	0.3750	1.0000	3	2,689.8	70,014	0.00	0.00
	2	0.196	100.00	10.20	0.3930	1.0000	3	1,688.7	76,821	0.95	0.67
	Σ							**3,425.4**	**57,102**	**0.35**	**0.25**
#26	1	0.155	400.00	1.40	0.3480	1.0000	2	23.5	4,623	1.48	1.08
	2	0.155	300.00	2.40	0.3340	1.0000	2	223.0	7,027	1.94	1.43
	Σ							**246.5**	**6,616**	**1.86**	**1.38**
#24	1	0.128	300.00	2.30	0.3360	1.0000	2	142.6	4,234	0.49	0.37
	2	0.136	300.00	2.70	0.3440	1.0000	2	156.0	5,467	0.69	0.51
	3	0.107	300.00	2.30	0.3330	1.0000	2	130.5	5,163	1.74	1.28
	4	0.163	400.00	1.60	0.3210	1.0000	2	117.0	5,534	1.71	1.25
	Σ							**413.0**	**4,459**	**0.52**	**0.33**
#25	1	0.125	400.00	1.90	0.3440	1.0000	2	67.8	7,753	3.82	2.71
	2	0.124	300.00	2.60	0.3280	1.0000	2	18.3	8,435	4.40	3.07
	3	0.122	175.00	4.90	0.2660	1.0000	2	220.7	18,283	10.89	7.52
	Σ							**560.2**	**15,558**	**3.88**	**0.78**
#27	1	0.127	175.00	5.90	0.3160	1.0000	2	227.1	23,856	13.64	9.65
	2	0.122	150.00	7.50	0.2920	1.0000	2	229.0	25,945	15.24	10.73
	3	0.070	125.00	8.40	0.3270	1.0000	2	51.3	14,063	7.33	5.09
	4	0.097	125.00	9.60	0.3170	1.0000	2	149.1	31,802	19.09	12.97
	5	0.126	125.00	8.90	0.3290	1.0000	2	413.8	28,401	14.71	10.41
	Σ							**1,872.8**	**29,782**	**12.72**	**2.77**
#29	1	0.190	125.00	9.80	0.3930	1.0000	3	2,025.8	86,051	4.01	2.83
	2	0.203	125.00	8.90	0.3940	1.0000	3	865.3	68,289	2.28	1.62
	3	0.193	125.00	8.40	0.3940	1.0000	3	650.4	61,594	2.23	1.56
	Σ							**8,834.4**	**71,508**	**7.80**	**2.18**
#32	1	0.210	150.00	7.70	0.3990	1.0000	3	1,137.5	64,212	1.95	1.39
	Σ							**9,448.4**	**63,077**	**3.77**	**1.20**

Copyright 1998 -2007 Pamela J. Schwab

Stru #	SWS #	Soil K	L (ft)	S (%)	C	P	PS #	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc (ml/l)	24VW (ml/l)
#31	1	0.204	125.00	8.70	0.3620	1.0000	3	1,459.0	62,828	1.19	0.85
	2	0.210	150.00	7.30	0.3990	1.0000	3	1,328.3	67,409	3.95	2.81
	3	0.210	175.00	4.50	0.3980	1.0000	3	539.2	45,502	3.16	2.24
	Σ							**2,515.1**	**41,599**	**0.63**	**0.49**
#33	Σ							**11,963.5**	**54,725**	**2.76**	**1.10**
#34	1	0.189	175.00	4.60	0.2250	1.0000	3	121.7	22,791	2.13	1.55
	2	0.206	175.00	5.10	0.3620	1.0000	3	286.9	44,058	4.10	3.00
	3	0.176	175.00	4.20	0.2510	1.0000	3	605.3	18,983	0.00	0.00
	Σ							**11,159.6**	**45,924**	**0.09**	**0.03**
#5	1	0.149	75.00	12.50	0.3230	1.0000	3	1,034.7	52,699	0.00	0.00
	2	0.133	75.00	15.80	0.3190	1.0000	2	882.3	70,193	42.92	29.78
	3	0.103	100.00	11.00	0.2030	1.0000	3	477.2	27,418	1.49	1.04
	4	0.093	75.00	13.80	0.2130	1.0000	2	151.7	27,429	17.29	12.07
	5	0.123	100.00	11.00	0.1370	1.0000	3	338.9	20,783	1.35	0.97
	6	0.149	75.00	14.70	0.1990	1.0000	3	482.1	45,729	3.62	2.59
	Σ							**2,651.8**	**41,867**	**3.61**	**1.97**
#6	1	0.208	175.00	4.30	0.3980	1.0000	3	369.3	42,677	3.27	2.31
	2	0.183	175.00	5.40	0.3910	1.0000	3	414.2	41,856	0.48	0.34
	3	0.188	150.00	7.60	0.3900	1.0000	3	743.1	58,940	2.20	1.55
	4	0.210	150.00	6.30	0.3990	1.0000	3	531.4	53,736	3.69	2.72
	5	0.185	125.00	8.10	0.3860	1.0000	3	522.2	55,347	2.64	1.88
	6	0.104	100.00	11.30	0.2240	1.0000	3	458.0	29,084	0.88	0.62
	7	0.164	100.00	11.20	0.3740	1.0000	3	700.8	65,996	0.00	0.00
	Σ							**4,790.3**	**36,533**	**0.21**	**0.12**
#7	1	0.208	150.00	7.80	0.3780	1.0000	3	2,177.7	48,781	0.00	0.00
	2	0.209	100.00	10.20	0.3940	1.0000	3	1,790.8	65,658	0.00	0.00
	3	0.210	150.00	6.70	0.3990	1.0000	3	801.8	49,036	0.00	0.00
	4	0.210	100.00	11.50	0.3990	1.0000	3	477.3	96,068	8.73	6.38
	5	0.210	150.00	7.10	0.3990	1.0000	3	608.5	63,520	5.23	3.80
	6	0.209	150.00	7.90	0.3990	1.0000	3	420.5	67,295	5.82	4.25
	7	0.206	75.00	15.50	0.3990	1.0000	3	836.5	118,836	9.71	7.12
	8	0.202	75.00	14.50	0.3980	1.0000	3	3,013.5	111,222	3.59	2.60
	Σ							**12,734.9**	**46,225**	**0.00**	**0.00**
#8	1	0.000	0.00	0.00	0.0000	1.0000	0	0.0	1	0.00	0.00
	Σ							**12,734.9**	**46,225**	**0.00**	**0.00**
#10	1	0.190	300.00	2.70	0.1930	1.0000	3	177.0	8,298	0.00	0.00
	2	0.153	200.00	3.50	0.3610	1.0000	2	104.5	12,354	6.02	4.35
	3	0.189	200.00	3.70	0.3190	1.0000	3	105.9	14,296	0.00	0.00
	4	0.190	300.00	2.10	0.1940	1.0000	3	61.5	8,188	0.23	0.17

Stru #	SWS #	Soil K	L (ft)	S (%)	C	P	PS #	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc (ml/l)	24VW (ml/l)
	5	0.201	300.00	2.00	0.3030	1.0000	3	67.2	9,536	0.00	0.00
	Σ							**12,452.2**	**42,273**	**0.11**	**0.07**
#1	1	0.157	150.00	6.80	0.3830	1.0000	2	525.9	33,536	17.76	12.57
	2	0.210	150.00	6.60	0.3990	1.0000	3	344.9	33,236	0.00	0.00
	3	0.149	200.00	3.90	0.3870	1.0000	2	184.0	12,655	5.25	3.82
	4	0.169	175.00	4.70	0.3950	1.0000	2	175.1	26,524	14.42	10.30
	5	0.157	100.00	10.10	0.3940	1.0000	2	100.5	55,458	33.92	23.86
	6	0.175	75.00	12.60	0.2840	1.0000	3	1,708.1	54,643	0.00	0.00
	Σ							**2,757.0**	**37,715**	**5.52**	**3.62**
#2	1	0.190	150.00	7.90	0.1930	1.0000	3	483.6	31,655	1.91	1.35
	2	0.184	175.00	4.80	0.2010	1.0000	3	182.9	18,684	0.49	0.35
	3	0.202	200.00	3.90	0.3220	1.0000	3	267.3	22,234	0.20	0.14
	4	0.203	150.00	7.40	0.3220	1.0000	3	1,176.7	44,218	0.00	0.00
	5	0.181	175.00	5.10	0.3710	1.0000	3	468.2	26,988	0.00	0.00
	Σ							**3,619.6**	**24,206**	**0.19**	**0.13**
#3	1	0.190	175.00	5.20	0.1930	1.0000	3	221.4	21,734	1.23	0.87
	2	0.177	175.00	4.20	0.2560	1.0000	3	236.3	17,524	0.00	0.00
	3	0.166	175.00	4.30	0.2290	1.0000	3	265.7	17,717	0.00	0.00
	Σ							**4,035.6**	**18,997**	**0.06**	**0.04**
#4	Σ							**4,035.6**	**18,997**	**0.06**	**0.04**
#9	1	0.189	175.00	4.44	0.1970	1.0000	3	350.3	16,517	0.00	0.00
	Σ							**4,042.0**	**16,916**	**0.00**	**0.00**
#11	Σ							**16,494.3**	**34,910**	**0.07**	**0.04**
#21	1	0.177	175.00	4.44	0.2560	1.0000	3	185.7	18,511	0.00	0.00
	2	0.184	175.00	5.81	0.2210	1.0000	3	286.5	27,896	1.39	0.99
	3	0.185	300.00	2.70	0.2180	1.0000	3	133.3	13,847	1.11	0.80
	4	0.175	300.00	2.66	0.2690	1.0000	3	157.7	11,371	0.00	0.00
	Σ							**16,455.3**	**33,282**	**0.03**	**0.02**
#18	1	0.193	300.00	2.80	0.2200	1.0000	3	233.6	13,072	0.20	0.15
	2	0.173	175.00	4.70	0.3880	1.0000	3	614.7	31,763	0.00	0.00
	Σ							**496.6**	**15,750**	**0.12**	**0.07**
#17	1	0.196	300.00	2.60	0.2600	1.0000	3	167.2	15,582	0.82	0.58
	Σ							**167.2**	**15,582**	**0.82**	**0.58**
#19	Σ							**663.8**	**14,808**	**0.28**	**0.18**
#15	1	0.201	125.00	8.20	0.3960	1.0000	3	1,267.2	54,687	0.00	0.00
	2	0.161	100.00	11.40	0.3060	1.0000	3	1,671.9	57,370	0.43	0.31
	3	0.118	100.00	10.20	0.2850	1.0000	2	873.0	27,740	14.56	10.46

Stru #	SWS #	Soil K	L (ft)	S (%)	C	P	PS #	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc (ml/l)	24VW (ml/l)
	Σ							**3,281.0**	**46,290**	**1.92**	**1.17**
#12	1	0.124	150.00	6.30	0.3070	1.0000	2	259.1	20,985	11.35	7.93
	2	0.132	200.00	3.60	0.3500	1.0000	2	66.5	14,727	8.34	5.68
	3	0.136	175.00	5.00	0.3330	1.0000	2	313.0	23,102	12.74	8.84
	4	0.188	200.00	3.40	0.3570	1.0000	2	404.6	15,016	6.20	4.48
	5	0.228	175.00	4.10	0.3640	1.0000	2	236.6	33,971	18.96	13.17
	Σ							**1,024.9**	**16,872**	**7.34**	**4.90**
#13	1	0.128	150.00	6.90	0.3390	1.0000	2	205.0	25,757	13.91	9.63
	2	0.130	175.00	5.70	0.3300	1.0000	2	321.8	23,501	12.64	8.87
	3	0.191	175.00	6.00	0.2890	1.0000	2	363.2	34,639	20.30	14.29
	4	0.122	175.00	5.10	0.3460	1.0000	2	124.9	26,092	15.97	11.02
	5	0.137	175.00	4.20	0.3530	1.0000	2	199.0	14,832	6.29	4.55
	Σ							**2,079.9**	**18,344**	**8.61**	**6.01**
#14	1	0.196	100.00	10.20	0.3980	1.0000	3	1,823.8	88,626	5.13	3.60
	2	0.193	150.00	6.70	0.4020	1.0000	3	1,202.1	57,829	2.49	1.77
	3	0.169	75.00	13.80	0.3240	1.0000	3	3,005.9	70,417	0.28	0.20
	4	0.114	100.00	11.00	0.2980	1.0000	3	193.5	37,483	1.77	1.28
	5	0.078	100.00	10.10	0.1830	1.0000	3	203.9	16,212	0.99	0.72
	6	0.084	150.00	7.10	0.2700	1.0000	2	126.0	13,104	7.06	5.08
	7	0.087	100.00	10.00	0.1840	1.0000	3	315.9	15,469	0.14	0.10
	8	0.126	150.00	6.70	0.2740	1.0000	2	438.7	17,197	8.46	6.18
	9	0.117	150.00	7.30	0.2600	1.0000	2	414.9	17,508	9.09	6.64
	10	0.115	125.00	8.50	0.2610	1.0000	2	253.2	18,957	10.12	7.38
	Σ							**7,172.5**	**83,385**	**1.80**	**0.36**
#16	1	0.200	200.00	3.30	0.3000	1.0000	3	377.7	19,309	0.34	0.24
	2	0.204	150.00	6.00	0.3630	1.0000	3	939.3	46,550	1.59	1.14
	3	0.210	150.00	6.10	0.3990	1.0000	3	715.4	57,910	5.27	3.86
	Σ							**12,480.7**	**57,021**	**1.79**	**0.63**
#20	1	0.186	175.00	4.80	0.2130	1.0000	3	318.0	20,003	0.08	0.06
	2	0.194	200.00	3.80	0.2330	1.0000	3	371.5	16,201	0.07	0.05
	Σ							**13,372.2**	**43,852**	**0.63**	**0.26**
#22	Σ							**29,827.5**	**35,065**	**0.24**	**0.13**
#23	1	0.172	175.00	4.20	0.2810	1.0000	3	260.3	18,176	0.00	0.00
	2	0.185	150.00	6.00	0.2160	1.0000	3	346.7	24,651	0.44	0.31
	Σ							**29,527.9**	**34,065**	**0.00**	**0.00**
#35	Σ							**40,687.5**	**31,691**	**0.02**	**0.01**
#36	1	0.190	175.00	5.94	0.2830	1.0000	3	248.3	26,262	0.00	0.00
	2	0.180	125.00	9.92	0.2410	1.0000	3	352.0	45,436	1.42	0.98

Stru #	SWS #	Soil K	L (ft)	S (%)	C	P	PS #	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc (ml/l)	24VW (ml/l)
	3	0.151	300.00	2.63	0.3890	1.0000	2	50.2	12,518	6.37	4.47
	Σ							**40,745.8**	**37,462**	**0.02**	**0.01**
#37	1	0.196	200.00	3.80	0.3980	1.0000	2	433.2	18,411	8.26	5.97
	2	0.193	175.00	5.40	0.4020	1.0000	3	576.2	47,282	1.47	1.07
	3	0.173	150.00	7.11	0.2770	1.0000	3	296.4	36,579	1.69	1.23
	4	0.171	150.00	6.52	0.2990	1.0000	2	368.1	21,649	10.16	7.45
	5	0.078	400.00	1.20	0.1830	1.0000	2	16.6	1,881	1.01	0.73
	Σ							**40,586.1**	**32,624**	**0.29**	**0.15**

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	5. Nearly bare and untilled, and alluvial valley fans	3.65	50.00	1,369.00	1.910	0.199
		8. Large gullies, diversions, and low flowing streams	1.57	157.00	10,030.00	3.750	0.742
#1	**1**	**Time of Concentration:**					**0.941**
#1	2	5. Nearly bare and untilled, and alluvial valley fans	6.63	70.00	1,056.00	2.570	0.114
		5. Nearly bare and untilled, and alluvial valley fans	1.98	150.00	7,573.00	1.400	1.502
#1	**2**	**Time of Concentration:**					**1.616**
#1	3	5. Nearly bare and untilled, and alluvial valley fans	1.65	117.00	7,070.00	1.280	1.534
		8. Large gullies, diversions, and low flowing streams	2.43	126.00	5,188.00	4.670	0.308
#1	**3**	**Time of Concentration:**					**1.842**
#1	4	5. Nearly bare and untilled, and alluvial valley fans	5.77	260.00	4,506.00	2.400	0.521
		8. Large gullies, diversions, and low flowing streams	2.84	168.00	5,924.00	5.050	0.325
#1	**4**	**Time of Concentration:**					**0.846**
#1	5	5. Nearly bare and untilled, and alluvial valley fans	19.93	180.00	903.00	4.460	0.056
		8. Large gullies, diversions, and low flowing streams	3.30	178.00	5,393.00	5.450	0.274
#1	**5**	**Time of Concentration:**					**0.330**
#1	6	5. Nearly bare and untilled, and alluvial valley fans	13.43	105.00	782.00	3.660	0.059
		8. Large gullies, diversions, and low flowing streams	2.62	283.00	10,822.00	4.850	0.619
#1	**6**	**Time of Concentration:**					**0.678**
#2	1	5. Nearly bare and untilled, and alluvial valley fans	6.84	70.00	1,024.00	2.610	0.108

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
		8. Large gullies, diversions, and low flowing streams	1.62	70.00	4,325.00	3.810	0.315
#2	**1**	**Time of Concentration:**					**0.423**
#2	2	5. Nearly bare and untilled, and alluvial valley fans	5.56	45.00	810.00	2.350	0.095
		8. Large gullies, diversions, and low flowing streams	0.86	40.00	4,663.00	2.770	0.467
#2	**2**	**Time of Concentration:**					**0.562**
#2	3	5. Nearly bare and untilled, and alluvial valley fans	5.89	50.00	849.00	2.420	0.097
		8. Large gullies, diversions, and low flowing streams	1.17	80.00	6,862.00	3.230	0.590
#2	**3**	**Time of Concentration:**					**0.687**
#2	4	5. Nearly bare and untilled, and alluvial valley fans	12.63	95.00	752.00	3.550	0.058
		8. Large gullies, diversions, and low flowing streams	1.40	135.00	9,630.00	3.550	0.753
#2	**4**	**Time of Concentration:**					**0.811**
#2	5	5. Nearly bare and untilled, and alluvial valley fans	11.02	70.00	635.00	3.320	0.053
		8. Large gullies, diversions, and low flowing streams	0.46	40.00	8,732.00	2.030	1.194
#2	**5**	**Time of Concentration:**					**1.247**
#3	1	5. Nearly bare and untilled, and alluvial valley fans	1.24	10.00	805.00	1.110	0.201
		8. Large gullies, diversions, and low flowing streams	1.33	40.00	3,017.00	3.450	0.242
#3	**1**	**Time of Concentration:**					**0.443**
#3	2	5. Nearly bare and untilled, and alluvial valley fans	0.68	10.00	1,478.00	0.820	0.500
		8. Large gullies, diversions, and low flowing streams	1.78	100.00	5,622.00	4.000	0.390
#3	**2**	**Time of Concentration:**					**0.890**
#3	3	5. Nearly bare and untilled, and alluvial valley fans	4.66	70.00	1,501.00	2.150	0.193
		8. Large gullies, diversions, and low flowing streams	1.17	60.00	5,126.00	3.240	0.439
#3	**3**	**Time of Concentration:**					**0.632**
#5	1	5. Nearly bare and untilled, and alluvial valley fans	19.06	285.00	1,495.00	4.360	0.095
		8. Large gullies, diversions, and low flowing streams	2.64	242.00	9,174.00	4.870	0.523
#5	**1**	**Time of Concentration:**					**0.618**
#5	2	5. Nearly bare and untilled, and alluvial valley fans	14.27	105.00	736.00	3.770	0.054
		8. Large gullies, diversions, and low flowing streams	4.08	297.00	7,279.00	6.050	0.334
#5	**2**	**Time of Concentration:**					**0.388**
#5	3	5. Nearly bare and untilled, and alluvial valley fans	8.27	35.00	423.00	2.870	0.040

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
		8. Large gullies, diversions, and low flowing streams	3.44	208.00	6,049.00	5.560	0.302
#5	**3**	**Time of Concentration:**					**0.342**
#5	4	5. Nearly bare and untilled, and alluvial valley fans	14.58	85.00	583.00	3.810	0.042
		8. Large gullies, diversions, and low flowing streams	4.53	248.00	5,473.00	6.380	0.238
#5	**4**	**Time of Concentration:**					**0.280**
#5	5	5. Nearly bare and untilled, and alluvial valley fans	5.07	70.00	1,382.00	2.250	0.170
		8. Large gullies, diversions, and low flowing streams	3.89	170.00	4,375.00	5.910	0.205
#5	**5**	**Time of Concentration:**					**0.375**
#5	6	5. Nearly bare and untilled, and alluvial valley fans	12.48	90.00	721.00	3.530	0.056
		8. Large gullies, diversions, and low flowing streams	5.16	274.00	5,308.02	6.810	0.216
#5	**6**	**Time of Concentration:**					**0.272**
#6	1	5. Nearly bare and untilled, and alluvial valley fans	5.36	75.00	1,399.00	2.310	0.168
		8. Large gullies, diversions, and low flowing streams	2.41	66.00	2,742.00	4.650	0.163
#6	**1**	**Time of Concentration:**					**0.331**
#6	2	5. Nearly bare and untilled, and alluvial valley fans	3.39	80.00	2,359.00	1.840	0.356
		8. Large gullies, diversions, and low flowing streams	2.63	80.00	3,039.00	4.860	0.173
#6	**2**	**Time of Concentration:**					**0.529**
#6	3	5. Nearly bare and untilled, and alluvial valley fans	4.60	34.00	739.00	2.140	0.095
		8. Large gullies, diversions, and low flowing streams	2.33	136.00	5,845.00	4.570	0.355
#6	**3**	**Time of Concentration:**					**0.450**
#6	4	5. Nearly bare and untilled, and alluvial valley fans	6.06	85.00	1,402.00	2.460	0.158
		8. Large gullies, diversions, and low flowing streams	2.52	96.00	3,810.00	4.760	0.222
#6	**4**	**Time of Concentration:**					**0.380**
#6	5	5. Nearly bare and untilled, and alluvial valley fans	7.24	70.00	967.00	2.690	0.099
		8. Large gullies, diversions, and low flowing streams	2.34	117.00	5,003.00	4.580	0.303
#6	**5**	**Time of Concentration:**					**0.402**
#6	6	5. Nearly bare and untilled, and alluvial valley fans	31.83	183.00	575.00	5.640	0.028
		8. Large gullies, diversions, and low flowing streams	3.38	270.00	7,990.00	5.510	0.402
#6	**6**	**Time of Concentration:**					**0.430**
#6	7	5. Nearly bare and untilled, and alluvial valley fans	23.08	325.00	1,408.00	4.800	0.081

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
		8. Large gullies, diversions, and low flowing streams	2.88	240.00	8,327.00	5.090	0.454
#6	**7**	**Time of Concentration:**					**0.535**
#7	1	5. Nearly bare and untilled, and alluvial valley fans	11.42	90.00	788.00	3.370	0.064
		8. Large gullies, diversions, and low flowing streams	1.46	230.00	15,769.00	3.620	1.210
#7	**1**	**Time of Concentration:**					**1.274**
#7	2	5. Nearly bare and untilled, and alluvial valley fans	10.97	60.00	547.00	3.310	0.045
		8. Large gullies, diversions, and low flowing streams	1.61	220.00	13,660.00	3.800	0.998
#7	**2**	**Time of Concentration:**					**1.043**
#7	3	5. Nearly bare and untilled, and alluvial valley fans	6.40	60.00	938.00	2.520	0.103
		8. Large gullies, diversions, and low flowing streams	1.72	171.00	9,931.00	3.930	0.701
#7	**3**	**Time of Concentration:**					**0.804**
#7	4	5. Nearly bare and untilled, and alluvial valley fans	19.23	80.00	416.00	4.380	0.026
		8. Large gullies, diversions, and low flowing streams	2.45	100.00	4,083.00	4.690	0.241
#7	**4**	**Time of Concentration:**					**0.267**
#7	5	5. Nearly bare and untilled, and alluvial valley fans	6.09	67.00	1,101.00	2.460	0.124
		8. Large gullies, diversions, and low flowing streams	2.51	80.00	3,184.00	4.750	0.186
#7	**5**	**Time of Concentration:**					**0.310**
#7	6	5. Nearly bare and untilled, and alluvial valley fans	5.93	63.00	1,062.00	2.430	0.121
		8. Large gullies, diversions, and low flowing streams	2.74	82.00	2,993.00	4.960	0.167
#7	**6**	**Time of Concentration:**					**0.288**
#7	7	5. Nearly bare and untilled, and alluvial valley fans	7.97	65.00	816.00	2.820	0.080
		8. Large gullies, diversions, and low flowing streams	3.48	153.00	4,400.00	5.590	0.218
#7	**7**	**Time of Concentration:**					**0.298**
#7	8	5. Nearly bare and untilled, and alluvial valley fans	6.60	50.00	758.00	2.560	0.082
		8. Large gullies, diversions, and low flowing streams	4.66	473.00	10,157.00	6.470	0.436
#7	**8**	**Time of Concentration:**					**0.518**
#9	1	5. Nearly bare and untilled, and alluvial valley fans	3.35	90.00	2,687.00	1.830	0.407
		8. Large gullies, diversions, and low flowing streams	0.58	20.00	3,463.00	2.270	0.423
#9	**1**	**Time of Concentration:**					**0.830**
#10	1	5. Nearly bare and untilled, and alluvial valley fans	1.24	41.00	3,317.00	1.110	0.830

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
		8. Large gullies, diversions, and low flowing streams	0.70	29.00	4,125.00	2.510	0.456
#10	**1**	**Time of Concentration:**					**1.286**
#10	2	5. Nearly bare and untilled, and alluvial valley fans	2.25	125.00	5,554.00	1.500	1.028
		8. Large gullies, diversions, and low flowing streams	2.13	85.00	3,997.00	4.370	0.254
#10	**2**	**Time of Concentration:**					**1.282**
#10	3	5. Nearly bare and untilled, and alluvial valley fans	1.39	68.00	4,904.00	1.170	1.164
		8. Large gullies, diversions, and low flowing streams	4.73	90.00	1,904.00	6.520	0.081
#10	**3**	**Time of Concentration:**					**1.245**
#10	4	5. Nearly bare and untilled, and alluvial valley fans	3.76	51.00	1,357.00	1.930	0.195
		8. Large gullies, diversions, and low flowing streams	0.65	22.00	3,385.00	2.410	0.390
#10	**4**	**Time of Concentration:**					**0.585**
#10	5	5. Nearly bare and untilled, and alluvial valley fans	1.63	88.00	5,391.16	1.270	1.179
#10	**5**	**Time of Concentration:**					**1.179**
#12	1	5. Nearly bare and untilled, and alluvial valley fans	4.50	75.00	1,667.00	2.120	0.218
		8. Large gullies, diversions, and low flowing streams	1.85	155.00	8,400.00	4.070	0.573
#12	**1**	**Time of Concentration:**					**0.791**
#12	2	5. Nearly bare and untilled, and alluvial valley fans	2.99	50.00	1,674.03	1.720	0.270
		8. Large gullies, diversions, and low flowing streams	1.67	70.00	4,201.17	3.870	0.301
#12	**2**	**Time of Concentration:**					**0.571**
#12	3	5. Nearly bare and untilled, and alluvial valley fans	4.04	57.00	1,411.00	2.000	0.195
		8. Large gullies, diversions, and low flowing streams	1.55	107.00	6,884.00	3.740	0.511
#12	**3**	**Time of Concentration:**					**0.706**
#12	4	5. Nearly bare and untilled, and alluvial valley fans	2.23	84.00	3,771.04	1.490	0.703
		8. Large gullies, diversions, and low flowing streams	1.62	186.00	11,515.60	3.810	0.839
#12	**4**	**Time of Concentration:**					**1.542**
#12	5	5. Nearly bare and untilled, and alluvial valley fans	3.68	53.00	1,442.00	1.910	0.209
		8. Large gullies, diversions, and low flowing streams	1.95	120.00	6,155.00	4.180	0.409
#12	**5**	**Time of Concentration:**					**0.618**
#13	1	5. Nearly bare and untilled, and alluvial valley fans	4.62	62.00	1,342.00	2.140	0.174
		8. Large gullies, diversions, and low flowing streams	1.91	157.00	8,225.00	4.140	0.551
#13	**1**	**Time of Concentration:**					**0.725**

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#13	2	5. Nearly bare and untilled, and alluvial valley fans	2.91	50.00	1,717.00	1.700	0.280
		8. Large gullies, diversions, and low flowing streams	2.28	183.00	8,039.00	4.520	0.494
#13	**2**	**Time of Concentration:**					**0.774**
#13	3	5. Nearly bare and untilled, and alluvial valley fans	6.18	95.00	1,537.00	2.480	0.172
		8. Large gullies, diversions, and low flowing streams	2.13	135.00	6,347.00	4.370	0.403
#13	**3**	**Time of Concentration:**					**0.575**
#13	4	5. Nearly bare and untilled, and alluvial valley fans	3.17	10.00	315.00	1.780	0.049
		8. Large gullies, diversions, and low flowing streams	2.30	100.00	4,344.00	4.550	0.265
#13	**4**	**Time of Concentration:**					**0.314**
#13	5	5. Nearly bare and untilled, and alluvial valley fans	3.10	70.00	2,255.00	1.760	0.355
		8. Large gullies, diversions, and low flowing streams	1.23	140.00	11,392.00	3.320	0.953
#13	**5**	**Time of Concentration:**					**1.308**
#14	1	5. Nearly bare and untilled, and alluvial valley fans	10.59	63.00	595.00	3.250	0.050
		8. Large gullies, diversions, and low flowing streams	2.60	151.00	5,808.00	4.830	0.334
#14	**1**	**Time of Concentration:**					**0.384**
#14	2	5. Nearly bare and untilled, and alluvial valley fans	7.28	67.00	920.00	2.690	0.095
		8. Large gullies, diversions, and low flowing streams	2.17	123.00	5,670.00	4.410	0.357
#14	**2**	**Time of Concentration:**					**0.452**
#14	3	5. Nearly bare and untilled, and alluvial valley fans	21.46	150.00	699.00	4.630	0.041
		8. Large gullies, diversions, and low flowing streams	3.10	364.00	11,728.00	5.280	0.617
#14	**3**	**Time of Concentration:**					**0.658**
#14	4	5. Nearly bare and untilled, and alluvial valley fans	3.39	35.00	1,032.00	1.840	0.155
		8. Large gullies, diversions, and low flowing streams	2.97	103.00	3,470.00	5.160	0.186
#14	**4**	**Time of Concentration:**					**0.341**
#14	5	5. Nearly bare and untilled, and alluvial valley fans	28.15	125.00	444.00	5.300	0.023
		8. Large gullies, diversions, and low flowing streams	4.18	246.00	5,886.00	6.130	0.266
#14	**5**	**Time of Concentration:**					**0.289**
#14	6	5. Nearly bare and untilled, and alluvial valley fans	3.18	40.00	1,257.00	1.780	0.196
		8. Large gullies, diversions, and low flowing streams	2.29	228.00	9,963.00	4.530	0.610
#14	**6**	**Time of Concentration:**					**0.806**

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#14	7	5. Nearly bare and untilled, and alluvial valley fans	16.72	100.00	598.00	4.080	0.040
		8. Large gullies, diversions, and low flowing streams	2.81	243.00	8,649.00	5.020	0.478
#14	**7**	**Time of Concentration:**					**0.518**
#14	8	5. Nearly bare and untilled, and alluvial valley fans	1.70	47.00	2,765.00	1.300	0.590
		8. Large gullies, diversions, and low flowing streams	2.44	274.00	11,208.00	4.690	0.663
#14	**8**	**Time of Concentration:**					**1.253**
#14	9	5. Nearly bare and untilled, and alluvial valley fans	2.87	105.00	3,657.00	1.690	0.601
		8. Large gullies, diversions, and low flowing streams	2.43	194.00	7,991.00	4.670	0.475
#14	**9**	**Time of Concentration:**					**1.076**
#14	10	5. Nearly bare and untilled, and alluvial valley fans	2.75	80.00	2,907.00	1.650	0.489
		8. Large gullies, diversions, and low flowing streams	2.41	172.00	7,149.00	4.650	0.427
#14	**10**	**Time of Concentration:**					**0.916**
#15	1	5. Nearly bare and untilled, and alluvial valley fans	12.80	54.00	422.00	3.570	0.032
		8. Large gullies, diversions, and low flowing streams	1.68	181.00	10,781.00	3.880	0.771
#15	**1**	**Time of Concentration:**					**0.803**
#15	2	5. Nearly bare and untilled, and alluvial valley fans	44.22	260.00	588.00	6.640	0.024
		8. Large gullies, diversions, and low flowing streams	2.45	254.00	10,354.00	4.690	0.613
#15	**2**	**Time of Concentration:**					**0.637**
#15	3	5. Nearly bare and untilled, and alluvial valley fans	10.04	85.00	847.00	3.160	0.074
		8. Large gullies, diversions, and low flowing streams	2.34	366.00	15,663.00	4.580	0.949
#15	**3**	**Time of Concentration:**					**1.023**
#16	1	5. Nearly bare and untilled, and alluvial valley fans	4.17	15.00	360.00	2.040	0.049
		8. Large gullies, diversions, and low flowing streams	1.42	108.00	7,618.00	3.570	0.592
#16	**1**	**Time of Concentration:**					**0.641**
#16	2	5. Nearly bare and untilled, and alluvial valley fans	8.70	62.00	713.00	2.940	0.067
		8. Large gullies, diversions, and low flowing streams	1.99	144.00	7,241.00	4.230	0.475
#16	**2**	**Time of Concentration:**					**0.542**
#16	3	5. Nearly bare and untilled, and alluvial valley fans	6.88	32.00	465.00	2.620	0.049
		8. Large gullies, diversions, and low flowing streams	2.29	81.00	3,543.00	4.530	0.217
#16	**3**	**Time of Concentration:**					**0.266**

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#17	1	5. Nearly bare and untilled, and alluvial valley fans	9.37	65.00	694.00	3.060	0.062
		8. Large gullies, diversions, and low flowing streams	1.19	56.00	4,712.00	3.270	0.400
#17	**1**	**Time of Concentration:**					**0.462**
#18	1	5. Nearly bare and untilled, and alluvial valley fans	9.00	60.00	667.00	2.990	0.061
		8. Large gullies, diversions, and low flowing streams	0.97	61.00	6,287.00	2.950	0.591
#18	**1**	**Time of Concentration:**					**0.652**
#18	2	5. Nearly bare and untilled, and alluvial valley fans	2.47	33.00	1,336.00	1.570	0.236
		8. Large gullies, diversions, and low flowing streams	2.01	164.00	8,154.00	4.250	0.532
#18	**2**	**Time of Concentration:**					**0.768**
#20	1	5. Nearly bare and untilled, and alluvial valley fans	11.87	45.00	379.00	3.440	0.030
		8. Large gullies, diversions, and low flowing streams	0.75	45.00	5,969.00	2.600	0.637
#20	**1**	**Time of Concentration:**					**0.667**
#20	2	5. Nearly bare and untilled, and alluvial valley fans	5.40	45.00	833.00	2.320	0.099
		8. Large gullies, diversions, and low flowing streams	1.30	98.00	7,547.00	3.410	0.614
#20	**2**	**Time of Concentration:**					**0.713**
#21	1	5. Nearly bare and untilled, and alluvial valley fans	4.09	60.00	1,467.00	2.020	0.201
		8. Large gullies, diversions, and low flowing streams	0.93	60.00	6,433.00	2.890	0.618
#21	**1**	**Time of Concentration:**					**0.819**
#21	2	5. Nearly bare and untilled, and alluvial valley fans	3.50	50.00	1,430.00	1.860	0.213
		8. Large gullies, diversions, and low flowing streams	2.15	60.00	2,785.00	4.400	0.175
#21	**2**	**Time of Concentration:**					**0.388**
#21	3	5. Nearly bare and untilled, and alluvial valley fans	1.70	15.00	881.00	1.300	0.188
		9. Small streams flowing bankfull	1.49	60.00	4,014.00	11.000	0.101
#21	**3**	**Time of Concentration:**					**0.289**
#21	4	5. Nearly bare and untilled, and alluvial valley fans	2.21	40.00	1,811.02	1.480	0.339
		8. Large gullies, diversions, and low flowing streams	0.84	50.00	5,949.54	2.750	0.600
#21	**4**	**Time of Concentration:**					**0.939**
#23	1	5. Nearly bare and untilled, and alluvial valley fans	2.44	65.00	2,660.01	1.560	0.473
		8. Large gullies, diversions, and low flowing streams	0.33	10.00	3,017.50	1.720	0.487
#23	**1**	**Time of Concentration:**					**0.960**
#23	2	5. Nearly bare and untilled, and alluvial valley fans	3.49	60.00	1,718.01	1.860	0.256

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
		8. Large gullies, diversions, and low flowing streams	1.66	65.00	3,926.06	3.860	0.282
#23	**2**	**Time of Concentration:**					**0.538**
#24	1	5. Nearly bare and untilled, and alluvial valley fans	1.71	430.00	25,118.00	1.300	5.367
#24	**1**	**Time of Concentration:**					**5.367**
#24	2	5. Nearly bare and untilled, and alluvial valley fans	1.84	430.00	23,393.00	1.350	4.813
#24	**2**	**Time of Concentration:**					**4.813**
#24	3	5. Nearly bare and untilled, and alluvial valley fans	1.82	155.00	8,498.00	1.350	1.748
		8. Large gullies, diversions, and low flowing streams	0.84	40.00	4,771.00	2.740	0.483
#24	**3**	**Time of Concentration:**					**2.231**
#24	4	5. Nearly bare and untilled, and alluvial valley fans	1.24	50.00	4,042.00	1.110	1.011
		8. Large gullies, diversions, and low flowing streams	0.49	60.00	12,150.00	2.100	1.607
#24	**4**	**Time of Concentration:**					**2.618**
#25	1	5. Nearly bare and untilled, and alluvial valley fans	0.51	10.00	1,950.00	0.710	0.762
		8. Large gullies, diversions, and low flowing streams	1.81	60.00	3,322.00	4.030	0.228
#25	**1**	**Time of Concentration:**					**0.990**
#25	2	5. Nearly bare and untilled, and alluvial valley fans	1.11	25.00	2,254.00	1.050	0.596
		8. Large gullies, diversions, and low flowing streams	2.36	75.00	3,178.00	4.600	0.191
#25	**2**	**Time of Concentration:**					**0.787**
#25	3	5. Nearly bare and untilled, and alluvial valley fans	3.23	30.00	929.00	1.790	0.144
		8. Large gullies, diversions, and low flowing streams	2.45	154.00	6,297.00	4.690	0.372
#25	**3**	**Time of Concentration:**					**0.516**
#26	1	5. Nearly bare and untilled, and alluvial valley fans	1.20	103.00	8,602.00	1.090	2.192
#26	**1**	**Time of Concentration:**					**2.192**
#26	2	5. Nearly bare and untilled, and alluvial valley fans	1.23	120.00	9,780.00	1.100	2.469
		8. Large gullies, diversions, and low flowing streams	2.18	184.00	8,454.00	4.420	0.531
#26	**2**	**Time of Concentration:**					**3.000**
#27	1	5. Nearly bare and untilled, and alluvial valley fans	4.32	50.00	1,158.02	2.070	0.155
		8. Large gullies, diversions, and low flowing streams	2.53	198.00	7,838.16	4.760	0.457
#27	**1**	**Time of Concentration:**					**0.612**
#27	2	5. Nearly bare and untilled, and alluvial valley fans	5.26	30.00	570.00	2.290	0.069
		8. Large gullies, diversions, and low flowing streams	3.15	278.00	8,822.00	5.320	0.460

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#27	**2**	**Time of Concentration:**					**0.529**
#27	3	5. Nearly bare and untilled, and alluvial valley fans	16.33	80.00	490.00	4.040	0.033
		8. Large gullies, diversions, and low flowing streams	2.15	225.00	10,443.00	4.400	0.659
#27	**3**	**Time of Concentration:**					**0.692**
#27	4	5. Nearly bare and untilled, and alluvial valley fans	12.43	65.00	523.00	3.520	0.041
		8. Large gullies, diversions, and low flowing streams	3.49	225.00	6,454.00	5.600	0.320
#27	**4**	**Time of Concentration:**					**0.361**
#27	5	5. Nearly bare and untilled, and alluvial valley fans	9.40	25.00	266.00	3.060	0.024
		8. Large gullies, diversions, and low flowing streams	2.32	364.00	15,700.00	4.560	0.956
#27	**5**	**Time of Concentration:**					**0.980**
#28	1	5. Nearly bare and untilled, and alluvial valley fans	5.25	40.00	762.00	2.290	0.092
		8. Large gullies, diversions, and low flowing streams	2.96	310.00	10,479.34	5.150	0.565
#28	**1**	**Time of Concentration:**					**0.657**
#28	2	5. Nearly bare and untilled, and alluvial valley fans	25.86	105.00	406.00	5.080	0.022
		8. Large gullies, diversions, and low flowing streams	2.96	310.00	10,479.34	5.150	0.565
#28	**2**	**Time of Concentration:**					**0.587**
#29	1	5. Nearly bare and untilled, and alluvial valley fans	11.58	30.00	259.00	3.400	0.021
		8. Large gullies, diversions, and low flowing streams	3.61	288.00	7,976.00	5.700	0.388
#29	**1**	**Time of Concentration:**					**0.409**
#29	2	5. Nearly bare and untilled, and alluvial valley fans	8.06	40.00	496.00	2.830	0.048
		8. Large gullies, diversions, and low flowing streams	2.90	252.00	8,693.55	5.100	0.473
#29	**2**	**Time of Concentration:**					**0.521**
#29	3	5. Nearly bare and untilled, and alluvial valley fans	7.25	25.00	345.00	2.690	0.035
		8. Large gullies, diversions, and low flowing streams	2.26	158.00	7,001.00	4.500	0.432
#29	**3**	**Time of Concentration:**					**0.467**
#30	1	5. Nearly bare and untilled, and alluvial valley fans	4.93	35.00	710.00	2.220	0.088
		8. Large gullies, diversions, and low flowing streams	1.67	243.00	14,540.00	3.870	1.043
#30	**1**	**Time of Concentration:**					**1.131**
#31	1	5. Nearly bare and untilled, and alluvial valley fans	2.91	15.00	515.00	1.700	0.084
		8. Large gullies, diversions, and low flowing streams	2.74	247.00	9,006.00	4.960	0.504
#31	**1**	**Time of Concentration:**					**0.588**

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#31	2	5. Nearly bare and untilled, and alluvial valley fans	7.46	25.00	335.00	2.730	0.034
		8. Large gullies, diversions, and low flowing streams	2.18	138.00	6,335.00	4.420	0.398
#31	**2**	**Time of Concentration:**					**0.432**
#31	3	5. Nearly bare and untilled, and alluvial valley fans	3.84	20.00	521.00	1.950	0.074
		8. Large gullies, diversions, and low flowing streams	2.24	108.00	4,826.00	4.480	0.299
#31	**3**	**Time of Concentration:**					**0.373**
#32	1	5. Nearly bare and untilled, and alluvial valley fans	3.48	22.00	632.00	1.860	0.094
		8. Large gullies, diversions, and low flowing streams	1.56	101.00	6,494.00	3.740	0.482
#32	**1**	**Time of Concentration:**					**0.576**
#34	1	5. Nearly bare and untilled, and alluvial valley fans	3.21	25.00	779.00	1.790	0.120
		8. Large gullies, diversions, and low flowing streams	2.80	63.00	2,251.00	5.010	0.124
#34	**1**	**Time of Concentration:**					**0.244**
#34	2	5. Nearly bare and untilled, and alluvial valley fans	5.75	40.00	696.00	2.390	0.080
		8. Large gullies, diversions, and low flowing streams	23.00	2,100.00	9,130.43	14.380	0.176
#34	**2**	**Time of Concentration:**					**0.256**
#34	3	5. Nearly bare and untilled, and alluvial valley fans	2.67	40.00	1,500.00	1.630	0.255
		8. Large gullies, diversions, and low flowing streams	1.28	98.00	7,675.00	3.380	0.630
#34	**3**	**Time of Concentration:**					**0.885**
#36	1	5. Nearly bare and untilled, and alluvial valley fans	3.21	105.00	3,274.00	1.790	0.508
		8. Large gullies, diversions, and low flowing streams	0.21	5.00	2,367.00	1.370	0.479
#36	**1**	**Time of Concentration:**					**0.987**
#36	2	5. Nearly bare and untilled, and alluvial valley fans	5.50	140.00	2,547.00	2.340	0.302
		8. Large gullies, diversions, and low flowing streams	1.58	30.00	1,897.00	3.770	0.139
#36	**2**	**Time of Concentration:**					**0.441**
#36	3	5. Nearly bare and untilled, and alluvial valley fans	2.03	80.00	3,938.62	1.420	0.770
		8. Large gullies, diversions, and low flowing streams	2.52	50.00	1,981.86	4.760	0.115
#36	**3**	**Time of Concentration:**					**0.885**
#37	1	5. Nearly bare and untilled, and alluvial valley fans	4.68	129.00	2,754.05	2.160	0.354
		8. Large gullies, diversions, and low flowing streams	0.16	10.00	6,108.73	1.210	1.402
#37	**1**	**Time of Concentration:**					**1.756**

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#37	2	5. Nearly bare and untilled, and alluvial valley fans	7.32	90.00	1,229.00	2.700	0.126
		8. Large gullies, diversions, and low flowing streams	1.62	70.00	4,309.01	3.820	0.313
#37	**2**	**Time of Concentration:**					**0.439**
#37	3	5. Nearly bare and untilled, and alluvial valley fans	8.10	100.00	1,234.00	2.840	0.120
		8. Large gullies, diversions, and low flowing streams	2.66	100.00	3,763.21	4.890	0.213
#37	**3**	**Time of Concentration:**					**0.333**
#37	4	5. Nearly bare and untilled, and alluvial valley fans	5.09	90.00	1,768.03	2.250	0.218
		8. Large gullies, diversions, and low flowing streams	0.36	30.00	8,326.39	1.800	1.284
#37	**4**	**Time of Concentration:**					**1.502**
#37	5	5. Nearly bare and untilled, and alluvial valley fans	0.81	20.00	2,466.09	0.900	0.761
		8. Large gullies, diversions, and low flowing streams	4.06	50.00	1,231.01	6.040	0.056
#37	**5**	**Time of Concentration:**					**0.817**

Subwatershed Muskingum Routing Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	2	8. Large gullies, diversions, and low flowing streams	1.29	107.00	8,294.00	3.400	0.677
#1	**2**	**Muskingum K:**					**0.677**
#1	3	8. Large gullies, diversions, and low flowing streams	1.27	113.00	8,880.00	3.380	0.729
#1	**3**	**Muskingum K:**					**0.729**
#1	4	8. Large gullies, diversions, and low flowing streams	1.35	171.00	12,634.00	3.490	1.005
#1	**4**	**Muskingum K:**					**1.005**
#1	5	8. Large gullies, diversions, and low flowing streams	1.49	274.00	18,349.00	3.660	1.392
#1	**5**	**Muskingum K:**					**1.392**
#1	6	8. Large gullies, diversions, and low flowing streams	1.49	274.00	18,349.00	3.660	1.392
#1	**6**	**Muskingum K:**					**1.392**
#2	2	8. Large gullies, diversions, and low flowing streams	0.53	20.00	3,756.00	2.180	0.478
#2	**2**	**Muskingum K:**					**0.478**
#2	3	8. Large gullies, diversions, and low flowing streams	0.55	25.00	4,570.00	2.210	0.574
#2	**3**	**Muskingum K:**					**0.574**
#2	4	8. Large gullies, diversions, and low flowing streams	0.55	25.00	4,570.00	2.210	0.574
#2	**4**	**Muskingum K:**					**0.574**

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#2	5	8. Large gullies, diversions, and low flowing streams	0.65	45.00	6,955.00	2.410	0.801
#2	**5**	**Muskingum K:**					**0.801**
#3	3	8. Large gullies, diversions, and low flowing streams	0.92	20.00	2,168.00	2.880	0.209
#3	**3**	**Muskingum K:**					**0.209**
#5	1	8. Large gullies, diversions, and low flowing streams	0.00	0.00	0.00	0.000	0.000
#5	**1**	**Muskingum K:**					**0.000**
#5	2	8. Large gullies, diversions, and low flowing streams	1.75	125.00	7,149.00	3.960	0.501
#5	**2**	**Muskingum K:**					**0.501**
#5	3	8. Large gullies, diversions, and low flowing streams	1.65	155.00	9,418.00	3.840	0.681
#5	**3**	**Muskingum K:**					**0.681**
#5	4	8. Large gullies, diversions, and low flowing streams	1.65	155.00	9,418.00	3.840	0.681
#5	**4**	**Muskingum K:**					**0.681**
#5	5	8. Large gullies, diversions, and low flowing streams	1.67	239.00	14,273.00	3.880	1.021
#5	**5**	**Muskingum K:**					**1.021**
#5	6	8. Large gullies, diversions, and low flowing streams	1.68	239.00	14,223.00	3.880	1.018
#5	**6**	**Muskingum K:**					**1.018**
#6	2	8. Large gullies, diversions, and low flowing streams	1.16	26.00	2,241.00	3.230	0.192
#6	**2**	**Muskingum K:**					**0.192**
#6	3	8. Large gullies, diversions, and low flowing streams	1.00	50.00	4,987.00	3.000	0.461
#6	**3**	**Muskingum K:**					**0.461**
#6	4	5. Nearly bare and untilled, and alluvial valley fans	1.00	50.00	4,987.00	1.000	1.385
#6	**4**	**Muskingum K:**					**1.385**
#6	5	8. Large gullies, diversions, and low flowing streams	1.02	89.00	8,685.00	3.030	0.796
#6	**5**	**Muskingum K:**					**0.796**
#6	6	8. Large gullies, diversions, and low flowing streams	1.06	126.00	11,860.00	3.090	1.066
#6	**6**	**Muskingum K:**					**1.066**
#6	7	8. Large gullies, diversions, and low flowing streams	1.06	126.00	11,860.00	3.090	1.066
#6	**7**	**Muskingum K:**					**1.066**
#7	1	8. Large gullies, diversions, and low flowing streams	0.00	0.00	0.00	0.000	0.000
#7	**1**	**Muskingum K:**					**0.000**
#7	2	8. Large gullies, diversions, and low flowing streams	0.00	0.00	0.00	0.000	0.000
#7	**2**	**Muskingum K:**					**0.000**
#7	4	8. Large gullies, diversions, and low flowing streams	1.16	140.00	12,037.00	3.230	1.035

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#7	**4**	**Muskingum K:**					**1.035**
#7	5	8. Large gullies, diversions, and low flowing streams	1.14	140.00	12,307.69	3.190	1.071
#7	**5**	**Muskingum K:**					**1.071**
#7	6	8. Large gullies, diversions, and low flowing streams	1.17	158.00	13,546.00	3.230	1.164
#7	**6**	**Muskingum K:**					**1.164**
#7	7	8. Large gullies, diversions, and low flowing streams	1.18	187.00	15,784.00	3.260	1.344
#7	**7**	**Muskingum K:**					**1.344**
#7	8	8. Large gullies, diversions, and low flowing streams	1.18	187.00	15,784.00	3.260	1.344
#7	**8**	**Muskingum K:**					**1.344**
#10	3	8. Large gullies, diversions, and low flowing streams	0.76	37.00	4,861.00	2.610	0.517
#10	**3**	**Muskingum K:**					**0.517**
#10	4	8. Large gullies, diversions, and low flowing streams	0.76	37.00	4,861.00	2.610	0.517
#10	**4**	**Muskingum K:**					**0.517**
#10	5	8. Large gullies, diversions, and low flowing streams	0.79	47.00	5,956.00	2.660	0.621
#10	**5**	**Muskingum K:**					**0.621**
#12	2	8. Large gullies, diversions, and low flowing streams	8.24	111.00	1,347.00	8.610	0.043
#12	**2**	**Muskingum K:**					**0.043**
#12	3	8. Large gullies, diversions, and low flowing streams	8.01	109.00	1,360.00	8.490	0.044
#12	**3**	**Muskingum K:**					**0.044**
#12	4	8. Large gullies, diversions, and low flowing streams	2.24	176.00	7,866.00	4.480	0.487
#12	**4**	**Muskingum K:**					**0.487**
#12	5	8. Large gullies, diversions, and low flowing streams	2.24	176.00	7,866.00	4.480	0.487
#12	**5**	**Muskingum K:**					**0.487**
#13	2	8. Large gullies, diversions, and low flowing streams	1.34	54.00	4,025.00	3.470	0.322
#13	**2**	**Muskingum K:**					**0.322**
#13	3	8. Large gullies, diversions, and low flowing streams	0.98	72.00	7,333.00	2.970	0.685
#13	**3**	**Muskingum K:**					**0.685**
#13	4	8. Large gullies, diversions, and low flowing streams	1.18	127.00	10,806.00	3.250	0.923
#13	**4**	**Muskingum K:**					**0.923**
#13	5	8. Large gullies, diversions, and low flowing streams	1.18	127.00	10,806.00	3.250	0.923
#13	**5**	**Muskingum K:**					**0.923**
#14	1	8. Large gullies, diversions, and low flowing streams	0.00	0.00	0.00	0.000	0.000
#14	**1**	**Muskingum K:**					**0.000**

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#14	2	8. Large gullies, diversions, and low flowing streams	0.83	58.00	6,957.00	2.730	0.707
#14	**2**	**Muskingum K:**					**0.707**
#14	3	8. Large gullies, diversions, and low flowing streams	0.81	77.00	9,480.00	2.700	0.975
#14	**3**	**Muskingum K:**					**0.975**
#14	4	8. Large gullies, diversions, and low flowing streams	0.86	147.00	17,117.00	2.770	1.716
#14	**4**	**Muskingum K:**					**1.716**
#14	5	8. Large gullies, diversions, and low flowing streams	0.88	175.00	19,934.00	2.810	1.970
#14	**5**	**Muskingum K:**					**1.970**
#14	6	8. Large gullies, diversions, and low flowing streams	0.95	211.00	22,155.00	2.920	2.107
#14	**6**	**Muskingum K:**					**2.107**
#14	7	8. Large gullies, diversions, and low flowing streams	0.96	257.00	26,835.00	2.930	2.544
#14	**7**	**Muskingum K:**					**2.544**
#14	8	8. Large gullies, diversions, and low flowing streams	0.96	257.00	26,835.00	2.930	2.544
#14	**8**	**Muskingum K:**					**2.544**
#14	9	8. Large gullies, diversions, and low flowing streams	0.95	307.00	32,146.59	2.930	3.047
#14	**9**	**Muskingum K:**					**3.047**
#14	10	8. Large gullies, diversions, and low flowing streams	0.96	339.00	35,382.00	2.930	3.354
#14	**10**	**Muskingum K:**					**3.354**
#15	1	8. Large gullies, diversions, and low flowing streams	0.00	0.00	0.00	0.000	0.000
#15	**1**	**Muskingum K:**					**0.000**
#15	2	8. Large gullies, diversions, and low flowing streams	1.14	86.00	7,535.00	3.200	0.654
#15	**2**	**Muskingum K:**					**0.654**
#15	3	8. Large gullies, diversions, and low flowing streams	1.25	115.00	9,236.00	3.340	0.768
#15	**3**	**Muskingum K:**					**0.768**
#16	2	8. Large gullies, diversions, and low flowing streams	0.58	24.00	4,161.00	2.270	0.509
#16	**2**	**Muskingum K:**					**0.509**
#16	3	8. Large gullies, diversions, and low flowing streams	0.51	37.00	7,269.00	2.140	0.943
#16	**3**	**Muskingum K:**					**0.943**
#17	1	8. Large gullies, diversions, and low flowing streams	0.00	0.00	0.00	0.000	0.000
#17	**1**	**Muskingum K:**					**0.000**
#18	1	8. Large gullies, diversions, and low flowing streams	0.00	0.00	0.00	0.000	0.000
#18	**1**	**Muskingum K:**					**0.000**
#18	2	8. Large gullies, diversions, and low flowing streams	1.02	62.00	6,103.00	3.020	0.561

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#18	**2**	**Muskingum K:**					**0.561**
#20	2	8. Large gullies, diversions, and low flowing streams	17.00	3,605.00	21,205.88	12.360	0.476
#20	**2**	**Muskingum K:**					**0.476**
#21	1	8. Large gullies, diversions, and low flowing streams	0.00	0.00	0.00	0.000	0.000
#21	**1**	**Muskingum K:**					**0.000**
#21	2	8. Large gullies, diversions, and low flowing streams	0.41	20.00	4,824.00	1.930	0.694
#21	**2**	**Muskingum K:**					**0.694**
#21	3	8. Large gullies, diversions, and low flowing streams	0.36	20.00	5,626.00	1.780	0.877
#21	**3**	**Muskingum K:**					**0.877**
#21	4	8. Large gullies, diversions, and low flowing streams	0.36	20.00	5,626.00	1.780	0.877
#21	**4**	**Muskingum K:**					**0.877**
#23	1	8. Large gullies, diversions, and low flowing streams	0.00	0.00	0.00	0.000	0.000
#23	**1**	**Muskingum K:**					**0.000**
#23	2	8. Large gullies, diversions, and low flowing streams	0.63	30.00	4,771.75	2.370	0.559
#23	**2**	**Muskingum K:**					**0.559**
#24	1	8. Large gullies, diversions, and low flowing streams	0.79	180.00	22,769.00	2.660	2.377
#24	**1**	**Muskingum K:**					**2.377**
#24	2	8. Large gullies, diversions, and low flowing streams	0.78	180.00	23,111.00	2.640	2.431
#24	**2**	**Muskingum K:**					**2.431**
#24	4	8. Large gullies, diversions, and low flowing streams	0.00	0.00	0.00	0.000	0.000
#24	**4**	**Muskingum K:**					**0.000**
#25	1	8. Large gullies, diversions, and low flowing streams	1.99	104.00	5,220.00	4.230	0.342
#25	**1**	**Muskingum K:**					**0.342**
#25	2	8. Large gullies, diversions, and low flowing streams	1.99	104.00	5,220.00	4.230	0.342
#25	**2**	**Muskingum K:**					**0.342**
#25	3	8. Large gullies, diversions, and low flowing streams	0.00	0.00	0.00	0.000	0.000
#25	**3**	**Muskingum K:**					**0.000**
#27	1	8. Large gullies, diversions, and low flowing streams	1.38	216.00	15,629.00	3.520	1.233
#27	**1**	**Muskingum K:**					**1.233**
#27	2	8. Large gullies, diversions, and low flowing streams	1.17	144.00	12,301.00	3.240	1.054
#27	**2**	**Muskingum K:**					**1.054**
#27	3	8. Large gullies, diversions, and low flowing streams	1.18	76.00	6,454.00	3.250	0.551
#27	**3**	**Muskingum K:**					**0.551**

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#27	4	8. Large gullies, diversions, and low flowing streams	1.18	76.00	6,454.00	3.250	0.551
#27	**4**	**Muskingum K:**					**0.551**
#28	1	8. Large gullies, diversions, and low flowing streams	1.30	84.00	6,445.17	3.420	0.523
#28	**1**	**Muskingum K:**					**0.523**
#29	1	8. Large gullies, diversions, and low flowing streams	0.88	37.00	4,210.00	2.810	0.416
#29	**1**	**Muskingum K:**					**0.416**
#29	2	8. Large gullies, diversions, and low flowing streams	0.88	26.00	2,949.00	2.810	0.291
#29	**2**	**Muskingum K:**					**0.291**
#31	1	8. Large gullies, diversions, and low flowing streams	1.35	76.00	5,639.00	3.480	0.450
#31	**1**	**Muskingum K:**					**0.450**
#31	2	8. Large gullies, diversions, and low flowing streams	1.15	20.00	1,734.00	3.220	0.149
#31	**2**	**Muskingum K:**					**0.149**
#34	1	8. Large gullies, diversions, and low flowing streams	0.73	65.00	8,900.00	2.560	0.965
#34	**1**	**Muskingum K:**					**0.965**
#34	2	8. Large gullies, diversions, and low flowing streams	0.73	65.00	8,900.00	2.560	0.965
#34	**2**	**Muskingum K:**					**0.965**
#36	3	8. Large gullies, diversions, and low flowing streams	2.71	80.00	2,957.00	4.930	0.166
#36	**3**	**Muskingum K:**					**0.166**
#37	2	8. Large gullies, diversions, and low flowing streams	0.29	30.00	10,319.91	1.610	1.780
#37	**2**	**Muskingum K:**					**1.780**
#37	3	8. Large gullies, diversions, and low flowing streams	0.31	30.00	9,800.71	1.650	1.649
#37	**3**	**Muskingum K:**					**1.649**
#37	4	8. Large gullies, diversions, and low flowing streams	0.29	30.00	10,319.91	1.610	1.780
#37	**4**	**Muskingum K:**					**1.780**
#37	5	8. Large gullies, diversions, and low flowing streams	0.56	100.00	17,956.54	2.230	2.236
#37	**5**	**Muskingum K:**					**2.236**

Copyright 1998 -2007 Pamela J. Schwab

Cottonwood Arroyo Pre-mine Hydrology and Sedimentology

The drainage subdivisions used to model the hydrology is shown on Exhibit 18.B.

Revised Febuary 2012

Art O'Hayre

Copyright 1998 -2007 Pamela J. Schwab

General Information

Storm Information:

Storm Type:	Type II-70
Design Storm:	100 yr - 6 hr
Rainfall Depth:	2.040 inches

Particle Size Distribution:

Size (mm)	PostMine-LoamySand	PreMine-LoamySand	PreMine-Badlands	LoamySand Postmining
2.0000	100.000%	100.000%	100.000%	0.000%
0.1000	26.500%	30.000%	83.500%	0.000%
0.0500	14.000%	17.000%	77.000%	0.000%
0.0020	11.000%	11.000%	56.000%	0.000%
0.0010	0.000%	0.000%	0.000%	0.000%

Copyright 1998 -2007 Pamela J. Schwab

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc. (ml/l)	24VW (ml/l)
#30	476.400	476.400	86.92	10.78	97.1	9,320	4.41	3.12
#28	1,217.900	1,217.900	832.25	93.54	5,541.5	59,612	0.74	0.53
#26	2,486.400	2,486.400	275.55	74.66	548.8	7,278	2.35	1.74
#24	8,061.800	8,061.800	386.57	224.86	949.6	4,970	0.73	0.46
#25	1,015.700	9,077.500	393.25	268.09	1,185.4	15,996	3.69	0.75
#27	1,783.700	13,347.600	724.52	419.60	3,780.3	31,465	13.44	2.82
#29	966.000	15,531.500	1,383.20	586.28	15,023.3	74,082	9.73	2.44
#32	293.700	16,301.600	1,413.07	623.43	16,148.1	65,499	6.14	1.76
#31	957.100	957.100	785.51	82.54	3,927.1	43,239	0.95	0.75
#33	0.000	17,258.700	1,524.15	705.97	20,075.2	57,140	4.55	1.65
#34	932.500	18,191.200	1,541.21	774.90	18,828.3	47,805	0.35	0.13
#5	2,023.000	2,023.000	1,349.47	134.18	4,549.4	44,265	4.91	2.73
#6	1,743.200	3,766.200	1,527.16	256.62	8,062.5	38,199	0.25	0.15
#7	2,395.300	6,161.500	2,444.68	466.74	20,462.9	48,159	0.00	0.00
#8	0.000	6,161.500	2,444.68	466.74	20,462.9	48,159	0.00	0.00
#10	1,053.200	7,214.700	2,478.16	546.78	20,048.7	44,185	0.15	0.09
#1	2,411.100	2,411.100	969.41	134.57	4,774.2	39,132	6.43	4.23
#2	1,497.000	3,908.100	1,059.91	257.90	6,149.0	25,315	0.21	0.14
#3	862.700	4,770.800	1,261.81	320.10	6,643.4	19,781	0.07	0.05
#4	0.000	4,770.800	1,261.81	320.10	6,643.4	19,781	0.07	0.05
#9	425.500	5,196.300	1,293.61	353.35	6,647.8	18,054	0.00	0.00
#11	0.000	12,411.000	3,374.35	900.14	26,696.5	36,391	0.09	0.05
#21	1,080.800	13,491.800	3,438.75	971.45	26,631.1	34,667	0.04	0.02
#18	848.500	848.500	434.05	59.62	885.6	17,901	0.19	0.12
#17	182.200	182.200	254.12	16.35	256.5	16,193	1.00	0.71
#19	0.000	1,030.700	603.09	75.97	1,142.2	16,875	0.37	0.24
#15	1,992.700	1,992.700	996.33	133.89	5,389.3	48,450	2.83	1.71
#12	3,494.500	3,494.500	739.31	126.25	2,083.8	17,988	8.18	5.49
#13	2,720.700	6,215.200	1,297.09	224.49	4,182.2	19,433	9.44	6.62
#14	5,096.800	11,312.000	1,550.26	540.08	12,534.2	88,446	3.03	0.57
#16	876.500	14,181.200	1,948.63	751.77	21,034.7	61,015	2.67	0.89
#20	681.900	15,893.800	2,001.09	886.93	22,465.7	46,594	1.11	0.44
#22	0.000	29,385.600	5,214.55	1,858.38	49,096.9	36,590	0.42	0.22
#23	752.900	30,138.500	5,165.20	1,905.61	48,634.1	35,589	0.04	0.02
#35	0.000	48,329.700	6,464.76	2,680.51	67,462.3	33,006	0.09	0.05
#36	730.590	49,060.290	6,428.18	2,717.89	67,548.5	38,350	0.03	0.01
#37	2,208.500	51,268.790	6,324.95	2,836.00	67,180.5	37,669	0.39	0.18

Copyright 1998 -2007 Pamela J. Schwab

Particle Size Distribution(s) at Each Structure

Structure #30:

Size (mm)	In/Out
2.0000	100.000%
0.1000	85.557%
0.0500	48.482%
0.0020	31.371%
0.0010	0.000%

Structure #28:

Size (mm)	In/Out
2.0000	100.000%
0.1000	100.000%
0.0500	100.000%
0.0020	96.519%
0.0010	0.000%

Structure #26:

Size (mm)	In/Out
2.0000	100.000%
0.1000	100.000%
0.0500	70.975%
0.0020	45.925%
0.0010	0.000%

Structure #24:

Size (mm)	In/Out
2.0000	100.000%
0.1000	100.000%
0.0500	91.071%
0.0020	70.221%
0.0010	0.000%

Structure #25:

Size (mm)	In/Out
2.0000	100.000%
0.1000	83.836%
0.0500	74.932%
0.0020	66.501%
0.0010	0.000%

Structure #27:

Size (mm)	In/Out
2.0000	100.000%
0.1000	73.416%
0.0500	52.287%
0.0020	39.482%
0.0010	0.000%

Structure #29:

Size (mm)	In/Out
2.0000	100.000%
0.1000	93.366%
0.0500	88.050%
0.0020	77.980%
0.0010	0.000%

Structure #32:

Size (mm)	In/Out
2.0000	100.000%
0.1000	98.135%
0.0500	93.024%
0.0020	82.321%
0.0010	0.000%

Structure #31:

Size (mm)	In/Out
2.0000	100.000%
0.1000	100.000%
0.0500	100.000%
0.0020	93.833%
0.0010	0.000%

Structure #33 (Inlet to North Fork Diversion):

Size (mm)	In/Out
2.0000	100.000%
0.1000	98.500%
0.0500	94.389%
0.0020	84.573%
0.0010	0.000%

Structure #34:

Size (mm)	In/Out
2.0000	100.000%
0.1000	100.000%
0.0500	100.000%
0.0020	97.937%
0.0010	0.000%

Structure #5:

Size (mm)	In/Out
2.0000	100.000%
0.1000	97.755%
0.0500	89.765%
0.0020	81.592%
0.0010	0.000%

Structure #6:

Size (mm)	In/Out
2.0000	100.000%
0.1000	100.000%
0.0500	100.000%
0.0020	98.129%
0.0010	0.000%

Structure #7:

Size (mm)	In/Out
2.0000	100.000%
0.1000	100.000%
0.0500	100.000%
0.0020	100.000%
0.0010	0.000%

Structure #8:

Size (mm)	In/Out
2.0000	100.000%
0.1000	100.000%
0.0500	100.000%
0.0020	100.000%
0.0010	0.000%

Structure #10:

Size (mm)	In/Out
2.0000	100.000%
0.1000	100.000%
0.0500	99.672%
0.0020	99.485%
0.0010	0.000%

Structure #1:

Size (mm)	In/Out
2.0000	100.000%
0.1000	92.714%
0.0500	81.846%
0.0020	76.465%
0.0010	0.000%

Structure #2:

Size (mm)	In/Out
2.0000	100.000%
0.1000	100.000%
0.0500	100.000%
0.0020	97.665%
0.0010	0.000%

Structure #3:

Size (mm)	In/Out
2.0000	100.000%
0.1000	100.000%
0.0500	100.000%
0.0020	99.062%
0.0010	0.000%

Structure #4:

Size (mm)	In/Out
2.0000	100.000%
0.1000	100.000%
0.0500	100.000%
0.0020	99.062%
0.0010	0.000%

Structure #9:

Size (mm)	In/Out
2.0000	100.000%
0.1000	100.000%
0.0500	100.000%
0.0020	100.000%
0.0010	0.000%

Structure #11:

Size (mm)	In/Out
2.0000	100.000%
0.1000	100.000%
0.0500	99.753%
0.0020	99.613%
0.0010	0.000%

Structure #21:

Size (mm)	In/Out
2.0000	100.000%
0.1000	100.000%
0.0500	100.000%
0.0020	99.702%
0.0010	0.000%

Structure #18:

Size (mm)	In/Out
2.0000	100.000%
0.1000	100.000%
0.0500	100.000%
0.0020	96.995%
0.0010	0.000%

Structure #17:

Size (mm)	In/Out
2.0000	100.000%
0.1000	100.000%
0.0500	100.000%
0.0020	82.629%
0.0010	0.000%

Structure #19:

Size (mm)	In/Out
2.0000	100.000%
0.1000	100.000%
0.0500	100.000%
0.0020	93.769%
0.0010	0.000%

Structure #15:

Size (mm)	In/Out
2.0000	100.000%
0.1000	100.000%
0.0500	94.463%
0.0020	90.477%
0.0010	0.000%

Structure #12:

Size (mm)	In/Out
2.0000	100.000%
0.1000	78.989%
0.0500	51.223%
0.0020	33.145%
0.0010	0.000%

Structure #13:

Size (mm)	In/Out
2.0000	100.000%
0.1000	75.897%
0.0500	46.580%
0.0020	30.140%
0.0010	0.000%

Structure #14:

Size (mm)	In/Out
2.0000	100.000%
0.1000	100.000%
0.0500	99.621%
0.0020	90.811%
0.0010	0.000%

Structure #16:

Size (mm)	In/Out
2.0000	100.000%
0.1000	100.000%
0.0500	98.395%
0.0020	89.680%
0.0010	0.000%

Structure #20:

Size (mm)	In/Out
2.0000	100.000%
0.1000	100.000%
0.0500	100.000%
0.0020	93.292%
0.0010	0.000%

Structure #22:

Size (mm)	In/Out
2.0000	100.000%
0.1000	100.000%
0.0500	100.000%
0.0020	96.769%
0.0010	0.000%

Structure #23:

Size (mm)	In/Out
2.0000	100.000%
0.1000	100.000%
0.0500	100.000%
0.0020	99.713%
0.0010	0.000%

Structure #35:

Size (mm)	In/Out
2.0000	100.000%
0.1000	100.000%
0.0500	100.000%
0.0020	99.217%
0.0010	0.000%

Structure #36:

Size (mm)	In/Out
2.0000	100.000%
0.1000	100.000%
0.0500	100.000%
0.0020	99.777%
0.0010	0.000%

Structure #37:

Size (mm)	In/Out
2.0000	100.000%
0.1000	99.797%
0.0500	98.990%
0.0020	98.362%
0.0010	0.000%

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#30	1	476.400	1.131	0.000	0.000	73.100	M	86.92	10.783
	Σ	**476.400**						**86.92**	**10.783**
#28	1	772.300	0.657	0.523	0.334	90.400	M	752.74	59.308
	2	445.600	0.587	0.000	0.000	90.400	M	467.33	34.234
	Σ	**1,217.900**						**832.25**	**93.542**
#26	1	447.600	2.192	0.000	0.000	74.200	M	52.15	11.131
	2	2,038.800	3.000	0.000	0.000	77.000	M	230.69	63.525
	Σ	**2,486.400**						**275.55**	**74.655**
#24	1	2,607.500	5.367	2.377	0.305	75.200	M	153.86	70.433
	2	2,331.900	4.813	2.431	0.304	74.700	M	144.95	60.455
	3	1,758.500	2.231	1.788	0.297	76.200	M	240.04	51.476
	4	1,363.900	2.618	0.000	0.000	77.000	M	173.49	42.495
	Σ	**8,061.800**						**386.57**	**224.858**
#25	1	515.200	0.990	0.342	0.357	78.200	M	161.95	17.593
	2	130.500	0.787	0.342	0.357	78.100	M	48.57	4.423
	3	370.000	0.516	0.000	0.000	85.700	M	316.29	21.215
	Σ	**9,077.500**						**393.25**	**268.089**
#27	1	354.400	0.612	1.233	0.337	83.100	M	227.69	17.118
	2	305.200	0.529	1.054	0.328	84.000	M	229.89	15.662
	3	289.800	0.692	0.551	0.328	75.500	M	96.22	8.028
	4	253.000	0.361	0.551	0.328	79.400	M	174.11	9.470
	5	581.300	0.980	0.000	0.000	82.300	M	249.37	26.582
	Σ	**13,347.600**						**724.52**	**419.604**
#29	1	508.800	0.409	0.416	0.312	89.500	M	621.45	37.080
	2	233.200	0.521	0.291	0.312	91.600	M	281.23	19.263
	3	224.000	0.467	0.000	0.000	90.000	M	262.75	16.791
	Σ	**15,531.500**						**1,383.20**	**586.280**
#32	1	293.700	0.576	0.000	0.000	93.000	M	361.60	26.368
	Σ	**16,301.600**						**1,413.07**	**623.431**
#31	1	431.100	0.588	0.450	0.336	91.500	M	480.90	35.394
	2	325.800	0.432	0.149	0.327	93.000	M	469.94	29.285
	3	200.200	0.373	0.000	0.000	92.900	M	306.19	17.858
	Σ	**957.100**						**785.51**	**82.537**
#33	Σ	**17,258.700**						**1,524.15**	**705.968**

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#34	1	91.700	0.244	0.965	0.300	92.300	M	157.04	7.958
	2	105.200	0.256	0.965	0.300	93.000	M	182.91	9.495
	3	735.600	0.885	0.000	0.000	88.900	M	529.41	51.478
	Σ	**18,191.200**						**1,541.21**	**774.899**
#5	1	503.600	0.618	0.000	0.000	87.600	M	431.41	32.518
	2	406.500	0.388	0.501	0.350	84.800	M	387.10	21.979
	3	439.600	0.342	0.681	0.347	87.800	M	530.42	28.890
	4	162.600	0.280	0.681	0.347	86.000	M	192.17	9.534
	5	294.100	0.375	1.021	0.348	92.000	M	427.35	24.849
	6	216.600	0.272	1.018	0.348	90.100	M	322.06	16.408
	Σ	**2,023.000**						**1,349.47**	**134.179**
#6	1	149.100	0.331	0.000	0.000	92.600	M	234.00	13.116
	2	245.000	0.529	0.192	0.328	88.100	M	239.24	16.340
	3	276.200	0.450	0.461	0.319	89.500	M	321.32	20.072
	4	158.400	0.380	1.385	0.185	93.000	M	241.78	14.207
	5	206.200	0.402	0.796	0.320	89.400	M	252.54	14.933
	6	414.000	0.430	1.066	0.323	87.200	M	431.96	26.139
	7	294.300	0.535	1.066	0.323	86.400	M	256.99	17.634
	Σ	**3,766.200**						**1,527.16**	**256.621**
#7	1	731.700	1.274	0.000	0.000	93.000	M	510.48	65.589
	2	445.800	1.043	0.000	0.000	93.000	M	363.36	39.948
	3	270.800	0.804	0.000	0.000	93.000	M	267.12	24.274
	4	78.900	0.267	1.035	0.328	93.000	M	135.40	7.113
	5	154.900	0.310	1.071	0.326	93.000	M	253.21	13.947
	6	101.400	0.288	1.164	0.328	92.900	M	169.28	9.070
	7	117.700	0.298	1.344	0.329	92.200	M	188.00	10.096
	8	494.100	0.518	1.344	0.329	91.300	M	588.05	40.082
	Σ	**6,161.500**						**2,444.68**	**466.740**
#8	1	0.000	0.000	0.000	0.000	1.000	0.00	0.000	
	Σ	**6,161.500**						**2,444.68**	**466.740**
#10	1	355.500	1.286	0.000	0.000	93.000	M	246.17	31.859
	2	307.100	1.282	0.668	0.305	83.200	M	113.34	14.918
	3	147.300	1.245	0.517	0.303	90.600	M	90.51	11.434
	4	126.400	0.585	0.517	0.303	93.000	M	154.15	11.351
	5	116.900	1.179	0.621	0.305	93.000	M	86.70	10.480
	Σ	**7,214.700**						**2,478.16**	**546.782**
#1	1	557.400	0.941	0.000	0.000	83.600	M	269.99	27.820
	2	169.600	1.616	0.677	0.333	93.000	M	97.53	15.200
	3	636.400	1.842	0.729	0.333	81.000	M	148.68	26.594
	4	223.400	0.846	1.005	0.336	84.100	M	121.50	11.530

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
	5	77.700	0.330	1.392	0.341	81.400	M	64.44	3.356
	6	746.600	0.678	1.392	0.341	88.200	M	623.33	50.074
	Σ	**2,411.100**						**969.41**	**134.574**
#2	1	257.000	0.423	0.000	0.000	93.000	M	374.44	23.118
	2	180.500	0.562	0.478	0.281	91.800	M	210.48	15.074
	3	200.700	0.687	0.574	0.283	93.000	M	220.68	18.000
	4	438.600	0.811	0.574	0.283	93.000	M	429.99	39.326
	5	420.200	1.247	0.801	0.293	88.000	M	218.78	27.811
	Σ	**3,908.100**						**1,059.91**	**257.902**
#3	1	172.600	0.443	0.000	0.000	93.000	M	245.91	15.489
	2	311.200	0.890	0.000	0.000	88.900	M	223.03	21.783
	3	378.900	0.632	0.209	0.314	87.900	M	325.75	24.926
	Σ	**4,770.800**						**1,261.81**	**320.099**
#4	Σ	**4,770.800**						**1,261.81**	**320.099**
#9	1	425.500	0.830	0.000	0.000	90.700	M	358.63	33.255
	Σ	**5,196.300**						**1,293.61**	**353.354**
#11	Σ	**12,411.000**						**3,374.35**	**900.137**
#21	1	272.800	0.819	0.000	0.000	86.900	M	183.13	16.861
	2	230.500	0.388	0.694	0.266	89.200	M	283.84	16.451
	3	181.100	0.289	0.877	0.256	91.300	M	280.07	14.716
	4	396.400	0.939	0.877	0.256	86.100	M	227.82	23.280
	Σ	**13,491.800**						**3,438.75**	**971.445**
#18	1	301.700	0.652	0.000	0.000	93.000	M	343.42	27.082
	2	546.800	0.768	0.561	0.320	86.300	M	370.15	32.542
	Σ	**848.500**						**434.05**	**59.624**
#17	1	182.200	0.462	0.000	0.000	93.000	M	254.12	16.351
	Σ	**182.200**						**254.12**	**16.351**
#19	Σ	**1,030.700**						**603.09**	**75.975**
#15	1	437.400	0.803	0.000	0.000	91.300	M	391.26	35.417
	2	549.000	0.637	0.654	0.327	91.300	M	575.39	44.478
	3	1,006.300	1.023	0.768	0.331	84.700	M	492.78	53.997
	Σ	**1,992.700**						**996.33**	**133.892**
#12	1	517.800	0.791	0.000	0.000	81.900	M	253.96	23.036
	2	229.000	0.571	0.043	0.418	80.100	M	124.82	8.994
	3	592.700	0.706	0.044	0.417	81.500	M	307.18	25.658
	4	1,806.900	1.542	0.487	0.362	76.700	M	350.97	55.002
	5	348.100	0.618	0.487	0.362	80.000	178.31	13.561	

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
	Σ	**3,494.500**						**739.31**	**126.252**
#13	1	411.600	0.725	0.000	0.000	79.700	M	183.88	15.700
	2	636.400	0.774	0.322	0.336	80.700	M	291.36	26.065
	3	319.000	0.575	0.685	0.318	85.500	M	251.02	18.050
	4	231.700	0.314	0.923	0.328	80.400	M	183.82	9.322
	5	1,122.000	1.308	0.923	0.328	74.700	M	210.47	29.098
	Σ	**6,215.200**						**1,297.09**	**224.487**
#14	1	405.900	0.384	0.000	0.000	90.800	M	546.94	31.913
	2	411.100	0.452	0.707	0.308	90.700	M	510.03	32.137
	3	787.400	0.658	0.975	0.307	91.400	M	812.59	64.232
	4	144.200	0.341	1.716	0.310	86.200	M	159.03	8.568
	5	343.800	0.289	1.970	0.312	86.500	M	413.08	20.780
	6	392.800	0.806	2.107	0.316	81.900	M	190.01	17.476
	7	528.200	0.518	2.544	0.316	87.200	M	494.68	33.311
	8	890.900	1.253	2.544	0.316	83.500	M	341.95	44.165
	9	741.400	1.076	3.047	0.316	84.800	M	351.34	40.044
	10	451.100	0.916	3.354	0.316	83.900	M	227.77	22.972
	Σ	**11,312.000**						**1,550.26**	**540.085**
#16	1	329.600	0.641	0.000	0.000	93.000	M	379.34	29.573
	2	348.400	0.542	0.509	0.286	92.500	M	432.31	30.323
	3	198.500	0.266	0.943	0.279	93.000	M	340.98	17.895
	Σ	**14,181.200**						**1,948.63**	**751.769**
#20	1	296.300	0.667	0.000	0.000	91.700	M	308.29	24.609
	2	385.600	0.713	0.476	0.440	93.000	M	413.48	34.579
	Σ	**15,893.800**						**2,001.09**	**886.931**
#22	**Σ**	**29,385.600**						**5,214.55**	**1,858.376**
#23	1	442.400	0.960	0.000	0.000	85.300	M	236.99	24.672
	2	310.500	0.538	0.559	0.291	89.500	M	326.13	22.562
	Σ	**30,138.500**						**5,165.20**	**1,905.611**
#35	**Σ**	**48,329.700**						**6,464.76**	**2,680.510**
#36	1	298.200	0.987	0.000	0.000	85.000	M	153.24	16.314
	2	196.800	0.441	0.000	0.000	87.900	M	211.08	12.962
	3	235.590	0.885	0.166	0.372	78.300	M	81.43	8.105
	Σ	**49,060.290**						**6,428.18**	**2,717.891**
#37	1	744.000	1.756	0.000	0.000	84.800	M	236.22	40.167
	2	296.000	0.439	1.780	0.243	87.800	M	316.41	19.381
	3	237.700	0.333	1.649	0.246	85.500	M	254.20	13.499
	4	561.400	1.502	1.780	0.243	84.100	M	193.60	28.954

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
	5	369.400	0.817	2.236	0.284	81.600	M	173.21	16.105
	Σ	**51,268.790**						**6,324.95**	**2,835.999**

Subwatershed Sedimentology Detail:

Stru #	SWS #	Soil K	L (ft)	S (%)	C	P	PS #	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc (ml/l)	24VW (ml/l)
#30	1	0.095	200.00	3.80	0.3720	1.0000	2	97.1	9,320	4.41	3.12
	Σ							**97.1**	**9,320**	**4.41**	**3.12**
#28	1	0.187	100.00	10.10	0.3750	1.0000	3	4,338.2	73,262	0.83	0.60
	2	0.196	100.00	10.20	0.3930	1.0000	3	2,720.2	80,011	2.01	1.43
	Σ							**5,541.5**	**59,612**	**0.74**	**0.53**
#26	1	0.155	400.00	1.40	0.3480	1.0000	2	57.3	5,194	1.90	1.38
	2	0.155	300.00	2.40	0.3340	1.0000	2	491.5	7,755	2.47	1.81
	Σ							**548.8**	**7,278**	**2.35**	**1.74**
#24	1	0.128	300.00	2.30	0.3360	1.0000	2	331.9	4,689	0.69	0.52
	2	0.136	300.00	2.70	0.3440	1.0000	2	370.4	6,080	1.07	0.79
	3	0.107	300.00	2.30	0.3330	1.0000	2	295.9	5,731	2.16	1.59
	4	0.163	400.00	1.60	0.3210	1.0000	2	258.2	6,111	2.13	1.55
	Σ							**949.6**	**4,970**	**0.73**	**0.46**
#25	1	0.125	400.00	1.90	0.3440	1.0000	2	144.5	8,472	4.38	3.12
	2	0.124	300.00	2.60	0.3280	1.0000	2	39.0	9,182	4.99	3.51
	3	0.122	175.00	4.90	0.2660	1.0000	2	389.9	19,291	11.68	8.13
	Σ							**1,185.4**	**15,996**	**3.69**	**0.75**
#27	1	0.127	175.00	5.90	0.3160	1.0000	2	424.5	25,447	14.88	10.58
	2	0.122	150.00	7.50	0.2920	1.0000	2	419.7	27,541	16.50	11.70
	3	0.070	125.00	8.40	0.3270	1.0000	2	119.4	15,575	8.52	5.95
	4	0.097	125.00	9.60	0.3170	1.0000	2	301.0	33,444	20.45	14.14
	5	0.126	125.00	8.90	0.3290	1.0000	2	789.9	30,401	16.28	11.59
	Σ							**3,780.3**	**31,465**	**13.44**	**2.82**
#29	1	0.190	125.00	9.80	0.3930	1.0000	3	3,300.2	89,222	5.11	3.64
	2	0.203	125.00	8.90	0.3940	1.0000	3	1,359.9	71,018	3.10	2.22
	3	0.193	125.00	8.40	0.3940	1.0000	3	1,052.2	63,883	3.03	2.14
	Σ							**15,023.3**	**74,082**	**9.73**	**2.44**
#32	1	0.210	150.00	7.70	0.3990	1.0000	3	1,746.7	66,745	2.70	1.93
	Σ							**16,148.1**	**65,499**	**6.14**	**1.76**

Stru #	SWS #	Soil K	L (ft)	S (%)	C	P	PS #	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc (ml/l)	24VW (ml/l)
#31	1	0.204	125.00	8.70	0.3620	1.0000	3	2,300.9	65,305	1.98	1.42
	2	0.210	150.00	7.30	0.3990	1.0000	3	2,036.7	70,003	4.74	3.39
	3	0.210	175.00	4.50	0.3980	1.0000	3	826.7	47,117	3.68	2.62
	Σ							**3,927.1**	**43,239**	**0.95**	**0.75**
#33	Σ							**20,075.2**	**57,140**	**4.55**	**1.65**
#34	1	0.189	175.00	4.60	0.2250	1.0000	3	187.0	23,363	2.32	1.70
	2	0.206	175.00	5.10	0.3620	1.0000	3	435.3	45,146	4.46	3.28
	3	0.176	175.00	4.20	0.2510	1.0000	3	1,007.3	20,005	0.00	0.00
	Σ							**18,828.3**	**47,805**	**0.35**	**0.13**
#5	1	0.149	75.00	12.50	0.3230	1.0000	3	1,761.5	55,417	0.26	0.18
	2	0.133	75.00	15.80	0.3190	1.0000	2	1,581.0	73,701	45.73	32.04
	3	0.103	100.00	11.00	0.2030	1.0000	3	800.7	28,422	1.85	1.32
	4	0.093	75.00	13.80	0.2130	1.0000	2	263.1	28,361	18.06	12.80
	5	0.123	100.00	11.00	0.1370	1.0000	3	527.0	21,481	1.58	1.14
	6	0.149	75.00	14.70	0.1990	1.0000	3	771.8	47,043	4.10	2.97
	Σ							**4,549.4**	**44,265**	**4.91**	**2.73**
#6	1	0.208	175.00	4.30	0.3980	1.0000	3	566.5	43,809	3.67	2.62
	2	0.183	175.00	5.40	0.3910	1.0000	3	696.7	43,787	1.15	0.81
	3	0.188	150.00	7.60	0.3900	1.0000	3	1,212.9	61,278	2.99	2.13
	4	0.210	150.00	6.30	0.3990	1.0000	3	814.1	55,762	4.31	3.20
	5	0.185	125.00	8.10	0.3860	1.0000	3	852.0	57,331	3.34	2.40
	6	0.104	100.00	11.30	0.2240	1.0000	3	781.6	30,493	1.34	0.95
	7	0.164	100.00	11.20	0.3740	1.0000	3	1,220.4	69,527	1.18	0.84
	Σ							**8,062.5**	**38,199**	**0.25**	**0.15**
#7	1	0.208	150.00	7.80	0.3780	1.0000	3	3,355.9	50,966	0.00	0.00
	2	0.209	100.00	10.20	0.3940	1.0000	3	2,757.2	68,474	0.00	0.00
	3	0.210	150.00	6.70	0.3990	1.0000	3	1,232.8	51,046	0.00	0.00
	4	0.210	100.00	11.50	0.3990	1.0000	3	724.5	98,573	9.53	7.00
	5	0.210	150.00	7.10	0.3990	1.0000	3	925.0	65,247	5.79	4.23
	6	0.209	150.00	7.90	0.3990	1.0000	3	640.0	69,035	6.39	4.69
	7	0.206	75.00	15.50	0.3990	1.0000	3	1,289.7	122,298	10.82	7.97
	8	0.202	75.00	14.50	0.3980	1.0000	3	4,762.8	115,519	4.96	3.61
	Σ							**20,462.9**	**48,159**	**0.00**	**0.00**
#8	1	0.000	0.00	0.00	0.0000	1.0000	0	0.0	1	0.00	0.00
	Σ							**20,462.9**	**48,159**	**0.00**	**0.00**
#10	1	0.190	300.00	2.70	0.1930	1.0000	3	272.9	8,677	0.00	0.00
	2	0.153	200.00	3.50	0.3610	1.0000	2	195.6	13,269	6.72	4.86
	3	0.189	200.00	3.70	0.3190	1.0000	3	170.7	15,060	0.00	0.00
	4	0.190	300.00	2.10	0.1940	1.0000	3	94.4	8,517	0.33	0.24

Stru #	SWS #	Soil K	L (ft)	S (%)	C	P	PS #	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc (ml/l)	24VW (ml/l)
	5	0.201	300.00	2.00	0.3030	1.0000	3	103.6	9,977	0.00	0.00
	Σ							**20,048.7**	**44,185**	**0.15**	**0.09**
#1	1	0.157	150.00	6.80	0.3830	1.0000	2	974.2	35,729	19.48	13.87
	2	0.210	150.00	6.60	0.3990	1.0000	3	531.9	34,819	0.00	0.00
	3	0.149	200.00	3.90	0.3870	1.0000	2	363.4	13,724	6.05	4.41
	4	0.169	175.00	4.70	0.3950	1.0000	2	321.0	28,267	15.78	11.32
	5	0.157	100.00	10.10	0.3940	1.0000	2	193.1	58,434	36.30	25.77
	6	0.175	75.00	12.60	0.2840	1.0000	3	2,876.0	57,530	0.00	0.00
	Σ							**4,774.2**	**39,132**	**6.43**	**4.23**
#2	1	0.190	150.00	7.90	0.1930	1.0000	3	741.4	32,869	2.28	1.62
	2	0.184	175.00	4.80	0.2010	1.0000	3	286.7	19,447	0.71	0.51
	3	0.202	200.00	3.90	0.3220	1.0000	3	410.8	23,164	0.46	0.33
	4	0.203	150.00	7.40	0.3220	1.0000	3	1,809.1	46,104	0.00	0.00
	5	0.181	175.00	5.10	0.3710	1.0000	3	794.1	28,621	0.00	0.00
	Σ							**6,149.0**	**25,315**	**0.21**	**0.14**
#3	1	0.190	175.00	5.20	0.1930	1.0000	3	339.6	22,578	1.48	1.05
	2	0.177	175.00	4.20	0.2560	1.0000	3	393.3	18,469	0.00	0.00
	3	0.166	175.00	4.30	0.2290	1.0000	3	449.8	18,658	0.06	0.04
	Σ							**6,643.4**	**19,781**	**0.07**	**0.05**
#4	Σ							**6,643.4**	**19,781**	**0.07**	**0.05**
#9	1	0.189	175.00	4.44	0.1970	1.0000	3	562.9	17,305	0.00	0.00
	Σ							**6,647.8**	**18,054**	**0.00**	**0.00**
#11	Σ							**26,696.5**	**36,391**	**0.09**	**0.05**
#21	1	0.177	175.00	4.44	0.2560	1.0000	3	321.5	19,609	0.00	0.00
	2	0.184	175.00	5.81	0.2210	1.0000	3	468.9	28,898	1.75	1.25
	3	0.185	300.00	2.70	0.2180	1.0000	3	208.9	14,256	1.25	0.91
	4	0.175	300.00	2.66	0.2690	1.0000	3	277.5	12,099	0.00	0.00
	Σ							**26,631.1**	**34,667**	**0.04**	**0.02**
#18	1	0.193	300.00	2.80	0.2200	1.0000	3	358.9	13,605	0.36	0.26
	2	0.173	175.00	4.70	0.3880	1.0000	3	1,076.7	33,688	0.00	0.00
	Σ							**885.6**	**17,901**	**0.19**	**0.12**
#17	1	0.196	300.00	2.60	0.2600	1.0000	3	256.5	16,193	1.00	0.71
	Σ							**256.5**	**16,193**	**1.00**	**0.71**
#19	Σ							**1,142.2**	**16,875**	**0.37**	**0.24**
#15	1	0.201	125.00	8.20	0.3960	1.0000	3	2,012.4	57,137	0.00	0.00
	2	0.161	100.00	11.40	0.3060	1.0000	3	2,649.4	59,791	1.19	0.85
	3	0.118	100.00	10.20	0.2850	1.0000	2	1,580.5	29,583	15.98	11.51

Stru #	SWS #	Soil K	L (ft)	S (%)	C	P	PS #	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc (ml/l)	24VW (ml/l)
	Σ							**5,389.3**	**48,450**	**2.83**	**1.71**
#12	1	0.124	150.00	6.30	0.3070	1.0000	2	498.5	22,410	12.48	8.80
	2	0.132	200.00	3.60	0.3500	1.0000	2	133.4	15,703	9.13	6.31
	3	0.136	175.00	5.00	0.3330	1.0000	2	607.5	24,640	13.97	9.79
	4	0.188	200.00	3.40	0.3570	1.0000	2	904.7	16,633	7.42	5.37
	5	0.228	175.00	4.10	0.3640	1.0000	2	476.5	36,486	20.95	14.66
	Σ							**2,083.8**	**17,988**	**8.18**	**5.49**
#13	1	0.128	150.00	6.90	0.3390	1.0000	2	417.2	27,706	15.46	10.81
	2	0.130	175.00	5.70	0.3300	1.0000	2	638.1	25,298	14.04	9.91
	3	0.191	175.00	6.00	0.2890	1.0000	2	645.3	36,645	21.88	15.51
	4	0.122	175.00	5.10	0.3460	1.0000	2	245.0	27,365	17.00	11.90
	5	0.137	175.00	4.20	0.3530	1.0000	2	478.0	16,624	7.66	5.54
	Σ							**4,182.2**	**19,433**	**9.44**	**6.62**
#14	1	0.196	100.00	10.20	0.3980	1.0000	3	2,894.3	91,132	6.10	4.33
	2	0.193	150.00	6.70	0.4020	1.0000	3	1,917.7	59,949	3.20	2.29
	3	0.169	75.00	13.80	0.3240	1.0000	3	4,755.6	73,521	1.21	0.87
	4	0.114	100.00	11.00	0.2980	1.0000	3	335.5	39,158	2.35	1.70
	5	0.078	100.00	10.10	0.1830	1.0000	3	350.3	16,865	1.22	0.89
	6	0.084	150.00	7.10	0.2700	1.0000	2	242.5	14,080	7.82	5.64
	7	0.087	100.00	10.00	0.1840	1.0000	3	540.9	16,298	0.40	0.29
	8	0.126	150.00	6.70	0.2740	1.0000	2	815.5	18,458	9.42	6.89
	9	0.117	150.00	7.30	0.2600	1.0000	2	749.6	18,705	10.00	7.32
	10	0.115	125.00	8.50	0.2610	1.0000	2	466.0	20,278	11.14	8.14
	Σ							**12,534.2**	**88,446**	**3.03**	**0.57**
#16	1	0.200	200.00	3.30	0.3000	1.0000	3	580.2	20,094	0.57	0.41
	2	0.204	150.00	6.00	0.3630	1.0000	3	1,454.1	48,328	2.14	1.53
	3	0.210	150.00	6.10	0.3990	1.0000	3	1,085.9	59,491	5.76	4.23
	Σ							**21,034.7**	**61,015**	**2.67**	**0.89**
#20	1	0.186	175.00	4.80	0.2130	1.0000	3	500.2	20,831	0.34	0.24
	2	0.194	200.00	3.80	0.2330	1.0000	3	570.9	16,880	0.26	0.18
	Σ							**22,465.7**	**46,594**	**1.11**	**0.44**
#22	Σ							**49,096.9**	**36,590**	**0.42**	**0.22**
#23	1	0.172	175.00	4.20	0.2810	1.0000	3	465.5	19,330	0.00	0.00
	2	0.185	150.00	6.00	0.2160	1.0000	3	567.6	25,763	0.79	0.56
	Σ							**48,634.1**	**35,589**	**0.04**	**0.02**
#35	Σ							**67,462.3**	**33,006**	**0.09**	**0.05**
#36	1	0.190	175.00	5.94	0.2830	1.0000	3	446.6	27,939	0.00	0.00
	2	0.180	125.00	9.92	0.2410	1.0000	3	592.7	47,347	2.10	1.47

Stru #	SWS #	Soil K	L (ft)	S (%)	C	P	PS #	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc (ml/l)	24VW (ml/l)
	3	0.151	300.00	2.63	0.3890	1.0000	2	106.7	13,665	7.26	5.12
	Σ							**67,548.5**	**38,350**	**0.03**	**0.01**
#37	1	0.196	200.00	3.80	0.3980	1.0000	2	783.3	19,671	9.21	6.67
	2	0.193	175.00	5.40	0.4020	1.0000	3	971.9	49,434	2.19	1.61
	3	0.173	150.00	7.11	0.2770	1.0000	3	521.1	38,313	2.27	1.66
	4	0.171	150.00	6.52	0.2990	1.0000	2	675.5	23,203	11.33	8.31
	5	0.078	400.00	1.20	0.1830	1.0000	2	32.1	2,023	1.12	0.81
	Σ							**67,180.5**	**37,669**	**0.39**	**0.18**

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	5. Nearly bare and untilled, and alluvial valley fans	3.65	50.00	1,369.00	1.910	0.199
		8. Large gullies, diversions, and low flowing streams	1.57	157.00	10,030.00	3.750	0.742
#1	**1**	**Time of Concentration:**					**0.941**
#1	2	5. Nearly bare and untilled, and alluvial valley fans	6.63	70.00	1,056.00	2.570	0.114
		5. Nearly bare and untilled, and alluvial valley fans	1.98	150.00	7,573.00	1.400	1.502
#1	**2**	**Time of Concentration:**					**1.616**
#1	3	5. Nearly bare and untilled, and alluvial valley fans	1.65	117.00	7,070.00	1.280	1.534
		8. Large gullies, diversions, and low flowing streams	2.43	126.00	5,188.00	4.670	0.308
#1	**3**	**Time of Concentration:**					**1.842**
#1	4	5. Nearly bare and untilled, and alluvial valley fans	5.77	260.00	4,506.00	2.400	0.521
		8. Large gullies, diversions, and low flowing streams	2.84	168.00	5,924.00	5.050	0.325
#1	**4**	**Time of Concentration:**					**0.846**
#1	5	5. Nearly bare and untilled, and alluvial valley fans	19.93	180.00	903.00	4.460	0.056
		8. Large gullies, diversions, and low flowing streams	3.30	178.00	5,393.00	5.450	0.274
#1	**5**	**Time of Concentration:**					**0.330**
#1	6	5. Nearly bare and untilled, and alluvial valley fans	13.43	105.00	782.00	3.660	0.059
		8. Large gullies, diversions, and low flowing streams	2.62	283.00	10,822.00	4.850	0.619
#1	**6**	**Time of Concentration:**					**0.678**
#2	1	5. Nearly bare and untilled, and alluvial valley fans	6.84	70.00	1,024.00	2.610	0.108

Copyright 1998 -2007 Pamela J. Schwab

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
		8. Large gullies, diversions, and low flowing streams	1.62	70.00	4,325.00	3.810	0.315
#2	**1**	**Time of Concentration:**					**0.423**
#2	2	5. Nearly bare and untilled, and alluvial valley fans	5.56	45.00	810.00	2.350	0.095
		8. Large gullies, diversions, and low flowing streams	0.86	40.00	4,663.00	2.770	0.467
#2	**2**	**Time of Concentration:**					**0.562**
#2	3	5. Nearly bare and untilled, and alluvial valley fans	5.89	50.00	849.00	2.420	0.097
		8. Large gullies, diversions, and low flowing streams	1.17	80.00	6,862.00	3.230	0.590
#2	**3**	**Time of Concentration:**					**0.687**
#2	4	5. Nearly bare and untilled, and alluvial valley fans	12.63	95.00	752.00	3.550	0.058
		8. Large gullies, diversions, and low flowing streams	1.40	135.00	9,630.00	3.550	0.753
#2	**4**	**Time of Concentration:**					**0.811**
#2	5	5. Nearly bare and untilled, and alluvial valley fans	11.02	70.00	635.00	3.320	0.053
		8. Large gullies, diversions, and low flowing streams	0.46	40.00	8,732.00	2.030	1.194
#2	**5**	**Time of Concentration:**					**1.247**
#3	1	5. Nearly bare and untilled, and alluvial valley fans	1.24	10.00	805.00	1.110	0.201
		8. Large gullies, diversions, and low flowing streams	1.33	40.00	3,017.00	3.450	0.242
#3	**1**	**Time of Concentration:**					**0.443**
#3	2	5. Nearly bare and untilled, and alluvial valley fans	0.68	10.00	1,478.00	0.820	0.500
		8. Large gullies, diversions, and low flowing streams	1.78	100.00	5,622.00	4.000	0.390
#3	**2**	**Time of Concentration:**					**0.890**
#3	3	5. Nearly bare and untilled, and alluvial valley fans	4.66	70.00	1,501.00	2.150	0.193
		8. Large gullies, diversions, and low flowing streams	1.17	60.00	5,126.00	3.240	0.439
#3	**3**	**Time of Concentration:**					**0.632**
#5	1	5. Nearly bare and untilled, and alluvial valley fans	19.06	285.00	1,495.00	4.360	0.095
		8. Large gullies, diversions, and low flowing streams	2.64	242.00	9,174.00	4.870	0.523
#5	**1**	**Time of Concentration:**					**0.618**
#5	2	5. Nearly bare and untilled, and alluvial valley fans	14.27	105.00	736.00	3.770	0.054
		8. Large gullies, diversions, and low flowing streams	4.08	297.00	7,279.00	6.050	0.334
#5	**2**	**Time of Concentration:**					**0.388**
#5	3	5. Nearly bare and untilled, and alluvial valley fans	8.27	35.00	423.00	2.870	0.040

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
		8. Large gullies, diversions, and low flowing streams	3.44	208.00	6,049.00	5.560	0.302
#5	**3**	**Time of Concentration:**					**0.342**
#5	4	5. Nearly bare and untilled, and alluvial valley fans	14.58	85.00	583.00	3.810	0.042
		8. Large gullies, diversions, and low flowing streams	4.53	248.00	5,473.00	6.380	0.238
#5	**4**	**Time of Concentration:**					**0.280**
#5	5	5. Nearly bare and untilled, and alluvial valley fans	5.07	70.00	1,382.00	2.250	0.170
		8. Large gullies, diversions, and low flowing streams	3.89	170.00	4,375.00	5.910	0.205
#5	**5**	**Time of Concentration:**					**0.375**
#5	6	5. Nearly bare and untilled, and alluvial valley fans	12.48	90.00	721.00	3.530	0.056
		8. Large gullies, diversions, and low flowing streams	5.16	274.00	5,308.02	6.810	0.216
#5	**6**	**Time of Concentration:**					**0.272**
#6	1	5. Nearly bare and untilled, and alluvial valley fans	5.36	75.00	1,399.00	2.310	0.168
		8. Large gullies, diversions, and low flowing streams	2.41	66.00	2,742.00	4.650	0.163
#6	**1**	**Time of Concentration:**					**0.331**
#6	2	5. Nearly bare and untilled, and alluvial valley fans	3.39	80.00	2,359.00	1.840	0.356
		8. Large gullies, diversions, and low flowing streams	2.63	80.00	3,039.00	4.860	0.173
#6	**2**	**Time of Concentration:**					**0.529**
#6	3	5. Nearly bare and untilled, and alluvial valley fans	4.60	34.00	739.00	2.140	0.095
		8. Large gullies, diversions, and low flowing streams	2.33	136.00	5,845.00	4.570	0.355
#6	**3**	**Time of Concentration:**					**0.450**
#6	4	5. Nearly bare and untilled, and alluvial valley fans	6.06	85.00	1,402.00	2.460	0.158
		8. Large gullies, diversions, and low flowing streams	2.52	96.00	3,810.00	4.760	0.222
#6	**4**	**Time of Concentration:**					**0.380**
#6	5	5. Nearly bare and untilled, and alluvial valley fans	7.24	70.00	967.00	2.690	0.099
		8. Large gullies, diversions, and low flowing streams	2.34	117.00	5,003.00	4.580	0.303
#6	**5**	**Time of Concentration:**					**0.402**
#6	6	5. Nearly bare and untilled, and alluvial valley fans	31.83	183.00	575.00	5.640	0.028
		8. Large gullies, diversions, and low flowing streams	3.38	270.00	7,990.00	5.510	0.402
#6	**6**	**Time of Concentration:**					**0.430**
#6	7	5. Nearly bare and untilled, and alluvial valley fans	23.08	325.00	1,408.00	4.800	0.081

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
		8. Large gullies, diversions, and low flowing streams	2.88	240.00	8,327.00	5.090	0.454
#6	**7**	**Time of Concentration:**					**0.535**
#7	1	5. Nearly bare and untilled, and alluvial valley fans	11.42	90.00	788.00	3.370	0.064
		8. Large gullies, diversions, and low flowing streams	1.46	230.00	15,769.00	3.620	1.210
#7	**1**	**Time of Concentration:**					**1.274**
#7	2	5. Nearly bare and untilled, and alluvial valley fans	10.97	60.00	547.00	3.310	0.045
		8. Large gullies, diversions, and low flowing streams	1.61	220.00	13,660.00	3.800	0.998
#7	**2**	**Time of Concentration:**					**1.043**
#7	3	5. Nearly bare and untilled, and alluvial valley fans	6.40	60.00	938.00	2.520	0.103
		8. Large gullies, diversions, and low flowing streams	1.72	171.00	9,931.00	3.930	0.701
#7	**3**	**Time of Concentration:**					**0.804**
#7	4	5. Nearly bare and untilled, and alluvial valley fans	19.23	80.00	416.00	4.380	0.026
		8. Large gullies, diversions, and low flowing streams	2.45	100.00	4,083.00	4.690	0.241
#7	**4**	**Time of Concentration:**					**0.267**
#7	5	5. Nearly bare and untilled, and alluvial valley fans	6.09	67.00	1,101.00	2.460	0.124
		8. Large gullies, diversions, and low flowing streams	2.51	80.00	3,184.00	4.750	0.186
#7	**5**	**Time of Concentration:**					**0.310**
#7	6	5. Nearly bare and untilled, and alluvial valley fans	5.93	63.00	1,062.00	2.430	0.121
		8. Large gullies, diversions, and low flowing streams	2.74	82.00	2,993.00	4.960	0.167
#7	**6**	**Time of Concentration:**					**0.288**
#7	7	5. Nearly bare and untilled, and alluvial valley fans	7.97	65.00	816.00	2.820	0.080
		8. Large gullies, diversions, and low flowing streams	3.48	153.00	4,400.00	5.590	0.218
#7	**7**	**Time of Concentration:**					**0.298**
#7	8	5. Nearly bare and untilled, and alluvial valley fans	6.60	50.00	758.00	2.560	0.082
		8. Large gullies, diversions, and low flowing streams	4.66	473.00	10,157.00	6.470	0.436
#7	**8**	**Time of Concentration:**					**0.518**
#9	1	5. Nearly bare and untilled, and alluvial valley fans	3.35	90.00	2,687.00	1.830	0.407
		8. Large gullies, diversions, and low flowing streams	0.58	20.00	3,463.00	2.270	0.423
#9	**1**	**Time of Concentration:**					**0.830**
#10	1	5. Nearly bare and untilled, and alluvial valley fans	1.24	41.00	3,317.00	1.110	0.830

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
		8. Large gullies, diversions, and low flowing streams	0.70	29.00	4,125.00	2.510	0.456
#10	**1**	**Time of Concentration:**					**1.286**
#10	2	5. Nearly bare and untilled, and alluvial valley fans	2.25	125.00	5,554.00	1.500	1.028
		8. Large gullies, diversions, and low flowing streams	2.13	85.00	3,997.00	4.370	0.254
#10	**2**	**Time of Concentration:**					**1.282**
#10	3	5. Nearly bare and untilled, and alluvial valley fans	1.39	68.00	4,904.00	1.170	1.164
		8. Large gullies, diversions, and low flowing streams	4.73	90.00	1,904.00	6.520	0.081
#10	**3**	**Time of Concentration:**					**1.245**
#10	4	5. Nearly bare and untilled, and alluvial valley fans	3.76	51.00	1,357.00	1.930	0.195
		8. Large gullies, diversions, and low flowing streams	0.65	22.00	3,385.00	2.410	0.390
#10	**4**	**Time of Concentration:**					**0.585**
#10	5	5. Nearly bare and untilled, and alluvial valley fans	1.63	88.00	5,391.16	1.270	1.179
#10	**5**	**Time of Concentration:**					**1.179**
#12	1	5. Nearly bare and untilled, and alluvial valley fans	4.50	75.00	1,667.00	2.120	0.218
		8. Large gullies, diversions, and low flowing streams	1.85	155.00	8,400.00	4.070	0.573
#12	**1**	**Time of Concentration:**					**0.791**
#12	2	5. Nearly bare and untilled, and alluvial valley fans	2.99	50.00	1,674.03	1.720	0.270
		8. Large gullies, diversions, and low flowing streams	1.67	70.00	4,201.17	3.870	0.301
#12	**2**	**Time of Concentration:**					**0.571**
#12	3	5. Nearly bare and untilled, and alluvial valley fans	4.04	57.00	1,411.00	2.000	0.195
		8. Large gullies, diversions, and low flowing streams	1.55	107.00	6,884.00	3.740	0.511
#12	**3**	**Time of Concentration:**					**0.706**
#12	4	5. Nearly bare and untilled, and alluvial valley fans	2.23	84.00	3,771.04	1.490	0.703
		8. Large gullies, diversions, and low flowing streams	1.62	186.00	11,515.60	3.810	0.839
#12	**4**	**Time of Concentration:**					**1.542**
#12	5	5. Nearly bare and untilled, and alluvial valley fans	3.68	53.00	1,442.00	1.910	0.209
		8. Large gullies, diversions, and low flowing streams	1.95	120.00	6,155.00	4.180	0.409
#12	**5**	**Time of Concentration:**					**0.618**
#13	1	5. Nearly bare and untilled, and alluvial valley fans	4.62	62.00	1,342.00	2.140	0.174
		8. Large gullies, diversions, and low flowing streams	1.91	157.00	8,225.00	4.140	0.551
#13	**1**	**Time of Concentration:**					**0.725**

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#13	2	5. Nearly bare and untilled, and alluvial valley fans	2.91	50.00	1,717.00	1.700	0.280
		8. Large gullies, diversions, and low flowing streams	2.28	183.00	8,039.00	4.520	0.494
#13	**2**	**Time of Concentration:**					**0.774**
#13	3	5. Nearly bare and untilled, and alluvial valley fans	6.18	95.00	1,537.00	2.480	0.172
		8. Large gullies, diversions, and low flowing streams	2.13	135.00	6,347.00	4.370	0.403
#13	**3**	**Time of Concentration:**					**0.575**
#13	4	5. Nearly bare and untilled, and alluvial valley fans	3.17	10.00	315.00	1.780	0.049
		8. Large gullies, diversions, and low flowing streams	2.30	100.00	4,344.00	4.550	0.265
#13	**4**	**Time of Concentration:**					**0.314**
#13	5	5. Nearly bare and untilled, and alluvial valley fans	3.10	70.00	2,255.00	1.760	0.355
		8. Large gullies, diversions, and low flowing streams	1.23	140.00	11,392.00	3.320	0.953
#13	**5**	**Time of Concentration:**					**1.308**
#14	1	5. Nearly bare and untilled, and alluvial valley fans	10.59	63.00	595.00	3.250	0.050
		8. Large gullies, diversions, and low flowing streams	2.60	151.00	5,808.00	4.830	0.334
#14	**1**	**Time of Concentration:**					**0.384**
#14	2	5. Nearly bare and untilled, and alluvial valley fans	7.28	67.00	920.00	2.690	0.095
		8. Large gullies, diversions, and low flowing streams	2.17	123.00	5,670.00	4.410	0.357
#14	**2**	**Time of Concentration:**					**0.452**
#14	3	5. Nearly bare and untilled, and alluvial valley fans	21.46	150.00	699.00	4.630	0.041
		8. Large gullies, diversions, and low flowing streams	3.10	364.00	11,728.00	5.280	0.617
#14	**3**	**Time of Concentration:**					**0.658**
#14	4	5. Nearly bare and untilled, and alluvial valley fans	3.39	35.00	1,032.00	1.840	0.155
		8. Large gullies, diversions, and low flowing streams	2.97	103.00	3,470.00	5.160	0.186
#14	**4**	**Time of Concentration:**					**0.341**
#14	5	5. Nearly bare and untilled, and alluvial valley fans	28.15	125.00	444.00	5.300	0.023
		8. Large gullies, diversions, and low flowing streams	4.18	246.00	5,886.00	6.130	0.266
#14	**5**	**Time of Concentration:**					**0.289**
#14	6	5. Nearly bare and untilled, and alluvial valley fans	3.18	40.00	1,257.00	1.780	0.196
		8. Large gullies, diversions, and low flowing streams	2.29	228.00	9,963.00	4.530	0.610
#14	**6**	**Time of Concentration:**					**0.806**

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#14	7	5. Nearly bare and untilled, and alluvial valley fans	16.72	100.00	598.00	4.080	0.040
		8. Large gullies, diversions, and low flowing streams	2.81	243.00	8,649.00	5.020	0.478
#14	**7**	**Time of Concentration:**					**0.518**
#14	8	5. Nearly bare and untilled, and alluvial valley fans	1.70	47.00	2,765.00	1.300	0.590
		8. Large gullies, diversions, and low flowing streams	2.44	274.00	11,208.00	4.690	0.663
#14	**8**	**Time of Concentration:**					**1.253**
#14	9	5. Nearly bare and untilled, and alluvial valley fans	2.87	105.00	3,657.00	1.690	0.601
		8. Large gullies, diversions, and low flowing streams	2.43	194.00	7,991.00	4.670	0.475
#14	**9**	**Time of Concentration:**					**1.076**
#14	10	5. Nearly bare and untilled, and alluvial valley fans	2.75	80.00	2,907.00	1.650	0.489
		8. Large gullies, diversions, and low flowing streams	2.41	172.00	7,149.00	4.650	0.427
#14	**10**	**Time of Concentration:**					**0.916**
#15	1	5. Nearly bare and untilled, and alluvial valley fans	12.80	54.00	422.00	3.570	0.032
		8. Large gullies, diversions, and low flowing streams	1.68	181.00	10,781.00	3.880	0.771
#15	**1**	**Time of Concentration:**					**0.803**
#15	2	5. Nearly bare and untilled, and alluvial valley fans	44.22	260.00	588.00	6.640	0.024
		8. Large gullies, diversions, and low flowing streams	2.45	254.00	10,354.00	4.690	0.613
#15	**2**	**Time of Concentration:**					**0.637**
#15	3	5. Nearly bare and untilled, and alluvial valley fans	10.04	85.00	847.00	3.160	0.074
		8. Large gullies, diversions, and low flowing streams	2.34	366.00	15,663.00	4.580	0.949
#15	**3**	**Time of Concentration:**					**1.023**
#16	1	5. Nearly bare and untilled, and alluvial valley fans	4.17	15.00	360.00	2.040	0.049
		8. Large gullies, diversions, and low flowing streams	1.42	108.00	7,618.00	3.570	0.592
#16	**1**	**Time of Concentration:**					**0.641**
#16	2	5. Nearly bare and untilled, and alluvial valley fans	8.70	62.00	713.00	2.940	0.067
		8. Large gullies, diversions, and low flowing streams	1.99	144.00	7,241.00	4.230	0.475
#16	**2**	**Time of Concentration:**					**0.542**
#16	3	5. Nearly bare and untilled, and alluvial valley fans	6.88	32.00	465.00	2.620	0.049
		8. Large gullies, diversions, and low flowing streams	2.29	81.00	3,543.00	4.530	0.217
#16	**3**	**Time of Concentration:**					**0.266**

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#17	1	5. Nearly bare and untilled, and alluvial valley fans	9.37	65.00	694.00	3.060	0.062
		8. Large gullies, diversions, and low flowing streams	1.19	56.00	4,712.00	3.270	0.400
#17	**1**	**Time of Concentration:**					**0.462**
#18	1	5. Nearly bare and untilled, and alluvial valley fans	9.00	60.00	667.00	2.990	0.061
		8. Large gullies, diversions, and low flowing streams	0.97	61.00	6,287.00	2.950	0.591
#18	**1**	**Time of Concentration:**					**0.652**
#18	2	5. Nearly bare and untilled, and alluvial valley fans	2.47	33.00	1,336.00	1.570	0.236
		8. Large gullies, diversions, and low flowing streams	2.01	164.00	8,154.00	4.250	0.532
#18	**2**	**Time of Concentration:**					**0.768**
#20	1	5. Nearly bare and untilled, and alluvial valley fans	11.87	45.00	379.00	3.440	0.030
		8. Large gullies, diversions, and low flowing streams	0.75	45.00	5,969.00	2.600	0.637
#20	**1**	**Time of Concentration:**					**0.667**
#20	2	5. Nearly bare and untilled, and alluvial valley fans	5.40	45.00	833.00	2.320	0.099
		8. Large gullies, diversions, and low flowing streams	1.30	98.00	7,547.00	3.410	0.614
#20	**2**	**Time of Concentration:**					**0.713**
#21	1	5. Nearly bare and untilled, and alluvial valley fans	4.09	60.00	1,467.00	2.020	0.201
		8. Large gullies, diversions, and low flowing streams	0.93	60.00	6,433.00	2.890	0.618
#21	**1**	**Time of Concentration:**					**0.819**
#21	2	5. Nearly bare and untilled, and alluvial valley fans	3.50	50.00	1,430.00	1.860	0.213
		8. Large gullies, diversions, and low flowing streams	2.15	60.00	2,785.00	4.400	0.175
#21	**2**	**Time of Concentration:**					**0.388**
#21	3	5. Nearly bare and untilled, and alluvial valley fans	1.70	15.00	881.00	1.300	0.188
		9. Small streams flowing bankfull	1.49	60.00	4,014.00	11.000	0.101
#21	**3**	**Time of Concentration:**					**0.289**
#21	4	5. Nearly bare and untilled, and alluvial valley fans	2.21	40.00	1,811.02	1.480	0.339
		8. Large gullies, diversions, and low flowing streams	0.84	50.00	5,949.54	2.750	0.600
#21	**4**	**Time of Concentration:**					**0.939**
#23	1	5. Nearly bare and untilled, and alluvial valley fans	2.44	65.00	2,660.01	1.560	0.473
		8. Large gullies, diversions, and low flowing streams	0.33	10.00	3,017.50	1.720	0.487
#23	**1**	**Time of Concentration:**					**0.960**
#23	2	5. Nearly bare and untilled, and alluvial valley fans	3.49	60.00	1,718.01	1.860	0.256

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
		8. Large gullies, diversions, and low flowing streams	1.66	65.00	3,926.06	3.860	0.282
#23	**2**	**Time of Concentration:**					**0.538**
#24	1	5. Nearly bare and untilled, and alluvial valley fans	1.71	430.00	25,118.00	1.300	5.367
#24	**1**	**Time of Concentration:**					**5.367**
#24	2	5. Nearly bare and untilled, and alluvial valley fans	1.84	430.00	23,393.00	1.350	4.813
#24	**2**	**Time of Concentration:**					**4.813**
#24	3	5. Nearly bare and untilled, and alluvial valley fans	1.82	155.00	8,498.00	1.350	1.748
		8. Large gullies, diversions, and low flowing streams	0.84	40.00	4,771.00	2.740	0.483
#24	**3**	**Time of Concentration:**					**2.231**
#24	4	5. Nearly bare and untilled, and alluvial valley fans	1.24	50.00	4,042.00	1.110	1.011
		8. Large gullies, diversions, and low flowing streams	0.49	60.00	12,150.00	2.100	1.607
#24	**4**	**Time of Concentration:**					**2.618**
#25	1	5. Nearly bare and untilled, and alluvial valley fans	0.51	10.00	1,950.00	0.710	0.762
		8. Large gullies, diversions, and low flowing streams	1.81	60.00	3,322.00	4.030	0.228
#25	**1**	**Time of Concentration:**					**0.990**
#25	2	5. Nearly bare and untilled, and alluvial valley fans	1.11	25.00	2,254.00	1.050	0.596
		8. Large gullies, diversions, and low flowing streams	2.36	75.00	3,178.00	4.600	0.191
#25	**2**	**Time of Concentration:**					**0.787**
#25	3	5. Nearly bare and untilled, and alluvial valley fans	3.23	30.00	929.00	1.790	0.144
		8. Large gullies, diversions, and low flowing streams	2.45	154.00	6,297.00	4.690	0.372
#25	**3**	**Time of Concentration:**					**0.516**
#26	1	5. Nearly bare and untilled, and alluvial valley fans	1.20	103.00	8,602.00	1.090	2.192
#26	**1**	**Time of Concentration:**					**2.192**
#26	2	5. Nearly bare and untilled, and alluvial valley fans	1.23	120.00	9,780.00	1.100	2.469
		8. Large gullies, diversions, and low flowing streams	2.18	184.00	8,454.00	4.420	0.531
#26	**2**	**Time of Concentration:**					**3.000**
#27	1	5. Nearly bare and untilled, and alluvial valley fans	4.32	50.00	1,158.02	2.070	0.155
		8. Large gullies, diversions, and low flowing streams	2.53	198.00	7,838.16	4.760	0.457
#27	**1**	**Time of Concentration:**					**0.612**
#27	2	5. Nearly bare and untilled, and alluvial valley fans	5.26	30.00	570.00	2.290	0.069
		8. Large gullies, diversions, and low flowing streams	3.15	278.00	8,822.00	5.320	0.460

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#27	**2**	**Time of Concentration:**					**0.529**
#27	3	5. Nearly bare and untilled, and alluvial valley fans	16.33	80.00	490.00	4.040	0.033
		8. Large gullies, diversions, and low flowing streams	2.15	225.00	10,443.00	4.400	0.659
#27	**3**	**Time of Concentration:**					**0.692**
#27	4	5. Nearly bare and untilled, and alluvial valley fans	12.43	65.00	523.00	3.520	0.041
		8. Large gullies, diversions, and low flowing streams	3.49	225.00	6,454.00	5.600	0.320
#27	**4**	**Time of Concentration:**					**0.361**
#27	5	5. Nearly bare and untilled, and alluvial valley fans	9.40	25.00	266.00	3.060	0.024
		8. Large gullies, diversions, and low flowing streams	2.32	364.00	15,700.00	4.560	0.956
#27	**5**	**Time of Concentration:**					**0.980**
#28	1	5. Nearly bare and untilled, and alluvial valley fans	5.25	40.00	762.00	2.290	0.092
		8. Large gullies, diversions, and low flowing streams	2.96	310.00	10,479.34	5.150	0.565
#28	**1**	**Time of Concentration:**					**0.657**
#28	2	5. Nearly bare and untilled, and alluvial valley fans	25.86	105.00	406.00	5.080	0.022
		8. Large gullies, diversions, and low flowing streams	2.96	310.00	10,479.34	5.150	0.565
#28	**2**	**Time of Concentration:**					**0.587**
#29	1	5. Nearly bare and untilled, and alluvial valley fans	11.58	30.00	259.00	3.400	0.021
		8. Large gullies, diversions, and low flowing streams	3.61	288.00	7,976.00	5.700	0.388
#29	**1**	**Time of Concentration:**					**0.409**
#29	2	5. Nearly bare and untilled, and alluvial valley fans	8.06	40.00	496.00	2.830	0.048
		8. Large gullies, diversions, and low flowing streams	2.90	252.00	8,693.55	5.100	0.473
#29	**2**	**Time of Concentration:**					**0.521**
#29	3	5. Nearly bare and untilled, and alluvial valley fans	7.25	25.00	345.00	2.690	0.035
		8. Large gullies, diversions, and low flowing streams	2.26	158.00	7,001.00	4.500	0.432
#29	**3**	**Time of Concentration:**					**0.467**
#30	1	5. Nearly bare and untilled, and alluvial valley fans	4.93	35.00	710.00	2.220	0.088
		8. Large gullies, diversions, and low flowing streams	1.67	243.00	14,540.00	3.870	1.043
#30	**1**	**Time of Concentration:**					**1.131**
#31	1	5. Nearly bare and untilled, and alluvial valley fans	2.91	15.00	515.00	1.700	0.084
		8. Large gullies, diversions, and low flowing streams	2.74	247.00	9,006.00	4.960	0.504
#31	**1**	**Time of Concentration:**					**0.588**

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#31	2	5. Nearly bare and untilled, and alluvial valley fans	7.46	25.00	335.00	2.730	0.034
		8. Large gullies, diversions, and low flowing streams	2.18	138.00	6,335.00	4.420	0.398
#31	**2**	**Time of Concentration:**					**0.432**
#31	3	5. Nearly bare and untilled, and alluvial valley fans	3.84	20.00	521.00	1.950	0.074
		8. Large gullies, diversions, and low flowing streams	2.24	108.00	4,826.00	4.480	0.299
#31	**3**	**Time of Concentration:**					**0.373**
#32	1	5. Nearly bare and untilled, and alluvial valley fans	3.48	22.00	632.00	1.860	0.094
		8. Large gullies, diversions, and low flowing streams	1.56	101.00	6,494.00	3.740	0.482
#32	**1**	**Time of Concentration:**					**0.576**
#34	1	5. Nearly bare and untilled, and alluvial valley fans	3.21	25.00	779.00	1.790	0.120
		8. Large gullies, diversions, and low flowing streams	2.80	63.00	2,251.00	5.010	0.124
#34	**1**	**Time of Concentration:**					**0.244**
#34	2	5. Nearly bare and untilled, and alluvial valley fans	5.75	40.00	696.00	2.390	0.080
		8. Large gullies, diversions, and low flowing streams	23.00	2,100.00	9,130.43	14.380	0.176
#34	**2**	**Time of Concentration:**					**0.256**
#34	3	5. Nearly bare and untilled, and alluvial valley fans	2.67	40.00	1,500.00	1.630	0.255
		8. Large gullies, diversions, and low flowing streams	1.28	98.00	7,675.00	3.380	0.630
#34	**3**	**Time of Concentration:**					**0.885**
#36	1	5. Nearly bare and untilled, and alluvial valley fans	3.21	105.00	3,274.00	1.790	0.508
		8. Large gullies, diversions, and low flowing streams	0.21	5.00	2,367.00	1.370	0.479
#36	**1**	**Time of Concentration:**					**0.987**
#36	2	5. Nearly bare and untilled, and alluvial valley fans	5.50	140.00	2,547.00	2.340	0.302
		8. Large gullies, diversions, and low flowing streams	1.58	30.00	1,897.00	3.770	0.139
#36	**2**	**Time of Concentration:**					**0.441**
#36	3	5. Nearly bare and untilled, and alluvial valley fans	2.03	80.00	3,938.62	1.420	0.770
		8. Large gullies, diversions, and low flowing streams	2.52	50.00	1,981.86	4.760	0.115
#36	**3**	**Time of Concentration:**					**0.885**
#37	1	5. Nearly bare and untilled, and alluvial valley fans	4.68	129.00	2,754.05	2.160	0.354
		8. Large gullies, diversions, and low flowing streams	0.16	10.00	6,108.73	1.210	1.402
#37	**1**	**Time of Concentration:**					**1.756**

Copyright 1998 -2007 Pamela J. Schwab

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#37	2	5. Nearly bare and untilled, and alluvial valley fans	7.32	90.00	1,229.00	2.700	0.126
		8. Large gullies, diversions, and low flowing streams	1.62	70.00	4,309.01	3.820	0.313
#37	**2**	**Time of Concentration:**					**0.439**
#37	3	5. Nearly bare and untilled, and alluvial valley fans	8.10	100.00	1,234.00	2.840	0.120
		8. Large gullies, diversions, and low flowing streams	2.66	100.00	3,763.21	4.890	0.213
#37	**3**	**Time of Concentration:**					**0.333**
#37	4	5. Nearly bare and untilled, and alluvial valley fans	5.09	90.00	1,768.03	2.250	0.218
		8. Large gullies, diversions, and low flowing streams	0.36	30.00	8,326.39	1.800	1.284
#37	**4**	**Time of Concentration:**					**1.502**
#37	5	5. Nearly bare and untilled, and alluvial valley fans	0.81	20.00	2,466.09	0.900	0.761
		8. Large gullies, diversions, and low flowing streams	4.06	50.00	1,231.01	6.040	0.056
#37	**5**	**Time of Concentration:**					**0.817**

Subwatershed Muskingum Routing Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	2	8. Large gullies, diversions, and low flowing streams	1.29	107.00	8,294.00	3.400	0.677
#1	**2**	**Muskingum K:**					**0.677**
#1	3	8. Large gullies, diversions, and low flowing streams	1.27	113.00	8,880.00	3.380	0.729
#1	**3**	**Muskingum K:**					**0.729**
#1	4	8. Large gullies, diversions, and low flowing streams	1.35	171.00	12,634.00	3.490	1.005
#1	**4**	**Muskingum K:**					**1.005**
#1	5	8. Large gullies, diversions, and low flowing streams	1.49	274.00	18,349.00	3.660	1.392
#1	**5**	**Muskingum K:**					**1.392**
#1	6	8. Large gullies, diversions, and low flowing streams	1.49	274.00	18,349.00	3.660	1.392
#1	**6**	**Muskingum K:**					**1.392**
#2	2	8. Large gullies, diversions, and low flowing streams	0.53	20.00	3,756.00	2.180	0.478
#2	**2**	**Muskingum K:**					**0.478**
#2	3	8. Large gullies, diversions, and low flowing streams	0.55	25.00	4,570.00	2.210	0.574
#2	**3**	**Muskingum K:**					**0.574**
#2	4	8. Large gullies, diversions, and low flowing streams	0.55	25.00	4,570.00	2.210	0.574
#2	**4**	**Muskingum K:**					**0.574**

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#2	5	8. Large gullies, diversions, and low flowing streams	0.65	45.00	6,955.00	2.410	0.801
#2	**5**	**Muskingum K:**					**0.801**
#3	3	8. Large gullies, diversions, and low flowing streams	0.92	20.00	2,168.00	2.880	0.209
#3	**3**	**Muskingum K:**					**0.209**
#5	1	8. Large gullies, diversions, and low flowing streams	0.00	0.00	0.00	0.000	0.000
#5	**1**	**Muskingum K:**					**0.000**
#5	2	8. Large gullies, diversions, and low flowing streams	1.75	125.00	7,149.00	3.960	0.501
#5	**2**	**Muskingum K:**					**0.501**
#5	3	8. Large gullies, diversions, and low flowing streams	1.65	155.00	9,418.00	3.840	0.681
#5	**3**	**Muskingum K:**					**0.681**
#5	4	8. Large gullies, diversions, and low flowing streams	1.65	155.00	9,418.00	3.840	0.681
#5	**4**	**Muskingum K:**					**0.681**
#5	5	8. Large gullies, diversions, and low flowing streams	1.67	239.00	14,273.00	3.880	1.021
#5	**5**	**Muskingum K:**					**1.021**
#5	6	8. Large gullies, diversions, and low flowing streams	1.68	239.00	14,223.00	3.880	1.018
#5	**6**	**Muskingum K:**					**1.018**
#6	2	8. Large gullies, diversions, and low flowing streams	1.16	26.00	2,241.00	3.230	0.192
#6	**2**	**Muskingum K:**					**0.192**
#6	3	8. Large gullies, diversions, and low flowing streams	1.00	50.00	4,987.00	3.000	0.461
#6	**3**	**Muskingum K:**					**0.461**
#6	4	5. Nearly bare and untilled, and alluvial valley fans	1.00	50.00	4,987.00	1.000	1.385
#6	**4**	**Muskingum K:**					**1.385**
#6	5	8. Large gullies, diversions, and low flowing streams	1.02	89.00	8,685.00	3.030	0.796
#6	**5**	**Muskingum K:**					**0.796**
#6	6	8. Large gullies, diversions, and low flowing streams	1.06	126.00	11,860.00	3.090	1.066
#6	**6**	**Muskingum K:**					**1.066**
#6	7	8. Large gullies, diversions, and low flowing streams	1.06	126.00	11,860.00	3.090	1.066
#6	**7**	**Muskingum K:**					**1.066**
#7	1	8. Large gullies, diversions, and low flowing streams	0.00	0.00	0.00	0.000	0.000
#7	**1**	**Muskingum K:**					**0.000**
#7	2	8. Large gullies, diversions, and low flowing streams	0.00	0.00	0.00	0.000	0.000
#7	**2**	**Muskingum K:**					**0.000**
#7	4	8. Large gullies, diversions, and low flowing streams	1.16	140.00	12,037.00	3.230	1.035

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#7	**4**	**Muskingum K:**					**1.035**
#7	5	8. Large gullies, diversions, and low flowing streams	1.14	140.00	12,307.69	3.190	1.071
#7	**5**	**Muskingum K:**					**1.071**
#7	6	8. Large gullies, diversions, and low flowing streams	1.17	158.00	13,546.00	3.230	1.164
#7	**6**	**Muskingum K:**					**1.164**
#7	7	8. Large gullies, diversions, and low flowing streams	1.18	187.00	15,784.00	3.260	1.344
#7	**7**	**Muskingum K:**					**1.344**
#7	8	8. Large gullies, diversions, and low flowing streams	1.18	187.00	15,784.00	3.260	1.344
#7	**8**	**Muskingum K:**					**1.344**
#10	3	8. Large gullies, diversions, and low flowing streams	0.76	37.00	4,861.00	2.610	0.517
#10	**3**	**Muskingum K:**					**0.517**
#10	4	8. Large gullies, diversions, and low flowing streams	0.76	37.00	4,861.00	2.610	0.517
#10	**4**	**Muskingum K:**					**0.517**
#10	5	8. Large gullies, diversions, and low flowing streams	0.79	47.00	5,956.00	2.660	0.621
#10	**5**	**Muskingum K:**					**0.621**
#12	2	8. Large gullies, diversions, and low flowing streams	8.24	111.00	1,347.00	8.610	0.043
#12	**2**	**Muskingum K:**					**0.043**
#12	3	8. Large gullies, diversions, and low flowing streams	8.01	109.00	1,360.00	8.490	0.044
#12	**3**	**Muskingum K:**					**0.044**
#12	4	8. Large gullies, diversions, and low flowing streams	2.24	176.00	7,866.00	4.480	0.487
#12	**4**	**Muskingum K:**					**0.487**
#12	5	8. Large gullies, diversions, and low flowing streams	2.24	176.00	7,866.00	4.480	0.487
#12	**5**	**Muskingum K:**					**0.487**
#13	2	8. Large gullies, diversions, and low flowing streams	1.34	54.00	4,025.00	3.470	0.322
#13	**2**	**Muskingum K:**					**0.322**
#13	3	8. Large gullies, diversions, and low flowing streams	0.98	72.00	7,333.00	2.970	0.685
#13	**3**	**Muskingum K:**					**0.685**
#13	4	8. Large gullies, diversions, and low flowing streams	1.18	127.00	10,806.00	3.250	0.923
#13	**4**	**Muskingum K:**					**0.923**
#13	5	8. Large gullies, diversions, and low flowing streams	1.18	127.00	10,806.00	3.250	0.923
#13	**5**	**Muskingum K:**					**0.923**
#14	1	8. Large gullies, diversions, and low flowing streams	0.00	0.00	0.00	0.000	0.000
#14	**1**	**Muskingum K:**					**0.000**

Copyright 1998 -2007 Pamela J. Schwab

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#14	2	8. Large gullies, diversions, and low flowing streams	0.83	58.00	6,957.00	2.730	0.707
#14	**2**	**Muskingum K:**					**0.707**
#14	3	8. Large gullies, diversions, and low flowing streams	0.81	77.00	9,480.00	2.700	0.975
#14	**3**	**Muskingum K:**					**0.975**
#14	4	8. Large gullies, diversions, and low flowing streams	0.86	147.00	17,117.00	2.770	1.716
#14	**4**	**Muskingum K:**					**1.716**
#14	5	8. Large gullies, diversions, and low flowing streams	0.88	175.00	19,934.00	2.810	1.970
#14	**5**	**Muskingum K:**					**1.970**
#14	6	8. Large gullies, diversions, and low flowing streams	0.95	211.00	22,155.00	2.920	2.107
#14	**6**	**Muskingum K:**					**2.107**
#14	7	8. Large gullies, diversions, and low flowing streams	0.96	257.00	26,835.00	2.930	2.544
#14	**7**	**Muskingum K:**					**2.544**
#14	8	8. Large gullies, diversions, and low flowing streams	0.96	257.00	26,835.00	2.930	2.544
#14	**8**	**Muskingum K:**					**2.544**
#14	9	8. Large gullies, diversions, and low flowing streams	0.95	307.00	32,146.59	2.930	3.047
#14	**9**	**Muskingum K:**					**3.047**
#14	10	8. Large gullies, diversions, and low flowing streams	0.96	339.00	35,382.00	2.930	3.354
#14	**10**	**Muskingum K:**					**3.354**
#15	1	8. Large gullies, diversions, and low flowing streams	0.00	0.00	0.00	0.000	0.000
#15	**1**	**Muskingum K:**					**0.000**
#15	2	8. Large gullies, diversions, and low flowing streams	1.14	86.00	7,535.00	3.200	0.654
#15	**2**	**Muskingum K:**					**0.654**
#15	3	8. Large gullies, diversions, and low flowing streams	1.25	115.00	9,236.00	3.340	0.768
#15	**3**	**Muskingum K:**					**0.768**
#16	2	8. Large gullies, diversions, and low flowing streams	0.58	24.00	4,161.00	2.270	0.509
#16	**2**	**Muskingum K:**					**0.509**
#16	3	8. Large gullies, diversions, and low flowing streams	0.51	37.00	7,269.00	2.140	0.943
#16	**3**	**Muskingum K:**					**0.943**
#17	1	8. Large gullies, diversions, and low flowing streams	0.00	0.00	0.00	0.000	0.000
#17	**1**	**Muskingum K:**					**0.000**
#18	1	8. Large gullies, diversions, and low flowing streams	0.00	0.00	0.00	0.000	0.000
#18	**1**	**Muskingum K:**					**0.000**
#18	2	8. Large gullies, diversions, and low flowing streams	1.02	62.00	6,103.00	3.020	0.561

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#18	**2**	**Muskingum K:**					**0.561**
#20	2	8. Large gullies, diversions, and low flowing streams	17.00	3,605.00	21,205.88	12.360	0.476
#20	**2**	**Muskingum K:**					**0.476**
#21	1	8. Large gullies, diversions, and low flowing streams	0.00	0.00	0.00	0.000	0.000
#21	**1**	**Muskingum K:**					**0.000**
#21	2	8. Large gullies, diversions, and low flowing streams	0.41	20.00	4,824.00	1.930	0.694
#21	**2**	**Muskingum K:**					**0.694**
#21	3	8. Large gullies, diversions, and low flowing streams	0.36	20.00	5,626.00	1.780	0.877
#21	**3**	**Muskingum K:**					**0.877**
#21	4	8. Large gullies, diversions, and low flowing streams	0.36	20.00	5,626.00	1.780	0.877
#21	**4**	**Muskingum K:**					**0.877**
#23	1	8. Large gullies, diversions, and low flowing streams	0.00	0.00	0.00	0.000	0.000
#23	**1**	**Muskingum K:**					**0.000**
#23	2	8. Large gullies, diversions, and low flowing streams	0.63	30.00	4,771.75	2.370	0.559
#23	**2**	**Muskingum K:**					**0.559**
#24	1	8. Large gullies, diversions, and low flowing streams	0.79	180.00	22,769.00	2.660	2.377
#24	**1**	**Muskingum K:**					**2.377**
#24	2	8. Large gullies, diversions, and low flowing streams	0.78	180.00	23,111.00	2.640	2.431
#24	**2**	**Muskingum K:**					**2.431**
#24	4	8. Large gullies, diversions, and low flowing streams	0.00	0.00	0.00	0.000	0.000
#24	**4**	**Muskingum K:**					**0.000**
#25	1	8. Large gullies, diversions, and low flowing streams	1.99	104.00	5,220.00	4.230	0.342
#25	**1**	**Muskingum K:**					**0.342**
#25	2	8. Large gullies, diversions, and low flowing streams	1.99	104.00	5,220.00	4.230	0.342
#25	**2**	**Muskingum K:**					**0.342**
#25	3	8. Large gullies, diversions, and low flowing streams	0.00	0.00	0.00	0.000	0.000
#25	**3**	**Muskingum K:**					**0.000**
#27	1	8. Large gullies, diversions, and low flowing streams	1.38	216.00	15,629.00	3.520	1.233
#27	**1**	**Muskingum K:**					**1.233**
#27	2	8. Large gullies, diversions, and low flowing streams	1.17	144.00	12,301.00	3.240	1.054
#27	**2**	**Muskingum K:**					**1.054**
#27	3	8. Large gullies, diversions, and low flowing streams	1.18	76.00	6,454.00	3.250	0.551
#27	**3**	**Muskingum K:**					**0.551**

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#27	4	8. Large gullies, diversions, and low flowing streams	1.18	76.00	6,454.00	3.250	0.551
#27	**4**	**Muskingum K:**					**0.551**
#28	1	8. Large gullies, diversions, and low flowing streams	1.30	84.00	6,445.17	3.420	0.523
#28	**1**	**Muskingum K:**					**0.523**
#29	1	8. Large gullies, diversions, and low flowing streams	0.88	37.00	4,210.00	2.810	0.416
#29	**1**	**Muskingum K:**					**0.416**
#29	2	8. Large gullies, diversions, and low flowing streams	0.88	26.00	2,949.00	2.810	0.291
#29	**2**	**Muskingum K:**					**0.291**
#31	1	8. Large gullies, diversions, and low flowing streams	1.35	76.00	5,639.00	3.480	0.450
#31	**1**	**Muskingum K:**					**0.450**
#31	2	8. Large gullies, diversions, and low flowing streams	1.15	20.00	1,734.00	3.220	0.149
#31	**2**	**Muskingum K:**					**0.149**
#34	1	8. Large gullies, diversions, and low flowing streams	0.73	65.00	8,900.00	2.560	0.965
#34	**1**	**Muskingum K:**					**0.965**
#34	2	8. Large gullies, diversions, and low flowing streams	0.73	65.00	8,900.00	2.560	0.965
#34	**2**	**Muskingum K:**					**0.965**
#36	3	8. Large gullies, diversions, and low flowing streams	2.71	80.00	2,957.00	4.930	0.166
#36	**3**	**Muskingum K:**					**0.166**
#37	2	8. Large gullies, diversions, and low flowing streams	0.29	30.00	10,319.91	1.610	1.780
#37	**2**	**Muskingum K:**					**1.780**
#37	3	8. Large gullies, diversions, and low flowing streams	0.31	30.00	9,800.71	1.650	1.649
#37	**3**	**Muskingum K:**					**1.649**
#37	4	8. Large gullies, diversions, and low flowing streams	0.29	30.00	10,319.91	1.610	1.780
#37	**4**	**Muskingum K:**					**1.780**
#37	5	8. Large gullies, diversions, and low flowing streams	0.56	100.00	17,956.54	2.230	2.236
#37	**5**	**Muskingum K:**					**2.236**

Attachment 18.B-5

Chaco River Unnamed Tributary Baseline Hydrology and Sedimentology SEDCAD™ Model Output

Copyright 1998 -2007 Pamela J. Schwab

UNNAMED TRIBUTARY TO CHACO PRE-MINE HYDROLOGY AND SEDIMENTOLOGY

PRE-MINE

BHP Billiton

Copyright 1998 -2007 Pamela J. Schwab

General Information

Storm Information:

Storm Type:	Type II-70
Design Storm:	2 yr - 6 hr
Rainfall Depth:	0.850 inches

Particle Size Distribution:

Size (mm)	CW1	CW2	CW3	CW4	CW5
0.4250	100.000%	100.000%	100.000%	100.000%	100.000%
0.2500	71.002%	79.759%	73.724%	79.290%	83.334%
0.1500	52.517%	62.156%	54.007%	60.839%	68.417%
0.0750	40.991%	48.658%	41.754%	47.304%	53.993%
0.0159	36.096%	42.458%	36.968%	41.409%	46.327%
0.0100	29.101%	34.107%	30.394%	33.504%	35.855%
0.0050	10.110%	8.789%	9.084%	8.485%	9.027%
0.0020	5.803%	5.220%	5.060%	4.944%	5.817%
0.0010	5.384%	4.878%	4.663%	4.594%	5.499%
0.0004	4.868%	4.198%	4.196%	3.982%	4.619%

Copyright 1998 -2007 Pamela J. Schwab

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Null	#1	==>	End	0.000	0.000	Unnamed Tributary to Chaco CHA S1 SW1

#1
Null

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc. (ml/l)	24VW (ml/l)
#1	287.200	287.200	49.89	2.27	157.5	77,436	31.75	20.44

Copyright 1998 -2007 Pamela J. Schwab

Particle Size Distribution(s) at Each Structure

Structure #1:

Size (mm)	In/Out
0.4250	100.000%
0.2500	100.000%
0.1500	90.136%
0.0750	69.686%
0.0159	61.698%
0.0100	50.726%
0.0050	15.161%
0.0020	8.445%
0.0010	7.782%
0.0004	7.003%

Copyright 1998 -2007 Pamela J. Schwab

Structure Detail:

Structure #1 (Null)

Unnamed Tributary to Chaco CHA S1 SW1

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#1	1	287.200	0.270	0.000	0.000	85.500	M	49.89	2.267
	Σ	**287.200**						**49.89**	**2.267**

Subwatershed Sedimentology Detail:

Stru #	SWS #	Soil K	L (ft)	S (%)	C	P	PS #	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc (ml/l)	24VW (ml/l)
#1	1	0.151	1,000.00	7.30	0.2450	1.0000	3	157.5	77,436	31.75	20.44
	Σ							**157.5**	**77,436**	**31.75**	**20.44**

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	5. Nearly bare and untilled, and alluvial valley fans	4.80	80.64	1,680.00	2.190	0.213
		8. Large gullies, diversions, and low flowing streams	7.30	122.64	1,680.00	8.100	0.057
#1	**1**	**Time of Concentration:**					**0.270**

Copyright 1998 -2007 Pamela J. Schwab

UNNAMED TRIBUTARY TO CHACO PRE-MINE HYDROLOGY AND SEDIMENTOLOGY

PRE-MINE -10-yr, 6-hr Storm

BHP Billiton

Copyright 1998 -2007 Pamela J. Schwab

General Information

Storm Information:

Storm Type:	Type II-70
Design Storm:	10 yr - 6 hr
Rainfall Depth:	1.280 inches

Particle Size Distribution:

Size (mm)	CW1	CW2	CW3	CW4	CW5
0.4250	100.000%	100.000%	100.000%	100.000%	100.000%
0.2500	71.002%	79.759%	73.724%	79.290%	83.334%
0.1500	52.517%	62.156%	54.007%	60.839%	68.417%
0.0750	40.991%	48.658%	41.754%	47.304%	53.993%
0.0159	36.096%	42.458%	36.968%	41.409%	46.327%
0.0100	29.101%	34.107%	30.394%	33.504%	35.855%
0.0050	10.110%	8.789%	9.084%	8.485%	9.027%
0.0020	5.803%	5.220%	5.060%	4.944%	5.817%
0.0010	5.384%	4.878%	4.663%	4.594%	5.499%
0.0004	4.868%	4.198%	4.196%	3.982%	4.619%

Copyright 1998 -2007 Pamela J. Schwab

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc. (ml/l)	24VW (ml/l)
#1	287.200	287.200	136.65	6.43	496.7	81,953	36.29	24.48

Copyright 1998 -2007 Pamela J. Schwab

Particle Size Distribution(s) at Each Structure

Structure #1:

Size (mm)	In/Out
0.4250	100.000%
0.2500	100.000%
0.1500	82.463%
0.0750	63.754%
0.0159	56.446%
0.0100	46.409%
0.0050	13.870%
0.0020	7.726%
0.0010	7.120%
0.0004	6.407%

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#1	1	287.200	0.270	0.000	0.000	85.500	M	136.65	6.435
	Σ	**287.200**						**136.65**	**6.435**

Subwatershed Sedimentology Detail:

Stru #	SWS #	Soil K	L (ft)	S (%)	C	P	PS #	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc (ml/l)	24VW (ml/l)
#1	1	0.151	1,000.00	7.30	0.2450	1.0000	3	496.7	81,953	36.29	24.48
	Σ							**496.7**	**81,953**	**36.29**	**24.48**

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	5. Nearly bare and untilled, and alluvial valley fans	4.80	80.64	1,680.00	2.190	0.213
		8. Large gullies, diversions, and low flowing streams	7.30	122.64	1,680.00	8.100	0.057
#1	**1**	**Time of Concentration:**					**0.270**

Copyright 1998 -2007 Pamela J. Schwab

UNNAMED TRIBUTARY TO CHACO PRE-MINE HYDROLOGY AND SEDIMENTOLOGY

PRE-MINE 25-yr, 6-hour PRECIPITATION

BHP Billiton

General Information

Storm Information:

Storm Type:	Type II-70
Design Storm:	25 yr - 6 hr
Rainfall Depth:	1.560 inches

Particle Size Distribution:

Size (mm)	CW1	CW2	CW3	CW4	CW5
0.4250	100.000%	100.000%	100.000%	100.000%	100.000%
0.2500	71.002%	79.759%	73.724%	79.290%	83.334%
0.1500	52.517%	62.156%	54.007%	60.839%	68.417%
0.0750	40.991%	48.658%	41.754%	47.304%	53.993%
0.0159	36.096%	42.458%	36.968%	41.409%	46.327%
0.0100	29.101%	34.107%	30.394%	33.504%	35.855%
0.0050	10.110%	8.789%	9.084%	8.485%	9.027%
0.0020	5.803%	5.220%	5.060%	4.944%	5.817%
0.0010	5.384%	4.878%	4.663%	4.594%	5.499%
0.0004	4.868%	4.198%	4.196%	3.982%	4.619%

Copyright 1998 -2007 Pamela J. Schwab

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc. (ml/l)	24VW (ml/l)
#1	287.200	287.200	204.62	9.79	787.9	84,130	38.23	26.15

Copyright 1998 -2007 Pamela J. Schwab

Particle Size Distribution(s) at Each Structure

Structure #1:

Size (mm)	In/Out
0.4250	100.000%
0.2500	100.000%
0.1500	79.764%
0.0750	61.668%
0.0159	54.599%
0.0100	44.890%
0.0050	13.416%
0.0020	7.473%
0.0010	6.887%
0.0004	6.197%

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#1	1	287.200	0.270	0.000	0.000	85.500	M	204.62	9.794
	Σ	**287.200**						**204.62**	**9.794**

Subwatershed Sedimentology Detail:

Stru #	SWS #	Soil K	L (ft)	S (%)	C	P	PS #	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc (ml/l)	24VW (ml/l)
#1	1	0.151	1,000.00	7.30	0.2450	1.0000	3	787.9	84,130	38.23	26.15
	Σ							**787.9**	**84,130**	**38.23**	**26.15**

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	5. Nearly bare and untilled, and alluvial valley fans	4.80	80.64	1,680.00	2.190	0.213
		8. Large gullies, diversions, and low flowing streams	7.30	122.64	1,680.00	8.100	0.057
#1	**1**	**Time of Concentration:**					**0.270**

Copyright 1998 -2010 Pamela J. Schwab

UNNAMED TRIBUTARY TO CHACO PRE-MINE HYDROLOGY AND SEDIMENTOLOGY

PRE-MINE 100-yr, 6-hour PRECIPITATION

BHP Billiton

General Information

Storm Information:

Storm Type:	Type II-70
Design Storm:	100 yr - 6 hr
Rainfall Depth:	2.040 inches

Particle Size Distribution:

Size (mm)	CW1	CW2	CW3	CW4	CW5
0.4250	100.000%	100.000%	100.000%	100.000%	100.000%
0.2500	71.002%	79.759%	73.724%	79.290%	83.334%
0.1500	52.517%	62.156%	54.007%	60.839%	68.417%
0.0750	40.991%	48.658%	41.754%	47.304%	53.993%
0.0159	36.096%	42.458%	36.968%	41.409%	46.327%
0.0100	29.101%	34.107%	30.394%	33.504%	35.855%
0.0050	10.110%	8.789%	9.084%	8.485%	9.027%
0.0020	5.803%	5.220%	5.060%	4.944%	5.817%
0.0010	5.384%	4.878%	4.663%	4.594%	5.499%
0.0004	4.868%	4.198%	4.196%	3.982%	4.619%

Copyright 1998 -2010 Pamela J. Schwab

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc. (ml/l)	24VW (ml/l)
#1	287.200	287.200	334.11	16.32	1,380.2	86,982	40.63	28.22

Copyright 1998 -2010 Pamela J. Schwab

Particle Size Distribution(s) at Each Structure

Structure #1:

Size (mm)	In/Out
0.4250	100.000%
0.2500	100.000%
0.1500	76.713%
0.0750	59.308%
0.0159	52.510%
0.0100	43.172%
0.0050	12.903%
0.0020	7.187%
0.0010	6.623%
0.0004	5.960%

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#1	1	287.200	0.270	0.000	0.000	85.500	M	334.11	16.324
	Σ	**287.200**						**334.11**	**16.324**

Subwatershed Sedimentology Detail:

Stru #	SWS #	Soil K	L (ft)	S (%)	C	P	PS #	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc (ml/l)	24VW (ml/l)
#1	1	0.151	1,000.00	7.30	0.2450	1.0000	3	1,380.2	86,982	40.63	28.22
	Σ							**1,380.2**	**86,982**	**40.63**	**28.22**

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	5. Nearly bare and untilled, and alluvial valley fans	4.80	80.64	1,680.00	2.190	0.213
		8. Large gullies, diversions, and low flowing streams	7.30	122.64	1,680.00	8.100	0.057
#1	**1**	**Time of Concentration:**					**0.270**

Attachment 18.B-6

Eroded and Parent Soil Particle Size Distribution Analysis February 2008 (edited March 2012)

ERODED AND PARENT SOIL PARTICLE SIZE DISTRIBUTION ANALYSIS

BHP NAVAJO COAL COMPANY

FEBRUARY 2008

PREPARED FOR:

BHP Navajo Coal Company

PREPARED BY:

UNIVERSITY OF KENTUCKY
BIOSYSTEMS AND AGRICULTURAL ENGINEERING DEPARTMENT
LEXINGTON, KENTUCKY 40546-0276

EDITED BY:

BHP Navajo Coal Company
(March 2012 *for formatting*)

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

1. INTRODUCTION

The Parent Soil and Eroded Particle Size Distribution (EPSD) analysis conducted on four different composite sediment samples from the BHP Billiton Navajo Extension Project area was complete and the results are presented herein. The analysis was completed using the composite samples that were forwarded to the University of Kentucky.

The report contains analysis for:

1. Eroded particle size analysis (rainfall simulator, wet sieve and particle size analyzer) based on 3 replicates per sediment sample.
2. Standard soil particle analysis (Mechanical sieving washing material finer than 0.106 mm. Disperse particles finer than 0.075 mm then use particle size analyzer) based on three replicates per sediment sample.
3. Organic material.
4. Calculation of K-factor.

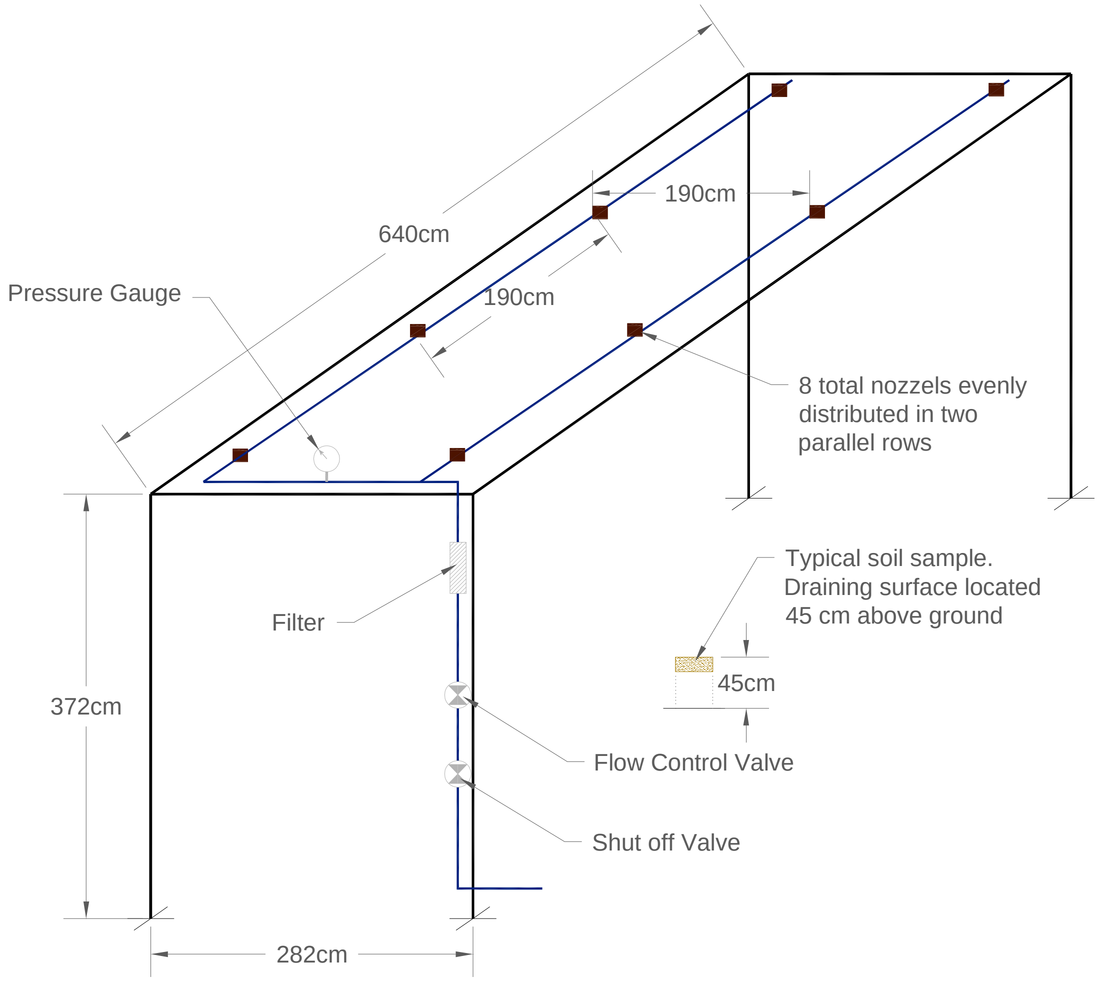
2. SEDIMENT CHARACTERIZATION

Soil samples, representing specific land uses and spatial distributions, were collected from designated locations around the Navajo Extension Project site. Each group of sample locations were selected to obtain a composite sample that is a reasonable representation of the sediment characteristics found in that particular watershed or area of interest. The particular sampling locations, used to make up the composite samples, were chosen by BHP consultants.

3. METHODOLOGY

The rainfall simulator developed at the University of Kentucky for erosion studies was utilized to generate the rainfall necessary to obtain the EPSD data from the soil samples. The simulator is approximately 6m by 3m and rainfall nozzles were located 3m above the soil samples to develop the proper rainfall distribution, drop size and raindrop velocity (see Figure 1). Nozzles were operated at 7 psi. The calibration consisted of a trade off between rainfall intensity and on/off pulse time while maintaining approximately a 7 psi pressure at the nozzles. Based on these calibrations a 2 seconds on, 3 seconds off pulse was utilized generating approximately a 2 in/hr (50 mm/hr) rainfall rate. The ~2 inch/hr rate (50 mm/hr) was based on the rainfall intensity for a 10-year 24-hour (Type II-70 rainfall distribution) design storm. The experiments were conducted for 1 hour to generate runoff that produced a large enough quantity of sediment to conduct analysis. The soil samples used for the rainfall simulator were located in rectangular containers (see Figure A3) with a surface area of approximately 0.53 ft^2 (6 ¾ in. wide by 11 ¼ in. long). Each container has a 9% slope inclination. Sediment-laden runoff was directed to a series of sieve trays that were located in an 18.75 L bucket and wet sieving was conducted. Rainfall was precluded from entering the buckets through protection afforded by plexiglass covers (see Figures A1 to A3 on Appendix A). The sediment that passed the 200 sieve was processed through the X-Ray particle size analyzer. No dispersion agent was used.

Figure 1: Schematic of the Rainfall Simulator used to obtain the EPSD of the soil samples.



3.1 Procedure

3.1.1 Eroded Particle Size Distribution

The three replicates of each soil sample are rained on for approximately one hour or until enough runoff containing sufficient sediment particles has been collected. The runoff is then sieved using a mechanical/pneumatic wet sieving device to obtain the portion of the particle distribution that is retained in the set of sieves #60 (0.250 mm), #100 (0.150 mm), #140 (0.106 mm) and #200 (0.075 mm). The wet sieve test procedure used in this case is an alternative from the standard test found in ASTM D1140 (American Standard for Testing Materials). The portion of the EPSD retained above 0.075 mm is then obtained by weighting the dried soil retained in each of the sieves. Once the wet sieving is complete, the finer portion of the sediments in the runoff is dried to retrieve the particles finer than 0.075 mm and an X-Ray particle size analyzer is used to obtain the remainder spectrum of the EPSD curve.

The particle size analyzer used for this analysis is a SEDIGRAPH 5100 from MICROMERITICS owned by the University of Kentucky (see Figure 2). This particle size analyzer uses the sedimentation technique, which measures the gravity-induced settling rates of different size particles in a liquid of known properties.

The SediGraph 5100 uses a narrow, horizontally collimated beam of X-rays to directly measure the relative mass concentration of particles in the liquid medium. This is accomplished by first measuring the intensity of a reference X-ray beam which is projected through the clear liquid medium prior to the introduction of the sample. A homogeneously dispersed mixture of solid sample and liquid is next circulated through the cell. The solid particles absorb (and scatter) some of the X-ray energy, which again is measured, this time to establish a value for full scale attenuation. Agitation of the mixture is ceased and the dispersion is allowed to settle while X-ray intensity is monitored. During the sedimentation process, the largest particles are first to fall below the measuring level, and each mass measurement represents the cumulative mass fraction of the remaining fine particles. Gradually, finer and finer particles settle out, ultimately clearing the measuring zone of suspended particles and allowing the X-ray beam to again pass through the cell unattenuated. The particle size analyzer determines particle size from velocity measurements by applying Stokes law under the known conditions of liquid density and viscosity and particle density. Settling velocity is determined at each relative mass measurement from knowledge of the distance the X-ray beam is from the top of the sample cell and the time at which the mass measurement was taken. From the velocity equals distance divided by time relationship, it can determine the maximum velocity of all particles remaining above the measurement zone, these velocities being associated with the finer particles. A sequence of closely-spaced measurements provides a distribution of mass fraction remaining in suspension versus velocity or size class or, as more commonly termed, cumulative mass percent finer. Finally, the SediGraph 5100 can measure particles from 300 to 0.10 µm equivalent spherical diameter.

The Sedigraph 5100 was maintained/tuned and calibrated by University of Kentucky personnel prior to the present ESPD analysis. The equipment was last calibrated on the 19th of April, 2007 following Micromeritics guidelines.

Figure 2: SediGraph 5100 Particle Size Analyzer

3.1.2 Parent Particle Size Distribution (PPSD)

The soil material is first air dried. The portion of dry soil passing sieve # 10 was then grinded to break up all clumps. A sample of approximately 500 g is obtained by quartering. The sample is then introduced to a rack of 7 different sieves with openings of decreasing size from top to bottom (a pan is placed below the stack to collect the finer portion). The rack of sieves is shaken using a mechanical powered shaker (see Figure A4 on Appendix A) for at least 10 minutes. The sieves used to obtain the spectrum of the PPSD above 0.075 mm were 8 in. (203 mm) in diameter and with openings of 2.000 mm, 0.595 mm, 0.425 mm, 0.250 mm, 0.150 mm, 0.106 mm and 0.075 mm (corresponding to sieves # 10, 30, 40, 60, 100, 140 and 200, respectively). After the sample is shaken, the mass of soil retained on sieves # 10, 30, 40, 60 and 100 are determined. The material collected in sieves # 140 and # 200 was washed through the sieves to remove all the remaining fines. In this case, portions retained on those two sieves are collected separately and oven-dried before the retained mass is measured.

The soil particles that passed through sieve #200 are first chemically dispersed using sodium hexametaphosphate dispersant and then analyzed using the X-Ray particle size analyzer.

3.1.3 Erodibility Factor K

Soil erosion by water for a specific watershed is usually calculated using the well known empirical Revised Universal Soil Loss Equation (Renard *et al.*) and is given by the following expression:

$$A = RKLSCP$$

A is the average soil loss per unit area, expressed in units selected for *K* and the time period specified by *R*. Normal English units are tons/acre/year.
R is the rainfall/runoff factor, which is the number of rainfall units for rainfall energy and runoff, plus the factor for runoff from snowmelt.
K is the soil erodibility factor, which is the rate of soil loss per unit of *R* for a given soil on a slope of 9% with slope length of 72.6 ft (22.1 m).
L is the slope length factor, which is the ratio of soil loss from a defined slope length relative to that from a slope length of 72.6 ft (22.1 m).
S is the slope steepness factor, which is the ratio of soil loss from a slope with a given steepness relative to that from a 9% slope.
C is the cover and management factor, which is the ratio of soil loss from an area with a known cover and management. And,
P is the supporting conservation practice factor.

The RUSLE K-Factor is a measure of a soil's resistance to erosive powers of rainfall energy and runoff. Practically, soil erodibility is an integration of the impacts of rainfall and runoff on soil loss for a given soil. Experimentally, soil loss erodibility is the soil loss per unit rainfall index on a standard erosion plot.

The K-factor can be obtained through 3 different sources. Through published data, Wischmeier nomograph developed from data collected on 55 different Midwestern USA agricultural soils or using the analytical approximation of the Wischmeier nomograph, which is given by the following relationship:

$$K = \frac{2.1\times 10^{-4}(12 - OM)M^{1.14} + 3.25(S_1 - 2) + 2.5(P_1 - 3)}{100}$$

where *K* is the soil erodibility factor in tons per acre per unit rainfall index $(\text{tons}\cdot\text{acre}\cdot\text{hr/hundreds}\cdot\text{acre}\cdot\text{ft}\cdot\text{tonsf}\cdot\text{in.})$, *OM* is the percentage organic matter, P_1 is the permeability index (1 to 4), S_1 is the soil structure index (1 to 6) and *M* is a parameter that depends on the parent particle size distribution and is given by:

$$M = (\%MS + \%VFS)(100 - \%CL)$$

where $\%CL$ is percentage clay (size < 0.002 mm in diameter), $\%MS$ is percentage silt (0.002 – 0.05 mm) and $\%VFS$ is percentage very fine sand (0.05 – 0.1 mm). The above equation is valid for values of $\%MS + \%VFS$ less than 70.

It is important to note that the Wischmeier nomograph works well for soils that have similar characteristics of those found in the Midwestern area of the United States; however it did not yield good results for Hawaiian soils, for example.

The percentage clay, silt and very fine sand are obtained directly from the parent particle size distribution (see 2.1.2). The percentage in organic matter *OM* is determined by firing the soil sample (around 25 grams) at a temperature of 550 °C for a period of 1 hour in a furnace. The loss by weight of the sample during this ignition is calculated as the organic matter. Results are reported as percent organic matter by weight in the soil.

The Wischmeier nomograph only considers soils with *OM* less or equal than 4%; thus the calculations were made by adjusting the *OM* to a maximum of 4%. Note that this reduction in the *OM* translates into a more conservative condition.

Since no information regarding permeability and structure of the sediment samples tested is available, only the first approximation of the K factor using the Wischmeier nomograph will be provided.

4. Results

4.1 Sample NMA: "Sandy"

Average total sediment mass yielded during rainfall simulator test: 28.32 g
Average mass of EPSD coarser than 0.250 mm: 14.02 g

4.1.1 Parent Soil Description

a) Texture: sand with few fine gravels.
b) Color: brown.
c) Fine fraction (< 0.075 mm): 3.255%
d) USDA Textural Classification: SAND

4.1.2 K – Factor Calculation

Organic Material: 0.854%
Percent Silt + Very Fine Sand (0.002 – 0.1 mm): 5.475%
Percent Sand (0.1 – 2 mm): 93.370 %

First Approximation: **K = 0.06**

4.1.3 Parent Particle Size Distribution

Table 1: Parent Particle Size Distribution for Sample NMA

Diameter (mm)	Average Percent Finer (%)
2	99.496
0.6	91.745
0.425	82.640
0.25	46.119
0.15	12.976
0.106	6.126
0.075	3.255
0.07079	2.957
0.06683	2.860
0.0631	2.745
0.05957	2.616
0.05623	2.474
0.05309	2.324
0.05012	2.170
0.04732	2.018
0.04467	1.870
0.04217	1.731
0.03981	1.603
0.03758	1.490
0.03548	1.390
0.0335	1.306
0.03162	1.237
0.02985	1.177
0.02818	1.130
0.02661	1.092
0.02512	1.060
0.02371	1.032
0.02239	1.008
0.02113	0.986
0.01995	0.966
0.01884	0.945
0.01778	0.927
0.01679	0.911
0.01585	0.897
0.01496	0.884
0.01413	0.873
0.01334	0.862
0.01259	0.852
0.01189	0.846
0.01122	0.838

Diameter (mm)	Average Percent Finer (%)
0.01059	0.833
0.01	0.828
0.009441	0.823
0.008913	0.821
0.008414	0.819
0.007943	0.816
0.007499	0.815
0.007079	0.815
0.006683	0.813
0.00631	0.810
0.005957	0.809
0.005623	0.806
0.005309	0.801
0.005012	0.796
0.004732	0.788
0.004467	0.779
0.004217	0.771
0.003981	0.759
0.003758	0.747
0.003548	0.736
0.00335	0.721
0.003162	0.708
0.002985	0.697
0.002818	0.684
0.002661	0.676
0.002512	0.668
0.002371	0.664
0.002239	0.659
0.002113	0.656
0.001995	0.651
0.001884	0.648
0.001778	0.641
0.001679	0.636
0.001585	0.628
0.001496	0.623
0.001413	0.615
0.001334	0.606
0.001259	0.600
0.001189	0.592
0.001122	0.586

Diameter (mm)	Average Percent Finer (%)
0.001059	0.577
0.001	0.567
0.000944	0.556
0.000891	0.544
0.000841	0.531
0.000794	0.520
0.00075	0.506
0.000708	0.493
0.000668	0.483
0.000631	0.473
0.000596	0.460
0.000562	0.450
0.000531	0.439
0.000501	0.426
0.000473	0.412
0.000447	0.400
0.000422	0.386
0.000398	0.374
0.000376	0.362
0.000355	0.351
0.000335	0.341
0.000316	0.334
0.000299	0.325
0.000282	0.318
0.000266	0.310
0.000251	0.301

Figure 3: Parent Particle Size Distributions Chart for Sample NMA

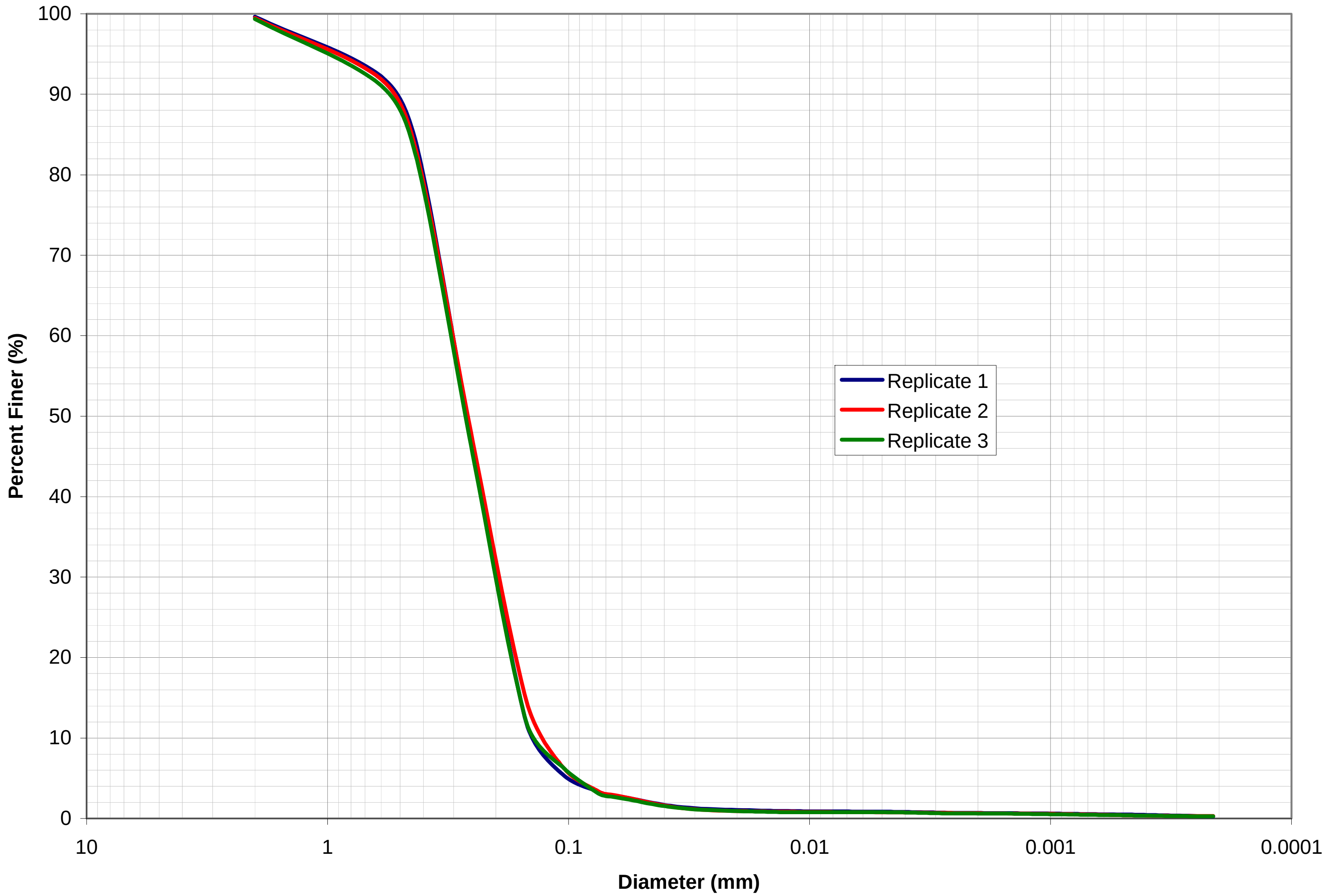
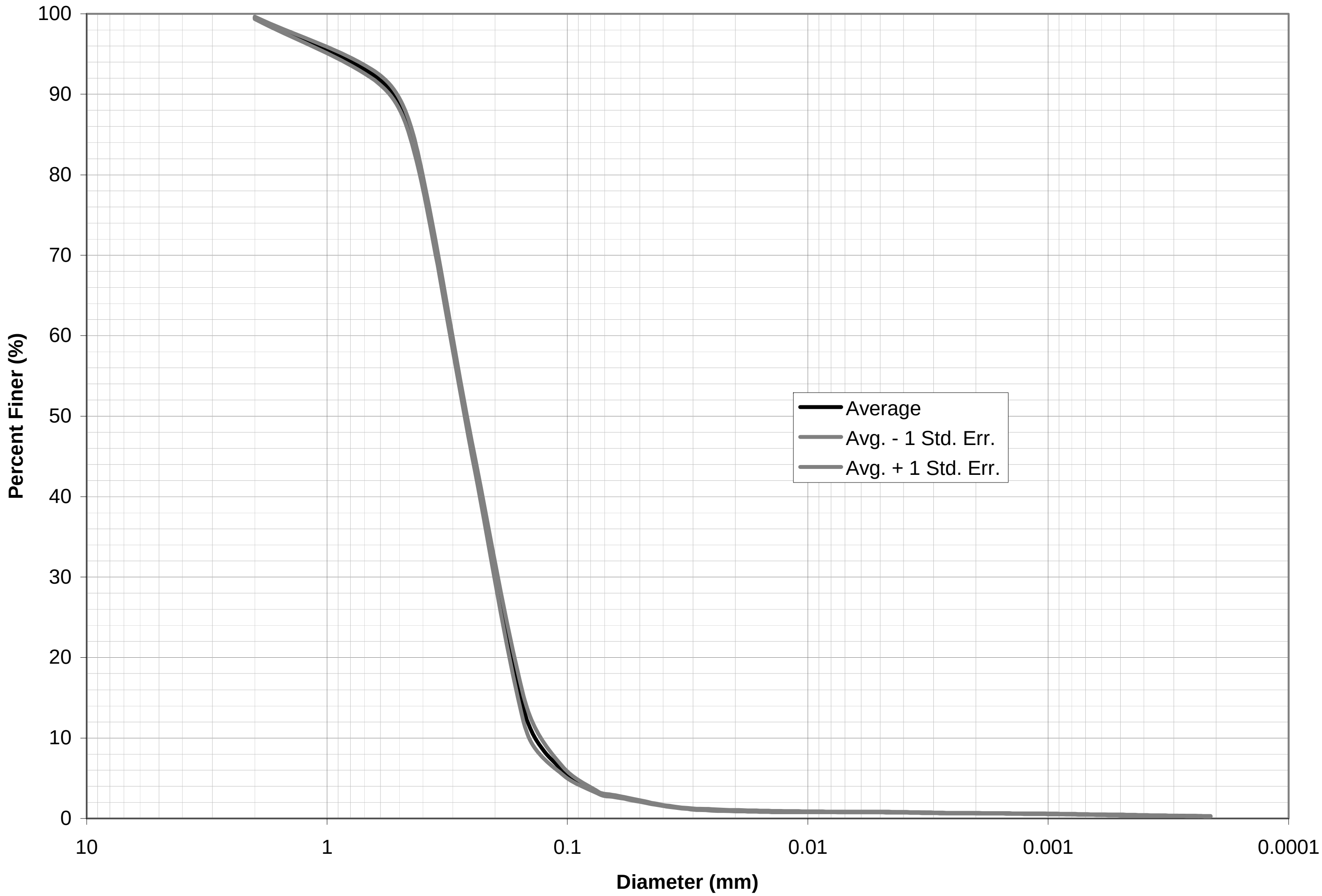


Figure 4: Average Parent Particle Size Distribution Chart for Sample NMA



4.1.4 Eroded Particle Size Distribution

Table 2: Eroded Particle Size Distribution for Sample NMA

Diameter (mm)	Average Percent Finer (%)
0.25	50.527
0.15	33.896
0.106	31.867
0.075	31.272
0.07079	31.272
0.06683	31.272
0.0631	31.272
0.05957	31.272
0.05623	31.272
0.05309	31.272
0.05012	31.272
0.04732	31.272
0.04467	31.272
0.04217	31.272
0.03981	31.272
0.03758	31.272
0.03548	31.272
0.0335	31.188
0.03162	31.104
0.02985	30.997
0.02818	30.905
0.02661	30.814
0.02512	30.714
0.02371	30.630
0.02239	30.529
0.02113	30.446
0.01995	30.362
0.01884	30.261
0.01778	30.178
0.01679	30.077
0.01585	29.929
0.01496	29.757
0.01413	29.543
0.01334	29.297
0.01259	29.026
0.01189	28.713
0.01122	28.354
0.01059	27.939
0.01	27.491
0.009441	27.005
0.008913	26.486
0.008414	25.897
0.007943	25.254
0.007499	24.514
0.007079	23.679
0.006683	22.783
0.00631	21.768
0.005957	20.684
0.005623	19.540
0.005309	18.344
0.005012	17.120
0.004732	15.916
0.004467	14.786
0.004217	13.728
0.003981	12.790
0.003758	11.976
0.003548	11.319
0.00335	10.810
0.003162	10.392
0.002985	10.082
0.002818	9.848
0.002661	9.653
0.002512	9.496
0.002371	9.371
0.002239	9.254
0.002113	9.163
0.001995	9.064
0.001884	8.997
0.001778	8.931
0.001679	8.890
0.001585	8.841
0.001496	8.816
0.001413	8.775
0.001334	8.758
0.001259	8.733
0.001189	8.716
0.001122	8.683
0.001059	8.666
0.001	8.625
0.000944	8.583
0.000891	8.559
0.000841	8.543
0.000794	8.527
0.00075	8.504
0.000708	8.480
0.000668	8.448
0.000631	8.409
0.000596	8.369
0.000562	8.322
0.000531	8.283
0.000501	8.235
0.000473	8.188
0.000447	8.141
0.000422	8.094
0.000398	7.929
0.000376	7.714
0.000355	7.483
0.000335	7.218
0.000316	6.945
0.000299	6.664
0.000282	6.349
0.000266	6.035
0.000251	5.712
0.000237	5.381
0.000224	5.033
0.000211	4.661

Figure 5: Eroded Particle Size Distributions Chart for Sample NMA

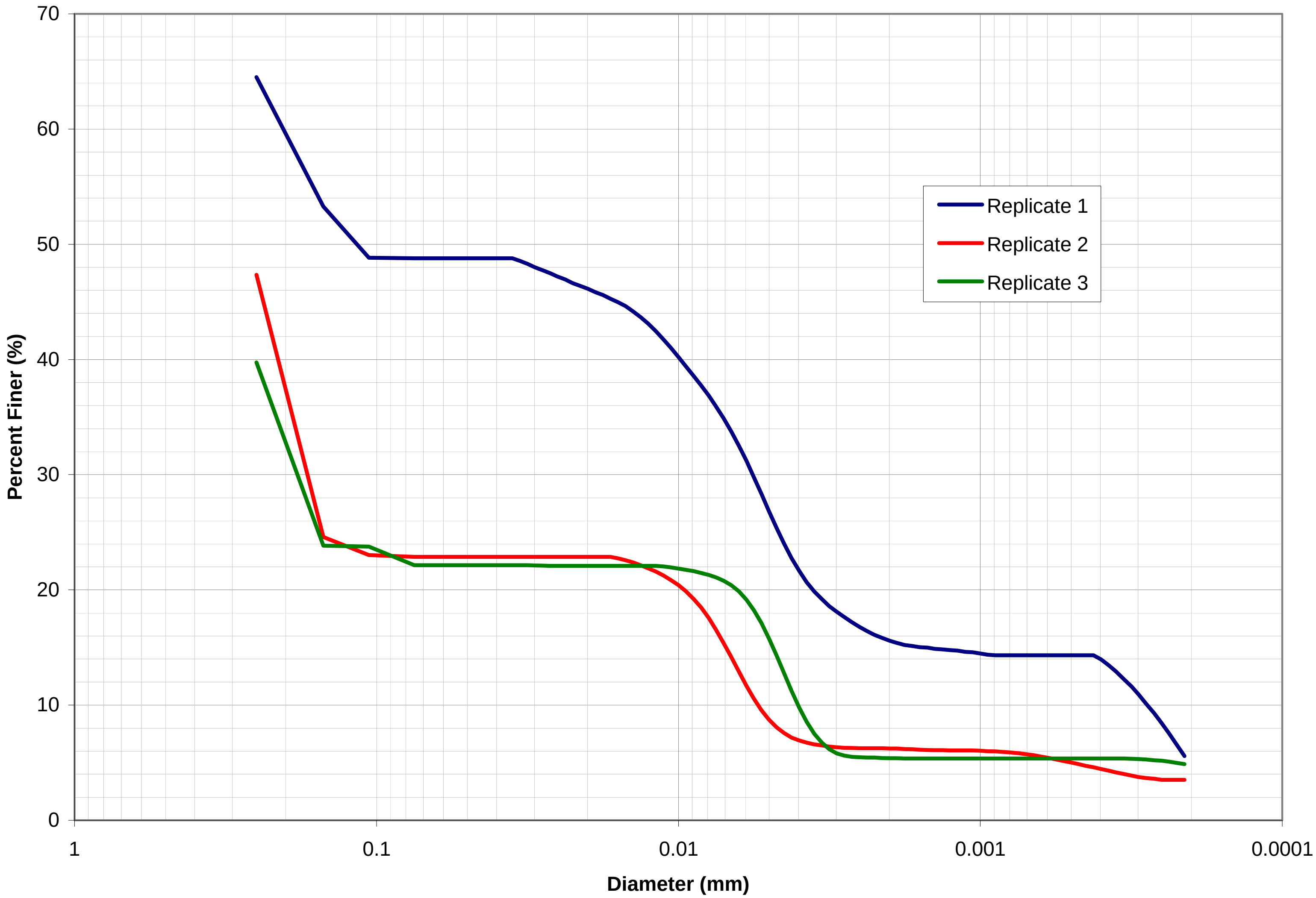


Figure 6: Average Eroded Particle Size Distribution Chart for Sample NMA

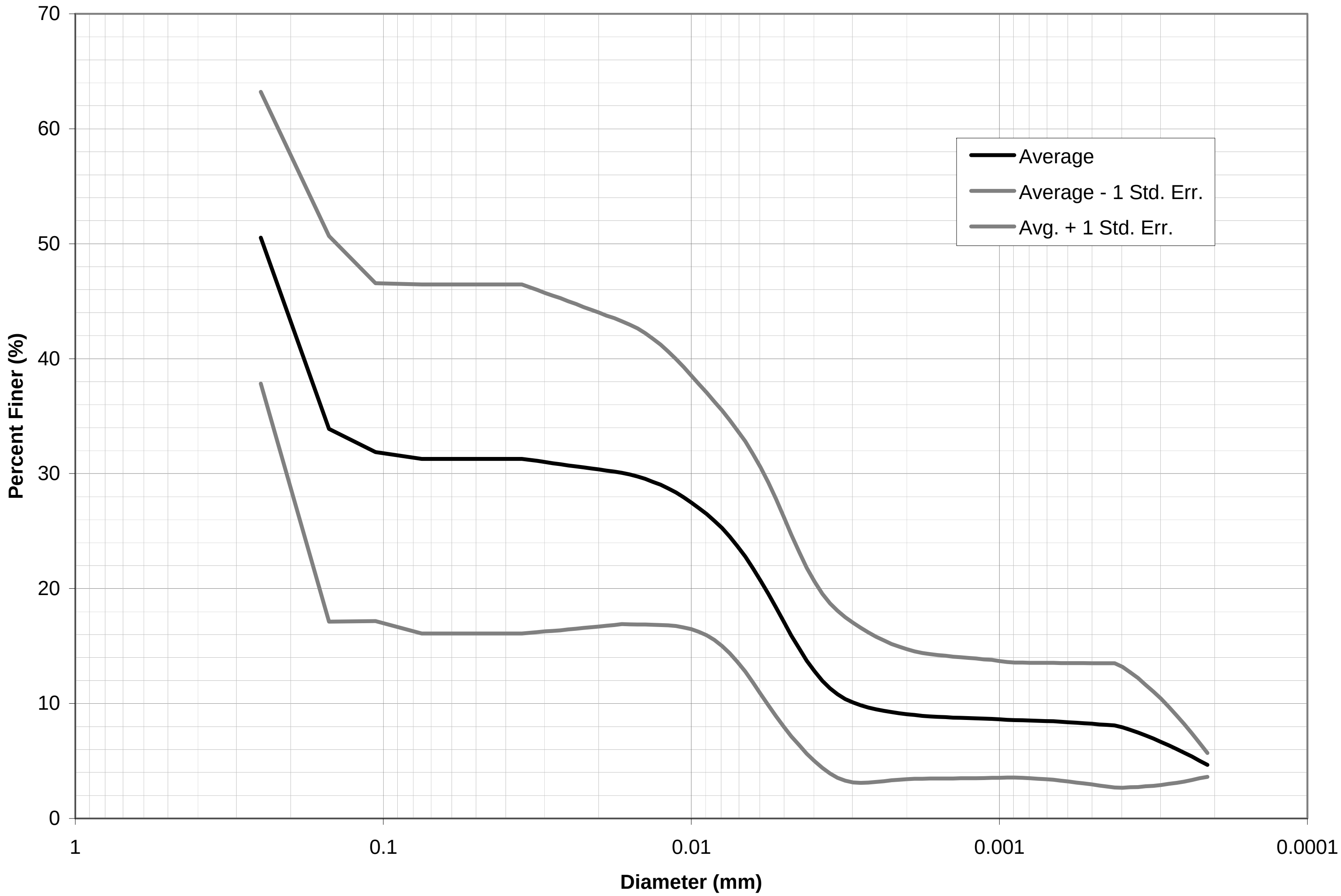
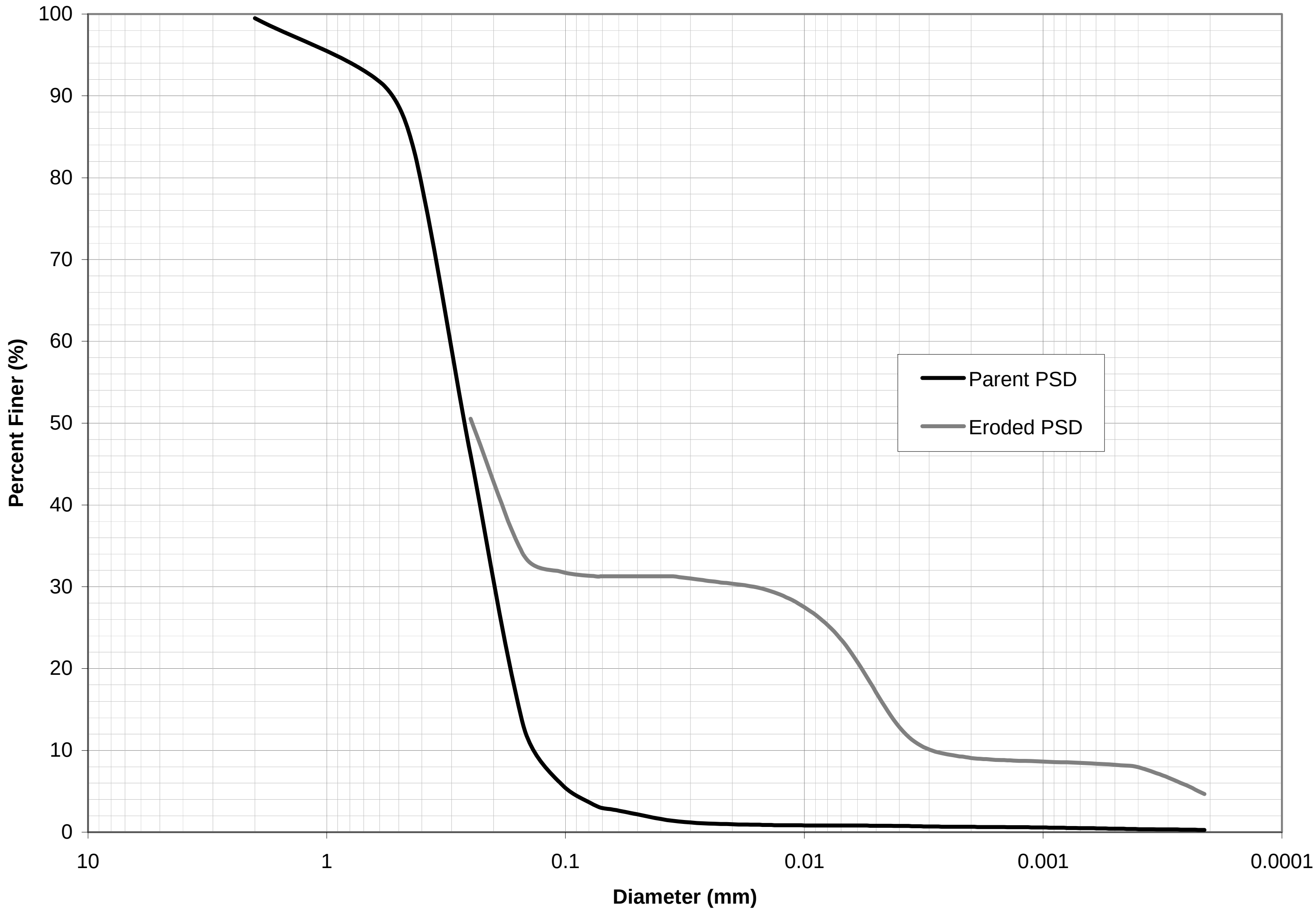


Figure 7: Combined Particle Size Distributions Chart for Sample NMA



4.2 Sample NMB: "Fine"

Average total sediment mass yielded during rainfall simulator test: 30.31g
Average mass of EPSD coarser than 0.250 mm: 4.36g

4.2.1 Description

a) Texture: fine sand with silts and fine gravels.
b) Color: grey.
c) Fine fraction (< 0.075%): 15.937%
d) USDA Textural Classification: LOAMY SAND

4.2.2 K – Factor Calculation

Organic Material: 6.445%
Percent Silt + Very Fine Sand (0.002 – 0.1 mm): 15.100%
Percent Sand (0.1 – 2 mm): 75.114%

First Approximation: **K = 0.08**

4.2.3 Parent Particle Size Distribution

Table 3: Parent Particle Size Distribution for Sample NMB

Diameter (mm)	Average Percent Finer (%)
2	93.744
0.6	73.095
0.425	63.904
0.25	43.103
0.15	21.889
0.106	18.629
0.075	15.937
0.07079	15.565
0.06683	15.420
0.0631	15.233
0.05957	15.013
0.05623	14.751
0.05309	14.456
0.05012	14.128
0.04732	13.784
0.04467	13.414
0.04217	13.033
0.03981	12.657
0.03758	12.281
0.03548	11.910
0.0335	11.551
0.03162	11.213
0.02985	10.885
0.02818	10.584
0.02661	10.294
0.02512	10.021
0.02371	9.769
0.02239	9.532
0.02113	9.301
0.01995	9.091
0.01884	8.887
0.01778	8.683
0.01679	8.500
0.01585	8.318
0.01496	8.135
0.01413	7.964
0.01334	7.797
0.01259	7.631
0.01189	7.475
0.01122	7.336
0.01059	7.207
0.01	7.088
0.009441	6.986
0.008913	6.895
0.008414	6.815
0.007943	6.740
0.007499	6.665
0.007079	6.595
0.006683	6.525
0.00631	6.449
0.005957	6.363
0.005623	6.277
0.005309	6.191
0.005012	6.094
0.004732	5.997
0.004467	5.890
0.004217	5.783
0.003981	5.664
0.003758	5.557
0.003548	5.429
0.00335	5.305
0.003162	5.177
0.002985	5.037
0.002818	4.882
0.002661	4.710
0.002512	4.528
0.002371	4.319
0.002239	4.083
0.002113	3.821
0.001995	3.531
0.001884	3.230
0.001778	2.925
0.001679	2.614
0.001585	2.330
0.001496	2.072
0.001413	1.846
0.001334	1.664
0.001259	1.513
0.001189	1.400
0.001122	1.304
0.001059	1.228
0.001	1.174
0.000944	1.126
0.000891	1.083
0.000841	1.057
0.000794	1.030
0.00075	1.014
0.000708	0.997
0.000668	0.987
0.000631	0.976
0.000596	0.965
0.000562	0.944
0.000531	0.922
0.000501	0.896
0.000473	0.869
0.000447	0.843
0.000422	0.811
0.000398	0.784
0.000376	0.768
0.000355	0.752
0.000335	0.735
0.000316	0.724
0.000299	0.707
0.000282	0.696
0.000266	0.685
0.000251	0.674

Figure 8: Parent Particle Size Distributions Chart for Sample NMB

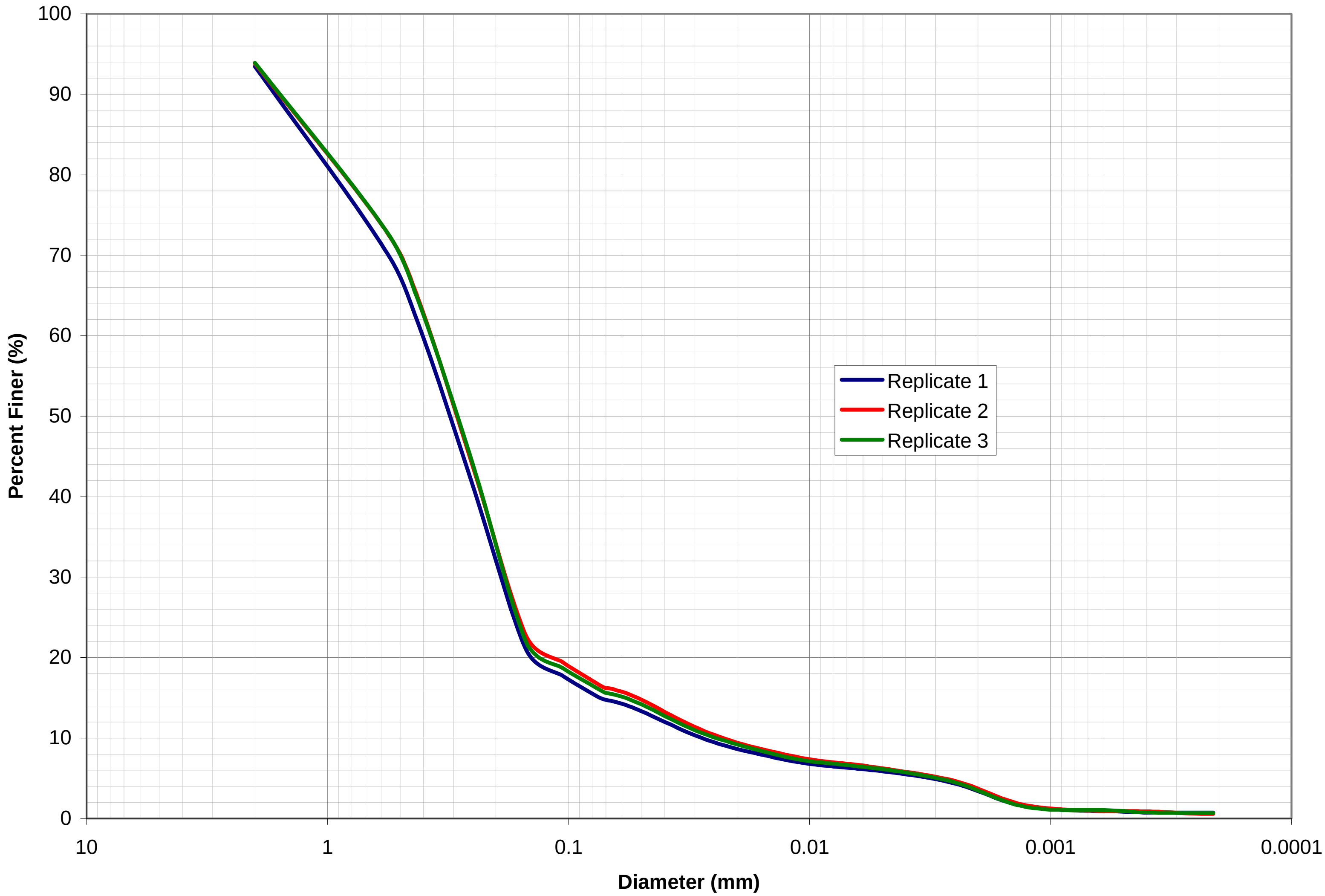
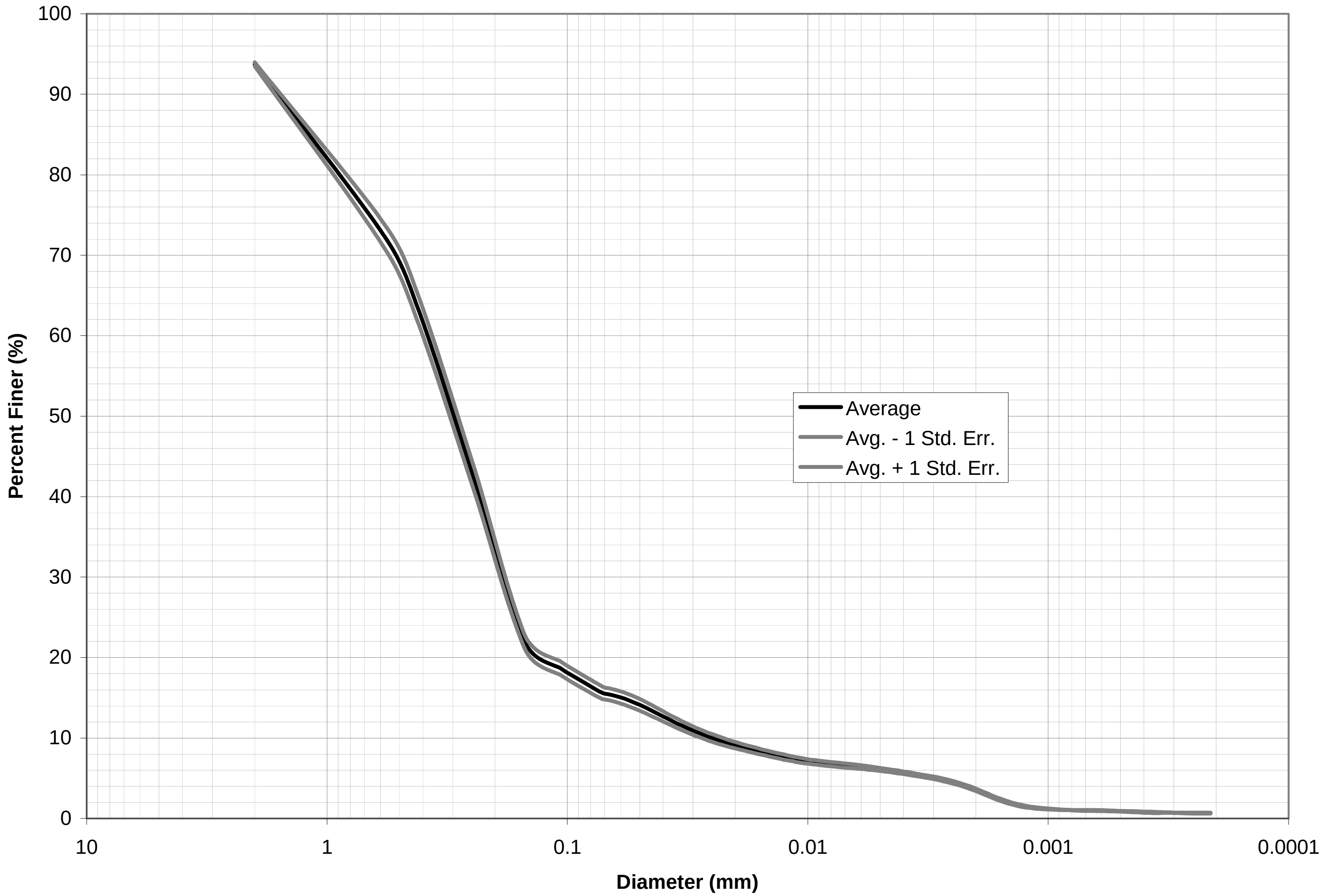


Figure 9: Average Parent Particle Size Distribution Chart for Sample NMB



4.2.4 Eroded Particle Size Distribution

Table 4: Eroded Particle Size Distribution for Sample NMB

Diameter (mm)	Average Percent Finer (%)
0.25	85.662
0.15	72.479
0.106	65.122
0.075	58.342
0.07079	58.110
0.06683	58.052
0.0631	57.974
0.05957	57.897
0.05623	57.820
0.05309	57.722
0.05012	57.605
0.04732	57.468
0.04467	57.312
0.04217	57.096
0.03981	56.862
0.03758	56.627
0.03548	56.372
0.0335	56.078
0.03162	55.786
0.02985	55.532
0.02818	55.259
0.02661	54.967
0.02512	54.659
0.02371	54.311
0.02239	53.924
0.02113	53.461
0.01995	52.939
0.01884	52.360
0.01778	51.704
0.01679	50.969
0.01585	50.138
0.01496	49.288
0.01413	48.303
0.01334	47.224
0.01259	46.007
0.01189	44.656
0.01122	43.054
0.01059	41.199
0.01	39.091
0.009441	36.710
0.008913	34.035
0.008414	31.104
0.007943	28.034
0.007499	24.920
0.007079	21.841
0.006683	18.973
0.00631	16.376
0.005957	14.130
0.005623	12.273
0.005309	10.807
0.005012	9.694
0.004732	8.875
0.004467	8.271
0.004217	7.843
0.003981	7.494
0.003758	7.224
0.003548	7.030
0.00335	6.857
0.003162	6.722
0.002985	6.586
0.002818	6.528
0.002661	6.469
0.002512	6.411
0.002371	6.392
0.002239	6.374
0.002113	6.335
0.001995	6.297
0.001884	6.258
0.001778	6.220
0.001679	6.162
0.001585	6.125
0.001496	6.087
0.001413	6.049
0.001334	6.030
0.001259	6.030
0.001189	6.030
0.001122	6.030
0.001059	6.030
0.001	6.030
0.000944	5.991
0.000891	5.951
0.000841	5.894
0.000794	5.856
0.00075	5.779
0.000708	5.723
0.000668	5.667
0.000631	5.592
0.000596	5.516
0.000562	5.441
0.000531	5.366
0.000501	5.291
0.000473	5.197
0.000447	5.122
0.000422	5.047
0.000398	4.953
0.000376	4.840
0.000355	4.745
0.000335	4.651
0.000316	4.556
0.000299	4.441
0.000282	4.286
0.000266	4.149
0.000251	4.011
0.000237	3.910
0.000224	3.810
0.000211	3.729

Figure 10: Eroded Particle Size Distributions Chart for Sample NMB

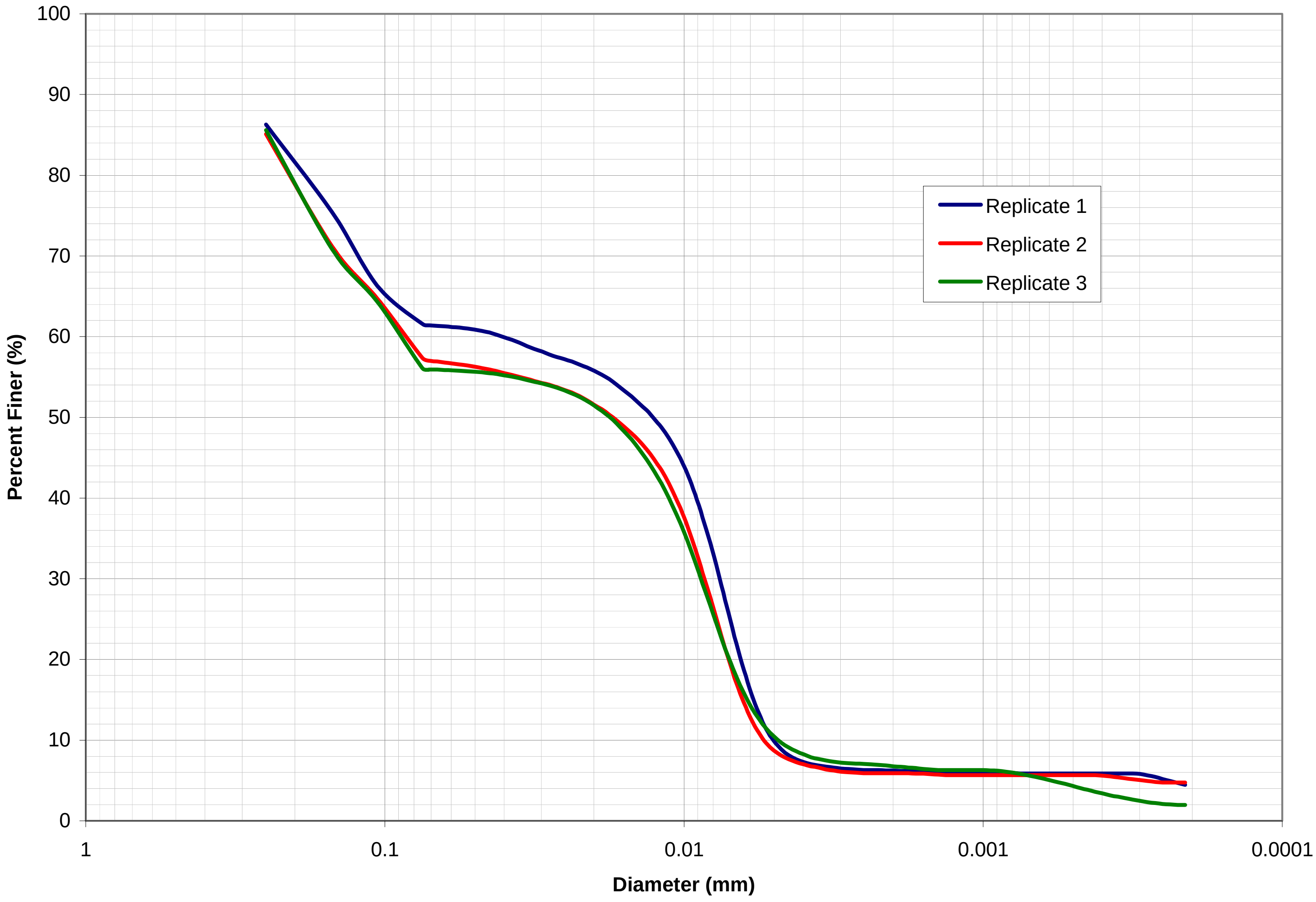


Figure 11: Average Eroded Particle Size Distribution Chart for Sample NMB

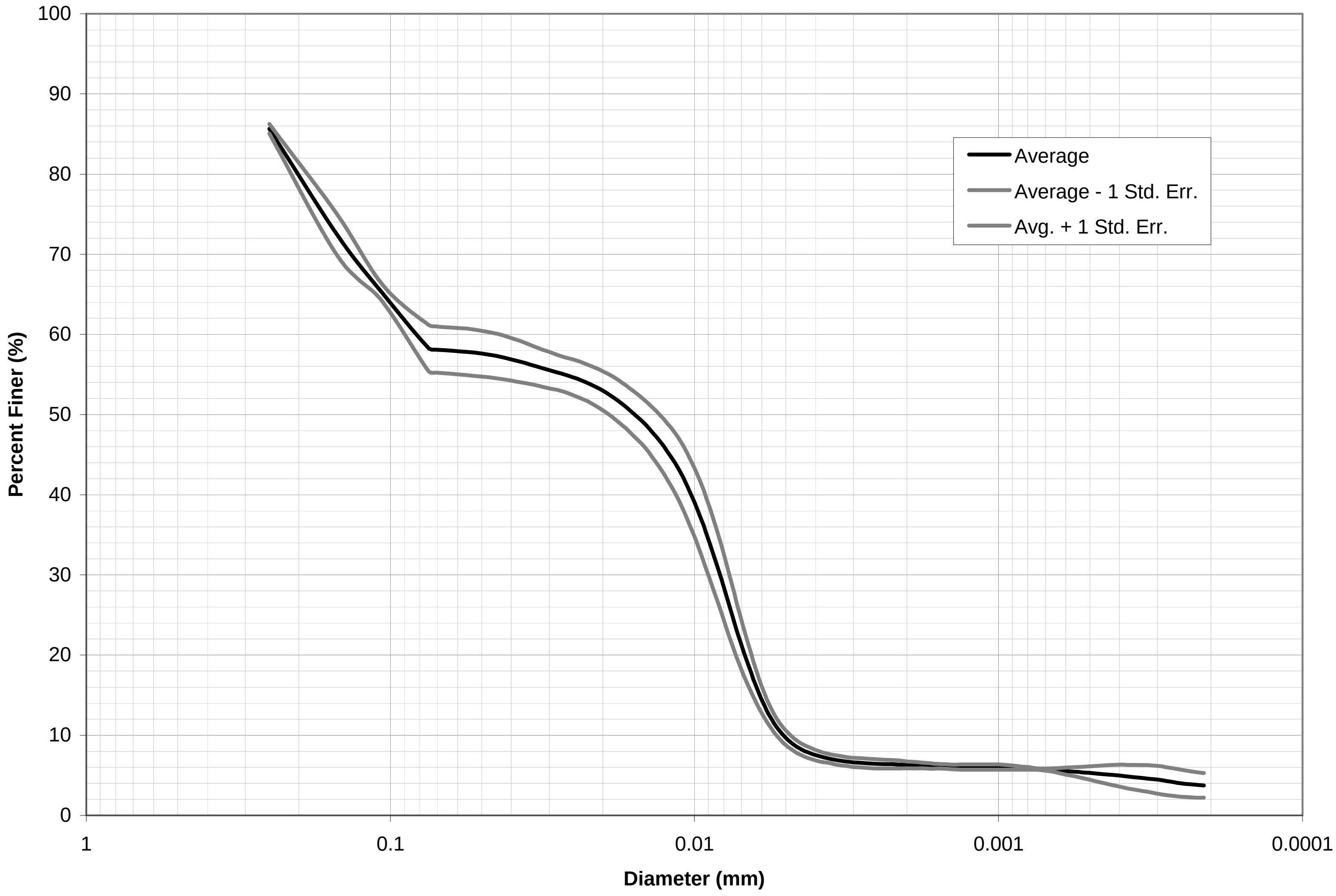
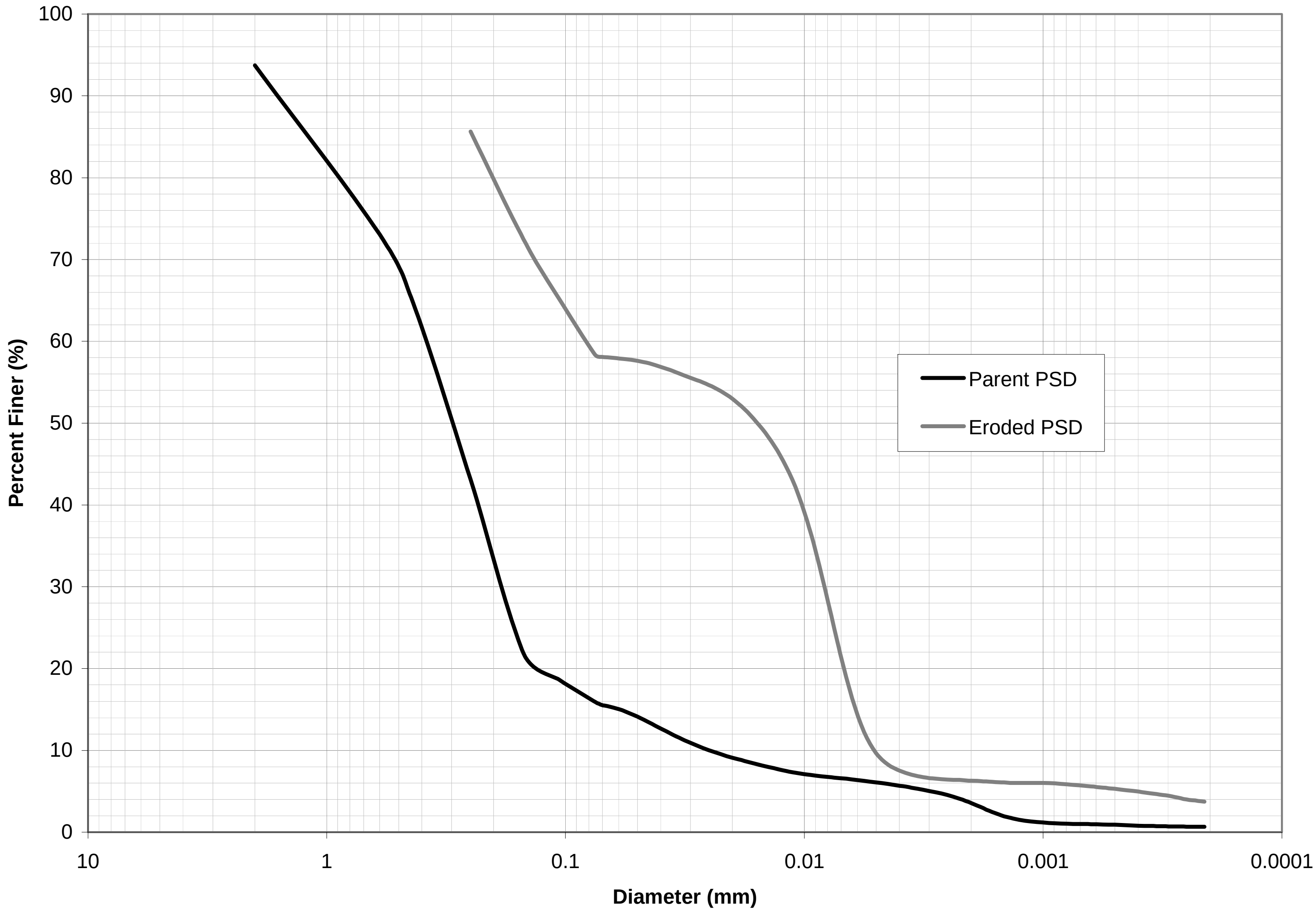


Figure 12: Combined Particle Size Distributions Chart for Sample NMB



4.3 Sample NMC: "Fine Loamy"

Average total sediment mass yielded during rainfall simulator test: 29.547g
Average mass of EPSD coarser than 0.250 mm: 6.71g

4.3.1 Description

a) Texture: fine sand with fine gravels.
b) Color: light grey.
c) Fine fraction (< 0.075%): 15.196%
d) USDA Textural Classification: LOAMY SAND

4.3.2 K – Factor Calculation

Organic Material: 2.860%
Percent Silt + Very Fine Sand (0.002 – 0.1 mm): 15.90%
Percent Sand (0.1 – 2 mm): 74.84%

First Approximation: **K = 0.08**

4.3.3 Parent Particle Size Distribution

Table 5: Parent Particle Size Distribution for Sample NMC

Diameter (mm)	Average Percent Finer (%)
2	94.392
0.6	76.394
0.425	67.811
0.25	49.075
0.15	25.542
0.106	19.553
0.075	15.196
0.07079	14.591
0.06683	14.372
0.0631	14.108
0.05957	13.801
0.05623	13.448
0.05309	13.059
0.05012	12.628
0.04732	12.192
0.04467	11.729
0.04217	11.277
0.03981	10.825
0.03758	10.393
0.03548	9.976
0.0335	9.592
0.03162	9.238
0.02985	8.910
0.02818	8.618
0.02661	8.338
0.02512	8.094
0.02371	7.859
0.02239	7.646
0.02113	7.443
0.01995	7.257
0.01884	7.086
0.01778	6.915
0.01679	6.765
0.01585	6.619
0.01496	6.485
0.01413	6.361
0.01334	6.253
0.01259	6.144
0.01189	6.040
0.01122	5.942
0.01059	5.854
0.01	5.765
0.009441	5.687
0.008913	5.609
0.008414	5.531
0.007943	5.469
0.007499	5.401
0.007079	5.350
0.006683	5.283
0.00631	5.221
0.005957	5.164
0.005623	5.097
0.005309	5.030
0.005012	4.962
0.004732	4.884
0.004467	4.795
0.004217	4.707
0.003981	4.613
0.003758	4.514
0.003548	4.410
0.00335	4.311
0.003162	4.212
0.002985	4.119
0.002818	4.025
0.002661	3.947
0.002512	3.864
0.002371	3.796
0.002239	3.722
0.002113	3.649
0.001995	3.571
0.001884	3.487
0.001778	3.404
0.001679	3.320
0.001585	3.232
0.001496	3.143
0.001413	3.060
0.001334	2.976
0.001259	2.893
0.001189	2.814
0.001122	2.741
0.001059	2.668
0.001	2.594
0.000944	2.526
0.000891	2.448
0.000841	2.380
0.000794	2.307
0.00075	2.234
0.000708	2.161
0.000668	2.083
0.000631	2.010
0.000596	1.932
0.000562	1.854
0.000531	1.781
0.000501	1.713
0.000473	1.645
0.000447	1.583
0.000422	1.521
0.000398	1.470
0.000376	1.423
0.000355	1.371
0.000335	1.330
0.000316	1.289
0.000299	1.253
0.000282	1.232
0.000266	1.212
0.000251	1.212

Figure 13: Parent Particle Size Distributions Chart for Sample NMC

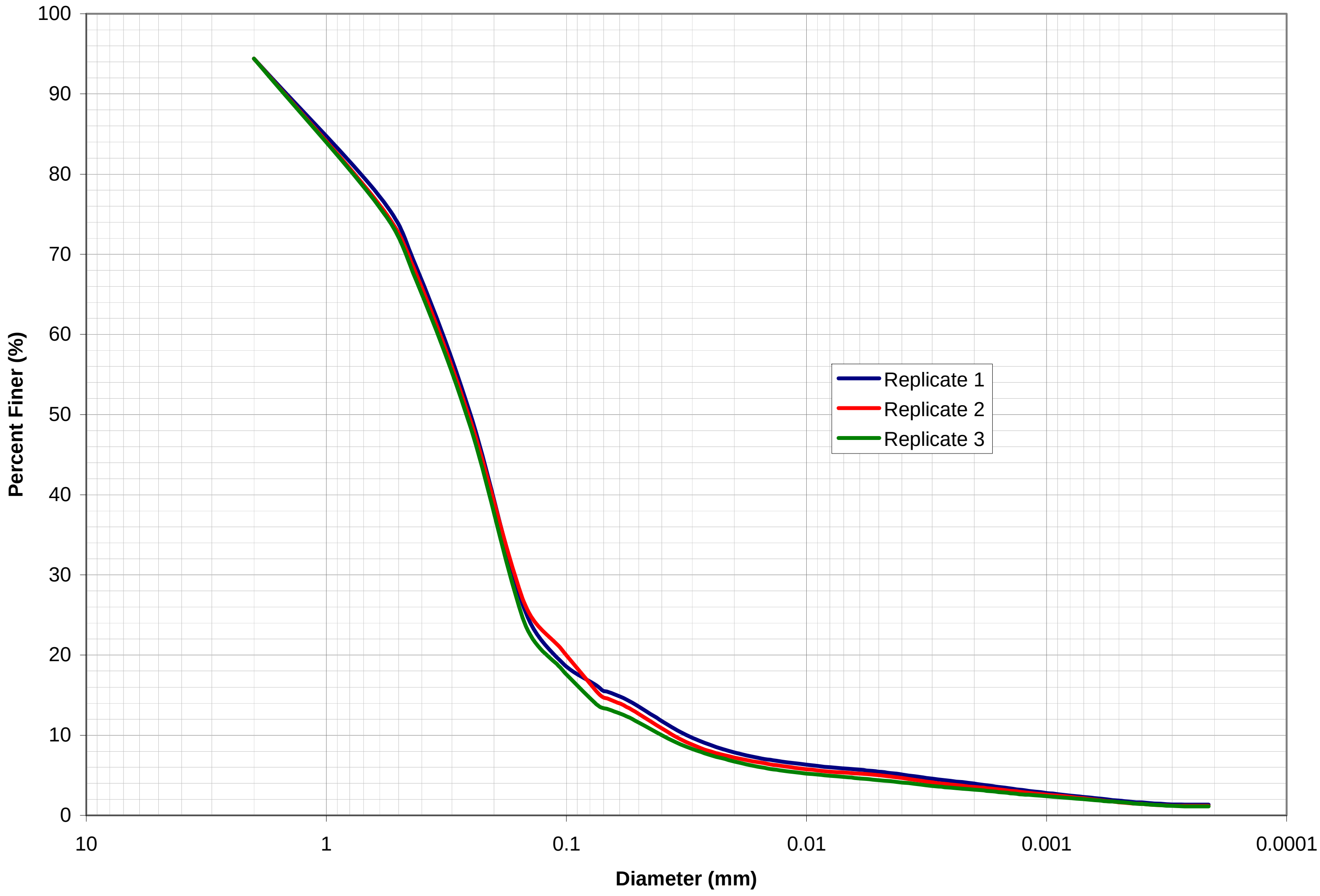
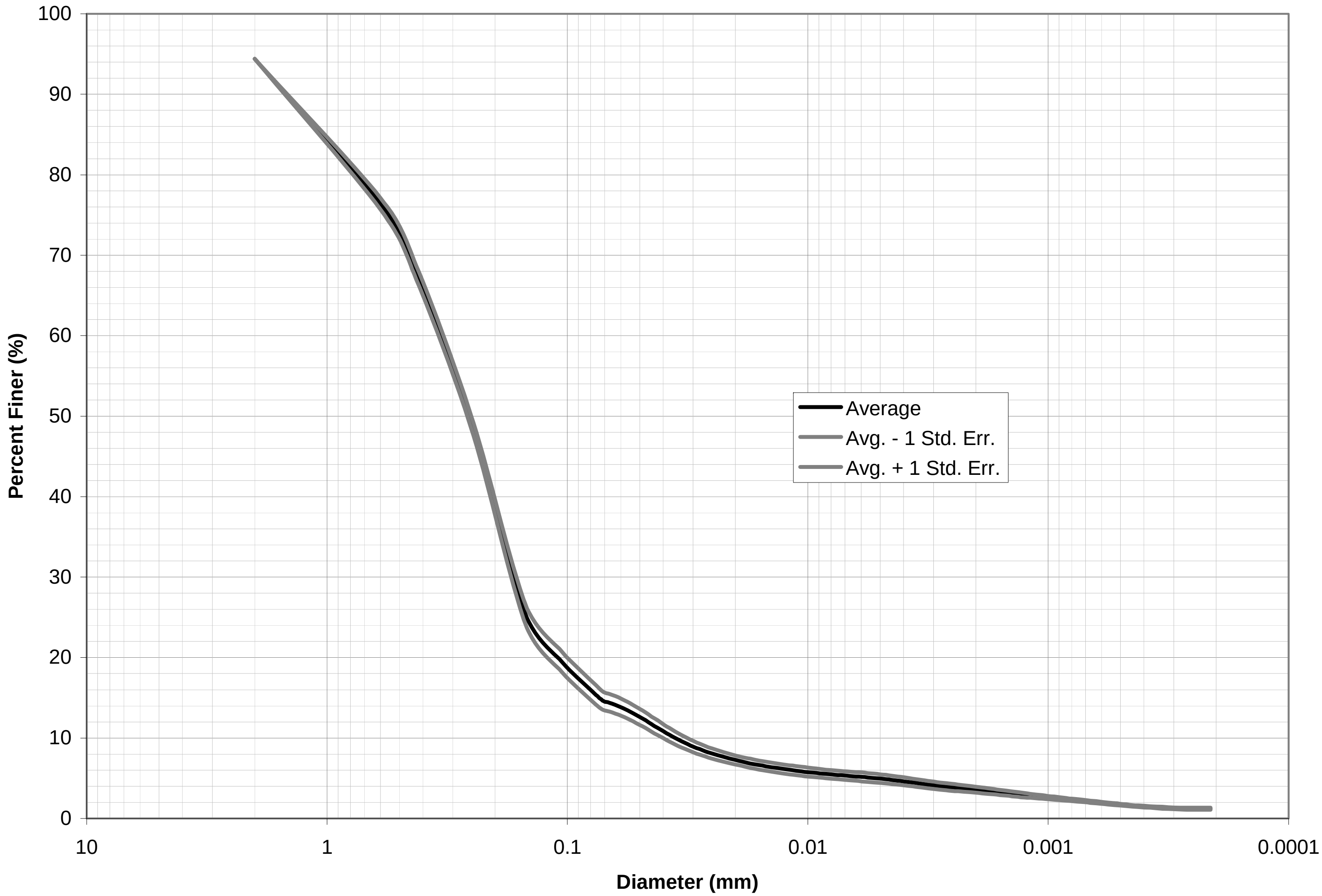


Figure 14: Average Parent Particle Size Distribution Chart for Sample NMC



4.3.4 Eroded Particle Size Distribution

Table 6: Eroded Particle Size Distribution for Sample NMC

Diameter (mm)	Average Percent Finer (%)
0.25	77.102
0.15	57.325
0.106	46.724
0.075	38.620
0.07079	38.515
0.06683	38.450
0.0631	38.384
0.05957	38.306
0.05623	38.175
0.05309	38.031
0.05012	37.887
0.04732	37.704
0.04467	37.495
0.04217	37.313
0.03981	37.104
0.03758	36.870
0.03548	36.675
0.0335	36.429
0.03162	36.181
0.02985	35.922
0.02818	35.662
0.02661	35.376
0.02512	35.051
0.02371	34.700
0.02239	34.322
0.02113	33.905
0.01995	33.437
0.01884	32.916
0.01778	32.332
0.01679	31.642
0.01585	30.862
0.01496	29.965
0.01413	28.911
0.01334	27.701
0.01259	26.281
0.01189	24.679
0.01122	22.907
0.01059	20.965
0.01	18.931
0.009441	16.871
0.008913	14.836
0.008414	12.958
0.007943	11.237
0.007499	9.749
0.007079	8.498
0.006683	7.520
0.00631	6.737
0.005957	6.151
0.005623	5.708
0.005309	5.382
0.005012	5.122
0.004732	4.926
0.004467	4.744
0.004217	4.601
0.003981	4.484
0.003758	4.380
0.003548	4.275
0.00335	4.210
0.003162	4.158
0.002985	4.119
0.002818	4.119
0.002661	4.106
0.002512	4.106
0.002371	4.106
0.002239	4.093
0.002113	4.093
0.001995	4.067
0.001884	4.028
0.001778	3.963
0.001679	3.885
0.001585	3.807
0.001496	3.716
0.001413	3.638
0.001334	3.559
0.001259	3.507
0.001189	3.493
0.001122	3.480
0.001059	3.480
0.001	3.480
0.000944	3.480
0.000891	3.480
0.000841	3.480
0.000794	3.480
0.00075	3.480
0.000708	3.480
0.000668	3.480
0.000631	3.480
0.000596	3.480
0.000562	3.480
0.000531	3.480
0.000501	3.480
0.000473	3.480
0.000447	3.467
0.000422	3.454
0.000398	3.401
0.000376	3.336
0.000355	3.245
0.000335	3.166
0.000316	3.089
0.000299	3.011
0.000282	2.908
0.000266	2.793
0.000251	2.666
0.000237	2.527
0.000224	2.350
0.000211	2.148

Figure 15: Eroded Particle Size Distributions Chart for Sample NMC

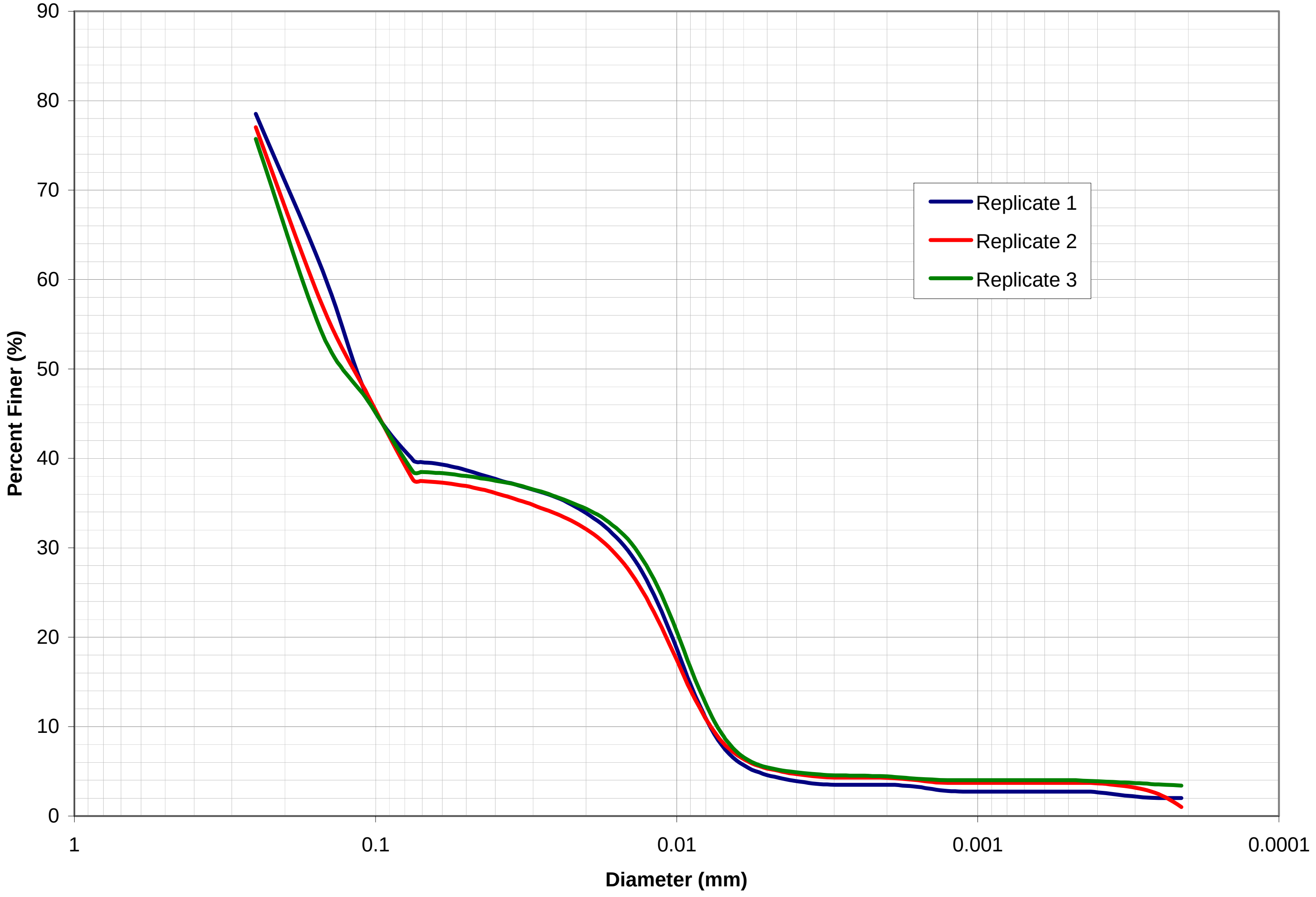


Figure 16: Average Eroded Particle Size Distribution Chart for Sample NMC

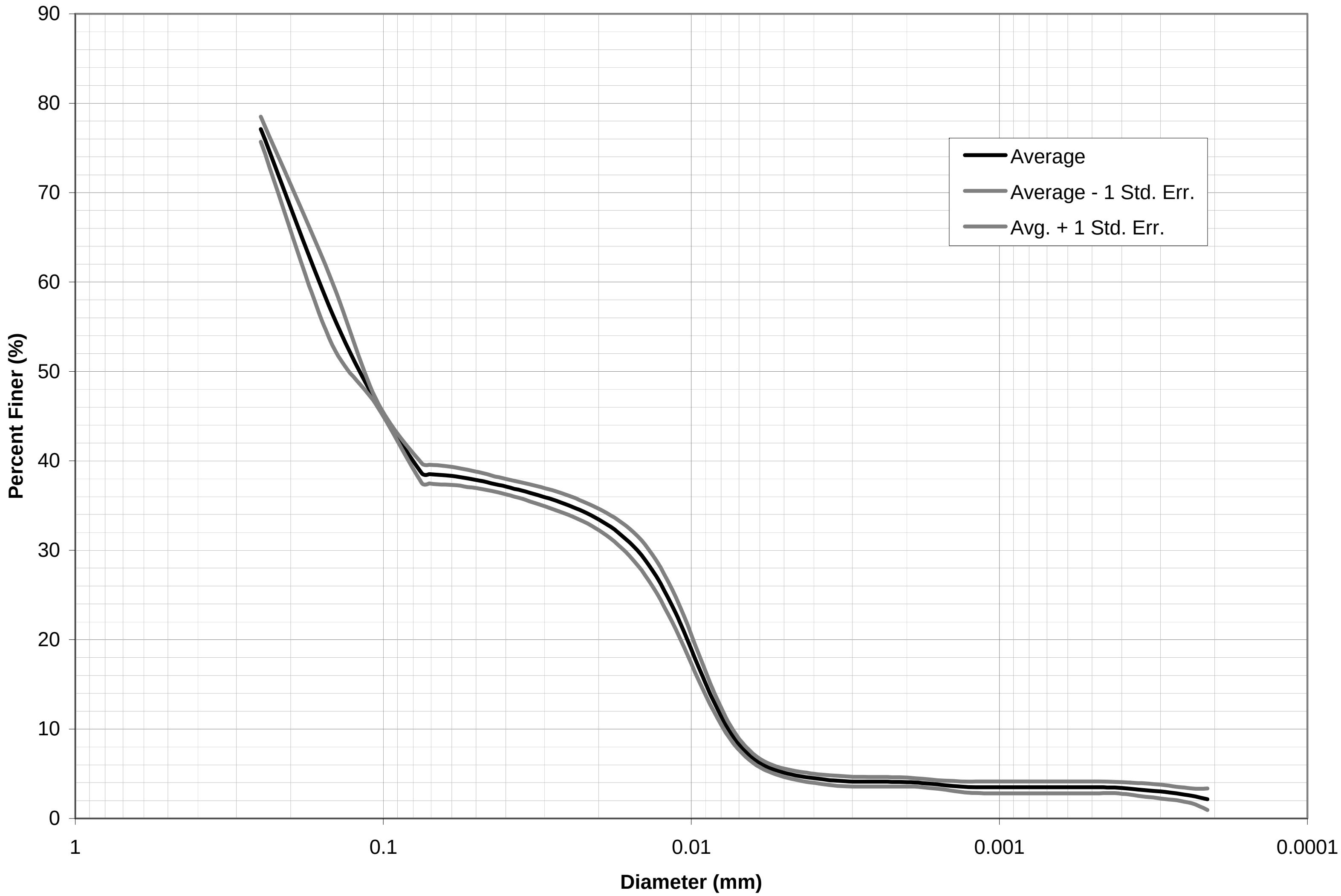
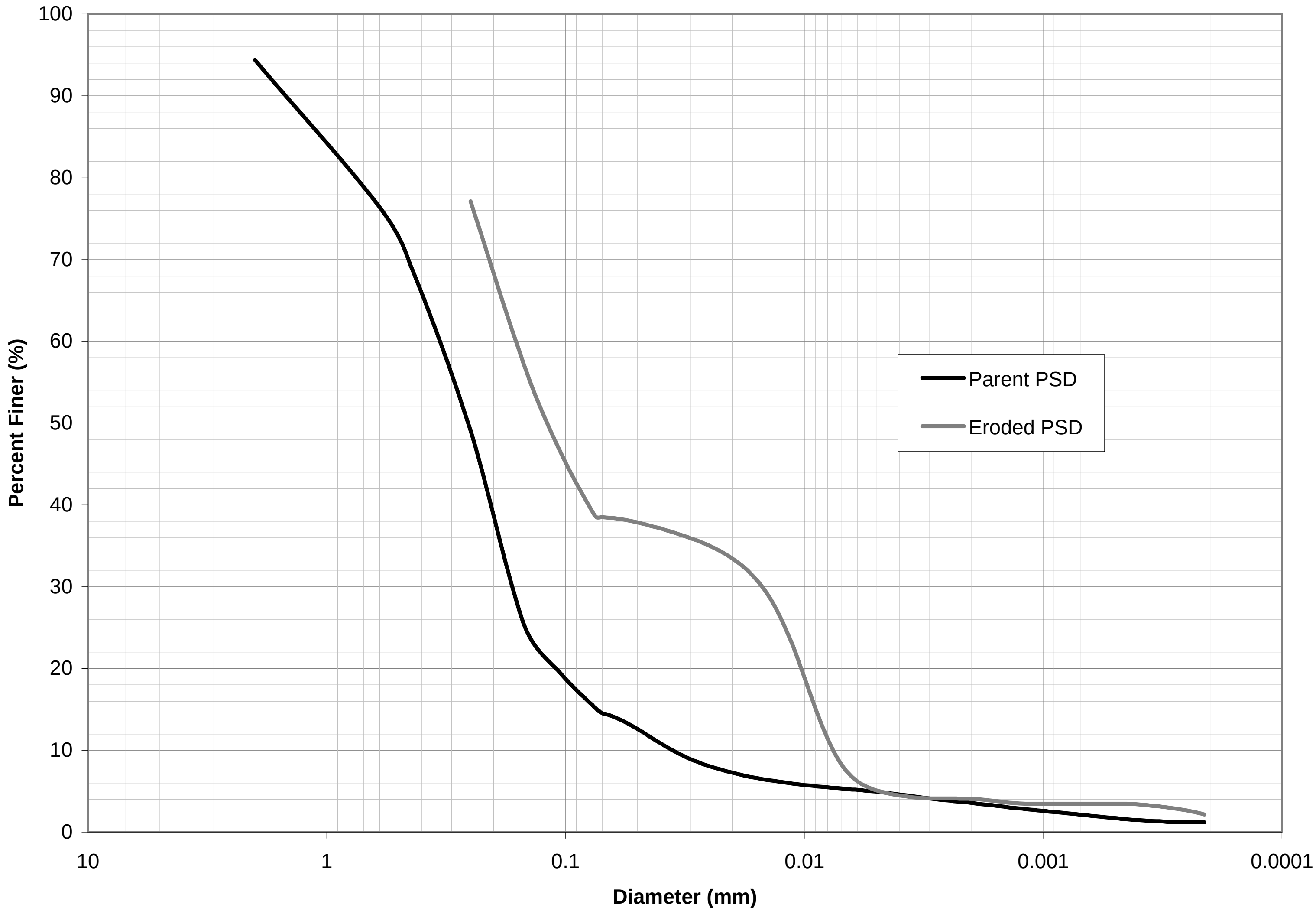


Figure 17: Combined Particle Size Distributions Chart for Sample NMC



4.4 Sample NMD: "Coarse Loamy"

Average total sediment mass yielded during rainfall simulator test: 54.46g
Average mass of EPSD coarser than 0.250 mm: 14.38g

4.4.1 Description

a) Texture: fine sand with silts and fine gravels.
b) Color: light brown.
c) Fine fraction (< 0.075%): 12.687%
d) USDA Textural Classification: SAND

4.4.2 K – Factor Calculation

Organic Material: 1.812%
Percent Silt + Very Fine Sand (0.002 – 0.1 mm): 15.0%
Percent Sand (0.1 – 2 mm): 79.86%

First Approximation: **K = 0.07**

4.4.3 Parent Particle Size Distribution

Table 7: Parent Particle Size Distribution for Sample NMD

Diameter (mm)	Average Percent Finer (%)
2	97.568
0.6	89.006
0.425	82.521
0.25	57.564
0.15	23.865
0.106	17.704
0.075	12.687
0.07079	11.997
0.06683	11.753
0.0631	11.456
0.05957	11.120
0.05623	10.727
0.05309	10.308
0.05012	9.863
0.04732	9.401
0.04467	8.935
0.04217	8.469
0.03981	8.033
0.03758	7.620
0.03548	7.237
0.0335	6.889
0.03162	6.580
0.02985	6.306
0.02818	6.067
0.02661	5.854
0.02512	5.667
0.02371	5.493
0.02239	5.336
0.02113	5.192
0.01995	5.062
0.01884	4.944
0.01778	4.826
0.01679	4.726
0.01585	4.626
0.01496	4.534
0.01413	4.447
0.01334	4.369
0.01259	4.295
0.01189	4.221
0.01122	4.156
0.01059	4.091
0.01	4.043
0.009441	3.991
0.008913	3.948
0.008414	3.913
0.007943	3.878
0.007499	3.847
0.007079	3.816
0.006683	3.790
0.00631	3.759
0.005957	3.729
0.005623	3.690
0.005309	3.646
0.005012	3.598
0.004732	3.546
0.004467	3.481
0.004217	3.411
0.003981	3.342
0.003758	3.263
0.003548	3.190
0.00335	3.107
0.003162	3.037
0.002985	2.967
0.002818	2.906
0.002661	2.854
0.002512	2.810
0.002371	2.771
0.002239	2.731
0.002113	2.697
0.001995	2.662
0.001884	2.622
0.001778	2.570
0.001679	2.518
0.001585	2.452
0.001496	2.391
0.001413	2.322
0.001334	2.248
0.001259	2.183
0.001189	2.122
0.001122	2.061
0.001059	1.999
0.001	1.947
0.000944	1.886
0.000891	1.838
0.000841	1.781
0.000794	1.720
0.00075	1.668
0.000708	1.607
0.000668	1.546
0.000631	1.481
0.000596	1.416
0.000562	1.355
0.000531	1.290
0.000501	1.225
0.000473	1.169
0.000447	1.121
0.000422	1.074
0.000398	1.035
0.000376	0.996
0.000355	0.970
0.000335	0.943
0.000316	0.912
0.000299	0.881
0.000282	0.837
0.000266	0.788
0.000251	0.730

Figure 18: Parent Particle Size Distributions Chart for Sample NMD

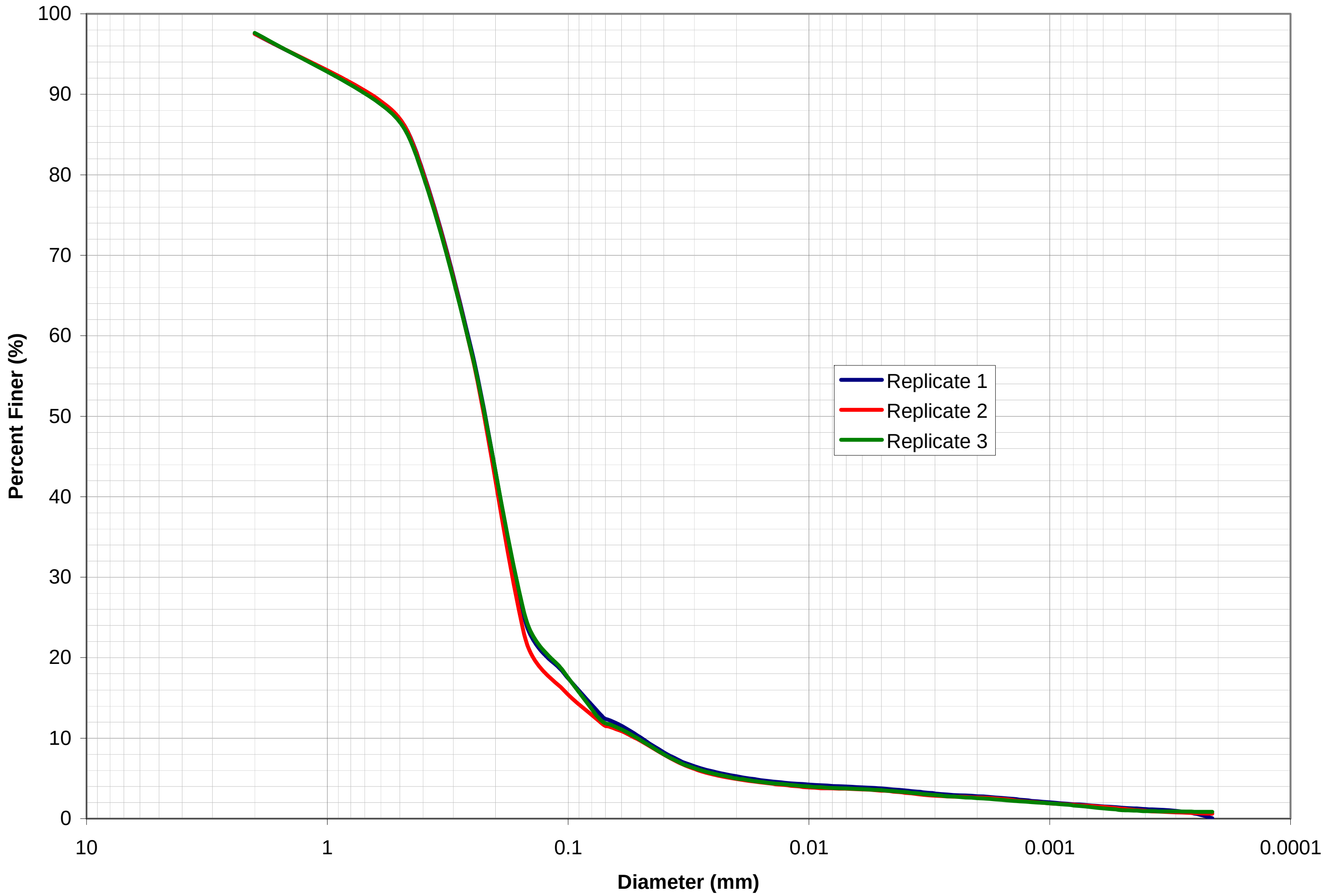
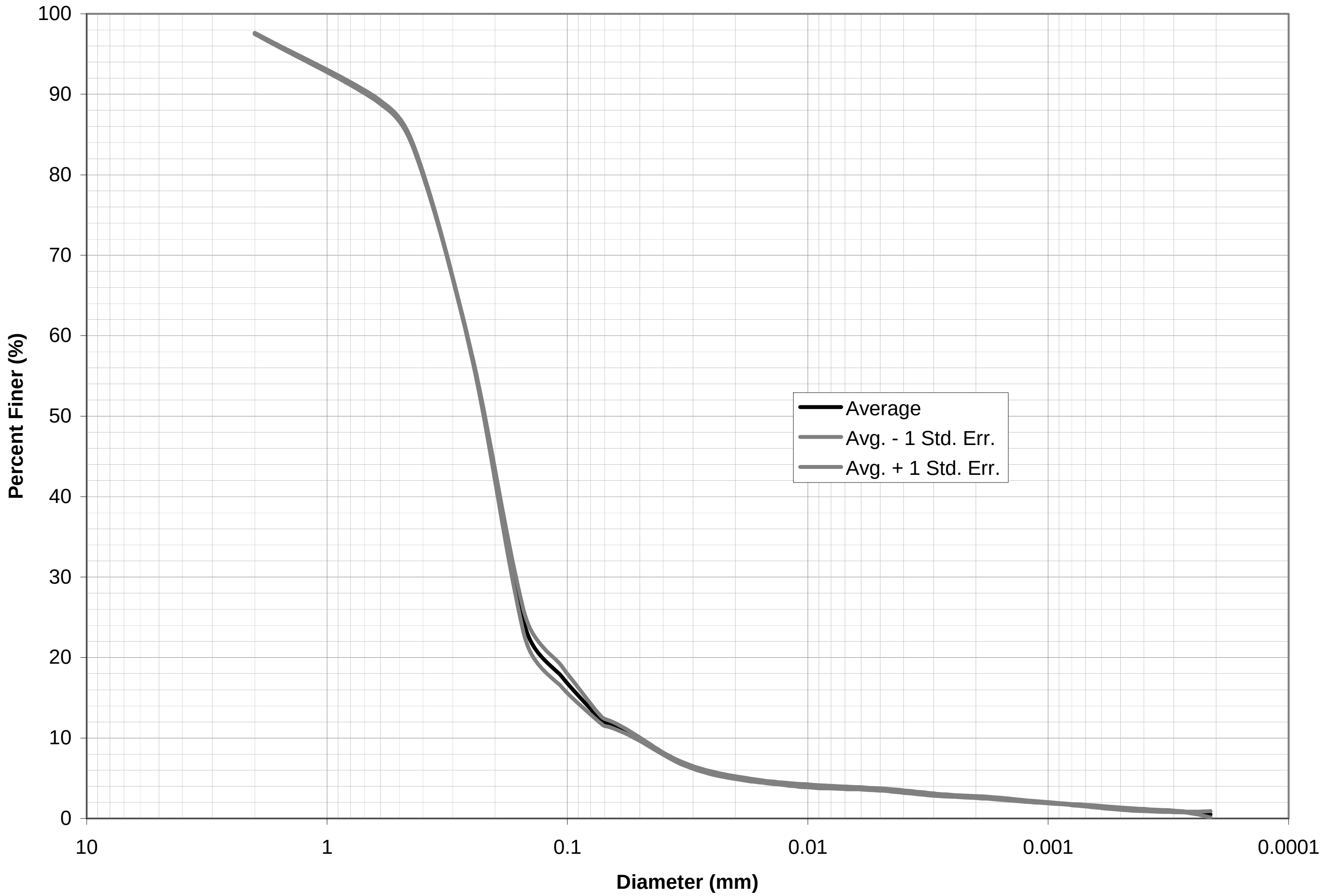


Figure 19: Average Parent Particle Size Distribution Chart for Sample NMD



4.4.4 Eroded Particle Size Distribution

Table 8: Eroded Particle Size Distribution for Sample NMD

Diameter (mm)	Average Percent Finer (%)
0.25	70.762
0.15	45.246
0.106	37.534
0.075	32.679
0.07079	32.669
0.06683	32.659
0.0631	32.640
0.05957	32.621
0.05623	32.582
0.05309	32.534
0.05012	32.467
0.04732	32.390
0.04467	32.289
0.04217	32.166
0.03981	32.052
0.03758	31.928
0.03548	31.818
0.0335	31.694
0.03162	31.608
0.02985	31.508
0.02818	31.421
0.02661	31.325
0.02512	31.215
0.02371	31.100
0.02239	30.980
0.02113	30.837
0.01995	30.684
0.01884	30.532
0.01778	30.365
0.01679	30.165
0.01585	29.955
0.01496	29.727
0.01413	29.455
0.01334	29.141
0.01259	28.765
0.01189	28.318
0.01122	27.808
0.01059	27.171
0.01	26.409
0.009441	25.501
0.008913	24.412
0.008414	23.111
0.007943	21.599
0.007499	19.885
0.007079	17.989
0.006683	15.969
0.00631	13.910
0.005957	11.902
0.005623	10.027
0.005309	8.362
0.005012	6.956
0.004732	5.810
0.004467	4.963
0.004217	4.323
0.003981	3.907
0.003758	3.631
0.003548	3.453
0.00335	3.345
0.003162	3.288
0.002985	3.246
0.002818	3.212
0.002661	3.203
0.002512	3.193
0.002371	3.183
0.002239	3.174
0.002113	3.164
0.001995	3.145
0.001884	3.126
0.001778	3.097
0.001679	3.058
0.001585	3.020
0.001496	2.963
0.001413	2.897
0.001334	2.831
0.001259	2.775
0.001189	2.728
0.001122	2.704
0.001059	2.690
0.001	2.690
0.000944	2.690
0.000891	2.690
0.000841	2.690
0.000794	2.690
0.00075	2.690
0.000708	2.690
0.000668	2.690
0.000631	2.690
0.000596	2.690
0.000562	2.690
0.000531	2.690
0.000501	2.690
0.000473	2.690
0.000447	2.690
0.000422	2.690
0.000398	2.690
0.000376	2.681
0.000355	2.662
0.000335	2.643
0.000316	2.624
0.000299	2.562
0.000282	2.477
0.000266	2.392
0.000251	2.283
0.000237	2.169
0.000224	2.042
0.000211	1.928

Figure 20: Eroded Particle Size Distributions Chart for Sample NMD

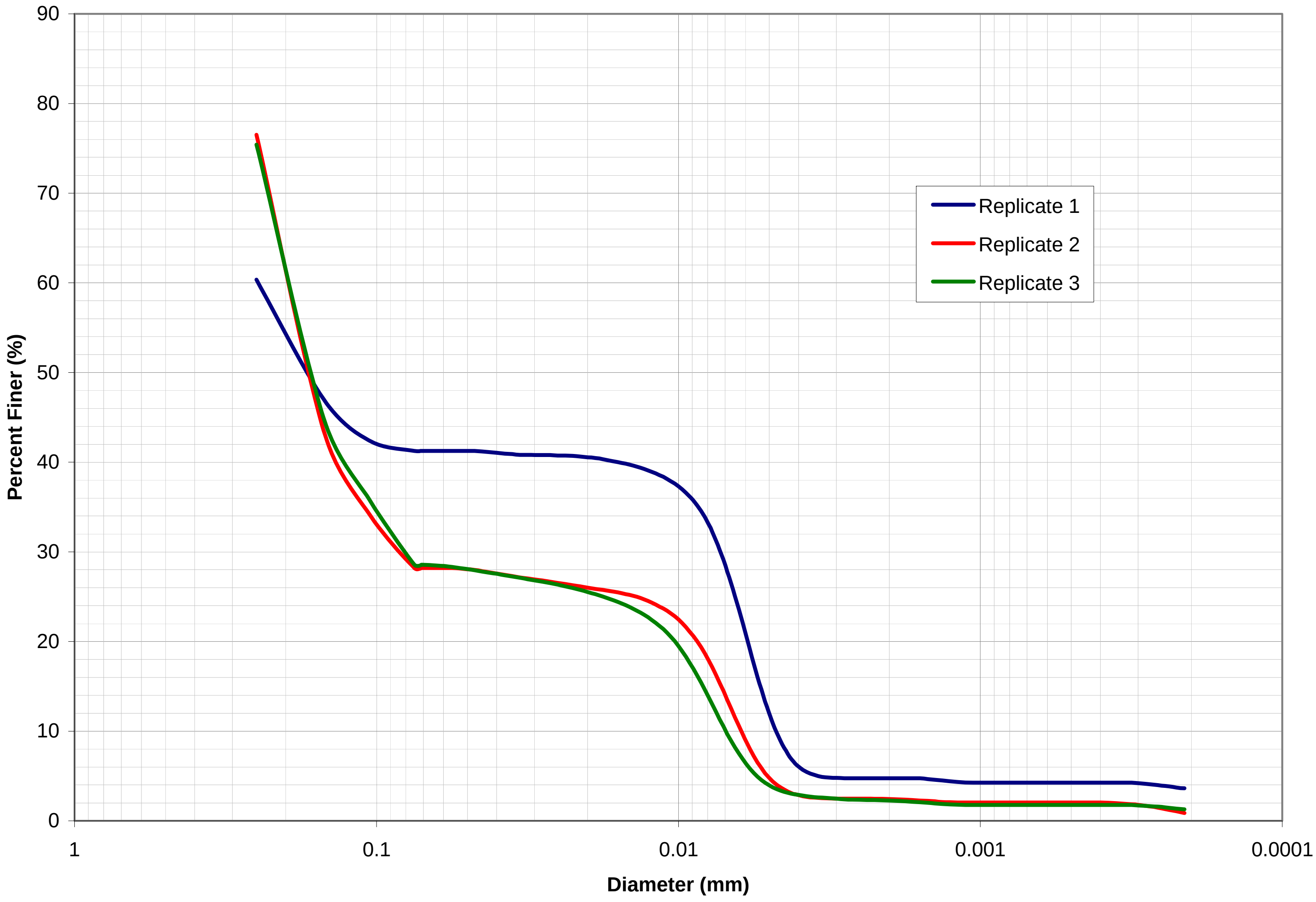


Figure 21: Average Eroded Particle Size Distribution Chart for Sample NMD

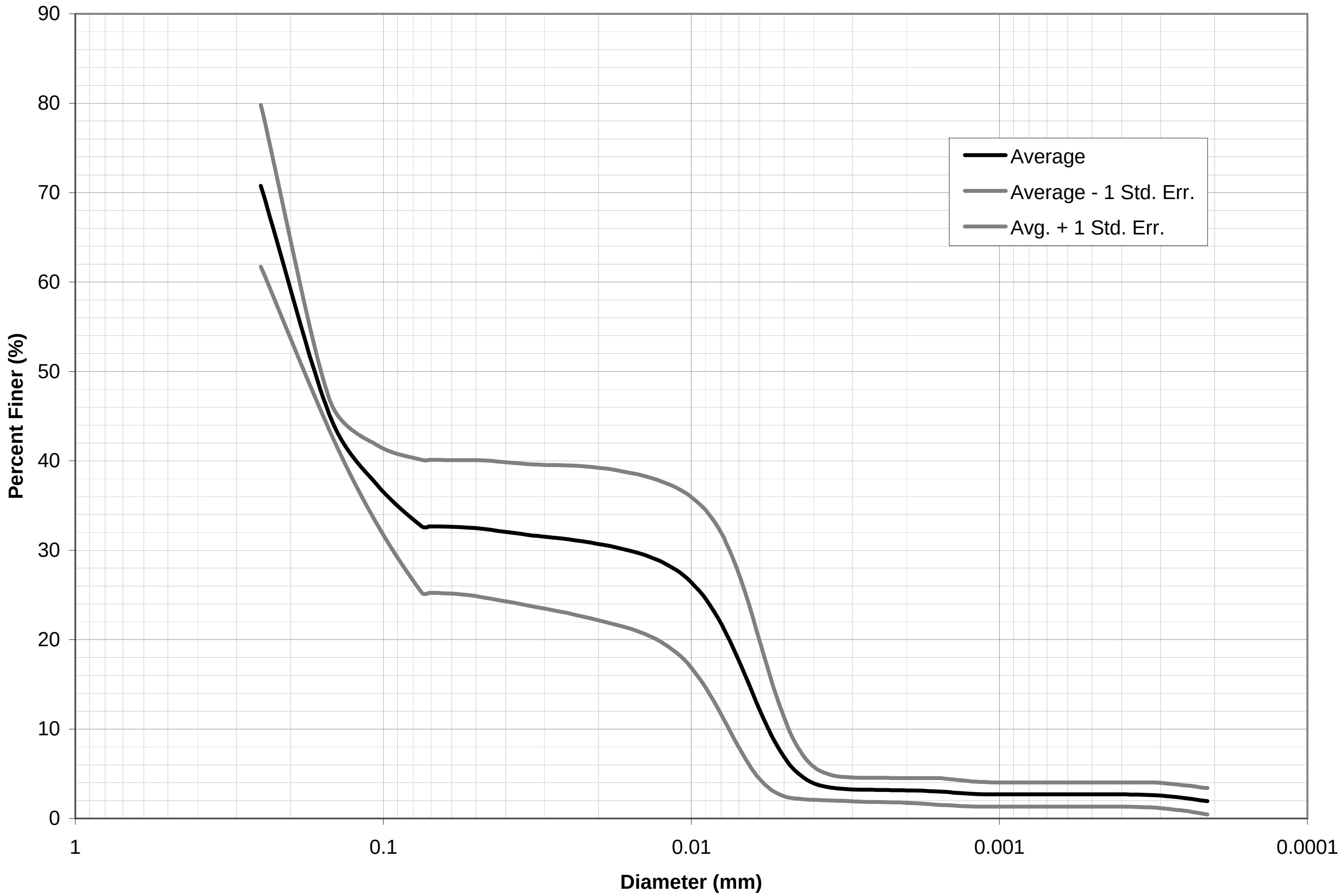
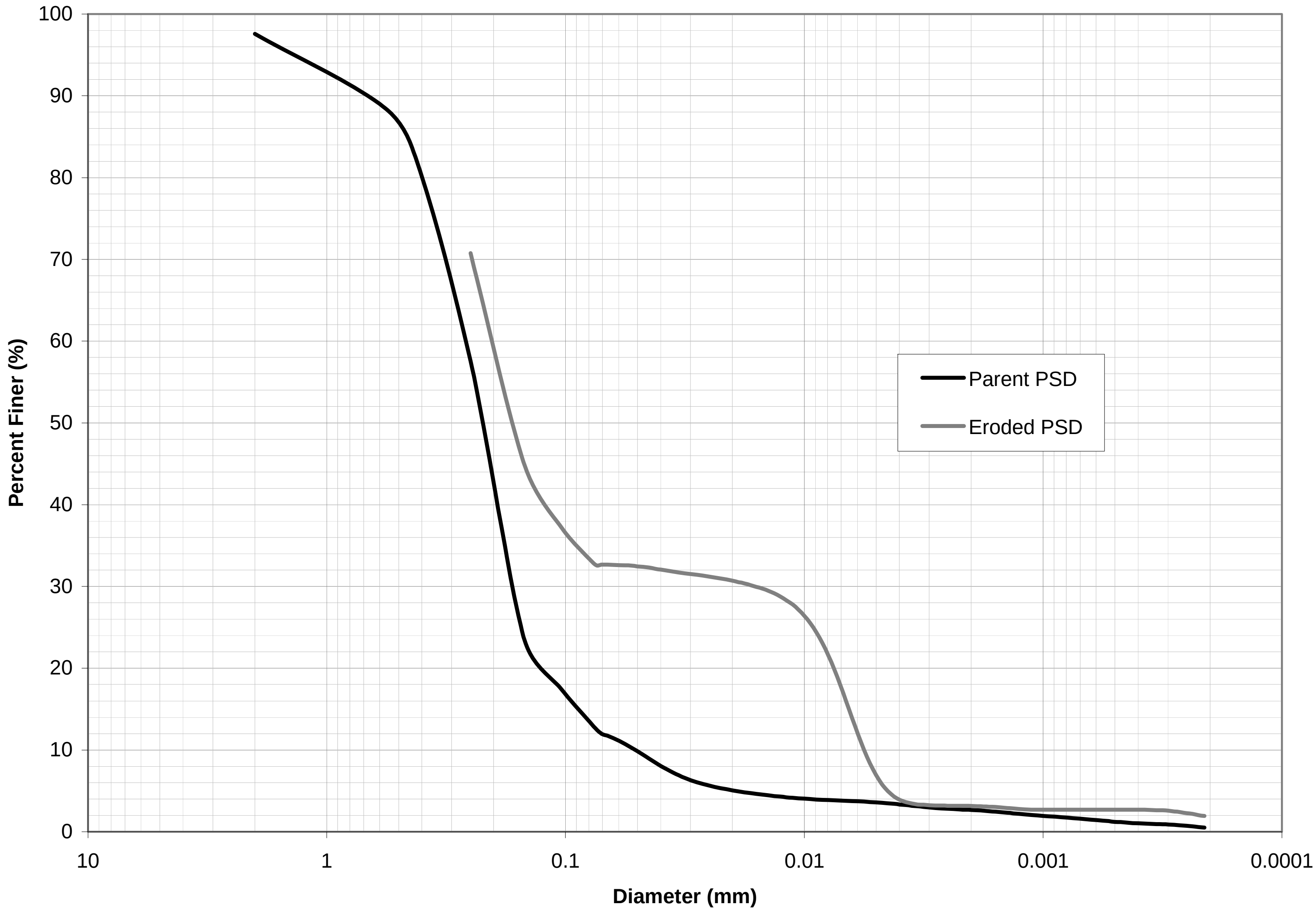


Figure 22: Combined Particle Size Distributions Chart for Sample NMD



5. References

1. Haan, C.T., Barfield, B.J. and Hayes, J.C. Design Hydrology and Sedimentology for Small Catchments. Academic Press, 1994.

2. Toy, T.J., Foster, G.R. Guidelines for the Use of the Revised Universal Soil Loss Equation (RUSLE) Version 1.06 on Mined Lands, Constructed Sites, and Reclaimed Lands. Office of Surface Mining, 1998.

3. Renard, K.G., Foster, G.R., Weesies, G.A., McCool, D.K., and D.C. Yoder, coordinators. 1996. USDA-ARS. Agriculture Handbook No. 703: Predicting soil erosion by water - a guide to conservation planning with the revised universal soil loss equation (RUSLE). Soil and Water Conservation Society office, Ankeny, IA.

4. USDA National Soil Erosion Research Laboratory. 1995. USDA - Water Erosion Prediction Project (WEPP) User Summary. NSERL Report N0.11, July 1995.

APPENDIX A: PHOTOS TAKEN DURING EPSD TESTING

Figure 23: Rainfall Simulator – General View

Figure 24: Rainfall Simulator – Soil Samples

Figure 25: Rainfall Simulator – Soil Samples (details)

Figure 26: Wet Sieve Test

Figure 27: Dry Sieve Test

Attachment 18.B-7

Baseline K-factor Laboratory Determination January 2008

Inter-Mountain Labs, Inc
1673 Terra Ave, Sheridan, Wyoming, 82801
(307) 672-8945

Soil Analysis Report
BHP Billiton

300 W Arrington, Suite 200
Farmington, NM 87401

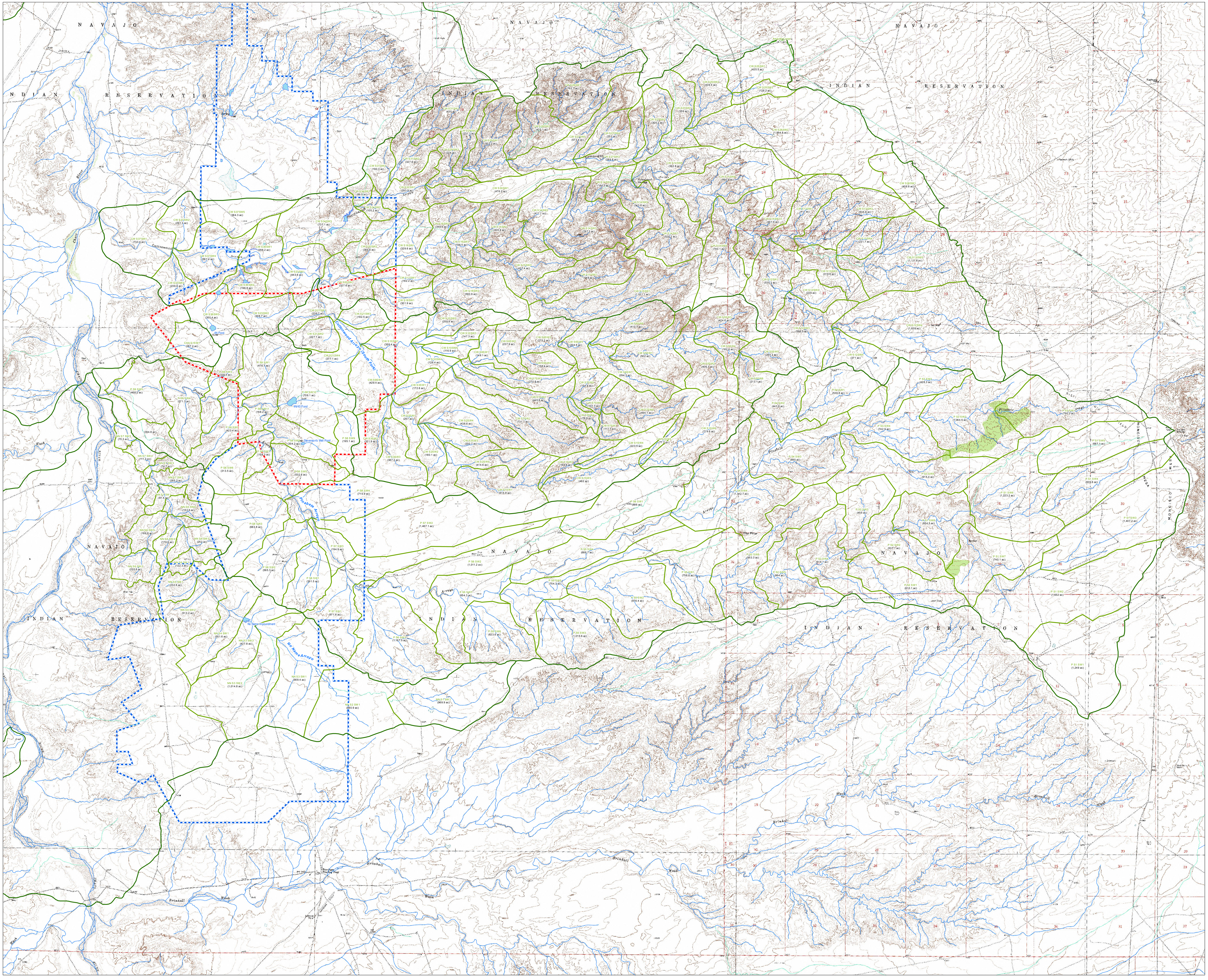
Project ID: NMEP Erodibility
Date Received: 1/10/2008

Report ID: S0801141001
Date Reported: 1/30/2008
Work Order: S0801141

Lab ID	Sample ID	Organic Matter %	Sand %	Silt %	Clay %	Very Fine Sand %	Texture	K-factor (t.ac.h/100acft.tf.in)	Structure s	Permeability p	M	Description
S0801141-001	Fine	4.7	39.0	31.0	30.0	9.3	Clay Loam	0.19	3	4	2821.0	OM - Walkley/Black
S0801141-002	Fine Loamy	1.1	53.0	26.0	21.0	12.6	Sandy Clay Loam	0.27	3	4	3049.4	OM - Walkley/Black
S0801141-003	Sandy	0.1	85.0	7.0	8.0	8.1	Loamy Sand	0.10	3	2	1389.2	OM - Walkley/Black
S0801141-004	Coarse Loamy	0.5	70.0	16.0	14.0	15.5	Sandy Loam	0.21	3	2	2709.0	OM - Walkley/Black
S0801141-001	Fine	4.5	39.0	31.0	30.0	9.3	Clay Loam	0.19	3	4	2821.0	OM - Walkley/Black w/o coal
S0801141-002	Fine Loamy	1.0	53.0	26.0	21.0	12.6	Sandy Clay Loam	0.27	3	4	3049.4	OM - Walkley/Black
S0801141-003	Sandy	0.1	85.0	7.0	8.0	8.1	Loamy Sand	0.10	3	2	1389.2	OM - Walkley/Black
S0801141-004	Coarse Loamy	0.5	70.0	16.0	14.0	15.5	Sandy Loam	0.21	3	2	2709.0	OM - Walkley/Black
S0801141-001	Fine	4.7	39.0	31.0	30.0	9.3	Clay Loam	0.19	3	4	2821.0	OM - LOI
S0801141-002	Fine Loamy	1.8	53.0	26.0	21.0	12.6	Sandy Clay Loam	0.26	3	4	3049.4	OM - LOI
S0801141-003	Sandy	0.6	85.0	7.0	8.0	8.1	Loamy Sand	0.10	3	2	1389.2	OM - LOI
S0801141-004	Coarse Loamy	1.2	70.0	16.0	14.0	15.5	Sandy Loam	0.19	3	2	2709.0	OM - LOI
S0801141-001	Fine	3.4	39.0	31.0	30.0	9.3	Clay Loam	0.21	3	4	2821.0	OM - LOI w/o coal
S0801141-002	Fine Loamy	1.6	53.0	26.0	21.0	12.6	Sandy Clay Loam	0.26	3	4	3049.4	OM - LOI
S0801141-003	Sandy	0.5	85.0	7.0	8.0	8.1	Loamy Sand	0.10	3	2	1389.2	OM - LOI
S0801141-004	Coarse Loamy	0.9	70.0	16.0	14.0	15.5	Sandy Loam	0.20	3	2	2709.0	OM - LOI

These Results apply only to the samples tested.

Reviewed by: ______________________
Chris Johnston, Soil Scientist



Legend

- SEDCAD Subwatersheds
- Watershed Boundaries [1]
- Ponds
- Artificial Canal/Ditch [1]
- Natural Stream [1]
- SMCRA Permit Boundary
- BNCC Lease and ROWs
- BNCC Resource Areas

Data Sources:
[1] Natioanl Hydrography Dataset

Coordinate System:
NAD 1927 State Plane New Mexico West FIPS 3003
Projection: Transverse Mercator
Datum: North American 1927

Units: Foot US

N

0 | 1,250 | 2,500 | 5,000 | 7,500 Feet
1:30,000

REV. No.	DATE	DRAFT BY	REVISION DESCRIPTION	ENG.	EQD.	PE.	
12-A	3/12/14	MPO	Prepared for Submittal to OSM		CKA		

APPROVALS

Exhibit 18.B-1

bhpbilliton
resourcing the future

BHP NAVAJO COAL COMPANY

Pinabete Permit Area
SEDCAD Subwatersheds

PREPARED BY: MD	DRAWN BY: MPO	PAPER SIZE: ARCH E
APPROVED BY: CKA	DATE: 3/12/12	

Appendix 18.C

Laboratory Reports for Pesticide and PCB Analyses of Pond Waters

Green Analytical 75 Suttle Street Durango CO, 81303	Project: BHP Project Number: [none] Project Manager: Debbie Zufelt	**Reported:** 04/22/08 14:33

Mid Penabete
T800496-02 (Water)

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
		SunStar Laboratories, Inc.							
Organochlorine Pesticides by EPA Method 8081A									
alpha-BHC	ND	1.00	ug/l	1	8041610	04/16/08	04/17/08	EPA 8081A	
gamma-BHC (Lindane)	ND	1.00	"	"	"	"	"	"	
beta-BHC	ND	1.00	"	"	"	"	"	"	
delta-BHC	ND	1.00	"	"	"	"	"	"	
Heptachlor	ND	1.00	"	"	"	"	"	"	
Aldrin	ND	1.00	"	"	"	"	"	"	
Heptachlor epoxide	ND	1.00	"	"	"	"	"	"	
gamma-Chlordane	ND	1.00	"	"	"	"	"	"	
alpha-Chlordane	ND	1.00	"	"	"	"	"	"	
Endosulfan I	ND	1.00	"	"	"	"	"	"	
4,4′-DDE	ND	1.00	"	"	"	"	"	"	
Dieldrin	ND	1.00	"	"	"	"	"	"	
Endrin	ND	1.00	"	"	"	"	"	"	
4,4′-DDD	ND	1.00	"	"	"	"	"	"	
Endosulfan II	ND	1.00	"	"	"	"	"	"	
4,4′-DDT	ND	2.00	"	"	"	"	"	"	
Endrin aldehyde	ND	1.00	"	"	"	"	"	"	
Endosulfan sulfate	ND	1.00	"	"	"	"	"	"	
Methoxychlor	ND	5.00	"	"	"	"	"	"	
Endrin ketone	ND	1.00	"	"	"	"	"	"	
Toxaphene	ND	20.0	"	"	"	"	"	"	
Surrogate: Tetrachloro-meta-xylene		*73.3 %*	*35-140*		"	"	"	"	
Polychlorinated Biphenyls by EPA Method 8082									
PCB-1016	ND	2.00	ug/l	1	8041611	04/16/08	04/17/08	EPA 8082	
PCB-1221	ND	2.00	"	"	"	"	"	"	
PCB-1232	ND	2.00	"	"	"	"	"	"	
PCB-1242	ND	2.00	"	"	"	"	"	"	
PCB-1248	ND	2.00	"	"	"	"	"	"	
PCB-1254	ND	2.00	"	"	"	"	"	"	
PCB-1260	ND	2.00	"	"	"	"	"	"	
Surrogate: Tetrachloro-meta-xylene		*68.4 %*	*35-140*		"	"	"	"	

CARDINAL LABORATORIES

PHONE (575) 393-2326 • 101 E. MARLAND • HOBBS, NM 88240

ANALYTICAL RESULTS FOR
GREEN ANALYTICAL LABORATORIES, INC.
ATTN: DEBBIE ZUFELT
75 SUTTLE STREET
DURANGO, CO 81303
FAX TO: (970) 247-4227

Receiving Date: 08/14/08
Reporting Date: 09/03/08
Project Number: 808-067-02
Project Name: BHP BILLITON NMEP
Project Location: NOT GIVEN
Lab Number: H15736-1
Sample ID: POND EAST OF L. PINABETE

Analysis Date: 08/21/08
Sampling Date: 08/12/08
Sample Type: SURFACE WATER
Sample Condition: COOL & INTACT
Sample Received By: ML
Analyzed By: CK

AROCLORS (PCB's) (mg/L)	Sample Result H15736-1	Method Blank	QC	True Value QC	%IA
PCB 1016	<0.020	<0.020	0.115	0.100	115
PCB 1221	<0.020	<0.020	NR	NR	NR
PCB 1232	<0.020	<0.020	NR	NR	NR
PCB 1242	<0.020	<0.020	0.082	0.100	82.1
PCB 1248	<0.020	<0.020	NR	NR	NR
PCB 1254	<0.020	<0.020	0.079	0.100	79.4
PCB 1260	<0.020	<0.020	0.093	0.100	92.5

	% Recovery
Nitrobenzene-d5	17.1
2-Fluorobiphenyl	22.3
Terphenyl-d14	0.0*

METHOD: SW-846 3510, 8270

*Note: Surrogate outside historical limits due to matrix interference.

Lab Director

09/03/08
Date

H15736PCB CAL

PLEASE NOTE: Liability and Damages. Cardinal's liability and client's exclusive remedy for any claim arising, whether based in contract or tort, shall be limited to the amount paid by client for analyses. All claims, including those for negligence and any other cause whatsoever shall be deemed waived unless made in writing and received by Cardinal within thirty (30) days after completion of the applicable service. In no event shall Cardinal be liable for incidental or consequential damages, including, without limitation, business interruptions, loss of use, or loss of profits incurred by client, its subsidiaries, affiliates or successors arising out of or related to the performance of services hereunder by Cardinal, regardless of whether such claim is based upon any of the above-stated reasons or otherwise. Results relate only to the samples identified above. This report shall not be reproduced except in full with written approval of Cardinal Laboratories.

Green Analytical 75 Suttle Street Durango CO, 81303	Project: GA Project Number: [none] Project Manager: Debbie Zufelt	**Reported:** 05/20/08 14:45

Pond East of Lower Pinabete
T800629-01 (Water)

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
SunStar Laboratories, Inc.									
Organochlorine Pesticides by EPA Method 8081A									
alpha-BHC	ND	1.00	ug/l	1	8051408	05/14/08	05/15/08	EPA 8081A	
gamma-BHC (Lindane)	ND	1.00	"	"	"	"	"	"	
beta-BHC	ND	1.00	"	"	"	"	"	"	
delta-BHC	ND	1.00	"	"	"	"	"	"	
Heptachlor	ND	1.00	"	"	"	"	"	"	
Aldrin	ND	1.00	"	"	"	"	"	"	
Heptachlor epoxide	ND	1.00	"	"	"	"	"	"	
gamma-Chlordane	ND	1.00	"	"	"	"	"	"	
alpha-Chlordane	ND	1.00	"	"	"	"	"	"	
Endosulfan I	ND	1.00	"	"	"	"	"	"	
4,4'-DDE	ND	1.00	"	"	"	"	"	"	
Dieldrin	ND	1.00	"	"	"	"	"	"	
Endrin	ND	1.00	"	"	"	"	"	"	
4,4'-DDD	ND	1.00	"	"	"	"	"	"	
Endosulfan II	ND	1.00	"	"	"	"	"	"	
4,4'-DDT	ND	2.00	"	"	"	"	"	"	
Endrin aldehyde	ND	1.00	"	"	"	"	"	"	
Endosulfan sulfate	ND	1.00	"	"	"	"	"	"	
Methoxychlor	ND	5.00	"	"	"	"	"	"	
Endrin ketone	ND	1.00	"	"	"	"	"	"	
Toxaphene	ND	20.0	"	"	"	"	"	"	
Surrogate: Tetrachloro-meta-xylene		*101 %*	*35-140*		"	"	"	"	
Polychlorinated Biphenyls by EPA Method 8082									
PCB-1016	ND	2.00	ug/l	1	8051407	05/14/08	05/15/08	EPA 8082	
PCB-1221	ND	2.00	"	"	"	"	"	"	
PCB-1232	ND	2.00	"	"	"	"	"	"	
PCB-1242	ND	2.00	"	"	"	"	"	"	
PCB-1248	ND	2.00	"	"	"	"	"	"	
PCB-1254	ND	2.00	"	"	"	"	"	"	
PCB-1260	ND	2.00	"	"	"	"	"	"	
Surrogate: Tetrachloro-meta-xylene		*84.7 %*	*35-140*		"	"	"	"	

CARDINAL LABORATORIES

PHONE (575) 393-2326 • 101 E. MARLAND • HOBBS, NM 88240

ANALYTICAL RESULTS FOR
GREEN ANALYTICAL LABORATORIES, INC.
ATTN: DEBBIE ZUFELT
75 SUTTLE STREET
DURANGO, CO 81303
FAX TO: (970) 247-4227

Receiving Date: 08/14/08
Reporting Date: 09/03/08
Project Number: 808-067-02
Project Name: BHP BILLITON NMEP
Project Location: NOT GIVEN
Sample ID: POND EAST OF L. PINABETE
Lab Number: H15736-1

Extraction Date: 08/19/08
Analysis Date: 09/02/08
Sampling Date: 08/12/08
Sample Type: SURFACE WATER
Sample Condition: COOL & INTACT
Sample Received By: ML
Analyzed By: CK

PESTICIDES (mg/L)	Sample Result H15736-1	Method Blank	QC	%IA	True Value QC
4,4'-DDE	<0.020	<0.002	0.050	99.1	0.050
4,4'-DDD	<0.050	<0.005	0.044	88.3	0.050
4,4'-DDT	<0.100	<0.010	0.062	124	0.050
Chlordane	<0.200	<0.020	0.091	91.1	0.100

	% Recovery
Nitrobenzene-d5	6.60*
2-Fluorobiphenyl	5.15*
Terphenyl-d14	0.0*

METHODS: EPA SW-846 8270

*Note: Surrogate recovery outside historical limits due to matrix interference and sample dilution.

Chemist

09/03/08
Date

PLEASE NOTE: Liability and Damages. Cardinal's liability and client's exclusive remedy for any claim arising, whether based in contract or tort, shall be limited to the amount paid by client for analyses. All claims, including those for negligence and any other cause whatsoever shall be deemed waived unless made in writing and received by Cardinal within thirty (30) days after completion of the applicable service. In no event shall Cardinal be liable for incidental or consequential damages, including, without limitation, business interruptions, loss of use, or loss of profits incurred by client, its subsidiaries, affiliates or successors arising out of or related to the performance of services hereunder by Cardinal, regardless of whether such claim is based upon any of the above-stated reasons or otherwise. Results relate only to the samples identified above. This report shall not be reproduced except in full with written approval of Cardinal Laboratories.

Green Analytical 75 Suttle Street Durango CO, 81303	Project: BHP Project Number: [none] Project Manager: Debbie Zufelt	**Reported:** 04/22/08 14:33

Mid No Name
T800496-01 (Water)

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
		SunStar Laboratories, Inc.							
Organochlorine Pesticides by EPA Method 8081A									
alpha-BHC	ND	1.00	ug/l	1	8041610	04/16/08	04/17/08	EPA 8081A	
gamma-BHC (Lindane)	ND	1.00	"	"	"	"	"	"	
beta-BHC	ND	1.00	"	"	"	"	"	"	
delta-BHC	ND	1.00	"	"	"	"	"	"	
Heptachlor	ND	1.00	"	"	"	"	"	"	
Aldrin	ND	1.00	"	"	"	"	"	"	
Heptachlor epoxide	ND	1.00	"	"	"	"	"	"	
gamma-Chlordane	ND	1.00	"	"	"	"	"	"	
alpha-Chlordane	ND	1.00	"	"	"	"	"	"	
Endosulfan I	ND	1.00	"	"	"	"	"	"	
4,4′-DDE	ND	1.00	"	"	"	"	"	"	
Dieldrin	ND	1.00	"	"	"	"	"	"	
Endrin	ND	1.00	"	"	"	"	"	"	
4,4′-DDD	ND	1.00	"	"	"	"	"	"	
Endosulfan II	ND	1.00	"	"	"	"	"	"	
4,4′-DDT	ND	2.00	"	"	"	"	"	"	
Endrin aldehyde	ND	1.00	"	"	"	"	"	"	
Endosulfan sulfate	ND	1.00	"	"	"	"	"	"	
Methoxychlor	ND	5.00	"	"	"	"	"	"	
Endrin ketone	ND	1.00	"	"	"	"	"	"	
Toxaphene	ND	20.0	"	"	"	"	"	"	
Surrogate: Tetrachloro-meta-xylene		*70.6 %*	*35-140*		"	"	"	"	
Polychlorinated Biphenyls by EPA Method 8082									
PCB-1016	ND	2.00	ug/l	1	8041611	04/16/08	04/17/08	EPA 8082	
PCB-1221	ND	2.00	"	"	"	"	"	"	
PCB-1232	ND	2.00	"	"	"	"	"	"	
PCB-1242	ND	2.00	"	"	"	"	"	"	
PCB-1248	ND	2.00	"	"	"	"	"	"	
PCB-1254	ND	2.00	"	"	"	"	"	"	
PCB-1260	ND	2.00	"	"	"	"	"	"	
Surrogate: Tetrachloro-meta-xylene		*68.0 %*	*35-140*		"	"	"	"	

CARDINAL LABORATORIES

PHONE (575) 393-2326 • 101 E. MARLAND • HOBBS, NM 88240

ANALYTICAL RESULTS FOR
GREEN ANALYTICAL LABORATORIES, INC.
ATTN: DEBBIE ZUFELT
75 SUTTLE STREET
DURANGO, CO 81303
FAX TO: (970) 247-4227

Receiving Date: 08/14/08
Reporting Date: 09/03/08
Project Number: 808-067-06
Project Name: BHP BILLITON NMEP
Project Location: NOT GIVEN
Lab Number: H15736-2
Sample ID: POND ALONG NO NAME

Analysis Date: 08/21/08
Sampling Date: 08/12/08
Sample Type: SURFACE WATER
Sample Condition: COOL & INTACT
Sample Received By: ML
Analyzed By: CK

AROCLORS (PCB's) (mg/L)	Sample Result H15736-2	Method Blank	QC	True Value QC	%IA
PCB 1016	<0.020	<0.020	0.115	0.100	115
PCB 1221	<0.020	<0.020	NR	NR	NR
PCB 1232	<0.020	<0.020	NR	NR	NR
PCB 1242	<0.020	<0.020	0.082	0.100	82.1
PCB 1248	<0.020	<0.020	NR	NR	NR
PCB 1254	<0.020	<0.020	0.079	0.100	79.4
PCB 1260	<0.020	<0.020	0.093	0.100	92.5

	% Recovery
Nitrobenzene-d5	49.2
2-Fluorobiphenyl	99.9
Terphenyl-d14	0.0*

METHOD: SW-846 3510, 8270

*Note: Surrogate outside historical limits due to matrix interference.

[signature]
Lab Director

09/03/08
Date

H15736PCB.GAL

PLEASE NOTE: Liability and Damages. Cardinal's liability and client's exclusive remedy for any claim arising, whether based in contract or tort, shall be limited to the amount paid by client for analyses. All claims, including those for negligence and any other cause whatsoever shall be deemed waived unless made in writing and received by Cardinal within thirty (30) days after completion of the applicable service. In no event shall Cardinal be liable for incidental or consequential damages, including, without limitation, business interruptions, loss of use, or loss of profits incurred by client, its subsidiaries, affiliates or successors arising out of or related to the performance of services hereunder by Cardinal, regardless of whether such claim is based upon any of the above-stated reasons or otherwise. Results relate only to the samples identified above. This report shall not be reproduced except in full with written approval of Cardinal Laboratories.

CARDINAL LABORATORIES

PHONE (575) 393-2326 • 101 E. MARLAND • HOBBS, NM 88240

ANALYTICAL RESULTS FOR
GREEN ANALYTICAL LABORATORIES, INC.
ATTN: DEBBIE ZUFELT
75 SUTTLE STREET
DURANGO, CO 81303
FAX TO: (970) 247-4227

Receiving Date: 08/14/08
Reporting Date: 09/03/08
Project Number: 808-067-12
Project Name: BHP BILLITON NMEP
Project Location: NOT GIVEN
Lab Number: H15736-3
Sample ID: WELL SITE POND

Analysis Date: 08/21/08
Sampling Date: 08/12/08
Sample Type: SURFACE WATER
Sample Condition: COOL & INTACT
Sample Received By: ML
Analyzed By: CK

AROCLORS (PCB's) (mg/L)	Sample Result H15736-3	Method Blank	QC	True Value QC	%IA
PCB 1016	<0.020	<0.020	0.115	0.100	115
PCB 1221	<0.020	<0.020	NR	NR	NR
PCB 1232	<0.020	<0.020	NR	NR	NR
PCB 1242	<0.020	<0.020	0.082	0.100	82.1
PCB 1248	<0.020	<0.020	NR	NR	NR
PCB 1254	<0.020	<0.020	0.079	0.100	79.4
PCB 1260	<0.020	<0.020	0.093	0.100	92.5

	% Recovery
Nitrobenzene-d5	62.2
2-Fluorobiphenyl	95.2
Terphenyl-d14	0.0*

METHOD: SW-846 3510, 8270

*Note: Surrogate outside historical limits due to matrix interference.

Lab Director

Date 09/03/08

H15736PCB GAL

PLEASE NOTE: Liability and Damages. Cardinal's liability and client's exclusive remedy for any claim arising, whether based in contract or tort, shall be limited to the amount paid by client for analyses. All claims, including those for negligence and any other cause whatsoever shall be deemed waived unless made in writing and received by Cardinal within thirty (30) days after completion of the applicable service. In no event shall Cardinal be liable for incidental or consequential damages, including, without limitation, business interruptions, loss of use, or loss of profits incurred by client, its subsidiaries, affiliates or successors arising out of or related to the performance of services hereunder by Cardinal, regardless of whether such claim is based upon any of the above-stated reasons or otherwise. Results relate only to the samples identified above. This report shall not be reproduced except in full with written approval of Cardinal Laboratories.

CARDINAL LABORATORIES

PHONE (575) 393-2326 • 101 E. MARLAND • HOBBS, NM 88240

ANALYTICAL RESULTS FOR
GREEN ANALYTICAL LABORATORIES, INC.
ATTN: DEBBIE ZUFELT
75 SUTTLE STREET
DURANGO, CO 81303
FAX TO: (970) 247-4227

Receiving Date: 08/14/08
Reporting Date: 09/03/08
Project Number: 808-067-12
Project Name: BHP BILLITON NMEP
Project Location: NOT GIVEN
Sample ID: WELL SITE POND
Lab Number: H15736-3

Extraction Date: 08/19/08
Analysis Date: 09/02/08
Sampling Date: 08/12/08
Sample Type: SURFACE WATER
Sample Condition: COOL & INTACT
Sample Received By: ML
Analyzed By: CK

PESTICIDES (mg/L)	Sample Result H15736-3	Method Blank	QC	%IA	True Value QC
4,4'-DDE	<0.020	<0.002	0.050	99.1	0.050
4,4'-DDD	<0.050	<0.005	0.044	88.3	0.050
4,4'-DDT	<0.100	<0.010	0.062	124	0.050
Chlordane	<0.200	<0.020	0.091	91.1	0.100

	% Recovery
Nitrobenzene-d5	13.8
2-Fluorobiphenyl	13.0
Terphenyl-d14	0.0*

METHODS: EPA SW-846 8270

*Note: Surrogate recovery outside historical limits due to matrix interference and sample dilution.

Chemist

09/03/08
Date

PLEASE NOTE: Liability and Damages. Cardinal's liability and client's exclusive remedy for any claim arising, whether based in contract or tort, shall be limited to the amount paid by client for analyses. All claims, including those for negligence and any other cause whatsoever shall be deemed waived unless made in writing and received by Cardinal within thirty (30) days after completion of the applicable service. In no event shall Cardinal be liable for incidental or consequential damages, including, without limitation, business interruptions, loss of use, or loss of profits incurred by client, its subsidiaries, affiliates or successors arising out of or related to the performance of services hereunder by Cardinal, regardless of whether such claim is based upon any of the above-stated reasons or otherwise. Results relate only to the samples identified above. This report shall not be reproduced except in full with written approval of Cardinal Laboratories.

Laboratory QA/QC Reports

Green Analytical 75 Suttle Street Durango CO, 81303	Project: BHP Project Number: [none] Project Manager: Debbie Zufelt	Reported: 04/22/08 14:33

Organochlorine Pesticides by EPA Method 8081A - Quality Control

SunStar Laboratories, Inc.

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch 8041610 - EPA 3510C GCMS/ECD										
Blank (8041610-BLK1)				Prepared: 04/16/08 Analyzed: 04/17/08						
Surrogate: Tetrachloro-meta-xylene	*ND*		*ug/l*	*1.00*		*75.3*	*35-140*			
alpha-BHC	ND	1.00	"							
gamma-BHC (Lindane)	ND	1.00	"							
beta-BHC	ND	1.00	"							
delta-BHC	ND	1.00	"							
Heptachlor	ND	1.00	"							
Aldrin	ND	1.00	"							
Heptachlor epoxide	ND	1.00	"							
gamma-Chlordane	ND	1.00	"							
alpha-Chlordane	ND	1.00	"							
Endosulfan I	ND	1.00	"							
4,4'-DDE	ND	1.00	"							
Dieldrin	ND	1.00	"							
Endrin	ND	1.00	"							
4,4'-DDD	ND	1.00	"							
Endosulfan II	ND	1.00	"							
4,4'-DDT	ND	2.00	"							
Endrin aldehyde	ND	1.00	"							
Endosulfan sulfate	ND	1.00	"							
Methoxychlor	ND	5.00	"							
Endrin ketone	ND	1.00	"							
Toxaphene	ND	20.0	"							
LCS (8041610-BS1)				Prepared: 04/16/08 Analyzed: 04/17/08						
Surrogate: Tetrachloro-meta-xylene	*0.827*		*ug/l*	*1.00*		*82.7*	*35-140*			
gamma-BHC (Lindane)	1.53	1.00	"	2.00		76.6	40-120			
Heptachlor	1.67	1.00	"	2.00		83.3	40-120			
Aldrin	1.59	1.00	"	2.00		79.3	40-120			
Dieldrin	1.98	1.00	"	2.00		99.0	40-120			
Endrin	2.10	1.00	"	2.00		105	40-120			
4,4'-DDT	2.01	2.00	"	2.00		101	40-120			

Green Analytical 75 Suttle Street Durango CO, 81303	Project: BHP Project Number: [none] Project Manager: Debbie Zufelt	**Reported:** 04/22/08 14:33

Organochlorine Pesticides by EPA Method 8081A - Quality Control

SunStar Laboratories, Inc.

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch 8041610 - EPA 3510C GCMS/ECD										
LCS Dup (8041610-BSD1)				Prepared: 04/16/08 Analyzed: 04/17/08						
Surrogate: Tetrachloro-meta-xylene	*0.903*		*ug/l*	*1.00*		*90.3*	*35-140*			
gamma-BHC (Lindane)	1.63	1.00	"	2.00		81.4	40-120	6.11	20	
Heptachlor	1.71	1.00	"	2.00		85.7	40-120	2.85	20	
Aldrin	1.64	1.00	"	2.00		82.2	40-120	3.60	20	
Dieldrin	2.01	1.00	"	2.00		101	40-120	1.72	20	
Endrin	2.19	1.00	"	2.00		110	40-120	4.12	20	
4,4'-DDT	2.03	2.00	"	2.00		102	40-120	1.03	20	

CARDINAL LABORATORIES

PHONE (575) 393-2326 • 101 E. MARLAND • HOBBS, NM 88240

ANALYTICAL RESULTS FOR
GREEN ANALYTICAL LABORATORIES, INC.
ATTN: DEBBIE ZUFELT
75 SUTTLE STREET
DURANGO, CO 81303
FAX TO: (970) 247-4227

Receiving Date: 08/14/08
Reporting Date: 09/03/08
Project Number: 808-067-06
Project Name: BHP BILLITON NMEP
Project Location: NOT GIVEN
Sample ID: POND ALONG NO NAME
Lab Number: H15736-2

Extraction Date: 08/19/08
Analysis Date: 09/02/08
Sampling Date: 08/12/08
Sample Type: SURFACE WATER
Sample Condition: COOL & INTACT
Sample Received By: ML
Analyzed By: CK

PESTICIDES (mg/L)	Sample Result H15736-2	Method Blank	QC	%IA	True Value QC
4,4'-DDE	<0.020	<0.002	0.050	99.1	0.050
4,4'-DDD	<0.050	<0.005	0.044	88.3	0.050
4,4'-DDT	<0.100	<0.010	0.062	124	0.050
Chlordane	<0.200	<0.020	0.091	91.1	0.100

	% Recovery
Nitrobenzene-d5	18.8
2-Fluorobiphenyl	18.1
Terphenyl-d14	31.0

METHODS: EPA SW-846 8270

Chemist

09/03/08
Date

H15736PH.GAL

PLEASE NOTE: Liability and Damages. Cardinal's liability and client's exclusive remedy for any claim arising, whether based in contract or tort, shall be limited to the amount paid by client for analyses. All claims, including those for negligence and any other cause whatsoever shall be deemed waived unless made in writing and received by Cardinal within thirty (30) days after completion of the applicable service. In no event shall Cardinal be liable for incidental or consequential damages, including, without limitation, business interruptions, loss of use, or loss of profits incurred by client, its subsidiaries, affiliates or successors arising out of or related to the performance of services hereunder by Cardinal, regardless of whether such claim is based upon any of the above-stated reasons or otherwise. Results relate only to the samples identified above. This report shall not be reproduced except in full with written approval of Cardinal Laboratories.

Green Analytical 75 Suttle Street Durango CO, 81303	Project: BHP Project Number: [none] Project Manager: Debbie Zufelt	**Reported:** 04/22/08 14:33

Polychlorinated Biphenyls by EPA Method 8082 - Quality Control

SunStar Laboratories, Inc.

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch 8041611 - EPA 3510C GCMS/ECD										
Blank (8041611-BLK1)				Prepared: 04/16/08 Analyzed: 04/17/08						
Surrogate: Tetrachloro-meta-xylene	*0.650*		*ug/l*	*1.00*		*65.0*	*35-140*			
PCB-1016	ND	2.00	"							
PCB-1221	ND	2.00	"							
PCB-1232	ND	2.00	"							
PCB-1242	ND	2.00	"							
PCB-1248	ND	2.00	"							
PCB-1254	ND	2.00	"							
PCB-1260	ND	2.00	"							
LCS (8041611-BS1)				Prepared: 04/16/08 Analyzed: 04/17/08						
Surrogate: Tetrachloro-meta-xylene	*0.766*		*ug/l*	*1.00*		*76.6*	*40-130*			
PCB-1016	7.55	2.00	"	10.0		75.5	40-130			
PCB-1260	10.8	2.00	"	10.0		108	40-130			
LCS Dup (8041611-BSD1)				Prepared: 04/16/08 Analyzed: 04/17/08						
Surrogate: Tetrachloro-meta-xylene	*0.670*		*ug/l*	*1.00*		*67.0*	*40-130*			
PCB-1016	6.83	2.00	"	10.0		68.3	40-130	9.96	30	
PCB-1260	9.06	2.00	"	10.0		90.6	40-130	17.2	30	

Notes and Definitions

DET	Analyte DETECTED
ND	Analyte NOT DETECTED at or above the reporting limit
NR	Not Reported
dry	Sample results reported on a dry weight basis
RPD	Relative Percent Difference

Green Analytical 75 Suttle Street Durango CO, 81303	Project: GA Project Number: [none] Project Manager: Debbie Zufelt	**Reported:** 05/20/08 14:45

Organochlorine Pesticides by EPA Method 8081A - Quality Control

SunStar Laboratories, Inc.

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch 8051408 - EPA 3510C GCMS/ECD										
Blank (8051408-BLK1)				Prepared: 05/14/08 Analyzed: 05/15/08						
Surrogate: Tetrachloro-meta-xylene	*ND*		*ug/l*	*1.00*		*90.6*	*35-140*			
alpha-BHC	ND	1.00	"							
gamma-BHC (Lindane)	ND	1.00	"							
beta-BHC	ND	1.00	"							
delta-BHC	ND	1.00	"							
Heptachlor	ND	1.00	"							
Aldrin	ND	1.00	"							
Heptachlor epoxide	ND	1.00	"							
gamma-Chlordane	ND	1.00	"							
alpha-Chlordane	ND	1.00	"							
Endosulfan I	ND	1.00	"							
4,4′-DDE	ND	1.00	"							
Dieldrin	ND	1.00	"							
Endrin	ND	1.00	"							
4,4′-DDD	ND	1.00	"							
Endosulfan II	ND	1.00	"							
4,4′-DDT	ND	2.00	"							
Endrin aldehyde	ND	1.00	"							
Endosulfan sulfate	ND	1.00	"							
Methoxychlor	ND	5.00	"							
Endrin ketone	ND	1.00	"							
Toxaphene	ND	20.0	"							
LCS (8051408-BS1)				Prepared: 05/14/08 Analyzed: 05/15/08						
Surrogate: Tetrachloro-meta-xylene	*0.935*		*ug/l*	*1.00*		*93.5*	*35-140*			
gamma-BHC (Lindane)	1.43	1.00	"	2.00		71.6	40-120			
Heptachlor	1.48	1.00	"	2.00		74.2	40-120			
Aldrin	1.40	1.00	"	2.00		70.1	40-120			
Dieldrin	1.69	1.00	"	2.00		84.5	40-120			
Endrin	1.98	1.00	"	2.00		98.8	40-120			
4,4′-DDT	1.82	2.00	"	2.00		90.8	40-120			

Green Analytical 75 Suttle Street Durango CO, 81303	Project: GA Project Number: [none] Project Manager: Debbie Zufelt	Reported: 05/20/08 14:45

Organochlorine Pesticides by EPA Method 8081A - Quality Control

SunStar Laboratories, Inc.

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch 8051408 - EPA 3510C GCMS/ECD										
Matrix Spike (8051408-MS1)		**Source: T800629-01**		Prepared: 05/14/08	Analyzed: 05/15/08					
Surrogate: Tetrachloro-meta-xylene	*1.06*		*ug/l*	*1.00*		*106*	*35-140*			
gamma-BHC (Lindane)	1.51	1.00	"	2.00	0.10	70.4	20-120			
Heptachlor	1.58	1.00	"	2.00	0.03	77.3	20-120			
Aldrin	1.47	1.00	"	2.00	ND	73.4	20-120			
Dieldrin	1.89	1.00	"	2.00	ND	94.4	20-120			
Endrin	1.97	1.00	"	2.00	ND	98.6	20-120			
4,4'-DDT	1.83	2.00	"	2.00	0.03	90.0	20-120			
Matrix Spike Dup (8051408-MSD1)		**Source: T800629-01**		Prepared: 05/14/08	Analyzed: 05/15/08					
Surrogate: Tetrachloro-meta-xylene	*0.994*		*ug/l*	*1.00*		*99.4*	*35-140*			
gamma-BHC (Lindane)	1.48	1.00	"	2.00	0.10	69.0	20-120	1.81	30	
Heptachlor	1.53	1.00	"	2.00	0.03	75.0	20-120	2.94	30	
Aldrin	1.42	1.00	"	2.00	ND	71.1	20-120	3.26	30	
Dieldrin	1.75	1.00	"	2.00	ND	87.4	20-120	7.69	30	
Endrin	1.85	1.00	"	2.00	ND	92.6	20-120	6.19	30	
4,4'-DDT	1.70	2.00	"	2.00	0.03	83.6	20-120	7.17	30	

Green Analytical 75 Suttle Street Durango CO, 81303	Project: GA Project Number: [none] Project Manager: Debbie Zufelt	**Reported:** 05/20/08 14:45

Polychlorinated Biphenyls by EPA Method 8082 - Quality Control

SunStar Laboratories, Inc.

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch 8051407 - EPA 3510C GCMS/ECD										
Blank (8051407-BLK1)				Prepared: 05/14/08 Analyzed: 05/15/08						
Surrogate: Tetrachloro-meta-xylene	*0.731*		*ug/l*	*1.00*		*73.1*	*35-140*			
PCB-1016	ND	2.00	"							
PCB-1221	ND	2.00	"							
PCB-1232	ND	2.00	"							
PCB-1242	ND	2.00	"							
PCB-1248	ND	2.00	"							
PCB-1254	ND	2.00	"							
PCB-1260	ND	2.00	"							
LCS (8051407-BS1)				Prepared: 05/14/08 Analyzed: 05/15/08						
Surrogate: Tetrachloro-meta-xylene	*0.862*		*ug/l*	*1.00*		*86.2*	*40-130*			
PCB-1016	9.82	2.00	"	10.0		98.2	40-130			
PCB-1260	9.58	2.00	"	10.0		95.8	40-130			
Matrix Spike (8051407-MS1)		**Source: T800629-01**		Prepared: 05/14/08 Analyzed: 05/15/08						
Surrogate: Tetrachloro-meta-xylene	*0.753*		*ug/l*	*1.00*		*75.3*	*40-130*			
PCB-1016	9.09	2.00	"	10.0	ND	90.9	40-130			
PCB-1260	9.21	2.00	"	10.0	ND	92.1	40-130			
Matrix Spike Dup (8051407-MSD1)		**Source: T800629-01**		Prepared: 05/14/08 Analyzed: 05/15/08						
Surrogate: Tetrachloro-meta-xylene	*0.819*		*ug/l*	*1.00*		*81.9*	*40-130*			
PCB-1016	9.85	2.00	"	10.0	ND	98.5	40-130	7.97	30	
PCB-1260	9.98	2.00	"	10.0	ND	99.8	40-130	8.02	30	

Notes and Definitions

DET	Analyte DETECTED
ND	Analyte NOT DETECTED at or above the reporting limit
NR	Not Reported
dry	Sample results reported on a dry weight basis
RPD	Relative Percent Difference

Appendix 18.D

Quality Assurance and Quality Control Results for Baseline Surface Water Quality Data from 2007 to 2008

Green Analytical Laboratories

DISSOLVED METALS SPIKE AND DUPLICATE DATA

LAB ID#							
708-176	Spike Data				Duplicate Data		
PARAMETER	Sample Result	Spike Result	Spike Conc.	Spike % Recovery	Sample Result	Duplicate Result	RPD %
Aluminum	0.00	2.25	**2.00**	**113**	<0.10	<0.10	**NC**
Arsenic	0.00	0.055	**0.050**	**110**	0.0030	0.0029	**3.39**
Barium	0.00	0.050	**0.050**	**100**	0.5030	0.5030	**0.00**
Boron	0.00	2.0	**2.0**	**100**	0.3	0.3	**0.00**
Cadmium	0.00	0.051	**0.050**	**102**	<0.00005	<0.00005	**NC**
Calcium	0.00	4.9	**5.0**	**98**	90.8	90.5	**0.33**
Chromium	0.00	0.052	**0.050**	**104**	0.005	0.005	**0.00**
Copper	0.00	0.051	**0.050**	**102**	0.0004	0.0004	**0.00**
Iron	0.00	0.98	**1.00**	**98**	<0.05	<0.05	**NC**
Lead	0.00	0.051	**0.050**	**102**	0.0022	0.0020	**9.52**
Magnesium *	0.00	1.4	**1.0**	**140**	16.9	16.4	**3.00**
Manganese	0.00	1.05	**1.00**	**105**	<0.0005	<0.0005	**NC**
Potassium	0.00	1.0	**1.0**	**100**	2.2	2.0	**9.52**
Selenium	0.00	0.278	**0.250**	**111**	0.009	0.009	**0.00**
Silver	0.00	0.053	**0.050**	**106**	<0.00005	<0.00005	**NC**
Sodium	0.00	50.3	**50.0**	**101**	19.3	18.1	**6.42**
Zinc	0.00	0.057	**0.050**	**114**	0.232	0.228	**1.74**

NC=Not calculated due to results less than the detection limit
NA=Data not available.

Green Analytical Laboratories

DISSOLVED METALS SRM AND BLANK DATA

LAB ID# 709-176	SRM Data				Blank Data	
PARAMETER	**SRM Result**	**True Value**	**SRM % Rec**	**Acceptance Range**	**Blank Result**	**Reporting Limit**
Aluminum	5.16	5.00	**103**	90-110 %	<0.10	0.10
Arsenic *	0.056	0.050	**112**	90-110 %	<0.0005	0.0005
Barium	0.055	0.050	**110**	90-110 %	<0.0005	0.0005
Boron	5.2	5.0	**104**	90-110 %	<0.1	0.1
Cadmium	0.054	0.050	**108**	90-110 %	<0.00005	0.00005
Calcium	5.0	5.0	**100**	90-110 %	<0.5	0.5
Chromium	0.055	0.050	**110**	90-110 %	<0.001	0.001
Copper	0.051	0.050	**102**	90-110 %	<0.0001	0.0001
Iron	5.04	5.00	**101**	90-110 %	<0.05	0.05
Lead	0.053	0.050	**106**	90-110 %	0.0001	0.0001
Magnesium	4.8	5.0	**96.0**	90-110 %	<0.5	0.5
Manganese	2.53	2.50	**101**	90-110 %	<0.005	0.005
Potassium	9.7	10.0	**97.0**	90-110 %	<0.5	0.5
Selenium *	0.278	0.250	**111**	90-110 %	<0.001	0.001
Silver *	0.058	0.050	**116**	90-110 %	<0.00005	0.00005
Sodium	16.0	16.2	**98.8**	90-110 %	<0.5	0.5
Zinc	0.06	0.05	**110**	90-110 %	<0.001	0.001

NA=Data not available.

Green Analytical Laboratories

TOTAL METALS SPIKE AND DUPLICATE DATA

LAB ID#							
708-176	Spike Data				Duplicate Data		
PARAMETER	Sample Result	Spike Result	Spike Conc.	Spike % Recovery	Sample Result	Duplicate Result	RPD %
Iron-T	0.00	3.99	**4.00**	**99.8**	0.16	0.14	**13.3**
Manganese-T	0.000	2.070	**2.00**	**104**	0.008	0.007	**13.3**
Mercury-T	0.0000	0.0020	**0.0020**	**100**	<0.0002	<0.0002	**NC**

NC=Not calculated due to results less than the detection limit
NA=Data not available.

Green Analytical Laboratories

TOTAL METALS SRM AND BLANK DATA

LAB ID# 708-176	SRM Data				Blank Data	
PARAMETER	SRM Result	True Value	SRM % Rec	Acceptance Range	Blank Result	Reporting Limit
Iron-T	5.04	5.00	**101**	90-110 %	<0.05	0.05
Manganese-T	2.53	2.50	**101**	90-110 %	<0.005	0.005
Mercury-T	0.0021	0.0020	**105**	90-110 %	<0.0002	0.0002

NA=Data not available.

Green Analytical Laboratories

WET CHEM SPIKE AND DUPLICATE DATA

LAB ID#							
708-176	Spike Data				Duplicate Data		
PARAMETER	Sample Result	Spike Result	Spike Conc.	Spike % Recovery	Sample Result	Duplicate Result	RPD %
Alkalinity	0	104	**100**	**104**	460	450	**2.20**
Chloride	1	101	**100**	**100**	4800	4750	**1.05**
EC	NMA	NMA	NMA	**NMA**	612	608	**0.66**
Fluoride	0.0	0.9	**1.0**	**90**	0.4	0.4	**0.00**
Nitrate/Nitrite	0.00	1.47	**1.54**	**95.5**	<0.02	<0.02	**NC**
pH	NMA	NMA	NMA	**NMA**	7.91	7.90	**0.13**
Phosphorus-T	0.00	0.29	**0.25**	**116**	0.23	0.21	**9.09**
Sulfate	0	50.0	**50.0**	**100**	410	400	**2.47**
TDS	NMA	NMA	NMA	**NMA**	915	910	**0.55**
TSS	NMA	NMA	NMA	**NMA**	31500	31450	**0.16**

NMA=Data not applicable to Method.
NC=Not calculated due to results less than the detection limit

Green Analytical Laboratories

WET CHEM SRM AND BLANK DATA

LAB ID# 708-176	SRM Data				Blank Data	
PARAMETER	SRM Result	True Value	SRM % Rec	Acceptance Range	Blank Result	Reporting Limit
Alkalinity	324	302	**107**	90-110 %	<10	10
Chloride	117	117	**100**	90-110 %	<10	10
EC	528	561	**94.1**	90-110 %	NMA	NMA
Fluoride	1.0	1.0	**100**	90-110 %	<1.0	1.0
Nitrate/Nitrite	0.48	0.50	**96.0**	90-110 %	<0.02	0.02
pH	8.32	8.40	**99.0**	90-110 %	NMA	NMA
Phosphorus-T	0.22	0.20	**110**	90-110 %	<0.05	0.05
Sulfate	335	320	**105**	90-110 %	<10	10
TDS	1235	1210	**102**	90-110 %	<10	10
TSS	173	158	**109**	90-110 %	<10	10

NMA=Data not applicable to Method.

Green Analytical Laboratories

DISSOLVED METALS SPIKE AND DUPLICATE DATA

LAB ID# 709-094	Spike Data				Duplicate Data		
PARAMETER	**Sample Result**	**Spike Result**	**Spike Conc.**	**Spike % Recovery**	**Sample Result**	**Duplicate Result**	**RPD %**
Aluminum	0.00	2.11	**2.00**	**106**	0.12	0.12	**0.00**
Arsenic	0.0000	0.050	**0.050**	**100**	0.0399	0.0373	**6.74**
Barium	0.0000	0.050	**0.050**	**100**	0.0013	0.0012	**8.00**
Boron	0.0	2.0	**2.0**	**102**	74.5	74.0	**0.67**
Cadmium	0.00000	0.049	**0.050**	**98**	<0.00005	<0.00005	**NC**
Calcium	0.0	4.9	**5.0**	**98**	428	418	**2.36**
Chromium	0.000	0.050	**0.050**	**100**	0.016	0.016	**0.00**
Copper	0.0000	0.050	**0.050**	**100**	0.0110	0.009	**20.0**
Iron	0.00	0.98	**1.00**	**98**	0.11	0.11	**0.00**
Lead	0.0000	0.050	**0.050**	**100**	0.0030	0.0028	**6.90**
Magnesium	0.0	1.1	**1.0**	**110**	13.5	13.0	**3.77**
Manganese	0.000	1.07	**1.00**	**107**	0.371	0.371	**0.00**
Potassium	0.0	1.0	**1.0**	**100**	269.0	260.0	**3.40**
Selenium	0.000	0.248	**0.250**	**99.2**	0.002	0.002	**0.00**
Silver	0.00000	0.052	**0.050**	**104**	<0.00005	<0.00005	**NC**
Sodium	0.0	49.1	**50.0**	**98.2**	309.0	306.0	**0.98**
Zinc	0.000	0.051	**0.050**	**102**	0.023	0.022	**4.44**

NC=Not calculated due to results less than the detection limit
NA=Data not available.

Green Analytical Laboratories

DISSOLVED METALS SRM AND BLANK DATA

LAB ID# 709-094	SRM Data				Blank Data	
PARAMETER	SRM Result	True Value	SRM % Rec	Acceptance Range	Blank Result	Reporting Limit
Aluminum	5.22	5.00	**104**	90-110 %	<0.10	0.10
Arsenic	0.051	0.050	**102**	90-110 %	<0.0005	0.0005
Barium	0.051	0.050	**102**	90-110 %	<0.0005	0.0005
Boron	5.3	5.0	**106**	90-110 %	<0.1	0.1
Cadmium	0.052	0.050	**104**	90-110 %	<0.00005	0.00005
Calcium	4.6	5.0	**92.0**	90-110 %	<0.5	0.5
Chromium	0.050	0.050	**100**	90-110 %	<0.001	0.001
Copper	0.049	0.050	**98.0**	90-110 %	<0.0001	0.0001
Iron	4.63	5.00	**92.6**	90-110 %	<0.05	0.05
Lead	0.051	0.050	**102**	90-110 %	<0.0001	0.0001
Magnesium *	4.3	5.0	**86.8**	90-110 %	<0.5	0.5
Manganese	2.67	2.50	**107**	90-110 %	<0.005	0.005
Potassium	8.9	10.0	**89.0**	90-110 %	<0.5	0.5
Selenium	0.248	0.250	**99.2**	90-110 %	<0.001	0.001
Silver	0.053	0.050	**106**	90-110 %	<0.00005	0.00005
Sodium	7.4	8.1	**91.4**	90-110 %	<0.5	0.5
Zinc	0.048	0.050	**96.0**	90-110 %	<0.001	0.001

NA=Data not available.

Green Analytical Laboratories

TOTAL METALS SPIKE AND DUPLICATE DATA

LAB ID# 708-094	Spike Data				Duplicate Data		
PARAMETER	Sample Result	Spike Result	Spike Conc.	Spike % Recovery	Sample Result	Duplicate Result	RPD %
Iron-T	0.00	4.15	**4.00**	**104**	<0.02	<0.02	**NC**
Manganese-T	0.000	2.05	**2.00**	**103**	0.042	0.040	**4.88**
Mercury-T	0.0000	0.0021	**0.002**	**105**	<0.0002	<0.0002	**NC**

NC=Not calculated due to results less than the detection limit
NA=Data not available.

Green Analytical Laboratories

TOTAL METALS SRM AND BLANK DATA

LAB ID# 709-094	SRM Data				Blank Data	
PARAMETER	**SRM Result**	**True Value**	**SRM % Rec**	**Acceptance Range**	**Blank Result**	**Reporting Limit**
Iron-T	5.25	5.00	**105**	90-110 %	<0.05	0.05
Manganese-T	2.61	2.50	**104**	90-110 %	<0.005	0.005
Mercury-T	0.002	0.002	**100**	90-110 %	<0.0002	0.0002

NA=Data not available.

Green Analytical Laboratories

WET CHEM SPIKE AND DUPLICATE DATA

LAB ID# 709-094	Spike Data				Duplicate Data		
PARAMETER	**Sample Result**	**Spike Result**	**Spike Conc.**	**Spike % Recovery**	**Sample Result**	**Duplicate Result**	**RPD %**
Alkalinity	1	101	**100**	**100**	224	220	**1.80**
Chloride	1	102	**100**	**101**	<10	<10	**NC**
EC	NMA	NMA	**NMA**	**NMA**	625	625	**0.00**
Fluoride	0.0	0.9	**1.0**	**90**	0.3	0.3	**0.00**
Nitrate/Nitrite	0.00	1.95	**1.92**	**102**	0.23	0.21	**9.09**
pH	NMA	NMA	**NMA**	**NMA**	8.02	7.95	**0.88**
Phosphorus-T	0.00	0.25	**0.25**	**100**	0.22	0.21	**4.65**
Sulfate	0	55.0	**50.0**	**110**	14600	14400	**1.38**
TDS	NMA	NMA	**NMA**	**NMA**	355	350	**1.42**
TSS	NMA	NMA	**NMA**	**NMA**	33600	32800	**2.41**

NMA=Data not applicable to Method.
NA=Data not available.

Green Analytical Laboratories

WET CHEM SRM AND BLANK DATA

LAB ID#						
709-094	SRM Data				Blank Data	
PARAMETER	SRM Result	True Value	SRM % Rec	Acceptance Range	Blank Result	Reporting Limit
Alkalinity	280	283	**98.9**	90-110 %	<10	10
Chloride	39	38	**103**	90-110 %	<10	10
EC	514	561	**91.6**	90-110 %	NMA	NMA
Fluoride	1.0	1.0	**100**	90-110 %	<1.0	1.0
Nitrate/Nitrite	0.51	0.50	**102**	90-110 %	<0.02	0.02
pH	8.28	8.40	**98.6**	90-110 %	NMA	NMA
Phosphorus-T	0.21	0.20	**105**	90-110 %	<0.05	0.05
Sulfate	345	320	**108**	90-110 %	<10	10
TDS	1245	1210	**103**	90-110 %	<10	10
TSS *	173	146	**118**	90-110 %	<10	10

NMA=Data not applicable to Method.
NA=Data not available.

Green Analytical Laboratories

DISSOLVED METALS SPIKE AND DUPLICATE DATA

LAB ID#							
709-141	Spike Data				Duplicate Data		
PARAMETER	Sample Result	Spike Result	Spike Conc.	Spike % Recovery	Sample Result	Duplicate Result	RPD %
Aluminum	0.00	0.51	**0.50**	**102**	0.19	0.16	**17.1**
Arsenic	0.0000	0.050	**0.050**	**100**	<0.0005	<0.0005	**NC**
Barium	0.0000	0.049	**0.050**	**98.0**	0.0398	0.0393	**1.26**
Boron	0.0	3.9	**4.0**	**96.3**	0.1	0.1	**0.00**
Cadmium	0.00000	0.0500	**0.050**	**100**	<0.00005	<0.00005	**NC**
Calcium	0.0	5.1	**5.0**	**102**	15.5	15.5	**0.00**
Chromium	0.000	0.050	**0.050**	**100**	0.009	0.009	**0.00**
Copper	0.0000	0.051	**0.050**	**102**	0.0702	0.0700	**0.29**
Iron	0.00	1.05	**1.00**	**105**	154	148	**3.97**
Lead	0.0000	0.049	**0.050**	**98.0**	0.0003	0.0003	**0.00**
Magnesium	0.0	1.1	**1.0**	**107**	3.0	2.9	**3.39**
Manganese	0.000	2.04	**2.00**	**102**	0.090	0.085	**5.71**
Potassium	3.0	3.9	**1.0**	**86.0**	3.0	3.0	**0.00**
Selenium	0.001	0.256	**0.250**	**102**	0.002	0.002	**0.00**
Silver	0.00000	0.051	**0.050**	**102**	<0.00005	<0.00005	**NC**
Sodium	0.0	54.3	**50.0**	**109**	90.2	90.1	**0.11**
Zinc	0.000	0.050	**0.050**	**100**	0.019	0.019	**0.00**

NC=Not calculated due to results less than the detection limit
NA=Data not available.

Green Analytical Laboratories

DISSOLVED METALS SRM AND BLANK DATA

LAB ID# 709-141	SRM Data				Blank Data	
PARAMETER	**SRM Result**	**True Value**	**SRM % Rec**	**Acceptance Range**	**Blank Result**	**Reporting Limit**
Aluminum	4.95	5.00	**99.0**	90-110 %	<0.10	0.10
Arsenic	0.052	0.050	**104**	90-110 %	<0.0005	0.0005
Barium	0.051	0.050	**102**	90-110 %	<0.0005	0.0005
Boron	5.1	5.0	**102**	90-110 %	<0.1	0.1
Cadmium	0.050	0.050	**100**	90-110 %	<0.00005	0.00005
Calcium	4.7	5.0	**94.0**	90-110 %	<0.5	0.5
Chromium	0.050	0.050	**100**	90-110 %	<0.001	0.001
Copper	0.050	0.050	**100**	90-110 %	<0.0001	0.0001
Iron	4.77	5.00	**95.4**	90-110 %	<0.05	0.05
Lead	0.050	0.050	**100**	90-110 %	<0.0001	0.0001
Magnesium	4.7	5.0	**94.0**	90-110 %	<0.5	0.5
Manganese	2.57	2.50	**103**	90-110 %	<0.005	0.005
Potassium	9.3	10.0	**93.0**	90-110 %	<0.5	0.5
Selenium	0.254	0.250	**102**	90-110 %	0.001	0.001
Silver	0.054	0.050	**108**	90-110 %	<0.00005	0.00005
Sodium	8.6	8.1	**106**	90-110 %	<0.5	0.5
Zinc	0.050	0.050	**100**	90-110 %	<0.001	0.001

NA=Data not available.

Green Analytical Laboratories

TOTAL METALS SPIKE AND DUPLICATE DATA

LAB ID#							
709-141	Spike Data				Duplicate Data		
PARAMETER	Sample Result	Spike Result	Spike Conc.	Spike % Recovery	Sample Result	Duplicate Result	RPD %
Iron-T	0.00	4.15	**4.00**	**104**	125	124	**0.80**
Manganese-T	0.000	2.050	**2.000**	**103**	7.60	7.31	**3.89**
Mercury-T	0.0000	0.0021	**0.002**	**105**	<0.0002	<0.0002	**NC**

NC=Not calculated due to results less than the detection limit
NA=Data not available.

Green Analytical Laboratories

TOTAL METALS SRM AND BLANK DATA

LAB ID#						
709-141	SRM Data				Blank Data	
PARAMETER	SRM Result	True Value	SRM % Rec	Acceptance Range	Blank Result	Reporting Limit
Iron-T	5.25	5.00	**105**	90-110 %	<0.05	0.05
Manganese-T	2.61	2.50	**104**	90-110 %	<0.005	0.005
Mercury-T	0.002	0.002	**100**	90-110 %	<0.0002	0.0002

NA=Data not available.

Green Analytical Laboratories

WET CHEM SPIKE AND DUPLICATE DATA

LAB ID#							
	Spike Data				Duplicate Data		
PARAMETER	Sample Result	Spike Result	Spike Conc.	Spike % Recovery	Sample Result	Duplicate Result	RPD %
Alkalinity	0	103	**100**	**103**	139	138	**0.72**
Chloride	0	104	**100**	**104**	<10	<10	**NC**
EC	NMA	NMA	**NMA**	**NMA**	570	560	**1.77**
Fluoride	0.0	0.9	**1.0**	**90.0**	0.2	0.2	**0.00**
Nitrate/Nitrite	0.00	1.84	**1.92**	**95.8**	2.55	2.54	**0.39**
pH	NMA	NMA	**NMA**	**NMA**	7.64	7.61	**0.39**
Phosphorus-T	0.00	0.27	**0.25**	**108**	0.26	0.22	**16.7**
Sulfate	0	53	**50**	**106**	2050	2050	**0.00**
TDS	NMA	NMA	**NMA**	**NMA**	330	320	**3.08**
TSS	NMA	NMA	**NMA**	**NMA**	8700	7700	**12.2**

NMA=Data not applicable to Method.
NA=Data not available.
NC=Not calculated due to results less than the detection limit

Green Analytical Laboratories

WET CHEM SRM AND BLANK DATA

LAB ID#						
709-141	SRM Data				Blank Data	
PARAMETER	SRM Result	True Value	SRM % Rec	Acceptance Range	Blank Result	Reporting Limit
Alkalinity	296	283	**105**	90-110 %	<10	10
Chloride	40	38	**106**	90-110 %	<10	10
EC *	495	561	**88.2**	90-110 %	NMA	NMA
Fluoride	1.0	1.0	**100**	90-110 %	<1.0	1.0
Nitrate/Nitrite	0.49	0.50	**98.0**	90-110 %	<0.02	0.02
pH	8.38	8.40	**100**	90-110 %	NMA	NMA
Phosphorus-T *	4.30	5.20	**82.7**	90-110 %	<0.05	0.05
Sulfate *	355	320	**111**	90-110 %	<10	10
TDS	1215	1210	**100**	90-110 %	<10	10
TSS *	173	155	**112**	90-110 %	<10	10

NMA=Data not applicable to Method.
NA=Data not available.

Green Analytical Laboratories

DISSOLVED METALS SPIKE AND DUPLICATE DATA

LAB ID#							
071009K001	Spike Data				Duplicate Data		
PARAMETER	Sample Result	Spike Result	Spike Conc.	Spike % Recovery	Sample Result	Duplicate Result	RPD %
Aluminum	0.00	2.04	**2.00**	**102**	<0.1	<0.1	**NC**
Arsenic	0.0000	0.052	**0.050**	**104**	0.0049	0.0048	**2.06**
Barium	0.0000	0.050	**0.050**	**100**	3.80	3.75	**1.32**
Boron	0.0	2.1	**2.00**	**105**	0.3	0.3	**0.00**
Cadmium	0.00000	0.050	**0.050**	**100**	<0.00005	<0.00005	**NC**
Calcium	0.0	5.2	**5.00**	**104**	1.2	1.2	**0.00**
Chromium	0.000	0.051	**0.050**	**102**	0.002	0.002	**0.00**
Copper	0.0000	0.050	**0.050**	**100**	0.0430	0.0400	**7.23**
Iron	0.00	1.06	**1.00**	**106**	102	102	**0.00**
Lead	0.0000	0.050	**0.050**	**100**	<0.0001	<0.0001	**NC**
Magnesium	0.0	1.1	**1.0**	**110**	<0.5	<0.5	**NC**
Manganese	0.000	1.060	**1.0**	**106**	0.069	0.068	**1.46**
Potassium	0.0	1.0	**1.0**	**100**	0.6	0.6	**0.00**
Selenium	0.006	2.67	**2.50**	**107**	0.022	0.022	**0.00**
Silver	0.00000	0.051	**0.050**	**102**	<0.00005	<0.00005	**NC**
Sodium	0.0	1.0	**1.00**	**100**	162	161	**0.62**
Zinc	0.000	0.052	**0.050**	**104**	0.001	0.001	**0.00**

NC=Not calculated due to results less than the detection limit
NA=Data not available.

Green Analytical Laboratories

DISSOLVED METALS SRM AND BLANK DATA

LAB ID#						
071009k001	SRM Data				Blank Data	
PARAMETER	SRM Result	True Value	SRM % Rec	Acceptance Range	Blank Result	Reporting Limit
Aluminum	5.30	5.00	**106**	90-110 %	<0.10	0.10
Arsenic	0.054	0.050	**108**	90-110 %	<0.0005	0.0005
Barium	0.052	0.050	**104**	90-110 %	<0.0005	0.0005
Boron	5.5	5.000	**110**	90-110 %	<0.1	0.1
Cadmium	0.050	0.050	**100**	90-110 %	<0.00005	0.00005
Calcium	5.0	5.000	**100**	90-110 %	<0.5	0.5
Chromium	0.052	0.050	**104**	90-110 %	<0.001	0.001
Copper	0.050	0.050	**100**	90-110 %	<0.0001	0.0001
Iron	5.18	5.0	**104**	90-110 %	<0.05	0.05
Lead	0.050	0.050	**100**	90-110 %	<0.0001	0.0001
Magnesium	4.9	5.0	**98.0**	90-110 %	<0.5	0.5
Manganese	2.76	2.50	**110**	90-110 %	<0.005	0.005
Potassium	1.0	1.0	**100**	90-110 %	<0.5	0.5
Selenium	0.267	0.250	**107**	90-110 %	0.006	0.001
Silver	0.052	0.050	**104**	90-110 %	<0.00005	0.00005
Sodium	8.2	8.1	**101**	90-110 %	<0.5	0.5
Zinc	0.051	0.050	**102**	90-110 %	<0.001	0.001

NA=Data not available.

Green Analytical Laboratories

TOTAL METALS SPIKE AND DUPLICATE DATA

LAB ID#							
071009k001	Spike Data				Duplicate Data		
PARAMETER	Sample Result	Spike Result	Spike Conc.	Spike % Recovery	Sample Result	Duplicate Result	RPD %
Iron-T	0.00	2.03	**2.00**	**102**	0.15	0.15	**0.00**
Manganese-T	0.000	1.05	**1.00**	**105**	0.080	0.080	**0.00**
Mercury-T	0.0000	0.0022	**0.002**	**110**	<0.0002	<0.0002	**NC**

NC=Not calculated due to results less than the detection limit
NA=Data not available.

Green Analytical Laboratories

TOTAL METALS SRM AND BLANK DATA

LAB ID#						
071009k001	SRM Data				Blank Data	
PARAMETER	SRM Result	True Value	SRM % Rec	Acceptance Range	Blank Result	Reporting Limit
Iron-T	4.69	5.00	**93.8**	90-110 %	<0.05	0.05
Manganese-T	2.43	2.50	**97.2**	90-110 %	<0.005	0.005
Mercury-T	0.002	0.002	**100**	90-110 %	<0.0002	0.0002

NA=Data not available.

Green Analytical Laboratories

WET CHEM SPIKE AND DUPLICATE DATA

LAB ID#							
071009k001	Spike Data				Duplicate Data		
PARAMETER	Sample Result	Spike Result	Spike Conc.	Spike % Recovery	Sample Result	Duplicate Result	RPD %
Alkalinity	0	106	**100**	**106**	99	99	**0.00**
Chloride	0	101	**100**	**101**	13	13	**0.00**
EC	NMA	NMA	**NMA**	**NMA**	1017	1015	**0.20**
Fluoride	0.0	0.9	**1.0**	**90.0**	<0.2	<0.2	**NC**
Nitrate/Nitrite	0.00	1.76	**1.92**	**91.7**	0.31	0.31	**0.00**
pH	NMA	NMA	**NMA**	**NMA**	8.07	8.05	**0.25**
Phosphorus-T	0.00	0.27	**0.25**	**108**	0.45	0.41	**9.30**
Sulfate	0	55.00	**50.00**	**110**	390	390	**0.00**
TDS	NMA	NMA	**NMA**	**NMA**	605	595	**1.67**
TSS	NMA	NMA	**NMA**	**NMA**	132000	131000	**0.76**

NMA=Data not applicable to Method.
NA=Data not available.
NC=Not calculated due to results less than the detection limit

Green Analytical Laboratories

WET CHEM SRM AND BLANK DATA

LAB ID#						
071009k001	SRM Data				Blank Data	
PARAMETER	SRM Result	True Value	SRM % Rec	Acceptance Range	Blank Result	Reporting Limit
Alkalinity	290	283	**102**	90-110 %	<10	10
Chloride	39	37.9	**103**	90-110 %	<10	10
EC	514	561	**91.6**	90-110 %	NMA	NMA
Fluoride	1.0	1.0	**100**	90-110 %	<1.0	1.0
Nitrate/Nitrite	0.51	0.50	**102**	90-110 %	<0.02	0.02
pH	8.38	8.40	**100**	90-110 %	NMA	NMA
Phosphorus-T	5.61	5.32	**105**	90-110 %	<0.05	0.05
Sulfate	340	321	**106**	90-110 %	<10	10
TDS	1175	1210	**97.1**	90-110 %	<10	10
TSS	156	173	**90.2**	90-110 %	<10	10

NMA=Data not applicable to Method.
NA=Data not available.

Green Analytical Laboratories

DISSOLVED METALS SPIKE AND DUPLICATE DATA

LAB ID#							
712051326+	Spike Data				Duplicate Data		
PARAMETER	Sample Result	Spike Result	Spike Conc.	Spike % Recovery	Sample Result	Duplicate Result	RPD %
Aluminum	0.00	2.04	**2.00**	**102**	<0.1	<0.1	**NC**
Arsenic	0.0000	0.050	**0.050**	**100**	0.0061	0.0057	**6.78**
Barium	0.0000	0.048	**0.050**	**96.0**	0.0089	0.0085	**4.60**
Boron	0.0	2.1	**2.0**	**104**	<0.1	<0.1	**NC**
Cadmium	0.00000	0.049	**0.050**	**98.0**	<0.00005	<0.00005	**NC**
Calcium	0.0	45.8	**50.0**	**91.6**	22.1	21.6	**2.29**
Chromium	0.000	0.049	**0.050**	**98.0**	0.007	0.007	**0.00**
Copper	0.0000	0.049	**0.050**	**98.0**	0.892	0.732	**19.7**
Iron	0.00	9.48	**10.0**	**94.8**	<0.05	<0.05	**NC**
Lead	0.0000	0.048	**0.050**	**96.0**	0.0001	0.0001	**0.00**
Magnesium	0.0	9.5	**10.0**	**95.0**	1.7	1.7	**0.00**
Manganese	0.000	1.16	**1.00**	**116**	0.017	0.017	**0.00**
Potassium	0.0	9.9	**10.0**	**99.0**	3.7	3.6	**2.74**
Selenium	0.000	0.250	**0.250**	**100**	0.179	0.170	**5.16**
Silver	0.00000	0.0500	**0.050**	**100**	<0.00005	<0.00005	**NC**
Sodium	0.0	481.0	**500**	**96.2**	194	190	**2.08**
Zinc	0.000	0.050	**0.050**	**100**	0.011	0.011	**0.00**

NC=Not calculated due to results less than the detection limit
NA=Data not available.

Green Analytical Laboratories

DISSOLVED METALS SRM AND BLANK DATA

LAB ID# 0712051326+	SRM Data				Blank Data	
PARAMETER	**SRM Result**	**True Value**	**SRM % Rec**	**Acceptance Range**	**Blank Result**	**Reporting Limit**
Aluminum	5.16	5.00	**103**	90-110 %	<0.10	0.10
Arsenic	0.0520	0.050	**104**	90-110 %	<0.0005	0.0005
Barium	0.0500	0.050	**100**	90-110 %	<0.0005	0.0005
Boron	5.2	5.0	**104**	90-110 %	<0.1	0.1
Cadmium	0.05100	0.050	**102**	90-110 %	<0.00005	0.00005
Calcium	5.3	5.0	**106**	90-110 %	<0.5	0.5
Chromium	0.050	0.050	**100**	90-110 %	<0.001	0.001
Copper	0.0500	0.050	**100**	90-110 %	<0.0001	0.0001
Iron	5.39	5.0	**108**	90-110 %	<0.05	0.05
Lead	0.0490	0.050	**98.0**	90-110 %	<0.0001	0.0001
Magnesium	5.2	5.0	**104**	90-110 %	<0.5	0.5
Manganese	2.65	2.50	**106**	90-110 %	<0.005	0.005
Potassium	10.9	10.0	**109**	90-110 %	<0.5	0.5
Selenium	0.261	0.250	**104**	90-110 %	<0.001	0.001
Silver *	0.06000	0.050	**120**	90-110 %	<0.00005	0.00005
Sodium	9.0	9.0	**100**	90-110 %	<0.5	0.5
Zinc	0.051	0.050	**102**	90-110 %	<0.001	0.001

NA=Data not available.

Green Analytical Laboratories

TOTAL METALS SPIKE AND DUPLICATE DATA

LAB ID# 0712051326+	Spike Data				Duplicate Data		
PARAMETER	Sample Result	Spike Result	Spike Conc.	Spike % Recovery	Sample Result	Duplicate Result	RPD %
Iron-T	0.00	4.21	**4.00**	**105**	42.9	40.6	**5.51**
Manganese-T	0.000	2.16	**2.00**	**108**	1.71	1.62	**5.41**
Mercury-T	0.0000	0.0020	**0.0020**	**100**	<0.0002	<0.0002	**NC**

NC=Not calculated due to results less than the detection limit
NA=Data not available.

Green Analytical Laboratories

TOTAL METALS SRM AND BLANK DATA

LAB ID#						
0712051326+	SRM Data				Blank Data	
PARAMETER	SRM Result	True Value	SRM % Rec	Acceptance Range	Blank Result	Reporting Limit
Iron-T	5.10	5.00	**102**	90-110 %	<0.05	0.05
Manganese-T	2.65	2.50	**106**	90-110 %	<0.005	0.005
Mercury-T	0.0021	0.0020	**105**	90-110 %	<0.0002	0.0002

NA=Data not available.

Green Analytical Laboratories

WET CHEM SPIKE AND DUPLICATE DATA

LAB ID#							
0712051326+	Spike Data				Duplicate Data		
PARAMETER	Sample Result	Spike Result	Spike Conc.	Spike % Recovery	Sample Result	Duplicate Result	RPD %
Alkalinity	0	106	**100**	**106**	224	220	**1.80**
Chloride	0	101	**100**	**101**	210	206	**1.92**
EC	NMA	NMA	**NMA**	**NMA**	708	704	**0.57**
Fluoride	0.0	0.9	**1.0**	**90.0**	<0.2	<0.2	**NC**
Nitrate/Nitrite	0.00	1.90	**1.92**	**99.0**	32.1	31.4	**2.20**
pH	NMA	NMA	**NMA**	**NMA**	8.19	8.10	**1.10**
Phosphorus-T	0.29	0.54	**0.25**	**100**	0.23	0.22	**4.44**
Sulfate	0	54	**50**	**108**	9800	9800	**0.00**
TDS	NMA	NMA	**NMA**	**NMA**	935	930	**0.54**
TSS	NMA	NMA	**NMA**	**NMA**	88000	85200	**3.23**

NMA=Data not applicable to Method.
NA=Data not available.
NC=Not calculated due to results less than the detection limit

Green Analytical Laboratories

WET CHEM SRM AND BLANK DATA

LAB ID#						
0712051326+	SRM Data				Blank Data	
PARAMETER	SRM Result	True Value	SRM % Rec	Acceptance Range	Blank Result	Reporting Limit
Alkalinity	274	283	**96.8**	90-110 %	<10	10
Chloride	37	37.9	**97.6**	90-110 %	<10	10
EC	556	561	**99.1**	90-110 %	NA	NA
Fluoride	1.0	1.0	**100**	90-110 %	<1.0	1.0
Nitrate/Nitrite	0.50	0.50	**100**	90-110 %	<0.02	0.02
pH	8.30	8.40	**98.8**	90-110 %	NA	NA
Phosphorus-T	5.49	5.32	**103**	90-110 %	<0.05	0.05
Sulfate	350	321	**109**	90-110 %	<10	10
TDS	1205	1210	**99.6**	90-110 %	<10	10
TSS *	18.0	21.9	**82.2**	90-110 %	<10	10

NA=Data not applicable to Method.
NA=Data not available.

Green Analytical Laboratories

DISSOLVED METALS SPIKE AND DUPLICATE DATA

LAB ID#							
802-052	**Spike Data**				**Duplicate Data**		
PARAMETER	**Sample Result**	**Spike Result**	**Spike Conc.**	**Spike % Recovery**	**Sample Result**	**Duplicate Result**	**RPD %**
Aluminum	0.00	2.33	**2.00**	**117**	1.69	1.65	**2.40**
Arsenic	0.0000	0.045	**0.050**	**90.0**	0.0093	0.0093	**0.00**
Barium	0.0000	0.046	**0.050**	**92.0**	0.0344	0.0328	**4.76**
Boron	0.1	2.3	**2.0**	**108**	0.4	0.4	**0.00**
Cadmium	0.00000	0.044	**0.050**	**88.0**	0.00006	0.00005	**18.2**
Calcium *	0.0	6.9	**5.00**	**138**	82.5	82.0	**0.61**
Chromium	0.000	0.044	**0.050**	**88.0**	0.002	0.002	**0.00**
Copper	0.0000	0.046	**0.050**	**92.0**	0.0174	0.0171	**1.74**
Iron *	0.00	1.40	**1.00**	**140**	<0.05	<0.05	**NC**
Lead	0.0000	0.045	**0.050**	**90.0**	0.0001	0.0001	**0.00**
Magnesium *	0.0	1.4	**1.0**	**140**	9.1	9.0	**1.10**
Manganese	0.000	1.20	**1.0**	**120**	0.008	0.008	**0.00**
Potassium *	0.0	1.4	**1.0**	**140**	0.86	0.82	**4.76**
Selenium	0.000	0.217	**0.250**	**86.8**	0.003	0.003	**0.00**
Silver *	0.00000	0.039	**0.050**	**78.0**	0.00005	0.00005	**0.00**
Sodium *	0.0	70.4	**50.0**	**141**	32.7	32.5	**0.61**
Zinc	0.000	0.044	**0.050**	**88.0**	0.006	0.006	**0.00**

NC=Not calculated due to results less than the detection limit
NA=Data not available.

Green Analytical Laboratories

DISSOLVED METALS SRM AND BLANK DATA

LAB ID#						
802.052	**SRM Data**				**Blank Data**	
PARAMETER	**SRM Result**	**True Value**	**SRM % Rec**	**Acceptance Range**	**Blank Result**	**Reporting Limit**
Aluminum	5.43	5.00	**109**	90-110 %	<0.10	0.10
Arsenic	0.049	0.050	**98.0**	90-110 %	<0.0005	0.0005
Barium	0.050	0.050	**100**	90-110 %	<0.0005	0.0005
Boron	5.4	5.0	**108**	90-110 %	0.1	0.1
Cadmium	0.046	0.050	**92.0**	90-110 %	<0.00005	0.00005
Calcium	4.5	5.0	**90.0**	90-110 %	<0.5	0.5
Chromium *	0.042	0.050	**84.0**	90-110 %	<0.001	0.001
Copper	0.050	0.050	**100**	90-110 %	<0.0001	0.0001
Iron	4.91	5.00	**98.2**	90-110 %	<0.05	0.05
Lead	0.049	0.050	**98.0**	90-110 %	<0.0001	0.0001
Magnesium	4.6	5.000	**92.0**	90-110 %	<0.5	0.5
Manganese *	2.78	2.50	**111**	90-110 %	<0.005	0.005
Potassium	9.6	10.0	**96.0**	90-110 %	<0.5	0.5
Selenium	0.244	0.250	**97.6**	90-110 %	<0.001	0.001
Silver	0.045	0.050	**90.0**	90-110 %	<0.00005	0.00005
Sodium	7.9	8.1	**97.5**	90-110 %	<0.5	0.5
Zinc	0.050	0.050	**100**	90-110 %	<0.001	0.001

NA=Data not available.

Green Analytical Laboratories

TOTAL METALS SPIKE AND DUPLICATE DATA

LAB ID#							
802-052	Spike Data				Duplicate Data		
PARAMETER	Sample Result	Spike Result	Spike Conc.	Spike % Recovery	Sample Result	Duplicate Result	RPD %
Iron-T	0.00	3.76	**4.00**	**94.0**	6.00	5.61	**6.72**
Manganese-T	0.000	1.97	**2.00**	**98.5**	1.280	1.270	**0.78**
Mercury-T	0.0000	0.0020	**0.0020**	**100**	<0.0002	<0.0002	**NC**

NC=Not calculated due to results less than the detection limit
NA=Data not available.

Green Analytical Laboratories

TOTAL METALS SRM AND BLANK DATA

LAB ID#						
802-052	SRM Data				Blank Data	
PARAMETER	SRM Result	True Value	SRM % Rec	Acceptance Range	Blank Result	Reporting Limit
Iron-T	5.21	5.00	**104**	90-110 %	<0.05	0.05
Manganese-T	2.73	2.50	**109**	90-110 %	<0.005	0.005
Mercury-T	0.0017	0.002	**85.0**	90-110 %	<0.0002	0.0002

NA=Data not available.

Green Analytical Laboratories

WET CHEM SPIKE AND DUPLICATE DATA

LAB ID#							
802-052	**Spike Data**				**Duplicate Data**		
PARAMETER	**Sample Result**	**Spike Result**	**Spike Conc.**	**Spike % Recovery**	**Sample Result**	**Duplicate Result**	**RPD %**
Alkalinity	0	102	**100**	**102**	104	100	**3.92**
Chloride	0	110	**100**	**110**	<10	<10	**NC**
EC	NMA	NMA	**NMA**	**NMA**	NA	NA	**NC**
Fluoride	0.0	0.9	**1.0**	**90.0**	0.5	0.5	**0.00**
Nitrate/Nitrite	0.10	1.79	**1.82**	**92.9**	<0.02	<0.02	**NC**
pH	NMA	NMA	**NMA**	**NMA**	8.76	8.67	**1.03**
Phosphorus-T	0.00	0.23	**0.25**	**92.0**	0.13	0.13	**0.00**
Sulfate	0	52	**50**	**104**	255	250	**1.98**
TDS	NMA	NMA	**NMA**	**NMA**	1200	1180	**1.68**
TSS	NMA	NMA	**NMA**	**NMA**	102000	99800	**2.18**

NMA=Data not applicable to Method.
NA=Data not available.
NC=Not calculated due to results less than the detection limit

Green Analytical Laboratories

WET CHEM SRM AND BLANK DATA

LAB ID#						
802-052	**SRM Data**				**Blank Data**	
PARAMETER	**SRM Result**	**True Value**	**SRM % Rec**	**Acceptance Range**	**Blank Result**	**Reporting Limit**
Alkalinity	176	186	**94.6**	90-110 %	<10	10
Chloride	25	25	**101**	90-110 %	<10	10
EC	527	561	**93.9**	90-110 %	NMA	NMA
Fluoride	1.0	1.0	**100**	90-110 %	<1.0	1.0
Nitrate/Nitrite	0.51	0.50	**102**	90-110 %	<0.02	0.02
pH	8.54	8.40	**102**	90-110 %	NMA	NMA
Phosphorus-T *	4.29	5.32	**80.6**	90-110 %	<0.05	0.05
Sulfate	335	321	**104**	90-110 %	<10	10
TDS	1180	1210	**97.5**	90-110 %	<10	10
TSS	97	104	**93.3**	90-110 %	<10	10

NMA=Data not applicable to Method.
NA=Data not available.

Green Analytical Laboratories

METALS SPIKE AND DUPLICATE DATA

LAB ID#							
804-076	Spike Data				Duplicate Data		
PARAMETER	Sample Result	Spike Result	Spike Conc.	Spike % Recovery	Sample Result	Duplicate Result	RPD %
Aluminum-T	0.00	4.22	**4.00**	**106**	1.16	1.14	**1.74**
Arsenic-T	0.0000	0.047	**0.050**	**94.0**	<0.0005	<0.0005	**NC**
Barium-T	0.0000	0.045	**0.050**	**90.0**	0.173	0.156	**10.3**
Boron-D	0.3	2.7	**2.0**	**120**	0.3	0.3	**0.00**
Cadmium-D	0.00000	0.045	**0.050**	**90.0**	<0.00005	<0.00005	**NC**
Chromium-D	0.000	0.048	**0.050**	**96.0**	0.002	0.002	**0.00**
Cobalt-D	0.0000	0.049	**0.050**	**98.0**	0.0028	0.0027	**6.92**
Copper-D	0.0000	0.048	**0.050**	**96.0**	0.148	0.121	**20.1**
Lead-D	0.0000	0.045	**0.050**	**90.0**	0.0001	0.0001	**0.00**
Mercury-T	0.000	0.002	**0.002**	**100**	<0.0002	<0.0002	**NC**
Selenium-T	0.000	0.250	**0.230**	**109**	0.069	0.067	**2.94**
Vanadium-D	0.0000	0.048	**0.050**	**96.0**	<0.0005	<0.0005	**NC**
Zinc-D	0.000	0.043	**0.050**	**86.0**	0.004	0.004	**0.00**

NC=Not calculated due to results less than the detection limit
NA=Data not available.

Green Analytical Laboratories

METALS SRM AND BLANK DATA

LAB ID#						
804-076	SRM Data				Blank Data	
PARAMETER	SRM Result	True Value	SRM % Rec	Acceptance Range	Blank Result	Reporting Limit
Aluminum-T	5.11	5.00	**102**	90-110 %	<0.10	0.10
Arsenic-T	0.049	0.050	**98.0**	90-110 %	<0.0005	0.0005
Barium-T	0.048	0.050	**96.0**	90-110 %	<0.0005	0.0005
Boron-D	5.0	5.0	**100**	90-110 %	<0.1	0.1
Cadmium-D	0.047	0.050	**94.0**	90-110 %	<0.00005	0.00005
Chromium-D	0.054	0.050	**108**	90-110 %	<0.001	0.001
Cobalt-D	0.054	0.050	**108**	90-110 %	<0.0001	0.0001
Copper-D	0.052	0.050	**104**	90-110 %	<0.0001	0.0001
Lead-D	0.048	0.050	**96.0**	90-110 %	<0.0001	0.0001
Mercury-T	0.002	0.002	**100**	90-110 %	<0.005	0.005
Selenium-T	0.241	0.250	**96.4**	90-110 %	<0.001	0.001
Vanadium-D	0.053	0.050	**106**	90-110 %	<0.00005	0.00005
Zinc-D	0.051	0.050	**102**	90-110 %	<0.001	0.001

NA=Data not available.

Green Analytical Laboratories

METALS SPIKE AND DUPLICATE DATA

LAB ID#							
805-056	Spike Data				Duplicate Data		
PARAMETER	Sample Result	Spike Result	Spike Conc.	Spike % Recovery	Sample Result	Duplicate Result	RPD %
Aluminum-T	0.00	4.27	**4.00**	**107**	0.60	0.50	**18.2**
Arsenic-T *	0.0000	3.18	**4.00**	**79.5**	0.0016	0.0016	**0.00**
Barium-T	0.0007	1.78	**2.00**	**89.0**	0.046	0.046	**0.00**
Boron-D	0.3	2.1	**2.0**	**90.0**	0.4	0.4	**0.00**
Cadmium-D	0.00000	0.049	**0.050**	**98.0**	<0.00005	<0.00005	**NC**
Chromium-D	0.000	0.049	**0.050**	**98.0**	0.002	0.002	**0.00**
Cobalt-D	0.0000	0.051	**0.050**	**102**	0.0001	0.0001	**0.00**
Copper-D	0.0000	0.048	**0.050**	**96.0**	0.001	0.001	**0.00**
Lead-D	0.0000	0.050	**0.050**	**100**	<0.0001	<0.0001	**NC**
Mercury-T	0.000	0.0023	**0.0020**	**115**	<0.0002	<0.0002	**NC**
Selenium-T	0.001	2.98	**3.00**	**99.3**	0.001	0.001	**0.00**
Vanadium-D	0.0000	0.052	**0.050**	**104**	0.0020	0.0020	**0.00**
Zinc-D	0.000	0.046	**0.050**	**92.0**	0.002	0.002	**0.00**

NC=Not calculated due to results less than the detection limit
NA=Data not available.

Green Analytical Laboratories

METALS SRM AND BLANK DATA

LAB ID#						
805-056	SRM Data				Blank Data	
PARAMETER	SRM Result	True Value	SRM % Rec	Acceptance Range	Blank Result	Reporting Limit
Aluminum-T	5.12	5.00	**102**	90-110 %	<0.10	0.10
Arsenic-T	0.054	0.050	**108**	90-110 %	<0.0005	0.0005
Barium-T	0.052	0.050	**104**	90-110 %	0.0007	0.0005
Boron-D	5.0	5.0	**100**	90-110 %	<0.1	0.1
Cadmium-D	0.055	0.050	**110**	90-110 %	<0.00005	0.00005
Chromium-D	0.054	0.050	**108**	90-110 %	<0.001	0.001
Cobalt-D	0.053	0.050	**106**	90-110 %	<0.0001	0.0001
Copper-D	0.051	0.050	**102**	90-110 %	<0.0001	0.0001
Lead-D	0.055	0.050	**110**	90-110 %	<0.0001	0.0001
Mercury-T *	0.0017	0.0020	**85.0**	90-110 %	<0.005	0.005
Selenium-T	0.260	0.250	**104**	90-110 %	0.001	0.001
Vanadium-D	0.053	0.050	**106**	90-110 %	<0.00005	0.00005
Zinc-D	0.052	0.050	**104**	90-110 %	<0.001	0.001

NA=Data not available.

Green Analytical Laboratories

DISSOLVED METALS SPIKE AND DUPLICATE DATA

LAB ID#							
807-116	Spike Data				Duplicate Data		
PARAMETER	Sample Result	Spike Result	Spike Conc.	Spike % Recovery	Sample Result	Duplicate Result	RPD %
Aluminum	0.00	2.04	**2.00**	**102**	<0.10	<0.10	**NC**
Arsenic	0.0000	0.047	**0.050**	**94.0**	0.0013	0.0013	**0.00**
Barium	0.0000	0.048	**0.050**	**96.0**	0.0198	0.0198	**0.00**
Boron	0.0	2.0	**2.0**	**100**	<0.1	<0.1	**NC**
Cadmium	0.00000	0.048	**0.050**	**96.0**	0.00030	0.00030	**0.00**
Calcium	0.0	5.7	**5.0**	**114**	48.2	48.0	**0.42**
Chromium	0.000	0.048	**0.050**	**96.0**	<0.001	<0.001	**NC**
Copper	0.0000	0.049	**0.050**	**98.0**	0.170	0.170	**0.00**
Iron	0.00	1.16	**1.00**	**116**	0.30	0.29	**3.39**
Lead	0.0000	0.047	**0.050**	**94.0**	0.0013	0.0013	**0.00**
Magnesium	0.0	1.2	**1.0**	**115**	4.6	4.6	**0.00**
Manganese	0.000	1.07	**1.00**	**107**	0.007	0.007	**0.00**
Potassium	0.0	1.0	**1.0**	**100**	6.1	6.1	**0.00**
Selenium	0.000	0.234	**0.250**	**93.6**	0.001	0.001	**0.00**
Silver	0.00000	0.049	**0.050**	**98.0**	<0.00005	<0.00005	**NC**
Sodium	0.0	58.4	**50.0**	**117**	112	111	**0.90**
Zinc	0.000	0.042	**0.050**	**84.0**	0.113	0.108	**4.52**

NC=Not calculated due to results less than the detection limit
NA=Data not available.

Green Analytical Laboratories

DISSOLVED METALS SRM AND BLANK DATA

LAB ID# 807-116	SRM Data				Blank Data	
PARAMETER	**SRM Result**	**True Value**	**SRM % Rec**	**Acceptance Range**	**Blank Result**	**Reporting Limit**
Aluminum	5.09	5.00	**102**	90-110 %	<0.10	0.10
Arsenic	0.048	0.050	**96.0**	90-110 %	<0.0005	0.0005
Barium	0.048	0.050	**96.0**	90-110 %	<0.0005	0.0005
Boron	5.2	5.0	**104**	90-110 %	<0.1	0.1
Cadmium	0.050	0.050	**100**	90-110 %	<0.00005	0.00005
Calcium	5.1	5.0	**102**	90-110 %	<0.5	0.5
Chromium	0.050	0.050	**100**	90-110 %	<0.001	0.001
Copper	0.048	0.050	**96.0**	90-110 %	<0.0001	0.0001
Iron	5.46	5.00	**109**	90-110 %	<0.05	0.05
Lead	0.049	0.050	**98.0**	90-110 %	<0.0001	0.0001
Magnesium	5.1	5.0	**102**	90-110 %	<0.5	0.5
Manganese	2.61	2.50	**104**	90-110 %	<0.005	0.005
Potassium	10.4	10.0	**104**	90-110 %	<0.5	0.5
Selenium	0.239	0.250	**95.6**	90-110 %	<0.001	0.001
Silver	0.049	0.050	**98.0**	90-110 %	<0.00005	0.00005
Sodium	8.9	8.1	**110**	90-110 %	<0.5	0.5
Zinc *	0.043	0.050	**86.0**	90-110 %	<0.001	0.001

NA=Data not available.

Green Analytical Laboratories

TOTAL METALS SPIKE AND DUPLICATE DATA

LAB ID#							
807-116	Spike Data				Duplicate Data		
PARAMETER	Sample Result	Spike Result	Spike Conc.	Spike % Recovery	Sample Result	Duplicate Result	RPD %
Iron-T	0.00	4.38	**4.00**	**110**	0.20	0.20	**0.00**
Manganese-T	0.000	2.11	**2.00**	**106**	2.55	2.48	**2.78**
Mercury-T	0.0000	0.0021	**0.0020**	**105**	<0.0002	<0.0002	**NC**

NC=Not calculated due to results less than the detection limit
NA=Data not available.

Green Analytical Laboratories

TOTAL METALS SRM AND BLANK DATA

LAB ID#						
807-116	SRM Data				Blank Data	
PARAMETER	SRM Result	True Value	SRM % Rec	Acceptance Range	Blank Result	Reporting Limit
Iron-T	5.46	5.00	**109**	90-110 %	<0.05	0.05
Manganese-T	2.61	2.50	**104**	90-110 %	<0.005	0.005
Mercury-T	0.002	0.002	**100**	90-110 %	<0.0002	0.0002

NA=Data not available.

Green Analytical Laboratories

WET CHEM SPIKE AND DUPLICATE DATA

LAB ID#							
807-116	Spike Data				Duplicate Data		
PARAMETER	Sample Result	Spike Result	Spike Conc.	Spike % Recovery	Sample Result	Duplicate Result	RPD %
Alkalinity	0	100	**100**	**100**	212	210	**0.95**
Chloride	0	101	**100**	**101**	<10	<10	**NC**
EC	NMA	NMA	**NMA**	**NMA**	723	721	**0.28**
Fluoride	0.0	1.0	**1.0**	**100**	<0.2	<0.2	**NC**
Nitrate/Nitrite	0.00	0.11	**0.10**	**110**	0.49	0.49	**0.00**
pH	NMA	NMA	**NMA**	**NMA**	7.49	7.47	**0.27**
Phosphorus-T	0.00	0.28	**0.25**	**112**	0.09	0.08	**11.8**
Sulfate	0	50	**50**	**100**	146	138	**5.63**
TDS	NMA	NMA	**NMA**	**NMA**	500	480	**4.08**
TSS	NMA	NMA	**NMA**	**NMA**	NA	NA	**NA**

NMA=Data not applicable to Method.
NA=Data not available.
NC=Not calculated due to results less than the detection limit

Green Analytical Laboratories

WET CHEM SRM AND BLANK DATA

LAB ID#						
807-116	SRM Data				Blank Data	
PARAMETER	SRM Result	True Value	SRM % Rec	Acceptance Range	Blank Result	Reporting Limit
Alkalinity	362	339	**107**	90-110 %	<10	10
Chloride	25	23	**110**	90-110 %	<10	10
EC	814	829	**98.2**	90-110 %	NMA	NMA
Fluoride	1.0	1.0	**100**	90-110 %	<1.0	1.0
Nitrate/Nitrite	0.50	0.50	**100**	90-110 %	<0.02	0.02
pH	9.09	9.29	**97.8**	90-110 %	NMA	NMA
Phosphorus-T	0.22	0.20	**110**	90-110 %	<0.05	0.05
Sulfate	325	321	**101**	90-110 %	<10	10
TDS	5050	4850	**104**	90-110 %	<10	10
TSS	102	110	**92.7**	90-110 %	<10	10

NMA=Data not applicable to Method.
NA=Data not available.

Green Analytical Laboratories

DISSOLVED METALS SPIKE AND DUPLICATE DATA

LAB ID# 808-067	Spike Data				Duplicate Data		
PARAMETER	Sample Result	Spike Result	Spike Conc.	Spike % Recovery	Sample Result	Duplicate Result	RPD %
Aluminum	0.00	2.37	**2.00**	**119**	<0.1	<0.1	**NC**
Arsenic	0.0000	0.056	**0.050**	**112**	0.0041	0.0040	**2.47**
Barium	0.0000	0.054	**0.050**	**108**	0.0977	0.0945	**3.33**
Boron	0.0	2.3	**2.00**	**117**	0.1	0.1	**0.00**
Cadmium	0.00000	0.056	**0.050**	**112**	0.00106	0.00100	**5.83**
Calcium	0.0	5.8	**5.0**	**116**	120.0	120.0	**0.00**
Chromium	0.000	0.058	**0.050**	**116**	<0.001	<0.001	**NC**
Cobalt	0.00000	0.056	**0.050**	**112**	0.00079	0.00078	**1.27**
Copper	0.0000	0.056	**0.050**	**112**	0.0068	0.0063	**7.63**
Iron	0.00	1.17	**1.00**	**117**	0.09	0.09	**0.00**
Lead	0.0000	0.054	**0.050**	**108**	0.0015	0.0015	**0.00**
Magnesium	0.0	1.2	**1.00**	**120**	14.8	14.7	**0.68**
Manganese *	0.000	1.23	**1.00**	**123**	0.009	0.009	**0.00**
Potassium	0.0	1.1	**1.00**	**110**	10.8	10.8	**0.00**
Selenium	0.000	0.286	**0.250**	**114**	0.001	0.001	**0.00**
Silver	0.00000	0.059	**0.050**	**118**	<0.00005	<0.00005	**NC**
Sodium	0.0	59.7	**50.0**	**119**	55.1	54.9	**0.36**
Vanadium	0.0000	0.055	**0.050**	**110**	0.0037	0.0037	**0.00**
Zinc	0.000	0.056	**0.050**	**112**	0.009	0.009	**0.00**

NC=Not calculated due to results less than the detection limit
NA=Data not available.

Green Analytical Laboratories

DISSOLVED METALS SRM AND BLANK DATA

LAB ID#						
808-067	SRM Data				Blank Data	
PARAMETER	SRM Result	True Value	SRM % Rec	Acceptance Range	Blank Result	Reporting Limit
Aluminum	5.19	5.00	**104**	90-110 %	<0.10	0.10
Arsenic	0.047	0.050	**94.0**	90-110 %	<0.0005	0.0005
Barium	0.049	0.050	**98.0**	90-110 %	<0.0005	0.0005
Boron	5.2	5.0	**104**	90-110 %	<0.1	0.1
Cadmium	0.048	0.050	**96.0**	90-110 %	<0.00005	0.00005
Calcium	5.1	5.0	**102**	90-110 %	<0.5	0.5
Chromium	0.050	0.050	**100**	90-110 %	<0.001	0.001
Cobalt	0.049	0.050	**98.0**	90-110 %	<0.00005	0.00005
Copper	0.048	0.050	**96.0**	90-110 %	<0.0001	0.0001
Iron	5.37	5.00	**107**	90-110 %	<0.05	0.05
Lead	0.049	0.050	**98.0**	90-110 %	<0.0001	0.0001
Magnesium	5.0	5.0	**100**	90-110 %	<0.5	0.5
Manganese	2.68	2.50	**107**	90-110 %	<0.005	0.005
Potassium	10.3	10.0	**103**	90-110 %	<0.5	0.5
Selenium	0.239	0.250	**95.6**	90-110 %	<0.001	0.001
Silver	0.051	0.050	**102**	90-110 %	<0.00005	0.00005
Sodium	8.7	8.1	**107**	90-110 %	<0.5	0.5
Vanadium	0.048	0.050	**96.0**	90-110 %	<0.0005	0.0005
Zinc	0.047	0.050	**94.0**	90-110 %	<0.001	0.001

NA=Data not available.

Green Analytical Laboratories

TOTAL METALS SPIKE AND DUPLICATE DATA

LAB ID#							
808-067	Spike Data				Duplicate Data		
PARAMETER	Sample Result	Spike Result	Spike Conc.	Spike % Recovery	Sample Result	Duplicate Result	RPD %
Aluminum-T	0.00	4.34	**4.00**	**109**	3.99	3.63	**9.45**
Arsenic-T	0.00	0.05	**0.05**	**106**	0.002	0.002	**0.00**
Barium-T	0.00	0.05	**0.05**	**98.0**	130	127	**2.33**
Boron-T	0.00	4.40	**4.00**	**110**	0.20	0.20	**0.00**
Iron-T	0.00	3.94	**4.00**	**98.5**	7.07	7.00	**1.00**
Manganese-T	0.000	2.05	**2.00**	**103**	4.35	4.30	**1.16**
Mercury-T	0.0000	0.0020	**0.0020**	**100**	<0.0002	<0.0002	**NC**
Selenium-T	0.000	0.255	**0.250**	**102**	<0.001	<0.001	**NC**

NC=Not calculated due to results less than the detection limit
NA=Data not available.

Green Analytical Laboratories

TOTAL METALS SRM AND BLANK DATA

LAB ID# 808-067	SRM Data				Blank Data	
PARAMETER	SRM Result	True Value	SRM % Rec	Acceptance Range	Blank Result	Reporting Limit
Aluminum-T	5.17	5.00	**103**	90-110 %	<0.05	0.05
Arsenic-T	0.050	0.050	**100**	90-110 %	<0.05	0.05
Barium-T	0.051	0.050	**102**	90-110 %	<0.05	0.05
Boron-T	5.30	5.00	**106**	90-110 %	<0.05	0.05
Iron-T	5.08	5.00	**102**	90-110 %	<0.05	0.05
Manganese-T	2.65	2.50	**106**	90-110 %	<0.005	0.005
Mercury-T	0.002	0.002	**100**	90-110 %	<0.0002	0.0002
Selenium-t	0.245	0.250	**98.0**	90-110 %	<0.005	0.005

NA=Data not available.

Green Analytical Laboratories

WET CHEM SPIKE AND DUPLICATE DATA

LAB ID#							
808-067	Spike Data				Duplicate Data		
PARAMETER	Sample Result	Spike Result	Spike Conc.	Spike % Recovery	Sample Result	Duplicate Result	RPD %
Alkalinity	0	106	**100**	**106**	182	180	**1.10**
Chloride	0	105	**100**	**105**	29	27	**7.14**
EC	NMA	NMA	**NMA**	**NMA**	NA	NA	**NA**
Fluoride	0.0	0.9	**1.0**	**90.0**	<0.2	<0.2	**NC**
Nitrate/Nitrite	0.00	0.11	**0.10**	**110**	0.49	0.49	**0.00**
pH	NMA	NMA	**NMA**	**NMA**	6.85	6.83	**0.29**
Phosphorus-T	0.00	0.24	**0.25**	**96.0**	0.21	0.20	**4.88**
Sulfate	0	55	**50**	**110**	840	820	**2.41**
TDS	NMA	NMA	**NMA**	**NMA**	240	225	**6.45**
TSS	NMA	NMA	**NMA**	**NMA**	1250000	1200000	**4.08**

NMA=Data not applicable to Method.
NA=Data not available.
NC=Not calculated due to results less than the detection limit

Green Analytical Laboratories

WET CHEM SRM AND BLANK DATA

LAB ID#						
808-067	SRM Data				Blank Data	
PARAMETER	SRM Result	True Value	SRM % Rec	Acceptance Range	Blank Result	Reporting Limit
Alkalinity	360	339	**106**	90-110 %	<10	10
Chloride	23	23	**101**	90-110 %	<10	10
EC *	NA	NA	**NA**	90-110 %	NMA	NMA
Fluoride	1.0	1.0	**100**	90-110 %	<1.0	1.0
Nitrate/Nitrite	0.48	0.50	**96.0**	90-110 %	<0.02	0.02
pH	9.03	8.90	**101**	90-110 %	NMA	NMA
Phosphorus-T	4.75	5.32	**89.3**	90-110 %	<0.05	0.05
Sulfate	350	321	**109**	90-110 %	<10	10
TDS	5040	4850	**104**	90-110 %	<10	10
TSS	102	110	**92.7**	90-110 %	<10	10

NMA=Data not applicable to Method.
NA=Data not available.

Green Analytical Laboratories

DISSOLVED METALS SPIKE AND DUPLICATE DATA

LAB ID#							
904-012	Spike Data				Duplicate Data		
PARAMETER	Sample Result	Spike Result	Spike Conc.	Spike % Recovery	Sample Result	Duplicate Result	RPD %
Aluminum	0.00	2.00	**2.0000**	**100**	<0.10	<0.10	**NC**
Arsenic	0.0000	0.0490	**0.0500**	**98.0**	0.0018	0.0017	**5.71**
Barium	0.0000	0.0500	**0.0500**	**100**	0.1011	0.0973	**3.83**
Boron	0.0	2.1	**2.00**	**105**	0.2	0.2	**0.00**
Cadmium	0.00000	0.05200	**0.05200**	**100**	<0.00005	<0.00005	**NC**
Calcium	0.0	24.8	**25.00**	**99.2**	6.5	6.1	**6.35**
Chromium	0.000	0.047	**0.050**	**94.0**	0.011	0.011	**0.00**
Cobalt	0.00000	0.04800	**0.05000**	**96.0**	0.00024	0.00023	**4.26**
Copper	0.0000	0.0450	**0.0500**	**90.0**	0.4630	0.4490	**3.07**
Iron	0.00	5.00	**5.00**	**100**			**NC**
Lead	0.0000	0.0480	**0.0500**	**96.0**	0.0003	0.0003	**0.00**
Magnesium	0.0	4.9	**5.00**	**98.0**	1.1	1.1	**0.00**
Manganese	0.00000	1.10000	**1.00000**	**110**	0.03400	0.03400	**0.00**
Potassium	0.0	4.9	**5.00**	**98.0**	4.5	4.3	**4.55**
Selenium	0.000	0.241	**0.250**	**96.4**	0.017	0.016	**6.06**
Silver	0.00000	0.04900	**0.05000**	**98.0**			**NC**
Sodium	0.0	249.0	**250.00**	**99.6**	603.0	567.0	**6.15**
Vanadium	0.00000	0.04600	**0.05000**	**92.0**	0.00310	0.00290	**6.67**
Zinc	0.000	0.047	**0.050**	**94.0**	0.009	0.009	**0.00**

NC=Not calculated due to results less than the detection limit
NA=Data not available.

Green Analytical Laboratories

DISSOLVED METALS SRM AND BLANK DATA

LAB ID# 904-012	SRM Data				Blank Data	
PARAMETER	**SRM Result**	**True Value**	**SRM % Rec**	**Acceptance Range**	**Blank Result**	**Reporting Limit**
Aluminum	5.20	5.00	**104**	90-110 %	<0.10	0.10
Arsenic	0.0500	0.0500	**100**	90-110 %	<0.0005	0.0005
Barium	0.0540	0.0500	**108**	90-110 %	<0.0005	0.0005
Boron	5.2	5.0	**104**	90-110 %	<0.1	0.1
Cadmium	0.05200	0.05000	**104**	90-110 %	<0.00005	0.00005
Calcium	5.1	5.0	**102**	90-110 %	<0.5	0.5
Chromium	0.049	0.050	**98.0**	90-110 %	<0.001	0.001
Cobalt	0.05000	0.05000	**100**	90-110 %	<0.00005	0.00005
Copper	0.0480	0.0500	**96.0**	90-110 %	<0.0001	0.0001
Iron	5.30	5	**106**	90-110 %	<0.05	0.05
Lead	0.0520	0.0500	**104**	90-110 %	<0.0001	0.0001
Magnesium	4.9	5.0	**98.0**	90-110 %	<0.5	0.5
Manganese	2.700	2.500	**108**	90-110 %	<0.005	0.005
Potassium	10.1	10.0	**101**	90-110 %	<0.5	0.5
Selenium	0.256	.25	**102**	90-110 %	<0.001	0.001
Silver	0.04700	0.05000	**94.0**	90-110 %	<0.00005	0.00005
Sodium	8.3	8.1	**102**	90-110 %	<0.5	0.5
Vanadium	0.049	0.050	**98.0**	90-110 %	<0.005	0.005
Zinc	0.051	0.050	**102**	90-110 %	<0.001	0.001

NA=Data not available.

Green Analytical Laboratories

TOTAL METALS SPIKE AND DUPLICATE DATA

LAB ID#							
904-012	Spike Data				Duplicate Data		
PARAMETER	Sample Result	Spike Result	Spike Conc.	Spike % Recovery	Sample Result	Duplicate Result	RPD %
Aluminum-T	0.00	3.72	**4.00**	**93.0**	0.28	0.26	**7.41**
Arsenic-T	0.000	0.047	**0.050**	**94.0**	0.003	0.003	**6.90**
Barium-T	0.000	0.051	**0.050**	**102**	0.272	0.252	**7.63**
Iron-T	0.05	3.60	**4.00**	**88.8**	1.91	1.90	**0.52**
Manganesse-T	0.00	1.90	**2.00**	**95.0**	0.29	0.24	**18.9**
Mercury-T	0.000	0.002	**0.002**	**100**	<0.0002	<0.0002	**NC**
Selenium-T	0.000	8.310	**8.00**	**104**	<0.001	<0.001	**NC**

NC=Not calculated due to results less than the detection limit
NA=Data not available.

Green Analytical Laboratories

TOTAL METALS SRM AND BLANK DATA

LAB ID#						
904-012	SRM Data				Blank Data	
PARAMETER	SRM Result	True Value	SRM % Rec	Acceptance Range	Blank Result	Reporting Limit
Aluminum-T	5.16	5.00	**103**	90-110 %	<0.005	0.005
Arsenic-T	0.055	0.050	**110**	90-110 %	<0.005	0.005
Barium-T	0.055	0.050	**110**	90-110 %	<0.005	0.005
Iron-T	5.03	5.00	**101**	90-110 %	0.05	0.05
Manganese-T	2.670	2.500	**107**	90-110 %	<0.005	0.005
Mercury-T	0.0021	0.0020	**105**	90-110 %	<0.005	0.005
Selenium-T	7.30	6.70	**109**	90-110 %	<0.0002	0.0002

NA=Data not available.

Green Analytical Laboratories

WET CHEM SPIKE AND DUPLICATE DATA

LAB ID#							
904-012	Spike Data				Duplicate Data		
PARAMETER	Sample Result	Spike Result	Spike Conc.	Spike % Recovery	Sample Result	Duplicate Result	RPD %
Alkalinity	0	105	**100**	**105**	308	306	**0.65**
Chloride	0	100	**100**	**100**	18	18	**0.00**
EC	NMA	NMA	**NMA**	**NMA**	798	798	**0.00**
Fluoride	0.3	1.3	**1.0**	**100**	1.6	1.6	**0.00**
Nitrate/Nitrite	0.00	0.11	**0.10**	**110**	0.17	0.17	**0.00**
pH	NMA	NMA	**NMA**	**NMA**	8.26	8.23	**0.36**
Phosphorus-T	0.00	0.24	**0.25**	**96.0**	0.11	0.10	**9.52**
Sulfate	0	52.00	**50.00**	**104**	6900	6900	**0.00**
TDS	NMA	NMA	**NMA**	**NMA**	1790	1760	**1.69**
TSS	NMA	NMA	**NMA**	**NMA**	11.0	9.7	**12.6**

NMA=Data not applicable to Method.

Green Analytical Laboratories

WET CHEM SRM AND BLANK DATA

LAB ID#						
904-012	SRM Data				Blank Data	
PARAMETER	SRM Result	True Value	SRM % Rec	Acceptance Range	Blank Result	Reporting Limit
Alkalinity	139	146	**95.2**	90-110 %	<10	10
Chloride	76	76	**100**	90-110 %	<10	10
EC	1515	1470	**103**	90-110 %	NMA	NMA
Fluoride	1.0	1.0	**100**	90-110 %	<1.0	1.0
Nitrate/Nitrite	0.50	0.50	**100**	90-110 %	<0.02	0.02
pH	8.99	9.19	**97.8**	90-110 %	NMA	NMA
Phosphorus-T	0.20	0.20	**100**	90-110 %	<0.05	0.05
Sulfate	335	321	**104**	90-110 %	<10	10
TDS	3795	3770	**101**	90-110 %	<10	10
TSS	123	133	**92.5**	90-110 %	<10	10

NMA=Data not applicable to Method.

Appendix 18.E

Monitoring Well and Vibrating Wire Piezometer Completion Diagrams

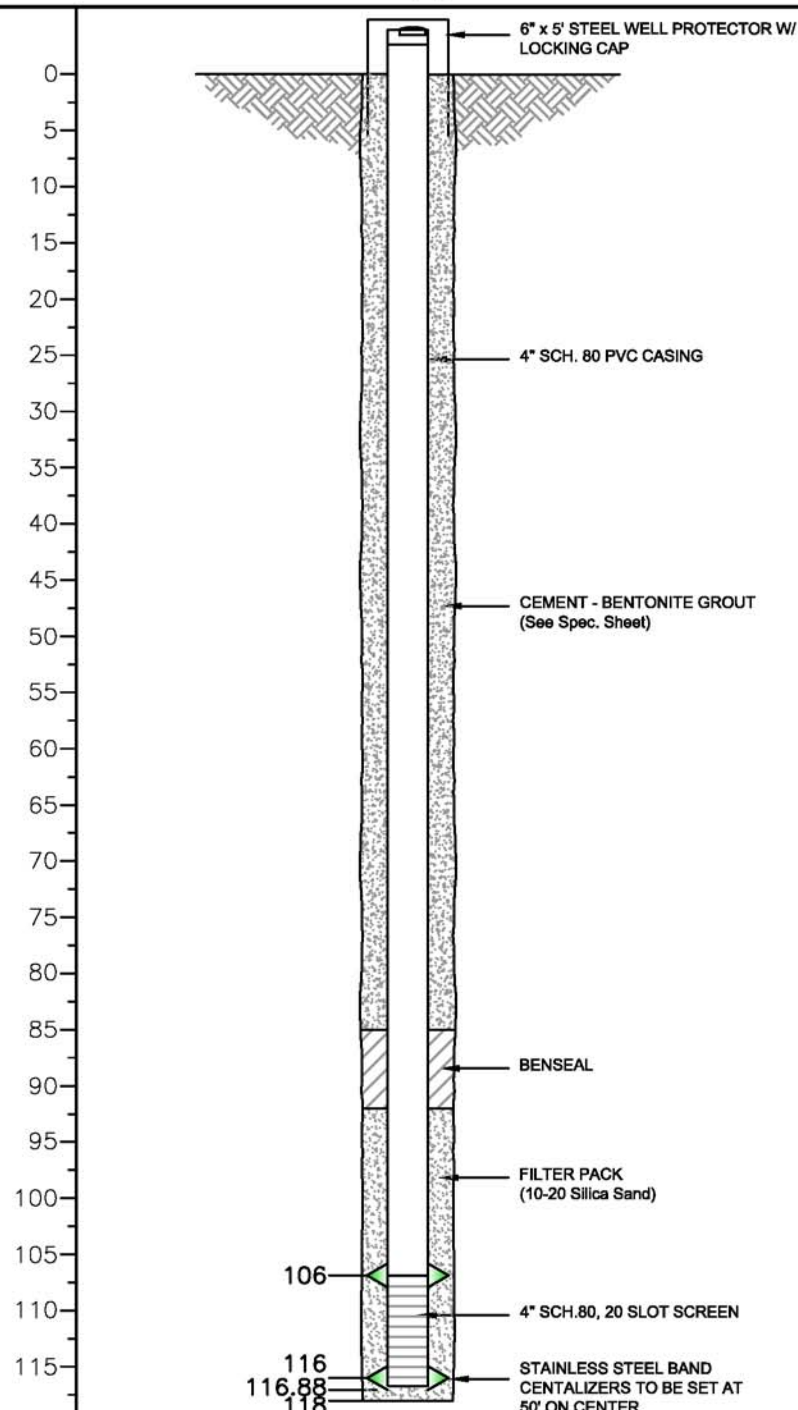
NORWEST
Applied Hydrology

KF2007-01

COMPLETION DIAGRAM & LITHOLOGIC LOG

PROJECT: NAVAJO MINE EXTENSION	WELL TYPE: MONITOR WELL	CASING DIAMETER: 4"
DRILLING CO: MO-TE	WELLHEAD TYPE: PROTECTIVE HEAD COVER	CASING MATERIAL: SCH 80 PVC
DRILLER: BOB	WELL COMPLETED: 7/28/07	BORING DIAMETER: 8-3/4"
CLIENT SUPERVISER: COLLETTE BROWN	WELL DEVELOPED: 7/28/07	TOP OF CASING ELEV. (FT): 5459.96
GEOLOGIST/SUPERVISOR: JOEL SOBOL	DATE SURVEYED: 8/29/07	GROUND ELEVATION (FT): 5457.22
AHA JOB#: 4010-00060-10	SCREEN SLOT SIZE: 0.02" MILL SLOT	LOCATION: AREA 4 SOUTH
DRILLING METHOD: AIR ROTARY	SCREEN TYPE: 4" SCH 80 PVC	NORTHING (FT): 1984390.9290
BORING STARTED: 7/28/07	FILTER PACK: 10-20 SILICA SAND	EASTING (FT): 307986.0078

LITHOLOGY LOG



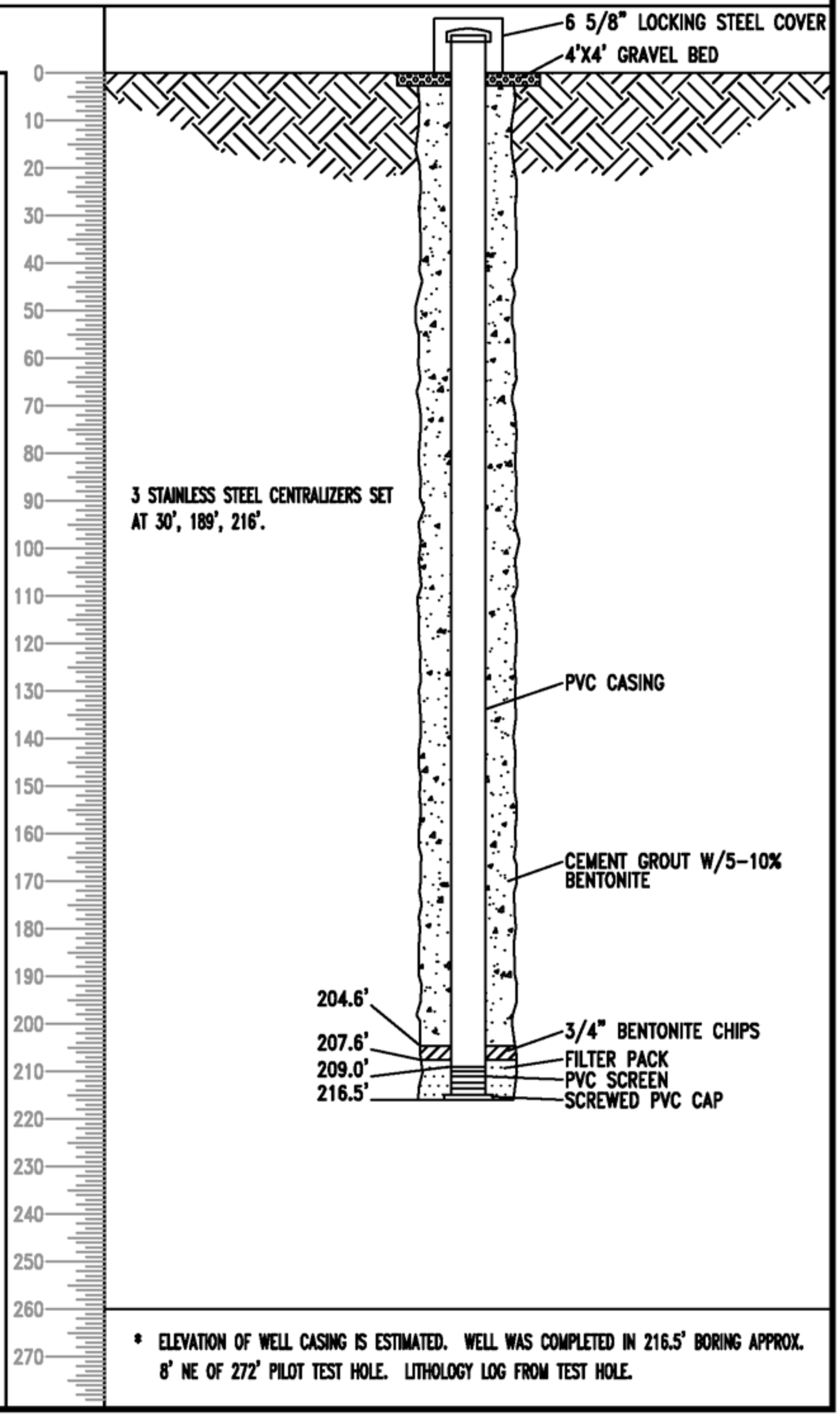
KF98-02

COMPLETION DIAGRAM & LITHOLOGIC LOG

NORWEST Applied Hydrology

PROJECT: NO NAME	WELL TYPE: MONITORING	CASING DIAMETER: 4"
DRILLING CO: SHARPE DRILLING	WELLHEAD TYPE: STICKUP (1.5')	CASING MATERIAL: SCH 80 PVC
DRILLER: RUSS SHARPE	WELL COMPLETED: 3/23/98	BORING DIAMETER: 7 7/8"
CLIENT SUPERVISER: RON VANVALKENBURG	WELL DEVELOPED: 3/28/98	TOP OF CASING ELEV. (FT): 5507.04
GEOLOGIST/SUPERVISOR: IAN PEARSON	DATE SURVEYED:	GROUND ELEVATION (FT): 5505.89
AHA JOB#: 43-4B	SCREEN SLOT SIZE: 0.02" MILL SLOT	LOCATION: AREA 4 SOUTH
DRILLING METHOD: AIR ROTARY	SCREEN TYPE: SCH 80 PVC	NORTHING (FT): 1,974,600.26
BORING STARTED: 3/22/98	FILTER PACK: 30-60 SAND	EASTING (FT): 303,887.43

LITHOLOGY LOG



* ELEVATION OF WELL CASING IS ESTIMATED. WELL WAS COMPLETED IN 216.5' BORING APPROX. 8' NE OF 272' PILOT TEST HOLE. LITHOLOGY LOG FROM TEST HOLE.

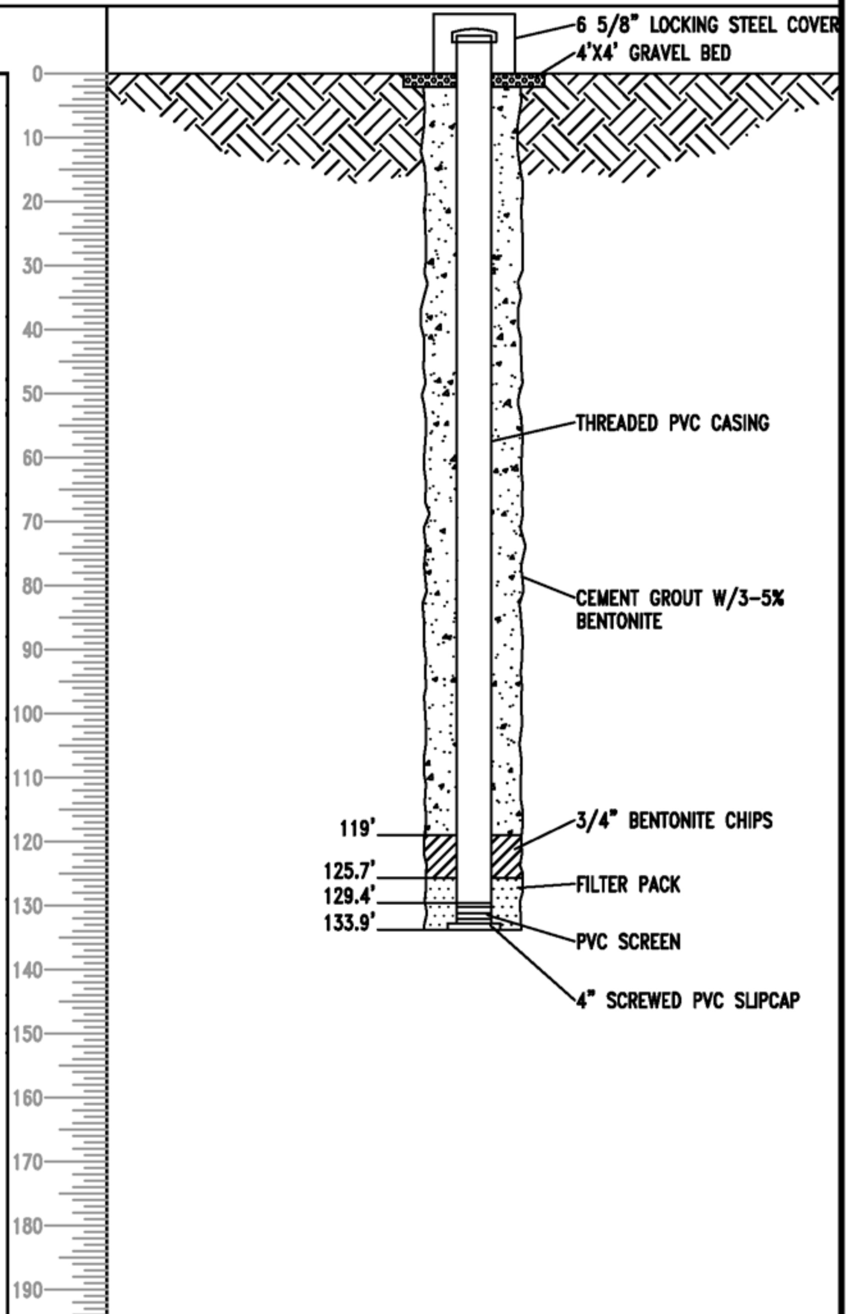
NORWEST
Applied Hydrology

KF98-03

COMPLETION DIAGRAM & LITHOLOGIC LOG

PROJECT: NO NAME	WELL TYPE: MONITORING	CASING DIAMETER: 4"
DRILLING CO: SHARPE DRILLING	WELLHEAD TYPE: STICKUP (2.3')	CASING MATERIAL: SCH 80 PVC
DRILLER: RUSS SHARPE	WELL COMPLETED: 3/27/98	BORING DIAMETER: 7 7/8"
CLIENT SUPERVISER: RON VANVALKENBURG	WELL DEVELOPED: 3/28/98	TOP OF CASING ELEV. (FT): 5425.53
GEOLOGIST/SUPERVISOR: IAN PEARSON	DATE SURVEYED:	GROUND ELEVATION (FT): 5423.45
AHA JOB#: 43-4B	SCREEN SLOT SIZE: 0.02" MILL SLOT	LOCATION: AREA 4 SOUTH
DRILLING METHOD: AIR ROTARY	SCREEN TYPE: SCH 80 PVC	NORTHING (FT): 1,984,271.05
BORING STARTED: 3/25/98	FILTER PACK: 10-20 SILICA SAND	EASTING (FT): 304,599.17

LITHOLOGY LOG



TOP OF CASING ELEVATION IS ESTIMATED. WELL WAS COMPLETED IN 134'. BORING IS APPROXIMATELY 10' NORTH OF 202' PILOT TEST HOLE. LITHOLOGY LOG FROM TEST HOLE. TEMP SURFACE CASING (21', PILOT) (24', WELL BORING) SET TO ISOLATE WATER BEARING ALLUVIUM

NORWEST Applied Hydrology

KF98-04

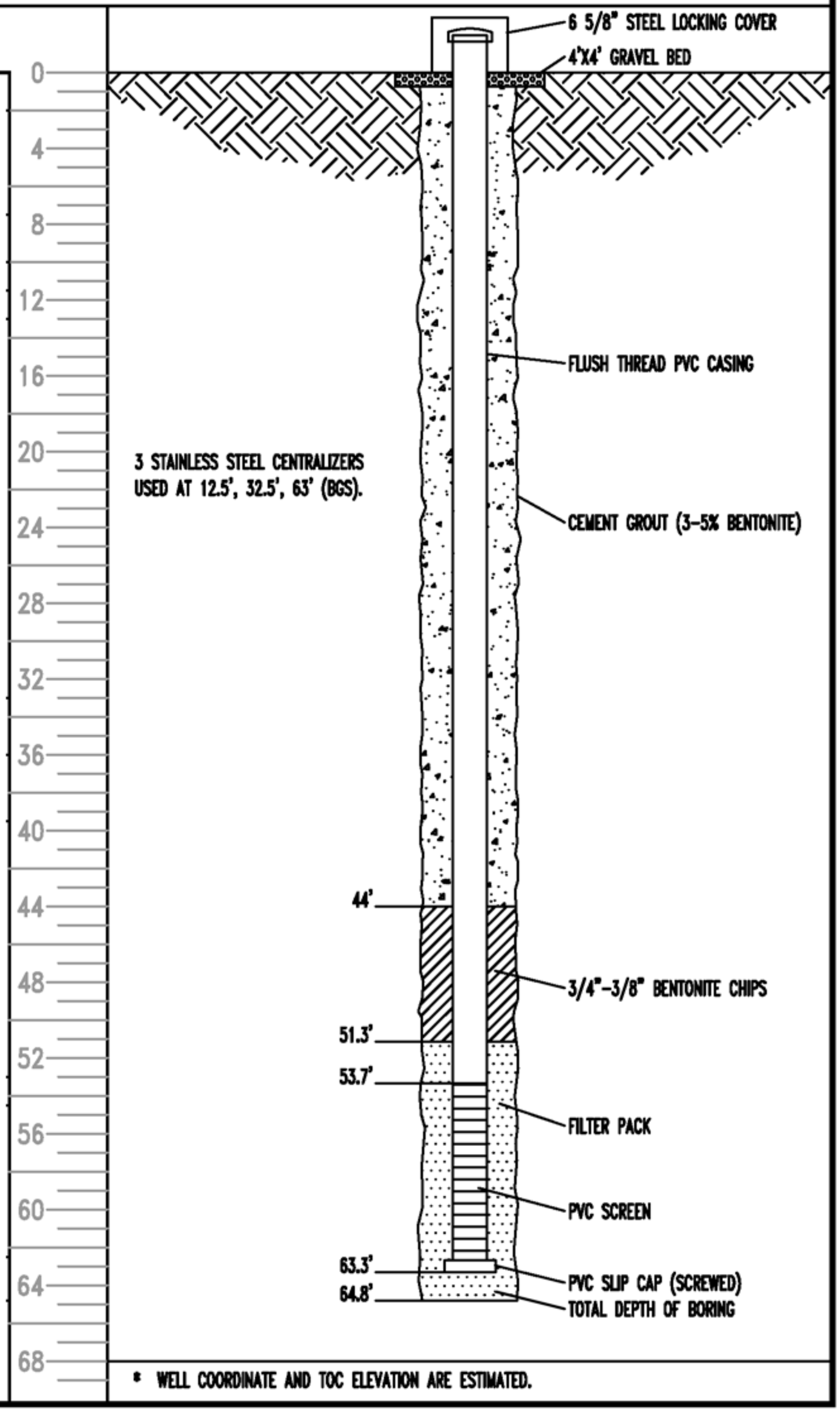
COMPLETION DIAGRAM & LITHOLOGIC LOG

PROJECT: NO NAME
DRILLING CO: SHARPE DRILLING
DRILLER: RUSS SHARPE
CLIENT SUPERVISER: RON VANVALKENBURG
GEOLOGIST/SUPERVISOR: IAN PEARSON
AHA JOB#: 43-4B
DRILLING METHOD: AIR ROTARY
BORING STARTED: 3/27/98

WELL TYPE: MONITORING
WELLHEAD TYPE: STICKUP (1.7')
WELL COMPLETED: 3/28/98
WELL DEVELOPED: 3/28/98
DATE SURVEYED:
SCREEN SLOT SIZE: 0.02" MILL SLOT
SCREEN TYPE: SCH 80 PVC
FILTER PACK: 10-20 SILICA SAND

CASING DIAMETER: 4"
CASING MATERIAL: SCH 80 PVC
BORING DIAMETER: 7 7/8"
TOP OF CASING ELEV. (FT): 5353.38
GROUND ELEVATION (FT): 5351.81
LOCATION: AREA 4 SOUTH
NORTHING (FT): 1,990,163.70
EASTING (FT): 300,368.91

LITHOLOGY LOG



* WELL COORDINATE AND TOC ELEVATION ARE ESTIMATED.

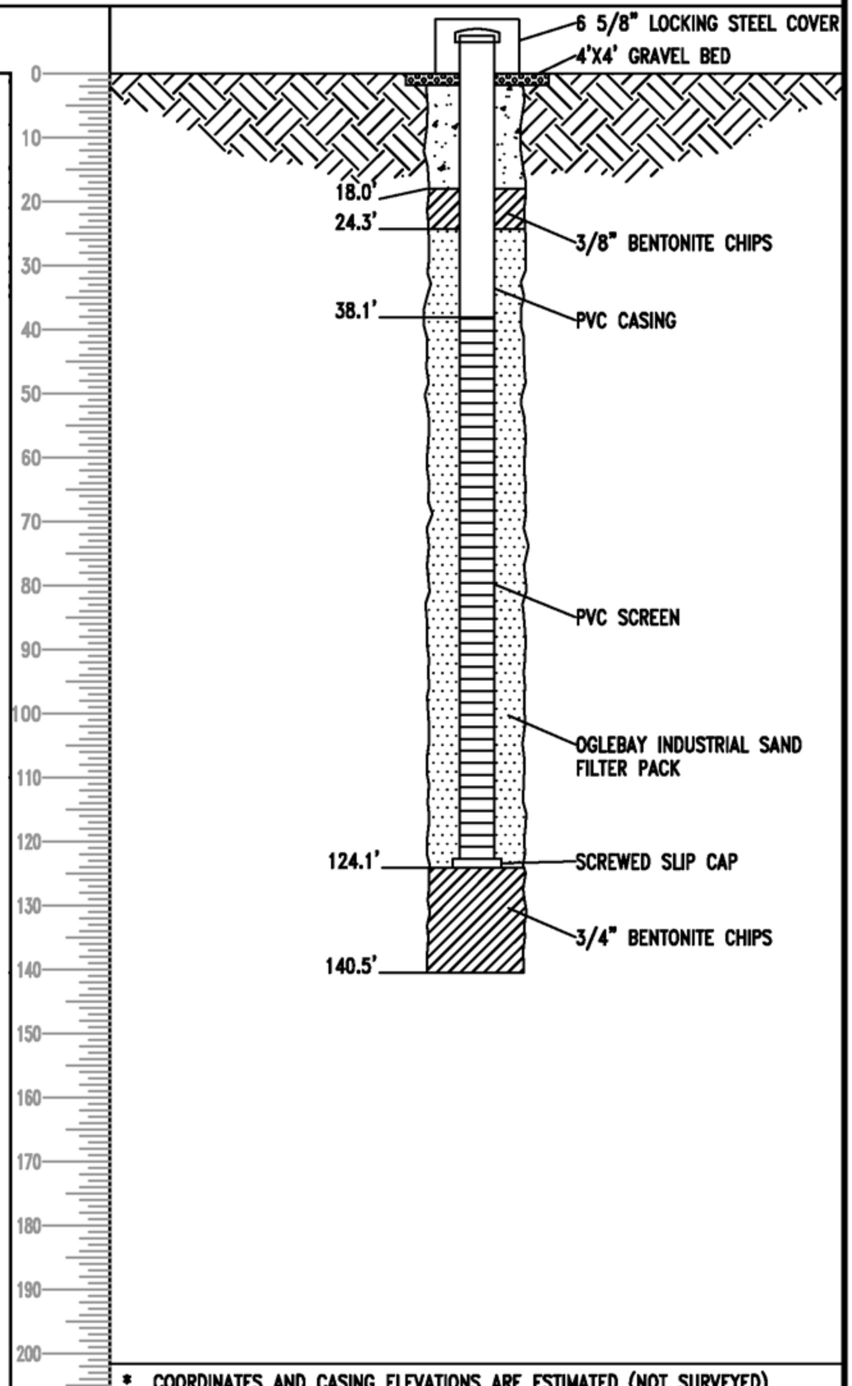
NORWEST
Applied Hydrology

KPC-98-01

COMPLETION DIAGRAM & LITHOLOGIC LOG

PROJECT: NO NAME	WELL TYPE: MONITORING	CASING DIAMETER: 4"
DRILLING CO: SHARPE DRILLING	WELLHEAD TYPE: STICKUP (1.6')	CASING MATERIAL: SCH 80 PVC
DRILLER: RUSS SHARPE	WELL COMPLETED: 3/21/98	BORING DIAMETER: 7 7/8"
CLIENT SUPERVISER: RON VALVALKENBURG	WELL DEVELOPED: 3/28/98	TOP OF CASING ELEV. (FT): 5366.46
GEOLOGIST/SUPERVISOR: IAN PEARSON	DATE SURVEYED:	GROUND ELEVATION (FT): 5365.20
AHA JOB#: 43-4B	SCREEN SLOT SIZE: 0.02" MILL SLOT	LOCATION: AREA 4 SOUTH
DRILLING METHOD: AIR ROTARY	SCREEN TYPE: SCH 80 PVC	NORTHING (FT): 1,993,801.95
BORING STARTED: 3/20/98	FILTER PACK: 30-60 SAND	EASTING (FT): 290,787.30

LITHOLOGY LOG



* COORDINATES AND CASING ELEVATIONS ARE ESTIMATED (NOT SURVEYED)
NO CENTRALIZERS WERE USED

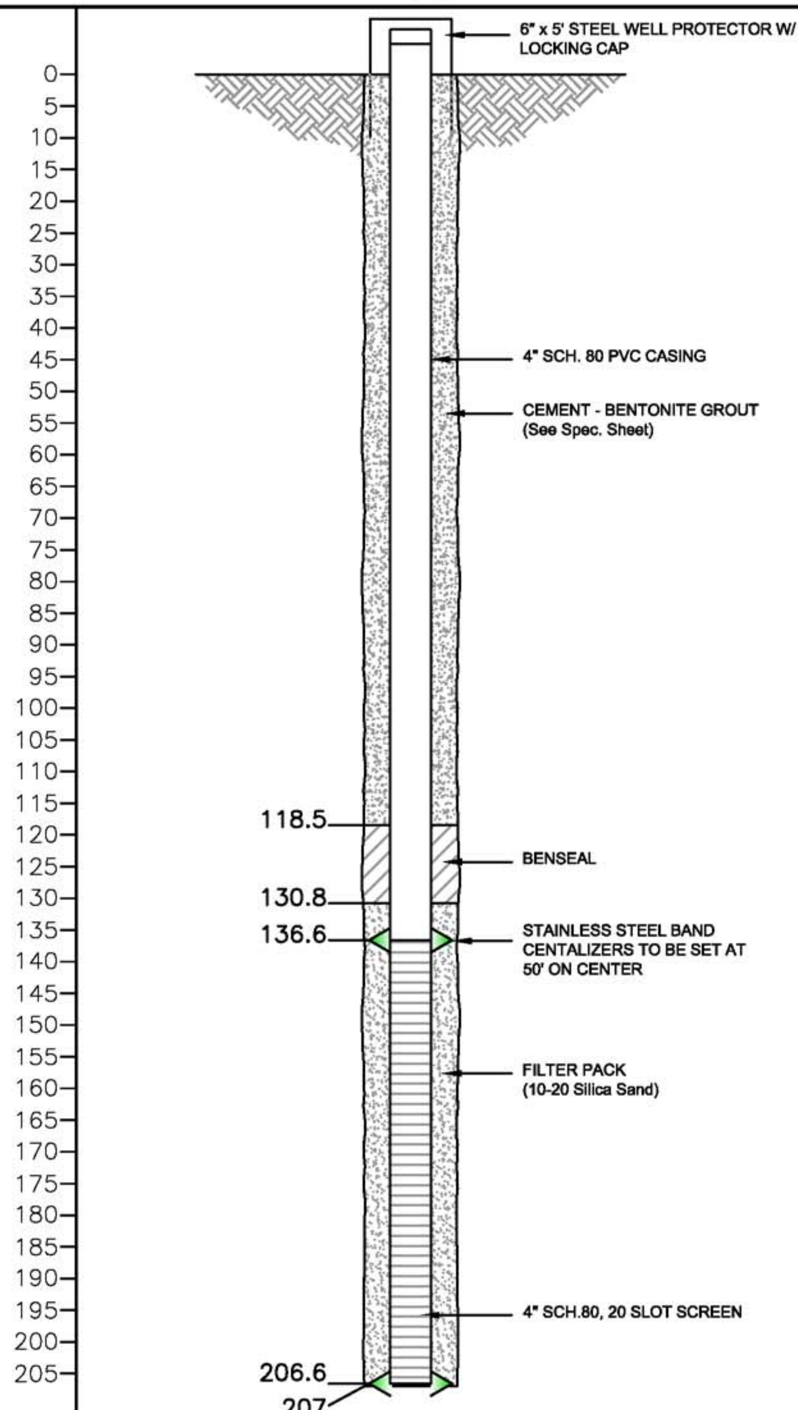
KPC2007-01

NORWEST
Applied Hydrology

COMPLETION DIAGRAM & LITHOLOGIC LOG

PROJECT: NAVAJO MINE EXTENSION	WELL TYPE: MONITORING WELL	CASING DIAMETER: 4"
DRILLING CO: MO-TE	WELLHEAD TYPE: PROTECTIVE HEAD COVER	CASING MATERIAL: 4" SCH 80 PVC
DRILLER: BOB	WELL COMPLETED: 7/29/07	BORING DIAMETER: 8-3/4"
CLIENT SUPERVISER: COLLETTE BROWN	WELL DEVELOPED: 7/29/07	TOP OF CASING ELEV. (FT): 5355.71'
GEOLOGIST/SUPERVISOR: JOEL SOBOL	DATE SURVEYED: 8/29/07	GROUND ELEVATION (FT): 5352.97
AHA JOB#: 4010-00060-10	SCREEN SLOT SIZE: 0.02"	LOCATION: AREA 4 SOUTH
DRILLING METHOD: AIR ROTARY	SCREEN TYPE: 4" SCH 80 PVC MILL SLOT	NORTHING (FT): 1995102.5555
BORING STARTED: 7/29/07	FILTER PACK: 10-20 SILICA SAND	EASTING (FT): 302595.6035

LITHOLOGY LOG



NORWEST
Applied Hydrology

KPC2007-02

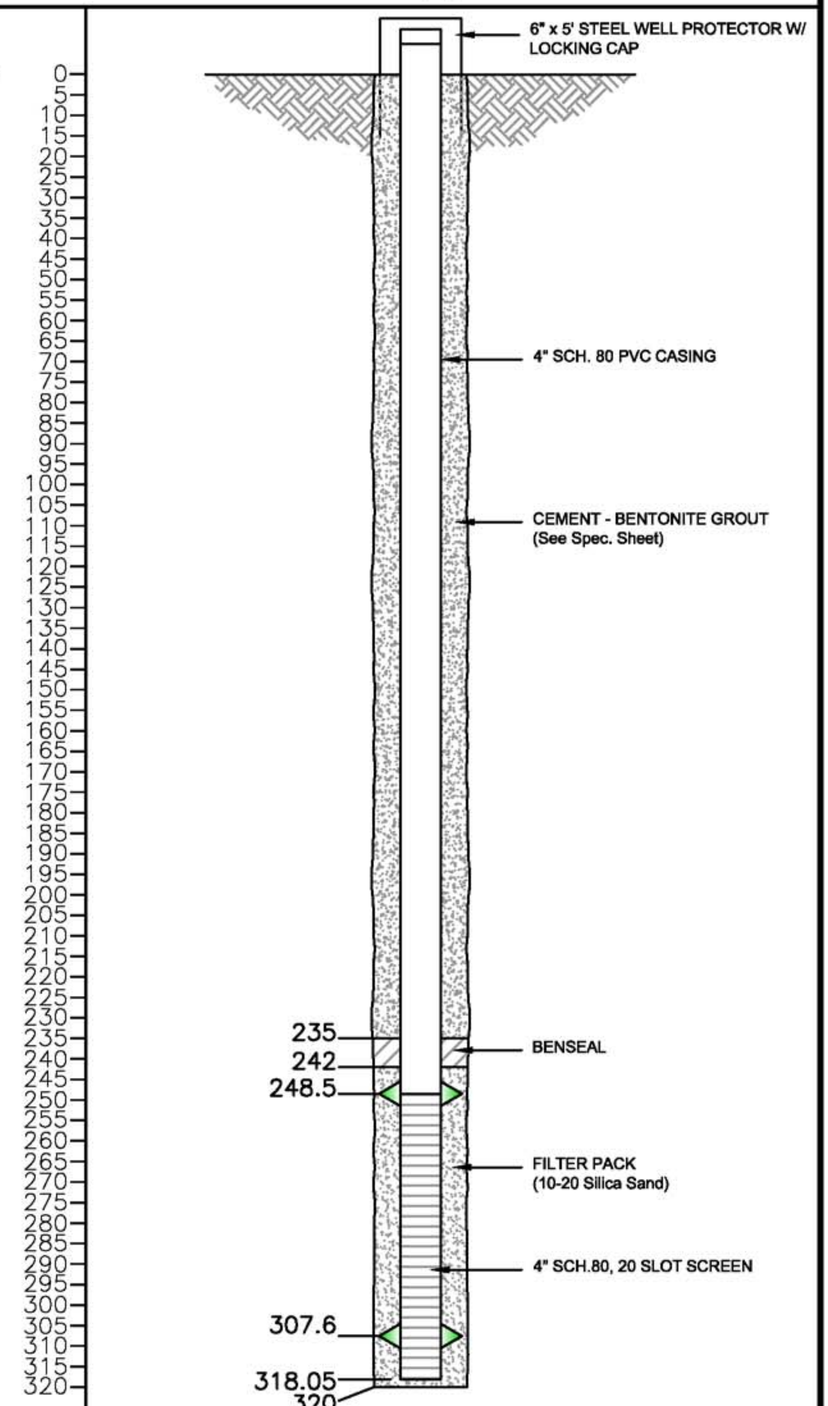
COMPLETION DIAGRAM & LITHOLOGIC LOG

PROJECT: NAVAJO MINE EXTENSION
DRILLING CO: MO-TE
DRILLER: BOB
CLIENT SUPERVISER: COLLETTE BROWN
GEOLOGIST/SUPERVISOR: JOEL SOBOL
AHA JOB#: 4010-00060-10
DRILLING METHOD: AIR ROTARY
BORING STARTED: 7/26/07

WELL TYPE: MONITORING WELL
WELLHEAD TYPE: PROTECTIVE HEAD COVER
WELL COMPLETED: 7/28/07
WELL DEVELOPED: 7/28/07
DATE SURVEYED: 8/29/07
SCREEN SLOT SIZE: 0.02"
SCREEN TYPE: 4" SCH 80 PVC MILL SLOT
FILTER PACK: 10-20 SILICA SAND

CASING DIAMETER: 4"
CASING MATERIAL: 4" SCH 80 PVC
BORING DIAMETER: 8-3/4"
TOP OF CASING ELEV. (FT): 5515.06
GROUND ELEVATION (FT): 5512.18
LOCATION: AREA 4 SOUTH
NORTHING (FT): 1975118.7726
EASTING (FT): 303891.1349

LITHOLOGY LOG



NORWEST
Applied Hydrology

KPC2007-03

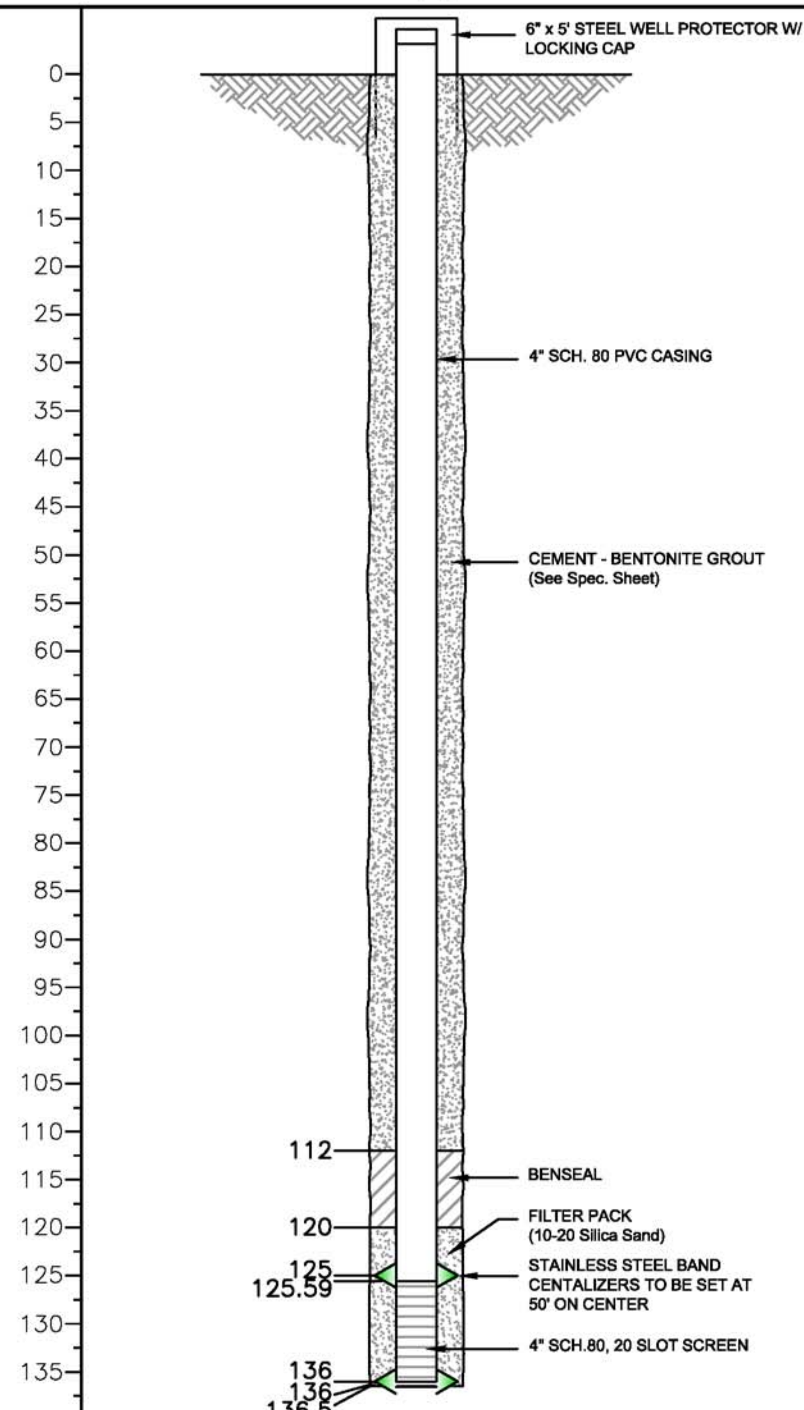
COMPLETION DIAGRAM & LITHOLOGIC LOG

PROJECT: NAVAJO MINE EXTENSION
DRILLING CO: MO-TE
DRILLER: BOB
CLIENT SUPERVISER: COLLETTE BROWN
GEOLOGIST/SUPERVISOR: JOEL SOBOL
AHA JOB#: 4010-00060-10
DRILLING METHOD: AIR ROTARY
BORING STARTED: 7/24/07

WELL TYPE: MONITORING WELL
WELLHEAD TYPE: PROTECTIVE HEAD COVER
WELL COMPLETED: 8/2/07
WELL DEVELOPED: 8/2/07
DATE SURVEYED: 8/29/07
SCREEN SLOT SIZE: 0.02"
SCREEN TYPE: 4" SCH 80 PVC MILL SLOT
FILTER PACK: 10-20 SILICA SAND

CASING DIAMETER: 4"
CASING MATERIAL: 4" SCH 80 PVC
BORING DIAMETER: 8-3/4"
TOP OF CASING ELEV. (FT): 5470.23
GROUND ELEVATION (FT): 5467.83
LOCATION: AREA 4 SOUTH
NORTHING (FT): 1982884.7045
EASTING (FT): 295091.1864

LITHOLOGY LOG



NORWEST
Applied Hydrology

NNA-1

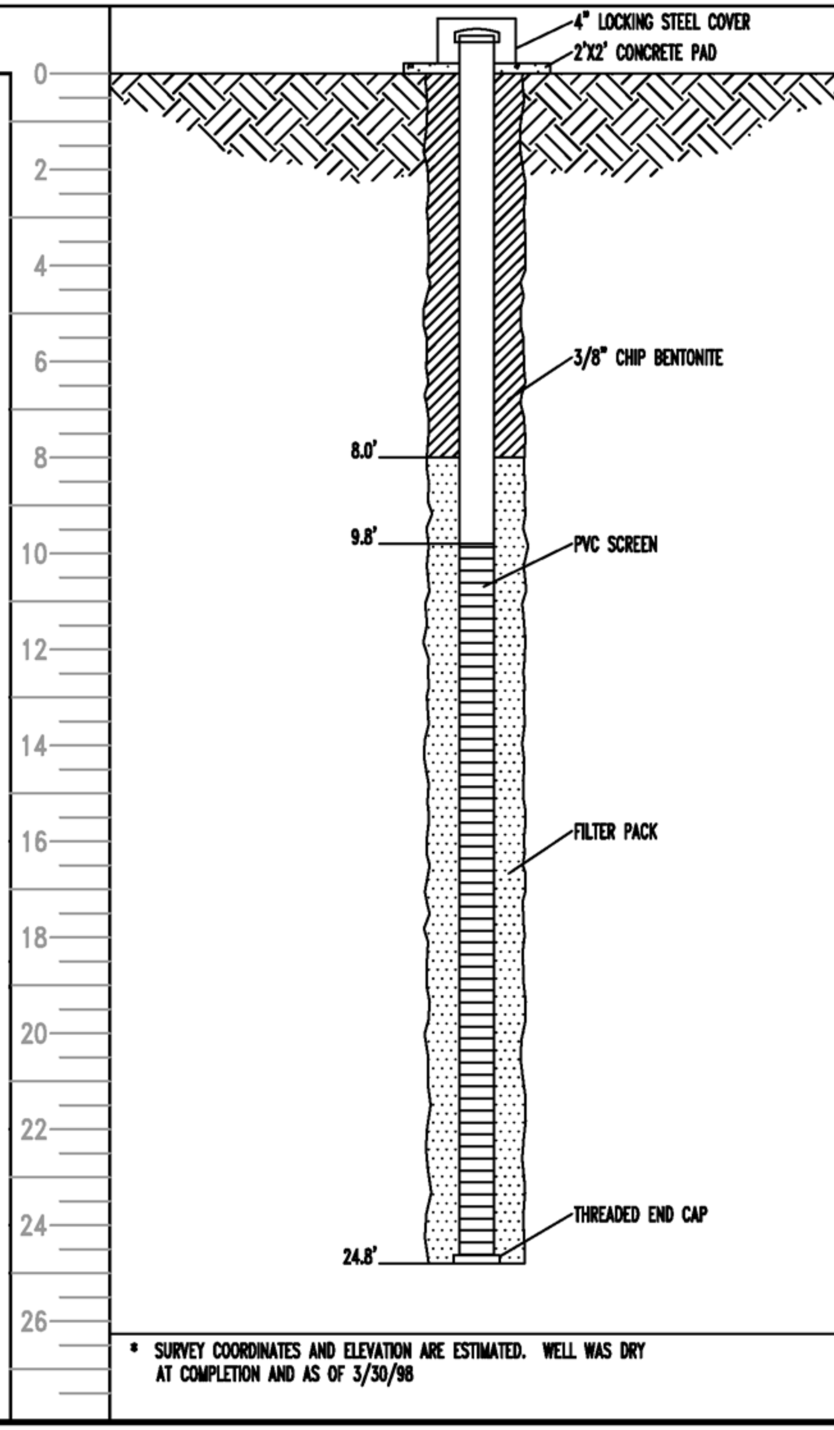
COMPLETION DIAGRAM & LITHOLOGIC LOG

PROJECT: NO NAME
DRILLING CO: PHILIP SERVICES CORP
DRILLER: KELLY PADILLA
CLIENT SUPERVISER: RON VANVALKENBURG
GEOLOGIST/SUPERVISOR: IAN PEARSON
AHA JOB#: 43-4B
DRILLING METHOD: HOLLOW STEM AUGER
BORING STARTED: 3/25/98

WELL TYPE: MONITORING
WELLHEAD TYPE: STICKUP (1.6')
WELL COMPLETED: 3/25/98
WELL DEVELOPED: WELL DRY
DATE SURVEYED:
SCREEN SLOT SIZE: 0.02" MILL SLOT
SCREEN TYPE: SCH 40 PVC
FILTER PACK: 10-20 SILICA SAND

CASING DIAMETER: 2"
CASING MATERIAL: SCH 40 PVC
BORING DIAMETER: 7 1/2"
TOP OF CASING ELEV. (FT): 5431.63
GROUND ELEVATION (FT): 5430.46
LOCATION: AREA 4 SOUTH
NORTHING (FT): 1,976,857.28
EASTING (FT): 296,773.43

LITHOLOGY LOG



* SURVEY COORDINATES AND ELEVATION ARE ESTIMATED. WELL WAS DRY AT COMPLETION AND AS OF 3/30/98

NORWEST
Applied Hydrology

NNA-2

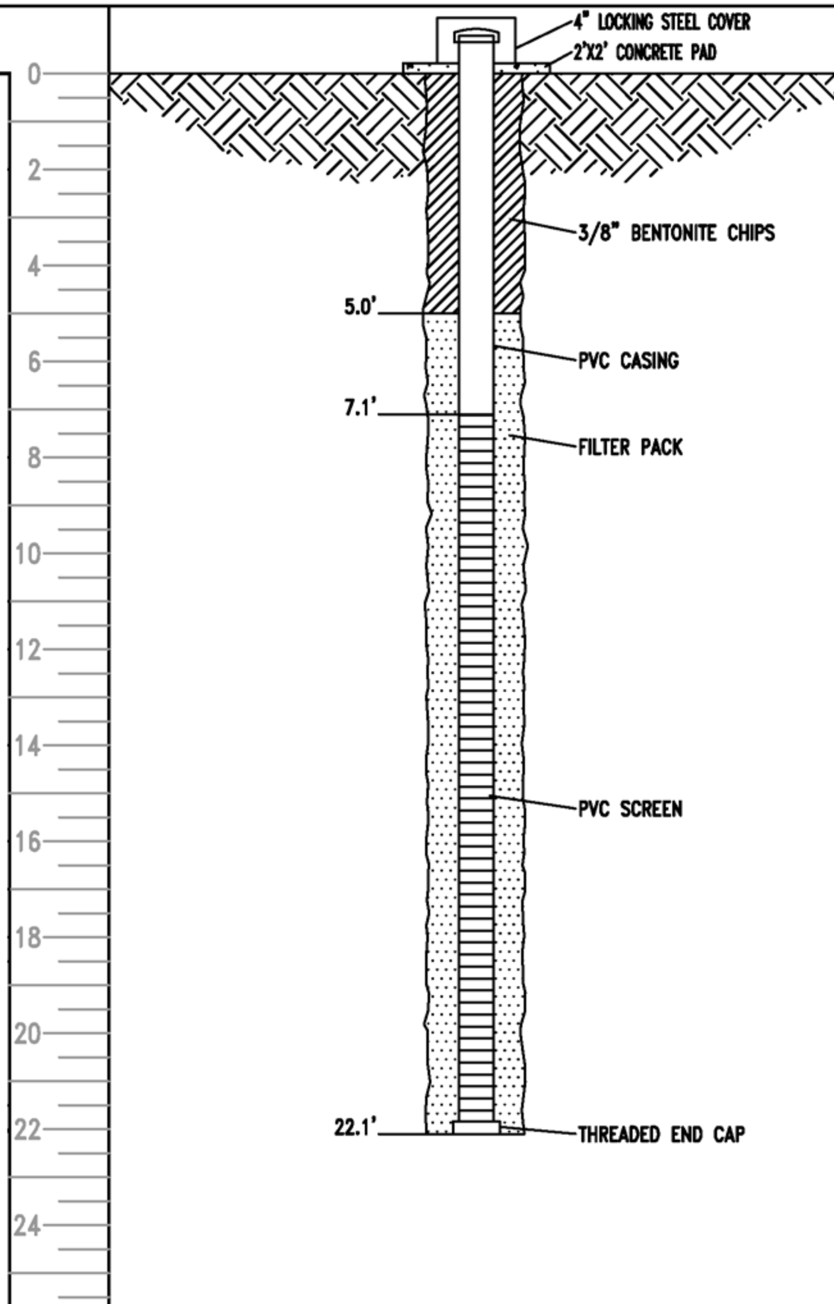
COMPLETION DIAGRAM & LITHOLOGIC LOG

PROJECT: NO NAME
DRILLING CO: PHILIP SERVICES CORP
DRILLER: KELLY PADILLA
CLIENT SUPERVISER: RON VANVALKENBURG
GEOLOGIST/SUPERVISOR: IAN PEARSON
AHA JOB#: 43-4B
DRILLING METHOD: HOLLOW STEM AUGER
BORING STARTED: 3/25/98

WELL TYPE: MONITORING
WELLHEAD TYPE: STICKUP (1.5')
WELL COMPLETED: 3/25/98
WELL DEVELOPED: WELL DRY
DATE SURVEYED:
SCREEN SLOT SIZE: 0.02" MILL SLOT
SCREEN TYPE: SCH 40 PVC
FILTER PACK: 10-20 SILICA SAND

CASING DIAMETER: 2"
CASING MATERIAL: SCH 40 PVC
BORING DIAMETER: 7 1/2"
TOP OF CASING ELEV. (FT): 5455.97
GROUND ELEVATION (FT): 5454.68
LOCATION: AREA 4 SOUTH
NORTHING (FT): 1,975,404.71
EASTING (FT): 299,547.33

LITHOLOGY LOG



* SURVEY COORDINATES AND ELEVATION ARE ESTIMATED. WELL WAS DRY AT COMPLETION AND AS OF 3/30/98

NORWEST
Applied Hydrology

PA-1

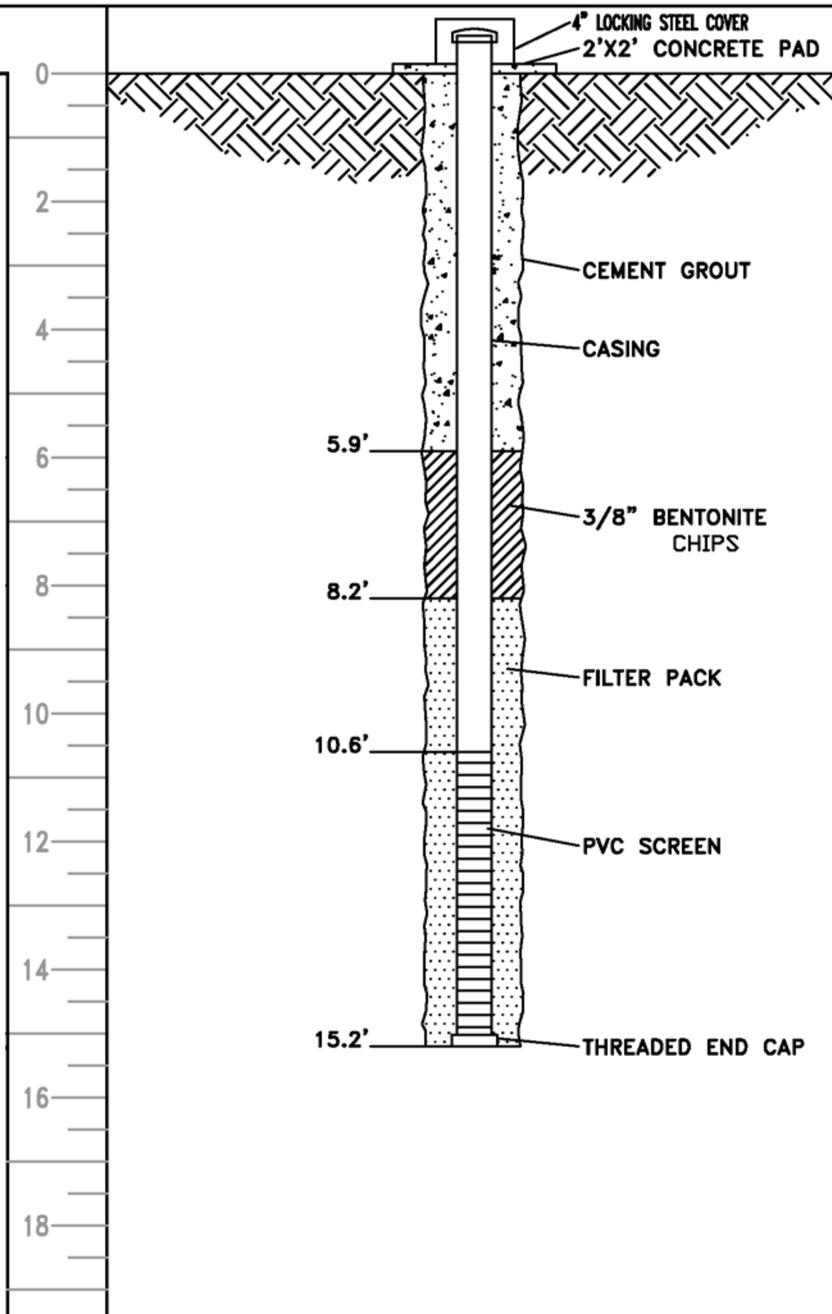
COMPLETION DIAGRAM & LITHOLOGIC LOG

PROJECT: NO NAME
DRILLING CO: PHILIP SERVICES
DRILLER: KELLY PADILLA
CLIENT SUPERVISER: RON VANVALKENBURG
GEOLOGIST/SUPERVISOR: IAN PEARSON
AHA JOB#: 43-4B
DRILLING METHOD: HOLLOW STEM AUGER
BORING STARTED: 3/25/98

WELL TYPE: MONITORING
WELLHEAD TYPE: STICKUP (1.7')
WELL COMPLETED: 3/25/98
WELL DEVELOPED: 3/28/98
DATE SURVEYED:
SCREEN SLOT SIZE: 0.02" MILL SLOT
SCREEN TYPE: SCH 40 PVC
FILTER PACK: 10-20 SILICA SAND

CASING DIAMETER: 2"
CASING MATERIAL: SCH 40 PVC
BORING DIAMETER: 7 1/2"
TOP OF CASING ELEV. (FT): 5352.90
GROUND ELEVATION (FT): 5351.24
LOCATION: AREA 4 SOUTH
NORTHING (FT): 1,990,260.27
EASTING (FT): 300,409.16

LITHOLOGY LOG



* SURVEY COORDINATES AND ELEVATION ARE ESTIMATED
DTW FROM TOC = 11.35' 3/29/98

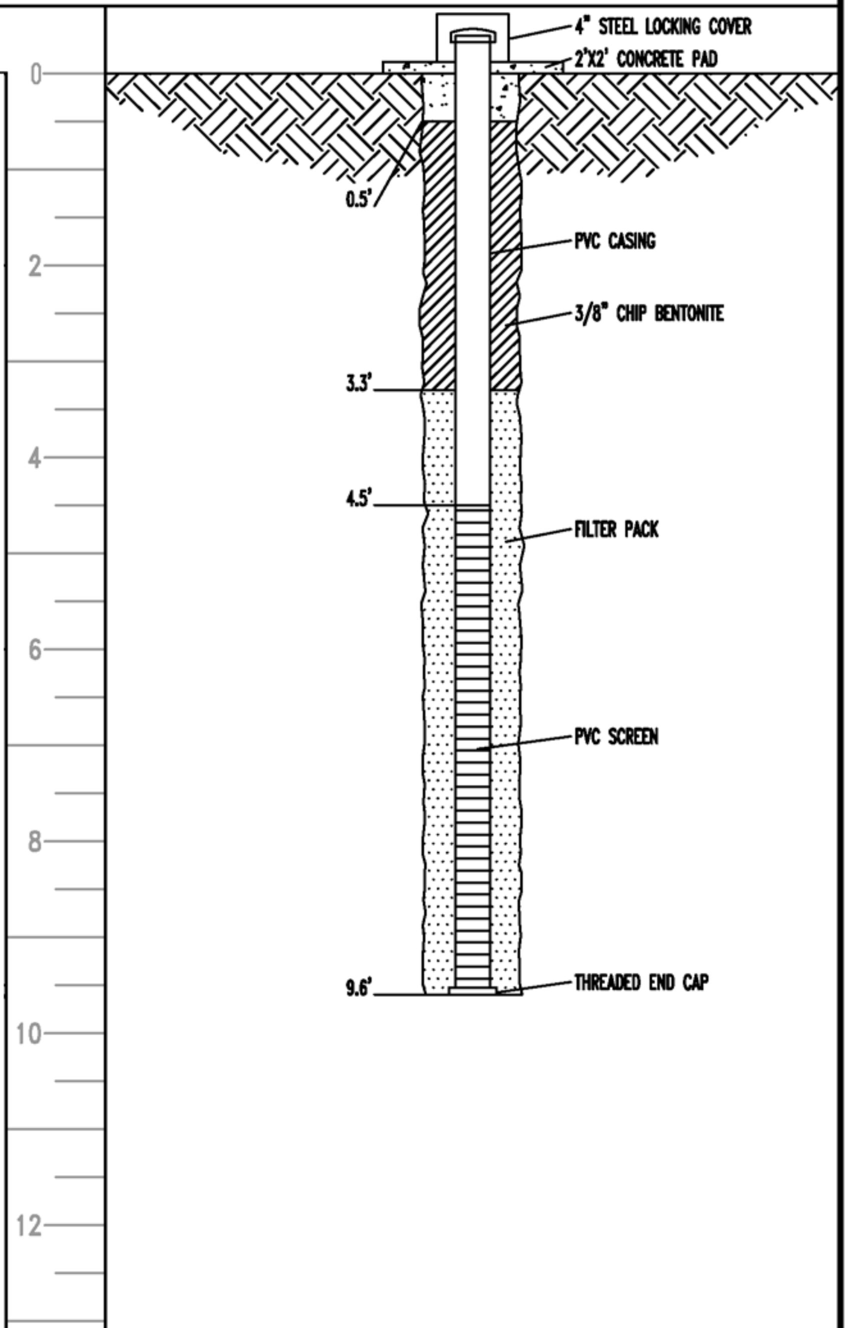
NORWEST
Applied Hydrology

PA-2

COMPLETION DIAGRAM & LITHOLOGIC LOG

PROJECT: NO NAME	WELL TYPE: MONITORING	CASING DIAMETER: 2"
DRILLING CO: PHILIP SERVICES CORP	WELLHEAD TYPE: STICKUP (2.15')	CASING MATERIAL: SCH 40 PVC
DRILLER: KELLY PADILLA	WELL COMPLETED: 3/25/98	BORING DIAMETER: 7 1/2"
CLIENT SUPERVISER: RON VANVALKENBURG	WELL DEVELOPED: 3/28/98	TOP OF CASING ELEV. (FT): 5431.43
GEOLOGIST/SUPERVISOR: IAN PEARSON	DATE SURVEYED:	GROUND ELEVATION (FT): 5429.60
AHA JOB#: 43-4B	SCREEN SLOT SIZE: 0.02" MILL SLOT	LOCATION: AREA 4 SOUTH
DRILLING METHOD: HOLLOW STEM AUGER	SCREEN TYPE: SCH 40 PVC	NORTHING (FT): 1,980,957.17
BORING STARTED: 3/25/98	FILTER PACK: 10-20 SILICA SAND	EASTING (FT): 306,702.95

LITHOLOGY LOG



* SURVEY COORDINATES AND ELEVATION ARE ESTIMATED
DTW FROM TOC = 7.69' 3/30/98

Appendix 18.F

Aquifer Testing Results from 1998 and 2007

HYDRAULIC TESTING RESULTS FOR NAVAJO MINE EXTENSION PROJECT AUGUST 2007

Hydraulic testing of the Pictured Cliffs Sandstone (PCS) and the No. 8 coal seam was performed at BHP Navajo Coal Company's Navajo Mine Extension Project from August 14-18, 2007 on the following wells: Kpc2007-01, Kpc2007-02, Kpc2007-03, and Kf2007-01. The analyses of the test results were performed using codes in the Aqtesolv software package show good agreement with the previous findings.

Results:

Well Kpc2007-01 (Pictured Cliffs Sandstone)

> A solution was obtained using the Theis Method, which assumes an extensive and homogeneous confined aquifer. The test was run with an average variable pumping rate of 0.95 gpm, results are attached. The solution indicates a transmissivity of 0.576 ft^2/day and a hydraulic conductivity of 0.0074 ft/day (2.6 $x10^{-6}$ cm/sec)

Well Kpc2007-02 (Pictured Cliffs Sandstone)

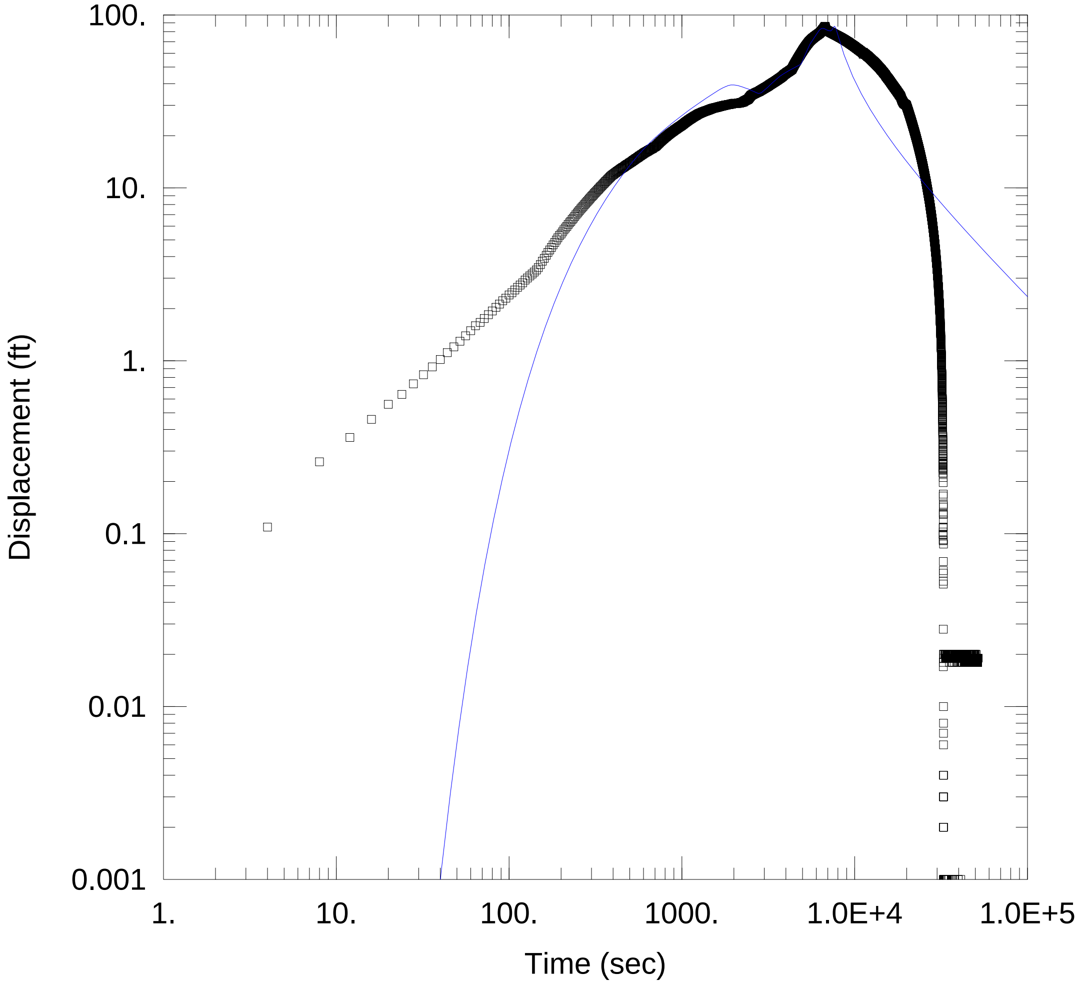
> The drawdown rate in this well during pumping exactly matched casing volume dewatering, and recovery after pumping was very slow. Consequently, the results ccould not be interpreted as a pumping test. Instead, the recovery portion was analyzed using the Bouwer-Rice method for slug tests in confined aquifers. The results are attached. The very low hydraulic conductivity value of 0.0001 ft/day (3.51 $x10^{-8}$ cm/sec) was obtained from this test, indicating the formation is either exceptionally tight or the screen interval is compromised by cement. Wet cement was found at the bottom of this well and the pH of the entire water column was 11.8.

Well Kpc2007-03 (Pictured Cliffs Sandstone)

> A slug test was performed at this well due to the low yield of the PCS combined with a water column of only 7 feet in the well based on an initial water level measurement of 129 ft. and a total well depth of 136 ft. A slug was made up with two-inch PVC, open at the top and packed with sand, and this was let below the water and later raised above it for falling and rising head tests. The Bouwer-Rice solution obtained the best fit to the data, and gave a hydraulic conductivity of 0.004 ft/day (1.4 $x10^{-6}$ cm/sec); the Hvorslev method gave 0.09 ft/day. The results are attached.

Well Kf2007-01 (No. 8A Seam)

> This test showed delayed initial response, an abrupt "catch-up", and a faster than expected recovery. The later portion of the pumping test gave favorable fits to type curves for the Neuman-Witherspoon (leaky aquitard) and Papadopulos-Cooper (including well bore storage). The early pumping and recovery anomalies may be due to poor development and movement of coal fines during pumping, washout or fracturing of coals. The pumping rate was variable but averaged 1.5 gpm. Transmissivities determined for the variable rate interpretations of the Neuman-Witherspoon and Papadopulos-Cooper methods were 1.92 ft^2/day and 1.398 ft^2/day, respectively. A hydraulic conductivity value of 0.056 ft/day (2.0 $x10^{-5}$ cm/sec) was obtained from the Papadopulos-Cooper test results.



WELL TEST ANALYSIS

Data Set: S:\...\Theis_UpdatedFlowRates_Kpc2007-01.aqt
Date: 10/29/08 Time: 08:48:36

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
Kpc2007-01	0	0

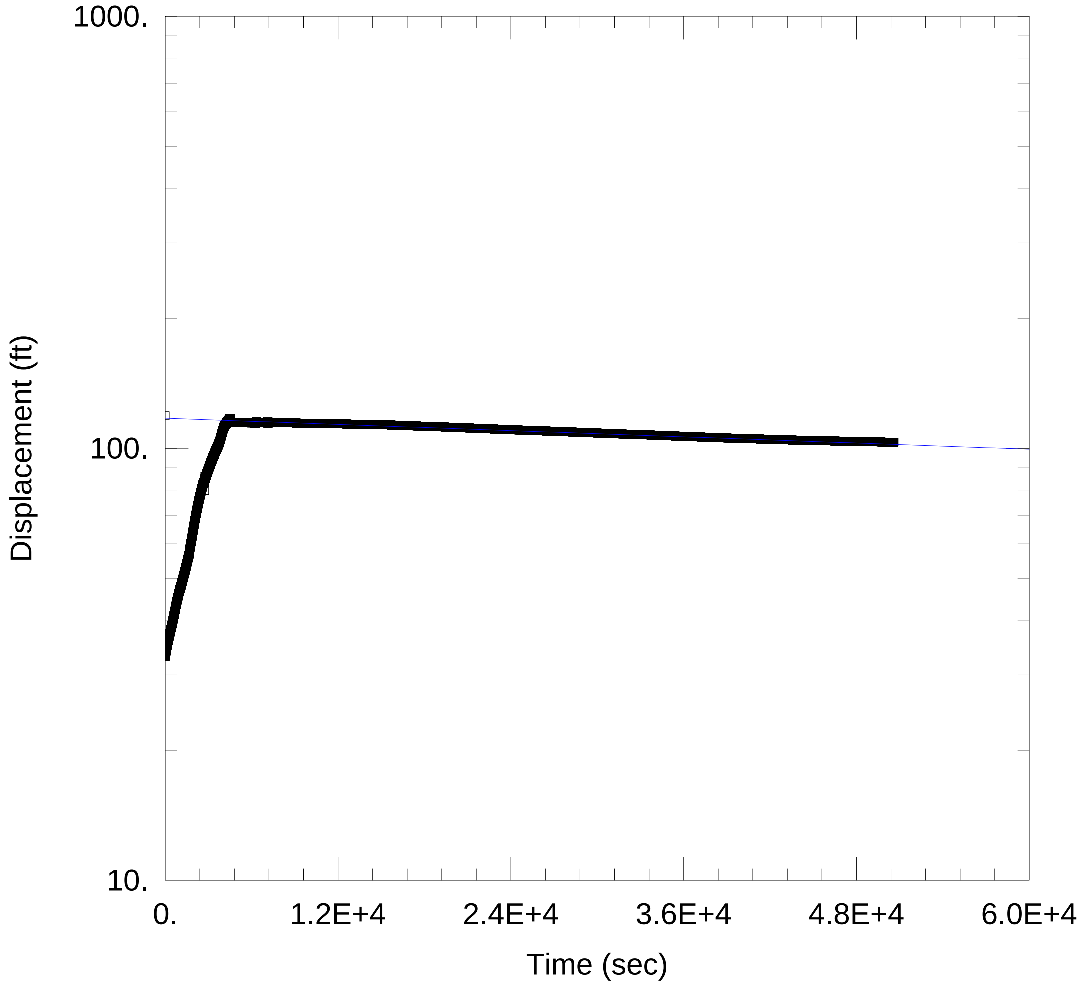
Observation Wells

Well Name	X (ft)	Y (ft)
□ Kpc2007-01	0	0

SOLUTION

Aquifer Model: Confined
Solution Method: Theis

T = 0.5761 ft^2/day
S = 0.0662
Kz/Kr = 1.
b = 70. ft



WELL TEST ANALYSIS

Data Set: S:\...\BouwerRice_Slug_Kpc2007-02_10-29-08.aqt
Date: 10/29/08 Time: 08:52:45

PROJECT INFORMATION

Test Well: Kpc2007-02
Test Date: 8/17/2007

AQUIFER DATA

Saturated Thickness: 78. ft Anisotropy Ratio (Kz/Kr): 1.

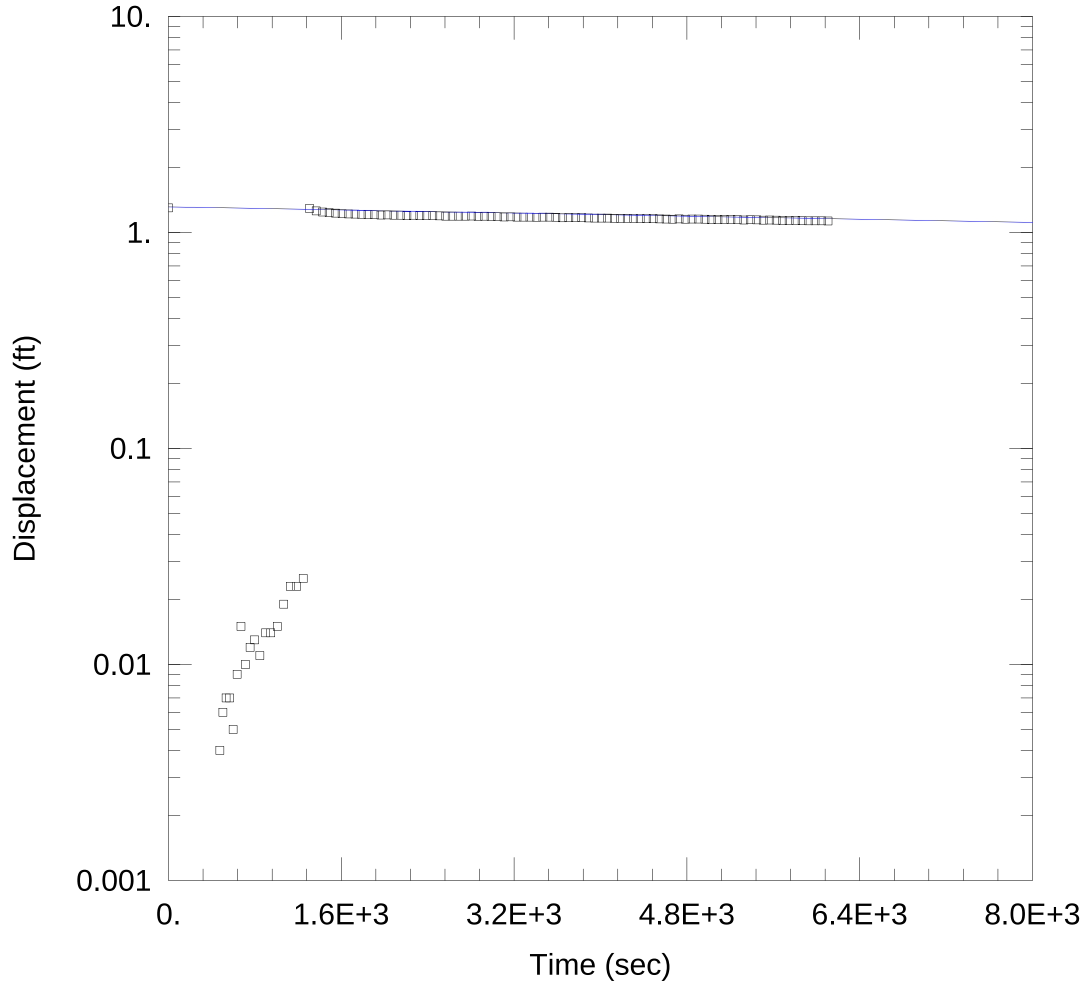
WELL DATA (Kpc2007-02)

Initial Displacement: 119. ft
Total Well Penetration Depth: 319. ft
Casing Radius: 0.1208 ft
Static Water Column Height: 152.2 ft
Screen Length: 70. ft
Well Radius: 0.3645 ft

SOLUTION

Aquifer Model: Confined Solution Method: Bouwer-Rice

K = 0.0001109 ft/day y0 = 117.3 ft



WELL TEST ANALYSIS

Data Set: S:\...\BouwerRice_Kpc2007-03.aqt
Date: 10/29/08 | Time: 08:55:00

PROJECT INFORMATION

Test Well: Kpc2007-03
Test Date: 8/17/2007

AQUIFER DATA

Saturated Thickness: 10. ft | Anisotropy Ratio (Kz/Kr): 1.

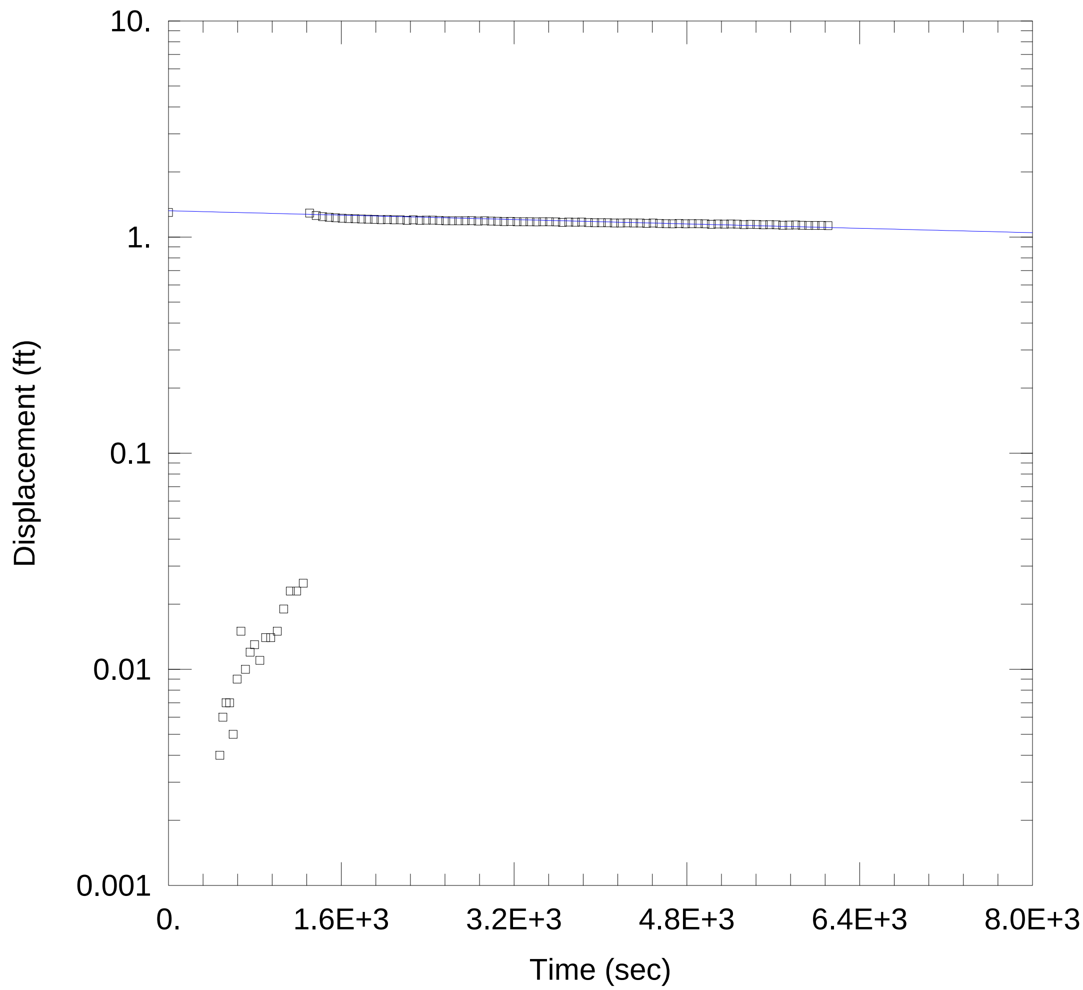
WELL DATA (Kpc2007-03)

Initial Displacement: 1.3 ft | Static Water Column Height: 129.4 ft
Total Well Penetration Depth: 135. ft | Screen Length: 10. ft
Casing Radius: 0.12 ft | Well Radius: 0.364 ft

SOLUTION

Aquifer Model: Confined | Solution Method: Bouwer-Rice

K = 0.004462 ft/day | y0 = 1.314 ft



WELL TEST ANALYSIS

Data Set: S:\...\Hvorslev_Kpc2007-03.aqt
Date: 10/29/08 Time: 08:55:41

PROJECT INFORMATION

Test Well: Kpc2007-03
Test Date: 8/17/2007

AQUIFER DATA

Saturated Thickness: 10. ft Anisotropy Ratio (Kz/Kr): 1.

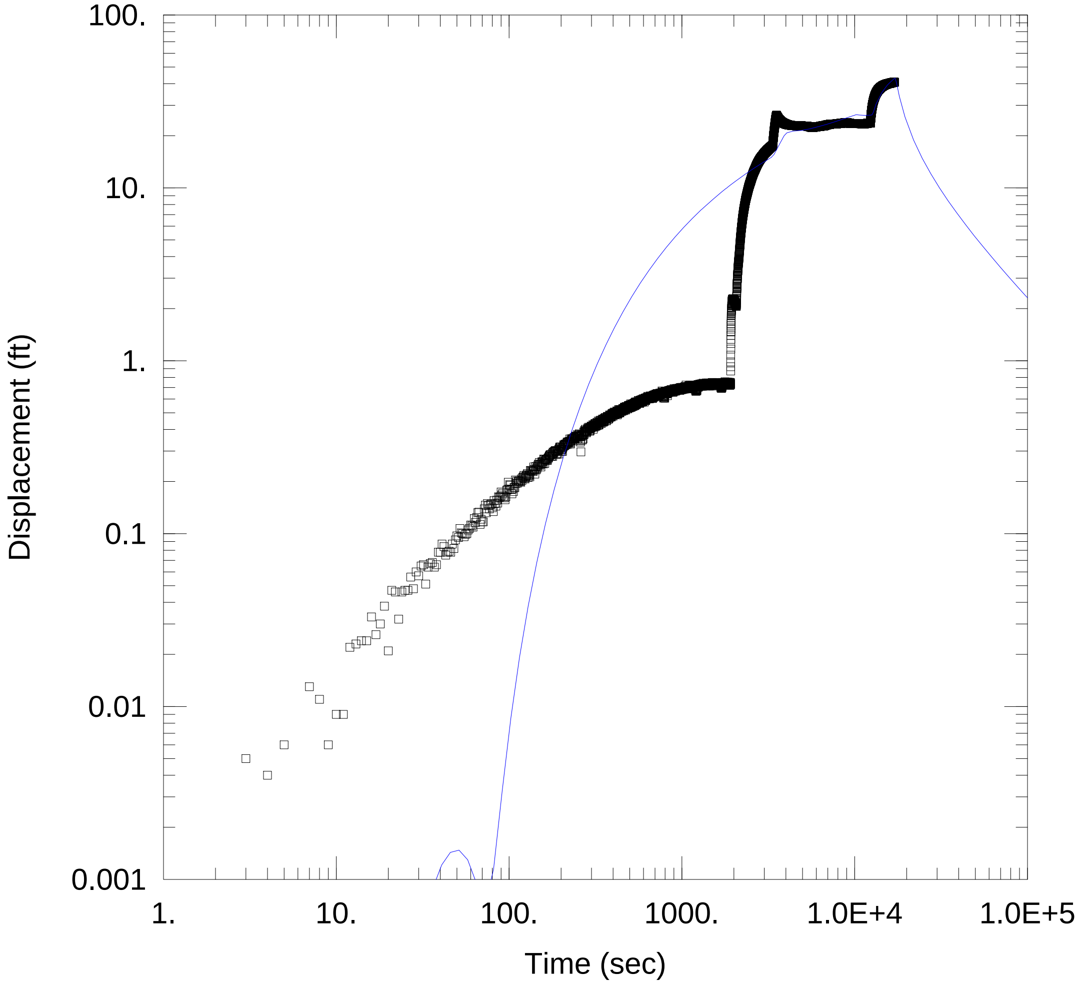
WELL DATA (Kpc2007-03)

Initial Displacement: 1.3 ft Static Water Column Height: 129.4 ft
Total Well Penetration Depth: 135. ft Screen Length: 10. ft
Casing Radius: 0.12 ft Well Radius: 0.364 ft

SOLUTION

Aquifer Model: Confined Solution Method: Hvorslev

K = 0.008505 ft/day y0 = 1.323 ft



WELL TEST ANALYSIS

Data Set: S:\...\NeumanWitherspoon_Kf2007-01.aqt
Date: 10/29/08 Time: 08:59:56

PROJECT INFORMATION

Test Well: Kf2007-01
Test Date: 8/17/2007

AQUIFER DATA

Saturated Thickness: 10. ft
Aquitard Thickness (b'): 1. ft
Anisotropy Ratio (Kz/Kr): 1.
Aquitard Thickness (b"): 1. ft

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
Kf2007-01	0	0

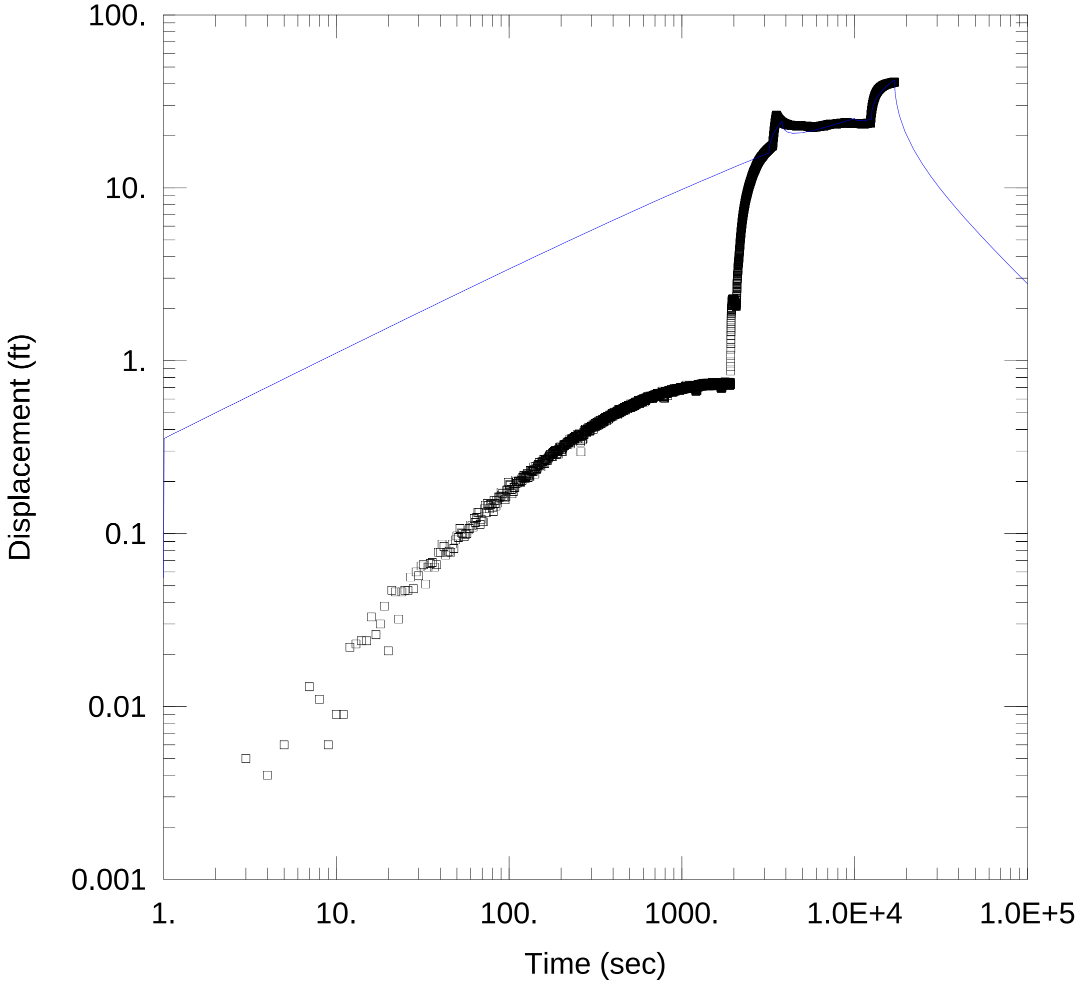
Observation Wells

Well Name	X (ft)	Y (ft)
□ Kf2007-01	0	0

SOLUTION

Aquifer Model: Leaky
Solution Method: Neuman-Witherspoon

T = 1.92 ft^2/day
r/B = 1.0E-5
T2 = 1. ft^2/day
S = 0.3391
ß = 1.0E-5
S2 = 1.0E-10



WELL TEST ANALYSIS

Data Set: S:\...\PapadopulosCooper_Kf2007-01.aqt
Date: 10/29/08 Time: 09:01:09

PROJECT INFORMATION

Test Well: Kf2007-01
Test Date: 8/17/2007

AQUIFER DATA

Saturated Thickness: 10. ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
Kf2007-01	0	0

Observation Wells

Well Name	X (ft)	Y (ft)
□ Kf2007-01	0	0

SOLUTION

Aquifer Model: Confined

Solution Method: Papadopulos-Cooper

T = 1.398 ft^2/day

S = 1.

r(w) = 0.364 ft

r(c) = 0.12 ft

PUMPING TEST RESULTS FOR PINABETE ALLUVIAL WELLS
MAY 16, 1998

Pumping tests of wells PA-1 and PA-2 completed in Pinabete Alluvium were performed at BHP Navajo Coal Company's Area 4 South on May 16, 1998. The analyses of the test results were performed using codes in the Aqtesolv software package.

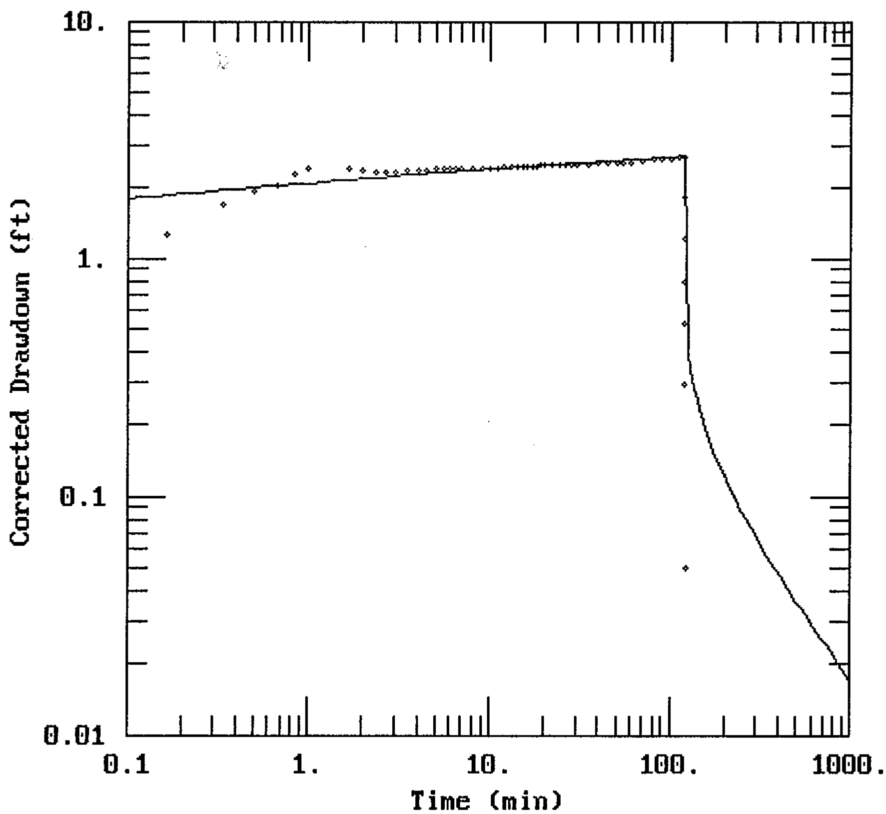
Results:

Well PA-1 (Pinabete Alluvium)

A solution was obtained using the Theis Method. The test was run with a constant pumping rate of 2.0 gpm, results are attached. The solution indicates a transmissivity of 230.7 ft^2/day and a hydraulic conductivity of 51.3 ft/day (1.8 $x10^{-2}$ cm/sec). The results are attached.

Well PA-2 (Pinabete Alluvium)

A solution was obtained using the Theis Method. The test was run with a constant pumping rate of 0.75 gpm, results are attached. The solution indicates a transmissivity of 75.62 ft^2/day and a hydraulic conductivity of 11.5 ft/day (4.1 $x10^{-3}$ cm/sec). The results are attached.



DATA SET:
PA1P&REC.AQT
08/25/98

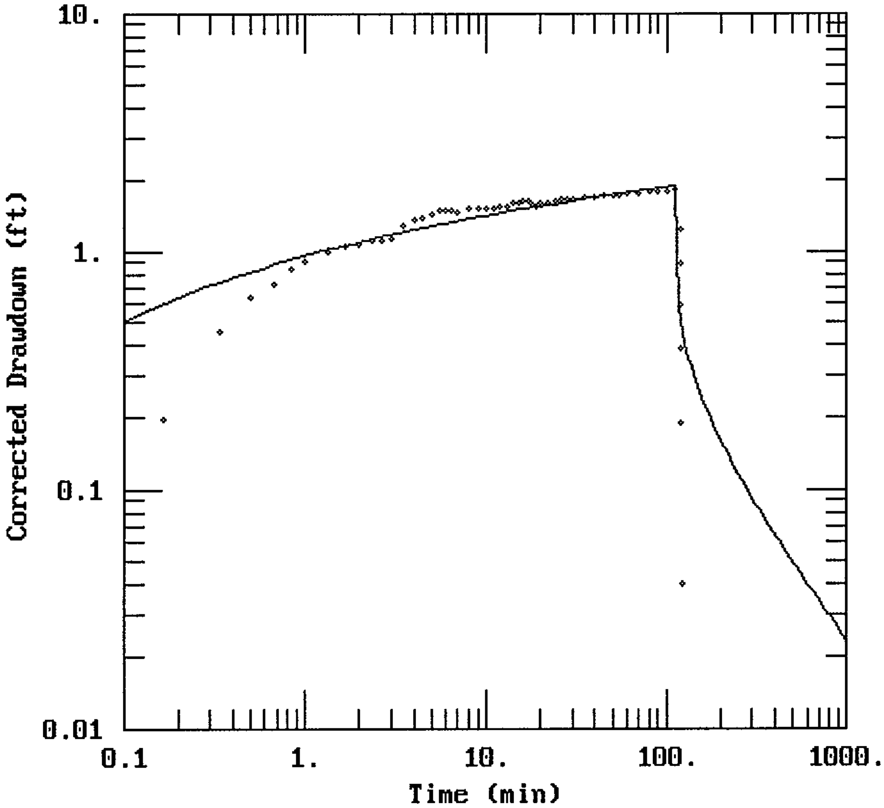
AQUIFER MODEL:
Unconfined

SOLUTION METHOD:
Theis

PROJECT DATA:
test date: 5/16/98
test well: PA-1
obs. well: PA-1

TEST DATA:
$Q = 0.2674\ ft^3/min$
$r = 0.\ ft$
$r_c = 0.08333\ ft$
$r_w = 0.08333\ ft$
$b = 7.\ ft$

PARAMETER ESTIMATES:
$T = 230.7\ ft^2/day$
$S = 7.791E-06$



DATA SET:
PA2P&REC.AQT
08/25/98

AQUIFER MODEL:
Unconfined

SOLUTION METHOD:
Theis

PROJECT DATA:
test date: 5/16/98
test well: PA-2
obs. well: PA-2

TEST DATA:
Q = 0.1003 ft^3/min
r = 0. ft
r_c= 0.08333 ft
r_w= 0.08333 ft
b = 7.5 ft

PARAMETER ESTIMATES:
T = 57.62 ft^2/day
S = 0.1073

Appendix 18.G

Quality Assurance and Quality Control Results for Baseline Groundwater Quality Data from 2007 to 2008

Green Analytical Laboratories

DISSOLVED METALS SPIKE AND DUPLICATE DATA

LAB ID#							
708-122	Spike Data				Duplicate Data		
PARAMETER	Sample Result	Spike Result	Spike Conc.	Spike % Recovery	Sample Result	Duplicate Result	RPD %
Arsenic	0.0000	0.049	**0.050**	**98**	0.054	0.054	**0.00**
Barium	0.0000	0.050	**0.050**	**100**	0.052	0.051	**1.94**
Boron	0.0	1.8	**2.0**	**88**	0.3	0.3	**0.00**
Cadmium	0.00000	0.048	**0.050**	**96**	0.052	0.050	**3.92**
Calcium	0.0	5.2	**5.0**	**104**	83.9	83.7	**0.24**
Chromium	0.000	0.052	**0.050**	**104**	0.055	0.052	**5.61**
Copper	0.0000	0.051	**0.050**	**102**	0.054	0.052	**3.77**
Iron	0.00	1.05	**1.00**	**105**	<0.05	<0.05	**NC**
Lead	0.0000	0.051	**0.050**	**102**	0.052	0.052	**0.00**
Magnesium	0.0	1.1	**1.0**	**106**	12.4	12.4	**0.00**
Manganese	0.00000	1.06	**1.00**	**106**	0.030	0.030	**0.00**
Potassium	0.0	1.20	**1.00**	**120**	1.4	1.2	**15.4**
Selenium	0.000	0.245	**0.250**	**98**	0.264	0.255	**3.47**
Silver	0.00000	0.050	**0.050**	**100**	0.052	0.052	**0.00**
Sodium	0.0	53.9	**50.0**	**108**	19.9	19.7	**1.01**
Uranium	0.00000	0.052	**0.050**	**104**	0.054	0.052	**3.77**
Zinc	0.000	0.050	**0.050**	**100**	0.052	0.050	**3.92**

NC=Not calculated due to results less than the detection limit
NA=Data not available.

Green Analytical Laboratories

DISSOLVED METALS SRM AND BLANK DATA

LAB ID# 708-122	SRM Data				Blank Data	
PARAMETER	SRM Result	True Value	SRM % Rec	Acceptance Range	Blank Result	Reporting Limit
Arsenic	0.054	0.050	**108**	90-110 %	<0.0005	0.0005
Barium	0.053	0.050	**106**	90-110 %	<0.0005	0.0005
Boron	5.10	5.00	**102**	90-110 %	<0.1	0.1
Cadmium	0.051	0.050	**102**	90-110 %	<0.00005	0.00005
Calcium	5.3	5.0	**106**	90-110 %	<0.5	0.5
Chromium *	0.057	0.050	**114**	90-110 %	<0.001	0.001
Copper	0.054	0.050	**108**	90-110 %	<0.0001	0.0001
Iron	5.45	5.00	**109**	90-110 %	<0.05	0.05
Lead	0.052	0.050	**104**	90-110 %	<0.0001	0.0001
Magnesium	5.20	5.00	**104**	90-110 %	<0.5	0.5
Manganese	2.61	2.50	**104**	90-110 %	<0.005	0.005
Potassium	10.3	10.0	**103**	90-110 %	<0.5	0.5
Selenium	0.269	0.250	**108**	90-110 %	<0.001	0.001
Silver	0.054	0.050	**108**	90-110 %	<0.00005	0.00005
Sodium	8.8	8.1	**109**	90-110 %	<0.5	0.5
Uranium	0.052	0.050	**104**	90-110 %	<0.00001	0.00001
Zinc	0.053	0.050	**106**	90-110 %	<0.001	0.001

NA=Data not available.

Green Analytical Laboratories

TOTAL METALS SPIKE AND DUPLICATE DATA

LAB ID#							
708-122	Spike Data				Duplicate Data		
PARAMETER	Sample Result	Spike Result	Spike Conc.	Spike % Recovery	Sample Result	Duplicate Result	RPD %
Iron-T	0.00	4.20	**4.00**	**105**	1.10	1.10	**0.0**
Manganese-T	0.000	2.20	**2.00**	**110**	0.055	0.053	**3.70**
Mercury-T	0.0000	0.0020	**0.0020**	**100**	<0.0002	<0.0002	**NC**

NC=Not calculated due to results less than the detection limit.
NA=Data not available.

Green Analytical Laboratories

TOTAL METALS SRM AND BLANK DATA

LAB ID# 708-122	SRM Data				Blank Data	
PARAMETER	SRM Result	True Value	SRM % Rec	Acceptance Range	Blank Result	Reporting Limit
Iron-T	5.00	5.00	**100**	90-110 %	<0.05	0.05
Manganese-T	2.610	2.500	**104**	90-110 %	<0.005	0.005
Mercury-T	0.002	0.002	**100**	90-110 %	<0.0002	0.0002

NA=Data not available.

Green Analytical Laboratories

WET CHEM SPIKE AND DUPLICATE DATA

LAB ID# 708-122	Spike Data				Duplicate Data		
PARAMETER	Sample Result	Spike Result	Spike Conc.	Spike % Recovery	Sample Result	Duplicate Result	RPD %
Alkalinity	0	99	**100**	**99**	1820	1800	**1.10**
Chloride	0	99	**100**	**99**	<10	<10	**NC**
EC	NMA	NMA	**NMA**	**NMA**	3570	3560	**0.28**
Fluoride	0.0	1.1	**1.0**	**110**	<0.2	<0.2	**NC**
Nitrate/Nitrite	0.09	0.17	**0.10**	**80**	<0.02	<0.02	**NC**
pH	NMA	NMA	**NMA**	**NMA**	8.20	8.19	**0.12**
Sulfate	0	52	**50**	**104**	520	500	**3.92**
TDS	NMA	NMA	**NMA**	**NMA**	2230	2215	**0.67**

NMA=Data not applicable to Method.
NC=Not calculated due to results less than the detection limit.

Green Analytical Laboratories

WET CHEM SRM AND BLANK DATA

LAB ID# 708-122	SRM Data				Blank Data	
PARAMETER	SRM Result	True Value	SRM % Rec	Acceptance Range	Blank Result	Reporting Limit
Alkalinity	332	352	**94.3**	90-110 %	<10	10
Chloride	119	112	**106**	90-110 %	<10	10
EC	527	561	**93.9**	90-110 %	NMA	NMA
Fluoride	1.0	1.0	**100**	90-110 %	<1.0	1.0
Nitrate/Nitrite	0.49	0.50	**98.0**	90-110 %	<0.02	0.02
pH	8.33	8.40	**99.2**	90-110 %	NMA	NMA
Sulfate	330	320	**103**	90-110 %	<10	10
TDS	1290	1220	**106**	90-110 %	<10	10

NMA=Data not applicable to Method.

Green Analytical Laboratories

DISSOLVED METALS SPIKE AND DUPLICATE DATA

LAB ID# 708-154	Spike Data				Duplicate Data		
PARAMETER	**Sample Result**	**Spike Result**	**Spike Conc.**	**Spike % Recovery**	**Sample Result**	**Duplicate Result**	**RPD %**
Arsenic	0.0000	0.049	**0.050**	**98.0**	<0.0005	<0.0005	**NC**
Barium	0.1130	0.159	**0.050**	**92.0**	0.1130	0.1120	**0.89**
Boron	0.0	2.0	**2.0**	**100**	0.3	0.3	**0.00**
Cadmium	0.00000	0.047	**0.050**	**94.0**	<0.00005	<0.00005	**NC**
Calcium	0.0	5.6	**5.0**	**112**	200.0	195.0	**2.53**
Chromium	0.000	0.048	**0.050**	**96.0**	0.005	0.005	**0.00**
Copper	0.1050	0.150	**0.050**	**90.0**	0.1090	0.1050	**3.74**
Iron	0.00	1.14	**1.00**	**114**	0.64	0.61	**4.80**
Lead	0.0000	0.049	**0.050**	**98.0**	0.0030	0.0030	**0.00**
Magnesium *	0.0	1.6	**1.0**	**161**	21.1	20.2	**4.36**
Manganese	0.00000	1.050	**1.000**	**105**	0.00800	0.00700	**13.3**
Potassium	0.0	1.1	**1.0**	**110**	13.7	13.5	**1.47**
Selenium	0.000	0.263	**0.250**	**105**	<0.001	<0.001	**NC**
Silver	0.00000	0.049	**0.050**	**98**	<0.00005	<0.00005	**NC**
Sodium	0.0	57.7	**50.0**	**115**	58.5	56.7	**3.13**
Uranium	0.00000	0.047	**0.050**	**94**	0.00069	0.00069	**0.00**
Zinc	0.000	0.051	**0.050**	**102**	<0.001	<0.001	**NC**

NC=Not calculated due to results less than the detection limit
NA=Data not available.

Green Analytical Laboratories

DISSOLVED METALS SRM AND BLANK DATA

LAB ID# 708-154	SRM Data				Blank Data	
PARAMETER	**SRM Result**	**True Value**	**SRM % Rec**	**Acceptance Range**	**Blank Result**	**Reporting Limit**
Arsenic	0.052	0.050	**104**	90-110 %	<0.0005	0.0005
Barium	0.048	0.050	**96.0**	90-110 %	<0.0005	0.0005
Boron	5.2	5.0	**104**	90-110 %	<0.1	0.1
Cadmium	0.049	0.050	**98.0**	90-110 %	<0.00005	0.00005
Calcium	5.4	5.0	**108**	90-110 %	<0.5	0.5
Chromium	0.053	0.050	**106**	90-110 %	<0.001	0.001
Copper	0.052	0.050	**104**	90-110 %	<0.0001	0.0001
Iron	5.46	5.00	**109**	90-110 %	<0.05	0.05
Lead	0.053	0.050	**106**	90-110 %	<0.0001	0.0001
Magnesium	5.2	5.0	**104**	90-110 %	<0.5	0.5
Manganese	2.53	2.50	**101**	90-110 %	<0.005	0.005
Potassium	11.0	10.0	**110**	90-110 %	<0.5	0.5
Selenium	0.273	0.250	**109**	90-110 %	<0.001	0.001
Silver	0.048	0.050	**96.0**	90-110 %	<0.00005	0.00005
Sodium	17.2	16.2	**106**	90-110 %	<0.5	0.5
Uranium	0.055	0.050	**110**	90-110 %	<0.00001	0.00001
Zinc	0.049	0.050	**98.0**	90-110 %	<0.001	0.001

NA=Data not available.

Green Analytical Laboratories

TOTAL METALS SPIKE AND DUPLICATE DATA

LAB ID#							
708-154	Spike Data				Duplicate Data		
PARAMETER	Sample Result	Spike Result	Spike Conc.	Spike % Recovery	Sample Result	Duplicate Result	RPD %
Iron-T	0.00	2.08	**2.00**	**104**	0.16	0.14	**13.3**
Manganese-T	0.000	1.05	**1.00**	**105**	0.008	0.007	**13.3**
Mercury-T	0.0000	0.0020	**0.0020**	**100**	<0.0002	<0.0002	**NC**

NC=Not calculated due to results less than the detection limit.
NA=Data not available.

Green Analytical Laboratories

TOTAL METALS SRM AND BLANK DATA

LAB ID#						
708-154	SRM Data				Blank Data	
PARAMETER	SRM Result	True Value	SRM % Rec	Acceptance Range	Blank Result	Reporting Limit
Iron-T	5.04	5.00	**101**	90-110 %	<0.05	0.05
Manganese-T	2.53	2.50	**101**	90-110 %	<0.005	0.005
Mercury-T	0.002	0.002	**100**	90-110 %	<0.0002	0.0002

NA=Data not available.

Green Analytical Laboratories

WET CHEM SPIKE AND DUPLICATE DATA

LAB ID#							
708-154	Spike Data				Duplicate Data		
PARAMETER	Sample Result	Spike Result	Spike Conc.	Spike % Recovery	Sample Result	Duplicate Result	RPD %
Alkalinity	0	102	**100**	**102**	312	310	**0.64**
Chloride	0	99	**100**	**99**	15	15	**0.00**
EC	NMA	NMA	**NMA**	**NMA**	1370	1370	**0.00**
Fluoride	0.5	1.5	**1.0**	**100**	0.8	0.8	**0.00**
Nitrate/Nitrite	0.00	0.10	**0.10**	**100**	<0.02	<0.02	**NC**
pH	NMA	NMA	**NMA**	**NMA**	9.55	9.55	**0.00**
Sulfate	0	50	**50**	**100**	3900	3900	**0.00**
TDS	NMA	NMA	**NMA**	**NMA**	530	520	**1.90**

NMA=Data not applicable to Method.
NC=Not calculated due to results less than the detection limit.

Green Analytical Laboratories

WET CHEM SRM AND BLANK DATA

LAB ID# 708-154	SRM Data				Blank Data	
PARAMETER	SRM Result	True Value	SRM % Rec	Acceptance Range	Blank Result	Reporting Limit
Alkalinity	340	352	**96.6**	90-110 %	<10	10
Chloride	119	112	**106**	90-110 %	<10	10
EC	519	561	**92.5**	90-110 %	NMA	NMA
Fluoride	1.0	1.0	**100**	90-110 %	<1.0	1.0
Nitrate/Nitrite	0.46	0.50	**92.0**	90-110 %	<0.02	0.02
pH	8.31	8.40	**98.9**	90-110 %	NMA	NMA
Sulfate	335	320	**105**	90-110 %	<10	10
TDS	1240	1220	**102**	90-110 %	<10	10

NMA=Data not applicable to Method.

Green Analytical Laboratories

DISSOLVED METALS SPIKE AND DUPLICATE DATA

LAB ID#							
0711161252+	Spike Data				Duplicate Data		
PARAMETER	Sample Result	Spike Result	Spike Conc.	Spike % Recovery	Sample Result	Duplicate Result	RPD %
Arsenic	0.0000	0.051	**0.050**	**102**	<0.0005	<0.0005	**NC**
Barium	0.0000	0.050	**0.050**	**100**	0.229	0.229	**0.00**
Boron	0.0	2.3	**2.0**	**115**	0.3	0.3	**0.00**
Cadmium	0.00000	0.050	**0.050**	**100**	0.00007	0.00006	**15.4**
Calcium	0.0	5.2	**5.0**	**104**	23.7	23.7	**0.00**
Chromium	0.000	0.050	**0.050**	**100**	0.002	0.002	**0.00**
Copper	0.0000	0.051	**0.050**	**102**	2.43	2.40	**1.24**
Iron	0.00	1.06	**1.00**	**106**	4.83	4.82	**0.21**
Lead	0.0000	0.050	**0.050**	**100**	0.0008	0.0008	**0.00**
Magnesium	0.0	1.1	**1.0**	**110**	4.8	4.7	**2.11**
Manganese	0.00000	1.04	**1.00**	**104**	3.68	3.51	**4.73**
Potassium	0.0	1.0	**1.0**	**100**	4.7	4.6	**2.15**
Selenium	0.000	0.255	**0.250**	**102**	<0.005	<0.005	**NC**
Silver	0.00000	0.052	**0.050**	**104**	<0.00005	<0.00005	**NC**
Sodium	0.0	52.9	**50.0**	**106**	242	240	**0.83**
Uranium	0.00000	0.051	**0.050**	**102**	0.00021	0.00021	**0.00**
Zinc	0.000	0.051	**0.050**	**102**	0.079	0.076	**3.87**

NC=Not calculated due to results less than the detection limit
NA=Data not available.

Green Analytical Laboratories

DISSOLVED METALS SRM AND BLANK DATA

LAB ID#						
0711161252+	SRM Data				Blank Data	
PARAMETER	SRM Result	True Value	SRM % Rec	Acceptance Range	Blank Result	Reporting Limit
Arsenic	0.049	0.050	**98.0**	90-110 %	<0.0005	0.0005
Barium	0.050	0.050	**100**	90-110 %	<0.0005	0.0005
Boron	5.10	5.00	**102**	90-110 %	<0.1	0.1
Cadmium	0.053	0.050	**106**	90-110 %	<0.00005	0.00005
Calcium	5.0	5.0	**100**	90-110 %	<0.5	0.5
Chromium	0.049	0.050	**98.0**	90-110 %	<0.001	0.001
Copper	0.050	0.050	**100**	90-110 %	<0.0001	0.0001
Iron	5.11	5.00	**102**	90-110 %	<0.05	0.05
Lead	0.049	0.050	**98.0**	90-110 %	<0.0001	0.0001
Magnesium	4.8	5.0	**96.0**	90-110 %	<0.5	0.5
Manganese	2.57	2.50	**103**	90-110 %	<0.005	0.005
Potassium	9.8	10.0	**98.0**	90-110 %	<0.5	0.5
Selenium	0.256	0.250	**102**	90-110 %	<0.001	0.001
Silver	0.054	0.050	**108**	90-110 %	<0.00005	0.00005
Sodium	8.3	8.1	**102**	90-110 %	<0.5	0.5
Uranium	0.055	0.050	**110**	90-110 %	<0.00001	0.00001
Zinc	0.053	0.050	**106**	90-110 %	<0.001	0.001

NA=Data not available.

Green Analytical Laboratories

TOTAL METALS SPIKE AND DUPLICATE DATA

LAB ID#							
0711161252+	Spike Data				Duplicate Data		
PARAMETER	Sample Result	Spike Result	Spike Conc.	Spike % Recovery	Sample Result	Duplicate Result	RPD %
Iron-T	0.00	3.74	**4.00**	**93.5**	8.99	8.69	**3.39**
Manganese-T	0.000	1.820	**2.00**	**91.0**	4.78	4.64	**2.97**
Mercury-T	0.0000	0.0020	**0.0020**	**100**	<0.0002	<0.0002	**NC**

NC=Not calculated due to results less than the detection limit.
NA=Data not available.

Green Analytical Laboratories

TOTAL METALS SRM AND BLANK DATA

LAB ID#						
0711161252+	SRM Data				Blank Data	
PARAMETER	SRM Result	True Value	SRM % Rec	Acceptance Range	Blank Result	Reporting Limit
Iron-T	5.11	5.00	**102**	90-110 %	<0.05	0.05
Manganese-T	2.57	2.50	**103**	90-110 %	<0.005	0.005
Mercury-T	0.002	0.002	**100**	90-110 %	<0.0002	0.0002

NA=Data not available.

Green Analytical Laboratories

WET CHEM SPIKE AND DUPLICATE DATA

LAB ID#							
0711161252+	Spike Data				Duplicate Data		
PARAMETER	Sample Result	Spike Result	Spike Conc.	Spike % Recovery	Sample Result	Duplicate Result	RPD %
Alkalinity	0	103	**100**	**103**	1750	1750	**0.00**
Chloride	0	99	**100**	**99**	308	304	**1.31**
EC	NMA	NMA	**NMA**	**NMA**	644	643	**0.16**
Fluoride	0.2	1.1	**1.0**	**92**	1.0	1.0	**0.00**
Nitrate/Nitrite	0.04	0.13	**0.10**	**90**	<0.02	<0.02	**NC**
pH	NMA	NMA	**NMA**	**NMA**	9.56	9.56	**0.00**
Sulfate	0	54	**50**	**108**	2500	2500	**0.00**
TDS	NMA	NMA	**NMA**	**NMA**	5820	5730	**1.56**

NMA=Data not applicable to Method.
NC=Not calculated due to results less than the detection limit.

Green Analytical Laboratories

WET CHEM SRM AND BLANK DATA

LAB ID#						
0711161252+	SRM Data				Blank Data	
PARAMETER	**SRM Result**	**True Value**	**SRM % Rec**	**Acceptance Range**	**Blank Result**	**Reporting Limit**
Alkalinity	276	283	**97.5**	90-110 %	<10	10
Chloride	39	37.9	**103**	90-110 %	<10	10
EC	568	561	**101**	90-110 %	NMA	NMA
Fluoride	2.0	2.0	**100**	90-110 %	<1.0	1.0
Nitrate/Nitrite	0.50	0.50	**100**	90-110 %	<0.02	0.02
pH	8.34	8.40	**99.3**	90-110 %	NMA	NMA
Sulfate	325	321	**101**	90-110 %	<10	10
TDS	1240	1210	**102**	90-110 %	<10	10

NMA=Data not applicable to Method.

Green Analytical Laboratories

DISSOLVED METALS SPIKE AND DUPLICATE DATA

LAB ID#							
0711060903+	Spike Data				Duplicate Data		
PARAMETER	Sample Result	Spike Result	Spike Conc.	Spike % Recovery	Sample Result	Duplicate Result	RPD %
Arsenic	0.0000	0.051	**0.050**	**102**	0.0050	0.0050	**0.00**
Barium	0.0000	0.050	**0.050**	**100**	0.0530	0.0500	**5.83**
Boron	0.0	0.5	**0.5**	**100**	0.5	0.5	**0.00**
Cadmium	0.00000	0.052	**0.050**	**104**	<0.005	<0.005	**NC**
Calcium	0.0	2.4	**2.5**	**96.0**	91.4	91.3	**0.11**
Chromium	0.000	0.047	**0.050**	**94.0**	0.002	0.002	**0.00**
Copper	0.0000	0.050	**0.050**	**100**	0.0100	0.0090	**10.5**
Iron	0.00	0.50	**0.50**	**100**	<0.05	<0.05	**NC**
Lead	0.0000	0.052	**0.050**	**104**	0.0002	0.0002	**0.00**
Magnesium	0.0	0.5	**0.5**	**100**	13.1	13.1	**0.00**
Manganese	0.00000	0.285	**0.250**	**114**	2.10000	2.10000	**0.00**
Potassium	0.0	0.5	**0.5**	**100**	1.4	1.4	**0.00**
Selenium	0.000	0.254	**0.250**	**102**	0.006	0.006	**0.00**
Silver	0.00000	0.057	**0.050**	**114**	<0.00005	<0.00005	**NC**
Sodium	0.0	25.4	**25.0**	**102**	16.4	16.4	**0.00**
Uranium	0.00000	0.053	**0.050**	**106**	0.00274	0.00270	**1.47**
Zinc	0.000	0.052	**0.050**	**104**	0.011	0.010	**9.52**

NC=Not calculated due to results less than the detection limit
NA=Data not available.

Green Analytical Laboratories

DISSOLVED METALS SRM AND BLANK DATA

LAB ID#						
0711060903+	SRM Data				Blank Data	
PARAMETER	SRM Result	True Value	SRM % Rec	Acceptance Range	Blank Result	Reporting Limit
Arsenic	0.052	0.050	**104**	90-110 %	<0.0005	0.0005
Barium	0.052	0.050	**104**	90-110 %	<0.0005	0.0005
Boron	5.000	5.000	**100**	90-110 %	<0.1	0.1
Cadmium	0.052	0.050	**104**	90-110 %	<0.00005	0.00005
Calcium	5.000	5.000	**100**	90-110 %	<0.5	0.5
Chromium	0.047	0.050	**94.0**	90-110 %	<0.001	0.001
Copper	0.051	0.050	**102**	90-110 %	<0.0001	0.0001
Iron	5.160	5.000	**103**	90-110 %	<0.05	0.05
Lead	0.050	0.050	**100**	90-110 %	0.0001	0.0001
Magnesium	4.850	5.000	**97.0**	90-110 %	<0.5	0.5
Manganese	2.560	2.500	**102**	90-110 %	<0.005	0.005
Potassium	9.900	10.000	**99.0**	90-110 %	<0.5	0.5
Selenium	0.255	0.250	**102**	90-110 %	<0.001	0.001
Silver	0.055	0.050	**110**	90-110 %	<0.00005	0.00005
Sodium	8.200	8.100	**101**	90-110 %	<0.5	0.5
Uranium	0.052	0.050	**104**	90-110 %	<0.00001	0.00001
Zinc	0.050	0.050	**100**	90-110 %	<0.001	0.001

NA=Data not available.

Green Analytical Laboratories

TOTAL METALS SPIKE AND DUPLICATE DATA

LAB ID#							
0711060903+	Spike Data				Duplicate Data		
PARAMETER	Sample Result	Spike Result	Spike Conc.	Spike % Recovery	Sample Result	Duplicate Result	RPD %
Iron-T	0.00	3.75	**4.00**	**93.8**	46.9	45.3	**3.47**
Manganese-T *	0.000	1.960	**2.00**	**98.0**	14.4	11.7	**20.7**
Mercury-T	0.0000	0.0020	**0.0020**	**100**	0.0002	0.0002	**0.00**

NC=Not calculated due to results less than the detection limit.
NA=Data not available.

Green Analytical Laboratories

TOTAL METALS SRM AND BLANK DATA

LAB ID# 0711060903+	SRM Data				Blank Data	
PARAMETER	SRM Result	True Value	SRM % Rec	Acceptance Range	Blank Result	Reporting Limit
Iron-T	4.97	5.00	**99.4**	90-110 %	<0.05	0.05
Manganese-T	2.59	2.50	**104**	90-110 %	<0.005	0.005
Mercury-T	0.002	0.002	**100**	90-110 %	<0.0002	0.0002

NA=Data not available.

Green Analytical Laboratories

WET CHEM SPIKE AND DUPLICATE DATA

LAB ID#							
0711060903+	**Spike Data**				**Duplicate Data**		
PARAMETER	**Sample Result**	**Spike Result**	**Spike Conc.**	**Spike % Recovery**	**Sample Result**	**Duplicate Result**	**RPD %**
Alkalinity	0	104	**100**	**104**	111	109	**1.82**
Chloride	0	103	**100**	**103**	152	150	**1.32**
EC	NMA	NMA	**NMA**	**NMA**	1250	1250	**0.00**
Fluoride	0.0	0.9	**1.0**	**90**	0.2	0.2	**0.00**
Nitrate/Nitrite	0.16	0.24	**0.10**	**80**	1.97	1.92	**2.57**
pH	NMA	NMA	**NMA**	**NMA**	7.53	7.51	**0.27**
Sulfate	0	54	**50**	**108**	96	94	**2.11**
TDS	NMA	NMA	**NMA**	**NMA**	415	405	**2.44**

NMA=Data not applicable to Method.
NC=Not calculated due to results less than the detection limit.

Green Analytical Laboratories

WET CHEM SRM AND BLANK DATA

LAB ID# 0711060903+	SRM Data				Blank Data	
PARAMETER	SRM Result	True Value	SRM % Rec	Acceptance Range	Blank Result	Reporting Limit
Alkalinity	290	283	**102**	90-110 %	<10	10
Chloride	36	37.9	**95.0**	90-110 %	<10	10
EC	580	561	**103**	90-110 %	NMA	NMA
Fluoride	1.0	1.0	**100**	90-110 %	<1.0	1.0
Nitrate/Nitrite	0.52	0.50	**104**	90-110 %	<0.02	0.02
pH	8.36	8.40	**100**	90-110 %	NMA	NMA
Sulfate	340	321	**106**	90-110 %	<10	10
TDS	1200	1210	**99.2**	90-110 %	<10	10

NMA=Data not applicable to Method.

Green Analytical Laboratories

DISSOLVED METALS SPIKE AND DUPLICATE DATA

LAB ID#							
0712051332+	Spike Data				Duplicate Data		
PARAMETER	Sample Result	Spike Result	Spike Conc.	Spike % Recovery	Sample Result	Duplicate Result	RPD %
Arsenic	0.0000	0.050	0.050	100	0.0060	0.0060	0.00
Barium	0.0000	0.048	0.050	96.0	0.0090	0.0090	0.00
Boron	0.8	2.8	2.00	100	<0.1	<0.1	NC
Cadmium	0.00000	0.049	0.050	98.0	<0.00005	<0.00005	NC
Calcium	0.0	45.8	50.0	91.6	22.1	21.6	2.29
Chromium	0.000	0.049	0.050	98.0	0.007	0.007	0.00
Copper	0.0000	0.049	0.050	98.0	0.0890	0.0730	19.8
Iron	0.00	9.48	10.0	94.8	48.60	45.10	7.47
Lead	0.0000	0.048	0.050	96.0	0.0001	0.0001	0.00
Magnesium	0.0	9.5	10.0	95.1	1.7	1.7	0.00
Manganese	0.00000	1.150	1.00	115	51.10000	50.00000	2.18
Potassium	0.0	9.9	10.0	99.3	3.7	3.6	2.74
Selenium	0.000	0.250	0.250	100	0.179	0.170	5.16
Silver	0.00000	0.050	0.050	100	<0.00005	<0.00005	NC
Sodium	0.0	481	500	96.2	194.0	190.0	2.08
Uranium	0.00000	0.049	0.050	98.0	0.01400	0.01400	0.00
Zinc	0.000	0.051	0.050	102	0.011	0.011	0.00

NC=Not calculated due to results less than the detection limit
NA=Data not available.

Green Analytical Laboratories

DISSOLVED METALS SRM AND BLANK DATA

LAB ID# 0712051332+	SRM Data				Blank Data	
PARAMETER	SRM Result	True Value	SRM % Rec	Acceptance Range	Blank Result	Reporting Limit
Arsenic	0.052	0.050	**104**	90-110 %	<0.0005	0.0005
Barium	0.051	0.050	**102**	90-110 %	<0.0005	0.0005
Boron *	5.7	5.0	**114**	90-110 %	<0.1	0.1
Cadmium	0.052	0.050	**104**	90-110 %	<0.00005	0.00005
Calcium	5.3	5.0	**106**	90-110 %	<0.5	0.5
Chromium	0.051	0.050	**102**	90-110 %	<0.001	0.001
Copper	0.050	0.050	**100**	90-110 %	<0.0001	0.0001
Iron	5.39	5.0	**108**	90-110 %	<0.05	0.05
Lead	0.049	0.050	**98.0**	90-110 %	<0.0001	0.0001
Magnesium	5.2	5.0	**104**	90-110 %	<0.5	0.5
Manganese *	2.91	2.50	**116**	90-110 %	<0.005	0.005
Potassium	10.9	10.0	**109**	90-110 %	<0.5	0.5
Selenium	0.261	0.250	**104**	90-110 %	<0.001	0.001
Silver *	0.061	0.050	**122**	90-110 %	<0.00005	0.00005
Sodium *	9.0	8.1	**111**	90-110 %	<0.5	0.5
Uranium	0.051	0.050	**102**	90-110 %	<0.00001	0.00001
Zinc	0.052	0.050	**104**	90-110 %	<0.001	0.001

NA=Data not available.

Green Analytical Laboratories

TOTAL METALS SPIKE AND DUPLICATE DATA

LAB ID# 0712051332+	Spike Data				Duplicate Data		
PARAMETER	Sample Result	Spike Result	Spike Conc.	Spike % Recovery	Sample Result	Duplicate Result	RPD %
Iron-T	0.00	4.20	**4.00**	**105**	42.9	40.6	**5.51**
Manganese-T	0.000	2.170	**2.000**	**109**	1.71	1.62	**5.41**
Mercury-T	0.0000	0.0020	**0.0020**	**100**	<0.0002	<0.0002	**NC**

NC=Not calculated due to results less than the detection limit.
NA=Data not available.

Green Analytical Laboratories

TOTAL METALS SRM AND BLANK DATA

LAB ID#						
0712051332+	SRM Data				Blank Data	
PARAMETER	SRM Result	True Value	SRM % Rec	Acceptance Range	Blank Result	Reporting Limit
Iron-T	5.10	5.00	**102**	90-110 %	<0.05	0.05
Manganese-T	2.650	2.500	**106**	90-110 %	<0.005	0.005
Mercury-T	0.002	0.002	**100**	90-110 %	<0.0002	0.0002

NA=Data not available.

Green Analytical Laboratories

WET CHEM SPIKE AND DUPLICATE DATA

LAB ID#							
0712051332+	Spike Data				Duplicate Data		
PARAMETER	Sample Result	Spike Result	Spike Conc.	Spike % Recovery	Sample Result	Duplicate Result	RPD %
Alkalinity	0	106	**100**	**106**	138	137	**0.73**
Chloride	0	101	**100**	**101**	210	206	**1.92**
EC	NMA	NMA	**NMA**	**NMA**	12400	12400	**0.00**
Fluoride	0.2	1.1	**1.0**	**89**	<0.2	<0.2	**NC**
Nitrate/Nitrite	0.04	0.13	**0.10**	**90**	0.07	0.06	**15.4**
pH	NMA	NMA	**NMA**	**NMA**	7.05	7.04	**0.14**
Sulfate	0		**50**	**0**	9800	9800	**0.00**
TDS	NMA	NMA	**NMA**	**NMA**	355	350	**1.42**

NMA=Data not applicable to Method.
NC=Not calculated due to results less than the detection limit.

Green Analytical Laboratories

WET CHEM SRM AND BLANK DATA

LAB ID# 0712051332+	SRM Data				Blank Data	
PARAMETER	SRM Result	True Value	SRM % Rec	Acceptance Range	Blank Result	Reporting Limit
Alkalinity	274	283	**96.8**	90-110 %	<10	10
Chloride	37	37.9	**97.6**	90-110 %	<10	10
EC	556	561	**99.1**	90-110 %	NMA	NMA
Fluoride	2.2	2.0	**110**	90-110 %	<1.0	1.0
Nitrate/Nitrite	0.54	0.50	**108**	90-110 %	<0.02	0.02
pH	8.22	8.40	**97.9**	90-110 %	NMA	NMA
Sulfate	350	321	**109**	90-110 %	<10	10
TDS	1360	1210	**112**	90-110 %	<10	10

NMA=Data not applicable to Method.

Green Analytical Laboratories

DISSOLVED METALS SPIKE AND DUPLICATE DATA

LAB ID# 0712070915+	Spike Data				Duplicate Data		
PARAMETER	**Sample Result**	**Spike Result**	**Spike Conc.**	**Spike % Recovery**	**Sample Result**	**Duplicate Result**	**RPD %**
Calcium	0.0	45.8	**50.0**	**91.6**	22.6	22.1	**2.24**
Iron	0.00	9.49	**10.0**	**94.9**	48.6	45.1	**7.47**
Magnesium	0.0	9.5	**10.0**	**95.0**	1.7	1.7	**0.00**
Potassium	0.0	9.9	**10.0**	**99.3**	3.7	3.6	**2.74**
Sodium	0.0	481	**500**	**96.2**	194.0	190.0	**2.08**

NC=Not calculated due to results less than the detection limit.
NA=Data not available.

Green Analytical Laboratories

DISSOLVED METALS SRM AND BLANK DATA

LAB ID# 0712070915+	SRM Data				Blank Data	
PARAMETER	SRM Result	True Value	SRM % Rec	Acceptance Range	Blank Result	Reporting Limit
Calcium	5.3	5.0	**105**	90-110 %	<0.5	0.5
Iron	5.40	5.0	**108**	90-110 %	<0.05	0.05
Magnesium	5.2	5.0	**104**	90-110 %	<0.5	0.5
Potassium	10.9	10.0	**109**	90-110 %	<0.5	0.5
Sodium *	9.0	8.1	**111**	90-110 %	<0.5	0.5

NA=Data not available.

Green Analytical Laboratories

WET CHEM SPIKE AND DUPLICATE DATA

LAB ID#							
0712070915+	Spike Data				Duplicate Data		
PARAMETER	Sample Result	Spike Result	Spike Conc.	Spike % Recovery	Sample Result	Duplicate Result	RPD %
Alkalinity	0	104	**100**	**104**	212	210	**0.95**
Chloride	0	100	**100**	**100**	<10	<10	**NC**
EC	NMA	NMA	**NMA**	**NMA**	702	700	**0.29**
Fluoride	0.0	1.0	**1.0**	**100**	0.5	0.5	**0.00**
Nitrate/Nitrite	NA	NA	**NA**	**NA**	NA	NA	**NA**
pH	NMA	NMA	**NMA**	**NMA**	5.28	5.25	**0.57**
Sulfate	0	53	**50**	**106**	600	590	**1.68**
TDS	NMA	NMA	**NMA**	**NMA**	335	325	**3.03**

NMA=Data not applicable to Method.
NC=Not calculated due to results less than the detection limit.
NA=Data not available.

Green Analytical Laboratories

WET CHEM SRM AND BLANK DATA

LAB ID#						
0712070915+	SRM Data				Blank Data	
PARAMETER	SRM Result	True Value	SRM % Rec	Acceptance Range	Blank Result	Reporting Limit
Alkalinity	272	283	**96.1**	90-110 %	<10	10
Chloride	38	37.9	**100**	90-110 %	<10	10
EC	547	561	**97.5**	90-110 %	NMA	NMA
Fluoride	1.0	1.0	**100**	90-110 %	<1.0	1.0
Nitrate/Nitrite	NA	NA	**NA**	90-110 %	NA	NA
pH	8.30	8.40	**98.8**	90-110 %	NMA	NMA
Sulfate	330	321	**103**	90-110 %	<10	10
TDS *	1010	1210	**83.5**	90-110 %	<10	10

NMA=Data not applicable to Method.
NA=Data not available.

Green Analytical Laboratories

DISSOLVED METALS SPIKE AND DUPLICATE DATA

LAB ID#							
802-077	Spike Data				Duplicate Data		
PARAMETER	Sample Result	Spike Result	Spike Conc.	Spike % Recovery	Sample Result	Duplicate Result	RPD %
Arsenic	0.0000	0.045	**0.050**	**90.0**	0.051	0.048	**6.06**
Barium	0.0000	0.046	**0.050**	**92.0**	0.054	0.051	**5.71**
Boron	0.1	2.3	**2.0**	**108**	0.4	0.4	**0.00**
Cadmium	0.00000	0.047	**0.050**	**94.0**	0.047	0.047	**0.00**
Calcium *	0.0	6.9	**5.0**	**138**	82.5	82.0	**0.61**
Chromium	0.000	0.044	**0.050**	**88.0**	0.050	0.045	**10.5**
Copper	0.0000	0.045	**0.050**	**90.0**	0.059	0.054	**8.85**
Iron *	0.00	1.40	**1.00**	**140**	<0.05	<0.05	**NC**
Lead	0.0000	0.045	**0.050**	**90.0**	0.047	0.046	**2.15**
Magnesium *	0.0	1.4	**1.0**	**140**	9.1	9.0	**1.10**
Manganese *	0.00000	1.20	**1.00**	**120**	0.008	0.008	**0.00**
Potassium *	0.0	1.4	**1.00**	**140**	0.9	0.8	**11.8**
Selenium	0.000	0.216	**0.250**	**86.4**	0.250	0.233	**7.04**
Silver	0.00000	0.040	**0.050**	**80.0**	0.046	0.043	**6.74**
Sodium *	0.1	70.4	**50.0**	**141**	32.7	32.5	**0.61**
Uranium	0.00000	0.049	**0.050**	**98.0**	0.050	0.047	**6.19**
Zinc	0.000	0.044	**0.050**	**88.0**	0.051	0.048	**6.06**

NC=Not calculated due to results less than the detection limit
NA=Data not available.

Green Analytical Laboratories

DISSOLVED METALS SRM AND BLANK DATA

LAB ID# 802-077	SRM Data				Blank Data	
PARAMETER	SRM Result	True Value	SRM % Rec	Acceptance Range	Blank Result	Reporting Limit
Arsenic	0.049	0.050	**98.0**	90-110 %	<0.0005	0.0005
Barium	0.052	0.050	**104**	90-110 %	<0.0005	0.0005
Boron	5.4	5.0	**108**	90-110 %	0.1	0.1
Cadmium	0.047	0.050	**94.0**	90-110 %	<0.00005	0.00005
Calcium	4.5	5.0	**90.0**	90-110 %	<0.5	0.5
Chromium	0.046	0.050	**92.0**	90-110 %	<0.001	0.001
Copper	0.055	0.050	**110**	90-110 %	<0.0001	0.0001
Iron	4.91	5.00	**98.2**	90-110 %	<0.05	0.05
Lead	0.049	0.050	**98.0**	90-110 %	<0.0001	0.0001
Magnesium	4.6	5.0	**92.0**	90-110 %	<0.5	0.5
Manganese	2.70	2.50	**108**	90-110 %	<0.005	0.005
Potassium	9.7	10.0	**97.0**	90-110 %	<0.5	0.5
Selenium	0.239	0.250	**95.6**	90-110 %	<0.001	0.001
Silver	0.045	0.050	**90.0**	90-110 %	<0.00005	0.00005
Sodium	7.9	8.1	**97.5**	90-110 %	<0.5	0.5
Uranium	0.053	0.050	**106**	90-110 %	<0.00001	0.00001
Zinc	0.046	0.050	**92.0**	90-110 %	<0.001	0.001

NA=Data not available.

Green Analytical Laboratories

TOTAL METALS SPIKE AND DUPLICATE DATA

LAB ID#							
802-077	**Spike Data**				**Duplicate Data**		
PARAMETER	**Sample Result**	**Spike Result**	**Spike Conc.**	**Spike % Recovery**	**Sample Result**	**Duplicate Result**	**RPD %**
Iron-T	0.20	3.70	**4.00**	**87.5**	9.60	9.40	**2.11**
Manganese-T	0.020	1.90	**2.00**	**94.0**	5.100	5.000	**1.98**
Mercury-T	0.0000	0.0020	**0.0020**	**100**	<0.0002	<0.0002	**NC**

NC=Not calculated due to results less than the detection limit.
NA=Data not available.

Green Analytical Laboratories

TOTAL METALS SRM AND BLANK DATA

LAB ID#						
802-077	SRM Data				Blank Data	
PARAMETER	SRM Result	True Value	SRM % Rec	Acceptance Range	Blank Result	Reporting Limit
Iron-T	5.24	5.00	**105**	90-110 %	<0.05	0.05
Manganese-T	2.700	2.500	**108**	90-110 %	<0.005	0.005
Mercury-T	0.002	0.002	**100**	90-110 %	<0.0002	0.0002

NA=Data not available.

Green Analytical Laboratories

WET CHEM SPIKE AND DUPLICATE DATA

LAB ID#							
802-077	**Spike Data**				**Duplicate Data**		
PARAMETER	**Sample Result**	**Spike Result**	**Spike Conc.**	**Spike % Recovery**	**Sample Result**	**Duplicate Result**	**RPD %**
Alkalinity	0	101	**100**	**101**	1320	1290	**2.30**
Chloride	0	109	**100**	**109**	10	10	**0.00**
EC	NMA	NMA	**NMA**	**NMA**	NA	NA	**NA**
Fluoride	0.0	0.9	**1.0**	**90**	1.0	1.0	**0.00**
Nitrate/Nitrite	0.03	0.12	**0.10**	**90**	11.80	11.50	**2.58**
pH	NMA	NMA	**NMA**	**NMA**	8.11	8.08	**0.37**
Sulfate	0	48	**50**	**96**	90	88	**2.25**
TDS	NMA	NMA	**NMA**	**NMA**	460	450	**2.20**

NMA=Data not applicable to Method.
NC=Not calculated due to results less than the detection limit.
NA=Data not available.

Green Analytical Laboratories

WET CHEM SRM AND BLANK DATA

LAB ID#						
802-077	SRM Data				Blank Data	
PARAMETER	SRM Result	True Value	SRM % Rec	Acceptance Range	Blank Result	Reporting Limit
Alkalinity	179	186	**96.2**	90-110 %	<10	10
Chloride	27	24.7	**109**	90-110 %	<10	10
EC	536	561	**95.5**	90-110 %	NMA	NMA
Fluoride	2.0	2.0	**100**	90-110 %	<1.0	1.0
Nitrate/Nitrite	0.52	0.50	**104**	90-110 %	<0.02	0.02
pH	8.35	8.40	**99.4**	90-110 %	NMA	NMA
Sulfate	340	321	**106**	90-110 %	<10	10
TDS	1320	1210	**109**	90-110 %	<10	10

NMA=Data not applicable to Method.
NA=Data not available.

Green Analytical Laboratories

DISSOLVED METALS SPIKE AND DUPLICATE DATA

LAB ID#							
802-089	Spike Data				Duplicate Data		
PARAMETER	Sample Result	Spike Result	Spike Conc.	Spike % Recovery	Sample Result	Duplicate Result	RPD %
Arsenic	0.0000	0.043	**0.050**	**86.0**	0.0011	0.0010	**9.52**
Barium	0.0000	0.044	**0.050**	**88.0**	0.0151	0.0150	**0.66**
Boron	0.1	2.3	**2.0**	**110**	0.4	0.4	**0.00**
Cadmium	0.00000	0.044	**0.050**	**88.0**	<0.00005	<0.00005	**NC**
Calcium *	0.0	6.9	**5.0**	**138**	82.5	82.0	**0.61**
Chromium	0.000	0.041	**0.050**	**82.0**	0.005	0.005	**0.00**
Copper	0.0000	0.047	**0.050**	**94.0**	0.0161	0.0161	**0.00**
Iron *	0.00	1.40	**1.00**	**140**	<0.05	<0.05	**NC**
Lead	0.0000	0.043	**0.050**	**86.0**	0.0001	0.0001	**0.00**
Magnesium *	0.0	1.4	**1.0**	**140**	9.1	9.0	**1.10**
Manganese	0.00000	1.200	**1.00**	**120**	0.00800	0.00800	**0.00**
Potassium *	0.0	1.4	**1.0**	**140**	0.9	0.8	**11.8**
Selenium	0.000	0.222	**0.250**	**88.8**	0.012	0.012	**0.00**
Silver	0.00000	0.041	**0.050**	**82.0**	<0.00005	<0.00005	**NC**
Sodium *	0.1	70.4	**50.0**	**141**	32.7	32.5	**0.61**
Uranium	0.00000	0.045	**0.050**	**90.0**	0.02240	0.02140	**4.57**
Zinc	0.000	0.042	**0.050**	**84.0**	0.075	0.074	**1.34**

NC=Not calculated due to results less than the detection limit
NA=Data not available.

Green Analytical Laboratories

DISSOLVED METALS SRM AND BLANK DATA

LAB ID#						
802-089	SRM Data				Blank Data	
PARAMETER	SRM Result	True Value	SRM % Rec	Acceptance Range	Blank Result	Reporting Limit
Arsenic	0.048	0.050	**96.0**	90-110 %	<0.0005	0.0005
Barium *	0.044	0.050	**88.0**	90-110 %	<0.0005	0.0005
Boron	5.4	5.0	**108**	90-110 %	0.1	0.1
Cadmium	0.049	0.050	**98.0**	90-110 %	<0.00005	0.00005
Calcium	4.5	5.0	**90.0**	90-110 %	<0.5	0.5
Chromium	0.046	0.050	**92.0**	90-110 %	<0.001	0.001
Copper *	0.043	0.050	**86.0**	90-110 %	<0.0001	0.0001
Iron	5.24	5.00	**105**	90-110 %	<0.05	0.05
Lead *	0.044	0.050	**88.0**	90-110 %	<0.0001	0.0001
Magnesium	4.6	5.0	**92.0**	90-110 %	<0.5	0.5
Manganese	2.73	2.50	**109**	90-110 %	<0.005	0.005
Potassium	9.7	10.0	**97.0**	90-110 %	<0.5	0.5
Selenium	0.261	0.250	**104**	90-110 %	<0.001	0.001
Silver	0.050	0.050	**100**	90-110 %	<0.00005	0.00005
Sodium	7.9	8.1	**97.3**	90-110 %	<0.5	0.5
Uranium	0.048	0.050	**96.0**	90-110 %	<0.00001	0.00001
Zinc	0.050	0.050	**100**	90-110 %	<0.001	0.001

NA=Data not available.

Green Analytical Laboratories

TOTAL METALS SPIKE AND DUPLICATE DATA

LAB ID#							
802-089	Spike Data				Duplicate Data		
PARAMETER	Sample Result	Spike Result	Spike Conc.	Spike % Recovery	Sample Result	Duplicate Result	RPD %
Iron-T	0.00	3.70	**4.00**	**92.5**	9.60	9.40	**2.11**
Manganese-T	0.020	1.90	**2.00**	**94.0**	5.10	5.00	**1.98**
Mercury-T	0.0000	0.002	**0.002**	**100**	<0.0002	<0.0002	**NC**

NC=Not calculated due to results less than the detection limit.
NA=Data not available.

Green Analytical Laboratories

TOTAL METALS SRM AND BLANK DATA

LAB ID# 802-089	SRM Data				Blank Data	
PARAMETER	SRM Result	True Value	SRM % Rec	Acceptance Range	Blank Result	Reporting Limit
Iron-T	5.24	5.00	**105**	90-110 %	<0.05	0.05
Manganese-T	2.73	2.50	**109**	90-110 %	<0.005	0.005
Mercury-T	0.002	0.002	**100**	90-110 %	<0.0002	0.0002

NA=Data not available.

Green Analytical Laboratories

WET CHEM SPIKE AND DUPLICATE DATA

LAB ID#							
802-089	Spike Data				Duplicate Data		
PARAMETER	Sample Result	Spike Result	Spike Conc.	Spike % Recovery	Sample Result	Duplicate Result	RPD %
Alkalinity	0	101	**100**	**101**	226	222	**1.79**
Chloride	0	109	**100**	**109**	32	32	**0.00**
EC	NMA	NMA	**NMA**	**NMA**	NA	NA	**NA**
Fluoride	0.0	0.9	**1.0**	**90**	0.3	0.3	**0.00**
Nitrate/Nitrite	0.03	0.13	**0.10**	**100**	11.8	11.5	**2.58**
pH	NMA	NMA	**NMA**	**NMA**	5.90	5.86	**0.68**
Sulfate	0	48	**50**	**96**	90	88	**2.25**
TDS	NMA	NMA	**NMA**	**NMA**	460	450	**2.20**

NMA=Data not applicable to Method.
NC=Not calculated due to results less than the detection limit.
NA=Data not available.

Green Analytical Laboratories

WET CHEM SRM AND BLANK DATA

LAB ID#						
802-089	SRM Data				Blank Data	
PARAMETER	SRM Result	True Value	SRM % Rec	Acceptance Range	Blank Result	Reporting Limit
Alkalinity	179	186	**96**	90-110 %	<10	10
Chloride	27	24.7	**109**	90-110 %	<10	10
EC	539	561	**96**	90-110 %	NMA	NMA
Fluoride	1.0	1.0	**100**	90-110 %	<1.0	1.0
Nitrate/Nitrite	0.52	0.50	**104**	90-110 %	<0.02	0.02
pH	8.35	8.40	**99**	90-110 %	NMA	NMA
Sulfate	340	321	**106**	90-110 %	<10	10
TDS	1320	1210	**109**	90-110 %	<10	10

NMA=Data not applicable to Method.

Green Analytical Laboratories

DISSOLVED METALS SPIKE AND DUPLICATE DATA

LAB ID#							
802-039	Spike Data				Duplicate Data		
PARAMETER	Sample Result	Spike Result	Spike Conc.	Spike % Recovery	Sample Result	Duplicate Result	RPD %
Arsenic	0.0000	0.045	**0.050**	**90.0**	0.0005	0.0005	**0.00**
Barium	0.0000	0.044	**0.050**	**88.0**	0.0080	0.0080	**0.00**
Boron *	0.0	2.0	**2.0**	**100**	0.17	0.13	**26.7**
Cadmium	0.00000	0.045	**0.050**	**90.0**	0.00011	0.00010	**9.52**
Calcium	0.0	51.3	**50.0**	**103**	110.0	109.0	**0.91**
Chromium	0.000	0.046	**0.050**	**92.0**	<0.001	<0.001	**NC**
Copper	0.0001	0.047	**0.050**	**93.8**	0.0060	0.0060	**0.00**
Iron	0.00	9.76	**10.0**	**97.6**	0.08	0.08	**0.00**
Lead	0.0001	0.042	**0.050**	**83.8**	0.0007	0.0007	**0.00**
Magnesium	0.0	9.7	**10.0**	**97.0**	7.3	7.3	**0.00**
Manganese	0.00000	1.110	**1.00**	**111**	0.00900	0.00800	**11.8**
Potassium	0.0	9.6	**10.0**	**96.0**	1.7	1.7	**0.00**
Selenium	0.000	0.226	**0.250**	**90.4**	<0.001	<0.001	**NC**
Silver	0.00000	0.044	**0.050**	**88.0**	<0.0005	<0.0005	**NC**
Sodium	0.0	484	**500**	**96.8**	320.0	314.0	**1.89**
Uranium	0.00000	0.044	**0.050**	**88.0**	0.00030	0.00030	**0.00**
Zinc	0.000	0.045	**0.050**	**90.0**	0.023	0.023	**0.00**

NC=Not calculated due to results less than the detection limit
NA=Data not available.

Green Analytical Laboratories

DISSOLVED METALS SRM AND BLANK DATA

LAB ID#						
802-039	SRM Data				Blank Data	
PARAMETER	SRM Result	True Value	SRM % Rec	Acceptance Range	Blank Result	Reporting Limit
Arsenic	0.045	0.050	**90.0**	90-110 %	<0.0005	0.0005
Barium	0.049	0.050	**98.0**	90-110 %	<0.0005	0.0005
Boron	5.1	5.0	**102**	90-110 %	<0.1	0.1
Cadmium	0.049	0.050	**98.0**	90-110 %	<0.00005	0.00005
Calcium	5.2	5.00	**104**	90-110 %	<0.5	0.5
Chromium	0.049	0.050	**98.0**	90-110 %	<0.001	0.001
Copper	0.049	0.050	**98.0**	90-110 %	0.0001	0.0001
Iron	5.19	5.00	**104**	90-110 %	<0.05	0.05
Lead	0.045	0.050	**90.0**	90-110 %	0.0001	0.0001
Magnesium	4.8	5.0	**96.0**	90-110 %	<0.5	0.5
Manganese	2.65	2.50	**106**	90-110 %	<0.005	0.005
Potassium	10.1	10.0	**101**	90-110 %	<0.5	0.5
Selenium	0.233	0.250	**93.2**	90-110 %	<0.001	0.001
Silver	0.044	0.050	**88.0**	90-110 %	<0.00005	0.00005
Sodium	8.8	8.1	**109**	90-110 %	<0.5	0.5
Uranium	0.048	0.050	**96.0**	90-110 %	<0.00001	0.00001
Zinc	0.049	0.050	**98.0**	90-110 %	<0.001	0.001

NA=Data not available.

Green Analytical Laboratories

TOTAL METALS SPIKE AND DUPLICATE DATA

LAB ID#							
802-039	Spike Data				Duplicate Data		
PARAMETER	Sample Result	Spike Result	Spike Conc.	Spike % Recovery	Sample Result	Duplicate Result	RPD %
Iron-T	0.00	3.76	**4.00**	**94.0**	6.01	5.61	**6.88**
Manganese-T	0.000	1.97	**2.00**	**98.5**	1.29	1.27	**1.56**
Mercury-T	0.0000	0.0020	**0.0020**	**100**	<0.0002	<0.0002	**NC**

NC=Not calculated due to results less than the detection limit.
NA=Data not available.

Green Analytical Laboratories

TOTAL METALS SRM AND BLANK DATA

LAB ID# 802-039	SRM Data				Blank Data	
PARAMETER	**SRM Result**	**True Value**	**SRM % Rec**	**Acceptance Range**	**Blank Result**	**Reporting Limit**
Iron-T	5.21	5.00	**104**	90-110 %	<0.05	0.05
Manganese-T	2.730	2.500	**109**	90-110 %	<0.005	0.005
Mercury-T *	0.002	0.002	**118**	90-110 %	<0.0002	0.0002

NA=Data not available.

Green Analytical Laboratories

WET CHEM SPIKE AND DUPLICATE DATA

LAB ID#							
802-039	Spike Data				Duplicate Data		
PARAMETER	Sample Result	Spike Result	Spike Conc.	Spike % Recovery	Sample Result	Duplicate Result	RPD %
Alkalinity	0	102	**100**	**102**	308	306	**0.65**
Chloride	0	101	**100**	**101**	<10	<10	**NC**
EC	NMA	NMA	**NMA**	**NMA**	NA	NA	**NA**
Fluoride	1.7	2.7	**1.0**	**106**	0.5	0.5	**0.00**
Nitrate/Nitrite	0.17	0.27	**0.10**	**100**	6.03	5.91	**2.01**
pH	NMA	NMA	**NMA**	**NMA**	7.44	7.41	**0.40**
Sulfate	0		**50**	**0**	104	104	**0.00**
TDS	NMA	NMA	**NMA**	**NMA**	1200	1180	**1.68**

NMA=Data not applicable to Method.
NC=Not calculated due to results less than the detection limit.
NA=Data not available.

Green Analytical Laboratories

WET CHEM SRM AND BLANK DATA

LAB ID# 802-039	SRM Data				Blank Data	
PARAMETER	SRM Result	True Value	SRM % Rec	Acceptance Range	Blank Result	Reporting Limit
Alkalinity	176	186	**94.6**	90-110 %	<10	10
Chloride	25	24.7	**101**	90-110 %	<10	10
EC	527	561	**93.9**	90-110 %	NMA	NMA
Fluoride	2.0	2.0	**100**	90-110 %	<1.0	1.0
Nitrate/Nitrite	0.50	0.50	**100**	90-110 %	<0.02	0.02
pH	8.36	8.40	**100**	90-110 %	NMA	NMA
Sulfate	320	321	**99.7**	90-110 %	<10	10
TDS	1180	1210	**97.5**	90-110 %	<10	10

NMA=Data not applicable to Method.

Green Analytical Laboratories

DISSOLVED METALS SPIKE AND DUPLICATE DATA

LAB ID#							
805-117	Spike Data				Duplicate Data		
PARAMETER	Sample Result	Spike Result	Spike Conc.	Spike % Recovery	Sample Result	Duplicate Result	RPD %
Arsenic	0.0000	0.053	**0.050**	**106**	<0.0005	<0.0005	**NC**
Barium	0.0000	0.046	**0.050**	**92.0**	0.0250	0.0240	**4.08**
Boron	0.0	2.0	**2.0**	**100**	0.7	0.7	**0.00**
Cadmium	0.00000	0.050	**0.050**	**100**	<0.00005	<0.00005	**NC**
Calcium	0.0	5.5	**5.0**	**110**	89.8	89.7	**0.11**
Chromium	0.000	0.050	**0.050**	**100**	0.004	0.004	**0.00**
Copper	0.0000	0.050	**0.050**	**100**	0.4300	0.4030	**6.48**
Iron	0.00	1.09	**1.00**	**109**	<0.05	<0.05	**NC**
Lead	0.0000	0.050	**0.050**	**100**	0.0003	0.0003	**0.00**
Magnesium	0.0	1.1	**1.0**	**110**	13.1	13.1	**0.00**
Manganese	0.00000	1.060	**1.00**	**106**	0.05100	0.05100	**0.00**
Potassium	0.0	1.0	**1.0**	**100**	0.8	0.8	**0.00**
Selenium *	0.000	0.261	**0.250**	**104**	0.007	0.005	**33.3**
Silver	0.00000	0.047	**0.050**	**94.0**	0.00006	0.00005	**18.2**
Sodium	0.0	54.7	**50.0**	**109**	52.0	51.8	**0.39**
Uranium	0.00000	0.050	**0.050**	**100**	0.01060	0.00950	**10.9**
Zinc	0.000	0.054	**0.050**	**108**	0.024	0.022	**8.70**

NC=Not calculated due to results less than the detection limit.
NA=Data not available.

Green Analytical Laboratories

DISSOLVED METALS SRM AND BLANK DATA

LAB ID#						
805-117	SRM Data				Blank Data	
PARAMETER	SRM Result	True Value	SRM % Rec	Acceptance Range	Blank Result	Reporting Limit
Arsenic	0.053	0.050	**106**	90-110 %	<0.0005	0.0005
Barium	0.053	0.050	**106**	90-110 %	<0.0005	0.0005
Boron	5.1	5.0	**102**	90-110 %	<0.1	0.1
Cadmium	0.051	0.050	**102**	90-110 %	<0.00005	0.00005
Calcium	5.1	5.00	**102**	90-110 %	<0.5	0.5
Chromium	0.051	0.050	**102**	90-110 %	<0.001	0.001
Copper	0.050	0.050	**100**	90-110 %	<0.0001	0.0001
Iron	5.42	5.00	**108**	90-110 %	<0.05	0.05
Lead	0.051	0.050	**102**	90-110 %	<0.0001	0.0001
Magnesium	5.0	5.0	**100**	90-110 %	<0.5	0.5
Manganese	2.54	2.50	**102**	90-110 %	<0.005	0.005
Potassium	10.3	10.0	**103**	90-110 %	<0.5	0.5
Selenium	0.257	0.250	**103**	90-110 %	<0.001	0.001
Silver *	0.059	0.050	**118**	90-110 %	<0.00005	0.00005
Sodium	8.7	8.1	**107**	90-110 %	<0.5	0.5
Uranium	0.052	0.050	**104**	90-110 %	<0.00001	0.00001
Zinc	0.050	0.050	**100**	90-110 %	<0.001	0.001

NA=Data not available.

Green Analytical Laboratories

TOTAL METALS SPIKE AND DUPLICATE DATA

LAB ID#							
805-117	Spike Data				Duplicate Data		
PARAMETER	Sample Result	Spike Result	Spike Conc.	Spike % Recovery	Sample Result	Duplicate Result	RPD %
Iron-T	0.00	3.96	**4.00**	**99.0**	4.13	4.09	**0.97**
Manganese-T	0.000	1.94	**2.00**	**97.0**	0.035	0.034	**2.90**
Mercury-T	0.0000	0.0022	**0.0020**	**110**	<0.0002	<0.0002	**NC**

NC=Not calculated due to results less than the detection limit.
NA=Data not available.

Green Analytical Laboratories

TOTAL METALS SRM AND BLANK DATA

LAB ID#						
805-117	SRM Data				Blank Data	
PARAMETER	SRM Result	True Value	SRM % Rec	Acceptance Range	Blank Result	Reporting Limit
Iron-T	5.23	5.00	**105**	90-110 %	0.06	0.05
Manganese-T	2.540	2.500	**102**	90-110 %	<0.005	0.005
Mercury-T	0.002	0.002	**100**	90-110 %	<0.0002	0.0002

NA=Data not available.

Green Analytical Laboratories

WET CHEM SPIKE AND DUPLICATE DATA

LAB ID# 805-117	Spike Data				Duplicate Data		
PARAMETER	**Sample Result**	**Spike Result**	**Spike Conc.**	**Spike % Recovery**	**Sample Result**	**Duplicate Result**	**RPD %**
Alkalinity	0	108	**100**	**108**	238	238	**0.00**
Chloride	0	99	**100**	**99**	11	11	**0.00**
EC	NMA	NMA	**NMA**	**NMA**	515	510	**0.98**
Fluoride	0.0	1.0	**1.0**	**100**	1.3	1.3	**0.00**
Nitrate/Nitrite	0.04	0.13	**0.10**	**90**	0.07	0.06	**15.4**
pH	NMA	NMA	**NMA**	**NMA**	7.79	7.75	**0.51**
Sulfate	0	54	**50**	**108**	3300	3300	**0.00**
TDS	NMA	NMA	**NMA**	**NMA**	3120	3080	**1.29**

NMA=Data not applicable to Method.
NC=Not calculated due to results less than the detection limit.

Green Analytical Laboratories

WET CHEM SRM AND BLANK DATA

LAB ID#						
805-117	SRM Data				Blank Data	
PARAMETER	SRM Result	True Value	SRM % Rec	Acceptance Range	Blank Result	Reporting Limit
Alkalinity	187	186	**101**	90-110 %	<10	10
Chloride	25	24.7	**101**	90-110 %	<10	10
EC	826	829	**100**	90-110 %	NMA	NMA
Fluoride	0.9	1.0	**90.0**	90-110 %	<1.0	1.0
Nitrate/Nitrite	0.51	0.50	**102**	90-110 %	<0.02	0.02
pH	9.11	9.29	**98.1**	90-110 %	NMA	NMA
Sulfate	325	321	**101**	90-110 %	<10	10
TDS	1100	1170	**94.0**	90-110 %	<10	10

NMA=Data not applicable to Method.

Green Analytical Laboratories

DISSOLVED METALS SPIKE AND DUPLICATE DATA

LAB ID#							
805-126	Spike Data				Duplicate Data		
PARAMETER	Sample Result	Spike Result	Spike Conc.	Spike % Recovery	Sample Result	Duplicate Result	RPD %
Arsenic	0.0000	0.053	**0.050**	**106**	<0.0005	<0.0005	**NC**
Barium	0.0000	0.046	**0.050**	**92.0**	0.0250	0.0240	**4.08**
Boron	0.0	2.0	**2.0**	**100**	0.7	0.7	**0.00**
Cadmium	0.00000	0.050	**0.050**	**100**	<0.00005	<0.00005	**NC**
Calcium	0.0	5.4	**5.0**	**108**	89.8	89.7	**0.11**
Chromium	0.000	0.050	**0.050**	**100**	0.004	0.004	**0.00**
Copper	0.0000	0.050	**0.050**	**100**	0.0432	0.0430	**0.46**
Iron	0.00	1.09	**1.00**	**109**	<0.05	<0.05	**NC**
Lead	0.0000	0.050	**0.050**	**100**	0.0003	0.0003	**0.00**
Magnesium	0.0	1.1	**1.0**	**110**	13.1	13.1	**0.00**
Manganese	0.00000	1.060	**1.00**	**106**	0.05100	0.05100	**0.00**
Potassium	0.0	1.0	**1.0**	**100**	0.8	0.8	**0.00**
Selenium *	0.000	0.261	**0.250**	**104**	0.007	0.005	**33.3**
Silver	0.00000	0.047	**0.050**	**94.0**	0.00006	0.00005	**18.2**
Sodium	0.0	54.7	**50.0**	**109**	52.0	51.8	**0.39**
Uranium	0.00000	0.050	**0.050**	**100**	0.01060	0.00950	**10.9**
Zinc	0.000	0.054	**0.050**	**108**	0.024	0.022	**8.70**

NC=Not calculated due to results less than the detection limit.
NA=Data not available.

DISSOLVED METALS SRM AND BLANK DATA

LAB ID# 805-126	SRM Data				Blank Data	
PARAMETER	**SRM Result**	**True Value**	**SRM % Rec**	**Acceptance Range**	**Blank Result**	**Reporting Limit**
Arsenic	0.053	0.050	**106**	90-110 %	<0.0005	0.0005
Barium	0.053	0.050	**106**	90-110 %	<0.0005	0.0005
Boron	5.1	5.0	**102**	90-110 %	<0.1	0.1
Cadmium	0.051	0.050	**102**	90-110 %	<0.00005	0.00005
Calcium	5.1	5.0	**102**	90-110 %	<0.5	0.5
Chromium	0.051	0.050	**102**	90-110 %	<0.001	0.001
Copper	0.050	0.050	**100**	90-110 %	<0.0001	0.0001
Iron	5.42	5.00	**108**	90-110 %	<0.05	0.05
Lead	0.051	0.050	**102**	90-110 %	<0.0001	0.0001
Magnesium	5.0	5.0	**100**	90-110 %	<0.5	0.5
Manganese	2.54	2.50	**102**	90-110 %	<0.005	0.005
Potassium	10.3	10.0	**103**	90-110 %	<0.5	0.5
Selenium	0.257	0.250	**103**	90-110 %	<0.001	0.001
Silver *	0.059	0.050	**118**	90-110 %	<0.00005	0.00005
Sodium	8.7	8.1	**107**	90-110 %	<0.5	0.5
Uranium	0.052	0.050	**104**	90-110 %	<0.00001	0.00001
Zinc	0.052	0.050	**104**	90-110 %	<0.001	0.001

NA=Data not available.

Green Analytical Laboratories

TOTAL METALS SPIKE AND DUPLICATE DATA

LAB ID#							
805-126	Spike Data				Duplicate Data		
PARAMETER	Sample Result	Spike Result	Spike Conc.	Spike % Recovery	Sample Result	Duplicate Result	RPD %
Iron-T	0.00	4.18	**4.00**	**105**	1.32	1.30	**1.53**
Manganese-T	0.000	1.06	**1.00**	**106**	0.051	0.051	**0.00**
Mercury-T	0.0000	0.0022	**0.0020**	**110**	<0.0002	<0.0002	**NC**

NC=Not calculated due to results less than the detection limit.
NA=Data not available.

Green Analytical Laboratories

TOTAL METALS SRM AND BLANK DATA

LAB ID#						
805-126	SRM Data				Blank Data	
PARAMETER	SRM Result	True Value	SRM % Rec	Acceptance Range	Blank Result	Reporting Limit
Iron-T	5.05	5.00	**101**	90-110 %	<0.05	0.05
Manganese-T	2.660	2.500	**106**	90-110 %	<0.005	0.005
Mercury-T	0.002	0.002	**100**	90-110 %	<0.0002	0.0002

NA=Data not available.

Green Analytical Laboratories

WET CHEM SPIKE AND DUPLICATE DATA

LAB ID#							
805-126	Spike Data				Duplicate Data		
PARAMETER	Sample Result	Spike Result	Spike Conc.	Spike % Recovery	Sample Result	Duplicate Result	RPD %
Alkalinity	0	108	**100**	**108**	238	238	**0.00**
Chloride	0	99	**100**	**99**	11	11	**0.00**
EC	NMA	NMA	**NMA**	**NMA**	515	510	**0.98**
Fluoride	0.0	1.0	**1.0**	**100**	1.3	1.3	**0.00**
Nitrate/Nitrite	0.04	0.13	**0.10**	**90**	0.08	0.08	**0.00**
pH	NMA	NMA	**NMA**	**NMA**	7.79	7.75	**0.51**
Sulfate	0	54	**50**	**108**	3300	3300	**0.00**
TDS	NMA	NMA	**NMA**	**NMA**	3120	3080	**1.29**

NMA=Data not applicable to Method.
NC=Not calculated due to results less than the detection limit.

Green Analytical Laboratories

WET CHEM SRM AND BLANK DATA

LAB ID#						
805-126	SRM Data				Blank Data	
PARAMETER	SRM Result	True Value	SRM % Rec	Acceptance Range	Blank Result	Reporting Limit
Alkalinity	187	186	**101**	90-110 %	<10	10
Chloride	25	24.7	**101**	90-110 %	<10	10
EC	826	829	**100**	90-110 %	NMA	NMA
Fluoride	0.9	1.0	**90**	90-110 %	<1.0	1.0
Nitrate/Nitrite	0.51	0.50	**102**	90-110 %	<0.02	0.02
pH	9.11	9.29	**98**	90-110 %	NMA	NMA
Sulfate	325	321	**101**	90-110 %	<10	10
TDS	1100	1170	**94**	90-110 %	<10	10

NMA=Data not applicable to Method.

Green Analytical Laboratories

DISSOLVED METALS SPIKE AND DUPLICATE DATA

LAB ID#							
808-094	**Spike Data**				**Duplicate Data**		
PARAMETER	**Sample Result**	**Spike Result**	**Spike Conc.**	**Spike % Recovery**	**Sample Result**	**Duplicate Result**	**RPD %**
Arsenic	0.0000	0.053	**0.050**	**106**	0.0042	0.0040	**4.88**
Barium	0.0000	0.049	**0.050**	**98.0**	0.0977	0.0945	**3.33**
Boron	0.0	2.3	**2.0**	**117**	0.1	0.1	**0.00**
Cadmium	0.00000	0.051	**0.050**	**102**	0.00107	0.00100	**6.76**
Calcium	0.0	5.8	**5.0**	**116**	120.0	120.0	**0.00**
Chromium	0.000	0.052	**0.050**	**104**	<0.001	<0.001	**NC**
Copper	0.0000	0.052	**0.050**	**104**	0.0068	0.0063	**7.63**
Iron	0.00	1.17	**1.00**	**117**	0.10	0.09	**10.5**
Lead	0.0000	0.056	**0.050**	**112**	0.0016	0.0015	**3.28**
Magnesium	0.0	1.2	**1.0**	**120**	14.7	14.6	**0.68**
Manganese *	0.00000	1.24	**1.00**	**124**	0.00900	0.00900	**0.00**
Potassium	0.0	1.1	**1.0**	**106**	10.8	10.8	**0.00**
Selenium	0.000	0.276	**0.250**	**110**	0.001	<0.001	**NC**
Silver	0.00000	0.052	**0.050**	**104**	<0.00005	<0.00005	**NC**
Sodium	0.0	59.7	**50.0**	**119**	55.1	54.9	**0.36**
Uranium	0.00000	0.056	**0.050**	**112**	0.00427	0.00427	**0.00**
Zinc	0.000	0.056	**0.050**	**112**	0.009	0.009	**0.00**

NC=Not calculated due to results less than the detection limit.
NA=Data not available.

Green Analytical Laboratories

DISSOLVED METALS SRM AND BLANK DATA

LAB ID#						
808-094	SRM Data				Blank Data	
PARAMETER	**SRM Result**	**True Value**	**SRM % Rec**	**Acceptance Range**	**Blank Result**	**Reporting Limit**
Arsenic	0.047	0.050	**94.0**	90-110 %	<0.0005	0.0005
Barium	0.049	0.050	**98.0**	90-110 %	<0.0005	0.0005
Boron	5.3	5.0	**106**	90-110 %	<0.1	0.1
Cadmium	0.048	0.050	**96.0**	90-110 %	<0.00005	0.00005
Calcium	5.1	5.0	**102**	90-110 %	<0.5	0.5
Chromium	0.050	0.050	**100**	90-110 %	<0.001	0.001
Copper	0.048	0.050	**96.0**	90-110 %	<0.0001	0.0001
Iron	5.38	5.00	**108**	90-110 %	<0.05	0.05
Lead	0.049	0.050	**98.0**	90-110 %	<0.0001	0.0001
Magnesium	5.0	5.0	**100**	90-110 %	<0.5	0.5
Manganese	2.69	2.50	**108**	90-110 %	<0.005	0.005
Potassium	10.3	10.1	**102**	90-110 %	<0.5	0.5
Selenium	0.239	0.250	**95.6**	90-110 %	<0.001	0.001
Silver	0.051	0.050	**102**	90-110 %	<0.00005	0.00005
Sodium	8.7	8.1	**107**	90-110 %	<0.5	0.5
Uranium	0.049	0.050	**98.0**	90-110 %	<0.00001	0.00001
Zinc	0.047	0.050	**94.0**	90-110 %	<0.001	0.001

NA=Data not available.

Green Analytical Laboratories

TOTAL METALS SPIKE AND DUPLICATE DATA

LAB ID# 808-094	Spike Data				Duplicate Data		
PARAMETER	Sample Result	Spike Result	Spike Conc.	Spike % Recovery	Sample Result	Duplicate Result	RPD %
Iron-T	0.00	3.94	**4.00**	**98.5**	7.10	7.00	**1.42**
Manganese-T	0.000	2.05	**2.00**	**103**	4.400	4.300	**2.30**
Mercury-T	0.0000	0.0022	**0.0020**	**110**	<0.0005	<0.0005	**NC**

NC=Not calculated due to results less than the detection limit.
NA=Data not available.

Green Analytical Laboratories

TOTAL METALS SRM AND BLANK DATA

LAB ID#						
808-094	SRM Data				Blank Data	
PARAMETER	SRM Result	True Value	SRM % Rec	Acceptance Range	Blank Result	Reporting Limit
Iron-T	5.09	5.00	**102**	90-110 %	<0.05	0.05
Manganese-T	2.65	2.50	**106**	90-110 %	<0.005	0.005
Mercury-T	0.002	0.002	**100**	90-110 %	<0.0002	0.0002

NA=Data not available.

Green Analytical Laboratories

WET CHEM SPIKE AND DUPLICATE DATA

LAB ID#							
808-094	Spike Data				Duplicate Data		
PARAMETER	Sample Result	Spike Result	Spike Conc.	Spike % Recovery	Sample Result	Duplicate Result	RPD %
Alkalinity	0	106	**100**	**106**	182	180	**1.10**
Chloride	0	105	**100**	**105**	1210	1180	**2.51**
EC	NMA	NMA	**NMA**	**NMA**	386	385	**0.26**
Fluoride	0.0	0.9	**1.0**	**90**	3.1	2.9	**6.67**
Nitrate/Nitrite	0.00	0.11	**0.10**	**110**	0.04	0.04	**0.00**
pH	NMA	NMA	**NMA**	**NMA**	7.79	7.78	**0.13**
Sulfate	0	54	**50**	**108**	3050	2950	**3.33**
TDS	NMA	NMA	**NMA**	**NMA**	240	225	**6.45**

NMA=Data not applicable to Method.
NC=Not calculated due to results less than the detection limit.

Green Analytical Laboratories

WET CHEM SRM AND BLANK DATA

LAB ID#						
808-094	SRM Data				Blank Data	
PARAMETER	SRM Result	True Value	SRM % Rec	Acceptance Range	Blank Result	Reporting Limit
Alkalinity	360	339	**106**	90-110 %	<10	10
Chloride	23	22.8	**101**	90-110 %	<10	10
EC *	NA	NA	**NA**	90-110 %	NMA	NMA
Fluoride	1.0	1.0	**100**	90-110 %	<1.0	1.0
Nitrate/Nitrite	0.50	0.50	**100**	90-110 %	<0.02	0.02
pH	9.05	8.90	**102**	90-110 %	NMA	NMA
Sulfate	340	321	**106**	90-110 %	<10	10
TDS	5040	4850	**104**	90-110 %	<10	10

NMA=Data not applicable to Method.
NA=Data not available.

Green Analytical Laboratories

DISSOLVED METALS SPIKE AND DUPLICATE DATA

LAB ID# 808-103	Spike Data				Duplicate Data		
PARAMETER	Sample Result	Spike Result	Spike Conc.	Spike % Recovery	Sample Result	Duplicate Result	RPD %
Arsenic	0.0000	0.053	**0.050**	**106**	0.0042	0.0040	**4.88**
Barium	0.0000	0.049	**0.050**	**98.0**	0.0977	0.0945	**3.33**
Boron	0.0	2.3	**2.000**	**117**	0.1	0.1	**0.00**
Cadmium	0.00000	0.051	**0.050**	**102**	0.00107	0.00100	**6.76**
Calcium	0.0	5.8	**5.0**	**116**	120.0	120.0	**0.00**
Chromium	0.000	0.052	**0.050**	**104**	<0.001	<0.001	**NC**
Copper	0.0000	0.052	**0.050**	**104**	0.0068	0.0063	**7.63**
Iron	0.00	1.17	**1.00**	**117**	0.10	0.09	**10.5**
Lead	0.0000	0.056	**0.050**	**112**	0.0016	0.0015	**3.28**
Magnesium	0.0	1.2	**1.0**	**120**	14.7	14.6	**0.68**
Manganese *	0.00000	1.24	**1.00**	**124**	0.00900	0.00900	**0.00**
Potassium	0.0	1.1	**1.0**	**110**	10.8	10.8	**0.00**
Selenium	0.000	0.276	**0.250**	**110**	0.001	<0.001	**NC**
Silver	0.00000	0.052	**0.050**	**104**	<0.00005	<0.00005	**NC**
Sodium	0.0	59.7	**50.0**	**119**	55.1	54.9	**0.36**
Uranium	0.00000	0.056	**0.050**	**112**	0.00427	0.00427	**0.00**
Zinc	0.000	0.056	**0.050**	**112**	0.009	0.009	**0.00**

NC=Not calculated due to results less than the detection limit.
NA=Data not available.

Green Analytical Laboratories

DISSOLVED METALS SRM AND BLANK DATA

LAB ID#						
808-103	SRM Data				Blank Data	
PARAMETER	SRM Result	True Value	SRM % Rec	Acceptance Range	Blank Result	Reporting Limit
Arsenic	0.047	0.050	**94.0**	90-110 %	<0.0005	0.0005
Barium	0.049	0.050	**98.0**	90-110 %	<0.0005	0.0005
Boron	5.3	5.0	**106**	90-110 %	<0.1	0.1
Cadmium	0.048	0.050	**96.0**	90-110 %	<0.00005	0.00005
Calcium	5.1	5.0	**102**	90-110 %	<0.5	0.5
Chromium	0.050	0.050	**100**	90-110 %	<0.001	0.001
Copper	0.048	0.050	**96.0**	90-110 %	<0.0001	0.0001
Iron	5.38	5.00	**108**	90-110 %	<0.05	0.05
Lead	0.049	0.050	**98.0**	90-110 %	<0.0001	0.0001
Magnesium	5.0	5.0	**100**	90-110 %	<0.5	0.5
Manganese	2.69	2.50	**108**	90-110 %	<0.005	0.005
Potassium	10.3	10.0	**103**	90-110 %	<0.5	0.5
Selenium	0.239	0.250	**95.6**	90-110 %	<0.001	0.001
Silver	0.051	0.050	**102**	90-110 %	<0.00005	0.00005
Sodium	8.7	8.1	**107**	90-110 %	<0.5	0.5
Uranium	0.049	0.050	**98.0**	90-110 %	<0.00001	0.00001
Zinc	0.047	0.050	**94.0**	90-110 %	<0.001	0.001

NA=Data not available.

Green Analytical Laboratories

TOTAL METALS SPIKE AND DUPLICATE DATA

LAB ID#							
808-103	Spike Data				Duplicate Data		
PARAMETER	Sample Result	Spike Result	Spike Conc.	Spike % Recovery	Sample Result	Duplicate Result	RPD %
Iron-T	0.00	3.94	**4.00**	**98.5**	7.10	7.00	**1.42**
Manganese-T	0.000	2.05	**2.00**	**103**	4.40	4.30	**2.30**
Mercury-T	0.0000	0.0022	**0.0020**	**110**	<0.0002	<0.0002	**NC**

NC=Not calculated due to results less than the detection limit.
NA=Data not available.

Green Analytical Laboratories

TOTAL METALS SRM AND BLANK DATA

LAB ID#						
808-103	SRM Data				Blank Data	
PARAMETER	SRM Result	True Value	SRM % Rec	Acceptance Range	Blank Result	Reporting Limit
Iron-T	5.09	5.00	**102**	90-110 %	<0.05	0.05
Manganese-T	2.65	2.50	**106**	90-110 %	<0.005	0.005
Mercury-T	0.002	0.002	**100**	90-110 %	<0.0002	0.0002

NA=Data not available.

Green Analytical Laboratories

WET CHEM SPIKE AND DUPLICATE DATA

LAB ID#							
808-103	**Spike Data**				**Duplicate Data**		
PARAMETER	**Sample Result**	**Spike Result**	**Spike Conc.**	**Spike % Recovery**	**Sample Result**	**Duplicate Result**	**RPD %**
Alkalinity	0	111	**100**	**111**	405	400	**1.24**
Chloride	0	105	**100**	**105**	1210	1180	**2.51**
EC	NMA	NMA	**NMA**	**NMA**	894	885	**1.01**
Fluoride	0.0	0.9	**1.0**	**90**	3.1	2.9	**6.67**
Nitrate/Nitrite	0.00	0.11	**0.10**	**110**	0.04	0.04	**0.00**
pH	NMA	NMA	**NMA**	**NMA**	8.07	8.07	**0.00**
Sulfate	0	54	**50**	**108**	3400	3300	**2.99**
TDS	NMA	NMA	**NMA**	**NMA**	255	255	**0.00**

NMA=Data not applicable to Method.
NC=Not calculated due to results less than the detection limit.

Green Analytical Laboratories

WET CHEM SRM AND BLANK DATA

LAB ID#						
808-103	**SRM Data**				**Blank Data**	
PARAMETER	**SRM Result**	**True Value**	**SRM % Rec**	**Acceptance Range**	**Blank Result**	**Reporting Limit**
Alkalinity	348	339	**103**	90-110 %	<10	10
Chloride	23	22.8	**101**	90-110 %	<10	10
EC	NA	NA	**NA**	90-110 %	NMA	NMA
Fluoride	1.0	1.0	**100**	90-110 %	<1.0	1.0
Nitrate/Nitrite	0.50	0.50	**100**	90-110 %	<0.02	0.02
pH	9.02	8.90	**101**	90-110 %	NMA	NMA
Sulfate	340	321	**106**	90-110 %	<10	10
TDS	1060	1170	**90.6**	90-110 %	<10	10

NMA=Data not applicable to Method.
NA=Data not available.

Green Analytical Laboratories

DISSOLVED METALS SPIKE AND DUPLICATE DATA

LAB ID#							
811-106	**Spike Data**				**Duplicate Data**		
PARAMETER	**Sample Result**	**Spike Result**	**Spike Conc.**	**Spike % Recovery**	**Sample Result**	**Duplicate Result**	**RPD %**
Arsenic	0.0000	0.051	**0.050**	**102**	0.0019	0.0016	**17.1**
Barium	0.0000	0.050	**0.050**	**100**	0.1310	0.1260	**3.89**
Boron	0.0	2.1	**2.0**	**105**	1.2	1.2	**0.00**
Cadmium	0.00000	0.049	**0.050**	**98.0**	<0.00005	<0.00005	**NC**
Calcium	0.0	5.8	**5.0**	**116**	85.5	85.4	**0.12**
Chromium	0.000	0.049	**0.050**	**98.0**	0.010	0.010	**0.00**
Copper	0.0000	0.050	**0.050**	**100**	0.0066	0.0063	**4.65**
Iron	0.00	1.16	**1.00**	**116**	0.40	0.40	**0.00**
Lead	0.0000	0.050	**0.050**	**100**	0.0018	0.0017	**5.71**
Magnesium	0.0	0.9	**1.0**	**90.0**	15.0	14.9	**0.67**
Manganese	0.00000	1.06	**1.00**	**106**	0.08000	0.08000	**0.00**
Potassium	0.0	1.2	**1.0**	**120**	0.3	0.3	**0.00**
Selenium	0.000	0.250	**0.250**	**100**	0.030	0.029	**3.39**
Silver	0.00000	0.053	**0.050**	**106**	<0.00005	<0.00005	**NC**
Sodium	0.0	58.7	**50.0**	**117**	27.8	27.8	**0.00**
Uranium	0.00000	0.049	**0.050**	**98.0**	0.00409	0.00394	**3.74**
Zinc	0.000	0.052	**0.050**	**104**	0.310	0.299	**3.61**

NC=Not calculated due to results less than the detection limit.
NA=Data not available.

Green Analytical Laboratories

DISSOLVED METALS SRM AND BLANK DATA

LAB ID#						
811-106	SRM Data				Blank Data	
PARAMETER	SRM Result	True Value	SRM % Rec	Acceptance Range	Blank Result	Reporting Limit
Arsenic	0.048	0.050	**96.0**	90-110 %	<0.0005	0.0005
Barium	0.050	0.050	**100**	90-110 %	<0.0005	0.0005
Boron	5.2	5.0	**104**	90-110 %	<0.1	0.1
Cadmium	0.048	0.050	**96.0**	90-110 %	<0.00005	0.00005
Calcium	5.1	5.0	**102**	90-110 %	<0.5	0.5
Chromium	0.046	0.050	**92.0**	90-110 %	<0.001	0.001
Copper	0.050	0.050	**100**	90-110 %	<0.0001	0.0001
Iron	5.41	5.00	**108**	90-110 %	<0.05	0.05
Lead	0.050	0.050	**100**	90-110 %	<0.0001	0.0001
Magnesium	5.0	5.0	**100**	90-110 %	<0.5	0.5
Manganese	2.62	2.50	**105**	90-110 %	<0.005	0.005
Potassium	10.8	10.0	**108**	90-110 %	<0.5	0.5
Selenium	0.246	0.250	**98.4**	90-110 %	<0.001	0.001
Silver	0.055	0.050	**110**	90-110 %	<0.00005	0.00005
Sodium	8.6	8.1	**106**	90-110 %	<0.5	0.5
Uranium	0.050	0.050	**100**	90-110 %	<0.00001	0.00001
Zinc	0.052	0.050	**104**	90-110 %	<0.001	0.001

NA=Data not available.

Green Analytical Laboratories

TOTAL METALS SPIKE AND DUPLICATE DATA

LAB ID#							
811-106	Spike Data				Duplicate Data		
PARAMETER	Sample Result	Spike Result	Spike Conc.	Spike % Recovery	Sample Result	Duplicate Result	RPD %
Iron-T	0.00	4.01	**4.00**	**100**	6.60	5.60	**16.4**
Manganese-T	0.000	2.12	**2.00**	**106**	0.121	0.112	**7.73**
Mercury-T	0.0000	0.0021	**0.0020**	**105**	<0.0002	<0.0002	**NC**

NC=Not calculated due to results less than the detection limit.
NA=Data not available.

Green Analytical Laboratories

TOTAL METALS SRM AND BLANK DATA

LAB ID# 811-106	SRM Data				Blank Data	
PARAMETER	**SRM Result**	**True Value**	**SRM % Rec**	**Acceptance Range**	**Blank Result**	**Reporting Limit**
Iron-T	4.94	5.00	**98.8**	90-110 %	<0.05	0.05
Manganese-T	2.62	2.50	**105**	90-110 %	<0.005	0.005
Mercury-T	0.002	0.002	**100**	90-110 %	<0.0002	0.0002

NA=Data not available.

Green Analytical Laboratories

WET CHEM SPIKE AND DUPLICATE DATA

LAB ID# 811-106	Spike Data				Duplicate Data		
PARAMETER	**Sample Result**	**Spike Result**	**Spike Conc.**	**Spike % Recovery**	**Sample Result**	**Duplicate Result**	**RPD %**
Alkalinity	0	102	**100**	**102**	1580	1570	**0.63**
Chloride	0	96	**100**	**96**	580	560	**3.51**
EC	NMA	NMA	**NMA**	**NMA**	711	709	**0.28**
Fluoride	0.0	1.0	**1.0**	**100**	0.5	0.5	**0.00**
Nitrate/Nitrite	0.00	0.12	**0.10**	**120**	0.66	0.65	**1.53**
pH	NMA	NMA	**NMA**	**NMA**	8.01	8.00	**0.12**
Sulfate	0	51	**50**	**102**	1850	1800	**2.74**
TDS	NMA	NMA	**NMA**	**NMA**	310	310	**0.00**

NMA=Data not applicable to Method.
NC=Not calculated due to results less than the detection limit.

Green Analytical Laboratories

WET CHEM SRM AND BLANK DATA

LAB ID#						
811-106	SRM Data				Blank Data	
PARAMETER	SRM Result	True Value	SRM % Rec	Acceptance Range	Blank Result	Reporting Limit
Alkalinity	186	179	**104**	90-110 %	<10	10
Chloride	48	47.5	**101**	90-110 %	<10	10
EC *	NA	NA	**NA**	90-110 %	NMA	NMA
Fluoride	1.0	1.0	**100**	90-110 %	<1.0	1.0
Nitrate/Nitrite	0.52	0.50	**104**	90-110 %	<0.02	0.02
pH	7.37	7.40	**100**	90-110 %	NMA	NMA
Sulfate	325	321	**101**	90-110 %	<10	10
TDS	3340	3100	**108**	90-110 %	<10	10

NMA=Data not applicable to Method.
NA=Data not available.

Green Analytical Laboratories

DISSOLVED METALS SPIKE AND DUPLICATE DATA

LAB ID#							
811-115	Spike Data				Duplicate Data		
PARAMETER	Sample Result	Spike Result	Spike Conc.	Spike % Recovery	Sample Result	Duplicate Result	RPD %
Arsenic	0.0000	0.045	**0.050**	**90.0**	0.0008	0.0008	**0.00**
Barium	0.0000	0.049	**0.050**	**98.0**	0.0174	0.0167	**4.11**
Boron	0.0	2.2	**2.0**	**110**	0.3	0.2	**8.33**
Cadmium	0.00000	0.050	**0.050**	**100**	<0.00005	<0.00005	**NC**
Calcium	0.0	5.1	**5.0**	**102**	101.0	101.0	**0.00**
Chromium	0.000	0.052	**0.050**	**104**	<0.001	<0.001	**NC**
Copper	0.0000	0.049	**0.050**	**98.0**	0.0091	0.0079	**14.1**
Iron	0.00	1.00	**1.00**	**100**	<0.05	<0.05	**NC**
Lead	0.0000	0.048	**0.050**	**96.0**	0.0000	0.0000	**0.00**
Magnesium	0.0	1.0	**1.0**	**100**	16.5	16.4	**0.61**
Manganese	0.00000	1.080	**1.00**	**108**	<0.005	<0.005	**NC**
Potassium	0.0	1.0	**1.0**	**100**	1.8	1.7	**5.71**
Selenium	0.000	0.235	**0.250**	**94.0**	0.006	0.006	**0.00**
Silver	0.00000	0.049	**0.050**	**98.0**	<0.00005	<0.00005	**NC**
Sodium	0.0	53.1	**50.0**	**106**	445.0	444.0	**0.22**
Uranium	0.00000	0.048	**0.050**	**96.0**	0.01230	0.01200	**2.47**
Zinc	0.000	0.049	**0.050**	**98.0**	0.007	0.007	**0.00**

NC=Not calculated due to results less than the detection limit.
NA=Data not available.

Green Analytical Laboratories

DISSOLVED METALS SRM AND BLANK DATA

LAB ID#						
811-115	SRM Data				Blank Data	
PARAMETER	SRM Result	True Value	SRM % Rec	Acceptence Range	Blank Result	Reporting Limit
Arsenic	0.048	0.050	**96.0**	90-110 %	<0.0005	0.0005
Barium	0.050	0.050	**100**	90-110 %	<0.0005	0.0005
Boron	5.1	5.0	**102**	90-110 %	<0.1	0.1
Cadmium *	0.056	0.050	**112**	90-110 %	<0.00005	0.00005
Calcium	5.0	5.0	**100**	90-110 %	<0.5	0.5
Chromium	0.050	0.050	**100**	90-110 %	<0.001	0.001
Copper	0.052	0.050	**104**	90-110 %	<0.0001	0.0001
Iron	5.30	5.00	**106**	90-110 %	<0.05	0.05
Lead	0.051	0.050	**102**	90-110 %	<0.0001	0.0001
Magnesium	4.9	5.0	**98.0**	90-110 %	<0.5	0.5
Manganese	2.59	2.50	**104**	90-110 %	<0.005	0.005
Potassium	10.6	10.0	**106**	90-110 %	<0.5	0.5
Selenium	0.256	0.250	**102**	90-110 %	<0.001	0.001
Silver	0.055	0.050	**110**	90-110 %	<0.00005	0.00005
Sodium	8.5	8.1	**105**	90-110 %	<0.5	0.5
Uranium	0.049	0.050	**98.0**	90-110 %	<0.00001	0.00001
Zinc	0.047	0.050	**94.0**	90-110 %	<0.001	0.001

NA=Data not available.

Green Analytical Laboratories

TOTAL METALS SPIKE AND DUPLICATE DATA

LAB ID#							
811-115	Spike Data				Duplicate Data		
PARAMETER	Sample Result	Spike Result	Spike Conc.	Spike % Recovery	Sample Result	Duplicate Result	RPD %
Iron-T	0.00	3.97	**4.00**	**99.3**	4.40	3.90	**12.0**
Manganese-T	0.000	2.08	**2.00**	**104**	0.100	0.100	**0.00**
Mercury-T	0.0000	0.0020	**0.0020**	**100**	<0.0002	<0.0002	**NC**

NC=Not calculated due to results less than the detection limit.
NA=Data not available.

Green Analytical Laboratories

TOTAL METALS SRM AND BLANK DATA

LAB ID#						
811-115	SRM Data				Blank Data	
PARAMETER	SRM Result	True Value	SRM % Rec	Acceptance Range	Blank Result	Reporting Limit
Iron-T	4.89	5.00	**97.8**	90-110 %	<0.05	0.05
Manganese-T	2.59	2.50	**104**	90-110 %	<0.005	0.005
Mercury-T	0.002	0.002	**100**	90-110 %	<0.0002	0.0002

NA=Data not available.

Green Analytical Laboratories

WET CHEM SPIKE AND DUPLICATE DATA

LAB ID#							
811-115	**Spike Data**				**Duplicate Data**		
PARAMETER	**Sample Result**	**Spike Result**	**Spike Conc.**	**Spike % Recovery**	**Sample Result**	**Duplicate Result**	**RPD %**
Alkalinity	0	102	**100**	**102**	1580	1570	**0.63**
Chloride	0	103	**100**	**103**	23	22	**4.44**
EC	NMA	NMA	**NMA**	**NMA**	626	624	**0.32**
Fluoride	0.0	1.0	**1.0**	**100**	1.5	1.5	**0.00**
Nitrate/Nitrite	0.00	0.12	**0.10**	**120**	0.66	0.65	**1.53**
pH	NMA	NMA	**NMA**	**NMA**	7.78	7.76	**0.26**
Sulfate	0	52	**50**	**104**	9600	9400	**2.11**
TDS	NMA	NMA	**NMA**	**NMA**	5620	5560	**1.07**

NMA=Data not applicable to Method.
NC=Not calculated due to results less than the detection limit.

Green Analytical Laboratories

WET CHEM SRM AND BLANK DATA

LAB ID#						
811-115	SRM Data				Blank Data	
PARAMETER	SRM Result	True Value	SRM % Rec	Acceptance Range	Blank Result	Reporting Limit
Alkalinity	186	179	**104**	90-110 %	<10	10
Chloride	23	20.9	**110**	90-110 %	<10	10
EC *	NA	NA	**NA**	90-110 %	NMA	NMA
Fluoride	1.0	1.0	**100**	90-110 %	<1.0	1.0
Nitrate/Nitrite	0.52	0.50	**104**	90-110 %	<0.02	0.02
pH	7.37	7.40	**100**	90-110 %	NMA	NMA
Sulfate	345	321	**107**	90-110 %	<10	10
TDS	3340	3100	**108**	90-110 %	<10	10

NMA=Data not applicable to Method.
NA=Data not available.