Trihydro CORPORATION

PRIVILEGED INFORMATION

May 27, 2010

Mr. Jim Hedges, Chairman
Fremont County Solid Waste Disposal District
P.O. Box 1400
Lander, WY 82520

RE: Independent Hydrologic and Regulatory Review, Sand Draw Landfill, Fremont County, Wyoming

Dear Mr. Hedges:

Trihydro Corporation (Trihydro) is pleased to present this report to the Fremont County Solid Waste Disposal District (FCSWDD). The purpose of this report is to provide an independent review of various subsurface investigations, monitoring reports, and permit application documents for Sand Draw Landfill. This report summarizes Trihydro's observations, conclusions, and recommendations relative to the characterization of the groundwater regime(s), the current monitoring system, and potential engineered containment system issues. Contributions to this report have been provided by Brian Smith, P.G., Joel Farber, P.E. & P.G., and Ken Schreuder, P.E. & P.G., which together offer over 70 years of consulting and regulatory experience to the FCSWDD.

Facility Information

The Sand Draw Landfill (facility) is located on land owned by the FCSWDD in Section 26, Township 34 North, Range 96 West, in Fremont County, Wyoming (Figure 1). The existing landfill operation is located on approximately 80 acres of land in the northeast corner of the permit area. The current permit area also includes approximately 133 acres of land adjacent to the western and southern boundaries of the existing landfill operation. The adjacent 133 acres (a.k.a. "proposed expansion area") has been designated for future disposal capacity, although specific design plans and capacity estimates have not yet been prepared.

The Sand Draw Landfill reportedly began receiving waste in 1982. The facility currently receives approximately 45,000 tons per year of municipal solid waste (MSW) and construction-demolition waste (CDW) for disposal in unlined cells. The base elevations of disposal cells vary, but are generally within approximately 15 to 20 feet of the original ground surface. Disposal cells are filled to elevations in excess of the original ground surface. The 2009 estimate of the remaining site life of the 80 acres that are part of the existing landfill operation is estimated to be approximately 31 years, or until year 2040 (IME 2010). The majority of the 80 acres that are part of the existing landfill operation have already received waste, so most of the remaining capacity is air space above the existing waste footprint. The Wyoming Department of Environmental Quality (WDEQ), Solid and Hazardous Waste Division (SHWD) has

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indicated that the remaining capacity of the 80 acres that are part of the existing landfill operation may be used without an engineered containment system (WDEQ 2010).

Site Setting

The Sand Draw Landfill is located on a relatively flat terrace at an elevation of approximately 5,500 feet above mean sea level (ft-amsl). The area typically receives less than 10 inches of precipitation per year, with approximately 80% of the precipitation occurring between April and October (inclusive), when the potential evapotranspiration rates are highest (DRI 2010). Several unnamed ephemeral drainages and surface water impoundments are present in the area. The closest perennial surface water feature is Beaver Creek, which lies several miles to the west and several hundred feet below the facility.

The Sand Draw Landfill lies within the Wind River Basin, an asymmetrical structural and depositional basin that formed during the Laramide orogeny, which was active from the Late Cretaceous to the Paleocene. The Wind River Basin is bounded on the north by the Absaroka Range, Owl Creek, and Bridger Mountains, on the west and southwest by the Wind River Range, on the south by the Granite Mountains, and on the east by the Casper Arch. The basin is filled with a relatively thick sequence of sediments that accumulated during the Late Cretaceous and Early Tertiary (Plafcan et al 1995).

The Sand Draw Landfill is underlain by the Tertiary (Lower Eocene) Wind River Formation, which is the most aerially-extensive water-bearing formation exposed at the surface of the Wind River Basin. Regionally, the Wind River Formation is characterized by an interbedded sequence of shale and siltstone that contains lenticular beds of fine- to coarse-grained sandstone of variable thickness and extent. The Wind River Formation generally produces calcium sulfate or sodium sulfate groundwater at depths of 50 to 1,200 feet. Some sodium bicarbonate and calcium bicarbonate groundwater is also reported (Whitcomb and Lowry 1968). Groundwater occurs under both confined and unconfined conditions within the Wind River Formation. Production rates are reported to vary from less than 50 gal/min to 3,000 gal/min (Plafcan et al 1995).

A number of subsurface investigations of the soil, geologic, and groundwater conditions in the vicinity of the Sand Draw Landfill have been completed using traditional drilling and sampling techniques for soil, rock, and groundwater. The majority of the surface soils at the facility are associated with the Almy-Monbutte-Rallod complex, which is characterized by loams, fine sandy loams, very fine sandy loams, and clay loams. Other common soil types include loams and clays associated with the Blazon-Rock outcrop-Carmody complex and the Cushol-Rock River association (USDA 1993). The subsurface lithology of the site is characterized by relatively flat-lying claystones, siltstones, and sandstones associated with the Wind River Formation.

Currently there are 24 groundwater monitoring wells associated with the facility. The total depths of the monitoring wells range from approximately 21 to 138 feet below ground surface (ft-bgs). Some of the existing monitoring wells are dry. Twelve of the existing monitoring wells reportedly have water column heights in excess of 1 foot, and the depths to static water levels range from approximately 18 to 127 ft-bgs (IME 2010b). The majority of the monitoring wells are screened in water-bearing sandstones, although some are screened in water-bearing siltstones and claystones. The water supply well for the facility produces water from a sandstone layer that was encountered between 161 and 173 ft-bgs.

Environmental Monitoring Program

The environmental monitoring program for the facility includes both groundwater and methane monitoring activities. The existing groundwater monitoring program for the facility includes ten wells (R-4, R-9S, R-9D, R13S, R-13D, R-18, R-19, R-20, R-21, and R-22) which are located around the perimeter of the existing 80-acre permit area (Figure 2). Static water levels in the wells are gauged monthly. Groundwater samples are collected on a quarterly basis from wells that produce enough water to allow collection of samples. Some wells (e.g., R-4 and R-19) have not produced enough water to collect samples. Groundwater samples are analyzed for the baseline parameters defined by Solid Waste Chapter 2, Section 6(b)(ii)(D)(II) and Appendix A. The current groundwater monitoring program for the existing facility commenced in July 2009 (IME 2010a).

Additional groundwater monitoring wells on the proposed 133-acre landfill expansion area are also gauged on monthly basis, but samples are not collected for laboratory analysis (Figure 2). The wells located on the proposed landfill expansion area are not part of the groundwater monitoring program for the existing landfill operation (IME 2010a). Several of the wells on the proposed landfill expansion area (R-12, R-16S, and R16D) are within 150 meters (approximately 492 feet) of the permit boundary for the existing landfill operation.

The existing methane monitoring program includes monitoring wells R-4 and R-19, the interior of the shop, and two vents associated with the methane venting system for the shop. Methane monitoring is completed on a quarterly basis in conjunction with quarterly groundwater monitoring program (IME 2010a).

Review of groundwater monitoring data from monitoring events in July 2009 and January 2010 noted the detection of acetone and trichlorofluoromethane in well R-9D (July 2009 and January 2010 events), and acetone in well R-20 (July 2009 event). The groundwater protection standard for acetone is 32,800 μg/L (Maximum Contaminant Limit, or MCL), and the groundwater protection standard for trichlorofluoromethane is 10,900 μg/L (Drinking Water Equivalent Level, or DWEL). Detections of the noted volatile organic compounds (VOCs) were several orders of magnitude below the associated groundwater protection standards.

Geophysical Investigation

HydroGEOPHYSICS, Inc. (HGI) completed a high resolution resistivity (HRR) study of the Sand Draw Landfill in 2008 (HGI 2009). The data and associated analysis provide a general indication regarding the vertical and lateral extent (i.e. volume) of resistive material, which is a primarily a function of the interconnectivity of the water in the soil or rock, and the chemical composition of the water itself.

A total of 34 lines of data were processed, but only a limited number of lines are proximal to subsurface lithologic/groundwater data points for correlation purposes. HRR lines with some degree of correlation to lithologic/groundwater data include:

- Line 1 is oriented north-south, and generally parallels geologic cross section C-C' (IME 2005). This line is in close proximity to wells R-18, R-9S, R-9D, R-20, and R-8.
- Line 3 is oriented north-south, and is in close proximity to wells R-13, R-13D, R-4, R-22, R-17 (boring), R-19, R-5, and R-5D. Line 3 does not parallel an existing geologic cross section.
- Line 4 is oriented west-east, and generally parallels geologic cross section L-L' (IME 2009). This line is in close proximity to wells R-11, R-12, R-13, and R-13-D.
- Line 7 is oriented west-east, and generally parallels geologic cross section K-K' (IME 2009). This line is in close proximity to wells R-14S, R-14D, R-8, R-15S, R-15D, R-16S, R-16D, R-9S, R-9D, R-17 (boring).
- Line 9 is oriented west-east, and generally parallels geologic cross section J-J' (IME 2009). This line is in close proximity to wells R-7, R-20, R-21, R-5, and R-5D.

Figure 20 of the HRR report represents a composite of resistive zones identified by the individual HRR lines. Laterally and vertically extensive resistive zones may suggest limited potential for migration of leachate. A relatively high density of resistive zones is suggested in the northern part of the proposed expansion area, although the zones do not appear to be laterally continuous. A relatively low density of resistive zones with limited lateral continuity is suggested in the southern part of the proposed expansion area. Figure 21 of the HRR report represents a composite of conductive zones identified by the individual HRR lines. Laterally and vertically extensive conductive zones have the potential to provide pathways for the migration of landfill contaminants. A moderate density of conductive zones is suggested in the northern part of the proposed expansion area, with the highest densities and some lateral continuity in the western half of the same area. A higher density of conductive zones with a relatively significant amount of lateral continuity is suggested in the southern part of the proposed expansion area. Figures 23 and 24 of the HRR presents horizontal slices of the inversion results for the northern and southern portions of the proposed expansion area, respectively. In general, higher variability is suggested at shallower depths, and the amount of variability appears to decrease with depth.

The HRR technology has several limitations. In general, resistivity surveys are sensitive to variations in conductivity, and minor variations in conductivity near the surface can create significant noise and decrease the sensitivity of the output. In the case of the Sand Draw Landfill, the prevalence of relatively dry surface soils (i.e., low conductivity and high resistivity) across the site has the potential to adversely impact the results. Furthermore, the report states that "HRR is not effective when discriminating layering or multiple discrete bodies that may interfere with one another. To help resolve these issues, HRR data are inverted with a numerical code to estimate the true resistivity of the subsurface." Plots of a discrete conductive target suggest that HRR processing tends to smear the target laterally, and inversion processing tends to smear the target vertically. In a complex interbedded environment such as the Wind River Formation, with subtle lateral and vertical transitions from clays to silts to sands, the ability of HRR technology to identify discrete or multiple layers is known to be limited. Inversion methods reportedly help resolve this issue. Comparison of inversion plots to geologic cross-sections suggests that the vertical extent of discrete saturated zones identified on geologic cross sections is not clearly delineated by the inversion plots, which is consistent with stated impacts of inversion processing.

While the HRR technology appears to be capable of generally delineating zones of high resistivity (i.e. low conductivity) from zones of low resistivity (i.e. high conductivity), generalized correlations regarding the relationship between grain size and moisture levels are made. Various sections of the report refer to a broad conductive zone that pervades the entire site at depths as shallow as 10 feet to at least 200 feet (Lines 3, 4, 7). Descriptions of specific lines state that the noted broad conductive zone "... likely represents the cumulative effect of the clay-rich lenses, sand lenses, and their respective levels of saturation." It does not appear that the HRR technology is capable of vertically distinguishing between saturated clays that may have relatively low permeabilities and saturated silts or sands that may have relatively high permeabilities. Additionally, it is not clear if coarser-grained materials with moisture levels that are high but below saturation would be identified as resistive or conductive by the HRR technology. If this is the case, the HRR technology may not be capable of evaluating areas that may be susceptible to transportation of contaminants via unsaturated flow.

Due to the apparent inability of the HRR technology to vertically distinguish between interbedded conductive clays and coarser-grained materials, the noted broad conductive zone could include multiple, highly permeable, and interconnected water-bearing silts and sands. If this is the case, subsurface disposal of wastes above the noted broad conductive zone could facilitate vertical and lateral migration of landfill contaminants.

Tritium and Isotope Investigation

Donald I. Siegel, PhD., evaluated tritium and oxygen/hydrogen isotope data for samples collected in November 2008 from monitoring wells R-7, R-8, R-9D, R-10, R-11, R-12, R-18, and R-20 (Siegel 2009). Siegel also evaluated carbon-14 data for samples collected in September 2009 from the shop well and monitoring wells R-9D, R-12, and R-18 (Siegel 2010). The tritium activity data indicated that the age of the groundwater samples was in excess of 50 years. The oxygen isotope ratios for the groundwater samples are notably different than the oxygen isotope ratios for recent precipitation and surface water in the area, suggesting that infiltration of precipitation is not currently a significant source of recharge. The subsequent carbon-14 data suggest the ages of the groundwater in the shop well and monitoring well R-12 are in the range of 4,500 to 6,000 years, while the ages of the groundwater in wells R-9D and R-18 are in the range of 17,000 to 22,000 years.

Siegel highlighted the data regarding the age of the groundwater, the presence of low-permeability siltstones and claystones above the water-bearing sandstones, relatively stable static water level data (with respect to precipitation and snowmelt events), and the results of geophysical studies (HGI 2009) as significant lines of evidence. In summary, Siegel concluded that the infiltration of precipitation and any associated leachate that may be produced "... could not plausibly reach the perched water bearing zones underneath, let alone the regional water table over 200 feet deep" (Siegel 2010).

The data evaluated by Siegel generally support a conclusion that the majority of the groundwater below the facility is a result of recharge that occurred well before the Sand Draw Landfill began receiving wastes. Siegel's conclusions are also supported by the lack of significant surface water features, relatively low precipitation rates, and relatively high evapotranspiration rates for areas with an established vegetative cover. However, in the course of landfill operations, excavations are created that can accumulate and concentrate precipitation, which can rapidly infiltrate wastes and the underlying soils. Although some of the accumulated moisture can still be removed by evaporation, the ongoing placement of wastes can limit the effectiveness of this process. Additionally, the lack of established vegetation in the active fill areas precludes the removal of accumulated moisture via transpiration.

The amount of water that may infiltrate wastes and the underlying soil at an unlined active landfill in a semi-arid environment is likely to be relatively small with respect to the amount of water applied, and unlikely to be a significant source of recharge for groundwater systems. However, there is a growing body of evidence from other unlined landfills in the semi-arid western U.S. and Wyoming which suggest that despite the relatively small amount of leachate that is being generated, landfill contaminants are being transported to underlying groundwater systems. In some cases, landfill gas is suspected of transporting contaminants. In other cases, unsaturated flow of pore water appears to be the primary transport mechanism. Trihydro is currently working with a number of landfill operators in Wyoming that are detecting reportable concentrations of constituents that are commonly associated with landfill gas and leachate, including VOCs. One of Trihydro's clients operates an unlined landfill located in a hydrogeologic setting similar to that at the Sand Draw Landfill, but with even lower precipitation rates (less than 8 inches/year) and significantly greater depths to groundwater (up to 175 feet). Recent monitoring data at the referenced facility includes repeated reportable detections of multiple VOCs, one of which has exceeded the associated groundwater protection standard.

Static Water Level Data

A time-series plot of static water level data from 1994 through 2010 is provided in the most recent environmental monitoring report for the facility (IME 2010b). Several observations were noted with respect to the time-series plot of the static water level data:

- The initial data for well R-8 varies from event to event, and may suggest a general decline over the period 1995 to 1997. The accuracy and consistency of the data for this period may have been affected, in part, by the gauging techniques and equipment that were reportedly used during this period.
- The data for well R-8 suggest a notable increase and subsequent decrease in static water levels, beginning in the fall of 1999 and continuing through the summer of 2000. The noted increase and subsequent decrease is defined by approximately eleven consecutive data points. Subsequent data for this well may suggest a long-term decreasing trend.
- Small but repetitive annual increases and decreases may be present in the data for well R-10.
- A long-term decreasing trend may be present in the data for well R-12.
- A long-term decreasing trend may be present in the data for well R-18, although notable short-term increases have occurred since the summer of 2009.
- Although the static water levels in individual wells are relatively consistent over the period of record, significant variability (approximately 140 ft) exists between wells, ranging from a low of approximately 5,345 ft-amsl (R-21), to a high of approximately 5,485 ft-amsl (R-8), over a distance of approximately 2100 ft.

One representation of the potentiometric surface uses static water level data for most of the existing wells, suggesting either a continuous or interconnected groundwater system across the existing landfill operation and the proposed expansion area (IME 2010b). The noted representation of the potentiometric surface includes an apparent southwest-northeast trending mound in the northern portion of the proposed expansion area, although an explanation regarding a potential recharge source is not provided. It is noted that the static water level data for well R-19, which is located on the east side of the existing facility, has not been used to prepare the representation of the potentiometric surface for the facility. The reported static water level in R-19 is at least 50 feet higher than the projection of the potentiometric surface in this portion of the facility. However, the reported static water level data for R-19 may be representative of water accumulated in the well cap, and not representative of the static water level of groundwater. Plans are reportedly underway to install a deeper monitoring well in the vicinity of R-19, with a screened interval that intersects the projection of the potentiometric surface (WDEQ 2010).

Major Ion Chemistry

Analytical data for a limited number of sampling events is available for the site. Trihydro prepared Piper plots of the cation and anion compositions (as percentages) for the January 2010 monitoring event (IME 2010b), which included wells R-9D, R-13D, R-18, R-20, R-21, and R-22. Piper plots for individual wells and all six wells are provided (Figures 3 though 9). The intersection of lines extended from the two sample points on the triangles to the central parallelogram gives a point that represents the major ion composition on a percentage basis. These plots are useful for visually describing the differences in major ion chemistry of groundwater systems, the associated hydrochemical facies, and data trends.

Figure 9, which contains plots for all the wells, indicates that the chemistry of wells R-18 (designated as a background well) and R-9D (designated as a down-gradient well, but may be hydraulically up-gradient of an existing portion of the active area) are similar and dominated by calcium cations and bicarbonate anions. The plots of the other down-gradient well data (R-13D, R-20, R-21, and R-22) suggest hydrochemical facies changes to lower concentrations of calcium cations and higher concentrations of sodium and potassium cations. The plots also suggest hydrochemical facies changes to lower concentrations of bicarbonate anions, and higher concentrations of chloride and fluoride anions. The distinct linearity of the noted hydrochemical facies changes may suggest a continuum across an interconnected groundwater system. If some degree of hydraulic connection exists between the up-gradient and down-gradient wells, the noted hydrochemical facies changes may be due to changes in the mineralogy of the water-bearing zones, or potential migration of landfill contaminants. In no hydraulic connection exists between the up-gradient and down-gradient wells, the noted hydrochemical facies change may be attributable to differences in the mineralogies of the water-bearing zones.

The limited number of sampling events precludes meaningful statistical analysis of the analytical data. As additional data becomes available, intrawell trend analysis of both up-gradient and down-gradient wells may help determine if there is evidence of ongoing changes in water quality, which would be counter-intuitive to the hypothesis of several investigators which suggest that the groundwater below the site is relatively old, isolated, and not influenced by the current landfill operations. Other types of graphical and statistical analysis may be helpful in defining similarities and differences in water quality between some monitoring wells.

Statutory and Regulatory Considerations

The following citations are provided to characterize the statutory and regulatory context in which this facility is regulated.

The Wyoming Environmental Quality Act (EQA) is codified in Title 35, Chapter 11 of Wyoming Statutes (W.S.). The following definitions are contained in W.S. 35-11-103(c):

(i) "Pollution" means contamination or other alteration of the physical, chemical or biological properties of any waters of the state, including change in temperature, taste, color, turbidity or odor of the waters or any discharge of any acid or toxic material, chemical or chemical compound, whether it be liquid, gaseous, solid, radioactive or other substance, including wastes, into any waters of the state which creates a nuisance or renders any waters harmful, detrimental or injurious to public health, safety or welfare, to domestic, commercial, industrial, agricultural, recreational or other legitimate beneficial uses, or to livestock, wildlife or aquatic life, or which degrades the water for its intended use, or adversely affects the environment. This term does not mean water, gas or other material which is injected into a well to facilitate production of oil, or gas or water, derived in association with oil or gas production and disposed of in a well, if the well used either to facilitate production or for disposal purposes is approved by authority of the state, and if the state determines that such injection or disposal well will not result in the degradation of ground or surface or water resources.

(vi) "Waters of the state" means all surface and groundwater, including waters associated with wetlands, within Wyoming.

Chapter 8 of the Wyoming Water Quality Rules and Regulations (WQRR) identifies quality standards for Wyoming groundwater. Chapter 8, Section 2 of the WQRR provides the definitions to supplement those definitions contained in W.S. 35-11-103 of the EQA, including:

(a) "Aquifer" means a zone, stratum or group of strata.

That can store and transmit water in sufficient quantities for a specific use.

(f) "Groundwater" means subsurface water that fills available openings in rock or soil materials such that they may be considered water saturated under hydrostatic Pressure.

(g) "Groundwaters of the State" are all bodies of underground water which are wholly or partially within the boundaries of the State; Groundwaters of the State is synonymous with Groundwaters of Wyoming.

(t) "Underground Water" means subsurface water, which is any body of water under the surface of the earth, including water in the vadose zone and groundwater.

(u) "Vadose Zone" means the unsaturated zone in the earth, between the land surface and the top of the first saturated aquifer which is not a perched water aquifer. The vadose zone characteristically contains liquid water under less than atmospheric pressure, and water vapor and air or other gases at atmospheric pressure. Perched water bodies exist within the vadose zone.

Chapter 8, Section 3 of the WQRR provides the following standards regarding protection of underground water:

(a) All waters, including groundwaters of the State, within the boundaries of the State of Wyoming are the property of the State; and control of the beneficial use of waters of the State resides with the Wyoming State Engineer.

(c) Protection shall be afforded all underground water bodies (including water in the vadose zone). Water being used for a purpose identified in W.S. 35-11-102 and 103(c)(i) shall be protected for its intended use and uses for which it is Suitable. Water not being put to use shall be protected for all uses for which it is suitable.

Chapter 1, Section 1(c) of the Wyoming Solid Waste Rules and Regulations (SWRR):

(i) For the purpose of these rules and regulations, unless the context otherwise requires:

"Aquifer" means a geologic formation, group of formations, or portion of a formation capable of yielding significant quantities of groundwater to wells or springs.

"Groundwater" means water below the land surface in a saturated zone of soil or rock.

"Release" includes, but is not limited to, any spilling, leaking, pumping, pouring, emptying, emitting, discharging, dumping, addition, escaping, leaching, or unauthorized disposal of any oil or hazardous substance which enters, or threatens to enter, waters of the state.

"Vadose zone" means the unsaturated zone between the land surface and the water table.

Chapter 2, Section 4(j)(i) of the Wyoming SWRR outlines the conditions under which operators of sanitary landfills may be exempted from the requirement to construct new landfill cells and horizontal expansions of existing cells with engineered containment systems. These conditions include:

(A) Native soils underlying the landfill are sufficiently impermeable to prevent potential contamination of groundwater through operation of the facility; and

(B) Waste types or operating practices minimize the potential for contamination of underlying soils and/or groundwater; and

(C) Site hydrologic conditions are sufficient to protect groundwater from contamination; and

(D) The facility receives less than 500 short tons of unprocessed household refuse or mixed household and industrial refuse per operating day, on a monthly average. Containment systems at these facilities shall include leachate collection and leak detection systems.

Conclusions and Recommendations

Based on review of the investigations, statutes, and regulations summarized above, Trihydro offers the following conclusions for consideration by the Board of the FCSWDD:

- Previous investigations describe the shallow water-bearing zone(s) intersected by the monitoring well network as "isolated," "compartmentalized," "perched," and not part of the deeper "regional aquifer." Some of the existing data suggest that monitoring wells at the facility may not penetrate a single, well-defined, laterally continuous aquifer that is capable of yielding significant quantities of groundwater. However, even though existing data may not be sufficient to definitely infer a hydrologic connection between all wells, some of the static water level data, major ion data, lithologic logs, and geophysical data suggest some degree of hydrologic connection in portions of the facility.

  It is also worth noting the descriptions of the water-bearing zone(s) provided by previous investigations do not provide a basis for concluding that the statutory and regulatory provisions regarding protection of "waters of the state" are any less relevant. The shallow water-bearing zone(s) below this site meet the statutory definition of "waters of the state", and are therefore subject to the same statutory and regulatory protections provided to large regional aquifers that are being used beneficially. Current provisions of Chapter 2 of the Wyoming SWRR provide some consideration other factors (e.g., the potential for future use of the groundwater, hydraulic connections to regional aquifers, and technical impracticability) during the corrective action process, but such considerations are not currently available when evaluating the design and anticipated performance of the facility with respect to protecting waters of the state.

- The site is underlain by various sequences of interbedded claystones, siltstones, and sandstones, some of which contain groundwater at relatively shallow depths relative the base of existing waste disposal units. Previous regional and local subsurface investigations confirm both vertical and lateral variability in the subsurface lithology, as well as the occurrence of groundwater. Although some subsurface lithologies may limit the migration of landfill contaminants, the documented vertical and lateral variability in the subsurface lithologies has the potential to provide pathways for both landfill gas and leachate. In consideration of the above, it appears unlikely that further subsurface investigation will be successful in demonstrating that native soils and hydrologic conditions are sufficient to protect groundwater from contamination (reference Wyoming SWRR Chapter 2, Section 4(j)(i)(A) and (C)).

Based on a review of the investigations, statutes, and regulations summarized above, and the associated conclusions, Trihydro offers the following recommendations for consideration by the Board of the FCSWDD:

- Although the subsurface conditions provide some level of protection for groundwater, and the groundwater system(s) has no obvious practical use at this time, disposal of waste in unlined cells has the potential to impact waters of the state. Therefore, consideration should be given to the use of engineered containments systems in the design of disposal units that are constructed in the proposed expansion area.
- The WDEQ/SHWD has indicated that ongoing waste disposal activities in the 80-acre parcel may continue without the utilization of an engineered containment system. It is possible that at some point

in the next 30 years, additional groundwater monitoring data or analysis may suggest that the quality of the groundwater below the existing landfill operation is decreasing, or applicable groundwater protection standards are being exceeded. In the event that this happens, consideration should be given to capping existing waste disposal areas (to limit the infiltration of precipitation that may generate leachate or landfill gas), and moving to the proposed expansion area, as discussed above. The ongoing collection and analysis of groundwater monitoring and landfill gas data is recommended because they have the potential to identify the emergence of such a scenario. However, the development and occurrence of a significant release cannot always be anticipated, and can develop relatively quickly. It may be prudent, therefore, to develop conceptual design plans for some portion of the proposed expansion area, and begin the process of securing the financial resources to complete the design and construction of the first lined cell.

- With the exception of the existing plans to install a deeper monitoring well in the vicinity of well R-19, further characterization and expansion of the existing groundwater monitoring network for the 80 acres that are currently receiving wastes does not appear to be a critical or eminent need. The existing monitoring wells provide a basic network that is capable of providing both up-gradient and down-gradient data at regular intervals around the perimeter of the facility. In the event that monitoring data identifies statistically significant increasing trends or exceedances of groundwater protection standards, additional subsurface investigation and expansion of the monitoring network may be warranted. Trihydro offers a similar recommendation regarding the adequacy of the existing groundwater monitoring network for the proposed expansion area, under the assumption that it will be developed with an engineered containment system.

An original, two copies, and an electronic version of this report are being transmitted at this time. At your convenience, you may contact me at (307) 332-5280 or kschreuder@trihydro.com to schedule a summary presentation to the FCSWDD Board, at which time I will be available to respond to questions and comments. Trihydro appreciates the opportunity to assist the FCSWDD with this matter.

Sincerely,
Trihydro Corporation

Ken Schreuder, P.E. & P.G.
Senior Engineer/Geologist

05-27-10

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Enclosures

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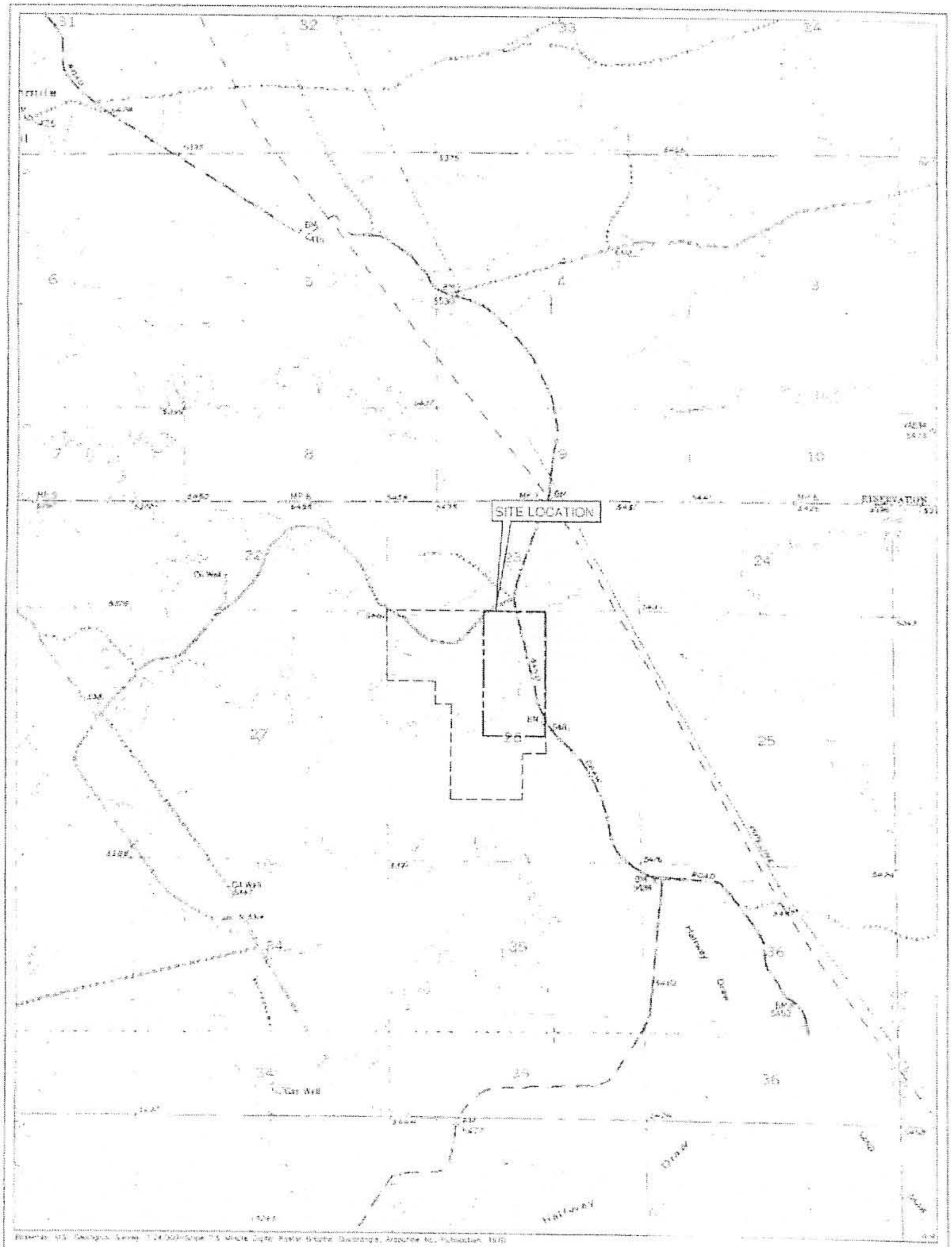
FIGURES



NOTE:
SITE LEGAL DESCRIPTION - TOWNSHIP 34 NORTH, RANGE 96 WEST, SECTION 26

EXPLANATION

EXISTING LANDFILL BOUNDARY

LANDFILL EXPANSION BOUNDARY

QUADRANGLE LOCATION

Trihydro CORPORATION

FIGURE 1

USGS LOCATION MAP

SAND DRAW LANDFILL
FREMONT COUNTY, WYOMING

EXPLANATION

R-6 MONITORING WELL AND DESIGNATION
EXISTING LANDFILL BOUNDARY
LANDFILL EXPANSION BOUNDARY
ROAD
FENCE

N

Trihydro CORPORATION

FIGURE 2

SITE MAP

SAND DRAW LANDFILL
FREMONT COUNTY, WYOMING

FIGURE 3. R-9D PIPER PLOT (JANUARY 2010 EVENT)
SAND DRAW LANDFILL, FREMONT COUNTY WY

R-9D
TDS = 1,900. mg/l

CATIONS
Ca = 170. mg/l
Mg = 8.8 mg/l
Na = 370. mg/l
K = 2.6 mg/l

ANIONS
HCO3 = 570. mg/l
CO3 = 0. mg/l
Cl = 34. mg/l
SO4 = 780. mg/l
F = 0.4 mg/l

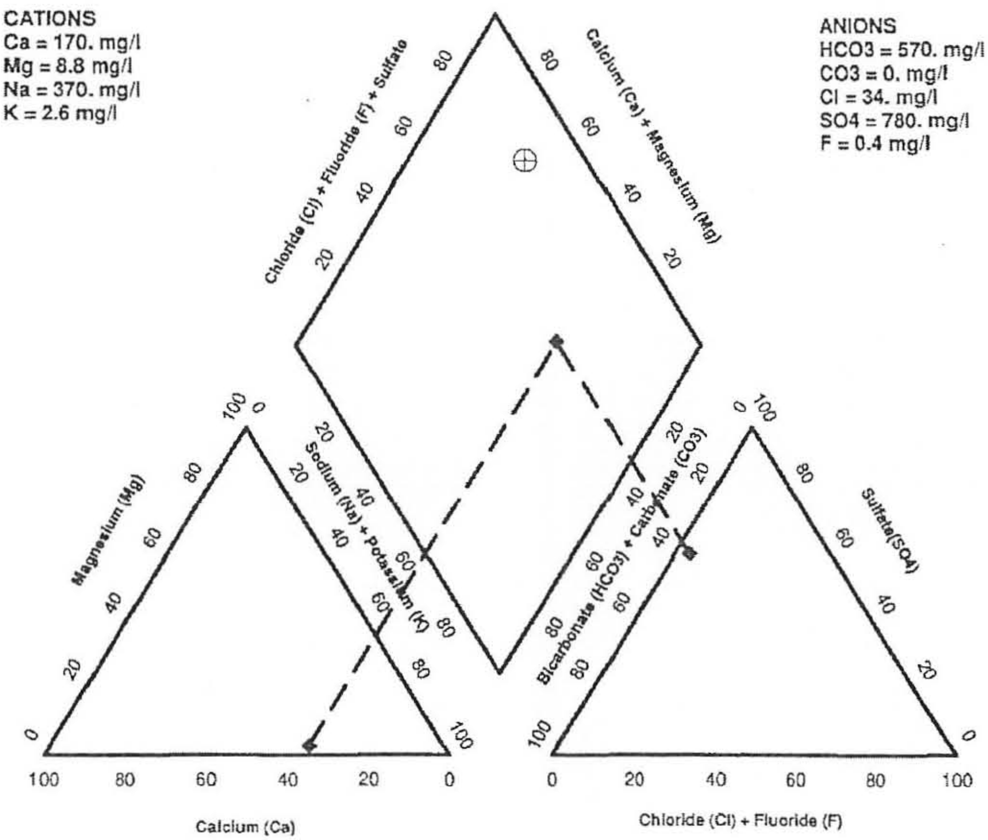


FIGURE 4. R-13D PIPER PLOT (JANUARY 2010 EVENT)
SAND DRAW LANDFILL, FREMONT COUNTY WY

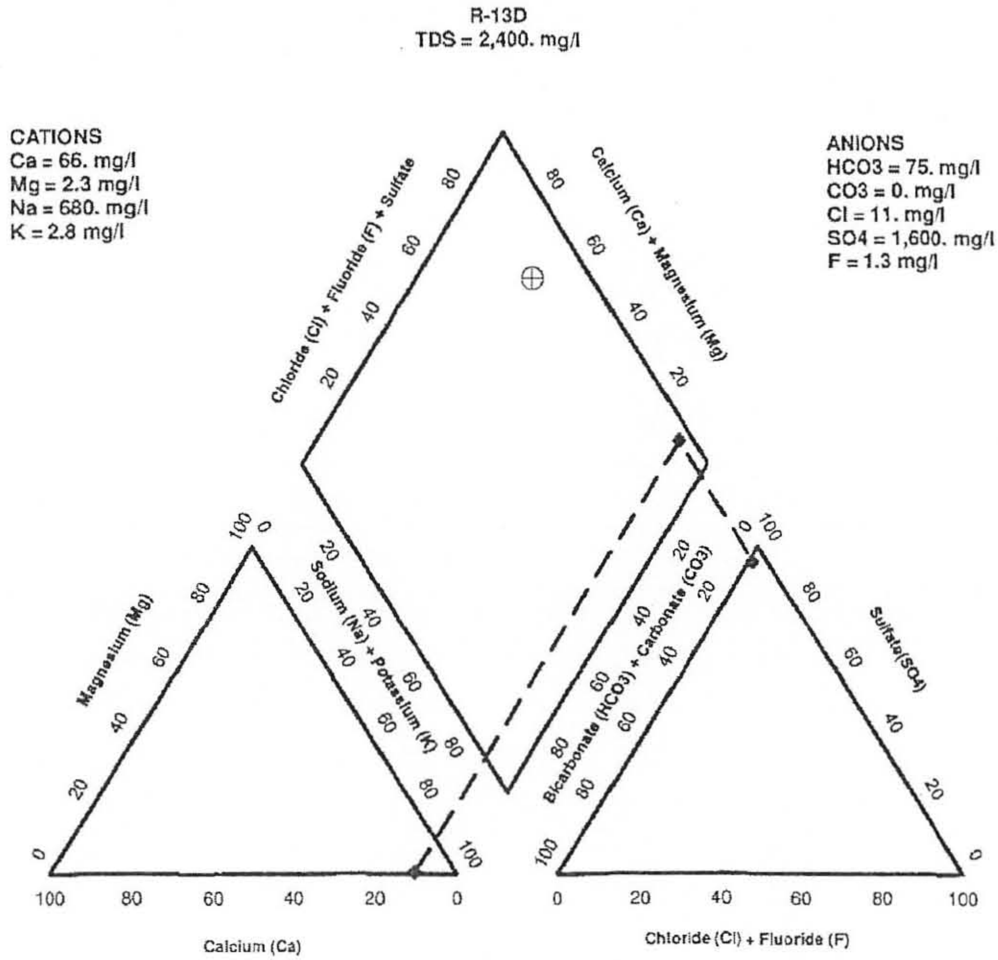


FIGURE 5. R-18 PIPER PLOT (JANUARY 2010 EVENT)
SAND DRAW LANDFILL, FREMONT COUNTY WY

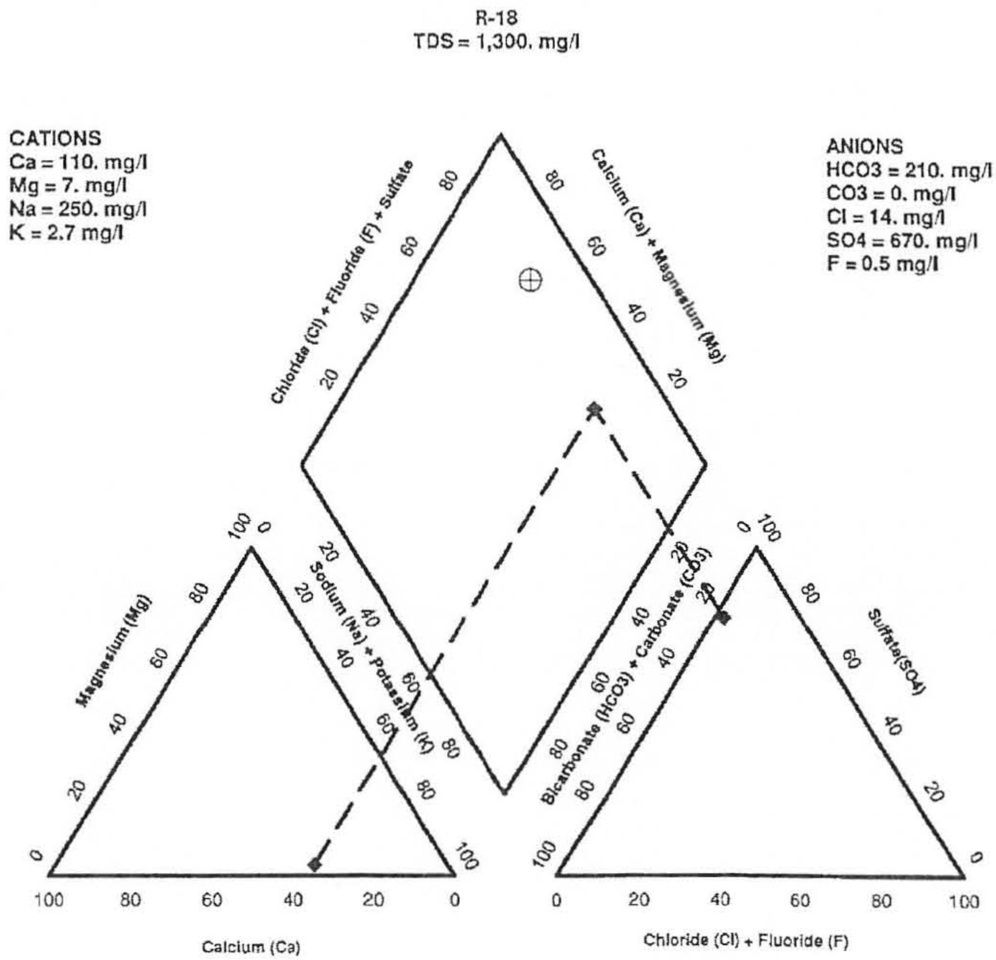


FIGURE 6. R-20 PIPER PLOT (JANUARY 2010 EVENT)
SAND DRAW LANDFILL, FREMONT COUNTY WY

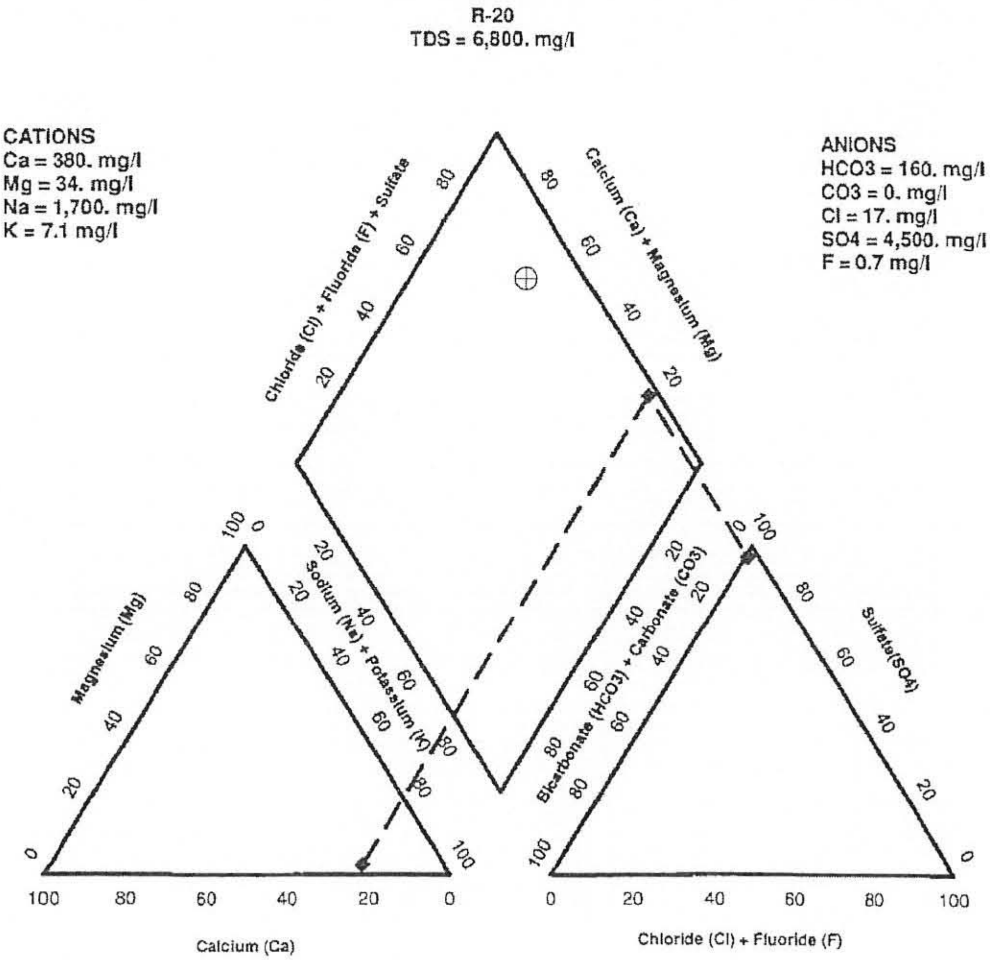


FIGURE 7. R-21 PIPER PLOT (JANUARY 2010 EVENT)
SAND DRAW LANDFILL, FREMONT COUNTY WY

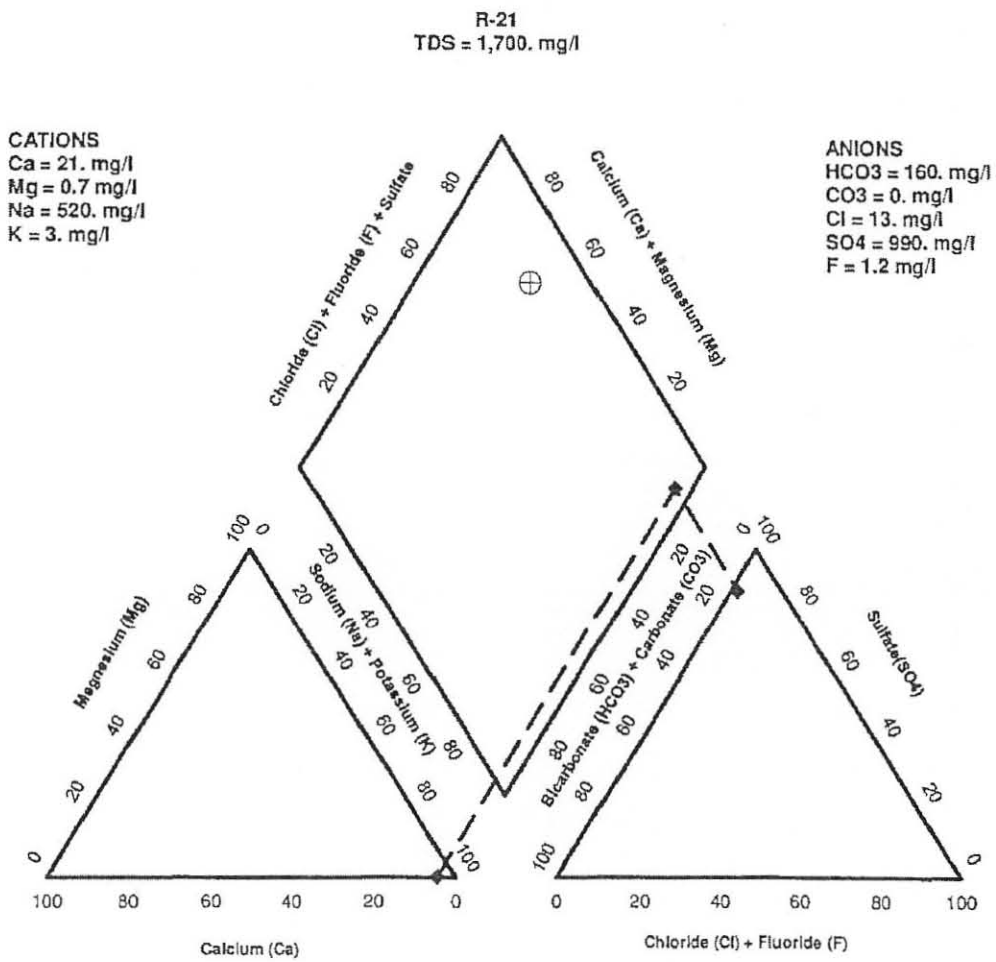


FIGURE 8. R-22 PIPER PLOT (JANUARY 2010 EVENT)
SAND DRAW LANDFILL, FREMONT COUNTY WY

R-22
TDS = 3,000. mg/l

CATIONS
Ca = 63. mg/l
Mg = 2. mg/l
Na = 840. mg/l
K = 3.2 mg/l

ANIONS
HCO3 = 350. mg/l
CO3 = 0. mg/l
Cl = 19. mg/l
SO4 = 1,700. mg/l
F = 0.4 mg/l

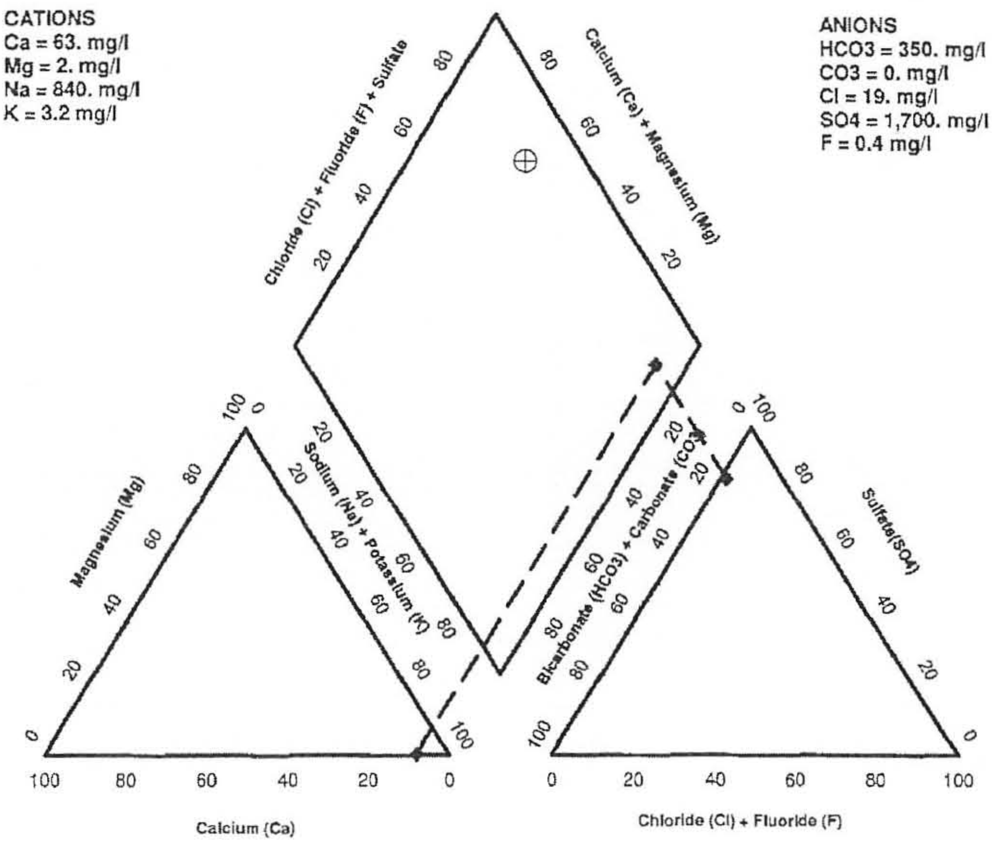
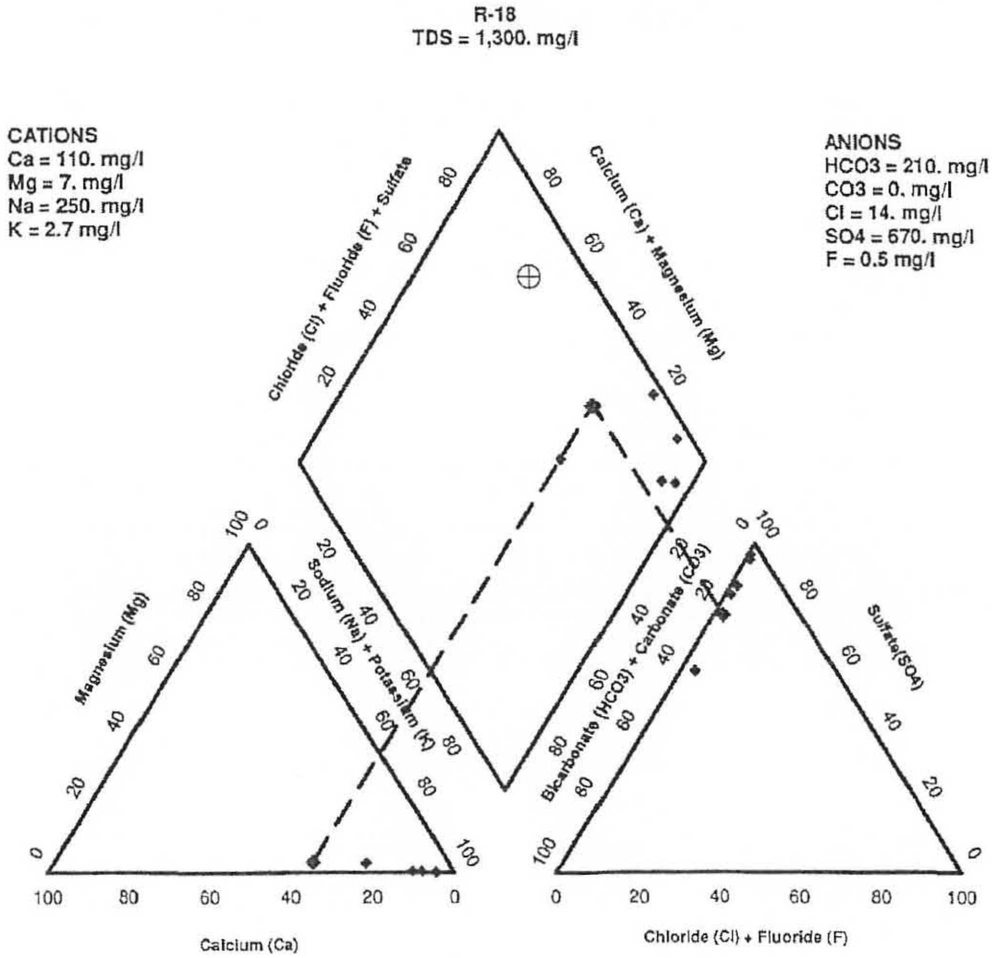


FIGURE 9. R-9D, R-13D, R-18, R-20, R-21, AND R-22 PIPER PLOT
(JANUARY 2010 EVENT)
SAND DRAW LANDFILL, FREMONT COUNTY WY



On 3/31/11 6:58 PM, "Ken Schreuder" <kschreuder@trihydro.com> wrote:
Dr. Siegel ... Trihydro referenced the information you previously provided regarding the work you've done at the Sand Draw Landfill in the permit application that was recently submitted to WDEQ. Copies of the information referenced are attached. WDEQ has raised a concern that the referenced work was not stamped by a Wyoming-licensed PE or PG, so they want us to either stamp it or remove it. I have no reason to question the validity of the laboratory data, but it was clearly not prepared by me or under my direct supervision, so I am reluctant to stamp it.

I am not sure if you are licensed as a PE or PG in Wyoming, but I would like to talk to you about this matter further. I am hoping that you can provide a sampling and analysis plan, chain-of-custody, QA/QC report, or any other supporting documentation to convince the WDEQ that the data is valid and can be used to interpret the hydrogeology of the site.

I would appreciate it if you could contact me by phone at your earliest convenience. Thank you in advance for your time.

Ken Schreuder, P.E., P.G.
Senior Engineer / Geologist

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EXHIBIT
tabbles
DEQ 48

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