Incoming. C0070041

#4143

ok

APPLICATION FOR COAL PERMIT PROCESSING

Permit Change ☒ New Permit ☐ Renewal ☐ Exploration ☐ Bond Release ☐ Transfer ☐

Permittee: West Ridge Resources, Inc.

Mine: West Ridge Mine **Permit Number:** C/007/0041

Title:

Description, Include reason for application and timing required to implement:

Modification of Chapter 7 of the West Ridge Mine MRP in response to Division Order DO-12A

Instructions: If you answer yes to any of the first eight questions, this application may require Public Notice publication.

Yes	No		
☐	☒	1.	Change in the size of the Permit Area? Acres: ________ Disturbed Area: ________ ☐ increase ☐ decrease.
☒	☐	2.	Is the application submitted as a result of a Division Order? DO# DO-12A
☐	☒	3.	Does the application include operations outside a previously identified Cumulative Hydrologic Impact Area?
☐	☒	4.	Does the application include operations in hydrologic basins other than as currently approved?
☐	☒	5.	Does the application result from cancellation, reduction or increase of insurance or reclamation bond?
☐	☒	6.	Does the application require or include public notice publication?
☐	☒	7.	Does the application require or include ownership, control, right-of-entry, or compliance information?
☐	☒	8.	Is proposed activity within 100 feet of a public road or cemetery or 300 feet of an occupied dwelling?
☐	☒	9.	Is the application submitted as a result of a Violation? NOV #
☐	☒	10.	Is the application submitted as a result of other laws or regulations or policies? *Explain:*
☐	☒	11.	Does the application affect the surface landowner or change the post mining land use?
☐	☒	12.	Does the application require or include underground design or mine sequence and timing? (Modification of R2P2)
☒	☐	13.	Does the application require or include collection and reporting of any baseline information?
☐	☒	14.	Could the application have any effect on wildlife or vegetation outside the current disturbed area?
☐	☒	15.	Does the application require or include soil removal, storage or placement?
☐	☒	16.	Does the application require or include vegetation monitoring, removal or revegetation activities?
☐	☒	17.	Does the application require or include construction, modification, or removal of surface facilities?
☐	☒	18.	Does the application require or include water monitoring, sediment or drainage control measures?
☐	☒	19.	Does the application require or include certified designs, maps or calculation?
☐	☒	20.	Does the application require or include subsidence control or monitoring?
☐	☒	21.	Have reclamation costs for bonding been provided?
☒	☐	22.	Does the application involve a perennial stream, a stream buffer zone or discharges to a stream?
☐	☒	23.	Does the application affect permits issued by other agencies or permits issued to other entities?
☐	☒	24.	Does the application include confidential information and is it clearly marked and separated in the plan?

Please attach three (3) review copies of the application. If the mine is on or adjacent to Forest Service land please submit four (4) copies, thank you. (These numbers include a copy for the Price Field Office)

I hereby certify that I am a responsible official of the applicant and that the information contained in this application is true and correct to the best of my information and belief in all respects with the laws of Utah in reference to commitments, undertakings, and obligations, herein.

David W. Hibbs	President	07/02/12	[signature]
Print Name	Position	Date	Signature (Right-click above choose certify then have notary sign below)

Subscribed and sworn to before me this 2nd day of July, 2012

Notary Public: [signature], state of Utah.

My commission Expires: 3-27-13

Commission Number: 578211 } ss:

Address: 345 N. 700 E

City: Price State: ut Zip: 8450

LINDA KERNS
NOTARY PUBLIC • STATE of UTAH
COMMISSION # 578211
COMM. EXP. 03-27-2013

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Form DOGM- C1 (Revised December 10, 2007)

APPLICATION FOR COAL PERMIT PROCESSING
Detailed Schedule Of Changes to the Mining And Reclamation Plan

Permittee: West Ridge Resources, Inc.
Mine: West Ridge Mine **Permit Number:** C/007/0041
Title:

Provide a detailed listing of all changes to the Mining and Reclamation Plan, which is required as a result of this proposed permit application. Individually list all maps and drawings that are added, replaced, or removed from the plan. Include changes to the table of contents, section of the plan, or other information as needed to specifically locate, identify and revise the existing Mining and Reclamation Plan. Include page, section and drawing number as part of the description.

Add	Replace	Remove	DESCRIPTION OF MAP, TEXT, OR MATERIAL TO BE CHANGED
☐	☒	☐	Chapter 7 text
☒	☐	☐	Appendix 7-17 Isotopic and solute investigation of groundwater systems in the West Ridge Mi
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Any other specific or special instruction required for insertion of this proposal into the Mining and Reclamation Plan.	Received by Oil, Gas & Mining
	RECEIVED JUL 02 2012 DIV. OF OIL, GAS & MINING

PH

PETERSEN HYDROLOGIC

2 July 2012

Mr. David Hibbs
West Ridge Resources, Inc.
P.O. Box 910
East Carbon, Utah 84520

RE: Isotopic and solute chemical investigation of groundwater systems at the West Ridge Mine

David,

At your request, we have performed an investigation of groundwater systems encountered underground at the West Ridge Mine using solute chemical and stable and unstable isotopic analysis. The results of this investigation are presented in this letter report.

Introduction

The West Ridge Mine, which is operated by West Ridge Resources, Inc., is located in "C" Canyon, approximately 5 miles north of the town of East Carbon, Utah. Mining operations at the West Ridge Mine commenced in 1999. Discharge of water from the mine began in early 2003. Since that time, discharge of water from the mine has been essentially continuous.

Mayo and Associates (1998) performed an investigation of groundwater and surface-water systems in the West Ridge area in support of the initial permitting of the West Ridge Mine (included as Appendix 7-1 in the West Ridge Mine MRP). Based on previous experience in the Wasatch Plateau and Book Cliffs coal fields, Mayo and Associates projected that groundwaters that would be intercepted in the Blackhawk Formation at the future West Ridge Mine would likely be old (2,000-20,000 years) and

2695 N. 600 E. LEHI, UTAH 84043 (801) 766-4006

would occur in isolated sandstone paleochannels that are not in hydraulic communication with surface waters and near-surface groundwaters.

The purpose of this investigation is to evaluate, using solute chemical and stable and unstable isotopic compositions, the nature and likely origin of groundwaters currently being intercepted at the West Ridge Mine. Additionally, implications regarding the likely source of intercepted groundwater in the mine are discussed.

Methods of Study

On 10 October 2011 and on 13 October 2011 we visited the West Ridge Mine to collect samples of groundwater for solute geochemical and stable and unstable isotopic analysis. Samples were collected from roof drip, floor seep, longwall gob drainage, and groundwater drainage from a horizontal degasification hole. Sampling locations were selected in areas where representative water samples could be collected (many old mining areas are now sealed and inaccessible).

An additional sample was previously collected by Mayo and Associates on 24 October 2000 and analyzed for tritium and carbon-14 isotopic compositions.

Mine water samples were collected for solute chemical analysis and for unstable radiocarbon (^{14}C) and tritium (^{3}H) analysis, and for the stable isotopes deuterium ($\delta^{2}H$), oxygen-18 ($\delta^{18}O$), and carbon-13 ($\delta^{13}C$). Radiocarbon, tritium, deuterium, oxygen-18, and carbon-13 analyses were performed at the Brigham Young University Laboratory of Isotope Geochemistry of Provo, Utah. A split of the sampled water from the gob drainage site was sent to the University of Miami, Tritium Laboratory in Miami, Florida for replicate tritium analysis. Solute chemical analyses were performed by the BYU Laboratory of Isotope Geochemistry.

Discharge, isotopic, solute chemical, and other data were compiled into electronic format for analysis. Data analysis was performed using graphical and computer methods.

Solute chemical data were analyzed graphically using Stiff (1951) diagrams and using the computer code WATEQF (Plummer et al., 1976).

Mean groundwater residence times were calculated using methods described by Fontes (1979), and Pearson (1972). Input parameters used in the mean residence time calculations were assigned as follows: $\delta^{13}C$ soil gas -18 to -22 ‰, $\delta^{13}C$ mineral carbonate 0 ‰, ^{14}C soil gas 100 percent modern carbon (pmC), and ^{14}C mineral carbonate 0 pmC.

Groundwater discharge temperatures were measured using a Taylor brand digital thermometer. Specific conductance measurements were performed using an Extech brand model EC400 conductivity meter with automatic temperature compensation. The instrument was calibrated using NIST traceable conductivity standard solutions. The pH measurements were performed using an Oakton brand model pH Testr 30 with automatic temperature compensation, which was calibrated using NIST traceable pH standard solutions.

Mine discharge rate and chemical information for mine waters were downloaded from the Utah Division of Oil, Gas and Mining on-line Coal Mine Water Quality Database available at http://linux1.ogm.utah.gov/cgi-bin/appx-ogm.cgi.

Presentation of Data

The locations of the in-mine sampling points are shown on Figure 1. Stiff (1951) diagrams depicting solute chemical compositions are shown on Figure 2. Cross-sections showing spatial relationships at the West Ridge Mine area are shown in Figures 3a and 3b. Additional relevant maps and geologic cross-sections are available in the Mayo and Associates (1998) report (Appendix 7-1 of the West Ridge Mine MRP). The results of the laboratory solute chemical analyses are presented in Table 1. Groundwater mineral saturation indices are presented in Table 2. The results of the stable and unstable isotopic analyses are presented in Table 3. Calculated groundwater mean residence times are presented in Table 4. Isotopic and solute laboratory reporting sheets are included in the Appendix.

Sample locations

Groundwater samples from four locations in the West Ridge Mine were collected for stable and unstable isotopic analysis and for solute geochemical analysis during October 2011. Samples were collected at a roof drip location, a floor seep location, a horizontal borehole, and from drainage from a longwall gob area. The roof drip sample (Back Bleeder XC 60.5 Entry 1 roof drip) is located in the northwestern portion of the mine in the bleeder entries of longwall panel #17, which was mined from April through September of 2011. The roof drip discharged slowly at less than 1 gpm. The floor seep sample was collected at essentially the same location in the mine as the roof drip (within about 100 feet) at a location where groundwater upwelled from the mine floor. The flow rate from the floor seep was estimated at approximately 1 gpm. The longwall gob drainage sample was collected from the gateroad entries adjacent to the mined-out longwall Panel #17. The sample was collected where an appreciable quantity of water (estimated at 250 gpm) flowed out from the gob area into the gateroad entry. The horizontal borehole sample was collected from a cased and perforated 8-inch degasification borehole which extends approximately 3,000 feet laterally into the coal seam. Water drained slowly from the well's water trap at less than 1 gpm.

An additional sample was collected for tritium and radiocarbon analysis in October 2000 by Mayo and Associates. This sample (Main Dips Belt XC 21) was collected from a series of roof drips in the main entries approximately 21 cross-cut entries in-by the mine portals. The total discharge from the roof drips was estimated at 4 gpm. The Main Dips Belt XC 21 sample was analyzed for radiocarbon and tritium only.

Solute chemistry

Chemical compositions of sampled West Ridge Mine groundwaters are presented in Table 1. The TDS concentrations of the mine groundwaters range from 764 to 1,431 mg/L. As depicted on the Stiff diagrams on Figure 2, there is considerable variability in the solute chemical type of the sampled groundwaters. Stiff diagrams are a useful analytical tool in evaluating the geochemical compositions of groundwaters and surface-waters. The solute composition (chemical type) of the water is represented by the shape of the diagram. The size of the Stiff diagram is a function of the total dissolved solids (TDS) concentration. The West Ridge Mine roof drip sample (Back Bleeder XC 60.5 Entry 1 Roof Drip) is of the sodium bicarbonate chemical type, with appreciable concentrations of magnesium, calcium, and sulfate and a TDS concentration of 764 mg/L. The floor seep at essentially the same location in the mine (Back Bleeder XC 60.5 Entry 2 floor seep) is of the magnesium sulfate chemical type with appreciable concentrations of calcium and bicarbonate. The floor seep had a TDS concentration of 1,431 mg/L, which is almost twice that of the adjacent roof drip. The longwall gob drainage water (Panel 17 Horizontal Borehole) is of the sodium bicarbonate chemical type with a TDS concentration of 813 mg/L. The horizontal borehole sample is of the sodium-sulfate-bicarbonate chemical type with a TDS concentration of 885 mg/L.

Mineral saturation indices for the West Ridge Mine groundwaters indicate that all of the four waters sampled during 2011 are supersaturated with respect to both calcite and dolomite (Table 2). This indicates that the waters have the thermodynamic tendency to precipitate these minerals. The waters are all undersaturated with respect to gypsum, which indicates the thermodynamic tendency of these waters to dissolve additional gypsum if the water encounters this mineral.

Unstable Isotopic Compositions

Radiocarbon and tritium isotopic information is useful for determining groundwater mean residence times. However, it is important to note that groundwater arriving at groundwater discharge points (i.e. springs or wells) rarely travels via pure piston flow. Rather, it is not uncommon for groundwater molecules discharging at springs or wells to have migrated to the discharge point from several different locations, each having recharged at different times. Consequently, the term "mean groundwater residence time", which is the average age of all of the water molecules sampled, is commonly used when evaluating the age of groundwater.

In this investigation, both tritium and radiocarbon (^{14}C) have been used to estimate the mean residence time of groundwaters. Tritium is used here primarily as a qualitative tool, indicating whether a groundwater has a component of water that recharged since about 1954. The presence of tritium in a groundwater, which has a half-life of about 12.3 years, is indicative of water that has recharged in about the past 50 years. The radiocarbon (^{14}C) content of a groundwater is used to calculate the number of years that have elapsed since the groundwater became isolated from soil-zone gasses and near-surface groundwaters. Groundwaters with radiocarbon activities greater than about 50 pmc in carbonate-rich terrains are usually indicative of modern groundwater. Groundwaters with radiocarbon activities significantly greater than about 50 pmC indicate the presence of anthropogenic carbon commonly associated atmospheric weapons testing, also suggesting modern origin.

Radiocarbon (^{14}C)

As shown on Table 4, the measured ^{14}C contents of the sampled West Ridge Mine groundwaters range from 2.28 to 10.52 pmC (percent modern carbon). Radiocarbon ages have been calculated for three of the five West Ridge Mine samples. (A radiocarbon age could not be calculated for the 15th West XC 32 Entry 2 Gob Drainage sample or for the Main Dips Belt XC 21 sample due to uncertainties in the characterization of the carbon histories of these waters based on the positive carbon-13 compositions). The radiocarbon ages of the three samples range from about 10,000 to 23,000 years (Table 4), which is indicative of paleo-recharge to the West Ridge Mine groundwater systems.

Tritium (^3H)

The measured tritium contents of the sampled West Ridge Mine groundwaters are presented in Table 3. Tritium concentrations of each of the five sampled West Ridge Mine groundwaters are very low (near the lower laboratory detection limit). The absence of tritium in these groundwaters indicates that the waters have been isolated from the surface or shallow groundwater systems for at least the past 50 years (Clark and Fritz, 1997).

Discussion

The carbon-14 and tritium contents of the groundwaters sampled at the West Ridge Mine demonstrate a lack of good hydraulic communication between the deep, ancient groundwater systems encountered in the mine workings and the overlying shallow recharge sources. The isotopic compositions of the West Ridge Mine groundwaters are consistent with the projection of Mayo and Associates (1998) that the Blackhawk Formation waters encountered in the mine would be very old and not in good hydraulic communication with surface waters and near-surface waters. This conclusion is not unanticipated based on 1) the very large thickness of overburden that separates the mined coal seam from the land surface and near-surface, shallow groundwater systems, and 2) the heterogeneous character of the rock strata, which include thick sequences of discontinuous, lenticular permeable strata encased in low-permeability shales, mudstones, and claystones, which greatly inhibit the potential for appreciable vertical and horizontal groundwater flow.

Seasonal variation is not apparent in the mine discharge rate data (Figure 4). Seasonal variability in the rates of individual groundwater inflows have not been observed at the West Ridge Mine (Personal communication, Dave Shaver, 2011).

Solute data indicate considerable spatial variability in chemical type and TDS concentrations of the West Ridge Mine groundwaters (see Figure 2 and Table 1). The observed chemical variability is not indicative of a continuous, regional aquifer. Rather, the observed chemical variability is suggestive of individual, isolated groundwater partitions that are not in strong hydrodynamic communication with adjacent partitions. It is particularly noteworthy that the roof drip sample (Back Bleeder Entry 1 roof drip) and the adjacent floor seep water (Back Bleeder Entry 2 floor seep) are of markedly different chemical compositions, even though the two sampling locations are only a few tens of feet apart horizontally. The roof drip water at this location has a TDS concentration that is about half that of the underlying floor seep water. This strongly suggests that the groundwater system overlying the coal seam is not in good hydrodynamic communication with the groundwater system underlying the coal seam. Such partitioning of groundwater systems is consistent with the findings of Mayo and Associates (1998).

Likely Source of Intercepted Groundwaters

The very old carbon-14 ages and the lack of tritium in the groundwaters encountered in the West Ridge Mine indicate that active recharge from near-surface sources or hydraulic communication with shallow, tritiated groundwater systems is not occurring. Rather, the old ages of the intercepted groundwater and the lack of tritium suggest the likelihood that the waters intercepted in the West Ridge Mine are being removed from storage in the deep, inactive-zone groundwaters systems that occur in the rock strata adjacent to the mine openings (Mayo and others, 2003).

It is noteworthy that the mine discharge rate has increased substantially over time since discharge first occurred from the mine in 2003 (Figure 4). This condition is likely attributable in large part to the fact that the rate of mining in recent years has greatly exceeded the mining rate in the first years of mining. Mining rates have increased substantially since 2009. West Ridge Mine personnel indicate that the total mining area opened during the period from 2009 to 2012 is significantly greater than that opened during the previous 8-year period from 1999-2007 (Personal Communication, David Hibbs, 2012). When mine openings intersect isolated, water-bearing geologic units with water held in storage, the rate at which such units are intersected and drained will largely control the rate at which the groundwater enters the mine workings. Thus, it is not unanticipated that the mine groundwater interception and mine water discharge rates would increase substantially as the mining rates, particularly the rates at which new mining districts are opened, increase.

West Ridge Mine personnel indicate that relatively little water was encountered in the mine workings when mining near the outcrop occurred during the early years of mining activities. The water that was encountered was predominantly sourced from the mine roof in these areas (Personal communication, Gary Gray, 2012). As mining progressed down-dip under deeper cover, increased amounts of water began to be intercepted. Much of this water originated from upwelling from the mine floor. It seems likely that the floor water is derived largely from the underlying Sunnyside Sandstone member of the Blackhawk Formation which directly underlies the mined Lower Sunnyside Coal Seam at the West Ridge Mine.

The specific water-bearing stratums that yield water to the mine workings are not known. This is largely due to the fact that most of the water intercepted in the West Ridge Mine drains from mined-out longwall gob areas (Personal communication, Dave Shaver, 2011). Because these areas are completely inaccessible to personnel, it is not possible to identify the specific origins of the water entering the mine gob areas after mining. However, in the general sense, it has been observed that groundwater enters the mine workings through 1) sandstone paleochannels in the mine roof, 2) upwelling of groundwater from the mine floor, and 3) along fault and fracture damage zones. It is likely that the bedrock fracturing associated with the longwall mining process enhances the permeability of water bearing strata adjacent to the mine openings through which groundwater enters the gob areas. The removal of the coal resource (which in most locations is largely impermeable) may also facilitate the inflow of groundwaters from overlying or underlying water-bearing strata.

While the exact source(s) of the intercepted mine waters are not known, it seems plausible that a major beach-barrier bar sandstone deposits within the Blackhawk Formation (such as the Sunnyside Member) could potentially contribute to the volume of water intercepted by the mine workings. The mined coal seam (the Lower Sunnyside Coal Seam) lies directly above the Sunnyside Sandstone Member. The Sunnyside Member is predominantly sandstone and is approximately 100 to 190 feet thick in the mine area (Mayo and Associates, 1998) which gives it a large potential groundwater storage volume. Additionally, large channel sandstone deposits are present in the upper unnamed member of the Blackhawk Formation, which is a shallow marine foreshore deposit that directly overlies the Lower Sunnyside Coal Seam. Appreciable groundwater storage volumes are potentially present in these channel sandstones. Other water-bearing sandstone units intersected by mining-induced fractures in the overburden geologic sequence could also potentially contribute water to the West Ridge Mine workings. As indicated previously, the carbon-14 and tritium data indicate that groundwater from the shallow, near-surface systems that support most springs in the area is not in good hydraulic communication with the deep, inactive-zone groundwaters encountered in the underground mine workings at the West Ridge Mine. Accordingly, it is considered exceedingly unlikely that shallow, active-zone groundwater systems that support springs and seeps in the area, or provide baseflow discharge to streams could be the source of the groundwater intercepted in the West Ridge Mine.

It should be noted that fault- and fracture-related groundwater inflows have been observed in the West Ridge Mine. As evidenced by the old carbon-14 dates and the absence of tritium in groundwaters encountered in the West Ridge Mine, it is evident that hydrodynamic communication with overlying active-zone groundwater systems has not been established through these faults or fractures. It is considered likely that the fault and fracture systems in the mine area provide pathways of enhanced secondary porosity which interconnect the mine openings with nearby, adjacent water-bearing strata. The abundant presence of soft shales, mudstones, and claystones, and the presence of hydrophyllic swelling clays in the rock strata likely limit the potential for fracture planes to remain open within these strata, particularly under the considerable confining pressures associated with the very thick overburden present at the West Ridge Mine.

References Cited

Clark, I.D., and Fritz, P., 1997, Environmental isotopes in Hydrogeology, CRC Press, LLC, Boca Raton, Florida, 328 p.

Fontes, J.C., and Garnier, J.M., 1979, Determination of the initial ^{14}C activity of the total dissolved carbon: A review of existing models and a new approach: Water Resources Research, v. 15, p. 399-413.

Mayo, A.L., Thomas, H.M., Peltier, S., Petersen, E.C., Payne, K., Holman, L.S., Tingey, D., Fogel, T., Black, B.J., Gibbs, T.D., 2003, Active and inactive groundwater flow systems: Evidence from a stratified, mountainous terrain, Geological Society of America Bulletin, V. 115; no. 12; p. 1456-1472.

Mayo and Associates, 1998, Investigation of surface-water and groundwater systems in the West Ridge area, Carbon County, Utah, consulting report for West Ridge Resources, Inc., Price, Utah.

Pearson, F.J., Jr., Bedinger, M.S., and Jones, B.F., 1972, Carbon-14 dates of water from Arkansas Hot springs, in Proceeding of eighth international conference on radiocarbon dating: Wellington, Royal Society of New Zealand, v. 1. P. 330-247.

Please feel free to contact me should you have any questions in this regard.

Sincerely,

Erik C. Petersen, P.G.
Principal Hydrogeologist
Utah PG #5373615-2250

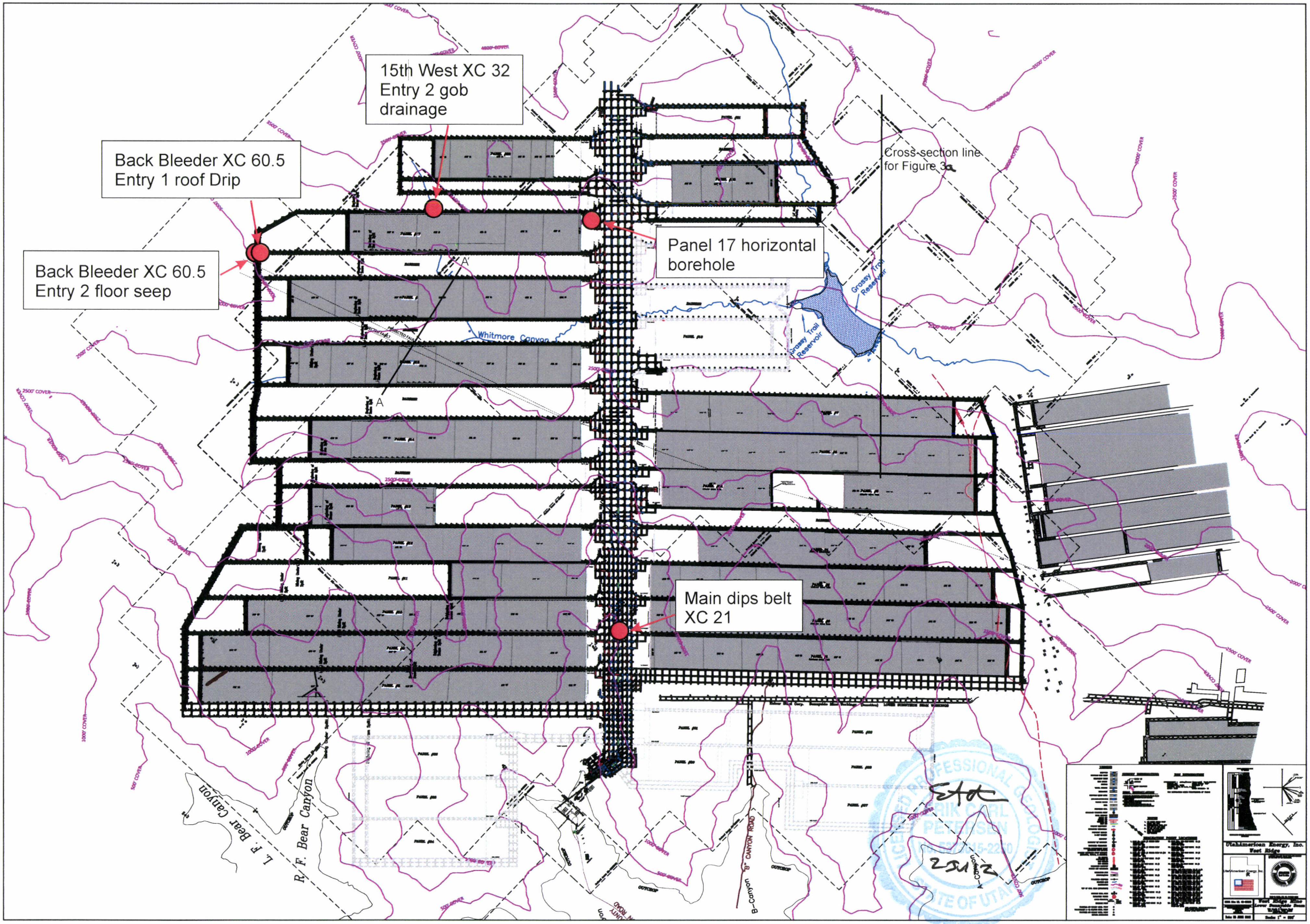

Figure 1 West Ridge Mine workings and groundwater sampling locations.

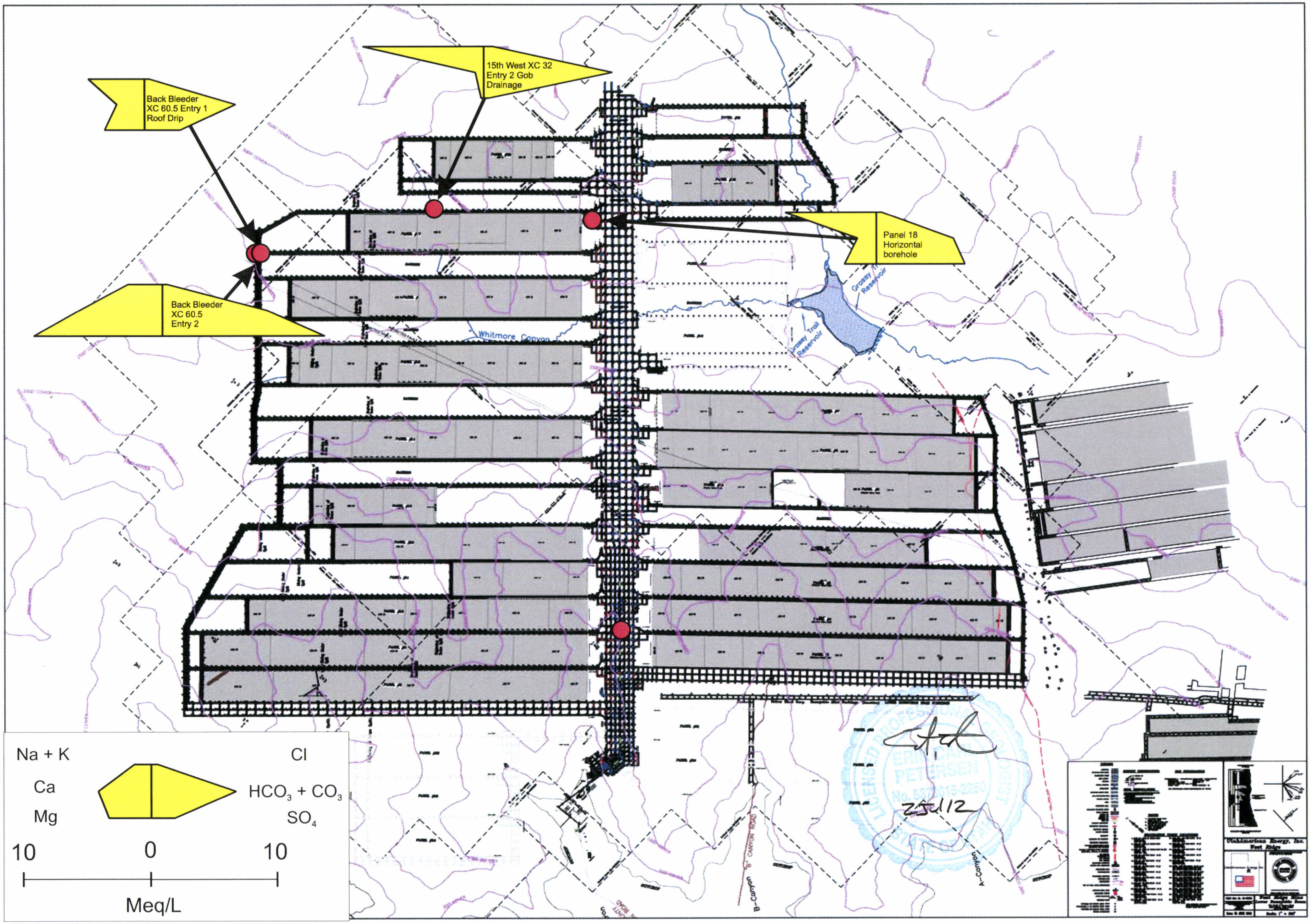

Figure 2 Stiff diagrams for West Ridge Mine groundwaters.

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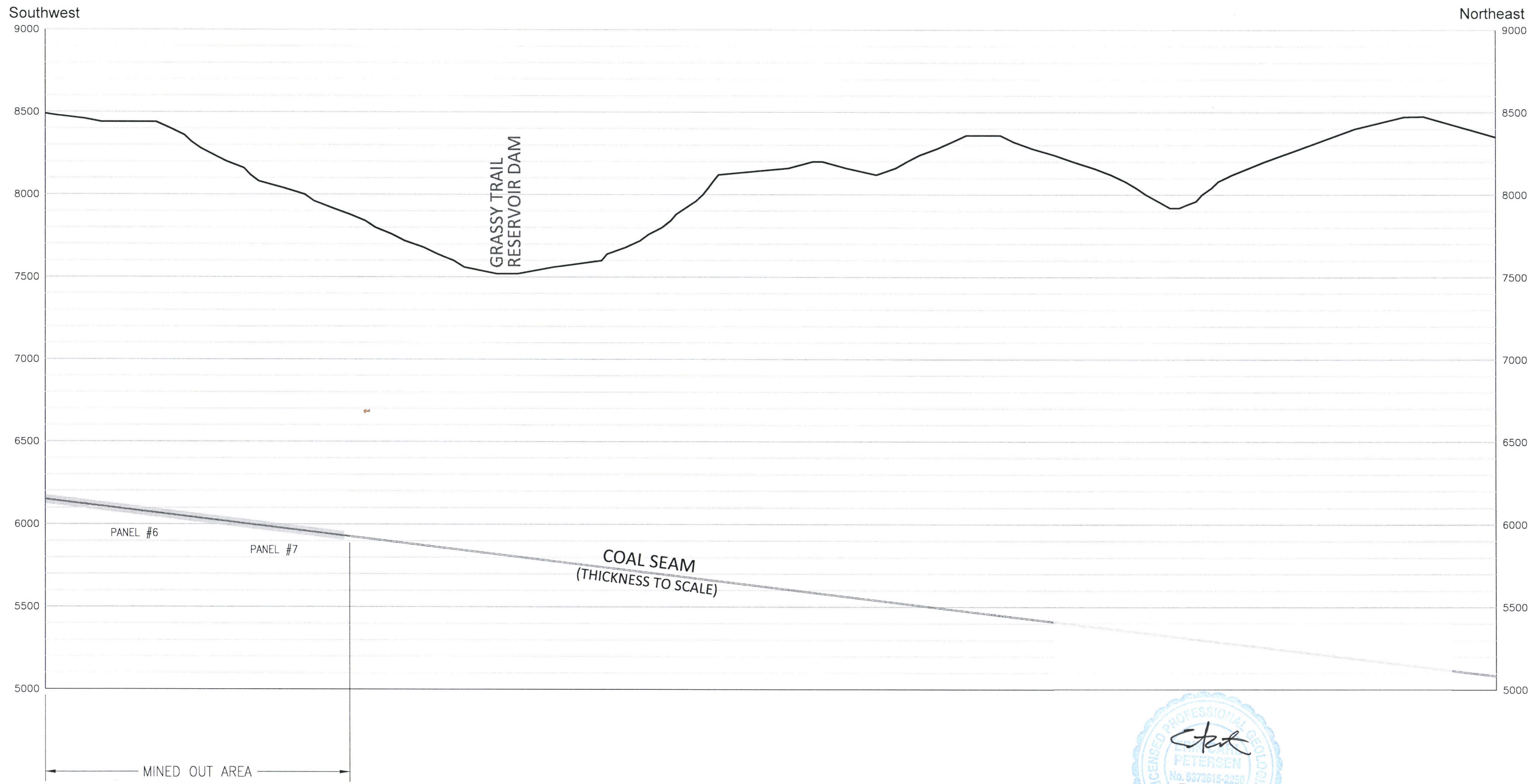


Figure 3a Cross-section showing coal seam thickness and overburden in West Ridge Mine area.

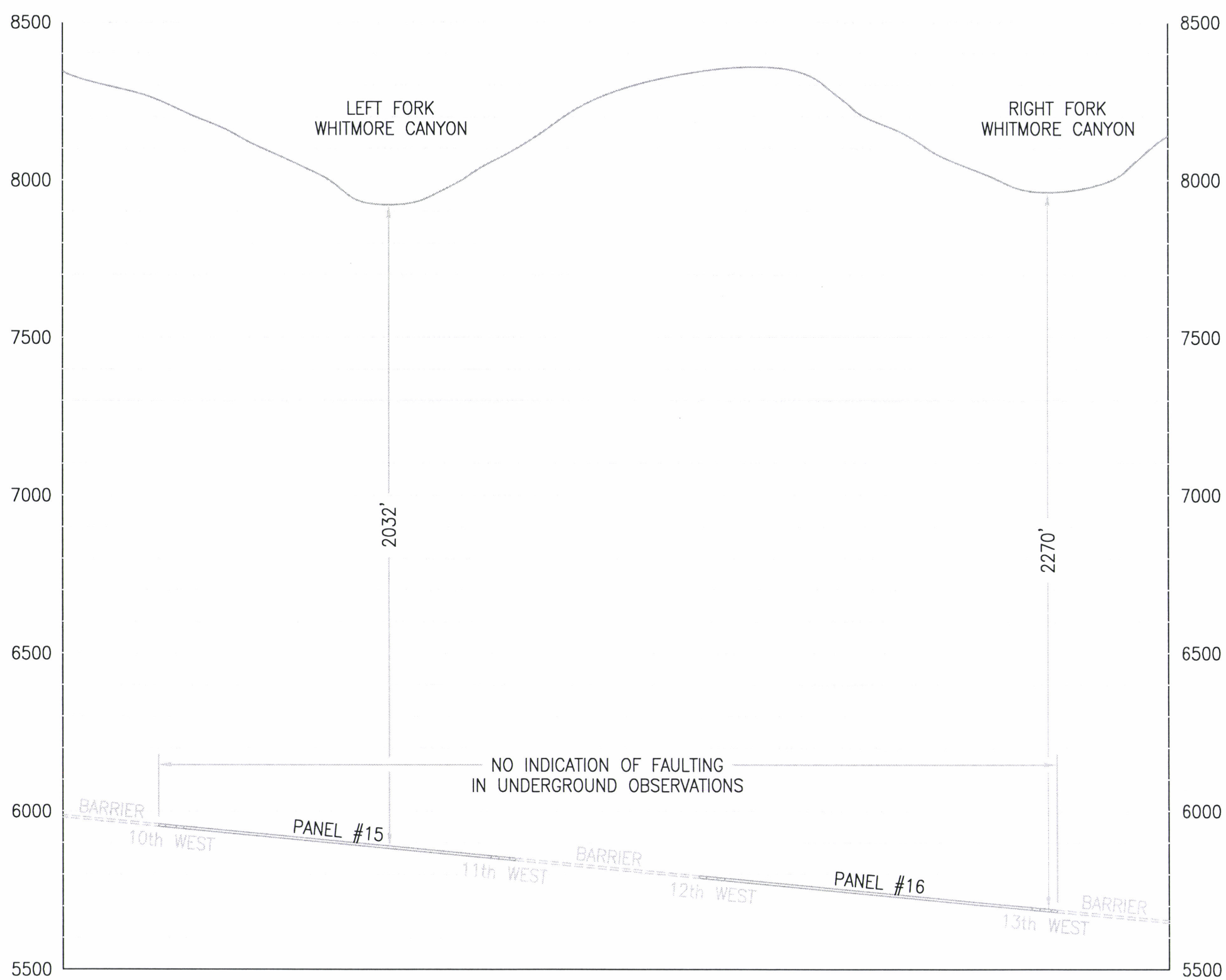
GRASSY TRAIL DAM/ WEST RIDGE MINE CROSS-SECTION

WEST RIDGE RESOURCES, INC.

794 NORTH "C" CANYON ROAD
EAST CARBON, UTAH 84520

MSHA MINE ID # 42-02233

DRAWN BY	PJ	SCALE	1" = 600'
APPROVED BY	DH	DATE	28 JUNE 2012
REVISION	2	SHEET	PLATE #1 of 1



SECTION A-A'

Figure 3b Cross-section showing coal seam thickness and overburden in the West Ridge Mine area.

LICENSED PROFESSIONAL GEOLOGIST
ERIK CARL PETERSEN
No. 5373615-2250
STATE OF UTAH
2-5-12

SOUTH-TO-NORTH SECTION	
WEST RIDGE RESOURCES, INC	
794 NORTH "C" CANYON ROAD EAST CARBON, UTAH 84520	
MSHA MINE ID # 42-02233	
DRAWN BY PJ	SCALE NONE
APPROVED BY DH	DATE 2 JULY 2012
SHEET	PLATE #1 of 1

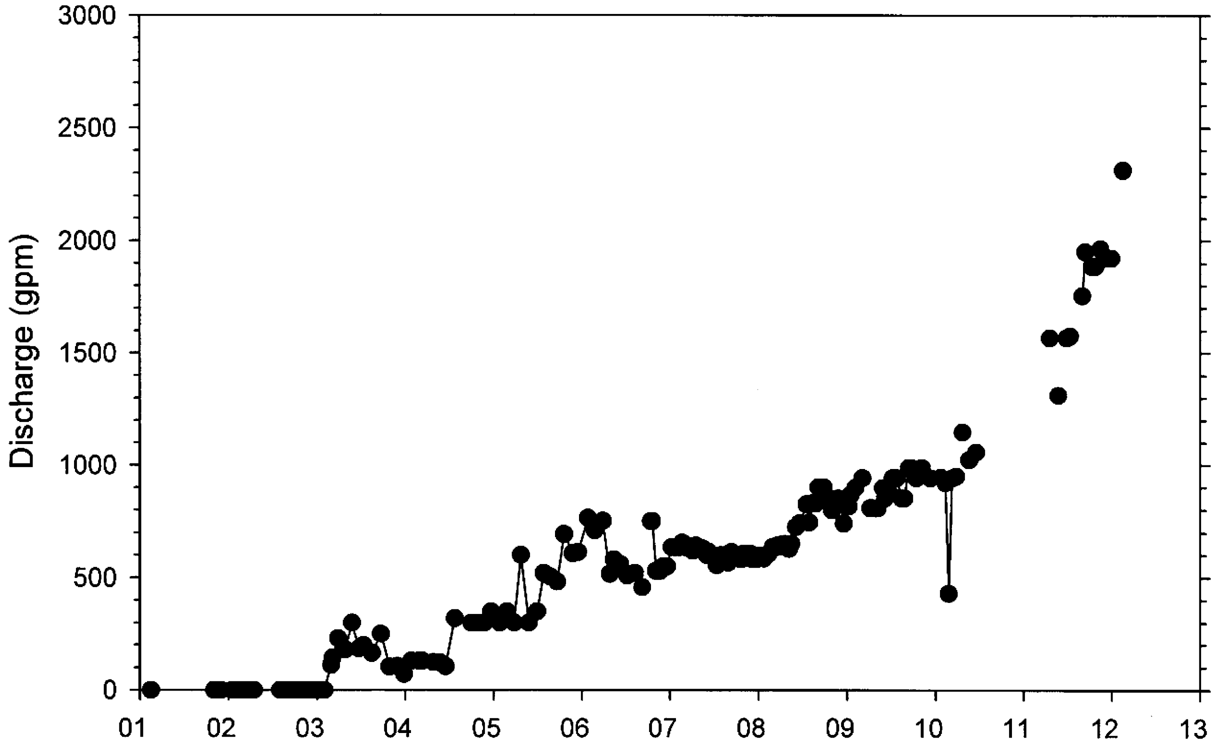


Figure 4 Plot of discharge from the West Ridge Mine (UPDES 002).

Table 1 Chemical compositions of groundwaters sampled in the West Ridge Mine.

	Sample Date	Q (gpm)	T (°C)	pH (S.U.)	Sp. Cond. (µS/cm)	TDS (mg/L)	Ca^{2+} (mg/L)	Mg^{2+} (mg/L)	Na^{+} (mg/L)	K^{+} (mg/L)	HCO_3^- (mg/L)	SO_4^{2-} (mg/L)	Cl^- (mg/L)	F^- (mg/L)	NO_3^- (mg/L)	Br^- (mg/L)	HPO_4^{2-} (mg/L)	Cations (meq/L)	Anions (meq/L)	Error (%)
Back Bleeder XC 60.5 Entry 1 Roof Drip	10-Oct-11	<1	21.1	8.34	890	764	42.85	37.34	88.34	20.06	429.7	130.62	13.24	0.94	1.11	<0.01	<0.01	9.56	10.20	-3.2
Back Bleeder XC 60.5 Entry 2 floor seep	10-Oct-11	1	25.3	7.24	1545	1431	127.9	120.4	44.41	27.61	493.0	602.68	14.21	0.43	<0.01	<0.01	<0.01	18.93	21.05	-5.3
Panel 17 Horizontal Borehole	10-Oct-11	<1	24.5	7.83	1022	813	28.8	29.67	133,9	46.61	361.9	328.12	15.22	0.87	1.47	<0.01	<0.01	12.33	13.26	-3.6
15th West XC 32 Entry 2 Gob Drainage	13-Oct-11	250	25.9	8.03	1244	885	13.2	2.59	206.2	14.80	603.9	16.17	25.1	2.83	<0.01	0.21	<0.01	10.22	11.10	-4.1

Note: The values for total dissolves solids presented above are a calculated summation of the analyzed dissolved species.

Table 2 Mineral saturation indices for groundwaters sampled at the West Ridge Mine.

	Sampling date	$SI_{calcite}$	$SI_{dolomite}$	SI_{gypsum}
Back Bleeder XC 60.5 Entry 1 Roof Drip	10-Oct-11	0.962	2.182	-1.767
Back Bleeder XC 60.5 Entry 2 floor seep	10-Oct-11	0.333	1.011	-0.881
Panel 17 Horizontal Borehole	10-Oct-11	0.217	0.807	-1.595
15th West XC 32 Entry 2 Gob Drainage	13-Oct-11	0.409	0.482	-3.107

Table 3 Isotopic compositions of groundwaters sampled at the West Ridge Mine.

	Sampling date	Deuterium (δ^2H_{VSMOW}) (‰)	Oxygen-18 ($\delta^{18}O_{VSMOW}$) (‰)	Carbon-13 ($\delta^{13}C$) (‰)	Carbon-14 (^{14}C) (pmC)	Tritium (^3H) (TU)
Back Bleeder XC 60.5 Entry 1 Roof Drip	10-Oct-11	-116.20	-15.34	-7.41	8.54	0.10
Back Bleeder XC 60.5 Entry 2 floor seep	10-Oct-11	-117.00	-15.57	-9.61	3.32	0.10
Panel 17 Horizontal Borehole	10-Oct-11	-112.50	-15.26	-7.99	10.52	0.20
15th West XC 32 Entry 2 Gob Drainage	13-Oct-11	-116.00	-15.47	+11.1	2.46	0.02
Main Dips belt XC21	24-Oct-00	---	---	+6.3	2.28	0.17

Note: Reported ^3H analysis for 15th West XC 32 Entry 2 Gob Drainage is a rerun on a duplicate split analyzed by University of Miami Tritium Laboratory

Table 4 Radiocarbon "age" calculations for West Ridge Mine groundwaters.

Back Bleeder XC 60.5 Entry 1 Roof Drip

	$\delta^{13}C_{(soil\ gas)}$ = -18 ‰	$\delta^{13}C_{(soil\ gas)}$ = -20 ‰	$\delta^{13}C_{(soil\ gas)}$ = -22 ‰	
Fontes model	14,700	14,700	14,700	radiocarbon years
Pearson model	13,000	12,130	11,340	radiocarbon years

Back Bleeder XC 60.5 Entry 2 floor seep

	$\delta^{13}C_{(soil\ gas)}$ = -18 ‰	$\delta^{13}C_{(soil\ gas)}$ = -20 ‰	$\delta^{13}C_{(soil\ gas)}$ = -22 ‰	
Fontes model	23,300	23,300	23,300	radiocarbon years
Pearson model	23,000	22,100	21,300	radiocarbon years

Panel 17 Horizontal Borehole

	$\delta^{13}C_{(soil\ gas)}$ = -18 ‰	$\delta^{13}C_{(soil\ gas)}$ = -20 ‰	$\delta^{13}C_{(soil\ gas)}$ = -22 ‰	
Fontes model	13,150	13,150	13,150	radiocarbon years
Pearson model	11,900	11,000	10,200	radiocarbon years

15th West XC 32 Entry 2 Gob Drainage

	$\delta^{13}C_{(soil\ gas)}$ = -18 ‰	$\delta^{13}C_{(soil\ gas)}$ = -20 ‰	$\delta^{13}C_{(soil\ gas)}$ = -22 ‰	
Fontes model	---	---	---	radiocarbon years
Pearson model	---	---	---	radiocarbon years

Main Dips Belt XC 21

	$\delta^{13}C_{(soil\ gas)}$ = -18 ‰	$\delta^{13}C_{(soil\ gas)}$ = -20 ‰	$\delta^{13}C_{(soil\ gas)}$ = -22 ‰	
Fontes model	---	---	---	radiocarbon years
Pearson model	---	---	---	radiocarbon years

Input parameters used in all calculations: $\delta^{13}C_{(mineral\ carbonate)}$ = 0 ‰
$^{14}C_{(soil\ gas)}$ = 100 pmC
$^{14}C_{(mineral)}$ = 0 pmC

Appendix

Laboratory Reporting Sheets

UNIVERSITY OF MIAMI
ROSENSTIEL
SCHOOL of MARINE &
ATMOSPHERIC SCIENCE

Tritium Laboratory
4600 Rickenbacker Causeway
Miami, Florida 33149-1031

Ph: 305-421-4100
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E-mail: Tritium@rsmas.miami.edu

March 15, 2012

TRITIUM LABORATORY

Data Release #12-014
Job # 2970

PETERSEN HYDROLOGIC
TRITIUM SAMPLES

James Happell

Digitally signed by James Happell
DN: cn=James Happell, o=Univ. of Miami, ou=RSMAS, email=jhappell@rsmas.miami.edu, c=US
Date: 2012.03.15 10:42:21 -04'00'

Dr. James D. Happell
Associate Research Professor

Distribution:
Erik C. Petersen
Petersen Hydrologic
2695 N. 600 E.
Lehi, UT 84043

GENERAL COMMENTS ON TRITIUM RESULTS

Tritium Scale New Half-life

Tritium concentrations are expressed in TU, where 1 TU indicates a T/H abundance ratio of 10^{-18}. The values refer to the tritium scale recommended by U.S. National Institute of Science and Technology (NIST, formerly NBS), and International Atomic Energy Agency (IAEA). The TU-numbers are based on the NIST tritium water standard #4926E. Age corrections and conversions are made using the recommended half-life of **12.32 years**, i.e., a decay rate of $\lambda = 5.626\%\ year^{-1}$. In this scale, 1 TU is equivalent to 7.151 dpm/kg H_2O, or 3.222 pCi/kg H_2O, or 0.1192 Bq/kg H_2O (Bq = disint/sec).

TU values are calculated for date of sample collection, REFDATE in the table, as provided by the submitter. If no such date is available, date of sample arrival at our laboratory is used.

The stated errors, eTU, are one standard deviation (1 sigma) including all conceivable contributions. In the table, QUANT is quantity of sample received, and ELYS is the amount of water taken for electrolytic enrichment. DIR means direct run (no enrichment).

Remark: From 1 Jan 1994 through 31 Dec 2001 we used the previously recommended value for the half-life, 12.43 years. The use of the new number, 12.32 years will in practice increase the reported TU-values by 0.9 %. This is insignificant since our reported values carry 1 sigma uncertainties of 3 % or more.

It is interesting to note that before 1994 we used the older, then recommended value of 12.26 years.

Very low tritium values

In some cases, negative TU values are listed. Such numbers can occur because the net tritium count rate is, in principle the difference between the count rate of the sample and that of a tritium-free sample (background count or blank sample). Given a set of "unknown" samples with no tritium, the distribution of net results should become symmetrical around 0 TU. The negative values are reported as such for the benefit of allowing the user unbiased statistical treatment of sets of the data. For other applications, 0 TU should be used.

Additional information

Refer to Services Rendered (Tritium), Section II.8, in the "Tritium Laboratory Price Schedule; Procedures and Standards; Advice on Sampling", and our Web-site www.rsmas.edu/groups/tritium.

Tritium efficiencies and background values are somewhat different in each of the nine counters and values are corrected for cosmic intensity, gas pressure and other parameters. For tritium, the efficiency is typically 1.00 cpm per 100 TU (direct counting). At 50× enrichment, the efficiency is equivalent to 1.00 cpm per 2.4 TU. The background is typically 0.3 cpm, known to about ± 0.02 cpm. Our reported results include not only the Poisson statistics, but also other experimental uncertainties such as enrichment error, etc.

End

Client: PETERSEN HYDROLOGIC
Recvd : 12/01/24
Job# : 2970
Final : 12/03/09

Purchase Order: Bill to: Erik Petersen
Contact: E. Petersen, 801/766-4006
2695 N. 600 E.
Lehi, UT 84043

West Ridge Sample

Cust	LABEL INFO	JOB.SX	REFDATE	QUANT	ELYS	TU	eTU
15	WEST XC32 E2 GOB DRAINAGE	2970.01	111013	1000	275	0.02	0.09

BYU *Laboratory of Isotope Geochemistry*
Department of Geological Sciences
BYU campus, Provo, Utah 84602
phone: (801) 422-3918

Client: Petersen Hydrologic, LLC
2695 N. 600 E.
Lehi, UT 84043

Reporting Date: 7-Jan-2012

Project: West Ridge
Snell & Wilmer, LLP

Tritium Analysis

Sample ID	BYU ID	Sample Date	^3H (TU)	+/- 1 σ	Sample Preparation
Back Bleeder XC 60.5 Entry 1 Roof Drip	9283	10-Oct-2011	0.1	0.1	Enriched
Back Bleeder XC 60.5 Entry 2	9284	10-Oct-2011	0.1	0.1	Enriched
Panel 17 Horizontal Borehole	9285	10-Oct-2011	0.2	0.1	Enriched
15th West XC 32 Entry 2 Gob Drainage	9286	13-Oct-2011	0.9	0.1	Enriched
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

NOTES:

Standardization was done using NIST Radioactivity Standard Reference Material SRM 436 1C Hydrogen-3.
Pretreatment:

David G. Tingey
Research Professor

GEOCHRON LABORATORIES
a division of Krueger Enterprises, Inc.

711 Concord Avenue ✦ Cambridge, Massachusetts 02138-1002 ✦ USA
t (617) 876-3691 *f* (617) 661-0148 www.geochronlabs.com

RADIOCARBON AGE DETERMINATION — REPORT OF ANALYTICAL WORK

Our Sample No.	**GX-27525**	Date Received:	12/19/2000
Your Reference:	West Ridge sample	Date Reported:	12/29/2000

Submitted by: Mr. Erik C. Petersen
Mayo & Associates, Inc.
710 East 100 North
Lindon, Utah 84042

Sample Name: **Main Dips Belt XC21 24 October 2000**

AGE = **2.28 ± 0.82 % of the modern (1950) ^{14}C years activity.**

Description: Sample of groundwater precipitate.

Pretreatment: The barium salt precipitate was rapidly vacuum filtered and immediately hydrolyzed, under vacuum, to recover carbon dioxide from the barium carbonates for the analysis. ^{13}C analysis was made from a small portion of the same evolved gas.

Comments:

$\delta^{13}C_{PDB}$ = **+ 6.3 ‰**

Notes: This date is based upon the Libby half life (5570 years) for ^{14}C. The error is +/- 1 s as judged by the analytical data alone. Our modern standard is 95% of the activity of N.B.S. Oxalic Acid.

The age is referenced to the year A.D. 1950.

UNIVERSITY OF
Miami
THE ROSENSTIEL SCHOOL

December 14, 2000

TRITIUM LABORATORY

Data Release #00-143
Job # 1409

MAYO & ASSOCIATES
TRITIUM SAMPLES

Dr. James D. Happell
Assistant Research Professor

Distribution:
Eric Petersen
Mayo & Associates
710 East 100 North
Lindon, UT 84042

Rosenstiel School of Marine and Atmospheric Science
Tritium Laboratory
4600 Rickenbacker Causeway
Miami, Florida 33149-1098
Phone: (305) 361-4100
Fax: (305) 361-4112

Revised 12 September 1995

GENERAL COMMENTS ON TRITIUM RESULTS

Tritium Scale (New)

Tritium concentrations are expressed in TU, where 1 TU indicates a T/H ratio of 10^{-18}. The values refer to the new tritium scale of U.S. National Institute of Science and Technology (formerly NBS), and based on their tritium water standard #4926 as measured on 1961/09/03 and again 1978/09/03, and age-corrected with the new half-life of 12.43 years, i.e., $\lambda = 5.576\%$ $year^{-1}$. In this scale, 1 TU is 7.088 dpm/kg H_2O, or 3.193 pCi/kg H_2O, or 0.1181 Bq/kg H_2O (Bq = disint/sec). TU values are calculated for date of sample collection, REFDATE in the table, as provided by the submitter. If no such date is available, date of sample arrival at our laboratory is used. The stated errors, eTU, are one standard deviation (1 sigma) including all conceivable contributions. In the table, QUANT is quantity of sample received, and ELYS is the amount of water taken for electrolytic enrichment. DIR means direct run (no enrichment).

Through 31 December 1993, we reported tritium values in the "old" scale using the half-life 12.26 years, i.e., $\lambda = 5.65\%$ $year^{-1}$. In that old scale, 1 TU(old) is 7.186 dpm/kg H_2O, 3.237 pCi/kg H_2O. To convert from the new scale back to the old at any given point in time, multiply the listed TU(new)-values by F, where

$$F = 0.9645 - (year-1990) \times 0.0008$$

i.e. for 1994 the factor is 0.9613. The formula is correct within 0.02% between 1962 and 1999. To convert data from the old scale to the new, divide by F.

Very low tritium values

In some cases, negative TU values are listed. Such numbers can occur because the net tritium count rate is, in principle the difference between the count rate of the sample and that of a tritium-free sample (background count or blank sample). Given a set of "unknown" samples with no tritium, the distribution of net results should become symmetrical around 0 TU. The negative values are reported as such for the benefit of allowing the user unbiased statistical treatment of sets of the data. For other applications, 0 TU should be used.

Reliability of results

Refer to Services Rendered (Tritium), Section II.8, in the "Tritium Laboratory Price Schedule; Procedures and Standards; Advice on Sampling". Tritium efficiencies and background values are different in the nine counters and values are corrected for cosmic intensity, gas pressure and other parameters. For tritium, the efficiency is typically 1.00 cpm per 100 TU (direct counting). At 50× enrichment, the efficiency is equivalent to 1.00 cpm per 2 TU. The background is about 0.3 cpm, known to about ± 0.02 cpm. Our reported results include not only the Poisson statistics, but also other experimental uncertainties such as enrichment error, etc.

References

Mann, W.B., M.P. Unterweger, and B.M. Coursey, Comments on the NBS tritiated-water standards and their use, *Int. J. Appl. Radiat. Isot.*, 33, 383-386, 1982.

Taylor, C.B., and W. Roether, A uniform scale for reporting low-level tritium measurements in water, *Int. J. Appl. Radiat. Isot.*, *33*, 377-382, 1982.

Client: MAYO and ASSOCIATES - WEST RIDGE
Recvd : 00/11/03
Job# : 1409
Final : 00/12/14

Purchase Order: 2000-
Contact: K. Payne 801/796-0211
710 E. 100 North, (F) 785-2387
Lindon, UT 84042

Cust	LABEL INFO	JOB.SX	REFDATE	QUANT	ELYS	TU	eTU
MAYO-	WEST RIDGE	1409.01	001024	1000	275	0.17*	0.09

* Average of duplicate runs

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Lehi, UT 84043

Reporting Date: 5-Feb-2012

Project: West Ridge
Snell & Willmer, LLP

Radiocarbon Age Analysis

Sample ID	BYU ID	Sample Date	^{14}C (pmc)	+/- 1 σ	$\delta^{13}C$ (‰)	+/- 1 σ
Back Bleeder XC 60.5 Entry 1 Roof Drip	9283	10-Oct-2011	8.54	0.06	-7.41	0.04
Back Bleeder XC 60.5 Entry 2	9284	10-Oct-2011	3.32	0.04	-9.61	0.04
Panel 17 Horizontal Borehole	9285	10-Oct-2011	10.52	0.06	-7.99	0.04
15th West XC 32 Entry 2 Gob Drainage	9286	13-Oct-2011	2.46	0.03	11.10	0.04
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

NOTES:

Pretreatment: Carbon was extracted from the water sample as barium carbonate precipitate. Carbon dioxide was recovered from the carbonate in a high-vacuum system for processing into benzene and isotopic analysis.

Comments: Percent modern carbon was calculated according to Stuvier, M. and Polach, HA, 1997, Discussion of ^{14}C data: Radiocarbon 19:355-63 by comparison against the activities of 4990C NBS oxalic acid and a total process blank. Based upon a Libby half life of 5568 years for ^{14}C.

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Client: Petersen Hydrologic, LLC
2695 N. 600 E.
Lehi, UT 84043

Reporting Date: 7 January 2012

Project: West Ridge
Snell & Wilmer, LLP

Sample ID **Back Bleeder XC 60.5 Entry 1 Roof Drip** (BYU# 9283)

Collection Date: 10-Oct-2011

Cations	mg/L	meq/L	
Calcium (Ca^{++})	42.85	2.14	EPA Method: 215.1
Magnesium (Mg^{++})	37.34	3.07	EPA Method: 242.1
Sodium (Na^{+})	88.34	3.84	EPA Method: 273.1
Potassium(K^{+})	20.06	0.51	EPA Method: 258.1
Anions			
Bicarbonate (HCO_3^-)	429.70	7.04	EPA Method: 310.1
Fluoride (F^-)	0.94	0.05	EPA Method: 300.0
Chloride (Cl^-)	13.24	0.37	EPA Method: 300.0
Nitrate (NO_3^-)	1.11	0.02	EPA Method: 300.0
Bromide (Br^-)	<0.01	0.00	EPA Method: 300.0
O-Phosphate (HPO_4^{--})	<0.01	0.00	EPA Method: 300.0
Sulfate (SO_4^{--})	130.62	2.72	
Cation/Anion Balance			ASTM: D 596-83
Total cations	9.56		
Total anions	10.20		
Percentage error (%)	-3.2		

*- Indicates concentration below the detection limit for the method used

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Lehi, UT 84043

Reporting Date: 7 January 2012

Project: West Ridge
Snell & Wilmer, LLP

Sample ID **Back Bleeder XC 60.5 Entry 2** (BYU# 9284)

Collection Date: 10-Oct-2011

Cations	mg/L	meq/L	
Calcium (Ca^{++})	127.90	6.38	EPA Method: 215.1
Magnesium (Mg^{++})	120.40	9.91	EPA Method: 242.1
Sodium (Na^{+})	44.41	1.93	EPA Method: 273.1
Potassium(K^{+})	27.61	0.71	EPA Method: 258.1
Anions			
Bicarbonate (HCO_3^-)	493.00	8.08	EPA Method: 310.1
Fluoride (F^-)	0.43	0.02	EPA Method: 300.0
Chloride (Cl^-)	14.21	0.40	EPA Method: 300.0
Nitrate (NO_3^-)	< 0.01	0.00	EPA Method: 300.0
Bromide (Br^-)	< 0.01	0.00	EPA Method: 300.0
O-Phosphate (HPO_4^{--})	< 0.01	0.00	EPA Method: 300.0
Sulfate (SO_4^{--})	602.68	12.55	
Cation/Anion Balance			ASTM: D 596-83
Total cations	18.93		
Total anions	21.05		
Percentage error (%)	-5.3		

*- Indicates concentration below the detection limit for the method used.

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Client: Petersen Hydrologic, LLC
2695 N. 600 E.
Lehi, UT 84043

Reporting Date: 7 January 2012

Project: West Ridge
Snell & Wilmer, LLP

Sample ID **Panel 17 Horizontal Borehole** (BYU# 9285)

Collection Date: 10-Oct-2011

Cations	mg/L	meq/L	
Calcium (Ca^{++})	28.80	1.44	EPA Method: 215.1
Magnesium (Mg^{++})	29.67	2.44	EPA Method: 242.1
Sodium (Na^{+})	166.90	7.26	EPA Method: 273.1
Potassium(K^{+})	46.61	1.19	EPA Method: 258.1
Anions			
Bicarbonate (HCO_3^-)	361.90	5.93	EPA Method: 310.1
Fluoride (F^-)	0.87	0.05	EPA Method: 300.0
Chloride (Cl^-)	15.22	0.43	EPA Method: 300.0
Nitrate (NO_3^-)	1.47	0.02	EPA Method: 300.0
Bromide (Br^-)	< 0.01	0.00	EPA Method: 300.0
O-Phosphate (HPO_4^{--})	< 0.01	0.00	EPA Method: 300.0
Sulfate (SO_4^{--})	328.12	6.83	
Cation/Anion Balance			ASTM: D 596-83
Total cations	12.33		
Total anions	13.26		
Percentage error (%)	-3.6		

*- Indicates concentration below the detection limit for the method used.

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Client: Petersen Hydrologic, LLC
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Lehi, UT 84043

Reporting Date: 7 January 2012

Project: West Ridge
Snell & Wilmer, LLP

Sample ID **15th West XC 32 Entry 2 Gob Drainage**
(BYU# 9286)

Collection Date: 13-Oct-2011

Cations	**mg/L**	meq/L	
Calcium (Ca^{++})	13.20	0.66	EPA Method: 215.1
Magnesium (Mg^{++})	2.59	0.21	EPA Method: 242.1
Sodium (Na^{+})	206.20	8.97	EPA Method: 273.1
Potassium(K^{+})	14.80	0.38	EPA Method: 258.1
Anions			
Bicarbonate (HCO_3^-)	603.90	9.90	EPA Method: 310.1
Fluoride (F^-)	2.83	0.15	EPA Method: 300.0
Chloride (Cl^-)	25.10	0.71	EPA Method: 300.0
Nitrate (NO_3^-)	< 0.01	0.00	EPA Method: 300.0
Bromide (Br^-)	0.21	0.00	EPA Method: 300.0
O-Phosphate (HPO_4^{--})	< 0.01	0.00	EPA Method: 300.0
Sulfate (SO_4^{--})	16.17	0.34	
Cation/Anion Balance			ASTM: D 596-83
Total cations	10.22		
Total anions	11.10		
Percentage error (%)	-4.1		

*- Indicates concentration below the detection limit for the method used.

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Client: Petersen Hydrologic, LLC
2695 N. 600 E.
Lehi, UT 84043

Reporting Date: 7-Jan-2012

Project: West Ridge
Snell & Wilmer, LLP

Stable Isotopic Data

Sample ID	BYU ID	Sample Date	$\delta^{18}O_{VSMOW}$	+/- 1 σ	δD_{VSMOW}	+/- 1 σ
Back Bleeder XC 60.5 Entry 1 Roof Drip	9283	10-Oct-2011	-15.34	0.20	-116.2	0.5
Back Bleeder XC 60.5 Entry 2	9284	10-Oct-2011	-15.57	0.20	-117.0	0.5
Panel 17 Horizontal Borehole	9285	10-Oct-2011	-15.26	0.20	-112.5	0.5
15th West XC 32 Entry 2 Gob Drainage	9286	13-Oct-2011	-15.47	0.20	-116.0	0.5
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

NOTES:

$\delta^{18}O_{VSMOW\,(sample)} = [(^{18}O/^{16}O)_{sample} - (^{18}O/^{16}O)_{VSMOW} / (^{18}O/^{16}O)_{VSMOW}] * 1000$

$\delta D_{VSMOW(sample)} = [(^{2}H/^{1}H)_{sample} - (^{12}H/^{1}H)_{VSMOW} / (^{2}H/^{1}H)_{VSMOW}] * 1000$

$\delta^{13}C_{VPDB\,(sample)} = [(^{13}C/^{12}C)_{sample} - (^{13}C/^{12}C)_{VPDB} / (^{13}C/^{12}C)_{VPDB}] * 1000$

$\delta^{18}O_{VSMOW\,(sample)}$, $\delta D_{VSMOW\,(sample)}$ and $\delta^{13}C_{VPDB\,(sample)}$ are the measured "delta" values for the given sample. $(^{18}O/^{16}O)_{sample}$, $(^{2}H/^{1}H)_{sample}$ and $(^{13}C/^{12}C)_{sample}$ are raw isotope ratios, and $(^{18}O/^{16}O)_{VSMOW}$ $(^{2}H/^{1}H)_{VSMOW}$ are the defined isotope ratios for hydrogen and oxygen of the VSMOW international standard. VPDB values for carbon are produced by analysis with reference gases calibrated to NBS-19.
Values are normalized to the VSMOW/SLAP scale (Coplen, 1988; Nelson, 2000; Nelson and Dettman, 2001); however, uncertainties in normalization are not included in error estimates.

David G. Tingey
Research Professor

~WEST RIDGE MINE - PERMIT APPLICATION PACKAGE~

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Note: Figures are located at the end of the Chapter 7 text.

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CHAPTER 7
R645-301-700 HYDROLOGY

Historical Note: In the spring of 2009, and again in the summer of 2010, the company constructed small catchment structures in the C Canyon drainage below the minesite. The purpose of these structures was to contain coal-fines which had accumulated in the drainage channel as a result of non-compliance discharge water from the mine, and to assist in the subsequent clean-up project. Please refer to Appendix 5-15 for a complete description of these catchment structures, including history, location, right-of-entry, as-built design, operational criteria, and reclamation information.

Historical Note 2: In the summer of 2011 the company acquired a modification of federal lease UTU-78562 along the eastern side of the permit area. Mining in this new lease will involve development mining under the stream in the Right Fork of Whitmore Canyon which supplies most of the water to the Grassy Trail Reservoir. Due to concerns for the water rights in this area the company has agreed to collecting additional hydrologic baseline data. This data acquisition will include, but is not limited to the following:

a) Installation and/or rehabilitation of measuring flumes in the upper and lower reaches of both Right and Left Forks of Whitmore Canyon above the reservoir (total of 4ea. flumes).

b) Installation of measuring/recording devices at each flume, within the normal operating flow limits of the flumes.

c) Installation of subsidence monitoring stations at 100' intervals along the bottom of the Right Fork drainage within the permit area.

d) Installation of flow meters within the underground mine water collection/pumping system sufficient to adequately assess the quantity and location of groundwater sources encountered in the mine works in the vicinity of the Right Fork.

e) On-site location and development of selected springs in the Right Fork area subject to future monitoring, conducted in conjunction with stakeholder input.

f) Expansion of the seep and spring survey in the Right Fork to include more of the upper drainage area above longwall Panel #22.

g) Completion of a detailed gain-loss analysis of the stream flow in the Right Fork within the area of proposed development mining.

It should be noted that there will be no longwall mining under (beneath) the Right Fork of Whitmore Canyon, nor any other mining that would result in subsidence under the drainage of the Right Fork. The only mining under the Right Fork will be a limited number of development entries associated with the longwall bleeder system. All such development mining associated with Panel #22 will be conducted at depths in excess of 2600' below the Right Fork drainage.

Information regarding the subsidence monitoring points in the Right Fork can be found in Appendix 5-18.

Information regarding the underground (in-mine) flow meters can be found in Appendix 7-16.

Information regarding the expanded seep and spring survey can be found in Appendix 7-6B.

Information regarding the gain-loss analysis of the Right Fork can be found in Appendix 7-15.

R645-301-711 General Requirements

This chapter includes a description of hydrology and hydrogeology of the West Ridge permit area. Specifically, this permit application includes:

711.100 Existing hydrologic resources according to R645-301-720.

711.200 Proposed operations and potential impacts to the hydrologic balance according to R645-301-730.

711.300 The methods and calculations utilized to achieve compliance with the hydrologic design criteria and plans according to R645-301-740.

711.400 Applicable hydrologic performance standards according to R645-301-750.

711.500 Reclamation activities according to R645-301-760.

NOTE: The following discussion for the remainder of R645-301-711 applies specifically to the Gob Gas Vent Hole (GVH) installation proposed in Bear Canyon. In order to facilitate the review it is presented here in its entirety rather than interspersed throughout the chapter. A more detailed and complete discussion of the Bear Canyon GVH proposal can be found in Appendix 5-14. Unless specifically noted in this following discussion, nothing related to the Bear Canyon GVH proposal affects the contents of the existing approved MRP as described hereinafter.

The GVH site will be located on the opposite side of the road (southeast side) from the primary canyon drainage channel. Therefore, construction and operation of the GVH facility will have no affect on the natural canyon drainage. Because of the limited size of the site (0.24 acres) and the narrow configuration within the confines of the narrow ledges of the canyon, there is insufficient room to construct a sediment control pond. Therefore the company intends to employ a combination of alternate sediment control methods at the site. During the construction phase of the pad site, adequate rows of excelsior logs will be placed downgrade from the site to prevent construction sediment from entering the channel. Once the pad site is finished, which should take less than two weeks, a disturbed area drainage ditch will be constructed along the toe of the cut. This ditch will be designed to handle the flow from the up-slope undisturbed area, the reclaimed cutslope, the drillpad, and the adjacent section of road. This ditch will discharge into the natural drainage channel a short distance below the drillhole location. This ditch will be armored with adequately-sized rip-rap for its entire length. This rip-rap will decrease the potential for erosion in the ditch, and will also act initially as a siltation trap as a certain amount of sediment is allowed to settle into the rip-rap voids.

The total length of the drainage ditch will be approximately 350'. At 50' intervals along its length energy dissipaters will be installed in the ditch. These energy dissipaters will consist of excelsior logs laid in the ditch perpendicular to the flow direction, and anchored securely with stakes. These dissipaters will reduce the flow velocity to help reduce erosion, and will also serve as siltation filters to help remove sediment prior to reaching the natural channel. In addition, a terminal set of excelsior logs will be installed in the ditch immediately above the point where it discharges into the natural channel. The installation, consisting of four (4 ea.) closely-spaced rows of excelsior logs will serve primarily as sediment traps, rather than energy dissipaters. This set will be located conveniently close to the road to facilitate regular cleaning and maintenance. The sediment traps will be inspected routinely to make sure they are functioning properly. There will be mine personnel attending to the GVH units on a daily basis, and will be instructed to check the sediment traps on a regular basis, and especially after storm events. If they are in need of repair and/or cleaning such maintenance will be done immediately. Sediment cleaned from the traps will be hauled off-site and disposed of at an approved facility, such as the permitted Wildcat Loadout Coal Mine Refuse Disposal Site (DOGM permit C/007/033). All excelsior logs will be installed according to the manufacture's instructions.

Immediately after the cutslopes have been excavated to create the pad-site, the slopes will be pocked, and reseeded. A layer of woodstraw will then be spread over the reseeded slopes. This straw serves to not only provide microclimate conditions to encourage seed germination, it also absorbs some of the energy from falling raindrops, and therefore helps control erosion on the slopes until revegetation can become established. The pocking, which consists of irregular depressions measuring about 24" x 36" x 18" deep, helps revegetation by holding the seed and water in place, and thereby helps minimize erosion as well.

During the drilling phase of the GVH installation, the pad area will be used as an equipment lay-down area for drill steel, drill casing, drilling mud, concrete, etc. The pad will also be used to accommodate the mud pits needed during the drilling operation. The mud pit will measure approximately 30' long x 10' wide x 10' deep, and will be located immediately down-canyon, i.e., southwest of, the drillholes, as shown in Attachment 1. The pit will be lined with a 12 mil plastic liner, with a 20 mil felt underlayment. Based on the diameter and total combined length of the drillholes, and assuming a swell factor of 40% for the cuttings, the estimated volume of cuttings is 1283 cubic feet, or 47 yds. This would result in a total depth of cuttings remaining in the bottom of the pit of about 4.28 ft. After the drillholes have been completed the remaining cuttings will be mixed with native material until it can be handled with heavy machinery. It will then be removed from the pit and hauled off-site to an approved disposal facility. After the cuttings have been removed, the pit will be backfilled and eliminated. The site will then be cleaned up and fine-graded prior to installing the methane extractor units (see Attachments 1 and 7 for details). A period of approximately two weeks will be required to construct the drillpad and to drill the holes. During this time interim sediment control will be provided by several rows of excelsior logs installed at the lower end of the construction site. Sediment is not expected to be a problem because of the short construction time involved (approx. 2 weeks), the low probability of rainfall events in late November at this elevation, and the temporary installation of the excelsior logs.

After the site has been constructed the entire operational pad area, as well as the adjacent road area and turnaround, will be graveled from the channel crossing up to the end of the road . This gravel will consist of a crushed rock 1.5" x 0" road base material, laid down and then compacted to a tight surface. This graveled surface will also serve to reduce erosion on the pad (and adjacent road segment) and thereby decrease sedimentation to the natural drainage.

In summary, the site will be an alternate sediment control area. Sediment will be controlled by the following combination of treatment methods:

1) Armoring the entire length of the drainage ditch with rip-rap.

2) Installation of energy dissipaters within the ditch to slow the flow velocity.

3) Installation of set of sediment control excelsior logs in the ditch ahead of the discharge point.

4) Pocking and revegetating the cutslope, including a layer of protective wood straw.

5) Graveling the pad-site and adjacent roadway

Refer to the site plan in Attachment 1 of Appendix 5-14 for the location of the drainage ditch, energy dissipaters, excelsior log siltation controls, and graveled area. See Attachment 11 of Appendix 5-14 for the drainage control calculations determined by Blackhawk Engineering. This report concludes that with *"...installation of the proposed sediment and erosion controls, there should be no adverse effects to the surface hydrology of this area."*

The GVH installation and operation should have no adverse affect on ground-water hydrology. The GVH site is located close to the area where the depth of cover over the longwall panels is the shallowest within the permit area. As a result, this area has been an area of interest in previous MRP amendments, resulting in enhanced water monitoring and subsidence monitoring requirements both above and below the GVH site. A more detailed discussion of the area hydrology can be found in R645-301-322.100 and R645-301-738 of the approved MRP. It should be noted that this area has been now been completely undermined since November, 2006, subsidence has stabilized, and no adverse affects to underground or surface hydrologic resources have been observed. Prior to final reclamation, all drillholes will be plugged and sealed in accordance with State and Federal regulations, as discussed in the Chapter 5 section of Appendix 5-14. See Attachment 10 of Appendix 5-14, prepared by Petersen Hydrologic, for a discussion of the potential hydrologic affects from the GVH installation and operation. This report concludes that *"adverse impacts to the hydrologic balance resulting from the installation and operation of the Bear Canyon GVH system are not anticipated."* The probable hydrologic consequences (PHC) section of the MRP (645-301-738) has been updated to include a discussion of the Bear Canyon GVH installation.

During drilling operations, as well as during the remainder of the operational life of the GVH installation, noncoal mine waste will be stored in suitable containers, and then disposed of off-site at an approved waste disposal facility. Hydrocarbons, including Diesel fuel, gasoline, oil and grease, will be stored in the factory supplied containment mounted within the machinery. If any stand-alone storage tanks are used they will be equipped with built-in containment capable of holding the entire contents of the tank. Absorbent pads and bags of absorbent granules will be kept on hand during the drilling operation, and later during the GVH operation, to be used in case of a spill of oil, fuel or grease. Used absorbent material will be disposed of at an approved disposal facility. All operations will be subject to the current Spill Prevention Control and Countermeasure Plan (SPCC) for the West Ridge Mine currently on file with the Division, and included in Attachment 14 for ready reference.

Prior to final reclamation, all drillholes will be plugged and sealed in accordance with State and Federal regulations, as discussed in the Chapter 5 section above. Upon final reclamation, any portion of the gravel surface that is stained or contaminated in any way with hydrocarbons will be dug up and hauled off the site to an approved waste disposal facility. After removing any contaminated gravel, the pad area and cutslopes will then be backfilled to approximate original contour, using fill material obtained from the adjacent roadway and leveling pads, and covering up the diversion ditch and the remaining gravel in the process. The slopes will then be re-topsoiled. The surface will then be pocked and re-seeded with an approved seed mix as described in the Chapter 2 discussion. A layer of wood straw will also be spread over the reclaimed slopes to help minimize erosion, and promote vegetation growth. After the reclaimed slopes have been topsoiled and reseeded, a row of excelsior logs will be installed along the full length of the toe of the slope between the slope and the remaining road, as shown on the Reclamation Plan, Attachment 1. The purpose of this row of excelsior logs is to control sediment off the site until the revegetation has become established.

These sediment control logs will remain in place until vegetation has been established adequate for Phase 2 bond release.

R645-301-712 Certification

All cross sections, maps, and plans have been prepared per R645-301-512.

R645-301-713 Inspection

Impoundments will be inspected as described under R645-301-514.300.

R645-301-720 Environmental Description

R645-301-721 General Requirements

The existing, pre-mining hydrologic resources within the permit and adjacent areas that may be affected by coal mining and reclamation operations are described by Mayo and Associates (1997; 7-1 "Groundwater Investigation of Proposed Mine Permit Area", 2001; 7-1A "Investigation of Surface-Water and Groundwater Systems in the Whitmore LBA Area") and Petersen Hydrologic (2012; Appendix 7-17) and summarized below.

Groundwater Resources

A spring and seep survey of the West Ridge area was conducted in 1985-86 by Kaiser Coal Corporation (1986) as shown in Appendix 7-6. Additional seep and spring survey data from the northeastern part of the project area was collected later in 1999 and 2010, as shown in Appendix 7-6A. Locations of the springs and seeps in this area are shown on Map 7-6 "Hydrologic Monitoring Map (Historical Monitoring Locations)". No water supply wells exist in the permit and adjacent areas.

Within the permit and adjacent areas, groundwater naturally discharges from alluvium and colluvium, and the Colton, North Horn, and Price River Formations. Over 90% of springs in the permit and adjacent areas issue either from alluvium/colluvium or the Colton and North Horn Formations, which form the caprock of nearly the entire permit area. Springs that issue from the Price River Formation are uncommon. Groundwater does not naturally discharge from the Castlegate and Blackhawk Formations within the permit and adjacent areas. However, groundwater occurs in some permeable horizons of the Blackhawk Formation. Most notably, groundwater is present in well DH86-2, which is open to the entire thickness of the Sunnyside Sandstone member of the Blackhawk Formation.

Springs that discharge from alluvium and colluvium and the Colton and North Horn Formations on the east slope of West Ridge in Whitmore Canyon contribute base flow to Grassy Trail Creek. Discharge from springs on the west side of West Ridge is small and is consumed by evapotranspiration and infiltration before reaching perennial streams.

Information on groundwater systems encountered in the underground West Ridge Mine workings, including seasonal water quality and quantity, likely source areas, and radiocarbon and tritium age dating of groundwaters is presented in Appendix 7-17.

Surface Water Resources

The mine permit area drains into Grassy Trail Creek via two principal drainages. The region east of West Ridge and west of Patmos Ridge drains into Grassy Trail Creek through Whitmore Canyon. Numerous small ephemeral creeks drain the western face of West Ridge and flow westward toward lower Grassy Trail Creek. Grassy Trail Creek ultimately discharges into the Price River near Woodside, Utah, approximately 20 miles to the south.

R645-301-722 Cross Sections and Maps

722.100 As described by Mayo and Associates (1997; Appendix 7-1, 2001; Appendix 7-1A), groundwater systems in the permit and adjacent area have limited areal and vertical extent due to the heterogeneous lithology of the rock units containing and overlying the coal-bearing strata. No aquifers exist in the permit and adjacent areas. Therefore, no map has been prepared to show the location and extent of subsurface water.

722.200 The location of surface water bodies can be found on Map 7-3 "Water Rights", which shows Grassy Trail Reservoir and its location with respect to the permit area.

722.300 Baseline monitoring stations are shown on Map 7-6 "Hydrologic Monitoring Map (Historical Monitoring Locations)". This map shows the stations that were utilized to collect historical baseline information in earlier monitoring programs conducted between 1985 and 1996. Maps and cross-sections relating to groundwater systems encountered in the West Ridge Mine underground workings are provided in Appendix 7-17.

722.400 The location of water wells is also shown on Map 7-6. DH 86-2 was monitored during 1986, 1987, 1997 and 1998.

722.500 Map 5-1 shows contours of the proposed disturbed mineyard area.

R645-301-723 Sampling and Analysis

Water quality sampling and analyses have been and will be conducted according to the "Standard Methods for the Examination of Water and Wastewater" or EPA methods listed in 40 CFR Parts 136 and 434. Laboratory reporting sheets indicate the specific method used for each parameter.

R645-301-724 Baseline Information

Baseline groundwater, surface water, geologic, and climatologic data are described by Mayo and Associates (1997; 7-1, 2001; 7-1A) and by Petersen Hydrologic (2012; 7-17).

724.100 Groundwater Information

The location of wells and springs are shown on Map 7-5, Seep/Spring Survey Map, and 7-6, Hydrologic Monitoring Map (Historical Monitoring Locations). Locations of underground monitoring points used for baseline data collection are shown in Appendix 7-17. Groundwater rights in and around the permit and adjacent areas are shown on Map 7-3 and tabulated in 7-5 "Water Rights Summary".

Kaiser Coal Company (a previous owner of the WEST RIDGE lease area) had identified and proposed monitoring for several other springs in the region. Review of their 1986 permit application to DOGM was interrupted by the sale of the coal leases to BP America in 1987. BP America retained JBR Consultants to proceed with baseline water monitoring. JBR Consultants renumbered previously monitored points into a different numbering system. In places of this WEST RIDGE Permit Application Package (such as Appendix 7-1, Table A-1) a cross-reference is made between the previous (Kaiser) spring numbers and the present (JBR) labels. Mining plans for both Kaiser Coal and BP America included a larger mining area. When WEST RIDGE acquired the property they did not acquire a portion of the coal lease area referred to as the north area. Therefore, in the WEST RIDGE PAP, those monitoring points that were north of Bear Canyon were eliminated from the baseline monitoring plan due to their distance from the current proposed mine workings and the low potential to be impacted by mining operations.

SP-1, SP-2 and SP-3 were spring monitoring points used by Kaiser Coal during the mid-1980's. These three points were located in Rock Canyon, several miles to the north of the WEST RIDGE permit area. They were eliminated from the monitoring program because they are quite a distance from the permit area and would not be affected by the WEST RIDGE mining operations.

Also, SP-4 and SP-5 (referred to in the Kaiser plan as S-40 and S-39) were eliminated from the monitoring plan because they occur about a mile north of Bear Canyon and are separated from the proposed mining area by several large drainages. The likelihood of impact to these sites is negligible since WEST RIDGE did not acquire coal leases in this area. SP-4 and SP-5 were monitored in 1988 and 1989 and found to be dry. These sites have been added to Map 7-6 for reference to historical monitoring locations.

SP-7 (Kaiser point S-22) is located about ½ mile north of the permit area. It was not included in the baseline monitoring program because access is poor and, during previous monitoring in the spring of 1986, flows were low (1-3 gpm). When this site was re-checked in 1988, 1989 and the fall of 1997 no flow could be found in the vicinity of the old spring. SP-10 (Kaiser S-1) is in the lower right-hand corner of the permit area was also eliminated from the baseline monitoring plan because of difficulty of access and low previous flow measurements. This site was also revisited in 1988, 1989 and 1997 and no flow or dampness could be located. No water rights exist on SP-4, SP-5, SP-7 or SP-10. SP-7 and SP-10 are included on Map 7-6 for reference to historical points.

Seasonal quality and quantity of groundwater and usage is described in the 1985-86 spring and seep survey (Appendix 7-6) and WEST RIDGE Resources, Inc.'s baseline monitoring during 1997 (Appendix 7-2 "Baseline Ground Water Monitoring & Analyses"). Additional information on seasonal quality and quantity of groundwater and usage is provided in Appendix 7-17. These data have been analyzed by Mayo and Associates (1997; Appendix 7-1, 2001; Appendix 7-1A).

Drill Hole 90-1

DH90-1 was developed as a water supply well by Sunnyside Coal Company, East Carbon City, and Sunnside City. Sunnside City and East Carbon City have a water right (91-4960) for 31.621 ac-ft per year (19.6 gpm) from this well.

Information for the state engineer's office in Price (Mark Page, Personnal Communication) indicates that the well has a total depth of 500 feet. The well has a gravel pack from 207 to 500 feet below ground surface. According to Sunnyside Coal Company (1993), the well is completed in the Price River and North Horn Formations.

Because the well is located two thirds of a mile from the lease boundary, and is completed in the Price River and North Horn Formations, it is very unlikely that mining in the permit area will affect groundwater systems that contribute water to DH90-1.

A spring and seep survey was performed by Petersen Hydrologic, LLC in the Right Fork of Whitmore Canyon drainage. The survey area encompasses portions of Sections 31 and 32, Township 13 South, Range 14 East, and Sections 5 and 6, Township 14 South, Range 14 East. The report of this spring and seep survey is provided in Appendix 7-6B.

Based on records of the Utah Division of Water Rights, there are no water rights associated with any of the springs or seeps located in the Right Fork of Whitmore Canyon within the permit area, although there are several stockwatering rights for surface water in the bottom of the drainage. Within the adjacent area outside the permit area the August, 2011 spring and seep survey (Appendix 7-6B) identified two springs which appear to have been developed in the past for livestock use. These are identified as RFS-6 and RFS-11. Neither of these springs have an associated water right. Upon further investigation it has been determined that RFS-11 is the same spring as the Section 5 Spring (see Map 7-7) which was previously identified by the stakeholders as one of the springs which should be monitored and which is now included in the company's operational water monitoring plan. Even though none of the springs within the permit area in the Right Fork have assigned water rights, based on discussions with Marc Stilson of the Utah Division of Water Rights, Price field office (December, 2011), all water in the Right Fork of Whitmore Canyon is appropriated (see Appendix 7-17).

724.200 Surface Water Information

The location of streams, reservoirs, and stock watering ponds are shown on Map 4-1. Surface water rights in and around the permit and adjacent area are shown on Map 7-3 and tabulated in Appendix 7-5 "Water Rights Summary".

WEST RIDGE Resources, Inc. anticipates that as mining progresses, it may become necessary to discharge water from the proposed mine. Mine water will be discharged to the ephemeral drainage in C Canyon. The location of the mine discharge point is shown on Maps 5-5 and 7-2, Mine Site Drainage Map.

Surface water quality and quantity is shown in WEST RIDGE Resources, Inc.'s baseline monitoring data (Appendix 7-3 "Baseline Surface Water Monitoring & Analyses") and is described in detail by Mayo and Associates (1997; Appendix 7-1, 2001; Appendix 7-1A). Additional surface and groundwater baseline data has been added to Appendix 7-1, Table A-1. Monitoring records from Kaiser Coal Company have been located and added to the data base. This includes monitoring of surface sites on ephemeral drainages around the area.

As described in R645-301-728.320, no acid drainage is expected from the proposed mining operation.

Upper Grassy Trail Creek Drainage

Most of the surface water flowing into Grassy Trail Creek in Whitmore Canyon above Sunnyside discharges from several ephemeral streams located on the western slopes Patmos Ridge (1998 Mayo and Associates report, Figure 15). These streams include Number Two Canyon, Pasture Canyon, Pole Canyon. Bear Canyon, Water Canyon, the Right and Left Forks of Whitmore Canyon, Graveyard Canyon, Hanging Rock Canyon, and Spring Canyon. No major streams flow into Grassy Trail Creek in Whitmore Canyon from the eastern slope of West Ridge due to the asymmetry of the ridge. Discharge in Grassy Trail Creek in Whitmore Canyon is regulated at Grassy Trail Reservoir.

Side tributaries to Grassy Trail Creek along the western slope of Patmos Ridge are characterized by steep gradients (greater than 25%), narrow canyons, and gravel streambeds with sand and silt where gradients are reduced. Tributary flow is intermittent and in response to precipitation events.

Above the reservoir, Grassy Trail Creek lies in a relatively broad canyon (30 to 100 yards wide) with a low gradient (3 to 4%). The channel bottom locally consists of boulders, gravel, sand, or mud. The Right and Left Forks of Grassy Trail Creek lie in narrow canyons with steep gradients. The Utah Supreme Court has determined that Grassy Trail Creek is an intermittent stream (Decree #3028). During wet periods, base flow above the reservoir is sustained by high elevation springs, mostly in the Colton Formation. During dry years, there is no sustaining groundwater baseflow to support flow in the creek. Below the reservoir Grassy Trail Creek is now a perennial stream due to the buffering effect of the reservoir.

Monitoring stations on Grassy Trail Creek have been established at ST-3, which is above Grassy Trail Reservoir near Hanging Rock Canyon, and below the reservoir at ST-8 near the confluence with Water Canyon (Mayo and Associates 1998 report, Figure 16). During May, June, August, and October of 1997, Andalex made stream flow measurements at these locations. On average, discharge between ST-3 and ST-8 increases by about 200 gpm during this time. In June, However, flow increased between these two stations by 1,700 gpm. We suspect that this increase is the result of surface water inflows from ephemeral side drainages during the snowmelt period.

Visual observations during low-flow stream conditions suggest significant base flow gains in the reach between the reservoir and the mouth of Whitmore Canyon. Mayo and Associates observed Grassy Trail Creek between the confluence with Water Canyon and the mouth of Whitmore Canyon on 21 November 1997. The results of the observations are presented below.

Location	Discharge (gpm)
Confluence with Water Canyon	150[1]
Base of Blue Gate Sandstone	298
Mouth of Whitmore Canyon	275[1]

[1] Estimated values; the channel was frozen over and measurements were not possible.

Discharge in Grassy Trail Creek doubled in the reach from the confluence with Water Canyon (alluvium overlying North Horn Formation) to the base of the Bluecastle Member of the Price River Formation. Much of the increase comes from several small springs and seeps, which visibly discharge from the stream bank into the creek. In the reach from below the Bluecastle Member to the mouth of Whitmore Canyon flow remained relatively constant. Most of the increase in flow occurs as the stream flows over alluvial and colluvial deposits. The canyon widens substantially in this reach and the alluvial deposits appear to be thicker than in the higher elevations in the canyon. The increase in stream flow is likely the result of delayed drainage from the alluvial and colluvial deposits. However, it is possible, though less likely, that the increase in flow is the result of groundwater leakage from permeable sandstone horizons in the Price River Formation.

No increase in discharge in Grassy Trail Creek is observed as the creek flows over the Blackhawk Formation near the mouth of the canyon. This suggests that there is no appreciable discharge from the Blackhawk Formation to the creek. This finding is in agreement with many other stream gain-loss measurements performed by Mayo and Associates in the Book Cliffs and Wasatch Plateau coal fields.

In the mouth of Whitmore Canyon, streamflow in Grassy Trail Creek is lost to the alluvial sediments associated with the Mancos Shale. Waddell (1981) reports that the composition of groundwater in the alluvium near the mouth of Whitmore Canyon in Whitmore Spring (D-15-13)1ddc-S1 and well (D-15-13)2 dad-1 have solute compositions and TDS concentrations that are similar to those in lower Grassy Trail Creek. This suggests that the creek and the thick alluvial deposits in the mouth of the canyon are probably in good hydraulic connection. Several springs with discharges of less than 10 gpm discharge from the alluvium near the mouth of the canyon. These springs are likely recharged from leakage from Grassy Trail Creek. During dry periods, Grassy Trail Creek dries up completely before reaching the confluence with Bear Creek and Rock Canyon Creeks west of the permit area. The reduction of flow in the creek in this reach is due primarily to infiltration into the thick alluvium and to losses to evapotranspiration.

Water Rights

Water rights on Grassy Trail Creek are shown on Map 7-3 and tabulated in Table 7-5.

Water Quality

Surface water in upper Grassy Trail Creek is of the magnesium-calcium-bicarbonate type with considerable concentrations of sodium and sulfate. Average TDS concentrations are approximately 350 mg/l at ST-3 and 277 mg/l at ST-8. Below the confluence with Water Canyon Creek, the TDS and chemical character of Grassy Trail Creek changes. The TDS steadily increases to about 1,000 mg/l. Na^+ becomes the dominant cation and there are also substantial increases in SO_4^{2-} and HCO_3^-.

Bear Canyon Drainage

Flow Characteristics

The discharge from the Bear Canyon drainage (which is tributary to Dugout Creek) is described as ephemeral in the Mayo and Associates report (p. 53). However, historical monitoring location ST-2 in the left fork of Bear Canyon is considered an intermittent stream monitoring site (Mayo and Associates report, page 52).

Flow in the upper reach of the left fork of Bear Canyon is intermittent for about 500 feet. Water in this upper reach is supported by intermittent discharge from a spring complex (including historical monitoring location SP-6). Intermittent flow is not sustained below this stretch of the drainage due to infiltration and therefore does not reach the LBA boundary.

Data from monitoring sites ST-4 and M-2 indicate that discharge from the Bear Canyon drainage is ephemeral. In May 1988, no flow was observed at M-2 (refer to Table A-1). The PHDI (Figure 3a and 3b) indicates that 1988 was not a drought year. No flow was observed at ST-4 during 1989; however, this year was the beginning of a drought period in the region. At ST-4, no flow was observed in the drainage in March, May, June, July, August or September 1997, or May, June, July, August or September 1998.

M-1 (ST-1) was a monitoring point used by Kaiser Coal during the mid-1980's. The point was identified as M-1 by Kaiser Coal in their 1986 permit application package. It was later redesignated as ST-1 by JBR Consultants in a monitoring plan later submitted for BP America. This point was located in Rock Canyon (approximately 2 miles to the northwest of the WEST RIDGE permit area in T. 13 S. R 13 E. Section 32 NW1/4 SW1/4 on Rock Creek. When WEST RIDGE (Andalex) took over the monitoring program in 1997, they decided to utilize the same numerical designations of the monitoring points to minimize confusion over numbering and to maintain continuity in the baseline monitoring plan and facilitate utilization of previously collected hydrology information. Rock Creek was not included in the baseline monitoring plan for the WEST RIDGE mine because of the distance from the lease area and the low potential for mining operations to have any impacts. However, rather than renumbering the stations and causing confusion, it was decided to leave the existing numbering scheme in place but sample only those site important to the current mining proposal. The WEST RIDGE monitoring program does not include ST-1 and this point is not shown on the operational monitoring map (Map 7-7).

Water Rights

Surface water rights (91-1717 and 91-1722) for the intermittent reach of the left fork of Bear Creek have a period of use of March 15 to October 31. Data from ST-2 indicate that water is available in the upper left fork during this period in normal to wet years. During dry years, this stretch is dry.

All other surface water rights for Bear Creek below the intermittent reach have a year-round period of use. However, as discussed above, all of Bear Creek below the headwaters of the upper left fork only supports ephemeral flow.

Water Quality

Surface water at ST-2 is a Mg^{2+}-HCO^{-}_{3}-SO_4^{2-} type water with elevated TDS (1,100 mg/l) relative to surface water in upper Grassy Trail Creek. Only one surface water sample has been collected at the ephemeral monitoring location M-2. This water had a TDS of 1,820 mg/l indicating that the quality of water naturally degrades between ST-2 and M-2.

Hydrologic Resources of the Topsoil Borrow Area

The 9.6 acre area identified as the topsoil borrow site is a gently, westward sloping bench. The surface is covered with sagebrush and pinyon juniper. No seeps or springs exist in or around the borrow site. What little surface runoff occurs would flow to ephemeral drainages downstream from the borrow site. Surface runoff is minimized by the vegetative cover and relatively deep soil horizons in this area. Due to the limited areal extent of the borrow area, it does not appear to contribute a significant amount of runoff to adjacent drainages. There are no known aquifers in this area that would be recharged by this watershed area.

During reclamation, if it is determined that topsoil resources from this potential borrow site are needed to achieve reclamation of the mine site, silt fencing would be placed around the outer limits of the borrow area to be disturbed. Topsoil would be stripped and stockpiled. The required amount of topsoil would then be removed from the borrow site. Care would be taken to contour the borrow pit such that runoff would be utilized to the fullest extent in the disturbed area. This would include gouging the regraded surface with pits approximately 24" wide, 36" long and 18" deep as well as sloping the regraded slopes inward to encourage precipitation infiltration on-site.

724.300 Geologic Information

Geologic information in sufficient detail to determine the probable hydrologic consequences of mining and determine whether reclamation can be accomplished, as required by R645, is provided in Chapter 6 of this permit application package and in Mayo and Associates (1997; Appendix 7-1, 2001; Appendix 7-1A).

724.400 Climatological Information

724.411 Seasonal precipitation

Average annual precipitation at Sunnyside is 13.3 inches (NCDC, 1997) while estimated potential evaporation is over 60 inches (Sunnyside Coal Company, 1993). Mean monthly precipitation at Sunnyside is shown on Figure 7-1 "Hydrologic Monitoring Protocols and Locations". On average, the area receives the greatest quantity of moisture in the late summer and early fall (August-October). The driest months are November to February.

The precipitation and temperature data described above is typical of the lowland areas at the base of the Book Cliffs. Although data are not available for the higher elevations of the permit area, average precipitation likely increases and average temperatures likely decreases with elevation.

The Palmer Hydrologic Drought Index (PHDI; NCDC, 1997; Karl, 1986; Guttman, 1991) indicates long-term climatic trends for the region. The PHDI is a monthly value generated by the National Climatic Data Center (NCDC) that indicates the severity of a wet or dry spell. The PHDI is computed from climatic and hydrologic parameters such as temperature, precipitation, evapotranspiration, soil water recharge, soil water loss, and runoff. Because the PHDI takes into account parameters that affect the balance between moisture supply and moisture demand, the index is a useful for evaluating the long-term relationship between climate and groundwater recharge and discharge. Figures 7-2 Palmer Hydrologic Drought Index for Utah Division 6 and 7-3 Palmer Hydrologic Drought Index for Utah Division 7 show the PHDI for Utah Division 6 (Uintah Basin) and Division 7 (Southeastern Utah), respectively. The permit area lies at the boundary of these two regions. These graphs indicate extremely wet years between the early and late 1980s, followed by several years of drought in the late 1980s and early 1990s. Since about 1993, wet and dry cycles have been shorter.

724.412 Winds direction and velocity

Wind data have been collected by SCA (Sunnyside Cogeneration Associates) during 1982 and 1983 for permitting of the power plant. These data (Sunnyside Coal Company, 1993) were collected in Dragerton (near East Carbon, Utah) atop a 45-meter tower. The data show that the majority of the winds are from the north-northeast clockwise through the south-southwest. The average annual wind speed is 6.2 mph.

Upper level winds, over 1,600 feet above the ground level, are generally from the southwest during most of the year. During the winter, air flow from the northeast is common. Local airflow patterns are primarily influenced by stream and river drainages. Wind speeds induced by the descent of dense cold air is generally light. The daytime flow is strongly influenced by surface heating effects which result in mixing between surface and upper level flows. In the permit area there is a general air flow toward the north and northeast during the day (high elevations) and toward the southwest (lower elevation) during the night. Wind speeds are usually light to moderate (below 20 mph). Higher wind speeds are generally associated with storm systems and higher elevations such as ridge tops.

724.413 Seasonal temperature ranges

Temperatures in the permit area vary greatly both daily and seasonally. Temperature data collected at the Sunnyside Mine engineering office (Sunnyside Coal Company, 1993) indicate that average temperatures are generally below freezing in the winter months and summertime temperatures range from 50 - 90°F.

724.500 Supplemental Information

Adverse impacts to the hydrologic balance either on or off the permit area are not expected to occur based on the probable hydrologic consequences determination in R645-301-728. Acid- and toxic-forming materials present in mining materials will not cause contamination of groundwater or surface-water supplies. Consequently, information regarding remedial and reclamation activities has not been prepared.

724.600 Renewable resource lands

Aquifers or areas for the recharge of aquifers do not exist within the permit and adjacent areas. As described by Mayo and Associates (1997; Appendix 7-1), groundwater systems in the permit and adjacent area have limited areal and vertical extent due to the heterogeneous lithology of the rock units containing and overlying the coal-bearing strata.

Limited groundwater recharge occurs on the land surface within the permit area because of the steep slopes and cliffs. Springs that discharge in the permit area are most likely associated with shallow alluvial and colluvial materials. Mining should not affect the recharge or discharge of these springs. Groundwater recharge to the Colton and North Horn Formations within the permit area may discharge as springs in Whitmore Canyon because of the northeasterly dip of the rocks. Due to abundant claystone and mudstone in these formations and the thickness of the interburden between these formations and the mining horizon, mining will not impact groundwater in these horizons.

Adjacent to the permit area, the upper slopes of the east side of West Ridge are the recharge area for Colton Formation groundwater systems that discharge as springs in Whitmore Canyon and contribute base flow to Grassy Trail Creek. These groundwater systems occur in the shallow subsurface and will not be undermined. Mining will have no impact on the recharge and discharge of these springs.

724.700 Not applicable.

R645-301-725 Baseline Cumulative Impact Area Information

Mayo and Associates (1997; Appendix 7-1, 2001; Appendix 7-1A) have analyzed geologic and hydrologic information and prepared a document describing the surface-water and groundwater systems of the permit and adjacent areas. Petersen Hydrologic (2012; Appendix 7-17) performed a solute chemical and isotopic investigation of groundwater systems within the West Ridge Mine workings. This report included additional baseline information and analysis of groundwater systems. These reports contain the information to assess the probable cumulative hydrologic impacts of coal mining and reclamation operations as required by R645-301-729.

The hydrology and geology of the area around Grassy Trail reservoir is discussed in a seismic analysis report (see Appendix 5-11) and the Phase II dam safety report (see Appendix 5-12). These reports conclude that it is unlikely that mining induced seismicity or subsidence will impact the performance of the Grassy Trail Dam and Reservoir. Based on the conclusion of this study the BLM has approved the R2P2 to allow full extraction longwall mining of Panel #7. BLM also added a special stipulation #17 to the federal lease related specifically to the Grassy Trail Reservoir, stating, "*The Lessee is and will remain liable for any and all damages or hazardous conditions resulting from the mining operations under the lease.*"

Based on BLM's approval the company then successfully mined longwall panel 7 from December, 2005 through September, 2006. Soon thereafter, RB&G Engineering prepared a summary post-mining report on the mining related affects on the reservoir (see Appendix 5-16). Still later, in 2010, RB7G Engineering prepared an additional update to the summary report (see Appendix 5-17). Based on these reports, BLM has recently approved the R2P2 to allow additional longwall mining of panel block 18-20 on the east side of the mains in the vicinity of (i.e., west and north of) Grassy Trail reservoir (see Appendix 5-3C). This new approval contains the same lease stipulation #17, as with the previous approval of panel 7.

R645-301-726 Modeling

No numerical models have been created for the permit area.

R645-301-727 Alternative Water Source Information

The determination of the probable hydrologic consequences (R645-301-728) indicates that the proposed coal mining activities will not result in the contamination, diminution, or interruption of groundwater or surface-water sources within the proposed or adjacent areas. Therefore, WEST RIDGE Resources, Inc. has not prepared information regarding alternative water sources.

The operator may be required to replace state-appropriated water only if a water user establishes that underground operations have contaminated, interrupted or diminished the flow of such appropriated rights. See Utah Code Ann. Section 40-10-18(15)(a). In Castle Valley Special Service District v. Utah Board of Oil, Gas & Mining, 938 P.2d 248, 252 (Utah 1996), the Utah Supreme Court determined that a water replacement plan is not required until a water user has shown impairment. No such showings have been made by any water users regarding these underground mining operations.

R645-301-728 Probable Hydrologic Consequences (PHC) Determination

This section describes the probable hydrologic consequences (PHC) of underground coal mining in the permit area. This determination is based on the data and information presented previously in this chapter and by Mayo and Associates (1997; Appendix 7-1, 2001; Appendix 7-1A) and Petersen Hydrologic (2012; Appendix 7-17). The PHC will be updated, if needed, following the collection and analyses of information gathered during the 1998 field season.

In association with the proposed mining in the Panel 22 extension area, additional hydrologic data have been collected and analyzed. A supplemental spring and seep survey was performed in the Panel 22 area by Petersen Hydrologic, LLC (See Appendix 7-6b). A stream gain/loss investigation was also performed in the Right Fork of Whitmore Canyon by Petersen Hydrologic, LLC (see Appendix 7-14). Permanently installed Parshall flumes were installed/rehabilitated in the Right Fork of

Grassy Trail Creek both above and below proposed mining areas. Baseline streamflow information from the Right Fork of Grassy Trail Creek is included in Appendix 7-14.

728.310 Potential adverse impacts to the hydrologic balance

Longwall coal mining may result in land subsidence and bedrock fracturing. Subsidence and fracturing have the potential to impact the hydrologic balance if fracturing increases the vertical hydraulic conductivity of overburden rock. Possible consequences of fracturing include decreasing discharge rates of near-surface groundwater while increasing the recharge rates of deeper groundwater systems.

Mining ~~will~~ occurs in the Lower Sunnyside Seam of the Blackhawk Formation. Over 90% of the springs in the West Ridge area discharge from near-surface groundwater systems in alluvial/colluvial materials and the Colton and North Horn Formations. The thick interburden between the mined horizon and the near-surface groundwater systems and the presence of swelling clays in the North Horn Formation will prevent fracturing and subsidence from increasing vertical hydraulic conductivities and decreasing spring discharge rates.

Groundwater encountered by mining operations in the West Ridge Mine is old. Radiocarbon age dating of in-mine groundwater samples by Petersen Hydrologic during 2011(Appendix 7-17) demonstrates that the sampled groundwaters recharged between about 10,000 and 23,000 years ago. The low tritium contents of these waters (near the laboratory detection levels) indicate that the mine waters have been isolated from the land surface and shallow groundwaters for at least the past 50 years. The result of the carbon-14 analysis indicates a radiocarbon content of 2.28 percent modern carbon. This is suggestive of very old groundwater. However, because of uncertainties in the characterization of the carbon history of the water (based on the positive carbon-13 composition), the calculation of a groundwater "age" is not possible. The groundwater at one of the 2011 sampling locations (15th West XC 32 Gob Drainage) had a positive carbon-13 composition. Because of uncertainties in the characterization of the carbon history of the water, the calculation of a groundwater "age" for that sample is not possible. ~~Groundwater that is encountered by mining operations will likely be old, meaning that recharge occurred thousands of years in the past.~~ Well DH86-2 encountered water in the Sunnyside Sandstone below the coal seam to be mined. This water has a radiocarbon age in excess of 11,000 years.

Groundwater systems encountered in the Blackhawk Formation occur in isolated sandstone paleochannels, fractures, and faults. The results of radiocarbon age dating and tritium analysis indicates that these groundwater systems are not in active hydraulic communication with the surface. These systems have limited areal and vertical extent. Mining could dewater some of these systems if they are intercepted during mining operations. ~~Because of the limited spatial extent of these systems, discharge from these isolated groundwater systems will cease soon after interception by mine workings.~~

Based on the sizes and groundwater storage volumes of water-bearing features potentially intercepted by mining operations, discharges that may persist for longer periods of time may be encountered in some portions of the West Ridge Mine. However, the potential for very long-term discharges of water from intercepted groundwater systems is considered low. This is because as described by Petersen Hydrologic (2012) the waters intercepted by the West Ridge Mine workings are of ancient origin and do not contain any appreciable tritium. Petersen Hydrologic indicates that the intercepted water is being removed from storage and is not being actively recharged by overlying shallow recharge sources. Accordingly, the volume of water that can be discharged into the mine workings from an inflow source is finite, and is largely a function of the size and water-bearing characteristics of the geologic feature being intercepted. If a groundwater system in one of the major Blackhawk Formation beach/barrier bar sandstones present in the geologic sequence adjacent to the coal seam were to be intercepted by the mine workings, the potential for discharge to occur over from that unit over a more prolonged period of time would exist. However, as discussed by Mayo and Associates (1998), groundwater systems in the Blackhawk Formation within the mountain core are not in good hydraulic communication with overlying recharge sources. Accordingly, the potential for the continued draining of a Blackhawk Formation sandstone unit deep within the mountain core to affect overlying shallow groundwater systems that support springs and seeps and provide baseflow to streams in the area would be minimal.

Groundwater discharging from the mine roof from a sandstone paleochannel into the West Ridge Mine workings was sampled for carbon-14 and tritium content on 24 October 2000 (Main Dips Belt XC21). The tritium content of this sample was very low (0.17 tritium units), which is near the lower laboratory detection limit. This indicates that the water sampled in the mine has been isolated from the land surface for at least the past 50 years. The result of the carbon-14 analysis indicates a radiocarbon content of 2.28 percent modern carbon. This is suggestive of very old groundwater. However, because of uncertainties in the characterization of the carbon history of the water (based on the positive carbon-13 composition), the calculation of a groundwater "age" is not possible. The antiquity of the water encountered underground at the West Ridge Mine demonstrates the lack of appreciable hydraulic communication with shallow groundwater systems and recharge sources. This condition is consistent with conditions encountered at coal mines elsewhere in the Book Cliffs and Wasatch Plateau coal mining districts of Utah.

Mining could also encounter water impounded in the old Sunnyside mine workings. In order to avoid accidentally mining into flooded workings, the West Ridge mine will perform exploratory drilling ahead of development when active mine works are within 500 feet of the projected Sunnyside workings. Face drills will be used to drill at least 100 feet out in advance of the actual mine face development. The exploratory face drill will be a small diameter and if water is encountered from the old works the drill hole can easily be plugged and sealed. The West Ridge mine plan assumes that development will proceed to within 300 feet of the old works. West Ridge mine intends to stay away from the old works but will drill ahead as a precautionary measure in the event that the mine maps or surveying has a margin of error.

Based on the analysis of the probable hydrologic consequences (PHC), it has been concluded that it is highly unlikely that mining in the West Ridge area will result in the decrease of groundwater discharge rates. This conclusion is based in large part on the observation that the deep, inactive-zone groundwaters intercepted in the West Ridge Mine workings are of ancient origin and are isolated from the shallow groundwater systems that support discharge at most springs in the permit and adjacent area. Mayo and Associates (Appendix 7-1) report that most springs in the permit and adjacent area have appreciable tritium contents and exhibit seasonal variability in discharge rates. These systems are isolated from the deep, inactive-zone groundwater systems encountered in the underground West Ridge Mine workings.

Grassy Trail Creek above Grassy Trail Reservoir flows across the WEST RIDGE permit area. The stream channel in this area is underlain by approximately 2,000 feet of cover, which includes the entire thickness of relatively unfaulted and unfractured North Horn Formation, which is known to form an effective barrier to vertical groundwater migration (Mayo and Associates, 1998) and is known to contain hydrophillic clays that swell when wetted to seal any fractures that may form. Therefore, the potential for the interception and diminution of surface water flows in Grassy Trail Creek as a result of mining induced subsidence is minimal. Where differential subsidence may potentially occur beneath Grassy Trail Creek, such as along longwall panel ends or above gate roads, there is the potential for localized increases or decreases in stream gradients. These changes can result in minor changes to the stream morphology, including changes in the number of pools, runs, glides, etc. Differential subsidence of the channel substrate also has the potential to result in temporary increases or decreases in sediment yield. However, because a steep, mountain stream flowing on alluvial or soft bedrock substrate has the tendency to rapidly erode elevated areas and deposit sediment in lowered areas, these effects are commonly short-lived, as the stream system is rapidly brought back into equilibrium.

In order to assess the impacts of full extraction mining beneath perennial streams in the Utah Coal District, several comprehensive investigations of the Burnout Canyon drainage above Canyon Fuel's Skyline Mine have been conducted (Forest Sciences Laboratory, 1998; Sidel, 2000). The findings of these investigations indicated that 1) baseflow discharge rates during and after subsidence of the drainage were not statistically different at the 0.05 level, 2) there was no indication that water was lost from Burnout Creek as a result of longwall undermining of the drainage, and 3) some minor changes in stream morphology, including changes in the pool/riffle ratio of the stream channel were noted; however, similar changes in the study's control area (James Canyon) were also noted, indicating that the observed morphological changes could have been at least in part the result of non-mining-related factors. They found that the changes in channel morphology were generally short lived. Subsequent to the publication of these investigations, the Burnout Canyon drainage has been further subsided as a result of multiple seam extraction beneath the creek. No perceptible or quantifiable impacts to the drainage have been detected as a result of this mining activity (USFS, 2001).

Burnout Creek and upper Grassy Trail Creek, both being relatively steep-gradient mountain streams, are in many senses generally comparable. However, while overburden thicknesses in the Burnout Canyon area range from about 600 to 850 feet, overburden thicknesses beneath Grassy Trail Creek are approximately 2,000 feet. Therefore, it is reasonable to assume that the hydrologic impacts to upper Grassy Trail Creek, where only single seam extraction under significantly greater cover, will be similar to (or lesser than) the minimal impacts experienced in the Burnout Canyon area.

For the reasons discussed above, it is believed that the impacts to Grassy Trail Creek above Grassy Trail Reservoir as a result of longwall mining beneath the creek will be negligible.

No mining is proposed beneath or within the angle of draw of Grassy Trail Reservoir. Therefore, the potential for loss of water from reservoir leakage is believed to be negligible.

Bear Canyon is situated in the northwest portion of the permit area within the SITLA lease area. This canyon is unique because it is within the right fork of this drainage that the cover over the longwall subsidence zone is the shallowest of anywhere in the entire permit area. In one part of the bottom of the (right fork) Bear Canyon drainage the cover over the longwall panes is approximately 325'. Due to the increased potential for the effects of subsidence to reach the surface in this area special attention has been focused on the hydrologic character of the Bear Canyon drainage.

Bear Canyon is typical of the canyons draining the southwest-facing front slopes of the Book Cliffs in this area. These canyons are generally shorter and drier than those drainages on the back-side of the Cliffs. Several baseline surveys of Bear Canyon right fork done in the late 1980's showed the drainage to be mostly dry and the canyon was identified as ephemeral along with other similar front-facing canyons in the permit area, such as "C" Canyon, "B" Canyon, and "A" Canyon. However, during site visits in June and July of 2005, substantial stream-flow was observed in the drainage. This occurrence of flow, along with the observation of riparian vegetation in the lower stretches of the canyon, has led to a re-evaluation of the classification of the drainage as intermittent. Also, because the area of the Bear Canyon watershed is greater than one square mile the drainage is classified as intermittent under DOGM regulations.

Historical observation of Bear Canyon shows the streamflow in the bottom of the drainage to be a combination of surface flow and subsurface flow. In those areas where bedrock is at or close to the surface, flow is forced up to the surface. In other areas where the alluvium in the channel is thick and porous the flow is subsurface and the stream channel is often dry. The stretches of channel exhibiting surface flow as opposed to subsurface flow will vary from season to season, and year to year depending on prior precipitation trends in the watershed. There are times when the entire length of the channel could be expected to exhibit surface flow, and other times when surface flow is confined to certain segments. And, according to past monitoring observations, there are often times when there is no flow in the stream channel. In order to better define the hydrologic character of the canyon WEST RIDGE Resources will expand the monitoring program in Bear Canyon by adding two new monitoring sites and relocating a third site (see Map 7-7 and Table 7-1).

As mentioned previously, there is a point in the right fork of Bear Canyon where cover over the longwall panel will be about 325' which is the shallowest surface cover of any place within the current WEST RIDGE mine plan. This, along with the fact that there are state-appropriated surface water rights in this drainage (refer to Appendix 7-5), makes this an area of special interest. There is reason to expect that full-extraction longwall mining will not adversely affect the hydrologic resources of the canyon in this area. According to Syd S. Peng, ("Coal Mine Ground Control", 1978, Wiley, New York) a general rule-of-thumb is that subsidence-related fractures can be expected for a distance above the coal seam equal to 50 times the mining height, which works out to be 316' for the shallow point in Bear Canyon, which is slightly less than the cover in that area. Therefore due to the shallowness of cover in this area there could be subsidence fractures which reach the surface in the bottom of the canyon, and mitigation will be done to protect the resource.

The shallow overburden point coincides with the inflection point of the longwall subsidence profile. Based on a 22 degree angle of draw the tension zone will extend along the surface from the inflection point (shallow point) downstream approximately 130'. Areas upstream from the inflection point will be in compression as the longwall panels are extracted in progression from the southwest to the northeast according to the approved mining plan. Cracks are more likely to open up in the tension zone as compared to the compression zone where lateral forces are pushing toward each other rater than pulling apart. As mining progresses to the northeast, cover increases rapidly because of the gradient of the channel bottom and the dip of the coal seam, and surface effects of subsidence should diminish in that direction. Therefore, it is expected that any cracking which might reach the surface should most likely appear in the canyon bottom in the 130' (plus/minus) tension zone down-canyon from the inflection point. Special subsidence monitoring will be focused on this area.

WEST RIDGE will establish two new hydrologic monitoring sites in the right fork of Bear Canyon. The first site (ST-11) will be located within the tension zone described above. This site was chosen because this location should be well-suited to determine if tension cracks have affected stream flow. It is also, coincidentally, one of the areas where the bedrock nature of the channel bottom forces water to the surface, thereby making streamflow measurements more accurate. The second site (ST-12) will be located about 2400' farther up-canyon in another area where, again, the bedrock nature of the channel allows for a more accurate streamflow measurement. A third monitoring site (ST-13) will be located below the forks of Bear Canyon just outside the permit area boundary. This site will replace the existing monitoring site ST-4.

During the flow season of 2005 and 2006 (that is, May 15 through September 15) site ST-11 will be monitored monthly as long as flow is present. This monthly monitoring will help better define the nature of streamflow prior to longwall extraction in the area, which is presently scheduled for May, 2007. Thereafter, monitoring will be done on the regular quarterly basis. Site ST-12 is more inaccessible, and could be dangerous to reach in the winter. Therefore this site will be monitored twice a year, once during late spring/early summer (expected peak flow) and once in late summer/early fall, when the canyons are normally much drier. Site ST-13 will be monitored quarterly.

The longwall is presently scheduled to pass under Bear Canyon in the spring of 2007. Prior to that, WEST RIDGE will complete a survey of a series of subsidence monitoring points established up the bottom of the drainage on either side of the inflection point. After the longwall has passed under the drainage these points will be re-surveyed and an accurate account undermined WEST RIDGE will visually inspect the area to determine if any effects of subsidence are apparent. Within thirty days of the inspection WEST RIDGE will submit a written report to the Division outlining the results of this inspection .

Recent site visits have determined the existence of riparian type vegetation in the lower reaches of Bear Canyon below the forks. WEST RIDGE commits to preparing a detailed vegetation survey and mapping of the canyon bottom with emphasis on the existence of riparian specie. This survey will be conducted during the growing season of 2005 or 2006. The survey will be done in consultation with Division biologists and the completed report will be added to the Mining and Reclamation Plan as an appendix.

If it is determined that mining-related subsidence has adversely impacted the hydrologic resources of Bear Canyon, including and state-appropriated water rights, WEST RIDGE will mitigate the damage. The first option would be to seal any cracks with the application of bentonite clay. Bentonite sealing compounds are available commercially made specifically for such applications. If bentonite sealing proved ineffective, WEST RIDGE would propose the installation of piping to transport stream water across the fracture zone to continue the flow downstream. Any work done in the stream channel would most likely require the issuance of a channel alteration permit from the Utah Division of Water Rights.

Adverse impacts to the hydrologic balance resulting from the installation and operation of the Bear Canyon gob vent holes (GVH) are not anticipated. The basis for this conclusion is summarized below.

The gob vent holes will be constructed in a manner that minimizes the potential for adverse impacts to groundwater and surface-water resources and the hydrologic balance in the area. The proposed construction designs for the GVH holes include a nominal 20 foot length of 16-inch non-perforated steel surface casing that will be cemented in place. The surface casings will isolate the wells from surface-water, soil moisture, and any shallow groundwater potentially present in the upper 20 feet and will prevent shallow water from entering the GVH wells. From approximately 20 to 200 feet below the surface, the proposed well construction plans call for the placement of 9.625-inch non-perforated steel casing that will be cemented into place. The cemented steel well casing will isolate groundwaters that may be present in bedrock groundwater systems in the upper 200 feet from the GVH wells and prevent the inflow of groundwater into the wells.

Proposed construction plans call for the lower approximately 150 feet of the GVH wells to be cased with 8.75-inch slotted steel casing that will be left open to the rock strata and will not be cemented. The purpose of the slotted steel casing is to allow the drainage of gob gasses into the well bore in the fractured rock strata overlying the Panel 8 gob. While there is the potential for drainage of some Blackhawk Formation groundwater into the GVH holes in the 150 feet interval overlying the longwall gob, the potential for appreciable or sustained groundwater drainage through these wells is minimal. This is because 1) groundwater systems in the Blackhawk Formation occur in hydraulically isolated groundwater partitions that are not in hydraulic communication with adjacent groundwater partitions, which limits the amount of groundwater that could potentially be drained, 2) the GVH holes are situated near the up-dip ends (outcrop locations) of the Castlegate Sandstone and Blackhawk Formation which limits groundwater recharge potential and the potential for the interception of regional groundwater systems, and 3) the 150-foot interval of the Blackhawk Formation overlying the gob area was likely intensely fractured as a result of the longwall mining prior to the construction of the wells which would likely have drained the groundwater partitions immediately overlying the gob area at the time of mining. For these reasons, the potential for drainage of appreciable groundwater or surface-water resources through the GVH drill holes is considered low.

The potential for detrimental impacts to the ephemeral Bear Canyon Creek drainage or any associated alluvial groundwater systems is considered remote. Appreciable baseflow alluvial groundwater systems were not identified near the GVH location during the 7 October 2008 site visit. Additionally, because the GVH well bores will be hydraulically isolated from the upper approximately 200 feet, the potential for impacts to water quality in the drainage are unlikely. The implementation of appropriate sediment control management practices will minimize the potential for increased sediment yield from the GVH site during the construction and operational phases of the GVH system.

Prior to final reclamation, the GVH drillholes will be plugged and sealed in accordance with State and Federal regulations. The casings will be plugged at the bottom to hold the concrete. A lean concrete mixture will be poured into the casing until the concrete is within five feet of the surface. At that time the casing will be cut off at ground level and the rest of the casing will be filled with lean concrete. The concrete will be allowed to harden before final reclamation is completed. In this manner, the potential for any long-term impacts to the hydrologic balance resulting from the GVH system will be minimized.

Spring Canyon is located in the northern part of the permit area in SITLA lease 44771. There are no state-appropriated water rights on this lease. (Refer to Appendix 7-5 for additional details.) The surface is privately owned by Penta Creek with whom WEST RIDGE maintains coal mining rights. Longwall mining in this area is not scheduled until the year 2014. In this area the coal seam is 2500' deep under the bottom of the Canyon. Spring Canyon, as the name would imply, contains several springs. The drainage area of Spring Canyon is well in excess of one square mile. The canyon supports a number of beaver dams indicative of perennial flow. WEST RIDGE will add three additional monitoring points to collect baseline water monitoring data in Spring Canyon, namely ST-15 located upstream from the junction of Grassy Trail Creek, SP-101 located on a channel-bottom spring a short ways up Little Spring Canyon (a fork of Spring Canyon), and SP-102 located about 1000' upstream from the junction of Little Spring Canyon. This spring emanates from the west side of the canyon approximately 200' up from the canyon bottom. Refer to Map 7-7 and Table 7-1 for details. For the first two years (starting with the third quarter of 2005) these sites will be monitored on a quarterly basis for baseline data according to the field measurements and laboratory measurements outlined in Table 7-2 (Surface Monitoring) and Table 7-3 (Groundwater Monitoring). Thereafter, all sites will be monitored for flow and field parameters on a quarterly basis.

The Grassy Trail Dam and Reservoir is located immediately outside the eastern boundary of the permit area. This dam/reservoir is owned and operated by the cities of East Carbon and Sunnyside, has a storage capacity of 916 acre-feet, and provides most of the culinary water supply to these municipalities. The dam lies approximately 1664' vertically and 995' horizontally away from the nearest point of projected underground mining (longwall panel #7). This equates to 31 degrees, which is greater than the normal angle of draw associated with longwall subsidence. WEST RIDGE Resources has hired R,B&G Engineering to prepare a detailed evaluation report of the potential effects of longwall mining on the dam and reservoir. This evaluation report was reviewed by the Division of Dam Safety, DOGM, Bureau of Land Management, and the cities of East Carbon and Sunnyside. The report analyzed the potential impacts from both subsidence and seismicity associated with full extraction mining, with specific emphasis on panel #7, the longwall panel projected for mining nearest to the dam. The report concluded that the risk to the dam and reservoir is minimal, and that event the maximum probable seismic event or subsidence scenario would be well within the safety factor of the dam. In addition, there are no known faults that intercept the dam that could be encountered in the mining of Panel #7. The Division of Dam Safety, the BLM, and the cities of East Carbon and Sunnyside have all accepted the conclusions of the report. This report (Grassy Trail Dam and Reservoir Seismicity Report) is included in Appendix 5-11. This report also includes as an appendix an independent report prepared by Agapito Associates (Estimated Impacts to the Grassy Trail Reservoir due to Longwall Mining) which addresses the potential effects on the dam/reservoir due to longwall induced subsidence. A companion report (Grassy Trail Dam & Reservoir Phase II Dam Safety Study) is included as Appendix 5-12. WEST RIDGE has committed to an intensive program of monitoring of the dam and reservoir during the mining of Panel #7. This monitoring plan is outlined in section 301-114.100 of this Mining & Reclamation Plan and is included indetail in Appendix 5-13.

Based on subsequent approval of the mine plan, panel #7 was extracted starting in December, 2005, and completing in September 2006. Extraction closest to the Grassy Trail Reservoir occurred in March, 2006. Monitoring, as described above, was conducted continuously during the mining of panel #7. As predicted by the RB&G report, there was no mining related damage to the dam, although some slumpage of the adjacent hillside occurred, resulting in minor movement of the west abutment of the dam. There was no loss of integrity of the earthen structure of the dam. In January, 2008, after the area above and adjacent to panel 7 had completely stabilized, RB&G Engineering prepared a post-mining Summary Report of the mining-induced seismicity. This report is included in Appendix 5-16.

After panel 7 was completed, longwall mining moved to the west side of the mains near the outcrop (more than two miles distant from the dam), and then proceeded to the northeast. Also during this time, the company went to a panel-barrier system of longwall extraction, replacing the previous side-by-side panel method. This panel-barrier system leaves a 400' wide solid barrier pillar between each longwall panel, and has significantly reduced the magnitude and frequency of mining-related seismic events. During the ensuing five years of mining, the company has continued to monitor the dam and reservoir. Results of this monitoring have been provided to all the regulatory agencies and the owners of the reservoir on a regular basis. The results of this monitoring have shown that all mining-related effects on the reservoir have stabilized. RB&G Engineering then, in September, 2010, prepared a summary report update of the subsequent mining-induced seismicity, and this report is included in Appendix 5-17.

On July, 21, 2010, BLM approved the R2P2 for federal lease UTU-78562 and approved mining of panels 18, 19 and 20 on the east side of the mains in the vicinity of the Grassy Trail Reservoir. In the decision document, BLM states, *"We agree with the conclusion that mining longwall panels 18 through 20 as submitted should have no adverse effects on the dam structure or reservoir. The dam structure has seen no detectable affects from the mining of panel number 7. The proposed panels are further distant from the reservoir and much further from the Grassy Trails Reservoir dam. Also, the new panel-barrier design has reduced dramatically the amount and intensity of any mining induced seismicity or subsidence. Additionally, this mining plan will comply with the lease stipulation to not subside perennial streams, unless authorized, as the Left Fork Whitmore Canyon Stream will be under a barrier pillar and no full extraction mining is planned under the stream."* A copy of the approved R2P2 for panels 18-20 is included in Appendix 5-3C. As with the previous mining of panel 7, the company commits to conducting the same level of intensive monitoring of the dam during longwall mining of panel block 18-20, as previously approved by the regulatory agencies, as stated above, and included in Appendix 5-13.

As mentioned in the BLM approval letter, mining of panel block 18-20 will be further distance away from the Grassy Trail dam than with panel 7. Panel 7 mined within 995' (horizontal) from the dam, while the closest mining from Block 18-20 would be more than 3000' (horizontal) away. Also, panel 7 was about 1664' stratigraphically lower than the dam; while panel block 18-20 is located more than 2200' lower than the dam. Also, panel 7 was mined using side-by-side panels, whereas panel block 18-20 will be mined as panel-barrier, further reducing the potential for seismicity.

It is considered very unlikely that adverse impacts to the hydrologic balance will occur as a result of mining activities in the 273.43-acre permit boundary change area that will allow longwall mining of Panel 22. The reasons for this conclusion are summarized below.

The coal seam in the development entries to be mined in the Panel 22 permit modification area is separated from the land surface by more than 2,650 feet of bedrock cover. The depth of cover overlying longwall Panel 22 will range from about 2,800 to 3,500 feet, which will make the West Ridge Mine the deepest coal mining in operation in the world when this area is mined.

The overburden in the Panel 22 permit modification and surrounding areas is made up of a heterogeneous sequence of bedrock formations which creates alternating horizons of mostly impermeable rocks and relatively permeable rocks (See Appendix 7-1). This heterogeneity prevents significant vertical or horizontal movement of groundwater within the overburden. The overburden present above the Panel 22 longwall mining area includes the entire thickness of the North Horn Formation, Price River Formation, Castlegate Sandstone, and portions of the Colton Formation. A southwest to northeast geologic cross section through the Whitmore Canyon and adjacent areas that depicts these relationships is provided in Appendix 7-1 (see cross-section A-A' in Figure 6 of Appendix 7-1). In particular, the North Horn Formation is known regionally to contain hydrophyllic clays that swell when wetted to seal fractures that may form (Appendix 7-1).

There will be no longwall mining beneath the Right Fork of Whitmore Canyon Creek. The only mining under the Right Fork will be the full-support mining of development entries associated with the longwall bleeder system. Using these mining techniques, no subsidence of the land surface is anticipated, and the potential for fracturing of overlying strata is minimized.

Accordingly, because only full-support development mining techniques will be used, there should be *no* subsidence of the stream bed in the Right Fork of Whitmore Canyon in the Panel 22 permit modification area. Accordingly, the potential for fracturing of overlying strata beneath the stream bed will be negligible.

It should be noted that the Division has previously approved development mining beneath the Right Fork of Whitmore Canyon. Development mining for longwall panel 20 has already occurred under the currently approved mining plan (under about 2,200 feet of cover). The proposed mining of development entries for longwall panel 20 in the panel 20 extension area will occur under an additional at least 400 feet of cover.

A stream gain/loss study was performed by Petersen Hydrologic, LLC in the Right Fork of Grassy Trail Creek in October 2011. A report summarizing the findings of this investigation is provided in Appendix 7-14. The purpose of the gain/loss study was to provide a baseline characterization of spatial variability in baseflow stream discharge rates in the stream reaches in proposed mining areas (i.e. to characterize gaining and losing reaches of the stream). Additionally, the study provides insights into interactions between groundwater and surface-water systems in the canyon.

Petersen Hydrologic reports that the maximum upstream flow (above proposed mining areas) on 24 October 2011 was 673 gpm measured at monitoring site 2. The maximum downstream flow (below proposed mining areas) on that same day was 712 gpm monitored at site 11. Discharge rates measured in the middle portions of the surveyed stream reach are somewhat lower.

During the field investigation, it was observed that materials comprising the stream channel substrate in the Right Fork consist of cobbles, gravels, and fine-grained sands and silts in varying proportions. The width of the valley bottom is also variable within the surveyed reach of the Right Fork. Both the uppermost and lowermost portions of the surveyed stream channel were relatively narrow bottomed, while the valley bottom widened considerably in the middle reaches. Also present in the middle reaches of the Right Fork was a series of beaver dams.

Discharge rates were measured at 11 locations along the surveyed stream course (see Appendix 7-14 for locations). At nine of these locations, discharge measurements were performed using a current-velocity meter and a wading rod. The other two measurements were performed at the permanently installed Parshall flumes in the Right Fork. The results of these measurements are presented in Appendix 7-14, (Appendix 7-14; Table 1, and are plotted in Figure 2).

When the stream was surveyed in October 2011, there was a net increase of 39 gpm from the maximum measured upstream flow (673 gpm) to the maximum downstream flow (712 gpm), which represents a gain of approximately 5.8%. The maximum up-stream discharge measurement was determined using the newly installed 3-foot Parshall flume at station RF-2. The maximum downstream discharge measurement was performed using a current-velocity meter and a wading rod at a location a short distance below the lower flume (RF-1). It should be noted that under ideal conditions, the accuracy range of stream flow measurements performed using a current velocity meter and wading rod is typically on the order of 5 to 10 percent. The typical range of measurement error for a well constructed and maintained Parshall flume is approximately 3 to 5% plus head detection error (see USBR water measurement manual). Thus the 5.8% measured difference between the maximum upstream and maximum downstream flow readings is within or slightly greater than the anticipated margin of error anticipated for the flow measurement techniques utilized.

Petersen Hydrologic concluded that it is likely that the decrease in stream discharge rates measured in the middle portion of the surveyed stream channel results from groundwater-surface-water interactions (i.e. the infiltration of surface flows into zones of permeable alluvium beneath the stream channel). This effect is likely most significant in the middle portions of the surveyed Right Fork where the canyon bottom widens and a series of beaver dams impounds surface waters on the underlying alluvial sediments.

Petersen Hydrologic concluded that the flux of water moving down the Right Fork drainage includes both surface flows within the stream channel and also waters migrating through subsurface zones of coarse alluvial sediments beneath the stream channel. Such occurrences are very common in streams in the region. In some zones, more water moves through the alluvium, in other zones it is less. Most notably, in the middle reaches of the surveyed stream, where the valley bottom is wide and a series of beaver dams impounds water over broad portions of the valley floor, the stream looses water which flows into the underlying alluvial groundwater system. In the lower reaches of the surveyed stream the valley bottom becomes narrower and stream discharge rates increase as water flows from the alluvium into the stream channel. It is important to note that discharge rates in the Right Fork at the most downstream monitoring point are similar to or slightly greater than those measured at the maximum upstream monitoring point (RF-2). What this indicates is that, while some Right Fork stream water recharges the alluvial groundwater system in the middle reaches of the surveyed stream, this same water likely reemerges at downstream locations in the drainage (i.e. there is no apparent loss of water from the drainage).

Petersen Hydrologic concluded that the measured 5.8 percent increase in discharge rate at the lower monitoring site relative to the maximum upstream site may be explained by 1) the forcing of alluvial groundwater to the surface near the mouth of the canyon as the valley width decreases, and perhaps also as the Grassy Trail Reservoir groundwater system is intersected, , 2) typical discharge measurement error, 3) minor contributions of groundwater to the stream flow in the surveyed reach of the stream, or 4) a combination of these factors.

What this indicates is that, while there may possibly be a modest gain of water in the stream, there is apparently no large source of groundwater gain between the stream areas above and below proposed mining areas.

What these discharge measurement indicate is that during baseflow conditions, approximately 94% of the water that flows down the Right Fork of Whitmore Canyon in proposed mining areas is sourced from regions higher in the drainage. These source areas are completely outside areas which could potentially be impacted by mining operations at the West Ridge Mine. Given that no mining-related subsidence of the stream channel or valley bottom is anticipated, and that the stream is separated by the underlying development entries by at least 2,650 feet of cover, it seems exceedingly unlikely that detrimental impacts to discharge rates in the Right Fork drainage could occur. Similarly, in the absence of physical changes to the stream channel itself, detrimental impacts to water quality in the stream are likewise not anticipated.

In the very unlikely event that impacts to the stream channel or underlying alluvial groundwater system were to occur as a result of mining-related activities at the West Ridge Mine, these would be readily detectable in discharge rates at the lower monitoring station in the Right Fork relative to upstream discharge rates measured at flume RF-2. Petersen Hydrologic indicates that in the lower reaches of the drainage, there is readily measurable discharge of alluvial groundwater into the overlying stream channel. Any potential upstream losses of flow (either from the stream itself or from the underlying alluvial groundwater system) should be manifest as a decrease in flow in the vicinity of the lower flume RF-1. Accordingly, because impacts to either the surface-water and/or alluvial groundwater components of the hydrologic balance in the area can be monitored at RF-1, and because of the very low level of risk associated with full-support development mining only, with no anticipated subsidence, under more than 2,650 feet of cover, the construction of alluvial groundwater monitoring wells does not seem warranted at this time. The fact that the essentially all of the water present in the drainage under baseflow conditions originates from areas outside the proposed mining areas (which will not be impacted) further supports this conclusion (see Appendix 7-14).

It should be noted here that Petersen Hydrologic indicates that the lower flume in the Right Fork of Whitmore Canyon (RF-1) is situated atop coarse grained alluvial deposits consisting largely of cobbles and gravels. Discharge measurements performed in the Right Fork on 24 October 2011 suggest that during baseflow conditions, an appreciable portion of the surface water present above the flume bypasses the flume itself and flows through the coarse alluvium beneath the flume (see Appendix 7-14). Accordingly, these factors should be considered when discharge data from RF-1 are interpreted. Accordingly, when discharge monitoring occurs at RF-1 during low-flow periods (when the relative contribution of the subsurface flow component is substantial and when the flows are near the lower working range of the flume, discharge monitoring will be performed a short distance below the RF-1 flume in order to gain a more accurate measurement of the stream flow in the lower Right Fork.

It should also be noted that during drought periods or at times when the stage of the Grassy Trail Reservoir is lowered, water levels in the Right Fork alluvial groundwater system near the reservoir may correspondingly decline. As a result of the declining alluvial water levels, upwelling of alluvial groundwater into the lower Right Fork stream channel could temporarily diminish or cease (i.e. much or even all of the water in the drainage could migrate through the coarse, permeable alluvium beneath the stream channel). The lack of the reemergence of the alluvial groundwater into the channel in this area would result in a decrease in the measured flow in the stream. Thus under persistent drought conditions or low reservoir levels it is possible that surface flow could be present in the vicinity of the upper flume (where the alluvium is apparently both less extensive and less permeable), but absent near the mouth of the drainage where the abundance of coarse-grained, permeable alluvium is present beneath the stream channel. Accordingly, it will be necessary to carefully evaluate climatic conditions and reservoir stage levels when evaluating the reasons for potential future low flows in the lower reaches of the

Right Fork.

If in the future a loss of flow in the Right Fork is suspected, it would be useful to at that time repeat the gain/loss investigation as performed by Petersen Hydrologic (Appendix 7-14) to quantify changes to the system that may have occurred.

While no longwall mining beneath the Right Fork drainage will occur, longwall mining beneath the adjacent upland areas will occur at panels 20, 21, and 22. For several reasons, it is considered very unlikely that the undermining of these areas will result in detrimental impacts to the hydrologic balance. The basis of this conclusion is described below.

It has been the previous experience at the West Ridge Mine that subsidence measured above longwall mining panels in this portion of the mine has been minimal (typically on the order of an inch or less, and in many instances it has been undetectable). Because of the very large depth of cover in proposed mining areas (2,700 to 3,500 feet), and the minimal amount of anticipated surface subsidence, it is considered unlikely that groundwater systems in the Colton Formation exposed at the land surface and in the upper several hundred feet of overburden in the area would be adversely affected by the proposed mining activities.

No springs have been identified in the area directly overlying longwall panel 22 within the panel 22 extension area. The springs identified in the area surrounding Panel 22 discharge from the Colton Formation. Beneath the Colton Formation lies the entire thicknesses of the North Horn Formation, Price River Formation, and the Castlegate Sandstone. The presence of these formations between the coal mine workings and the land surface creates an effective hydraulic barrier to downward groundwater flow. A single spring (6-113) overlies a gateroad entry for Panel 22 in the existing permit area which has already been approved for mining. Spring 6-113 discharges from the Colton Formation at a rate of about 1.5 gpm (Appendix 7-6a). Spring 6-113 is separated from the proposed Panel 22 mine workings by about 2,800 feet of bedrock overburden. The presence of the more than ½ mile vertical thickness of relatively impermeable bedrock strata that separates spring 6-113 from the mine workings, and the minimal anticipated ground subsidence associated with the longwall mining (likely less than an inch) suggests that the potential for impacts to this spring is minimal.

Springs RFS-1 and RFS-2 were identified in the 2011 Petersen Hydrologic spring and seep survey (Appendix 7-6b). These springs are located several hundred feet from Panel 22 and, due to the thick overburden thickness and the lack of any anticipated subsidence should not be impacted.

Springs 6-104, 6-105, 6-106, and 6-107 all discharge from alluvial deposits near the Right Fork stream channel (Appendix 7-6a). Coal mining in the vicinity of these alluvial springs will consist of full support development mining only. As no subsidence in these areas is anticipated, and because the springs are separated from the development mine entries by more than 2,600 feet of overburden, impacts to these springs are considered unlikely.

It is illustrative to compare the recommended minimum overburden thicknesses for coal mines as recommended by the SME in the Mining Engineers Handbook (See Chapter 10.6, "Mine Subsidence"). The Mining Engineers Handbook recommends that *for total extraction mining* a vertical distance between the mine and a water body *with potential for causing catastrophic damage* should be a minimum of 60 times the coal mining height. The same vertical separation distance is recommended for protection of aquifers overlying total extraction mining areas. (A similar standard has often been applied by Federal and State regulatory agencies in Utah coal mining permitting activities). Using a conservative estimate of a 10-foot coal seam thickness to be mined, the minimum overburden thickness required for protection of overlying surface water bodies and aquifers situated above total extraction areas would be 600 feet. Given that the overburden thickness above the proposed longwall Panel 22 ranges from about 2,800 to 3,500 feet, it is calculated that the overburden thickness present above Panel 22 is 4.6 to 5.8 times the minimum recommended by SME. Similarly, given that the vertical distance between the Panel 22 bleeder entries and the stream channel in the Right Fork of Whitmore Canyon exceeds about 2,650 feet, it is calculated that the overburden thickness there is 4.4 times the minimum thickness recommended by SME for *total extraction mining* below the creek. Given that only full support development entry mining will occur beneath the creek, it follows that the potential for adverse impacts to the creek bed as a result of the proposed development mining is negligible based on considerations set fourth by SME.

It should be noted that groundwater has previously been encountered in fault systems at the West Ridge Mine. Water bearing fault zones have also been occasionally encountered at other surrounding coal mines in the Book Cliffs coal mining district. If a water-bearing fault system were to be intercepted by the mine workings in the Panel 22 permit modification area, groundwater inflows from the fault system could occur. However, because of the thickness of the overburden in the area (> 2,700 feet), and the poor vertical water transmitting potential of the clay-rich overburden lithologies (which are known regionally to contain clay minerals that have the tendency to heal mining-induced fractures when wetted), the potential for a possible fault system to intercept shallow groundwater systems that could support springs or provide baseflow to streams is considered low (See Appendix 7-1).

As mining progresses beneath the Right Fork of Grassy Trail Creek drainage, the rates of groundwater interception in each longwall panel area will be closely monitored. West Ridge Resources plans to install a total of six flow meters to measure the discharge from each of the three longwall panels in the Right Fork of Grassy Trail Creek drainage (two each in Panels 20, 21, and 22). The locations of these flow meters are shown in Appendix 7-16. By having flow meters at the outflow points of the longwall panels (located at sumps in both the headgate and tailgate entries) it will be possible to quantify the groundwater interception rates in each panel as the drainage is undermined.

If substantial, sustained inflows of groundwater (exceeding about 250 gpm for more than one month) are encountered when mining in the Right Fork drainage (longwall Panels 20, 21, and 22), a qualified Hydrogeologist will perform a hydrogeologic investigation of the intercepted groundwater system. It should be noted that the interception of modest quantities of ancient Blackhawk Formation groundwater during mining operations in the Left Fork is anticipated (this is a common occurrence in essentially all Utah coal mines). The less common occurrence of a sustained, significant flow will warrant further hydrogeologic investigation. The purpose of the hydrogeologic investigation will be to characterize the intercepted groundwater system and, where possible, determine its likely source. Where directed to do so by the Division, the results of the hydrogeologic investigation will be incorporated as a revision of this PHC.

It should be noted that after the mining in this district is completed, that portion of the mine will be permanently sealed. As a result, discharge data from this area can be collected only for as long as the area remains open and accessible. Based on current mining projections, this area will likely be sealed in early- to mid-2013.

As noted by Petersen Hydrologic (2012) the discharge rate from the West Ridge Mine has increased substantially over time since discharge first occurred from the mine in 2003 (see discharge rate data for site UPDES 002). This condition is likely attributable in large part to the fact that the rate of mining in recent years has greatly exceeded the mining rate in the first years of mining. Mining rates have increased substantially since 2009. West Ridge Mine personnel indicate that the total mining area opened during the period from 2009 to 2012 is significantly greater than that opened during the previous 8-year period from 1999-2007 (Personal Communication, David Hibbs, 2012). When mine openings intersect isolated, water-bearing geologic units with water held in storage, the rate at which such units are intersected and drained will largely control the rate at which the groundwater enters the mine workings. Thus, it is not unanticipated that the mine groundwater interception and mine water discharge rates would increase substantially as the mining rates, particularly the rates at which new mining districts are opened, increase.

West Ridge Mine personnel indicate that relatively little water was encountered in the mine workings when mining near the outcrop occurred during the early years of mining activities. The water that was encountered was predominantly sourced from the mine roof in these areas (Personal communication, Gary Gray, 2012). As mining progressed rapidly down-dip under deeper cover, increased amounts of water began to be intercepted. Much of this water originated from upwelling from the mine floor. It seems likely that the floor water is derived largely from the underlying Sunnyside Sandstone member of the Blackhawk Formation which directly underlies the mined Lower Sunnyside Coal Seam at the West Ridge Mine.

The specific water-bearing stratums that yield water to the mine workings are not known. This is largely due to the fact that most of the water intercepted in the West Ridge Mine drains from mined-out longwall gob areas (Personal communication, Dave Shaver, 2011). Because these areas are completely inaccessible to personnel, it is not possible to identify the specific origins of the water entering the mine gob areas after mining. However, in the general sense, it has been observed that groundwater enters the mine workings through 1) sandstone paleochannels in the mine roof, 2) upwelling of groundwater from the mine floor, and 3) along fault and fracture damage zones. It is likely that the bedrock fracturing associated with the longwall mining process enhances the permeability of water bearing strata adjacent to the mine openings through which groundwater enters the gob areas. The removal of the coal resource (which in most locations is largely impermeable) may also facilitate the inflow of groundwaters from overlying or underlying water-bearing strata.

While the exact source(s) of the intercepted mine waters are not known, it seems plausible that a major beach-barrier bar sandstone deposits within the Blackhawk Formation (such as the Sunnyside Member) could potentially contribute to the volume of water intercepted by the mine workings. The mined coal seam (the Lower Sunnyside Coal Seam) lies directly above the Sunnyside Sandstone Member. The Sunnyside Member is predominantly sandstone and is approximately 100 to 190 feet thick in the mine area (Mayo and Associates, 1998) which gives it a large potential groundwater storage volume. Additionally, large channel sandstone deposits are present in the upper unnamed member of the Blackhawk Formation, which is a shallow marine foreshore deposit that directly overlies the Lower Sunnyside Coal Seam. Appreciable groundwater storage volumes are potentially present in these channel sandstones. Other water-bearing sandstone units intersected by mining-induced fractures in the overburden geologic sequence could also potentially contribute water to the West Ridge Mine workings. As indicated previously, the carbon-14 and tritium data indicate that groundwater from the shallow, near-surface systems that support most springs in the area is not in good hydraulic communication with the deep, inactive-zone groundwaters encountered in the underground mine workings at the West Ridge Mine. Accordingly, it is considered exceedingly unlikely that shallow, active-zone groundwater systems that support springs and seeps in the area, or provide baseflow discharge to streams could be the source of the groundwater intercepted in the West Ridge Mine.

It should be noted that fault- and fracture-related groundwater inflows have been observed in the West Ridge Mine. As evidenced by the old carbon-14 dates and the absence of tritium in groundwaters encountered in the West Ridge Mine, it is evident that hydrodynamic communication with overlying active-zone groundwater systems has not been established through these faults or fractures. It is considered likely that the fault and fracture systems in the mine area provide pathways of enhanced secondary porosity which interconnect the mine openings with nearby, adjacent water-bearing strata. The abundant presence of soft shales, mudstones, and claystones, and the presence of hydrophyllic swelling clays in the rock strata likely limit the potential for fracture planes to remain open within these strata, particularly under the considerable confining pressures associated with the very thick overburden present at the West Ridge Mine.

The quantity of water utilized underground as mine process water is variable based on mining conditions. Typically, in total the amount utilized over the entire underground mining operation may amount to a few hundred gallons per minute. However, a substantial amount of the water (perhaps more than 50%) used underground is non-consumptive. After use, this water generally flows to sump areas where it is pumped from the mine as part of the mine discharge water.

728.320 Presence of acid-forming or toxic-forming materials

Acid-forming materials in western coal mines generally consist of sulfide minerals, namely pyrite and marcasite, which, when exposed to air and water, are oxidized causing the production of H^+ ions (acid). Oxidation of pyrite will occur in the mine; however, acidic waters will not be observed in the mine. The acid is quickly consumed by dissolution of abundant, naturally occurring carbonate minerals. Iron is readily precipitated, as iron-hydroxide, and excess iron will be not observed in mine discharge water.

No other acid-forming materials or any toxic-forming materials have been identified or are suspected to exist in materials to be disturbed by mining.

728.331 Sediment yield from the disturbed area

Undisturbed drainage from C Canyon upstream from the mine yard facility area will, for the most part, be culverted underneath the mine site by means of a 4' diameter corrugated metal pipe in the right fork and a 3' diameter culvert in the left fork drainage. This culvert has been sized to meet or exceed the design storm for this drainage area. Runoff from the mine site disturbed area and whatever natural runoff which flows onto the disturbed area will be channeled to the mine site sediment pond. The drainage control system for the mine site is shown on Map 7-2.

The culvert and ditch system is designed to handle drainage from a 10 year, 24 hour event. Any storm event that exceeds this amount will flow through the mine yard drainage structures to the sediment pond. If a storm should exceed the design event and the magnitude of the runoff exceeds the pond capacity, the over flow will be channeled through the pond cells and out the emergency spillway to the natural drainage channel below the sediment pond. This overflow will have a lower suspended solid content than the inflow to the pond or any drainage which may be flowing down the natural drainage channel. The sediment pond will detain the inflowing water and allow suspended solids to settle out in the pond cells prior to discharge. Given the ephemeral nature of the drainages and the fact that the sediment pond is designed for the complete retention of the 10 year, 24 hour storm event, it is unlikely that discharge from the sediment pond will occur very often if ever. Since the sediment pond is designed to completely contain the 10 year, 24 hour event, only a limited amount of outflow, that in excess of the design event, would be discharged. Excess water contained in the sediment pond following runoff events would be allowed to settle and evaporate, or be decanted in a controlled manner through the primary discharge pipe to reduce the potential for erosion downstream.

Using the Universal Soil Loss Equation (USLE), an estimate of the annual sediment yield from the mine site disturbed area (in the pre-mining condition) is 0.3082 acre-feet per year. In the operational phase, this same area (the mine yard disturbed area) would then yield 0.3090 acre-feet per year. During the postmining phase, the estimated annual sediment yield is projected to be 0.2679 acre-feet per year. Even though the sediment yield from this area will be greater during the operational phase, the sediment pond has been designed to handle the sediment yield from the disturbed area and retain it in the pond. This will effectively reduce the sediment yield from the disturbed area to an insignificant amount during the operational phase of the mine.

The sediment pond will be constructed as soon as practical at the mine site during construction. When reclamation of the mine yard is initiated following the operational phase, the sediment pond will be removed during removal of the bypass culvert and restoration of the natural channel through the site. Silt fences will be installed adjacent to the reclaimed channel to collect and contain sediment from the regraded site. The silt fences will be constructed approximately along contour with overlapping ends to prevent drainage from going around the ends. Refer to Map 5-9. Because the surface of the regraded area will be gouged with a backhoe bucket to create large depressions, the depressions of the regraded area will also act as a sediment trap. It is anticipated that sediment yield from the reclaimed area will be similar to other adjacent undisturbed areas.

During reclamation, if it is determined that topsoil resources are needed from the topsoil borrow site to achieve reclamation of the mine site, silt fencing would be placed around the outer limits of the borrow area to be disturbed. Topsoil would be stripped and stockpiled. The required amount of topsoil would then be removed from the borrow site. Care would be taken to contour the borrow pit such that runoff infiltration would be maximized to the fullest extent within the disturbed area. This would include gouging the regraded surface with pits approximately 24" wide, 36" long and 18" deep as well as sloping the regraded slopes inward to encourage precipitation infiltration on-site.

There will be no new surface disturbances associated with the 273.43-acre Panel 22 permit modification area. Little or no subsidence of the land surface is anticipated as a result of the proposed mining operations (likely a few inches or less). Accordingly, no increase in sediment yield from disturbed areas is anticipated as a result of mining and reclamation activities in the permit modification area.

728.332 Impacts to important water quality parameters

Since 2003, mine discharge waters from the West Ridge Mine have been discharged to ~~WEST RIDGE Resources, Inc. anticipates that at some time it may be necessary to discharge water from its proposed mine into~~ the C Canyon drainage. The distance from the ~~proposed~~ discharge point in the ephemeral C Canyon to the confluence with the first perennial stream, Grassy Trail Creek near Sunnyside Junction, is approximately 10 miles. Because of the general aridity of the region, and the permeable nature of the alluvial sediments over which the discharge water will flow, it is likely that some of the mine discharge water will infiltrate into the alluvial sediments beneath the creek bed. ~~it is unlikely that the above-ground flow of discharge water will persist to the confluence with Grassy Trail Creek.~~ When mine water is discharged into an ephemeral drainage from Andalex's Tower Mine (located in the Book Cliffs 15 miles north of West Ridge), water flows in the drainage for less than one mile before the flow is entirely lost to infiltration or evapotranspiration. Likewise, Icelander Creek, which flows over alluvial sediments at the base of the Book Cliffs Escarpment just south of East Carbon, flows for only about 4 miles before being totally lost to infiltration. ~~Therefore, there will most likely be no impacts to important water quality parameters in Grassy Trail Creek from proposed mining operations because mine discharge water will likely not reach the creek.~~ Currently, West Ridge Mine discharge waters do flow from the mine to the confluence with Grassy Trail Creek. As anticipated, it is apparent that the saturation of alluvial sediments along the C Canyon drainage has occurred as a result of the mine water flowing through the C Canyon drainage. The alluvial groundwater systems are likely perched atop the underlying low-permeability Mancos Shale sediments. ~~However, if mine discharge water were to persist in the stream channel to the confluence with Grassy Trail Creek, the volume of discharge water entering the creek will be only a fraction of that which discharged from the mine.~~

The discharge rate of West Ridge Mine water during 2011 averaged approximately 1,800 gpm. During the 15-month period from January 2011 to March 2012, the TDS concentration of the West Ridge Mine discharge water averaged 1,254 mg/L.

Discharge water from the Sunnyside Mines located southeast of West Ridge had TDS concentrations of about 1,600 mg/l, with the dominant ions being sodium, sulfate, and bicarbonate (Sunnyside Coal Company, 1993). The chemical composition of this water is similar to that of waters that have been in contact with the Mancos Shale. The TDS concentration of discharge water from the West Ridge Mine is likely similar to or of better quality than that discharged from the Sunnyside Mines. ~~WEST RIDGE Resources, Inc.'s proposed new mine will likely be similar to discharge from the Sunnyside Mines.~~

The TDS concentration of water in Grassy Trail Creek at the mouth of Whitmore Canyon, (USGS station 0931430) near the upper contact with the Mancos Shale, averaged 988 mg/l between 1979 and 1984, with the dominant ions being sodium, sulfate, and bicarbonate (Waddell, 1981). The water quality of Grassy Trail Creek after flowing over 11 miles of Mancos Shale sediments to the confluence with the C Canyon drainage near Sunnyside Junction is significantly degraded.

Due to the ~~low anticipated volume of mine discharge water which will flow into Grassy Trail Creek, and the~~ similarity of the chemistry of the mine discharge water to the water in the creek, the water quality in Grassy Trail Creek will likely not be significantly impacted by mine discharge water.

Because of the poor quality of the water naturally flowing in Grassy Trail Creek near Sunnyside Junction and the apparent quality of the West Ridge Mine discharge water ~~relatively small quantities of mine discharge water (if any)~~ which are flowing into the creek, important water quality parameters in Grassy Trail Creek, such as sodium, sulfate, and bicarbonate will not be significantly increased.

Some of the water from the West Ridge Mine infiltrates ~~any potential discharge from WEST RIDGE Resources, Inc.'s proposed new mine will infiltrate~~ into the alluvial sediments in Clark Valley near the Book Cliffs escarpment. This results in a rise in the local water table, or the creation of a perched water table above impermeable layers. Shale layers in the Mancos Shale will prohibit significant downward migration of these waters. The raising of the local water table has apparently resulted ~~may result~~ in increased vegetation in the area. The increase in vegetation and the presence of surface water in the drainage would be a positive impact on wildlife and the local ecosystem. There are no known water rights or surface facilities adjacent to the stream drainage that could be impacted by the rising water table. Because the water quality of groundwaters in the Mancos Shale is naturally poor (with TDS significantly greater than 1,600 mg/l), the addition of mine discharge water to this system will not have any detrimental effects on water quality.

The Sunnyside mines discharged water from the mine workings for many years. This water was put to beneficial use for agricultural purposes such as growing alfalfa crops and also for irrigating the municipal golf course, from the time it was built in 1967 up to the closure of the mine in 1993. The city park also used the mine water for irrigation since the mid-1940's. Sunnyside Coal Company had an approved UPDES permit with a TDS concentration limit of 1,650 mg/l for the mine water discharge. Excess water was discharged into Grassy Trail Creek where it was also utilized by cattle and wildlife.

The chemical quality of groundwater discharging from springs above the proposed coal mine will not be adversely affected by underground mining operations. The chemical quality of surface water flowing in upper Grassy Trail Creek will likewise not be adversely affected by underground mining operations. It has been demonstrated (Mayo and Associates, 1997; Appendix 7-1, 2001; Appendix 7-1A) that deep groundwaters adjacent to the coal seams throughout the Book Cliffs and Wasatch Plateau coal fields are hydraulically isolated from shallow overlying groundwater systems which support springs and provide baseflow to streams at the surface. There is no mechanism by which important water quality parameters in shallow groundwater systems above the West Ridge Mine ~~WEST RIDGE Resources, Inc.'s proposed coal mine~~ may be adversely impacted by mining operations.

There are no known springs of significance in the lease and adjacent area which discharge from locations that are stratigraphically or topographically below the coal seam to be mined. The thick Mancos Shale will prevent the migration of any mine discharge water downward to formations underlying the Mancos Shale. No seeps or spring exist within or adjacent to the proposed topsoil borrow area to the west of C Canyon.

There should be no change to the quality of mine discharge waters as a result of mining in the 273.43-acre Panel 22 permit modification area. This conclusion is based on the assumption that mining conditions and the hydrogeochemical regime in the proposed mining area will be similar to those encountered elsewhere in the West Ridge Mine. The chemical quality of groundwater discharging from springs in the permit boundary change area should not be adversely impacted as a result of the proposed mining operations. This conclusion is based on the fact that 1) springs in the area are separated from the underlying mine workings by more than 2,500 feet of overburden, and 2) because of the minimal subsidence anticipated in the area, significant impacts to bedrock or alluvial strata that support groundwater flow to spring discharge locations likely will not occur.

728.333 Flooding or streamflow alteration

Discharge from the West Ridge Mine has occurred on an essentially continuous basis since 2003. The mine water is discharged to the C Canyon drainage. ~~WEST RIDGE Resources, Inc. anticipates that at some time it may be necessary to discharge water from its proposed mine into the C Canyon drainage~~. The discharge point is about 1 mile above the confluence with B Canyon. Both C and B Canyons are ephemeral drainages that rarely have flow. The stream channel in this drainage is large enough to contain torrential thunderstorm events that commonly exceed several cfs in this region. The anticipated discharge rate from the mine is unknown at this time. However, historic discharges from nearby mines in the Book Cliffs coal field (Soldier Canyon and Sunnyside) average about 300 to 400 gpm. It is possible that over the life of the mine the discharge rate from the West Ridge Mine ~~WEST RIDGE Resources, Inc.'s proposed mine~~ could be in this same range. However, it must be noted that as new mine workings are developed in "wet" areas, the discharge rate may temporarily exceed this amount. It is anticipated that similar mining conditions will be encountered in mine workings in the proposed the 273.43-acre permit boundary change area that will allow longwall mining of Panel 22. The discharge rates from these mines have been quite variable over time due to the nature of the groundwater systems encountered in the mines. Groundwater encountered in coal mines in the Book Cliffs and Wasatch Plateau coal fields is contained mostly in sandstone channels and in fractures and faults. It is not unusual for large portions of the mines to be mostly dry. For these reasons, the mine discharge rate is more a function of the amount of new mine area recently opened than the total size of the mine. At the Soldier Canyon Mine, mining proceeded for several years before any significant water sources were encountered and thus, no discharge occurred. Similar experiences are reported at Andalex's Tower

Mine. For the first four years of mining at the West Ridge Mine, discharge of mine water did not occur. Beginning in February 2003, sustained discharge of mine water from the West Ridge Mine began to occur. During 2003, the mine discharge rate averaged about 170 gpm. During the next several years, the mine-water discharge rate increased. By 2011, the average discharge rate exceeded 1,700 gpm. ~~Thus, although short-term increases in mine discharge rates will likely occur, the long-term average will probably be in the range of 300 to 400 gpm if water is encountered.~~

It is not anticipated that the discharge of a few cubic feet per second (cfs) of mine discharge water will cause flooding or significant alteration of the streambed in the C Canyon drainage. ~~A discharge of 300 to 400 gpm will not cause flooding or significant alteration of the streambed in the C Canyon drainage.~~ The channel geometry in C Canyon is primarily the result of erosion which occurs during torrential thunderstorm events where the flow in the drainage is several times that anticipated from the West Ridge Mine. ~~WEST RIDGE Resources, Inc.'s proposed mine.~~ The mine discharge will easily be contained within the inner stream channel, which should be stable. Additionally, if a constant~~, relatively small~~ discharge is achieved in C Canyon as a result of mine discharge, the net effect will be a positive one. Vegetation densities along the stream bank will increase causing increased bank stability and decreased erosion. Wildlife habitat will also be improved with the available water and the vegetation growing on the stream bank.

No streams exist in or adjacent to the proposed topsoil borrow area west of C Canyon in section 16, T. 14 S., R. 13 E.

Rates of Groundwater interception at the West Ridge Mine have varied with time and location during the period of operation of the mine. While some areas of the mine have been relatively dry, other portions have been considerably wetter. While it is not possible to predict with certainty the quantities of water that will be intercepted in any given mining area, it seems unlikely that anomalous quantities of water (of such a magnitude that flooding or streamflow alteration resulting from the discharge of mine water to the surface) will be encountered in the Panel 22 permit modification area.

Based on several factors, it is considered unlikely that gravity discharge will occur from the West Ridge Mine portals after mine closure. However, it should be noted that due to the complex nature of the hydrogeology of the mountainous regions in which the West Ridge Mine exists, there can be no guarantee that discharge from the mine portals after mine closure will not occur.

The coal seam at the West Ridge Mine dips steeply to the northeast at about 13 degrees into the mountain escarpment. Accordingly, for groundwater to discharge from the mine portals, it would be necessary for the entire mined are to fill completely with groundwater (i.e. all of the mine workings are at an elevation lower than the mine portal elevation). Petersen Hydrologic, LLC (2012; Appendix 7-17) reports that the water intercepted by the West Ridge Mine working is ancient in origin, with radiocarbon ages ranging from about 10,000 to 23,0000 years. The lack of tritium in the intercepted mine water indicates that the groundwaters have been isolated from the surface for at least the past 50 years. Petersen Hydrologic (2012) further concludes that the groundwaters encountered in the West Ridge Mine are apparently being removed from storage in the deep, mountain-core area. The heterogeneity and low permeability of the rock strata overlying mined areas minimizes the potential for both vertical and horizontal flow of groundwater. Accordingly, the potential for recharge to the groundwater systems from which old water has been drained from storage is low. Therefore, because the rocks which previously held the stored groundwater would be drained with little potential for the system to recharge, the potential for continued inflows of groundwater into the mine workings from the deep, mountain-core groundwater systems after mine closure also seems low. It should also be noted that because of the steep dip of the rock strata to the northeast into the mountain front, in order for the flooded mine workings to have sufficient hydraulic head to result in portal discharge, the groundwater system that recharges the abandoned mine workings must have a hydraulic head equal to or greater than the portal elevation. Additionally, the quantity of water that would be required to recharge the abandoned mine workings would also need to include sufficient water to re-saturate the adjacent permeable bedrock horizons that are hydraulically connected to the mine openings which have previously been drained during mining operations in addition to sufficient water to fill the volume of the open mine voids themselves. As indicated by Mayo and Associates, strong hydraulic communication between the Blackhawk Formation coal seams and overlying geologic formations is not apparent.

It is noteworthy that gravity discharge from the adjacent Kaiser Steel Corp. Sunnyside Mine workings has not occurred in the 19 years that have transpired since the closure of that mine in 1993. Similar conditions would be anticipated at the adjacent West Ridge Mine workings after mine closure.

728.334 Groundwater and surface water availability

Mining in the permit area (including the 273.43-acre permit boundary change area that will allow longwall mining of Panel 22) will not significantly affect the availability of groundwater. Groundwaters in the Blackhawk Formation exist in highly compartmentalized partitions, both vertically and horizontally, and the formation does not act as a hydraulically continuous aquifer. Groundwater systems in the Blackhawk Formation are hydraulically isolated from overlying, modern groundwaters (See Appendix 7-1 and Appendix 7-17). The effects of locally dewatering the Blackhawk Formation adjacent to mine openings will not have any significant impact on groundwater availability in the region surrounding the mine.

There are no groundwater supply wells in the mine lease area or adjacent to it. Likewise, there are no water supply wells in the 273.43-acre Panel 22 permit modification area. The removal of water from horizons immediately above and below the mined horizon will not impact any water supplies. Rather, underground mining makes water available from the Blackhawk Formation that was previously inaccessible.

Because of the extreme thicknesses of the bedrock overburden in the Panel 22 permit modification area, and the fact that only full-support development mining will occur beneath the Right Fork of Whitmore Canyon Creek (with more than 2,700 feet of cover), it is considered very unlikely that adverse impacts to the availability of surface waters in the creek will occur (See discussion in Section 728.310). Similarly, because of the extreme thickness of bedrock overburden overlying longwall Panel 22 (about 2,700 to 3,500 feet), adverse impacts to discharge from springs in the area are not anticipated (See discussion in Section 728.310).

Petersen Hydrologic (2012; Appendix 7-17) performed an isotopic investigation of groundwater systems at the West Ridge Mine. In-mine groundwaters sampled as part of this investigation were old, with radiocarbon ages ranging from about 10,000 to 23,000 years. Tritium was absent in the sampled groundwaters. These isotopic characteristics of the in-mine groundwater systems demonstrate that they are isolated from the shallow, tritium-rich active-zone groundwater systems that support most spring and seep discharges in the area (see Mayo and Associates, 1998; Appendix 7-1). As a result of the hydraulic isolation that exists between the deep, inactive-zone groundwater systems encountered in the West Ridge Mine and the shallow, active-zone groundwater systems that support springs and seeps, and the heterogeneous, low-permeable character of the rocks that comprise the interburden between these two groundwater systems, contamination, diminution, or interruption of State-appropriated waters are not anticipated.

For the reasons discussed above (including Section 728.310) the underground coal mining and reclamation activities in the Panel 22 permit modification area should not result in the contamination, diminution, or interruption of State-appropriated water.

728.400 The hydrology and geology of the area around Grassy Trail reservoir is discussed in a seismic analysis report (see Appendix 5-11) and the Phase II dam safety report (see Appendix 512). These reports conclude that it is unlikely that mining induced seismicity or subsidence will impact the performance of the Grassy Trail Dam and Reservoir. Based on the conclusion of this study the BLM has approved the R2P2 to allow full extraction longwall mining of Panel #7. BLM also added a special stipulation #17 to the federal lease related specifically to the Grassy Trail Reservoir, stating, "*The Lessee is and will remain liable for any and all damages or hazardous conditions resulting from the mining operations under the lease.*"

Based on BLM's approval the company then successfully mined longwall panel 7 from December, 2005 through September, 2006. Soon thereafter, RB&G Engineering prepared a summary post-mining report on the mining related affects on the reservoir (see Appendix 5-16). Still later, in 2010, RB7G Engineering prepared an additional update to the summary report (see e). Based on these reports, BLM has recently approved the R2P2 to allow additional longwall mining of panel block 18-20 on the east side of the mains in the vicinity of (i.e., west and north of) Grassy Trail reservoir (see Appendix 5-3C). This new approval contains the same reference to lease stipulation #17, as with the previous approval of panel 7.

R645-301-729 CUMULATIVE HYDROLOGIC IMPACT ASSESSMENT (CHIA)

The Division will provide an assessment of the probable cumulative hydrologic impacts of the proposed coal mining and reclamation operation and all anticipated coal mining and reclamation operations upon surface and groundwater systems in the cumulative impact area.

R645-301-730 OPERATION PLAN

R645-301-731 GENERAL REQUIREMENTS

A plan has been included to minimize disturbance to the hydrologic balance, to prevent material damage, and to support postmining land use.

731.100 Hydrologic Balance Protection

Groundwater Protection

Although testing has shown that no significant impacts from acid or toxic producing materials should occur, groundwater quality will be protected by handling runoff in a manner which minimizes the infiltration into the groundwater system. Examples of techniques that may be utilized to accomplish this would include routing disturbed area drainage to the sediment pond through properly sized ditches and culverts and diverting undisturbed drainage through a bypass pipe past the disturbed area.

Within the disturbed area, drainage will be directed to ditches by sloping the yard areas. The ditches will be appropriately sized to handle flow from the 10 year/24 hour event. Culverts within the drainage system have also been sized to meet or exceed the 10 year, 24 hour design criteria.

Surface Water Protection

Coal mining and reclamation activities will be conducted according to the following plan.

The sediment pond will be installed as soon as possible during construction of the surface facility area. The pond will be appropriately sized to handle the design storm event (10 year, 24 hour) for the mine site.

Protection of surface water will incorporate measures cited under Groundwater Protection. All surface runoff from the mine site disturbed area will be diverted to the sediment pond for treatment. The sediment pond has been designed to provide total containment for the 10 year/24 hour storm plus three years of sediment accumulation. Based on sampling of the soils in the area and the fact that waste rock material will not be stored on the surface, it is unlikely that the sediment pond will impound acid- or toxic-drainage.

It is anticipated, based on the climate of the area, that the sediment pond will remain dry most of the time. (This has been demonstrated to be true for existing coal mining operations in central Utah.) Water in the pond should evaporate rapidly following precipitation events. Infiltration into ground water zones is not expected because of the interbedded nature of the strata below the pond. Thick sequences of shale in the bedrock below the pond will greatly limit the vertical movement of water. Also, the alkaline nature of other sediment flowing to the sediment pond would serve to neutralize any low pH materials when mingled together.

To minimize disturbance to the undisturbed drainage, large diameter bypass culverts will be installed beneath the mine yard facility to allow runoff upstream above the mine site to continue downstream without coming in contact with and becoming contaminated by the mine yard area.

The bypass culvert system will be the first structure to be installed during construction of the mine site facility. Undisturbed area drainage will be bypassed under the disturbed area to minimize the amount of drainage that must be treated by the sediment pond. The bypass culverts will allow natural drainage to continue down the drainage course unaffected by the mining operation. A 36" diameter culvert will be installed in the left fork and a 48" diameter culvert will be installed in the right fork. A 48" culvert will be installed in the main canyon below the confluence of the forks. The size of the culverts will adequately pass the 100 year, 6 hour flow event even though a smaller culvert would meet the requirements of the regulations.

At the topsoil pile locations, undisturbed drainage will be diverted around the stockpiles with ditches at the edge of the pile toward the undisturbed drainage channel. The ditches will divert water away from the stockpile to minimize erosion. The ditches have been sized to convey flow from the 10 year, 24 hour event. The ditches will slope 1% toward the natural drainage. A typical ditch design is presented in Appendix 7-4 "West Ridge Mine Sedimentation and Drainage Control Plan". The stockpiled topsoil material will be loosely piled and have an irregular, pitted surface or contour furrows to help retain runoff from precipitation events and to reduce erosion until vegetation becomes reestablished. A diversion ditch will be constructed at the edge of the stockpile to divert undisturbed drainage away from the stockpile. Silt fencing will be placed around the perimeter of the stockpile to treat any runoff from the pile.

The topsoil stockpile and test plots will be designated as Alternate Sediment Control Areas (ASCAs).

Refer to Appendix 5-5 for a complete discussion on the construction of the topsoil stockpiles. Refer to Appendix 7-4 for details of the drainage control designs. Map 2-4 depicts the drainage controls of the topsoil stockpile areas.

731.200 Water Monitoring

This section describes the hydrologic monitoring plan. Locations of operational surface-water and groundwater monitoring sites are indicated on Map 7-7. Hydrologic monitoring protocols, sampling frequencies, and sampling sites are described in Tables 7-1 through 7-5. _Operational field and laboratory hydrologic monitoring parameters for surface water are listed in Table 7-2, and for groundwater in Table 7-3. The hydrologic monitoring parameters have been selected in consultation with the DOGM's directive Tech-004, *Water Monitoring Programs for Coal Mines.*

Water monitoring reports will be submitted on a quarterly basis to UDOGM. Should any ground water or surface water samples indicate noncompliance with the permit conditions, the operator will promptly notify the Division and immediately provide for any accelerated or additional monitoring necessary to determine the nature and extent of noncompliance and will provide the results of the sampling to the Division.

Operational field and laboratory parameters were measured quarterly for the first ten years of mine operation, rather than for only the first two years as originally proposed in the MRP. The original MRP stated that after a two-year period of quarterly monitoring, if sampling has adequately characterized the hydrology in the area, a request would be made to reduce monitoring to field parameters and one operational analytical sample collected during low flow (3rd Quarter). It also stated, the physical parameters and chemical composition of springs and streams in and around the permit area should be adequately characterized following the collection of three years of baseline laboratory data and two years of operational laboratory data. (The first year of field data was collected in 1985-1986. The original MRP further stated that, thereafter, continued quarterly monitoring for laboratory parameters would probably not enhance the scientific understanding of hydrologic systems in the mine permit area. Beginning in 2nd Quarter of 2011, WEST RIDGE Resources, Inc. ~~will implement this reduced schedule for ST-10 and~~ will officially drop stream sites ST-5, ST-6A, ST-7, ST-11, ST-12 and ST-13 and spring sites SP-15, SP-16, WR-1 and WR-2. Also, beginning 2nd Quarter of 2011, a total of four flumes will be added, two in the left fork, (LF-1 and LF-2) and two in the right fork, (RF-1 and RF-2). Two springs in the right fork will be added, road spring and Section 5 spring; and 1 stream in the right fork, Patterfore Stream.

Each of the sampling locations and their hydrologic significance are described below. However, in order to comply with UDOGM directive Tech-004, baseline samples will be collected from each spring in the monitoring program during the low flow (fall) sampling and from each stream monitoring site during low flow every five years beginning with the first mid-term review. The five year baseline samples will be repeated every five years until reclamation is complete.

Two years of baseline monitoring has been performed at all monitoring sites; subsequently, the quarterly operational monitoring schedule was utilized through 2010. Monitoring as specified herein will continue through reclamation until bond release unless otherwise modified.

Streams

Grassy Trail Creek is the only perennial stream in the permit and adjacent areas. Four sites on Grassy Trail Creek have been monitored.

Stream site ST-10 is located on the north end of our mining panels, this site will be replaced by a new 2' parshall flume called LF-2. ~~a reduction in laboratory analyses from quarterly to annually will be implemented beginning 2nd Quarter of 2011.~~ Stream site ST-3 is located below the confluence with Hanging Rock Canyon. Stream site ST-8 is located just above the confluence with Water Canyon, downstream of the permit area and ST-9 is located on upper Grassy Trail Creek at the inlet to Grassy Trail Reservoir. In 2nd Quarter of 2011, Patterfore Stream was added to the permit. This stream site is located north of the extent of our mining panels in the right hand fork of Grassy Trail. These monitoring sites on Grassy Trail Creek will be used to document any potential changes in stream flow or water quality that may be attributable to mining at WEST RIDGE, so data collection efforts at these sites will continue~~. while ST-10 will be on the reduced monitoring schedule.~~ A description of Upper Grassy Trail water quality included above, which was included in the original verison of the MRP based upon two years of data, indicates that magnesium, calcium, and bicarbonate are the major ionic components, and that TDS at ST-3 is 350 mg/L. After 10 more years of data collected, analysis indicates that the assessment is still correct: those three ions still represent the majority of the dissolved solids in Upper Grassy Trail Creek, and calculated average TDS at ST-3 is 358 mg/L. Further, quarterly water quality monitoring shows that there is relatively minor temporal variation in water quality at these sites, based upon an assessment of their major ions as represented by Stiff, Piper, and Schoeller Diagrams (see Appendix 7-11). ~~Therefore, reduction in collecting analytical samples from quarterly to annually at ST-10 is supported by the record.~~

One tributary to Grassy Trail Creek within Whitmore Canyon is also monitored. ST-15 is located in at the mouth of Spring Canyon, and has been monitored since 2003. No flows have been reported since that time. It will continue to be monitored quarterly, and operational samples will be collected if flow is occurring during quarterly visits.

The sample point RST-1 was added 3rd Quarter of 2010. This site is located on the right fork of Whitmore Canyon above Grassy Trail Reservoir. In 2nd Quarter of 2011, this site will be replace by a 3' parshall flume called RF-1. This site will continue to be monitored quarterly and analyzed for operational field and laboratory parameters.

On the west side of West Ridge, five stations have been monitored for many years on ephemeral drainages contributing to lower Grassy Trail Creek. They are ST-4 (lower Bear Creek), ST-5 (below confluence of B and C Canyons), ST-6A and ST-6 (above and below the mine site, respectively, in C Canyon) and ST-7 (below A Canyon). ST-4 was monitored by visual observation of the channel for flowing water. ST-5 had a crest gauge and automatic sampler while ST-6A, ST-6 and ST-7 each had a crest gauge and bottle samplers. The west side of West Ridge stream monitoring stations, are described as follows:

ST-4 No monitoring equipment was ever located at this site. The purpose of this station was to conduct baseline observations for two years to determine whether this portion of Bear Creek acted as an ephemeral or intermittent stream channel. Based on monthly monitoring during 1997 and 1998, it has been determined that intermittent flow does not occur in the lower section of Bear Creek and the channel responds only as an ephemeral drainage following substantial rainfall events. This continued to be documented at this site until 2005, when it was officially dropped from the monitoring plan in July 2005.

ST-5 From 1997 through 2008, this location contained the ISCO automatic sampler and a crest gage. This station monitored drainage from both the B and C Canyon drainages. However, based on field observations, virtually all of the flow comes from the B Canyon drainage, primarily the lower side drainages and adjacent Mancos slopes. Both the B and C Canyon drainages respond as ephemeral drainages. In recent years, this site typically continued flows that were 100 percent comprised of mine discharge. While originally intended to cover both B and C Canyon drainages because surface facilities were contemplated in both of these canyons, its locations below the confluence is no longer important since surface facilities are contained within C Canyon, and not in B Canyon. Because the site has served its primarily purpose (to document the ephemeral nature of flows) and because it represents essentially the same data as is also collected upstream at ST-6, this site will be dropped from the monitoring plan beginning 2nd quarter of 2011.

ST-6 and ST-6A

These two stations are located below and above the proposed mine site in C Canyon, respectively. A crest gage (as described above) and bottle samplers were installed at these sites in 1997, with only partial success at registering flows or collecting samples. Once operations began at the mine, improving access and communications, these structures were less important. The long record of data at ST-6A indicated very little, if any, flow at this site even during severe precipitation events; snow melt runoff often appears to consist of underflow through the heavy organic matter in the cannel bottom. Further, once mine discharge began, ST-6 generally receives continuous flow comprised of 100 percent mine discharge. Therefore, there is no correlation between flows at ST-6A and ST-6. The area below ST-6A was last mined in February 2007. Beginning 2nd quarter of 2011 ST-6A will be dropped while ST-6 will continue to be monitored. Although there have been some changes in ionic strength of this water over the years, as shown by Stiff, Piper, and Schoeller Diagrams (see Appendix 7-11), the basic ionic makeup of the water remains fairly constant. This water is also sampled for UPDES samples just a short distance upstream from ST-6 on a monthly basis, which provides analytical data for compliance purposes.

ST-7 A crest gage and sampler bottles have been located in the A Canyon drainage since 1997, however equipment functionality in this very flashy and sediment-laden stream has been minimal. Originally established to document drainage, it has not served any purpose in the monitoring plan for many years, since the haul road was constructed elsewhere. Further, there are no surface facilities planned for this drainage and underground mining has been progressing in the opposite direction. This site will no longer be monitored after 2nd quarter of 2011.

ST-11 This site, located in Bear Canyon, was added to the monitoring plan in 2005, for reasons described above in Section 728. It has been monitored since that time, but no flows have ever been reported. The area below ST-11 was mined out in November, 2006. This site will be dropped beginning 2nd quarter of 2011.

ST-12 This site, also located in Bear Canyon and described above in Section 728, has similarly been monitored since 2005. The area below ST-12 was mined out in October 2007. No flows have been reported since that time. It will be dropped from the monitoring plan beginning in 2nd quarter 2011 as there is no longer any reason to document flow regime in this reach of Bear Canyon.

ST-13 Similarly, this site is located in Bear Canyon, and was added to the monitoring plan in 2005, for reasons described above in Section 728. It has been monitored since that time, but no flows have been reported. This site will be dropped from the monitoring plan beginning in 2nd quarter 2011.

Springs

Eight_springs in the permit and adjacent areas have been monitored since at least 1999; some of these have been monitored by WEST RIDGE since 1997, and some even earlier by other entities. Two other springs, SP-101 and SP-102 have been monitored since 2003. Four of these springs (SP-12, SP-13, SP-15, and SP-16) discharge from the lower slopes of West Ridge in Whitmore Canyon. Two springs, WR-1 and WR-2, discharge from the upper slope of West Ridge in Whitmore Canyon. Refer to Map 7-7. One spring (SP-8) discharges in the upper drainage of C Canyon. Hanging Rock Spring (S-80), SP-101 and SP-102 are located near the northeast corner of the permit area and discharges from the east slopes of Whitmore Canyon.

Most of the monitoring stations in this monitoring program are located on the east slope of West Ridge. This is because, with the exception of SP-8, there are no springs that are suitable for monitoring on the west side of West Ridge.

Beginning in 2nd Quarter of 2011, monitoring at SP-15, SP-16, WR-1 and WR-2 will be discontinued. These sites are away from the direction that mining is occurring or will occur in the future, a long record is in place to document that no impacts have occurred, and any past subsidence activities have long ceased. WR-1 is located outside the West Ridge Mine permit area. It was undermined by the adjacent Sunnyside Mine workings at a depth of more than 2000' below the surface as shown on Plate 7-7. This area was undermined at least fifteen years ago. WR-2 is located 2400' above the underlying coal seam and was undermined in June, 2004 as part of the West Ridge mining operation. Subsidence monitoring has been conducted by Ware Surveying as a part of the continuing monitoring program for the Grassy Trail Reservoir located not far away. Several of the subsidence points were located above longwall panel 7 and are less than 1700' feet from WR-2. These points were undermined in March, 2006. This survey shows that mining-induced subsidence in these areas has been completely stabilized for the past three years (see Appendix 7-13). Since WR-2 was undermined by longwall panel 5 nearly two years prior to the Grassy Trails subsidence points, this provides strong assurance that the area around WR-2 has now been similarly stabilized for an even longer time period.

At sites SP-12, SP-13, SP-101, SP-102, S-80 and SP-8, quarterly monitoring will continue.

Beginning 2nd Quarter of 2011, two springs in the right fork will be added to the monitoring plan. The first will be called road spring and the second will be called Section 5 spring.

Wells

Only one groundwater monitoring well (DH86-2) exists in the permit area. This well monitors the Sunnyside Sandstone Member of the Blackhawk Formation, which is below the coal seam that will be mined. In addition to field parameters and operational water quality parameters, water level will be measured in this well. Because data collected at this site since 1997 exhibits more variability than at the other monitoring sites, quarterly analytical sampling will continue.

Underground Sampling

UG-1 Staring in the fall of 2010, West Ridge Resources will begin an underground monitoring program on the pre-treatment mine-water. A monthly sample of the in-mine water will be collected prior to treatment and analyzed for operational field and laboratory parameters. Parameters will include total and dissolved iron, sulfate, alkalinity, total and dissolved solids, field conductivity, field temperature, field dissolved oxygen and field pH. The sample will be collected in 9th right between the seal and treatment area. This sample point will be called UG-1. Please refer to Appendix 5-15, Attachment 10 for a description and location of UG-1.

Underground Flow Meters, Right Fork Longwall Panels

In order to determine the possible affects of mining within the watershed of the Right Fork of Whitmore Canyon, the company has committed to installing flow meters in the underground mine works. Longwall panels #20, 21 and 22 are the only panels proposed to mine within the Right Fork watershed, as depicted on Map 5-4A and Map 7-8. (It should be noted that there will be no longwall mining conducted under the Right Fork; the only mining to extend under the Right Fork will be the development mining associated with the gate-roads and bleeder entries.) Any water encountered in mining these panels will have to be pumped out of the mine through any of the six development entries (gate-roads) associated with these panels (2 each gate-roads per panel). Therefore the company commits to installing a total of 6 each flow meters, one in each gate-road of the these panels in order to measure the amount of water encountered in the mine within the vicinity of the Right Fork drainage. The flow meters will be installed at the sumps where the gate-roads connect to the main entries, and where the minewater is collected and pumped into the main discharge waterline.

The specific location of these flowmeters is shown on the map in Appendix 7-16, and also Map 7-7. The flow meters will be installed at such time that any water is encountered in quantities sufficient to require pumping. The flow meters will be equipped to read instantaneous flow and total flow. The flow readings will be reported to the Division on a monthly basis. If the total cumulative flow from these meters exceeds 250 gpm (0.5 cfs) for a period of more than one month, the company will notify the Division and will initiate a hydrogeologic investigation and a subsequent revision of the PHC. The flow meters will be monitored and reported as long as any water continues to flow from these panels, or until this area of the mine is sealed, according to MSHA and BLM approvals. Under the current production schedule, the entire lower end of the mine will be sealed around March, 2013 for safety reasons, at which time the only remaining mining will be several small longwall panels near the outcrop.

Grassy Trail Flumes

In response to an agreement between the company and the owners of the Grassy Trail Dam/Reservoir (East Carbon City, Sunnyside City and Sunnyside Cogen Power Plant) flow measurements, field parameters, and lab analysis of the Right and Left Forks of Whitmore Canyon above the reservoir will be taken, as described below:

RF-1 This is a 3' Parshall flume located in the Right Fork immediately above the reservoir. This is an existing flume, owned by East Carbon City, which was recently restored to operational condition. Initial flow readings began in May, 2011. This flume will be equipped with a recording device. This flume is located downstream from any proposed mining activity below (underground). This flume now replaces RST-1 as a stream monitoring point.

RF-2 This is a newly installed 3' Parshall flume, (June, 2011). It is located in the Right Fork approximately one mile upstream (north) of the reservoir. It is also located upstream from the most northerly extent of any proposed projected future mining below. The location of this flume was selected to provide baseline flow data, in conjunction with RF-1 located downstream, to help assess the affects of potential future mining on the stream flow of the Right Fork. This flume will be equipped with a recording device.

LF-1 This is a newly installed 2' Parshall flume, (June, 2011) located in the Left Fork immediately above the reservoir. It is located in an area where an old flume, owned by East Carbon City, was previously located, but has for many years been dysfunctional. Although the coal reserves under the Left Fork have already been mined, LF-1 will provide baseline flow data to help assess the affects of previous longwall mining on the stream flow of the Left Fork. LF-1 will become an active monitoring site as soon as construction is complete, scheduled for July, 2011. This flume will be equipped with a recording device. When completed, LF-1 will replace ST-9 as a stream monitoring location.

LF-2 This is a new 2' Parshall flume located in the Left Fork approximately two miles upstream (west) of the reservoir, and is presently (July, 2011) under construction. Although the coal reserves under the Left Fork have already been mined, LF-2 will be located upstream from any mined out area below. The location of this flume was selected to provide baseline flow data, in conjunction with LF-1 downstream, to help assess the affect of previous longwall mining on the stream flow of the Left Fork. This flume will be equipped with a recording device. LF-2 will become an active monitoring site as soon as construction is complete, scheduled for July, 2011. When completed, LF-2 will replace ST-10 as a stream monitoring location.

In previous discussions with the Division, West Ridge Resources had committed to installing Parshall flumes with continuous recording devices in both the Right and Left Forks of Whitmore Canyon. These commitments were based on the then proposed mining plan, which contemplated longwall mining with potential subsidence directly beneath the Right Fork drainage. Subsequently, as mining has progressed, due to unforeseen geologic conditions, the proposal for longwall mining beneath the Right Fork was abandoned.

Under the currently proposed mining plan, only full-support mining of development entries beneath the Right Fork is proposed. Given that 1) no subsidence of the stream channel is anticipated, and 2) the proposed development entries are isolated from the overlying stream channel by more than 2,000 feet of low-permeability bedrock overburden, the potential risk associated with the currently proposed mining activities in the Right Fork is minimal, and as such does not seem to warrant the intensive, continuous monitoring protocols previously contemplated. Additionally, it has become evident that the collection of continuous stream discharge data from the Whitmore Canyon Flumes would likely not be straightforward. The basis for this conclusion and West Ridge Resources' proposal for on-going monitoring at the Whitmore Canyon monitoring stations are discussed below.

While the currently installed continuous stream flow monitoring devices at the Whitmore Canyon Flumes can be operated successfully during the snow-free and ice-free period of the year, these systems generally cannot provide reliable discharge data when there is the possibility of snow and ice being present in the canyon (which can be approximately half of the year). This is because 1) the water in the stilling wells and piping can become frozen or blocked during cold periods resulting in the collection of non-representative discharge data, or 2) the primary measuring device (i.e. the flume itself) can be impacted by ice or accumulated snow (i.e. the accumulation of ice along the edges of the flume throat, the development of layers of surface ice in the flume throat or approach section, or the physical blockage of the flume with ice, snow, or other debris). These conditions can result in the user unknowingly computing and compiling erroneous discharge data at the flumes. The interpretation of data collected when there is a possibility of snow and ice being present becomes very problematic (i.e. it is unknown whether a change in the flume stage is a result of an actual change in the stream flow rate or whether it is a result with a problem at the flume).

Additionally, the flumes installed in Whitmore Canyon are either 2-foot or 3-foot Parshall flumes. Accurate discharge data can be determined using these flumes during the high-flow and mid-season flows when discharge rates are in the normal working range of the flumes. However, during seasonal low-flow conditions, or during drought conditions, the flows in the streams may drop below the normal working range of the flumes (resulting in less accurate flow readings). Accordingly, discharge monitoring at these sites during the seasonal low-flow or drought conditions may be performed using an alternate appropriate discharge measurement technique a short distance below the flume locations. However, during these conditions when the alternate, manual data collection techniques are employed, continuous data collection obviously cannot be accomplished.

It should also be noted that the flumes and the automated data collection systems are not the property of West Ridge Resources. Accordingly, the maintenance and availability of these systems is beyond the control of West Ridge Resources.

While no impacts to discharge rates in the streams are anticipated, the types of impacts that could conceivably occur would likely not be of the sort that would necessitate the collection of continuous discharge data collected at frequent intervals. The level of risk to these stream associated with the proposed mining activities in the drainage is considered to be very low. Accordingly, it seems reasonable that quarterly monitoring of these streams would be sufficient to identify and quantify potential future impacts to the streams.

See Appendix 7-14 for Grassy Trail Reservoir - Right Fork Historical Flow Data. See Plate 7-7 for Water Monitoring Location Points.

The company acknowledges that concerns have been raised by certain stakeholders regarding previous proposals for longwall mining under the Right Fork. However, due to unfavorable geologic conditions recently encountered in the coal seam, the company has now abandoned plans for any longwall mining under the Right Fork. Nonetheless, in deference to the concerns of the stakeholders, the company proposes to continue with additional hydrologic baseline measures discussed previously, including the following:

a) *Installation and/or rehabilitation of measuring flumes in the upper and lower reaches of both Right and Left Forks of Whitmore Canyon above the reservoir (total of 4ea. flumes).*

b) *Installation of measuring/recording devices at each flume, within the normal operating flow limits of the flumes.*

c) *Installation of survey elevation monitoring stations at 100' intervals along the bottom of the Right Fork drainage within the permit area.*

d) *Installation of flow meters within the underground mine water collection/pumping system sufficient to adequately assess the quantity of groundwater sources encountered in the mine works in the vicinity of the Right Fork.*

e) *On-site location and development of selected springs in the Right Fork area subject to future monitoring, conducted in conjunction with stakeholder input.*

f) *Expansion of the seep and spring survey in the Right Fork to include more of the upper drainage area above longwall Panel #22.*

g) *Completion of a detailed gain-loss analysis of the stream flow in the Right Fork within the area of proposed development* mining.

Table 7- 1 HYDROLOGIC MONITORING PROTOCOLS AND LOCATIONS

Streams			
RST-1 (1)			See note below
ST-3	Flow, Field, Lab Analysis	Quarterly	Grassy Trail Creek
ST-6	Flow, Field, Lab Analysis	Quarterly	C Canyon
ST-8	Flow, Field, Lab Analysis	Quarterly	Grassy Trail Creek
ST-9 (2)			See note below
ST-10 (3)			See note below
ST-15	Flow, Field, Lab Analysis	Quarterly	Spring Canyon Stream
Patterfore	Flow, Field, Lab Analysis	Quarterly	Right Fork of Grassy Trail Reservoir
Flumes			
LF-1	Flow (4), Field, Lab Analysis	Quarterly	Left Fork of Grassy Trail Reservoir
LF-2	Flow (4), Field, Lab Analysis	Quarterly	Left Fork of Grassy Trail Reservoir
RF-1	Flow (4), Field, Lab Analysis	Quarterly	Right Fork of Grassy Trail Reservoir
RF-2	Flow (4), Field, Lab Analysis	Quarterly	Right Fork of Grassy Trail Reservoir
Springs			
SP-8	Flow, Field, Lab Analysis	Quarterly	North Horn Fm. In C Canyon
SP-12	Flow, Field, Lab Analysis	Quarterly	Colton Fm. Upper Whitmore Canyon
SP-13	Flow, Field, Lab Analysis	Quarterly	Colton Fm. Upper Whitmore Canyon
SP-101	Flow, Field, Lab Analysis	Quarterly	Little Spring Bottom
SP-102	Flow, Field, Lab Analysis	Quarterly	Spring Canyon Hillside
S-80	Flow, Field, Lab Analysis	Quarterly	Hanging Rock Spring
Road Spring	Flow, Field, Lab Analysis	Quarterly	Right Fork of Grassy Trail Reservoir
Sec 5 Spring	Flow, Field, Lab Analysis	Quarterly	Right Fork of Grassy, Section 5
Wells			
DH86-2	Water Level, Field, Lab	Quarterly	Sunnyside Sandstone in C Canyon
Underground			
UG-1	Field, Lab Analysis	Monthly	West Ridge Mine
U-14E	Flow only	Monthly	West Ridge Mine – 14 East
U-15E	Flow only	Monthly	West Ridge Mine – 15 East

U-16E	Flow only	Monthly	West Ridge Mine – 16 East
U-17E	Flow only	Monthly	West Ridge Mine – 17 East
U-18E	Flow only	Monthly	West Ridge Mine – 18 East
U-19E	Flow only	Monthly	West Ridge Mine – 19 East

Notes:

(1) RF-1 replaced RST-1 in 2011.
(2) LF-1 replaced ST-9 in 2011.
(3) LF-2 replaced ST-10 in 2011.
(4) During low-flow conditions, discharge at these sites may be measured a short distance below the flumes using an appropriate alternate measurement technique.

ST-5, ST-6A, ST-7, ST-11, ST-12, ST-13, SP-15, SP-16, WR-1 and WR-2 were dropped in 2011.

Table 7-2 SURFACE WATER OPERATIONAL WATER QUALITY MONITORING

Field Measurements	Reported As
Flow	gpm
pH	pH units
Specific Conductivity	μs/cm @ 25°C
Dissolved Oxygen	mg/l
Temperature	°C
Laboratory Measurements	**Reported As**
Total Dissolved Solids	mg/l
Total Suspended Solids	mg/l
Carbonate	mg/l
Bicarbonate	mg/l
Alkalinity, Total	mg/l
Hardness	mg/l
Calcium (Dissolved)	mg/l
Chloride	mg/l
Iron (Total)	mg/l
Iron (Dissolved)	mg/l
Magnesium (Dissolved)	mg/l
Manganese (Total)	mg/l
Manganese (Dissolved)	mg/l
Potassium (Dissolved)	mg/l
Sodium (Dissolved)	mg/l
Sulfate	mg/l
Oil and Grease	mg/l
Cations	meq/l
Anions	meq/l
Cation/Anion Balance	%

Table 7-3 GROUNDWATER OPERATIONAL WATER QUALITY MONITORING

Field Measurements	Reported As
pH	pH units
Specific Conductivity	μs/cm @ 25°C
Temperature	°C
Laboratory Measurements	**Reported As**
Total Dissolved Solids	mg/l
Carbonate	mg/l
Bicarbonate	mg/l
Alkalinity, Total	mg/l
Hardness	mg/l
Calcium (Dissolved)	mg/l
Chloride	mg/l
Iron (Total)	mg/l
Iron (Dissolved)	mg/l
Magnesium (Dissolved)	mg/l
Manganese (Total)	mg/l
Manganese (Dissolved)	mg/l
Potassium (Dissolved)	mg/l
Sodium (Dissolved)	mg/l
Sulfate	mg/l
Cations	meq/l
Anions	meq/l
Cation/Anion Balance	%

Table 7-4 UPDES DISCHARGE POINT MONITORING

MONITORING POINTS	FREQUENCY
001	Monthly
002	Monthly

FIELD MEASUREMENTS	REPORTED AS
Flow	gpd
pH	pH units
Specific Conductivity	μs/cm @ 25°C
Temperature	°C

LABORATORY MEASUREMENTS	MAXIMUM
Oil and Grease (if sheen is visible)	10 mg/l
Total Suspended Solids	70 mg/l
Total Iron	1.0 mg/l
Total Dissolved Solids	One ton/day

Table 7-5 UG-1 UNDERGROUND MONITORING POINT

MONITORING POINT	FREQUENCY
UG-1	Monthly

FIELD MEASUREMENTS	REPORTED AS
pH	pH units
Specific Conductivity	μs/cm @ 25°C
Dissolved Oxygen	mg/l
Temperature	°C

LABORATORY MEASUREMENTS	REPORTED AS
Total Dissolved Solids	mg/l
Total Suspended Solids	mg/l
Iron (Total)	mg/l
Iron (Dissolved)	mg/l
Sulfate	mg/l
Alkalinity	mg/l

*Please refer to Appendix 5-15, Attachment 10 for a description and location of UG-1.

MONITORING POINT	FREQUENCY
U-14E	Monthly
U-15E	Monthly
U-16E	Monthly
U-17E	Monthly
U-18E	Monthly
U-19E	Monthly

FIELD MEASUREMENTS	REPORTED AS
Flow	gpm

*If the total cumulative flow from these meters exceeds 250 gpm (0.5 cfs) for a period of more than one month, the company will notify the Division and will initiate a hydrogeologic investigation and a subsequent revision of the PHC.

731.300 Based on testing of roof and floor materials, formation of acid- or toxic-materials does not appear to be a concern. Roof and floor materials will be permanently stored underground and will not brought to the surface for disposal.

Samples of the roof, floor and coal from an outcrop of the Lower Sunnyside coal seam in the left fork of C Canyon were collected for analyses. The samples were sent to Inter-Mountain Laboratories, Inc. in Sheridan, Wyoming and analyzed according to Table 6 in DOGM's "Guidelines for Management of Topsoil and Overburden for Underground and Surface Coal Mining". The Table 6 parameters were run on the samples to look for toxic or acid-forming materials. Refer to Appendix 6-1 for the laboratory analyses. The Table 6 sampling regime was intended for soil materials which are going to be used a plant growth medium during final reclamation. It is not likely that any significant amount of the roof, floor or coal material would be incorporated in the regraded fill material at the time of final reclamation because there will not be any coal processing or coal preparation at the minesite. Also, prior to reclamation of the minesite, all coal will be removed from the minesite and sold.

Chemicals and petroleum products to be used at the mine will be stored in a controlled manner. The following products may be used by mining operations: diesel fuel, gasoline, grease, motor oil, water based hydraulic fluid, antifreeze, brake fluid, gear lubricating oil, rock dust, magnesium chloride, spray paint and stopping sealant. Chemicals and petroleum products to be used at the mine will be stored in a controlled manner. Petroleum products such as diesel fuel, transmission oil and grease will be stored in the mine yard in a contained, concrete structure. Other miscellaneous products would be stored in the mine warehouse.

Emulsion fluid spills will be minimized through the following:

-Emulsion fluid will not be mixed on the surface. The emulsion concentrate is delivered to the minesite in factory sealed 500 gallon containers. These containers area specifically designed to be easily handled by standard equipment at the mine site and transferred to mobile equipment for transport underground near the longwall equipment.

-Most longwall installations now utilize a bio-degrade able emulsion fluid in accordance with the manufacturer's recommendations. The emulsion mixture is very dilute, typically 2 parts emulsion fluid to 98 parts water.

-Any accidental longwall fluid spills on the surface would be cleaned up like any other spill in accordance with the site specific Spill Prevention Control and Countermeasure Plan. The sediment pond cells would provide an effective line of defense against any offsite contamination.

-Any emulsion fluid spill underground would go to an underground sump where water is typically stored and reused underground. Any water discharged from the mine would be tested and analyzed in accordance with the approve UPDES permit.

-The C Canyon drainage is ephemeral and supports no aquatic life. The closest flowing stream is Grassy Trail Creek which is over 11 miles to the southwest.

731.400 All water wells utilized during the operating phase will be abandoned in accordance with the rules outlined in "Administrative Rules For Water Well Drillers, State of Utah, Division of Water Rights, 1987". Closure of the wells will be conducted by a licensed well driller.

Final abandonment of the proposed water monitoring well DH 86-2 (at the mine site) will be conducted prior to completion of final reclamation. The abandoned well will be filled to within two feet of the surface with Neat Cement conforming to ASTM standard C150, a cement grout consisting of equal parts of cement conforming to ASTM standard C150 and sand/aggregate with no more than 6 gallons of water per sack of cement or bentonite-based products specifically designed for permanent well abandonment.

The cement will be introduced at the bottom of the well and placed progressively upward to within two feet of the surface. The casing will be severed a minimum of two feet below the ground surface. A minimum of two feet of compacted native material will be placed above the abandoned well upon completion.

Within 30 days of the completion of well abandonment procedures, a report will be submitted to the state engineer by the responsible licensed driller giving data related to the abandonment of the well. The report shall be made on forms furnished by the state engineer and shall contain the information required, including but not limited to:

1) Name of licensed driller or other person(s) performing abandonment procedures,

2) Name of well owner at time of abandonment,

3) Address or location of well by section, township and range,

4) Abandonment materials, equipment and procedures used,

5) Water right or file number covering the well,

6) Final disposition of the well,

7) Date of completion.

731.500 Discharges

731.510 The West Ridge Mine will be operating in the Lower Sunnyside seam which is the same seam mined by Kaiser Sunnyside mine immediately to the southeast of the West Ridge reserves. WEST RIDGE intends to mine around old Sunnyside mine workings. There is a possibility that the old Sunnyside works may contain water, especially in the northeasterly areas which are the furthest down dip. WEST RIDGE Resources has acquired all of the most current certified mine maps of the Sunnyside old works. The Kaiser mining operation was a large operation with a sophisticated engineering, surveying and drafting department. WEST RIDGE Resources is confident that these maps were accurately surveyed and updated and accurately portray the extent of the old works. Nonetheless, extreme caution will be exercised as mine development is being driven out toward the old works. WEST RIDGE Resources will employ professional licensed, certified land surveyors to monitor the progress of the underground mine development. All surveying in the West Ridge mine will be tied to the same surveying coordinates and control as was used for the Sunnyside mine. When the West Ridge works are within 500 feet of the projected Sunnyside works exploratory drilling will begin ahead of the development. Face drills will be used to drill at least 100 feet out in advance of the actual mine face development. The exploratory face drill will be a small diameter and if water is encountered from the old works the drill hole can easily be plugged and sealed. The West Ridge mine plan assumes that development will proceed to within 300 feet of the old works. West Ridge mine intends to stay away from the old works but will drill ahead as a precautionary measure in the event that the mine maps or surveying has a margin of error.

731.520 Gravity Discharges From Underground Mining Activities

Surface entries and accesses to underground workings will be located and managed to prevent or control gravity discharge from the mine. All workings will dip away (downdip) from the portals. It is anticipated that the mine will be relatively dry but in the event that discharge becomes necessary, the discharge will comply with the performance standards of the regulations and requirements of the UPDES permit before being discharged off the permit area.

Refer to Map 6-2, Coal Seam Structure Map for the Lower Sunnyside seam structure contours.

731.520 Gravity Discharges From Underground Mining Activities

Surface entries and accesses to underground workings will be located and managed to prevent or control gravity discharge from the mine. All workings will dip away (downdip) from the portals. It is anticipated that the mine will be relatively dry but in the event that discharge becomes necessary, the discharge will comply with the performance standards of the regulations and requirements of the UPDES permit before being discharged off the permit area.

Refer to Map 6-2, Coal Seam Structure Map for the Lower Sunnyside seam structure contours.

731.600 Stream Buffer Zones

The natural drainage channels in the main C Canyon and right fork of C Canyon drainage are classified as intermittent by the regulatory definition. (The watershed area is greater than one square mile). The channel operates like a ephemeral drainage channel although no drainage flow in the channel has been recorded during the last two years of monitoring.

A buried culvert will be placed through the proposed disturbed area to convey drainage from precipitation events past the mine site. The undisturbed bypass culvert system will be sized to handle runoff from the 100 year, 6 hour precipitation event. This is well in excess of the 10 year, 6 hour design event required by the regulations for a temporary diversion. The larger culvert is being proposed as an extra measure of safety and protection for the mineyard. Stream buffer zone markers will be placed at the north and south ends of the mine site facility area above the drainage channel to prevent channel disturbance by surface operations.

Mining activities will minimize impact to the undisturbed area by use of diversion ditches and the sediment pond to control and contain sediment and disturbed area runoff within the mineyard facility area.

It was determined by the Division of Water Rights that no stream alteration permit would be required for culverting of the C Canyon drainage. Refer to the August 19, 1998 letter included in Appendix 7-9.

The proposed undisturbed drainage channel diversion is discussed in greater detail under R645-301-742.300 and in Appendix 7-4.

Grassy Trail Creek is an intermittent stream located in the permit area in Whitmore Canyon located northeast of West Ridge. In this area the coal seam to be mined is 2000' below the streambed. Technically speaking, mining will be conducted within the 100' stream buffer zone, but only as measured horizontally. Therefore, no stream_buffer zone protection measures on the surface are anticipated. In the "Investigation of Surface Water and Ground Water Systems in the Whitmore LBA Area, Carbon County, Utah" (Appendix 7-1A), Mayo and Associates concludes that "the stream channel in this area is underlain by approximately 2,000 feet of cover, which includes the entire thickness of relatively unfaulted and unfractured North Horn Formation, which is known to form an effective barrier to vertical groundwater migration (Mayo and Associates, 1998) and is known to contain hydrophyllic clays that swell when wetted to seal any fractures that may form. Therefore, the potential for the interception and diminution of surface water flows in Grassy Trail Creek as a result of mining induced subsidence is minimal." Mining related impacts to fish, wildlife and other hydrologic resources is expected to be correspondingly minimal.

731.700 Cross Sections and Maps

There is no flowing surface water within the permit area and no water supply intakes. Surface receiving waters are at least ten miles to the southwest where the ephemeral drainage system reaches Grassy Trail Creek near the Sunnyside Junction (junction of Highway 123 and State Road 6). Refer to Map 1-1 for the location of Grassy Trail Creek. All disturbed area runoff will flow into the sediment pond where it will be contained.

The location of the water monitoring well, the water supply pipeline from East Carbon and the water storage tanks to be used are shown on Map 5-5.

Water monitoring stations and water monitoring well DH 86-2 are shown on Map 7-6. Operational monitoring stations are depicted on Map 7-7 "Operational Monitoring Map". Refer to Table 7-1 for a listing of the operational monitoring locations.

Map 5-5 shows the location of the proposed sediment pond.

Cross sections for the proposed sedimentation pond are presented on Map 7-4A "Sediment Pond Cross-Sections".

731.800 Water Rights and Replacement

No surface coal mining and reclamation activities (strip mining) will occur in the affected permit area.

Mining should not have any impact on the existing water rights in and around the proposed mining area.

R645-301-732 SEDIMENT CONTROL MEASURES

732.100 Siltation structures will be constructed and maintained in accordance with the applicable regulations. Siltation structures will not be removed until authorized by the Division of Oil, Gas and Mining.

Alternative sediment control measures will be used in areas where the surface disturbance is minor and sediment control is expected to be restored fairly rapidly with revegetation. Alternate sediment controls will be used on the topsoil stockpile and test plot areas. At these locations diversion ditches will divert undisturbed area runoff away from the site. Silt fencing will be utilized to minimize siltation from the sites. The surface of the stockpile will be pocked and roughened to retain moisture and minimize runoff from the disturbed surface. The surface area will be revegetated to minimize surface erosion. The alternate sediment control area located in the right fork is 0.46 acres while the stockpile area for the left fork is 1.13 acres.

The other ASCA (alternate sediment control area) will be at the office and parking lot area below the mine yard facility area. This 1.37 acre area will be sloped to one end of the pad area where a sediment retention basin will be used for sediment control. In addition, the slopes and embankment of the office pad will be revegetated to control sedimentation and erosion.

732.200 The sedimentation pond has been designed in compliance with the appropriate regulations. Refer to Maps 7-4 and 7-4A for the sediment pond plan and cross-section details. The sediment pond will be reclaimed during reclamation of the mineyard facilities. Refer to Appendix 5-5 for the complete details of the reclamation plan.

732.300 Diversions will be constructed and maintained with respect to R645-301-742.100 and 742.300.

732.400 Road Drainage

Roads within the disturbed area will be designed and constructed to utilize standard designs for surface drainage control, culvert size and spacing and grade. Refer to Map 5-5, Surface Facility Map.

Drainage ditches and culverts have been designed to handle a 10 year, 24 hour storm event. The larger design capacity will also provide additional capacity above what is required by the regulations, for a greater margin of safety in the mineyard during operations.

Riprap will be placed around the inlet end of the culverts to a height of at least

6" above the required headwall for each culvert. The outlet of the main canyon bypass culvert will be equipped with adequately sized riprap to slow the outlet velocity and prevent erosion to the natural downstream channel.

Trash racks will be placed on all undisturbed bypass culvert inlets to prevent floating debris and rocks from plugging the culvert. The trash racks will be slanted 3/4 inch steel bars welded on six inch centers across the flared inlet structures of each culvert. The bars will be sloped from the front of the inlet up to the top of the culvert. Use of trash racks on the smaller culverts within the mine yard drainage system will be at the discretion of the operator and based on site specific conditions.

R645-301-733 IMPOUNDMENTS

733.100 General Plans

A sediment impoundment structure (sediment pond) is proposed for treatment of disturbed area runoff from the mineyard facility area. The pond will be located near the southern end of the mine yard (refer to Map 5-5) and has been designed to contain and treat drainage from the 10 year, 24 hour event. The associated conveyance structures, such as culverts and ditches, have been sized to convey drainage from the 10 year, 24 hour event into the sediment pond. Appendix 7-4 provides the detailed designs and calculations used to derive the pond capacity, ditch and culvert sizes.

733.110 The designs and calculations have been certified by a registered, professional engineer experience in the design and construction of sediment ponds.

733.120 Maps 7-4 and 7-4A depict the pond design in plan view and in cross-section. Calculations made in Appendix 7-4 are based on the design dimensions presented in the above-mention maps.

733.130 The sediment pond has been designed to contain runoff from the mineyard disturbed area as well as several contributing undisturbed drainage areas. The runoff and sediment yield have been calculated using a 10 year, 24 hour precipitation event. Because of the narrowness and steep gradient of the canyon at the downstream end of the mine yard facility area, the sediment pond has been designed to have two cells that will contain the total volume of the 10 year, 24 hour design event plus three years of sediment storage (using 0.1 acre-feet of sediment per disturbed acre). Sediment will be captured by both cells (A and B). The total sediment storage capacity of the sediment pond for a three year interval is 1.845 acre feet, however, the sediment will be cleaned out when the storage capacity reaches 60%. Sediment indicator stakes will be placed at various locations in both the upper and lower cells (A and B) so that a visual determination of the 60% level can be made.

The required volume for the sediment pond is calculated at 7.052 acre feet, including 3 years of sediment storage. The actual pond volume at the principal spillway is 7.669 acre-feet. Refer to Appendix 7-4 for the pond design calculations. Refer to Map 7-4 for the individual cell dimensions and features. The upper cell will be approximately 18.5' feet deep from the cell bottom to the crest of the embankment while cell B will be approximately 14' feet deep. Neither of the cells meet the size specifications that require them to be regulated by MSHA under 30 CFR 77.216(a).

The pond will provide a theoretical detention time of 24 hours. The upper cell (cell A) of the sediment pond will be constructed with an open channel spillway at a minimum depth of 1.5' below the top of the dam. The open-channel spillway will be constructed of grouted rip-rap or concrete, and will have a minimum 5' bottom width with 2h :1v side slopes. The lower cell (cell B) will be constructed with a combination of 2 spillways. The principal spillway will be a 36" C.M.P. culvert riser and oil skimmer. This spillway will overflow at an elevation at least 3' below the top of the dam. This spillway will discharge directly into the bypass culvert (UC-OO) which is located beneath the pond. In the unlikely event of failure of the principal spillway, the lower pond cell will also be equipped with a second (emergency) culvert spillway, consisting of a 36" C.M.P. culvert riser and oil skimmer, with a minimum depth of 2.0' below the top of the dam. This spillway will also flow directly into the undisturbed bypass culvert (UC-OO).

Discharge from the pond will be in accordance with the UPDES permit issued for the facility. Decanting the pond will be accomplished by using a portable submersible pump with an inverted inlet to decant the pond if necessary. A sample will be collected prior to decanting to determine if the water quality will meet the requirements of the UPDES permit.

UPDES sample point # 1 is located at the principal spillway of the sediment pond. (see Map 7-4). This sample point will be used if and when the pond fills to capacity and must be decanted. Access to this sampling point will be provided by a walkway which will be constructed from the crest of the pond embankment out to the primary spillway. This walkway will be substantially constructed of steel, with an expanded metal walk surface and adequate handrails. It will be attached to the steel structure of the primary spillway /oil skimmer structure. During discharge activities personnel in charge of the sampling will walk to the end of the walkway to collect samples

Decanting of this pond will be done manually using a small mobile gasoline powered pump. When used, the pump will be positioned on the spillway walkway, (see Map 7-4). The end of the suction hose will be equipped with a float so that the decanted water is sucked from the top layer of pond water which should contain less sediment. The discharge line of the pump will feed directly into the primary spillway. Mine personal will take samples at the discharge end of the pump line as it enters the principal spillway. Samples will be secured and analyzed in accordance with the approved UPDES permit.

UPDES sample point #2 is located at the culvert riser near the mine portals. This riser leads directly into the main bypass culvert. The riser will be 42" in diameter, large enough to allow access by mine personnel. The purpose of UPDES sample point #2 is to sample any water that may be discharged from the mine in the future. It is not known at this time if or when such discharge may be necessary. However, if mine discharge becomes necessary, a discharge line (most likely 6" to 8" diameter) would be installed in the return entries (to keep from freezing) and would exit the mine through the fan portal. From the fan it is a short distance over to the culvert where the line would discharge directly into the main bypass culvert riser the discharge line will be equipped with a small petcock value that will conveniently allow the operator to take a UPDES sample whenever water is being discharged from the mine. Samples will be secured and analyzed in accordance with the approved UPDES permit. Refer to Appendix 7-10 for the UPDES general permit.

Inlet ditches to the pond will be protected from erosion by using concrete, culverts or rip rap to convey drainage down to the water level.

The principal spillway in cell B will be a 36" cmp culvert fitted with an oil skimmer. This spillway will carry the peak flow from the 25 year, 6 hour event at a depth of 0.89' over the pipe.

The emergency spillway, located on cell B, will also be a 36" cmp culvert fitted with an oil skimmer. This spillway will be utilized, if necessary, to convey any flow in excess of the 25 year, 6 hour precipitation event out of the pond.

The sediment pond is a temporary feature. It will be removed during final reclamation of the mine site.

733.140 No previous mining has occurred under the sediment pond location, nor is mining proposed under that site. Therefore, there should be no effect on the sediment pond due to past or future mining activities.

The pond will be constructed according to design criteria listed in Appendix 7-4 under "Design and Construction Specifications For Sedimentation Pond".

The sediment pond will be removed upon cessation of mining.

733.150 A structural stability analysis was performed on the pond embankment slopes by Agapito Associates, Inc. The results of their analysis are presented in Appendix 5-4.

The pond embankment (the east slope of the pond) will be keyed into bedrock or natural ground. The bedrock appears to be competent at this location with no visible faults or fractures that would impair the operation and stability of the pond.

733.160 A certified sediment and drainage control plan containing design details (Appendix 7-4) is presented in this permit application package.

733.200 Permanent and Temporary Impoundments

Maps and cross-sections for the sediment pond have been prepared and certified. Refer to Maps 7-4 and 7-4A. Details of the pond design are presented in Appendix 7-4.

The sediment pond will collect runoff from the disturbed area during mining operations. Because the pond is a temporary structure, it has been sized according to requirements for the 10 year, 24 hour storm event. The calculated required volume for this storm event is 7.052 acre-feet, which includes a volume for three years of sediment storage. The actual design volume for the pond is 7.669 acre-feet. The pond will have a principal and emergency spillway in cell B. The maximum pond volume will be 7.669 acre-feet at the principal spillway and the maximum height water could be impounded in either of the cells is 16.5 feet (to the principal spillway in cell A). The pond therefore does not meet the criteria for MSHA regulation.

In addition to the principal spillway, the pond's emergency spillway has also been designed to safely pass the peak flow from the 25 year, 6 hour precipitation event. Any discharge from this pond will meet the requirements of the UPDES permit for the facility.

No mining will occur underneath the sediment pond nor has any mining been done beneath this location in the past. The potential effect on the structure from subsidence of subsurface strata would be nonexistent.

This temporary impoundment will be constructed and maintained to comply with the appropriate requirements. No permanent impoundments are being proposed. Reclamation of the structure will be as presented in the reclamation portion of Chapters 5 and 7 and in Appendix 5-5, Construction and Reclamation Plan.

R645-301-734 DISCHARGE STRUCTURES

Discharge structures will be constructed and maintained to comply with R645-301-744. Refer to the discussion under R645-301-744.

R645-301-735 DISPOSAL OF EXCESS SPOIL

No areas are presently designated for disposal of excess spoil. No excess spoil is anticipated during the life of the mine.

R645-301-736 COAL MINE WASTE

No coal mine waste disposal areas are being planned in the mine yard. Any waste generated will be disposed of in an approved, permitted disposal site.

R645-301-737 NONCOAL MINE WASTE

Noncoal mine waste will be stored in dumpsters, or in a contained manner, in a designated portion of the disturbed area near the shop/warehouse. Final disposal of noncoal mine waste will be in an approved, waste disposal site and will comply with R645-301-747.

R645-301-738 TEMPORARY CASING AND SEALING OF WELLS

Sealing of the groundwater monitoring well and any future wells will comply with R645-301-748. Refer to R645-301-765 for the well abandonment plan. The groundwater monitoring well will be used for monitoring only and is locked in a closed position between sampling events.

R645-301-740 DESIGN CRITERIA AND PLANS

Site specific plans that incorporate design criteria for control of drainage from disturbed and undisturbed areas are presented below.

R645-301-742 **SEDIMENT CONTROL MEASURES**

Sediment control measures have been designed to prevent, to the extent possible, additional contributions of sediment to stream flow or runoff outside the permit area, to meet effluent limitations and to minimize erosion.

The most significant sediment control measure will be to collect all disturbed area runoff and divert it into a sediment pond designed for total containment of the 10 year, 24 hour precipitation event. Runoff from undisturbed areas above the mining site will be diverted, as much as possible, to reduce the amount of runoff to be treated by the sediment pond. Refer to Appendix 7-4 for the "West Ridge Mine Sedimentation and Drainage Control Plan" and Map 7-1 "Drainage Area Map " and Map 7-2 "Mine Site Drainage Map" for the mine site drainage calculations and diversion culvert specifications.

Additional measures to be taken may include: interim reclamation of disturbance, where practical, to reduce runoff and erosion; rip rapping or lining diversion ditches, where necessary, to reduce erosion; and using straw bales and check dams to control flow, sediment and erosion. A discussion of alternate sediment controls measures is presented in Appendix 7-4 for the ASCA areas (topsoil stockpile, test plots and office pad). Designs for the sediment controls will be according to information presented in Appendix 7-4 and Maps 5-5, 5-8, 7-1, and 7-4.

Snow removal activities at the mine site will attempt to stockpile any large amounts of snow in those snow storage site locations indicated on Map 7-2. The snow stockpile locations are primarily designed for storing snow clear from some of the larger pad areas. Snow will still be plowed to the side of roadways and small pad areas.

742.220 Minimizing contributions of suspended solids and sediment to streamflow or runoff outside the permit area will be accomplished by constructing a multiple cell sediment pond for sediment treatment and storage of runoff from the disturbed area. The sediment pond has been designed to provide adequate sediment storage and detention time for the 10 year, 24 hour precipitation event. The pond has a principal and emergency spillway in cell B which is designed to pass the peak flow from the design event as required by the regulations. The design of both the principal and emergency spillways will accommodate the peak flow of 23.71 cfs from a 25 year, 6 hour event.

Water will be decanted in accordance with the UPDES permit for the facility. A submersible pump will be used to decant the pond if needed.

The sediment in the pond cells will be removed when it reaches 60% of the maximum design sediment level in cells A and B of the pond. Two sediment markers will be installed at various locations in the bottom of the cells for evaluation of the sediment level. Refer to Map 7-4 for information regarding the sediment pond configuration. Refer to Appendix 7-4 for the "West Ridge Mine Sedimentation and Drainage Control Plan" for design calculations.

The sediment pond cell will be cleaned out upon reaching the 60% of the maximum sediment capacity. Clean out will be done during late fall or early winter, October-December, when the chance of thunderstorms is the lowest and the pond is dry. Decanting of the pond prior to cleanout will probably be unnecessary due to the arid nature of the climate. However, if decanting is necessary, the water will be allowed to settle for a minimum of 24 hours. The water will be drawn down as much as possible by pumping it into the adjacent cell.

Prior to sediment removal, samples will be taken from the sediment on the bottom to determine the depth of sediment as well as the nature of the material to be removed. Samples will be composited and analyzed according to Table 6 of DOGM's "Guidelines For Management Of Topsoil And Overburden For Underground And Surface Coal Mining".

The sediment pond does not meet the size criteria of MSHA 30 CFR 77.216(a).

The sediment pond has been designed with a primary and emergency spillway each capable of safely discharging the peak flow from the 25 year, 6 hour precipitation event. This should provide an additional measure of safety to prevent damage to the pond's integrity.

The construction site for the sediment pond will be cleared of all vegetation and debris prior to the removal of topsoil. Topsoil, if present, will be removed from the pond site and stockpiled in the topsoil storage area. In areas where fill is to be placed for the pond impoundment, natural ground will be removed for at least 12" below the base of the structure. Native material will be used when possible. The fill will be placed in lifts not to exceed 15" and compacted. Compaction of the fill material will be 95% or greater. Silt fencing and straw bales will be used to treat drainage from the site until the sediment pond embankment is constructed.

742.300 Diversions

General Requirements

Flow from undisturbed areas will be diverted away, where possible, from disturbed areas by means of temporary diversions (i.e. undisturbed drainage culverts). The diversions have been designed to minimize impacts to the hydrologic balance of the permit and adjacent areas.

All of the undisturbed drainage diversions (bypass culverts) have been sized, as a minimum, to meet the 100 year, 6 hour event for maximum protection of the mine yard area, sediment pond and undisturbed drainage below. The design incorporates structural stability and protection against flooding and damage to life and property. Designs for all diversions are presented in Appendix 7-4 and the structure locations depicted on Map 7-1. The map and plan have been certified by a registered, professional engineer.

The sediment pond has been designed and located such that if any of the temporary drainage structures (disturbed area culverts and ditches) within the disturbed area were to exceed their capacity, all drainage would still flow to and be treated by the sediment pond. Four culverts will convey drainage into the sediment pond. These inlets, have been designed to pass the flow from a 10 year, 24 hour precipitation event in order to provide more capacity and an extra measure of protection.

Following completion of mining activities, the undisturbed drainage diversion culverts, which will bypass the undisturbed drainage past the disturbed area, will be removed and the natural channel restored. Restoration of the channel will seek to reestablish a natural appearance to the drainage channel while providing a suitable channel configuration. Refer to Appendix 5-5 for a detailed discussion of the reclamation plan for the C Canyon drainage channel.

Based on measurements taken during field investigations and baseline mapping in the mine yard area, it will be possible to restore the channel to a configuration similar to what exists at the present time (pre-disturbance). Refer to Map 5-1 which is the existing topography of the site. Refer to Map 5-9, Mine Site Reclamation, for the proposed channel alignment and configuration.

Vegetation surveys conducted during June and August of 1997 confirm that there is no riparian zone in the existing drainage channels. Refer to Appendix 3-1 in Chapter 3 for information regarding vegetation of the mine site area.

742.400 Road Drainage

Roads within the disturbed area will be designed and constructed to provide environmental protection and safety and will adequately provide for surface drainage control, sufficient culvert design and spacing.

The placement of the road will seek to minimize downstream sedimentation and disturbance to the road due to runoff. The road will be located on the most stable available surface.

Primary Roads

Drainage structures on the road within the mineyard will be designed and constructed to pass the peak runoff from a minimum of a 10 year, 24 hour precipitation event.

Culverts will be designed so as to avoid plugging, collapse or erosion at the inlets and outlets. Trash racks will be installed where deemed appropriate by the operator.

The culvert calculations for the C Canyon county road culvert located within the disturbed area are provided in Appendix 7-8 C Canyon Road Station 406+70 - Culvert Sizing. The culvert was sized for a 25 year storm using the UDOT Small Area Method, the same method used to size the other culverts on the C Canyon road as well.

Following mining activities, the channel will be completely restored by removing the mine yard pad fill and regrading slopes to approximate original contour. In topsoiled areas, the channel will be reestablished by removing the geotextile fabric once the pad fill has been removed. Below the geotextile will be the original channel materials in their original arrangement. The restored channel will merge with the undisturbed downstream drainage southwest of the mine office area. The gradient of the channel and the side slopes will be similar to the premining channel.

No riparian area exists along the present drainage channel. The proposed seed mix to be used for final reclamation will incorporate species that presently exist in and adjacent to the channel area. The seed will be applied to the regraded channel side slopes by hydroseeding or hand broadcasting and raking. Containerized plants would also be planted along specified portions of the reclaimed channel.

R645-301-743 **IMPOUNDMENTS**

The proposed sediment pond is less than the size criteria listed in MSHA, 30 CFR 77.216(a). It has been designed and certified according to R645-301-512. Since the impoundment (sediment pond) is a temporary structure, regulations require the principal and emergency spillway to be designed to safely pass the 25 year, 6 hour precipitation event.

The impoundment will be inspected as described under R645-301-514.300.

R645-301-744 **DISCHARGE STRUCTURES**

Discharge from the sediment pond and bypass culvert will be controlled by riprap energy dissipators below the outlet ends downstream from the culvert outlet. The calculations and design specifications for the spillway are presented in Appendix 7-4.

R645-301-745 **DISPOSAL OF EXCESS SPOIL**

No areas are presently designated for disposal of excess spoil. No excess spoil is anticipated during the life of the mine. Refer to the discussion in Chapter 5, section R645-301-553 under Spoil and Waste (553.200).

No valley fills or head-of-hollow fills are being proposed.

No durable rock fills are included in the operation plan.

R645-301-746 **COAL MINE WASTE**

No coal mine waste piles are being proposed.

R645-301-747 **DISPOSAL OF NONCOAL MINE WASTE**

Noncoal mine waste, including but not limited to grease, lubricants, paints, flammable liquids, garbage, machinery, lumber and other combustible materials generated during coal mining and reclamation operations will be placed and stored in a controlled manner at the designated location near the shop/warehouse, (see Map 5-5) within the disturbed area or in a state-approved solid waste disposal area. No noncoal waste will be permanently disposed of within the permit area. Dumpsters will be used for collection and disposal of trash.

Lubricants, solvents, and grease will be stored in a covered area with limited access to prevent accidental contact from machinery. The storage area will be in the vicinity of the shop/warehouse. Any leakage at the fuel storage site will be contained within concrete lined or steel containment structures. Surface runoff will be diverted away from the storage site. Should any uncontrolled discharge of oil or petroleum products occur within the general mine yard area, the sediment pond would act as a last line of defense for the containment of any such spills and prevent flow into the natural drainage system. A Spill Prevention Control and Countermeasure (SPCC) Plan will be posted at the shop/warehouse.

A dumpster will be placed in a convenient location for disposal of nonhazardous trash. Used/broken equipment will be stored within the storage area of the mine yard. As the entire storage area reports to the sediment pond, the exact location of storage will be left to the discretion of the operator as long as the storage of materials does not block ditches or roadways.

R645-301-748 **CASING AND SEALING OF WELLS**

The water monitoring well (DH86-2) will be cased, sealed or plugged to prevent acid or toxic drainage from entering ground or surface water, to minimize disturbance to the hydrologic balance and to ensure safety when no longer utilized.

Upon completion of monitoring activities, the groundwater monitoring well will be permanently sealed by filling the hole with cement to within two feet of the top of the hole. Two feet of compacted native material will be placed above the sealed hole and the area reseeded.

Any future water or monitoring wells will be abandoned in a similar manner.

R645-301-750 **PERFORMANCE STANDARDS**

All mining and reclamation operations will be conducted to minimize disturbances to the hydrologic balance within the permit and adjacent areas, to prevent material damage to the hydrologic balance outside the permit area and support approved postmining land uses.

R645-301-751 WATER QUALITY STANDARDS AND EFFLUENT LIMITATIONS

WEST RIDGE Resources, Inc. has obtained a UPDES discharge permit to cover any possible discharge from the sediment pond. Refer to Appendix 7-10.

R645-301-752 SEDIMENT CONTROL MEASURES

Sediment control measures will be located, maintained, constructed and reclaimed according to plans and designs given under R645-301-732, R645-301-742 and R645-301-760.

752.100 Siltation Structures and Diversions

Siltation structures and diversions will be located, maintained, constructed and reclaimed according to plans and designs given under R645-301-732, R645-301-742 and R645-301-763.

752.200 Road Drainage

Any roads within the disturbed area will be located, designed, reconstructed and maintained to control erosion, minimize contributions to stream flow, minimize diminution of the surface and ground water systems and refrain from significantly altering the normal flow of water in the drainage channel in accordance with R645-301-732.400, R645-301-742.400 and R645-301-762.

Drainage for the roads within the mine yard disturbed area has been addressed in Appendix 7-4 under culvert and ditch designs. The road configuration is presented on Map 5-5.

R645-301-753 IMPOUNDMENTS AND DISCHARGE STRUCTURES

Impoundments and discharge structures will be located, maintained, constructed and reclaimed to comply with R645-301-733, R645-301-734, R645-301-743, R645-301-745 and R645-301-760.

R645-301-754 DISPOSAL OF EXCESS SPOIL, COAL MINE WASTE AND NONCOAL MINE WASTE

Disposal for coal mine waste and noncoal mine waste will be located, maintained, constructed and reclaimed as described in R645-301-735, R645-301-736, R645-301-745, R645-301-746, R645-301-747 and R645-301-760.

R645-301-755 CASING AND SEALING OF WELLS

All wells will be managed to comply with R645-301-748 and R645-301-765. Water monitoring wells will be managed on a temporary basis according to R645-301-738

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R645-301-760 RECLAMATION

R645-301-761 GENERAL REQUIREMENTS

All temporary structures will be removed and reclaimed before bond release is sought. The restored channel will follow the grade, alignment and sinuosity of the original natural channel. Suitable riprap already existing in the stream channel will provide adequate protection against erosion, as demonstrated by the stability of the existing natural channel.

R645-301-762 ROADS

The access road is a Carbon County public road and will be left in place and maintained by Carbon County. A turnaround will be left at the end of the road.

R645-301-763 SILTATION STRUCTURES

Siltation structures will be maintained until removal is authorized by the Division and the disturbed area has been stabilized and revegetated.

When the sediment controls are removed, the land on which the siltation structures are located will be regraded and revegetated. Refer to Chapter 5 for the regrading plans of siltation structures and Chapter 3 regarding the revegetation plan for reclamation.

R645-301-764 STRUCTURE REMOVAL

Appendix 5-1 presents a detailed timetable and outline for the removal of all structures on the minesite area. Removal of the siltation structures will be contingent upon DOGM approval. The sediment pond will be removed in conjunction with the reclamation of the mine yard.

R645-301-765 PERMANENT CASING AND SEALING OF WELLS

Permanent closure of the monitoring well 86-2 will be in accordance with the requirements of "Administrative Rules for Water Well Drillers", July 15, 1987, State of Utah, Division of Water Rights.

The abandoned well will be filled to within two feet of the surface with Neat Cement conforming to ASTM standard C150, a cement grout consisting of equal parts of cement conforming to ASTM standard C150 and sand/aggregate with no more than 6 gallons of water per sack of cement or bentonite-based products specifically designed for permanent well abandonment.

The cement will be introduced at the bottom of the well and placed progressively upward to within two feet of the surface. The casing will be severed a minimum of 2 feet below the ground surface. A minimum of 2 feet of compacted native material will be placed above the abandoned well upon completion.

Within 30 days of the completion of well abandonment procedures, a report will be submitted to the state engineer by the responsible licensed driller giving data related to the abandonment of the well. The report shall be made on forms furnished by the state engineer and shall contain the information required, including but not limited to:

1) Name of licensed driller or other person(s) performing abandonment procedures,
2) Name of well owner at time of abandonment,
3) Address or location of well by section, township and range,
4) Abandonment materials, equipment and procedures used,
5) Water right or file number covering the well,
6) Final disposition of the well,
7) Date of completion.

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