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2.7 Hydrology

NUREG-1569 Section 2.7 states that, "characterization of the hydrology at in situ leach uranium extraction facilities must be sufficient to establish the potential effects of in situ operations on the adjacent surface-water and groundwater resources and the potential effects of surface-water flooding on the in situ leach facility" (NRC, 2003). To meet these requirements, this section addresses surface water features (**Section 2.7.1**), groundwater characteristics (**Section 2.7.2**), surface water and groundwater quality (**Section 2.7.3**), water use information (**Section 2.7.4**), and the overall hydrologic conceptual model (**Section 2.7.5**) based on the geology and hydrology of the Permit Area. Water use, which is limited in the vicinity of the Permit Area, is addressed in **Section 2.2.2.**

2.7.1 Surface Water

2.7.1.1 Drainage Characteristics

The Permit Area is located in the Great Divide Basin, a topographically closed system which drains internally, due to a divergence in the Continental Divide. Most of the surface water is runoff from precipitation or snowmelt, and it quickly infiltrates, recharging shallow groundwater, evaporates, or is consumed by plants through evapotranspiration. Alluvial deposits, if any, along drainages are not extensive, and the shallow aquifer, Battle Spring, underlying the Permit Area is unconfined, unconsolidated, and poorly stratified. The shallow water table is typically 80 to 150 feet below ground surface (ft bgs).

There are no perennial or intermittent streams within the Permit Area or on adjacent lands. The only officially named drainage within the Permit Area is Battle Spring Draw, which is dry for the majority of the year (**Figure D6-1**). A 1:24,000 USGS topographic map was imported into GIS, and used to conduct the drainage network analyses described in this section. Three primary watersheds drain ninety-nine percent of the Permit Area. These watersheds have been named Western Draw, West Battle Spring Draw, and East Battle Spring Draw for the purposes of this application. The Western Draw watershed covers 2.9 mi^2, of which 2.4 mi^2 are within the Permit Area; the West Battle Spring Draw watershed cover 7.0 mi^2, of which 3.1 mi^2 are within the Permit Area; the East Battle Spring Draw watershed covers 5.1 mi^2, of which 1.0 mi^2 is within the Permit Area. The entire Permit Area drains into the Battle Spring Flat, approximately nine miles southwest of the Permit Area. Much of the water conveyed through the ephemeral channels does not reach Battle Spring Flat. Instead, it infiltrates into the alluvium and recharges the Battle Spring aquifer.

The average slope of the Battle Spring Draw (northeastern) drainage in the Permit Area is 1.2 percent, the central drainage has an average slope of 1.5 percent, and the southwestern drainage has an average slope of 1.7 percent. The sinuosity (length of the channel divided by the length of valley) was calculated for the major channel in each basin. The sinuosity values for the northeastern Battle Spring Draw, central, and southwestern basins are 1.02, 1.15, and 1.16, respectively. The drainage densities range from 3.3 miles per square mile in the southwestern basin to 4.6 miles per square mile and 4.5 miles per square mile in the central and northeastern basins, respectively. A longitudinal profile of the northeastern Battle Spring Draw within the Permit Area is shown in **Figure 2.7-2**.

The existing drainages are incised, wide u-shaped and trapezoidal cross-sectional morphologies. Vertical and slumping banks exist where active erosion is occurring. The channels near the downstream boundary of the Permit Area are incised three to six feet and are ten to 15 feet wide. The channel side-slopes range in slope from 1:1 to approximately 2.5:1. The bed material in the larger draws is sandy textured and non-cohesive. Draws around the Permit Area are typically vegetated with sagebrush.

Annual runoff in the Permit Area is very low due to the high infiltration capacity and low annual precipitation. The channels are dry for the majority of the year. Drainages in the Permit Area are naturally ephemeral and primarily flow during spring snowmelt as saturated overland flow when soil moisture is at a maximum. The quantity of spring runoff is variable, depending on the amount of winter snowfall accumulation. Peak runoff from high intensity rain events can be significant; but surface flow is generally short-lived. Storm-water runoff after high intensity rain events is very rare because surface water infiltrates very rapidly or evaporates. Some intermittent and localized flow can occur near a small number of springs; but no surface runoff has been observed from springs within the Permit Area.

Runoff data are limited for the ephemeral and intermittent streams in the Great Divide Basin. There are two USGS streamflow gaging stations within 40 miles of the Permit Area; but they are on perennial streams and are not representative of drainages in the Permit Area. On April 6, 1976, the USGS measured the instantaneous discharge of Lost Soldier Creek, approximately 14.5 miles northeast of the Permit Area. The measurement of 0.2 cubic feet per second was taken during spring runoff so the source of water was predominantly snowmelt (USGS, 2006).

A method for estimating peak stream discharge in ungaged watersheds in response to storms with recurrence intervals from two to 100 years has been developed by Miller

(2003). Miller analyzed streamflow data for hundreds of gaged watersheds in Wyoming ranging from one to 1,200 square miles, and developed regional regression relationships based upon basin characteristics (drainage area, geographic factors, elevation, etc.). The most significant independent variables in Sweetwater County were drainage area and latitude. The equations used for each calculation as well as the associated percent errors are summarized in **Table 2.7-1**. **Table 2.7-2** shows the calculated peak discharge at the downstream boundary of the three principal watersheds, delineated as Points A2, B4, and C2 in **Figure 2.7-1**. Due to the incised nature and the width of the channels, flows from the 100-year flood would likely remain mostly within the channels.

One small (less than one-quarter acre) detention pond exists in the Permit Area, which acts as an off-channel storage area for stock watering. This is Crooked Well Reservoir which is shown in **Figure 2.7-3**. This pond is dry for the majority of the year and typically fills from spring snowmelt during the months of March and April. Wetland vegetation has not been observed around this impoundment. This detention pond is not included in the active surface water rights in the area.

2.7.1.2 Surface Water Quality

Under the WDEQ Water Quality Division (WQD) Classification, Battle Spring Draw is listed as a Class 3B water body. Beneficial uses for Class 3B waters can include recreation, wildlife, "other aquatic life," agriculture, industry, and scenic value, but do not include drinking water, game fish, non-game fish, and fish consumption.

Background historic surface water quality within the study area was characterized using water quality data from 1974 and 1975 that were collected as part of the environmental report for the Sweetwater Uranium permit application (Shephard Miller Inc., 1994). Samples were collected at Battle Spring, which is seven miles southwest of the Permit Area. The historic dataset is small, and more representative of groundwater quality than surface water quality so are not directly comparable to expected surface water conditions within the Permit Area. The water-quality data for the historic sampling at Battle Spring are summarized in **Table 2.7-3**. Historic sampling of Battle Spring in July 1974 showed that pH was highly alkaline at 9.5. Uranium concentrations ranged from 0.006 to 0.95 milligrams per liter (mg/L).

In April 2006, storm-water samplers were installed at 12 locations in the Permit Area (**Figures 2.7-4** and **2.7-5**). In April 2007, an additional sampler was added to represent an area in the southeastern corner that was added to the Permit Area in the summer of 2006. Three samplers were installed to capture runoff as it enters the Permit Area from the upstream side, and the others capture runoff within the Permit Area or at the downstream boundary. The water samples were collected to characterize the quality of ephemeral surface runoff. The sampling locations were selected based on their topographic potential to concentrate ephemeral surface flow.

Seven samplers collected full, one-liter samples from snowmelt runoff in March and April 2007. These samples were collected on April 17, 2007. The water quality data for these seven samples are summarized in **Table 2.7-4**.

Ionic strength was low in all samples, probably due to the majority of the sample being snowmelt water that did not come into contact with the underlying soil. For all samples, the dissolved and total concentrations of trace metals were near or below the detection limit. Radiometric parameters, including uranium, lead-210, polonium-210, and thorium-230, were generally below detection with the exception of dissolved uranium, which was detected at very low concentrations (0.0003 to 0.0004 mg/L) in two samples, suspended uranium (0.0003 to 0.0009 mg/L) in two samples, and total uranium (0.0003 to 0.0009 mg/L) in four samples. Total radium-226 was detected at a low concentration (0.5 picoCuries per liter [pCi/L]) in one sample. This was the LC2 location in the center of the Permit Area in one of the larger channels. Gross alpha was also detected in small amounts (1.1 to 3.6 pCi/L) in six samples. The highest concentration of 3.6 pCi/L was again from the LC2 location. The pH of the sites was slightly acidic to neutral ranging from 6.39 to 7.12. Conductivity was low with less than 100 microSiemens per centimeter for all samples.

In general, the quality of water was very good for all samples. The radiometric parameters detected in the LC2 correlate well with the radiological scans of the Permit Area. This central area has the highest radioactivity, as indicated by the results from the radiological surveys. Still, the levels are well below all Wyoming agricultural and drinking water standards.

2.7.2 Groundwater Occurrence

This section describes the regional and local groundwater hydrology including hydrostratigraphy, groundwater flow patterns, hydraulic gradient, and aquifer parameters. The discussion is based on information from investigations performed within the Great Divide Basin, data presented in previous applications/reports for the Permit Area, and the geologic information presented in **Section 2.6**. Regional and site baseline groundwater quality conditions are discussed in **Sections 2.7.3**, and the conceptual site hydrologic model is summarized in **Section 2.7.4** of this application.

2.7.2.1 Regional Hydrogeology

The Project is located within the northeastern portion of the Great Divide Basin. The basin is topographically closed with all surface water drainage being to the interior of the basin (**Figure 2.7-1**). Available data suggest that groundwater flow within the basin is predominately toward the interior of the basin (Collentine, 1981; Welder, 1966; and Mason, 2005). A generalized potentiometric surface map of the Battle Spring/Wasatch Formations, prepared by Welder and McGreevey (1966), indicates groundwater movement toward the center of the basin (**Figure 2.7-6**). Fisk (1967) suggests that aquifers within the Great Divide Basin may be in communication with aquifers in the Washakie Basin to the south and that groundwater may potentially move across the Wamsutter Arch between the basins.

The topographically elevated area known as the Green Mountains (Townships 26 and 27 North, between Ranges 90 to 94 West) was identified by Fisk as a major recharge area to aquifers within the northeastern portion of the Great Divide Basin (1967). The Rawlins Uplift, Rock Springs Uplift, and Creston Junction, located east, southwest, and southeast, respectively, from the Permit Area, were also identified as major recharge areas for aquifers within the Great Divide Basin (Fisk, 1967). The main discharge area for the Battle Spring/Wasatch aquifer system is to a series of lakes, springs and playa lakes beds near the center of the basin. Groundwater potentiometric elevations within the Tertiary aquifer system in the central portion of the basin are generally close to the land surface.

The Battle Spring Formation crops out over most of the northeastern portion of the Great Divide Basin, including much of the Permit Area. The Battle Spring Formation is considered part of the Tertiary aquifer system by Collentine et al. (1981). The Tertiary aquifer system is identified as "the most important and most extensively distributed and accessible groundwater source in the study area" (Collentine, 1981). This aquifer system includes the laterally equivalent Wasatch Formation (to the west and south) and the underlying Fort Union and Lance Formations. The base of the Tertiary aquifer system is marked by the occurrence of the Lewis Shale. The Lewis Shale is generally considered a regional aquitard, although this unit does produce limited amounts of water from sandstone lenses at various locations within the Great Divide Basin and to the south in the Washakie Basin.

Shallower aquifer systems that can be significant water supply aquifers within the Great Divide Basin include the Quaternary and Upper Tertiary aquifer systems. However, as previously stated, the Battle Spring Formation of the Tertiary aquifer system crops out over most of the northeast part of the basin; and the Quaternary and Upper Tertiary aquifer systems are absent or minimal in extent. The shallower aquifer systems are only important sources of groundwater in localized areas, typically along the margin of the basin where the Battle Spring Formation is absent. Aquifer systems beneath the Tertiary include the Mesaverde, Frontier, Cloverly, Sundance-Nugget and Paleozoic aquifer systems (Collentine, 1981). In the northeast Great Divide Basin, these aquifer systems are only important sources of water in the vicinity of outcrops near structural highs such as the Rawlins Uplift.

For purposes of this application, only hydrogeologic units younger than and including the Lewis Shale (Upper Cretaceous age) are described, with respect to general hydrologic properties and potential for groundwater supply. The Lewis Shale is an aquitard and is considered the base of the hydrogeologic sequence of interest within the Great Divide Basin. Units deeper than the Lewis Shale are generally too deep to economically develop for water supply or have elevated total dissolved solid (TDS) concentration that renders them unusable for human consumption. Exceptions to this can be found along the very eastern edge of the basin, tens of miles from the Permit Area, where some Lower Cretaceous and older units provide relatively good quality water from shallow depths. Hydrologic units of interest within the northeast Great Divide Basin are shown on the stratigraphic column in **Figure 2.7-7** and further described below, from deepest to shallowest:

- Lewis Shale (aquitard between Tertiary and Mesaverde aquifer systems);
- Fox Hills Formation
- Lance Formation (Tertiary aquifer system);
- Fort Union Formation (Tertiary aquifer system);
- Battle Spring Formation-Wasatch Formation (Tertiary aquifer system);
- Undifferentiated Tertiary Formations (Upper Tertiary aquifer system, including Bridger, Uinta, Bishop Conglomerate, Browns Park, and South Pass); and
- Undifferentiated Quaternary Deposits (Quaternary aquifer system).

Discussion of the regional characteristics for each of these hydrostratigraphic units is provided below.

Lewis Shale

The Lewis Shale underlies the Fox Hills Formation and is generally considered an aquitard in the Great Divide Basin. This unit is described by Welder and McGreevey (1966) as light to dark gray, carbonaceous shale with beds of siltstone and very fine-grained sandstone. The Lewis Shale is up to 2,700 feet thick, generally increasing in thickness toward the east side of the basin. In the Permit Area, the Lewis Shale is 1,200 feet thick. Small quantities of water may be available from the thin sandstone beds within this unit near the margins of the basin. The Lewis Shale acts as the confining unit between the Tertiary and Mesaverde aquifer systems.

Fox Hills Formation

Fox Hills Formation overlies the Lewis Shale and consists of very fine-grained sandstone, siltstone and coal beds. It is not considered to be an important aquifer in the Permit Area.

Lance Formation

Overlying the Fox Hills Formation is the Lance Formation, consisting, predominately, of very fine-to fine-grained lenticular, clayey, calcareous sandstone. Shale, coal, and lignite beds are present within the formation, which reaches a maximum thickness of approximately 4,500 feet (Welder, 1966). In the Permit Area, the Lance Formation is 2,950 feet thick.

Collentine and others (1981) include the Lance Formation (Aquifer) as the lower-most aquifer within the Tertiary aquifer system. However, the Lance Aquifer is included as part of the Mesaverde aquifer system by Freethey and Cordy (1991). Several stock wells, located along the eastern outcrop area of the basin, are completed in the Lance Aquifer. The stock wells have estimated yields of five to 30 gpm. Hydraulic conductivity for the Mesaverde aquifer system reported by Freethey and Cordy (1991) (which, by the authors' designation, includes the Fox Hills Sandstone, Lewis Shale, and Mesaverde Group, in addition to the Lance Aquifer) is reported to range from 0.0003 to 2.2 feet per day (ft/d). Because of the limited number of wells completed within the Lance Aquifer in the Great Divide Basin, there are insufficient data to develop representative potentiometric surface maps for this hydrologic unit. However the potentiometric surface is most likely similar in orientation to that seen in the overlying Fort Union and Battle Spring/Wasatch aquifers, with inferred groundwater movement generally toward the center of the basin. No regionally extensive aquitards between the Fort Union and Lance Formation were identified or reported in the hydrologic studies, investigations, and reports reviewed for this permit application.

Fort Union Formation

The Paleocene-age Fort Union Formation is between the Lance Formation and the overlying Wasatch and Battle Spring Formations, reaching a maximum thickness of approximately 6,000 feet within the Great Divide/Washakie Basin area. In the Permit Area, it is 4,650 feet thick. The Fort Union Formation is present at or near land surface in a band around the Rock Springs Uplift and in the northeastern corner of the Great Divide Basin (Mason, 2005). The Fort Union Formation is described as a fine- to coarse-grained sandstone with coal and carbonaceous shale. Siltstone and claystone are present in the upper part of the formation (Welder, 1966).

A potentiometric surface map prepared by Naftz (1996) that groups the Fort Union aquifer with the Battle Spring/Wasatch aquifers, shows inferred movement of groundwater toward the basin center (**Figure 2.7-8**).

The Fort Union aquifer is largely undeveloped and unknown as a source of groundwater supply except in areas where it occurs at shallow depths along the margins of the basin. Well yields from the Fort Union aquifer within the Great Divide and Washakie Basins range from three to 300 gpm. Estimates of transmissivity for the Fort Union aquifer are highly variable. Ahern (1981) estimated transmissivity of less than three square feet per day (ft^2/d) for ten Fort Union Formation oil fields in the Green River Basin. Collentine and others (1981) reported transmissivity of the Fort Union aquifer as characteristically less than 325 ft^2/d from oil well data.

Water quality for the Fort Union aquifer is described in **Section 2.7.3**.

Battle Spring Formation- Wasatch Formation

The most important water-bearing aquifers within the Great Divide Basin are in the Wasatch Formation and the Battle Spring Formation. The Wasatch and Green River Formations grade into the Battle Spring Formation in the northeastern portion of the basin. The Battle Spring Formation is absent along the eastern margin of the Great Divide Basin near the county line between Sweetwater and Carbon Counties. The termination of the Battle Spring Formation to the east is controlled, largely, by structural features, including the Rawlins Uplift to the east and the Green Mountains to the north. A dry oil test in Section 14, Township 24 North, Range 90 West, located within a few miles of the eastern limit of the Battle Spring Formation, had a reported thickness of over 6,000 feet of fine- to coarse-grained sandstone that was interpreted by the American Stratigraphic Company as the Battle Spring Formation. Within the Permit Area, the Battle Spring/Wasatch Formations are 6,200 feet thick.

The Battle Spring Formation is described as an arkosic, fine- to coarse-grained sandstone with claystone and minor conglomerates. There are typically several water-bearing sands within the Battle Spring Formation. The Battle Spring aquifers are included in the Tertiary aquifer system, as defined by Collentine (1981).

Groundwater within the Battle Spring aquifers is typically under confined conditions, although locally unconfined conditions exist. The potentiometric surface within the Battle Spring aquifers is usually within 200 feet of the ground surface (Welder, 1966). Most wells drilled for water supply in this unit are less than 1,000 feet deep. The potentiometric surface map of Wasatch and Battle Spring aquifers (**Figure 2.7-6**) indicates groundwater movement toward the center of the basin (Welder, 1966). From the Permit Area, the potentiometric surface dips to the southwest at approximately 50 feet per mile (ft/mi) (a hydraulic gradient of 0.01 foot per foot [ft/ft]). The hydraulic gradient becomes steeper near the margins of the basin, where recharge to the aquifer is occurring.

Collentine and others (1981) report that wells completed in the Battle Spring aquifers typically yield 30 to 40 gpm; but that yields as high as 150 gpm are possible. Collentine and others (1981) also reported that pump tests conducted on 26 wells completed within the Battle Spring aquifers resulted in transmissivity values ranging from 3.9 to 423 ft^2/d, although most wells were less than 67 ft^2/d. Specific capacity was less than one gallon per minute per foot for 23 of 26 wells tested.

Water quality for the Wasatch/Battle Spring aquifers is described in **Section 2.7.3**.

Undifferentiated Tertiary and Quaternary Sediments

Undifferentiated Tertiary and Quaternary units above the Battle Spring/Wasatch Formations can be sources of water supply; but wells in the northeastern part of the Great Divide Basin are rare and generally limited to the margins of the basin where the Battle Spring Formation is not present. Commonly, along the margins of the basin, hydrostratigraphic units younger than the Battle Spring/Wasatch have been deposited on rocks of Cretaceous age or older. Water supply wells along the margins of the basin are often completed in both the older hydrostratigraphic units and Tertiary and Quaternary sediments. Water quality within these units tends to be variable and of limited quantity.

The undifferentiated Tertiary units consist of interbedded claystone, sandstone and conglomerate with the coarser grained facies providing suitable groundwater resources where present. The undifferentiated Tertiary units are absent within the Permit Area and are not discussed further.

The undifferentiated Quaternary units consist of clay, silt, sand, gravel and conglomerates that are poorly consolidated to unconsolidated (Welder, 1966). These units represent windblown, alluvial and lake deposits. Where present, these deposits can provide acceptable yields of groundwater of relatively good quality. Thin deposits of Quaternary sediments are present within surface drainages in the Permit Area but are usually above the water table and unsaturated. Therefore, Quaternary sediments are not an important groundwater source in the vicinity of the Project and are not described further.

2.7.2.2 Site Hydrogeology

LC ISR, LLC has been collecting lithologic, water level, and pump test data as part of its ongoing evaluation of hydrologic conditions at the Project. In addition to recent data acquisition, historic data collected for Conoco (Hydro-Search, Inc., 1982) were used to support this evaluation. Drilling and installation of borings and monitor wells is ongoing to provide additional data to further refine the site hydrologic conceptual model. Water level measurements, both historic and recent, provide data to assess potentiometric surface, hydraulic gradients and inferred groundwater flow directions for the aquifers of interest at the Project. A recently completed long-term pump test (Petrotek Engineering Corporation, 2007) and several shorter-term pump tests (Hydro-Engineering, 2007), as well as the pump tests conducted for Conoco (Hydro-Search, Inc., 1982), were used to evaluate hydrologic properties of the aquifers of interest, to assess hydraulic characteristics of the confining units, and to evaluate impacts to the hydrologic system of the Fault through the Permit Area (**Section 2.6.2.2**).

Figure 2.7-9 shows the monitor wells, current and historic, that were used in the site hydrologic evaluation. **Table 2.7-5** provides data for those wells to the extent available.

Hydrostratigraphic Units

LC ISR, LLC has employed the following nomenclature for the hydrostratigraphic units of interest within the Project. The primary uranium production zone is identified as the HJ Horizon. The HJ Horizon is subdivided into the Upper (UHJ), Middle (MHJ) and Lower (LHJ) Sands. The HJ Horizon is bounded above and below by aerially extensive confining units identified as the Lost Creek Shale and the Sage Brush Shale, respectively. Overlying the Lost Creek Shale is the FG Horizon. The deepest sand in the FG Horizon, the Lower FG (LFG) Sand, is the overlying aquifer to the HJ Horizon. Beneath the Sage Brush Shale is the KM Horizon. The uppermost sand within the KM Horizon, designated the Upper KM (UKM) Sand, is a potential secondary production zone and also the underlying aquifer to the HJ Horizon. The No Name Shale separates the UKM and Middle KM (MKM) Sand. The MKM Sand is the underlying aquifer to the UKM Sand. The shallowest occurrence of groundwater within the Permit Area occurs within the DE Horizon, which is above the FG Horizon. **Figure 2.7-10** depicts the hydrostratigraphic relationship of these units.

A brief description of each hydrostratigraphic unit follows, going from shallowest to deepest.

DE Horizon

The DE Horizon is the shallowest occurrence of groundwater within the Permit Area, although the horizon is not saturated in all portions of the Permit Area. The DE Horizon consists of a sequence of sands and discontinuous clay/shale units. In the southern part of the Permit Area, sands of the DE Horizon coalesce with sands of the FG Horizon. The top of the unit ranges from 100 to 200 ft bgs.

FG Horizon

The top of the FG Horizon occurs at depths of approximately 200 to 250 ft bgs on the north side of the Fault and 300 to 350 ft bgs on the south side of the fault within the Permit Area (**Section 2.6.2.2**). The FG Horizon is subdivided into the Upper (UFG), Middle (MFG) and Lower (LFG) Sands. The total thickness of the FG Horizon is approximately 160 feet. The basal unit in the FG Horizon, the LFG Sand, ranges from 20 to 50 feet thick within the Permit Area. The LFG Sand is designated as the overlying aquifer for the HJ Horizon.

Lost Creek Shale

Underlying the FG Sands is the Lost Creek Shale. The Lost Creek Shale appears continuous across the Permit Area, ranging from five to 45 feet in thickness. Typically, this unit has a thickness of 10 to 25 feet (**Figure 2.7-10**). The Lost Creek Shale is the confining unit between the overlying aquifer (LFG Sand) and the HJ Horizon. The confining characteristics of the Lost Creek Shale have been demonstrated with a pump test, as described later in this application.

HJ Horizon

The HJ Horizon is the primary target for uranium production at the Lost Creek Project. For purposes of uranium ISR operations, the HJ Horizon has been subdivided into three Sands: the Upper HJ (UHJ), Middle HJ (MHJ) and the Lower (LHJ) Sand. These sands are generally composed of coarse-grained arkosic sands with thin lenticular intervals of fine sand, mudstone and siltstone. The bulk of the uranium mineralization is present in the MHJ Sand. The total thickness of the HJ Horizon ranges from 100 to 160 feet, averaging approximately 120 feet (**Figure 2.7-10**). The top of the HJ Horizon ranges from approximately 300 to 450 ft bgs within the Permit Area. The three sands are generally separated by thin clayey units that are not laterally extensive and, based on pump test results, do not act as confining units to prevent groundwater movement vertically between the HJ Sands. The underlying aquifer to the HJ Horizon is the UKM Sand, which is also a potential uranium production zone. Therefore, the deepest sand within the HJ Horizon, the LHJ Sand, is also designated as the overlying aquifer to the UKM Sand.

Sage Brush Shale

Beneath the HJ Horizon is the Sage Brush Shale, with the top of the shale ranging from 450 to 550 ft bgs. The Sage Brush Shale is laterally extensive and ranges from five to 75 feet in thickness (**Figure 2.7-10**). The Sage Brush Shale is the lower confining unit to the HJ Horizon. The confining characteristics of this unit have been demonstrated through pump tests, as described in later sections of this application.

UKM Sand

The UKM Sand is present beneath the Sage Brush Shale. The UKM Sand is the upper member of the KM Horizon and is generally a massive coarse sandstone with lenticular fine sandstone intervals. The UKM Sand is the underlying aquifer to the HJ Horizon but is also a potential production zone within the Permit Area. The UKM Sand is typically 30 to 60 feet thick but can reach to over 75 feet in thickness (**Figure 2.7-10**). The top of the UKM Sand is usually between 450 and 600 ft bgs within the Permit Area. The decision to proceed with a license amendment for production of the UKM Sand will depend on the results of additional delineation drilling and characterization of the lower confining unit and underlying aquifer that are described below.

No Name Shale

The No Name Shale at the base of the UKM Sand has not yet been fully characterized. The top of the unit is approximately 480 to 650 ft bgs. This unit is generally ten to 30 feet thick. This shale will be the lower confining unit to the UKM Sand. Additional drilling is being conducted and a pump test is planned for the fall of 2007 to assess the confining characteristics of this unit.

MKM Sand

The MKM Sand is the underlying aquifer to the UKM Sand. Information on the MKM Sand is limited at this time. Additional borings are being drilled to evaluate the geologic and hydrologic characteristics of this sand. A pump test is planned to assess the hydrologic relationship between the UKM and MKM Sands in the fall of 2007.

Potentiometric Surface, Groundwater Flow Direction and Hydraulic Gradient

The LC ISR, LLC hydrologic evaluation of the Project included measurement of water levels in monitor wells completed in the overlying aquifers (DE and LFG), the HJ Horizon, and the underlying aquifer (UKM) to assess the potentiometric surface, groundwater flow direction and hydraulic gradient of those units. Additional historic water level data were available from the Conoco hydrologic evaluation of the site (Hydro-Search Inc., 1982). **Table 2.7-6** lists static water level data recorded in 1982, 2006 and 2007.

The potentiometric surface determined in December 2008 for the DE Horizon is shown in **Figure 2.7-11a**. The groundwater flow direction is to the southwest. In 2006, the horizontal hydraulic gradient calculated from only two wells completed in the DE Sand on the south side of the Fault was 0.0064 ft/ft (33.0 ft/mi) (**Table 2.7-7**). Additional DE monitor wells were installed in the fall of 2008. Based on water levels collected in 2008, the horizontal hydraulic gradient across the permit area in the DE aquifer is approximately 0.007 ft/ft on both sides of the Lost Creek Fault.

Water levels collected from the overlying aquifer (LFG Sand) in 2008, 2006, and 1982 indicate a southwesterly groundwater flow direction (**Figure 2.7-11b** and **Figure 2.7-11c**). Data from 1982 and 2006 indicate horizontal hydraulic gradients for the LFG aquifer range from 0.0046 to 0.0058 ft/ft (24.3 to 30.6 ft/mi). Based on the 2008 data across the permit area, the horizontal hydraulic gradient ranged from 0.005 ft/ft north of the Lost Creek Fault to 0.007 ft/ft south of the Fault.

The potentiometric surface for the HJ Horizon is shown on **Figure 2.7-11d** and **Figure 2.7-11e**. The water level data were collected in December 2008 and just prior to beginning a long-term pump test in June 2007 respectively. From the figures, it is evident that the Fault provides a significant hydraulic barrier to groundwater flow. In 2007, the potentiometric surface on the north side of the Fault is 15 feet higher than on the south side, based on wells located approximately 100 feet apart on either side of the Fault (Wells HJT104 and HJMP107). During the long-term pump test, the hydraulic barrier effect of the Fault was confirmed, as described more fully in the following section on aquifer properties. Based on the potentiometric surface maps, groundwater is inferred to flow to the west-southwest, generally consistent with the regional flow system. The Fault may redirect groundwater more westward than if the Fault were not present. Data from 1982 and 2006 are shown on **Figure 2.7-11f**. There is an insufficient number of data points to accurately represent the potentiometric surface for those measurement periods. However, the data illustrate the difference in water levels within the HJ Horizon across the Fault.

The horizontal hydraulic gradient for the HJ Sand, determined from water level data from 1982, 2006 and 2007, ranged from 0.0034 to 0.0056 ft/ft (18.0 to 29.6 ft/mi). **Table 2.7-7** summarizes the hydraulic gradients determined from the water level data.

Figure 2.7-11g and **Figure 2.7-11h** show the potentiometric surface of the UKM Sand for data collected in 2008, 2006, and 1982. The difference in hydraulic heads across the Fault does not appear as pronounced for the UKM Sand as for the other shallower sands. Horizontal hydraulic gradients calculated for the UKM Sand from 1982 and 2006 water level data ranged from 0.0053 to 0.0063 ft/ft (28.0 to 33.3 ft/mi) (**Table 2.7-7**). Similar to the overlying horizons, the general flow direction is southwest.

The similarity in hydraulic gradients between the HJ aquifer and the DE, LFG and UKM aquifers suggests that, although there is a difference in potentiometric heads, the orientation of the potentiometric surface is probably similar.

Vertical hydraulic gradients were determined by measuring water levels in closely grouped wells completed in different hydrostratigraphic units. **Figure 2.7-12** shows the location of the well groups used for the assessment of vertical hydraulic gradients. **Table 2.7-8** summarizes the calculated vertical gradients between the DE, LFG, HJ and UKM aquifers. Vertical hydraulic gradients range from 0.05 to 0.34 ft/ft between the LFG, HJ and UKM aquifers and consistently indicate decreasing hydraulic head with depth. The vertical gradient between the DE and LFG aquifers is minimal in the two places measured. This is consistent with earlier observations that the DE and LFG Sands coalesce in places within the Permit Area. Of the six well groups evaluated, the only place where a downward potential is not evident is between the DE and LFG aquifers in the southwest portion of the Permit Area. The vertical gradients indicate the potential for groundwater flow is downward. A downward potential is indicative of an area of recharge, as opposed to an upward potential that is normally indicative of an area of groundwater discharge. A downward gradient is consistent with the structural and stratigraphic location of the Project with regard to Great Divide Basin.

Aquifer Properties

Aquifer properties for the Battle Spring aquifers within the Permit Area have been estimated from historic and recent pump tests. Hydro-Search Inc. performed a hydrologic evaluation in 1982 to determine the feasibility of in situ production of the Conoco uranium orebody at Lost Creek. Hydro-Search Inc conducted two 25-hour tests within the HJ Horizon. Both pump tests were conducted at a rate of 30 gpm and on the south side of the Fault. The locations of the pumping wells and monitor wells are shown in **Figure 2.7-13**. The results of the tests were variable, with one test indicating a transmissivity of approximately 95 ft^2/d (700 gallons per day per foot [gpd/ft]) and the other indicating a value of 270 ft^2/d (2,000 gpd/ft). The storativity calculated from the first test averaged 5×10^{-4}. There was no reported response in the HJ aquifer north of the Fault. Monitor wells in the overlying (LFG) and underlying (UKM) aquifers did not show any effects from the pump test as reported by Hydro-Search Inc. (1982). Results of the pump tests are summarized in **Table 2.7-9**.

2006 Pump Tests

Hydro-Engineering, Inc. (2007) conducted several short-term single well pump tests and three longer multi-well pump tests in October 2006. The single well tests ranged from 30 minutes to five hours in duration at rates from 0.67 to 14 gpm. The long-term tests were from 20 to 45 hours long at rates of 15 to 19 gpm. Each of the long-term tests were conducted in HJ well completions. The locations of the wells included in the pump test program are shown on **Figure 2.7-13**. Results of the pump test are summarized in **Table 2.7-9**.

The range of transmissivity calculated by Hydro-Engineering for the HJ aquifer was from 44 to 400 ft^2/d (330 to 3,000 gpd/ft). None of the HJ tests indicated significant communication with the overlying or underlying aquifers. There was also no indication of hydraulic communication across the fault in any of the pump tests. Hydro-Engineering concluded that the Fault acts as a hydraulic barrier (2007).

The Hydro-Engineering data suggest that the transmissivity of the LFG aquifer, calculated from four tested wells, was generally much lower than the values estimated for the HJ aquifer. The range of transmissivity for the LFG aquifer was 4.4 to 40 ft^2/d (33 to 303 gpd/ft). Transmissivity for the UKM aquifer, estimated from single well tests at four wells, was similar to but lower than the HJ aquifer, ranging from 26 to 115 ft^2/d (195 to 858 gpd/ft). Three DE well completions were tested, with resulting transmissivity of 1.3 to 130 ft^2/d (10 to 1,000 gpd/ft). Additional discussion regarding the results of the testing are included in **Attachment 2.7-1**.

2007 Pump Tests

In June to July 2007, a long-term pump test was conducted in the HJ aquifer at Well LC19M (Petrotek Engineering Corporation, 2007). LC19M had been previously tested by Hydro-Engineering (2007) and is located on the north side of the Fault. The objectives of the test were to further develop aquifer characteristics of the HJ Horizon, to evaluate the hydraulic impacts of the Fault, and to demonstrate confinement of the production zone (HJ Horizon) aquifer. HJ monitor wells, on both sides of the Fault and within distances likely to be impacted by the pump test, were included as observation wells. Observation wells in the overlying (LFG) and underlying (UKM) aquifers near the pumping well and across the Fault were also monitored during the test. **Table 2.7-10** lists the data for monitor wells included in the pump test. **Figure 2.7-14** includes the locations of the pumping well and all observation wells included in the test.

Pre-pumping monitoring was performed several days in advance of the test to establish baseline conditions and to evaluate barometric effects. A step-rate test was performed on June 23, 2007 to determine a suitable pumping rate for the long-term test. The long-term test was started at 17:20 hours on June 27, 2007 and was terminated on July 3, 2007 at 10:51 hours. The total duration of the test was 5.7 days (8,251 minutes). The average pumping rate during the test was 42.9 gpm. Maximum drawdown in the pumping well was 93.3 feet. Monitoring was continued after pump shut-in to record recovery.

The transmissivity calculated from five wells completed in the HJ aquifer on the north side of the Fault (including the pumping well) were similar, ranging from 30.0 to 75.5 ft^2/d and averaging 68.3 ft^2/d. The average hydraulic conductivity calculated for the five wells, assuming an aquifer thickness of 120 feet, was 0.57 ft/d. Storativity calculated from those wells ranged from 6.6×10^{-5} to 1.5×10^{-4} and averaged 1.1×10^{-4}. **Table 2.7-11** summarizes the analyses of the pump test. Drawdown at the end of the test in the HJ aquifer is shown on **Figure 2.7-15**. **Figure 2.7-16** shows the water levels in the HJ monitor wells at the end of the test.

A pair of observation wells was placed on either side of the Fault, within 100 feet of each other. Well HJT104, located on the north side of the Fault, had a maximum drawdown of 40.5 feet at the end of the test. Well HJMP107 (south of the Fault) in the HJ Horizon had a net decrease of 1.4 feet from the beginning of the test to the end of pumping. At least a portion of that change is attributable to a declining trend in water levels that was observed in all monitor wells prior to the start of the test. The reason for the background trend observed has not been identified; however, it might be a result of offset pumping (e.g., LC ISR, LLC's first two water supply wells that are screened over multiple sands).

At the beginning of the test, the water level at HJT104 was at 6,770.68 feet above mean sea level (ft amsl) and the water level at HJMP107 was at 6,754.85 ft amsl, a head difference of almost 15 feet with the higher head north of the Fault. At the end of the pump test, the water levels for HJT104 and HJMP107 were 6,730.14 ft amsl and 6753.47 ft amsl, respectively. The drawdown observed in HJT104 (immediately north of the Fault) was greater than 40 feet, and the water level difference between HJT104 and HJMP107 (across the Fault from each other) was 23 feet with the higher head south of the Fault. Minor responses to pumping were observed across the Fault (e.g., approximately 0.3 to 0.7 feet of drawdown related to pumping in HJMP107 and other wells south of the Fault). Based on the results, the Fault, while not entirely sealing, significantly impedes groundwater flow, even under considerable hydraulic stress.

The response of the overlying and underlying aquifers during the pump tests was small (e.g., on the order of 0.2 to 0.5 feet); but the water level responses did correspond to the start and stop of pumping from LCM19 in the HJ Horizon. The underlying/overlying responses appear to be relatively consistent, regardless of distance from the pumping well, the hydrostratigraphic interval monitored, or the location relative to the Fault. These water level changes suggest potential impacts from off-site pumping or background trends that, because of distance from the monitor wells, are manifested at multiple locations at the same or similar times. As previously stated, a declining trend in water level elevations was observed prior to the start of the test. Most of the wells showed an initial inverted response (increase in water level) at the start of the test and then resumed a gradual downward trend during the test. This phenomenon was also observed and noted by Hydro-Engineering during the 2006 pump tests. It is possible that some of the response could be caused by: 1) pumping in the drilling water well (LC-1) which is completed in both the DE and FG Horizons; 2) communication across multiple sands due to the scissors nature of the Fault distant from the pumping well location; or 3) both. Additional discussion regarding the results of the testing are included in **Attachment 2.7-2**.

A second long term pump test was conducted to evaluate aquifer properties on the south side of the Lost Creek Fault using LC16M as the pumping well. A step-rate test was performed on pumping well LC16M October 7, 2007 to determine a suitable pumping rate for the long-term test. The long-term test for LC16M was started at 14:10 hours on October 22, 2007 and was terminated on October 28, 2007 at 01:00 hours when the generator used in the test failed. However, the HJ aquifer had been sufficiently stressed at that point and the pumping portion of the test was terminated. The total duration of the test was 5.5 days (7,850 minutes). The average pumping rate during the test was 37.4 gpm. Maximum drawdown in the pumping well was 69.3 feet. Monitoring was continued after pump shut-in to record recovery from the LC16M test.

The transmissivity calculated from six wells completed in the HJ aquifer on the south side of the Lost Creek Fault (including the pumping well LC16M) were similar, ranging from 56.7 to 110.0 ft^2/d and averaging 77.7 ft^2/d. The average hydraulic conductivity calculated for the six wells, assuming an aquifer thickness of 120 feet, was 0.65 ft/d. Storativity calculated from four of the monitoring wells ranged from 3.5×10^{-5} to 1.4×10^{-4} and averaged 7.3×10^{-5}. Well HJT105 had a calculated storativity of 9.1×10^{-5} which appears anomalously high and was not included in the average. Storativity was not, nor could be, calculated from the pumping well. **Table D6-10b** summarizes the analyses of the LC16M pump test. Drawdown near the end of the test in the HJ aquifer is shown on **Figure D6-16**.

The drawdown resulting from pumping LC16M shows a cone of depression developed around the pumping well that is elongated roughly parallel to the Lost Creek Fault (**Figure D6-16**). There is also drawdown within the HJ aquifer north of the Fault, although it is relatively minor. The same wells located about 100 feet apart and across the Fault from one another, Wells HJMP107 and HJT104, that were evaluated during the LC19M test were evaluated during the LQ16M test. Well HJMP107, located on the same side of the Fault as the pumping well, had nearly 25 feet of drawdown near the end of the test. Well HJT104, located approximately 100 feet north of Well HJMP107 and north of the Fault, had approximately 2.2 feet of drawdown at the end of pumping. The data from the LC16M pump test appear consistent with the LC19M pump test, showing that the Lost Creek Fault, while not impermeable, is a significant barrier to groundwater flow.

As in the LC19M pump test, the response of the overlying and underlying aquifers during the LC16M pump test was small (e.g., less than one foot in the LFG and less than two feet in the UKM); but the water level responses were coincident with the start and stop of pumping from LC16M (**Figure D6-16**). The response was slightly more pronounced in the UKM and occurred on both sides of the Lost Creek Fault. There were no observation points in the LFG aquifer across the Fault in the LC16M test. Similar to the LC19M pump test, results from the LC16M test indicate limited hydraulic communication between the HJ aquifer and the overlying LFG and underlying UKM aquifers. Additional discussion regarding the results of the testing are included in **Attachment 2.7-3**.

It is noted that detailed mine unit pump tests will be conducted during development of each future mine unit. As such, additional investigations will be performed to assess the background trends observed, characteristics of the Fault and potential communication between the sands monitored for the 2007 test. Based on testing results to date, it is anticipated that any minor communication between the HJ Horizon and the overlying and underlying sands can be managed through operational practices, detailed monitoring, and engineering operations. In this regard, the potential communication observed at Lost Creek is much lower (e.g., five to ten times less) than has been observed in other ISR operations where engineering practices were successfully implemented to isolate lixiviant from overlying and underlying aquifers. **Figure 2.7-17** summarizes the results of the Hydro-Search, Inc. (1982), Hydro-Engineering (2007), and Petrotek Engineering Corporation (2007) pump test results.

The 2007 pump test data support the following conclusions:

- the pump test results provide sufficient aquifer characterization of the HJ Horizon;
- the HJ Horizon has sufficient transmissivity such that mining operations can be conducted consistent with the Operations Plan (see **Section 3.0**);
- the HJ Horizon is sufficiently isolated from the overlying and underlying sands by the Lost Creek and Sage Brush Shales;
- hydraulic continuity of the HJ Horizon has been demonstrated over a large scale (e.g., more than 1,000 feet) such that mine planning (e.g., mine unit and monitor well layout) can proceed;
- hydraulic properties of the Fault have been defined over the test area to an extent such that mine planning can be achieved; and
- testing data to date indicate that the Fault significantly restricts flow in the HJ Horizon.

2.7.3 Groundwater Quality

This section describes the regional and local groundwater quality based on information from investigations performed within the Great Divide Basin, data presented in previous applications/reports for the Permit Area, and recent data collected in the Permit Area.

2.7.3.1 Regional Groundwater Quality

Water quality within the Great Divide Basin ranges from very poor to excellent. Groundwater in the near surface, more permeable aquifers is generally of better quality than groundwater in deeper and less permeable aquifers. Groundwater with TDS less than 3,000 mg/L can generally be found at depths less than 1,500 feet within the Tertiary aquifer system, which includes the Battle Spring/Wasatch, Fort Union and Lance aquifers (Collentine, 1981).

Water quality for the Great Divide Basin is available from a large number of sources including the USGS National Water Information System (NWIS) database, the University of Wyoming Water Resources Data System (WRDS) and the USGS Produced Waters Database. Much of these data are tabulated in "Water Resources of Sweetwater County, Wyoming", a USGS Scientific Investigation Report by Mason and Miller (2005). However, the quality and accuracy of much of the data are difficult to assess. This section of the permit application describes general water quality of the Great Divide Basin, primarily by reference to these sources.

Mason and Miller (2005) noted that water quality in Sweetwater County is highly variable within even a single hydrogeologic unit; and that water quality tends to be better near outcrop areas, where recharge occurs. They also noted that groundwater quality samples from the Quaternary and Tertiary aquifers are most likely biased toward better water quality and do not necessarily represent a random sampling, for the following reasons. Wells and springs that do not produce useable water usually are abandoned or not developed. Deeper portions of the aquifers typically are not exploited as a groundwater resource because a shallower water supply may be available. As a result, these water sources do not become part of the sampled network of wells and springs that ultimately make up the available groundwater database. Groundwater quality samples from deeper Mesozoic and Paleozoic hydrostratigraphic units are often available where oil and gas production or exploration has occurred. Therefore, groundwater samples from older geologic units may have less bias in representing ambient groundwater quality than samples collected from Quaternary and Tertiary aquifers.

Water quality within the shallow Tertiary aquifers generally represents sodium-bicarbonate to sodium-sulfate water types. TDS levels within the Wasatch aquifer in the west and south parts of the Great Divide Basin tend to be high relative to the US EPA's Secondary Drinking Water Standard (SDWS) of 500 mg/L, even within the shallow aquifers. TDS levels within the Battle Spring/ Wasatch aquifers are generally below 500 mg/L along the northern flank of the Great Divide Basin (which includes the Permit Area). Elevated TDS levels (greater than 3,000 mg/L) are present within the Wasatch aquifer along the eastern edge of the Washakie Basin and within the Fort Union and Lance aquifers along the east side of the Rock Springs uplift. Elsewhere within the Great Divide and Washakie Basins, TDS levels in the Tertiary aquifer system are typically between 1,000 and 3,000 mg/L (Collentine, 1981).

Low-TDS waters within the Battle Spring aquifer are predominately sodium-bicarbonate type waters. With increasing salinity, the water type tends to become more calcium-sulfate dominated. However, this trend is not exhibited in the Wasatch, Fort Union and Lance aquifers within the Great Divide and Washakie Basins. The Wasatch and Lance aquifers are characterized by predominately sodium-sulfate type waters, particularly near outcrop areas. The Fort Union is more variable in composition.

Water quality data for Tertiary aquifers away from the outcrop areas are sparse, but available data indicate that TDS levels increase rapidly away from the basin margins. A Lance pump test in Section 14, Township 23 North, Range 99 West has TDS levels in excess of 35,000 mg/L. A Fort Union test in Section 25, Township 13 North, Range 95 West had TDS levels in excess of 60,000 mg/L, based on resistivity logs (Collentine, 1981). Water quality samples from produced water in the Wasatch and Fort Union Formations from an average depth of 3,500 feet had TDS values ranging from 1,050 to 153,000 mg/L with a median value of 13,900 mg/L (Mason, 2005). TDS from four wells completed in the Fort Union Formation located along the margins of the basin ranged from 800 to 3,400 mg/L (Welder and McGreevy, 1966).

A graph of TDS versus sampling depth for produced water samples from the Wasatch Formation in Sweetwater County prepared by Mason and Miller (2005) shows that, at depths greater than 3,000 feet, TDS values are typically above 10,000 mg/L. It is noted that the Mason and Miller data set is small for a large area and may be biased by data from the southern part of the Great Divide Basin; few site-specific data directly applicable to the Project are available.

Water quality within the Battle Spring aquifer is generally good in the northeast portion of the basin with TDS levels usually less than 1,000 mg/L and frequently less than 200 mg/L. Water type within the Battle Spring aquifer is typically sodium bicarbonate to sodium sulfate. Mason and Miller (2005) reviewed eighteen groundwater samples, collected from the Battle Spring aquifer, and observed that those samples represented some of the best overall quality of those studied in Sweetwater County. Sulfate levels can be elevated in Tertiary aquifers, but are generally low in the shallow aquifers of the

Battle Spring Formation. Out of eighteen samples included in the Mason study, only one sample exceeded the WDEQ Class I Drinking Water Standard for sulfate of 250 mg/L. Most of the samples were also below the WDEQ TDS Class I Drinking Water Standard of 500 mg/L. Nitrate, fluoride and arsenic levels were below WDEQ and EPA standards for all of the samples.

Notable exceptions to the relatively good water quality included waters with elevated radionuclides. Uranium and radium-226 (Ra-226) concentrations exceeded their respective EPA Maximum Contaminant Levels (MCLs) of 0.03 mg/l and 5 pCi/l in some of the samples; radon-222 (Rn-222) concentrations were also relatively high in some samples (Mason, 2005); and the presence of high levels of uranium in Tertiary sediments and groundwater of the Great Divide Basin has been well documented. The Lost Creek Shroeckingerite deposit, located northwest of the Permit Area, is noted for high uranium levels in groundwater. Uranium-bearing coals are also present in Great Divide Basin. Sediments of the Battle Spring Formation were derived from the Granite Mountains and contain from 0.0005 to 0.001 percent uranium (Masursky, 1962). Based on historical exploration results, certain areas of the Battle Spring Formation (e.g., Lost Creek) contain much higher uranium concentrations.

Water quality for aquifer systems deeper than the Tertiary (such as the Mesaverde aquifer system) are not described in this report; because they are several thousands of feet deep in the vicinity of the Project and are separated from the Tertiary aquifer system by the Lewis Shale, a regional aquitard. The deeper aquifer systems of the Great Divide Basin will not impact nor be impacted by ISR activities at the Project.

2.7.3.2 Site Groundwater Quality

Information regarding site water quality is primarily derived from reconnaissance studies conducted by Conoco (Hydro-Search, Inc., 1982) and ongoing exploration and delineation of the Project by LC ISR, LLC.

Groundwater Monitoring Network and Parameters

Conoco installed 12 wells, separated into four groups, to evaluate aquifer properties and water quality of the uranium ore-bearing sands and overlying and underlying aquifers within the Permit Area. Three of the groups included wells completed within the HJ aquifer and the overlying (LFG) and underlying (UKM) aquifers. The fourth group included three wells completed within the HJ aquifer. The location of the wells is shown on **Figure 2.7-18.** The Conoco wells were sampled for the parameters listed in **Table 2.7-12.**

LC ISR, LLC installed wells in 2006 completed in the DE, LFG, HJ and UKM aquifers and initiated baseline sampling for the same constituents as Conoco, with the addition of alkalinity (as calcium carbonate [$CaCO_3$]), gross alpha, gross beta and radium-228. Additional wells were installed in 2007, and four quarters of sampling have been completed for these wells. Another ten wells were installed in late 2008 and are being incorporated into the groundwater monitoring network, as outlined below. The locations of the LC ISR, LLC monitor wells that have been sampled for water quality are indicated on **Figure 2.7-19**.

Groundwater Quality Sampling Results

Ten of the 12 monitor wells installed by Conoco were sampled in August 1982. Hydro-Search, Inc. reported that there were no major differences in water quality between the HJ aquifer and the overlying and underlying aquifers (1982). The predominant ions were calcium and sulfate. TDS values were all below the WDEQ Class I Standard of 500, ranging from 200 to 490 mg/L (**Figure 2.7-20a**). The pH of the waters ranged from 7.1 to 8.5, indicating slightly alkaline conditions. Chloride levels were very low, ranging from seven to 18 mg/L.

One of the sampled wells had an obstruction in the well and elevated pH (11.1) and potassium (54 mg/L) values. It was determined that the sampling results are not representative of the site aquifers and that the well is possibly contaminated with cement.

Most trace constituents were below the detection limits. Selenium was present in two samples at 0.023 mg/L, which was above the WDEQ standard at that time (0.01 mg/l). The WDEQ Class I Standard and the EPA MCL are currently 0.05 mg/L. Ra-226 was detected in all of the samples, with a range of 2.5 to 300 pCi/L. Only two samples, one collected from the overlying aquifer and one from the underlying aquifer, were below the WDEQ Class I Standard and EPA MCL for Ra-226 (5.0 pCi/L). **Figure 2.7-20b** depicts the distribution of Ra-226 from the 1982 sampling round. Elevated Ra-226 groundwater concentrations are common within and around uranium ore-bodies. Uranium levels ranged from below detection (less than 0.005 mg/L) to 0.48 mg/L. Six of the ten samples exceeded the current EPA MCL for uranium (0.03 mg/L) (**Figure 2.7-20c**).

LC ISR, LLC began baseline sampling in September 2006. Quarterly water level measurements and water quality samples were collected from 17 monitor wells:

- DE Monitor Wells: LC29M, LC30M and LC31M;
- LFG Monitor Wells: LC15M, LC18M, LC21M, and LC25M;
- HJ Monitor Wells: LC16M, LC19M, LC22M, and LC26M; and
- UKM Monitor Wells: LC17M, LC20M, LC23M, LC24M, LC27M, and LC28M.

At the time of the pump tests (and when the original LC ISR NRC TR was submitted), wells LC27M and LC28M were believed to have been completed in the HJ Horizon. However, since the aquifer test analyses report was completed in March 2007, a revised interpretation of the stratigraphy surrounding wells LC27M and LC28M has been conducted based on more recent drill data. The new interpretation of the stratigraphic sequence for wells LC27M and LC28M concludes that the wells are completed in the UKM Sand as opposed to the HJ Horizon.

In October 2008, ten additional wells were installed. Quarterly samples from these monitoring wells began in August 2009, but two wells completed in the DE Sand (MB-7 and MB-10) have insufficient water for sampling. The eight functioning monitor wells are:

- DE Monitor Wells: MB-1;
- LFG Monitor Wells: MB-2, MB-5, and MB-8;
- HJ Monitor Wells: MB-3B, MB-6, and MB-9; and
- UKM Monitor Wells: MB-4

Sampling dates and baseline water quality results for each of the 25 (operational) monitor wells are displayed in **Table 2.7-13**.

Table 2.7-13 shows that the WDEQ TDS Class I standard is exceeded at one well in the DE, HJ and UKM aquifers. Twenty two out of the 25 wells have TDS levels below the Class I Standard. The distribution of TDS is shown in **Figure 2.7-21a**. Sulfate exceeds the WDEQ Class I Standard (250 mg/L) in one DE monitor well (LC31M) and one HJ monitor well (LC26M). The average distribution of sulfate from September 2006 to May 2007 is shown in **Figure 2.7-21b**. As with the Conoco monitoring results, chloride values are low with a maximum of 32 mg/L and all but four samples at ten mg/L or lower (**Table 2.7-13**).

Piper diagrams have been developed to compare groundwater quality between individual wells (**Figure 2.7-22a**) and between different aquifers (**Figure 2.7-22b**). The individual well comparison plots the average value for each of the wells for all of the samples analyzed. The piper diagram comparing different aquifers represents the average water quality for all wells sampled within individual aquifers (DE, LFG, HJ and UKM). Groundwater within the shallow Battle Spring aquifers beneath the Permit Area is a calcium sulfate to calcium bicarbonate type water. There is some variability in water chemistry when the wells are compared individually. However, when the average for the aquifers is plotted, there is no significant difference in major water chemistry between the production zone and overlying and underlying aquifers. As additional water quality from the new MB wells is obtained, it will be compared with other regional water quality data.

The trace constituents, boron, cadmium, chromium, copper, mercury, molybdenum, nickel, and vanadium were at or below detection limits for all samples. Zinc was at or below the reporting limit for all but two samples, both of which were well under the WDEQ and EPA criteria. Ammonia exceeded the WDEQ Class I Standard in two monitor wells. Selenium exceeded the WDEQ Class I Standard and EPA MCL (0.05 mg/L) in one DE monitor well. Dissolved Iron exceeded the WDEQ Class I Standard and EPA Secondary Standard (0.3 mg/L) in two DE monitor wells (LC29M and MB-1), two LFG monitor wells (LC18M and LC21M), and one UKM monitor well (LC24M). Manganese was above the WDEQ Class I Standard and EPA Secondary Standard (0.05 mg/L) in three of the four DE monitor wells, but was either below detection limit or did not exceed those standards in all other sampled aquifers.

With the exception of UKM monitor wells LC17M, LC23M, LC27M, and LC28M; HJ monitor well MB-6; and LFG monitor well MB-5, every monitor well had at least one sample exceed the EPA Uranium MCL of 0.03 mg/L. The average uranium concentration of the monitor wells sampled in the baseline monitoring program (0.227 mg/L) is approximately an order of magnitude greater than the MCL. The average distribution of uranium at individual wells from September 2006 to May 2007 is shown on **Figure 2.7-23a**.

The average distribution of radium-226+228 is shown on **Figure 2.7-23b**. The WDEQ Class I Standard and EPA MCL for radium-226+228 is 5.0 pCi/L. **Table 2.7-14** summarizes the number of wells in each aquifer that exceed the EPA MCL.

In summary, general water quality in the shallow Battle Spring aquifers within the Permit Area tends to be relatively good, with the exception of the presence of radionuclides. TDS and sulfate values are relatively low, with occasional exceedances of WDEQ Class I standards. Manganese is elevated above state and federal secondary standards in the water table aquifer (DE) but is below standards in deeper confined aquifers in the vicinity of the uranium orebodies. Radium-226+228 exceeds the EPA MCL in over two-thirds of the samples collected and the average uranium concentration is approximately an order of magnitude greater than the EPA MCL for that constituent. Elevated concentration of these constituents is consistent with the presence of uranium orebodies.

2.7.4 Hydrologic Conceptual Model

A hydrologic conceptual model of the Project and surrounding area has been developed to provide a framework that allows LC ISR, LLC to make decisions regarding optimal methods for extracting uranium from mineralized zones, and to minimize environmental and safety concerns caused by ISR operations.

LC ISR, LLC will use ISR technology at the Project to extract uranium from permeable uranium-bearing sandstones within the upper portion of the Battle Spring Formation, at depths ranging from 350 to 900 feet. A conceptual hydrologic model of the Project is summarized below.

2.7.4.1 Regional Groundwater Conceptual Model

The Project is located within the northeastern portion of the Great Divide Basin. The Eocene Battle Spring Formation crops out over most of the northeastern portion of the Great Divide Basin, including the Permit Area. The total thickness of the Battle Spring Formation in the vicinity of the Permit Area is approximately 6,200 feet. The Battle Spring Formation contains multiple aquifers that are a part of the Tertiary aquifer system. Groundwater flow within the Battle Spring aquifers is primarily toward the interior of the basin, southwest of the Project. Recharge to the Battle Spring aquifers within the Project area is mostly the result of infiltration of precipitation to the north and northeast in the Green Mountains and Ferris Mountains. Based on available information, discharge from the Battle Spring aquifers is predominately to a series of lakes, springs, and playa lake beds near the center of the basin. Some groundwater from the Battle Spring aquifers is discharged through pumping for stock watering, irrigation, industrial, and domestic use.

The Battle Spring Formation is described as an arkosic fine- to coarse-grained sandstone with claystone and conglomerates. Groundwater within the Battle Spring aquifers is typically under confined conditions, although locally unconfined conditions exist. The potentiometric surface within the Battle Spring aquifers is usually within 200 feet of the ground surface. Most wells drilled for water supply in this unit are less than 1,000 feet deep. Wells completed in the Battle Spring aquifers typically yield 30 to 40 gpm but yields as high as 150 gpm are possible.

Water quality within the shallow Tertiary aquifers generally represents sodium-bicarbonate to sodium-sulfate water types. TDS levels within the Battle Spring aquifers are generally below 500 mg/L along the northern flank of the Great Divide Basin near areas of outcrop. Low TDS waters within the Battle Spring aquifer are predominately sodium-bicarbonate type waters. With increasing salinity, the water type tends to become more calcium-sulfate dominated. Notable exceptions to the relatively good water quality included waters with elevated radionuclides (uranium, radium-226 and radon-228). High levels of uranium are common in Tertiary sediments and groundwater of the Great Divide Basin. The Lost Creek Shroeckingerite deposit located northwest of the Project is noted for high uranium levels in groundwater. Uranium-bearing coals are present in the Wasatch Formation in the central part of the Great Divide Basin.

As described previously, the Battle Spring Formation outcrops over most of the Permit Area. The Battle Spring is the shallowest occurrence of groundwater within the Permit Area. Water-bearing Quaternary and Tertiary units younger than the Battle Spring Formation are present several miles to the north and east and are hydraulically up-gradient of the Permit Area. Therefore, ISR operations conducted at the Project will have no impact on those shallower hydrostratigraphic units.

2.7.4.2 Site Groundwater Conceptual Model

Hydrostratigraphic Units

The hydrostratigraphic units of interest within the Battle Spring Formation, with respect to the Project include, from shallowest to deepest:

- DE Horizon (shallowest occurrence of groundwater):
  - sands and discontinuous clay/shale units, top of unit 100 to 200 ft bgs;
  - coalesces with underlying FG Horizon to the south; and
  - water levels in the DE Sand are typically 140 to 200 ft bgs;
- Upper No Name Shale (upper confining unit to the FG Horizon):
  - 0 to 50 feet thick;
- FG Horizon (includes overlying aquifer to HJ Horizon):
  - subdivided into UFG, MFG and LFG Sands;
  - total thickness of Horizon is 100 feet;
  - top of unit is 200 to 350 ft bgs;
  - LFG Sand the overlying aquifer to HJ Horizon;
  - LFG Sand is 20 to 50 feet thick; and
  - water levels in the LFG Sand are typically 160 to 200 ft bgs;
- Lost Creek Shale (upper confining unit to the HJ Horizon):
  - laterally continuous across Permit Area;
  - five to 45 feet thick; and
  - confining properties demonstrated from water levels and pump test;
- HJ Horizon (contains the primary production zone):
  - subdivided into UHJ, MHJ, and LHJ Sands, although sands are hydraulically connected;
  - coarse-grained arkosic sands with thin lenticular intervals of fine sand, mudstone and siltstone;
  - averages 120 feet thick;
  - top of unit is 300 to 450 feet bgs; and
  - water levels in the HJ Horizon range from 150 to 200 ft bgs;
- Sage Brush Shale (lower confining unit to the HJ Horizon and upper confining unit to the KM Horizon):

    - laterally continuous across Permit Area;
    - five to 75 feet thick;
    - top of unit 450 to 550 ft bgs; and
    - confining properties demonstrated from water levels and pump test;
- KM Horizon (includes secondary production zone, lower confining units, and underlying aquifers):
    - subdivided into UKM, MKM and LKM Sands;
    - massive coarse sandstones with thin lenticular fine sandstone intervals;
    - top of unit is 450 to 600 ft bgs;
    - UKM Sand is a secondary production zone and first underlying aquifer;
    - UKM Sand is 30 to 60 feet thick;
    - water levels in the UKM Sand are generally 185 to 220 ft bgs;
    - No Name Shale is the lower confining unit to the UKM Sand;
    - No Name Shale is ten to 30 feet thick and laterally extensive but will require additional characterization; and
    - MKM is the underlying aquifer to the UKM Sand, but will require additional characterization.

Potentiometric Surface and Hydraulic Gradients

Potentiometric surface of the HJ Horizon indicates that groundwater flow is to the west-southwest under a hydraulic gradient of 0.003 to 0.006 ft/ft (15.8 to 31.6 ft/mi), generally consistent with the regional flow system. The Fault acts as a hydraulic barrier to groundwater flow as demonstrated from water level differences of 15 feet across the Fault within the HJ Horizon and the pump test results. The Fault may redirect groundwater more westward than if it were not present. Groundwater flow direction and hydraulic gradients for the overlying (DE and FG) and underlying aquifers (UKM) are generally similar to that of the HJ Horizon. The potentiometric heads decrease with depth. Differences in water level elevations between the LFG, HJ and UKM aquifers indicate that confining units are present between these hydrostratigraphic units. Pump tests indicate the presence of confining units between the LFG and HJ aquifers and between the HJ and UKM aquifers.

Vertical hydraulic gradients range from 0.050 to 0.34 ft/ft between the LFG, HJ and UKM aquifers and consistently indicate decreasing hydraulic head with depth. The vertical gradients indicate the potential for groundwater flow is downward. The vertical gradients also support the confining nature of the Lost Creek and Sage Brush Shale. The vertical gradient between the DE and LFG aquifers is minimal, consistent with observations that those hydrostratigraphic units coalesce in places within the Permit Area.

Aquifer Properties

Transmissivity for the HJ Horizon ranges from 35 to 400 ft^2/d (260 to 3,000 gpd/ft). Based on long-term pump tests, the estimated "effective" transmissivity (because of the impacts of the Fault) is 60 to 70 ft^2/d (450 to 525 gpd/ft) on the north side of the Fault. Because of the boundary effect of the Fault (e.g., the system is not an infinite-acting aquifer), the actual transmissivity of the aquifer, without impacts from the Fault, would be higher. Storativity of the HJ Horizon ranges from 5.0×10^{-5} to 5.0×10^{-4}.

Based on more limited testing, the transmissivity of the LFG aquifer is lower than for the HJ Horizon ranging from 4.4 to 40 ft^2/d (30 to 300 gpd/ft). The range of transmissivity of the UKM aquifer is similar to but slightly lower than the HJ aquifer, from 26 to 115 ft^2/d (195 to 860 gpd/ft). Transmissivity of the DE Horizon is variable, ranging from 1.3 to 130 ft^2/d (10 to 1,000 gpd/ft). Storativity values have not been determined for the overlying and underlying aquifers at this time because no multi-well pump tests have been conducted within those aquifers. However, it is expected that storativity values in the FG and KM Horizons will be similar to the range observed in the HJ Horizon. The DE Horizon is at least partially under unconfined conditions and therefore will have a specific yield instead of a storage coefficient. Long-term multi-well pump tests will be performed in the fall of 2007 to collect additional data regarding aquifer properties of the overlying and underlying aquifers.

Water Quality

Water quality within the hydrostratigraphic units of interest (the production zones and overlying and underlying aquifers) is generally good with respect to major chemistry. TDS and sulfate levels are typically below respective WDEQ Class I Standards and EPA SDWS, although occasionally, regulatory standards are exceeded. Chloride levels are low, (typically less than ten mg/L) making this parameter a good indicator for excursion monitoring. There is no significant difference in major water chemistry between the production zone and overlying and underlying aquifers.

Trace metals generally are below WDEQ Class I Standards and EPA MCLs in the production zone, overlying and underlying aquifers. Ammonia, arsenic, iron, and selenium occasionally exceed the respective standards. Manganese is present above the regulatory standards in over half of the samples collected from the DE Horizon. Manganese was below the WDEQ Class I Standards and EPA MCL in all samples from other hydrostratigraphic units.

Uranium is present in nearly all of the wells at levels exceeding the EPA MCL of 0.03 mg/L. For example, the average uranium concentration for all of the hydrostratigraphic units of interest is 0.31 mg/L, an order of magnitude greater than the EPA MCL.

Radium-226+228 levels exceed the EPA MCL and WDEQ Class I Standard (five pCi/L) in two-thirds of the samples collected. The percentage of wells that exceed radium-226+228 standards is greater for the HJ and UKM aquifers than for the FG and DE Horizons. Dissolved radionuclide levels are commonly elevated in groundwater associated with uranium-bearing sandstones.

Summary

The uranium bearing sandstones within the upper Battle Spring Formation appear to be suitable targets for ISR operations. The primary production zone aquifer (HJ Sand) is bounded by laterally extensive upper and lower confining units, as demonstrated by static water level differences and responses to pump tests. Aquifer properties (transmissivity, hydraulic conductivity and storativity) are within the ranges observed at other ISR operations that have successfully extracted uranium reserves. Water quality is generally consistent throughout the hydrostratigraphic units of interest. Elevated radionuclides are present in the groundwater, but this is consistent with the presence of uranium ore deposits within the sandstones. The Fault acts as a hydraulic barrier to flow and will need to be accounted for in mine unit design and operation.

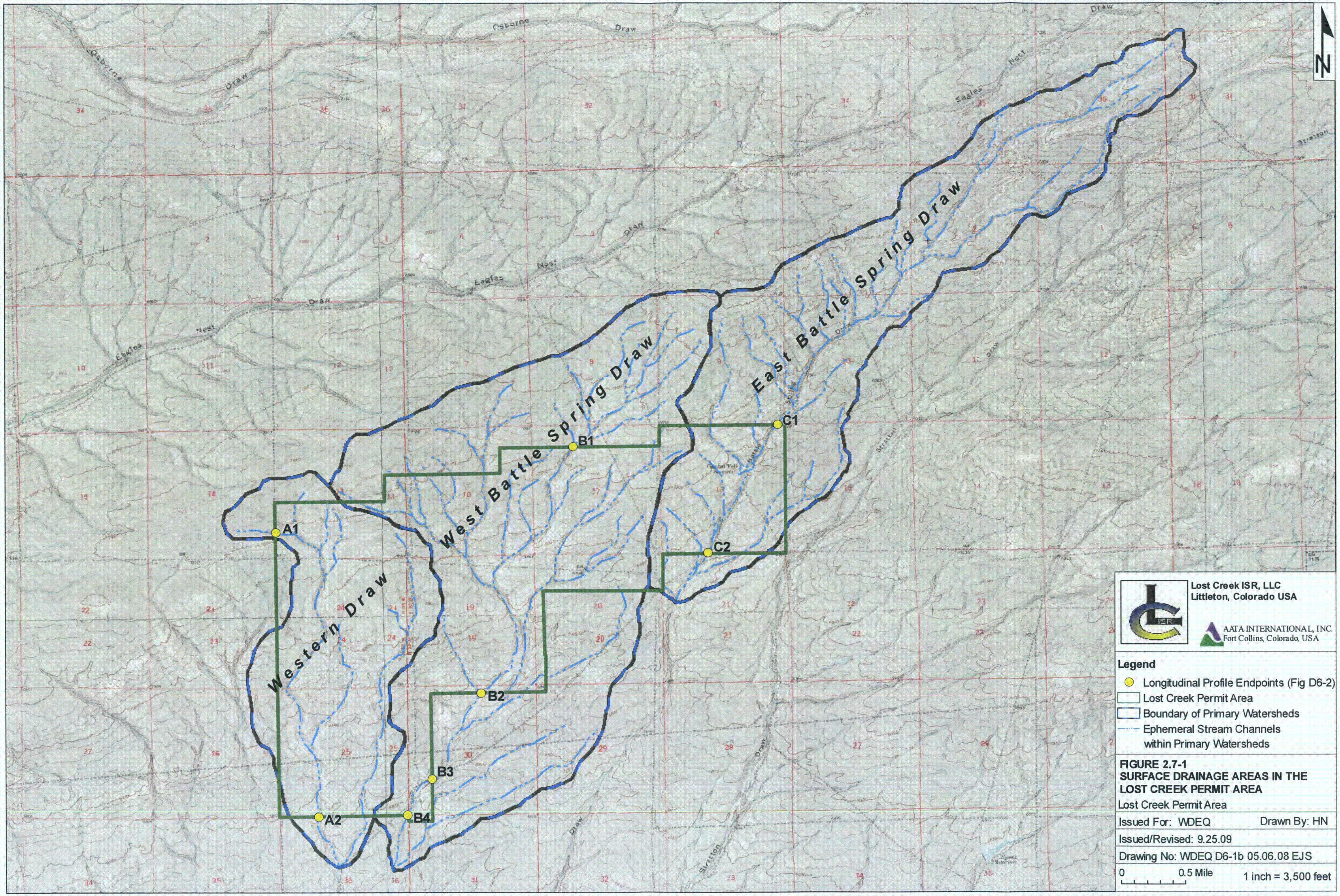


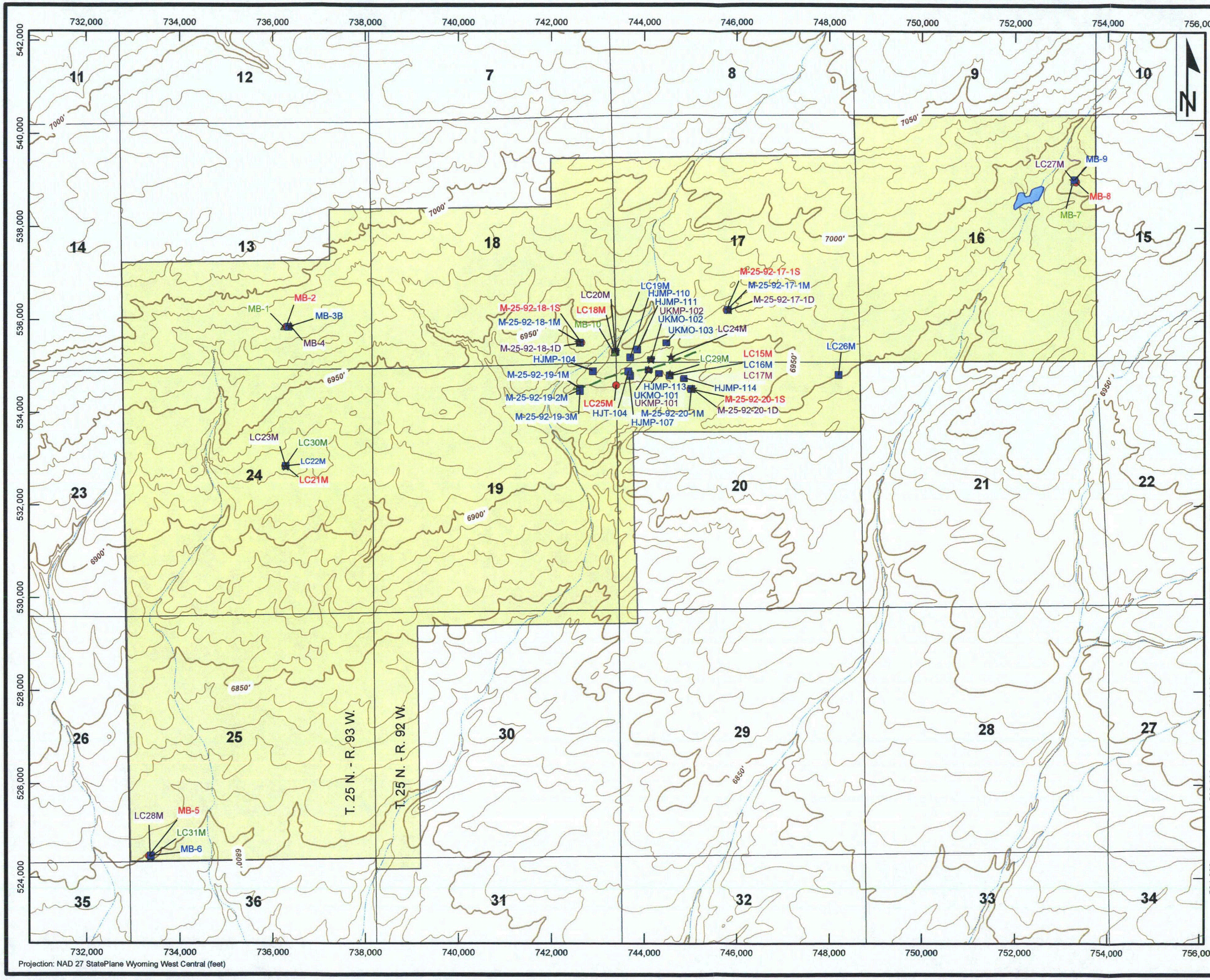
FIGURE 2.7-1
SURFACE DRAINAGE AREAS IN THE LOST CREEK PERMIT AREA

Lost Creek Permit Area

Issued For: WDEQ | Drawn By: HN

Issued/Revised: 9.25.09

Drawing No: WDEQ D6-1b 05.06.08 EJS



Legend

Monitor Wells

- ▲ DE Horizon
- ● LFG Horizon
- ■ HJ Horizon
- ★ UKM Horizon
- Lost Creek Fault
- Lost Creek Permit Boundary

Notes:

1) Wells numbered as: 'M-Township-Range-Section-depth' (e.g., M-25-92-17-1S) were installed by Conoco-TexasGulf in the 1980s and subsequently abandoned.
2) All other wells shown on the map were installed as part of the Lost Creek Project for the LC16M and LC19M pump tests and baseline water quality sampling.

Scale: 1:24,000

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FIGURE 2.7-9
Location Map, Lost Creek Monitor Wells

Lost Creek Permit Area

Issued For: WDEQ-LQD 1.0 Drawn By: JM

Issued/ Revised: 04.06.09

Drawing No.: WDEQ_LQD_FIG_D6-9.mxd

0 2,000 4,000 Feet

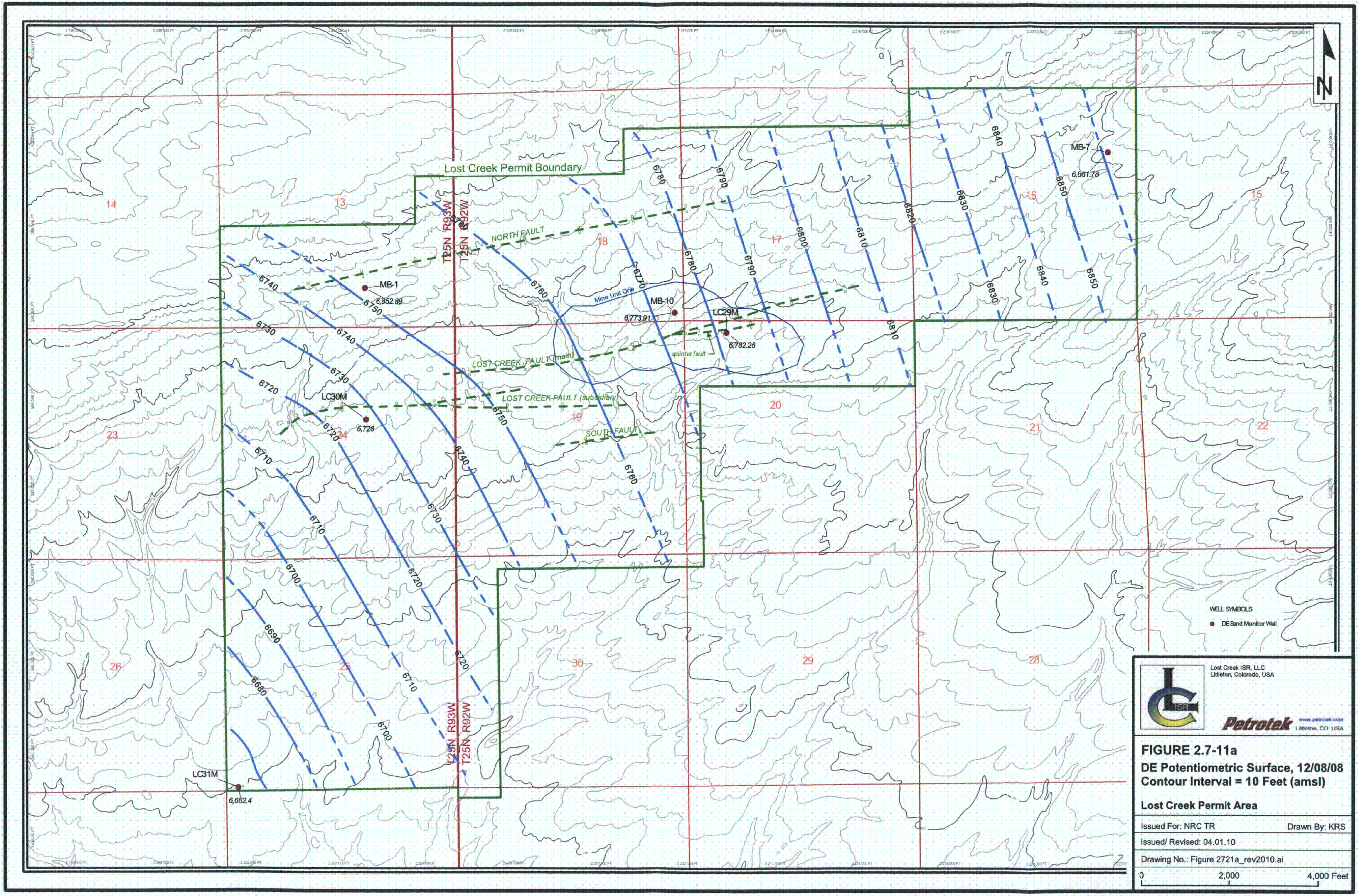


FIGURE 2.7-11a

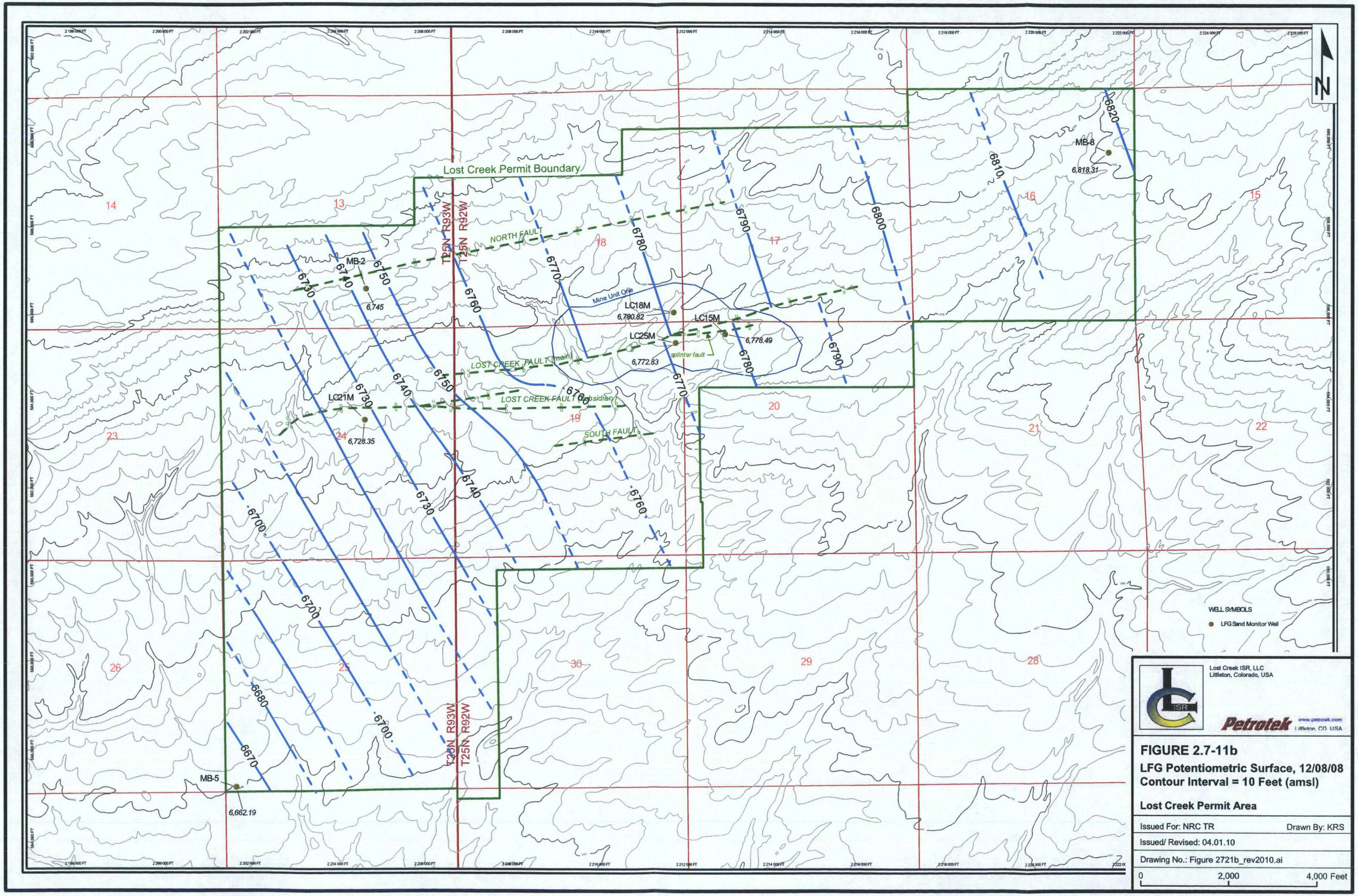
DE Potentiometric Surface, 12/08/08
Contour Interval = 10 Feet (amsl)

Lost Creek Permit Area

Issued For: NRC TR | Drawn By: KRS

Issued/ Revised: 04.01.10

Drawing No.: Figure 2721a_rev2010.ai



Lost Creek Permit Boundary
NORTH FAULT
LOST CREEK FAULT (main)
LOST CREEK FAULT (subsidiary)
SOUTH FAULT
splinter fault
Mine Unit One
T25N R93W
T25N R92W
MB-2
6,745
LC18M
6,780.82
LC15M
6,778.49
LC25M
6,772.83
LC21M
6,728.35
MB-8
6,818.31
MB-5
6,662.19
6670
6680
6700
6730
6740
6750
6760
6770
6780
6790
6800
6810
6820
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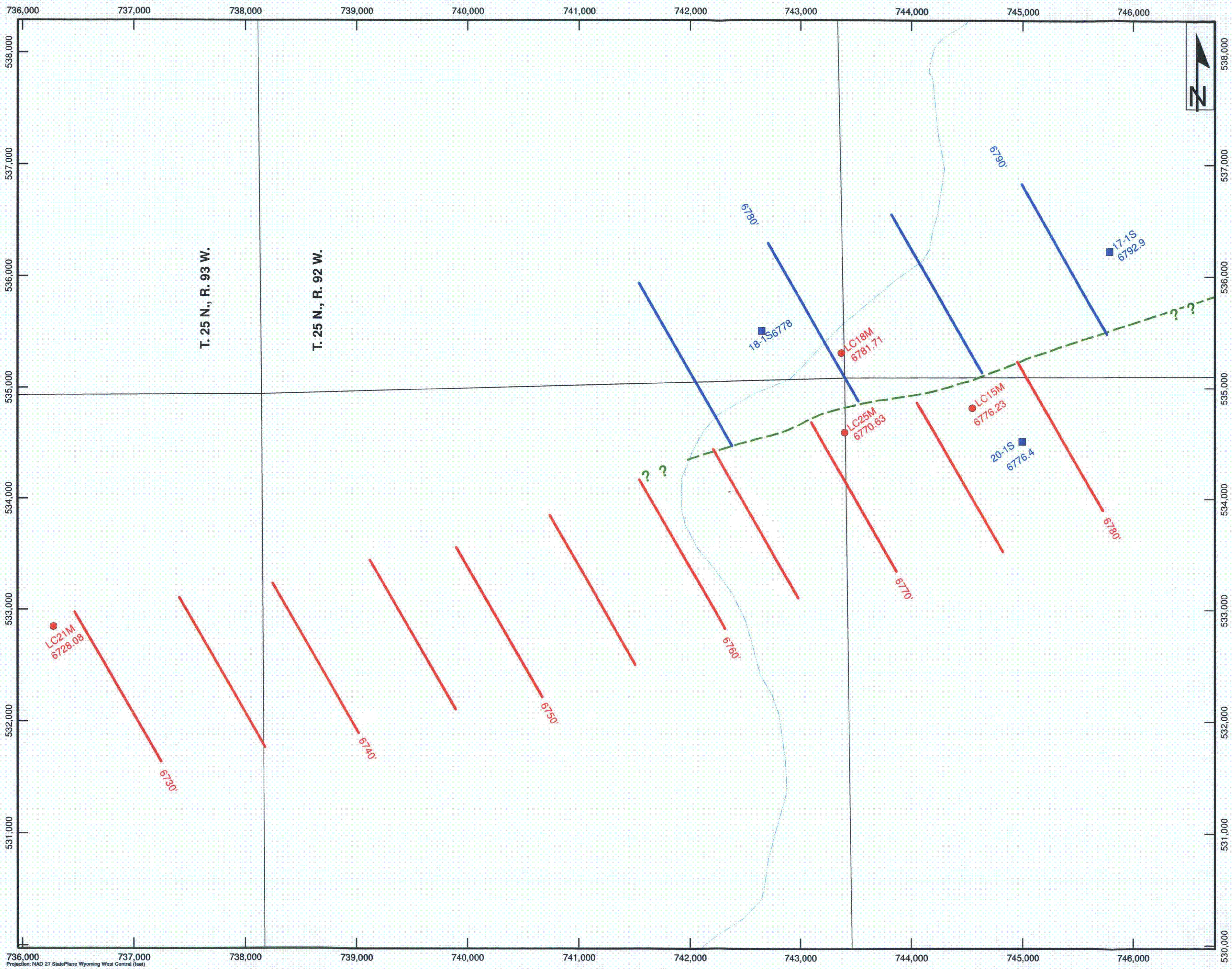
30
N
WELL SYMBOLS
LFG Sand Monitor Well
Lost Creek ISR, LLC
Littleton, Colorado, USA
ISR
Petrotek
www.petrotek.com
Littleton, CO USA
FIGURE 2.7-11b
LFG Potentiometric Surface, 12/08/08
Contour Interval = 10 Feet (amsl)
Lost Creek Permit Area
Issued For: NRC TR
Drawn By: KRS
Issued/ Revised: 04.01.10
Drawing No.: Figure 2721b_rev2010.ai
0
2,000
4,000 Feet



Legend

- October 2006 Water Level Elevation
- August 1982 Water Level Elevation
- August 1982 Potentiometric Surface
- October 2006 Potentiometric Surface
- Lost Creek Fault

Scale: 1:10,000

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FIGURE 2.7-11c

Potentiometric Surface, Overlying Aquifer (LFG), August 1982 and October 2006 Lost Creek Permit Area

Issued For: NRC TR	Drawn By: JM
Issued/ Revised: 10.22.07	
Drawing No.: LC-TR Figure 2.7-11c.mxd	

0 500 1,000 Feet

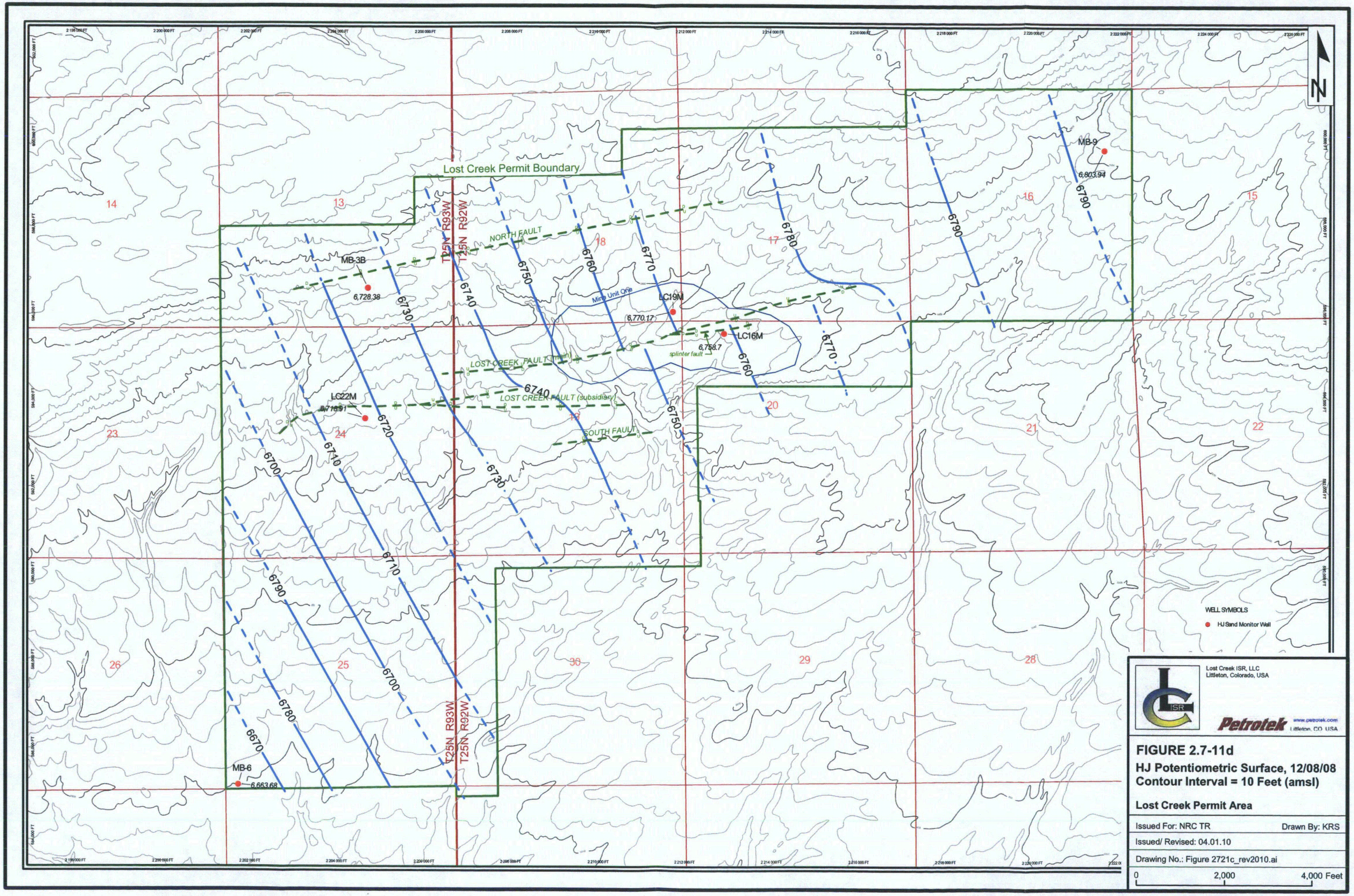

FIGURE 2.7-11d

HJ Potentiometric Surface, 12/08/08
Contour Interval = 10 Feet (amsl)

Lost Creek Permit Area

Issued For: NRC TR — Drawn By: KRS

Issued/ Revised: 04.01.10

Drawing No.: Figure 2721c_rev2010.ai

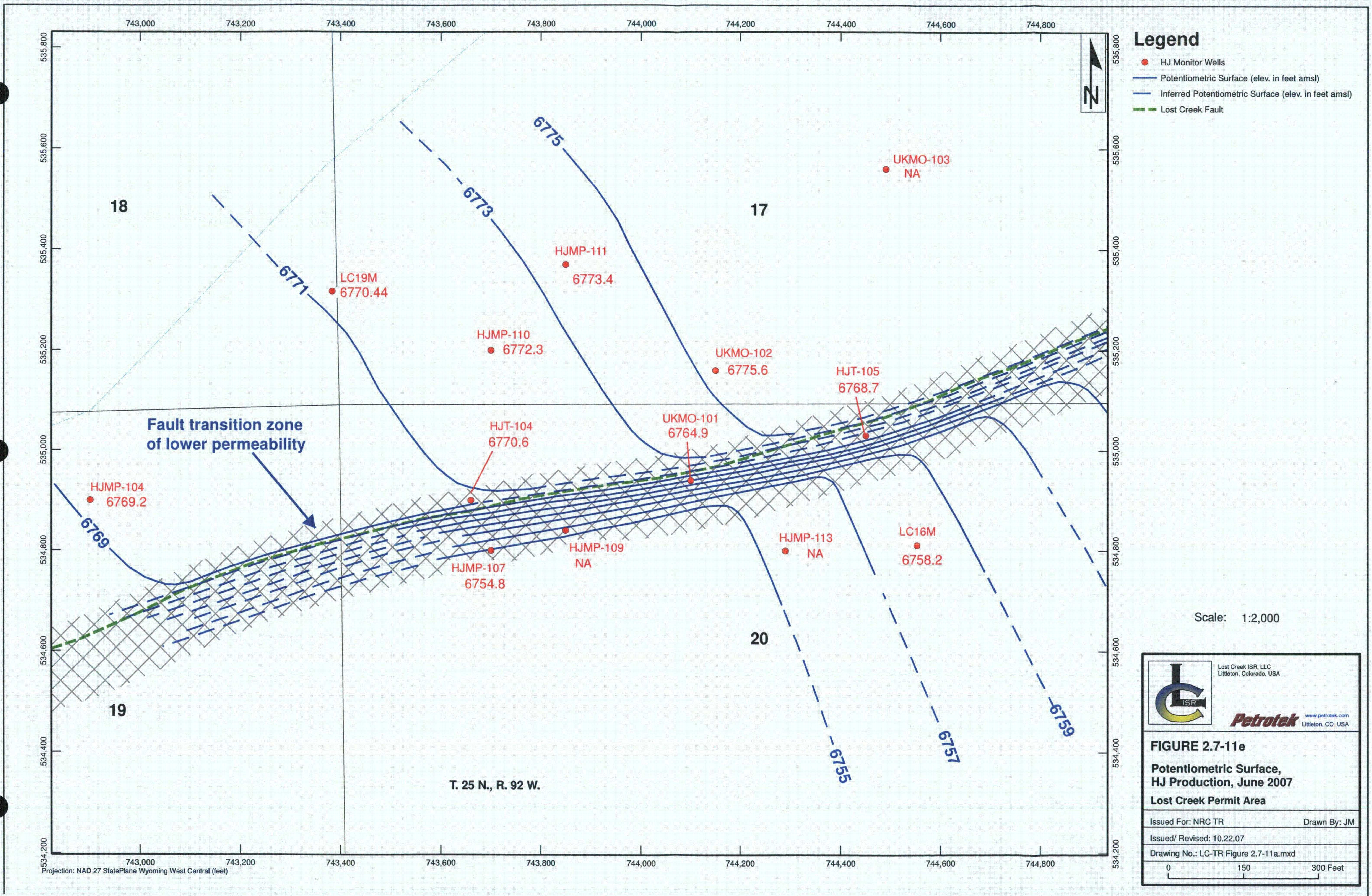

FIGURE 2.7-11e

Potentiometric Surface, HJ Production, June 2007

Lost Creek Permit Area

Issued For: NRC TR

Drawn By: JM

Issued/ Revised: 10.22.07

Drawing No.: LC-TR Figure 2.7-11a.mxd

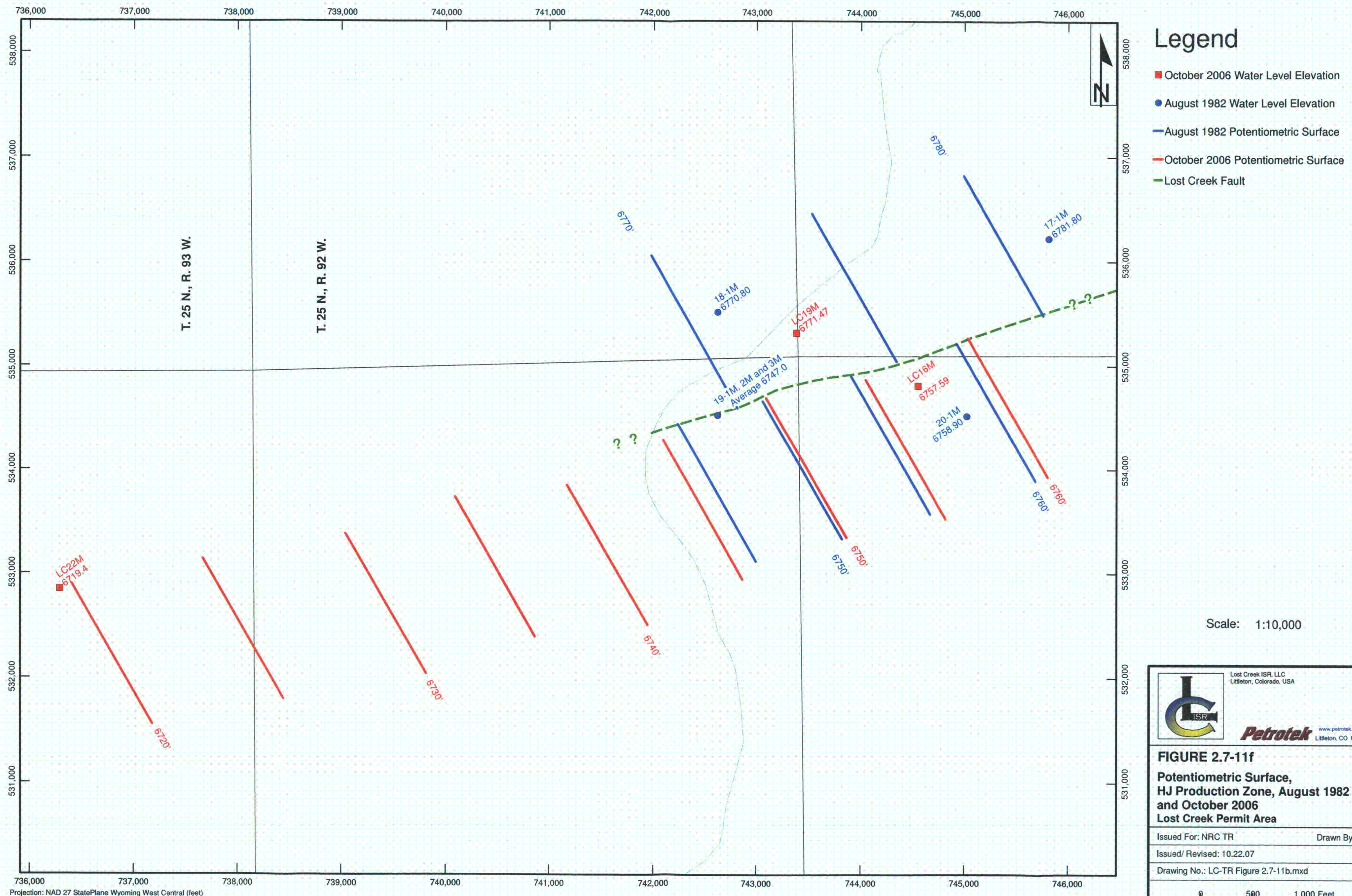

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FIGURE 2.7-11f

Potentiometric Surface, HJ Production Zone, August 1982 and October 2006 Lost Creek Permit Area

Issued For: NRC TR — Drawn By: JM

Issued/ Revised: 10.22.07

Drawing No.: LC-TR Figure 2.7-11b.mxd

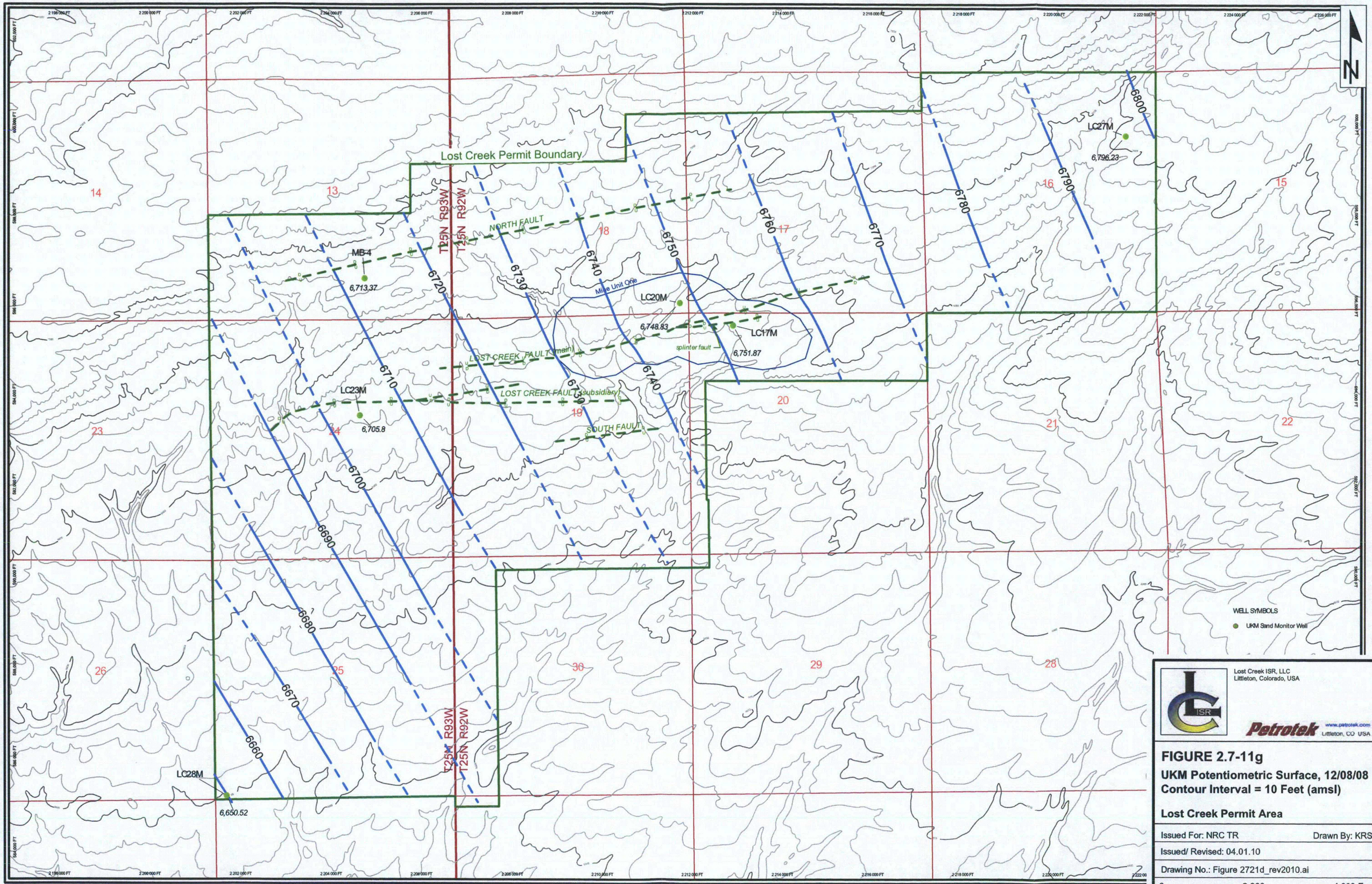

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FIGURE 2.7-11g

UKM Potentiometric Surface, 12/08/08
Contour Interval = 10 Feet (amsl)

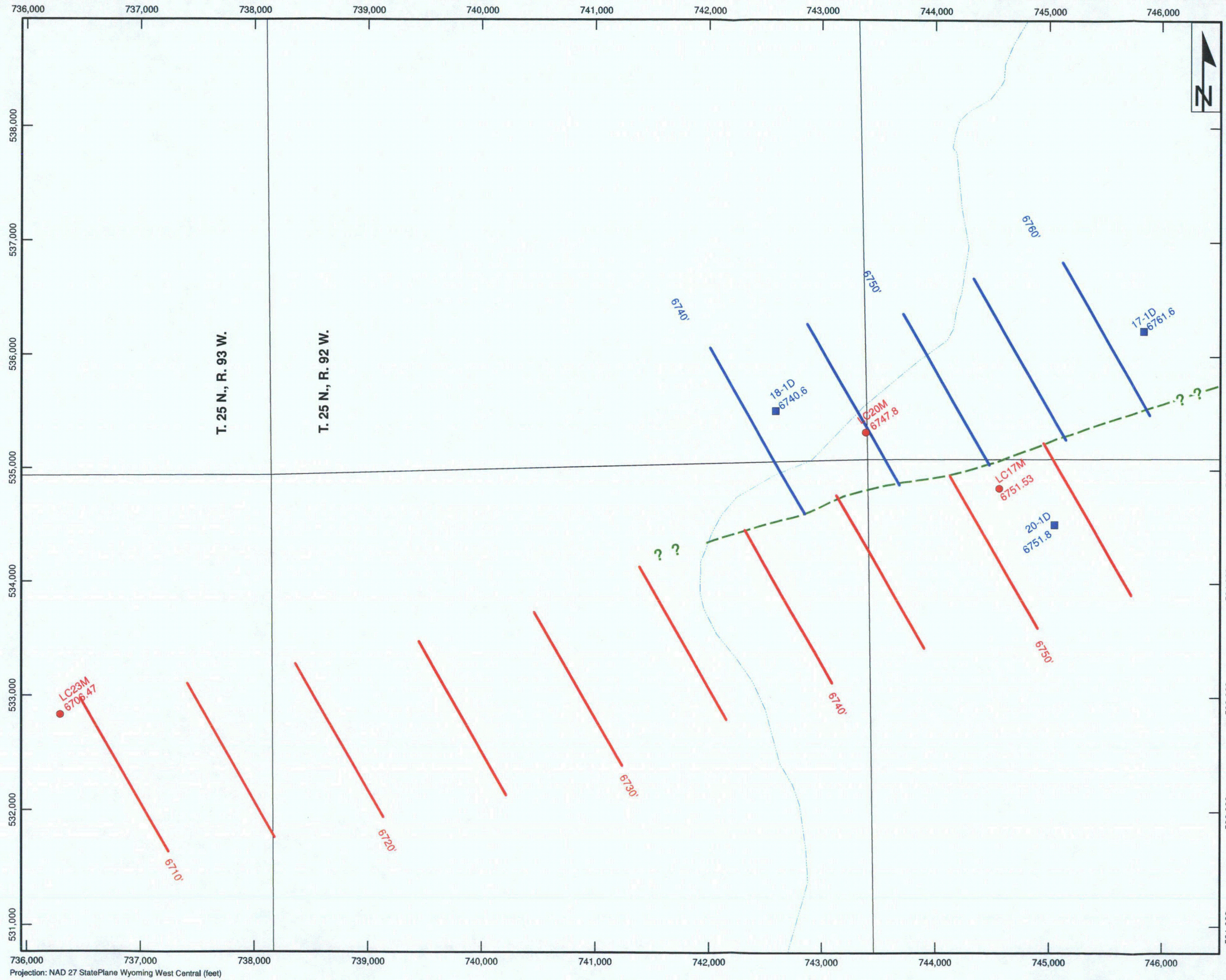
Lost Creek Permit Area

Issued For: NRC TR — Drawn By: KRS

Issued/ Revised: 04.01.10

Drawing No.: Figure 2721d_rev2010.ai

0 — 2,000 — 4,000 Feet



Legend

- October 2006 water Level Elevation
- August 1982 Water Level Elevation
- October 2006 Potentiometric Surface
- August 1982 Potentiometric Surface
- Lost Creek Fault

Scale: 1:10,000

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FIGURE 2.7-11h

Potentiometric Surface, Underlying Aquifer (UKM), August 1982 and October 2006
Lost Creek Permit Area

Issued For: NRC TR
Drawn By: JM
Issued/ Revised: 10.22.07
Drawing No.: LC-TR Figure 2.7-11d.mxd

0 500 1,000 Feet

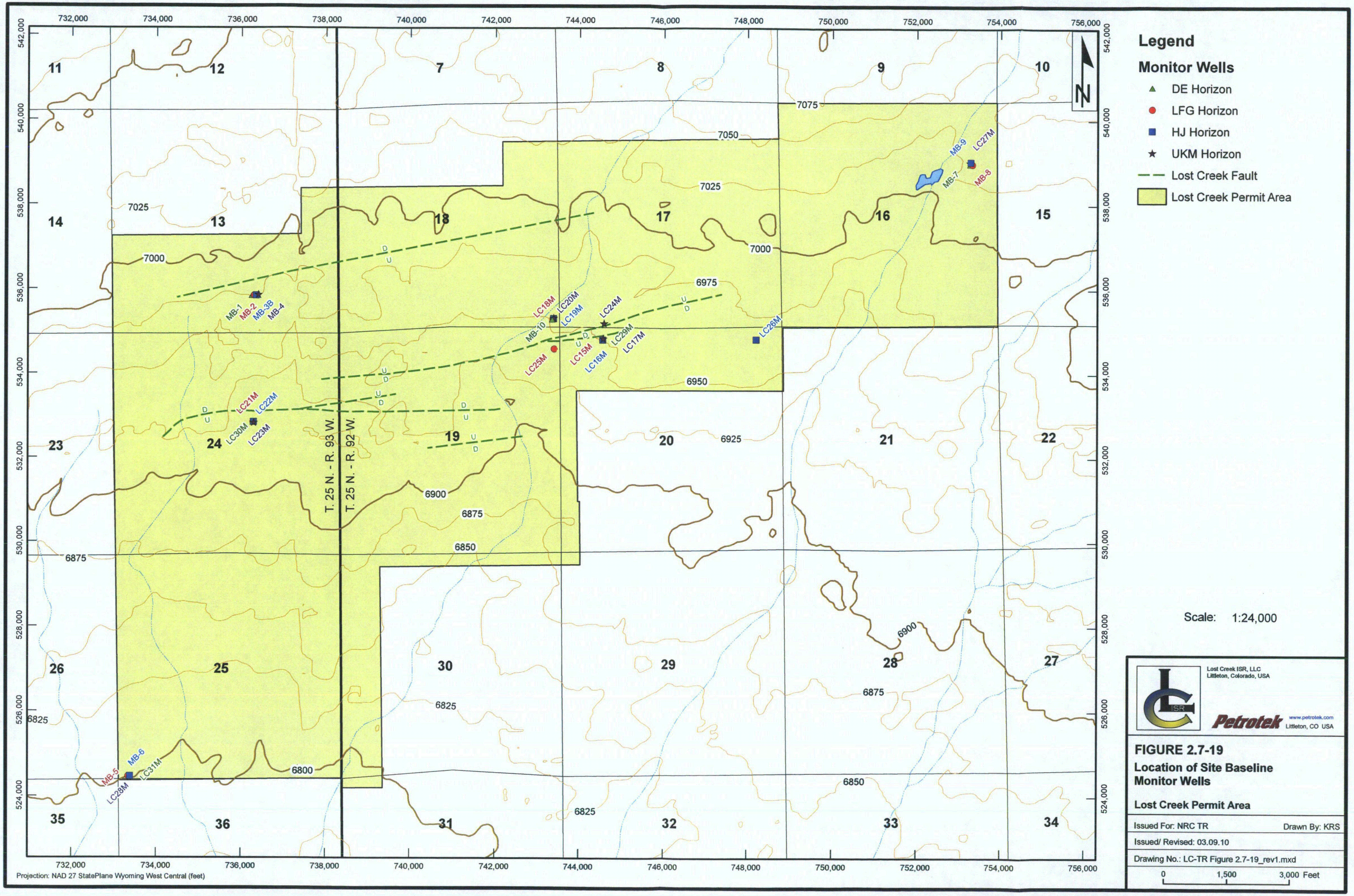
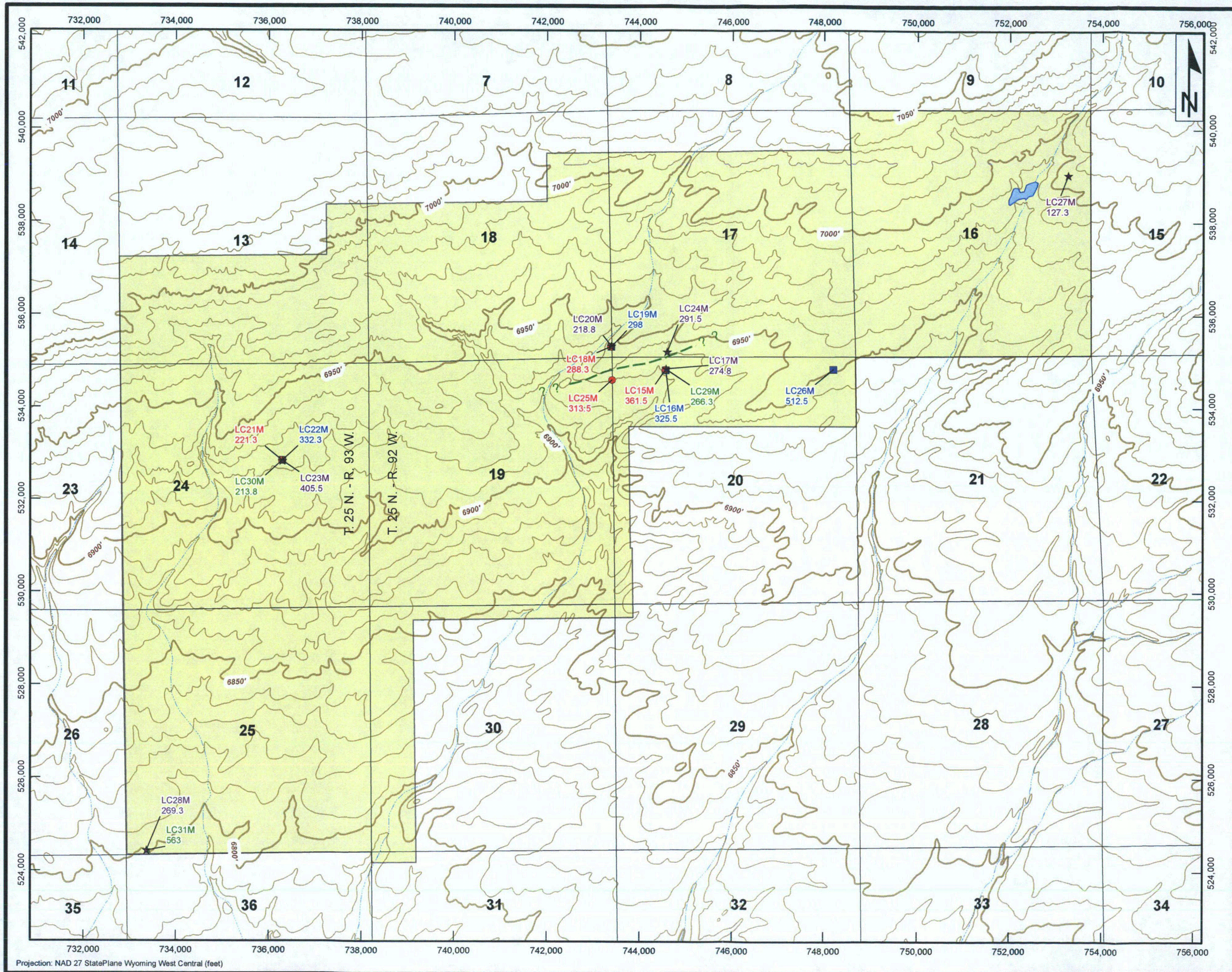


FIGURE 2.7-19
Location of Site Baseline Monitor Wells



Legend

- DE Monitor Well (TDS value in mg/L)
- LFG Monitor Well (TDS value in mg/L)
- HJ Monitor Well (TDS value in mg/L)
- UKM Monitor Well (TDS value in mg/L)
- Lost Creek Fault
- Lost Creek Permit Area

Scale: 1:24,000

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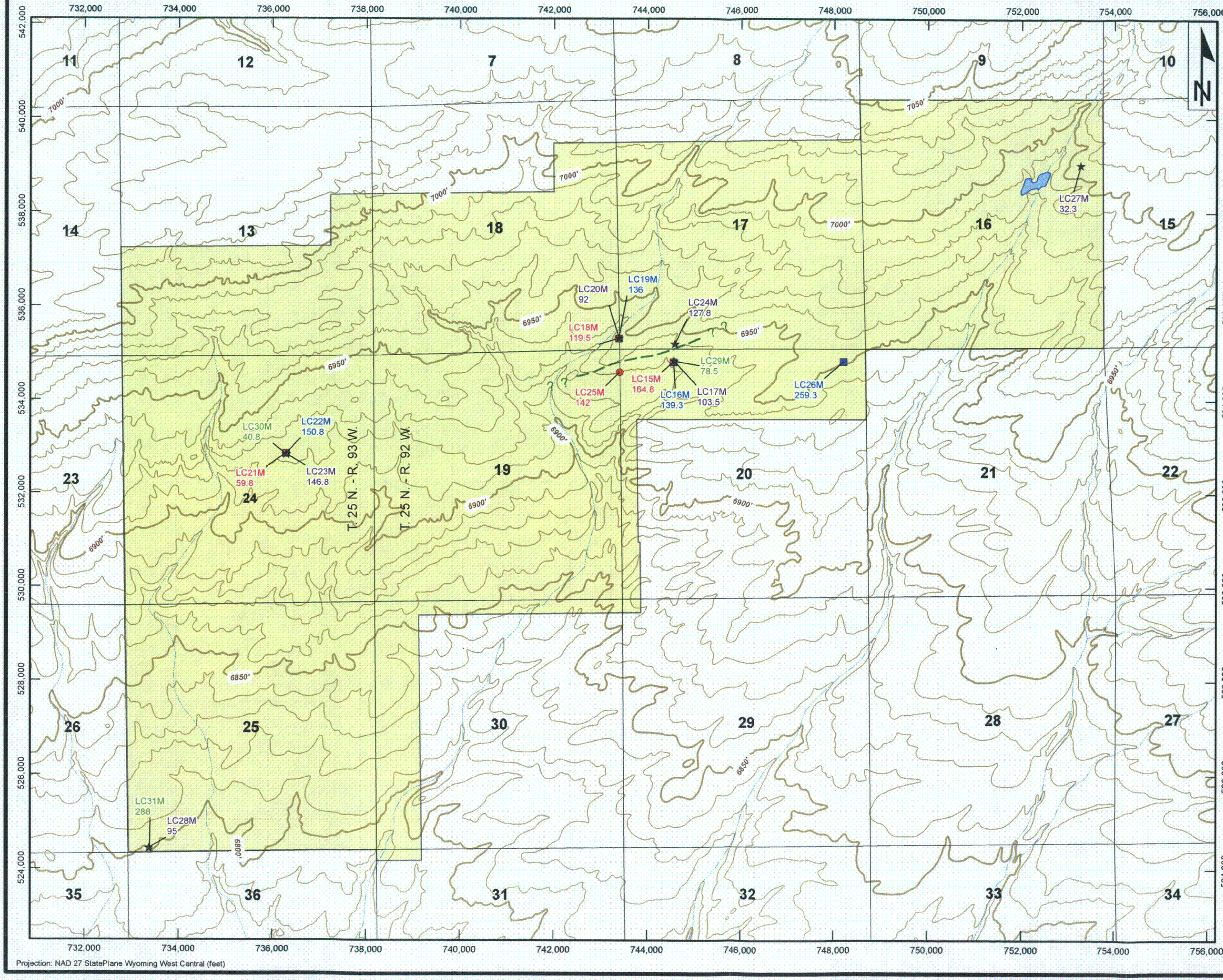
FIGURE 2.7-21a
Distribution of Average TDS September 2006 to May 2007

Lost Creek Permit Area

Issued For: WDEQ-LQD 1.0 Drawn By: JM
Issued/ Revised: 04.13.09
Drawing No.: WDEQ_LQD_FIG_D6-26a.mxd

0 1,500 3,000 Feet



Legend

- ▲ DE Monitor Well (Sulfate value in mg/L)
- ● LFG Monitor Well (Sulfate value in mg/L)
- ■ HJ Monitor Well (Sulfate value in mg/L)
- ★ UKM Monitor Well (Sulfate value in mg/L)
- – – Lost Creek Fault
- Lost Creek Permit Area

Scale: 1:24,000

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FIGURE 2.7-21b

Distribution of Average Sulfate September 2006 to May 2007

Lost Creek Permit Area

Issued For: WDEQ-LQD 1.0 Drawn By: JM

Issued/ Revised: 04.13.09

Drawing No.: WDEQ_LQD_FIG_D6-26b.mxd

0 1,500 3,000 Feet

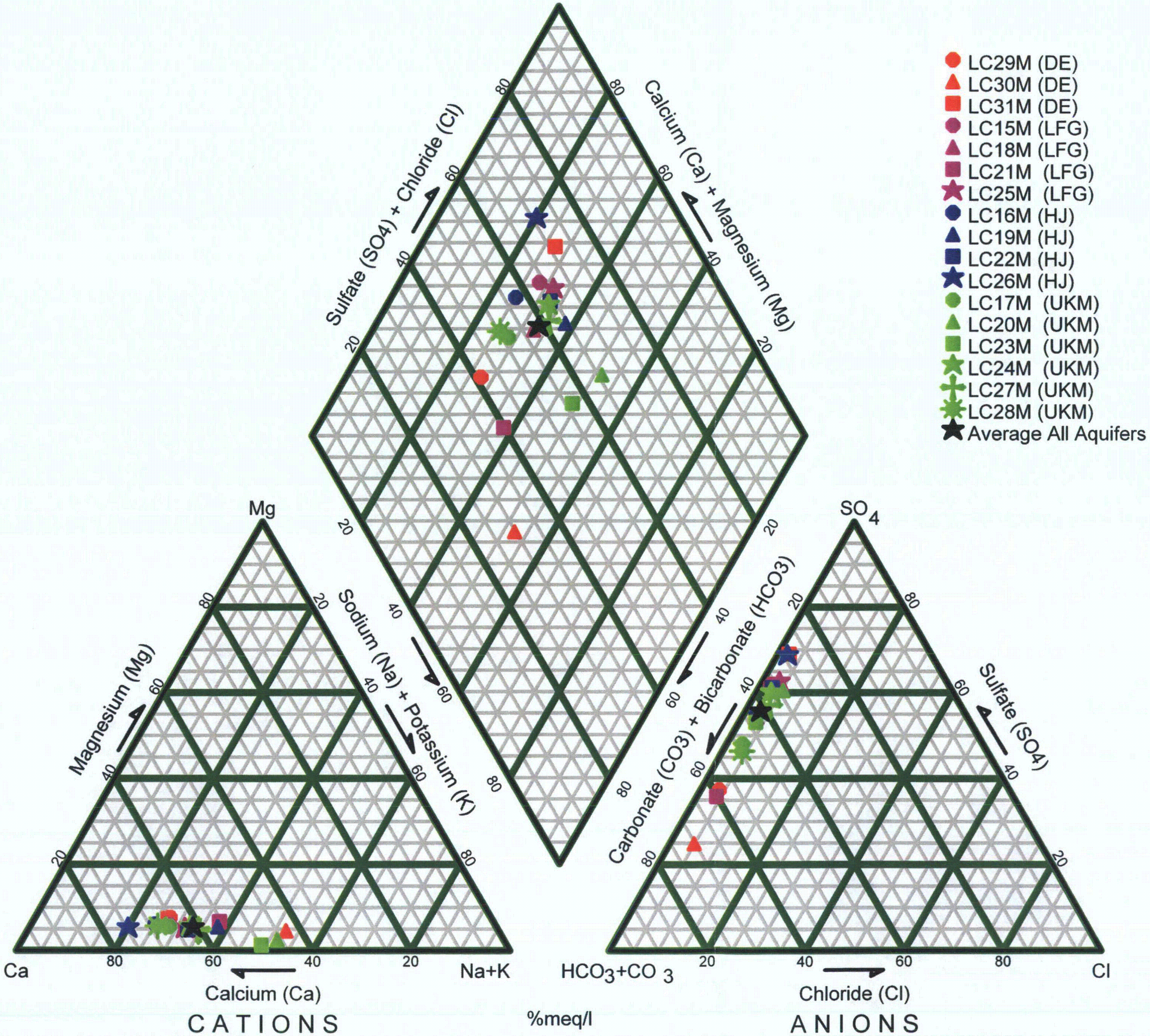

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FIGURE 2.7-22a

Piper Diagram - Average Water Quality at Individual Monitor Wells

Lost Creek Permit Area

Issued For: NRC TR | Drawn By: JM

Issued/ Revised: 12.08.08

Drawing No.: WDEQ_LQD_FIG_D6-27a.mxd

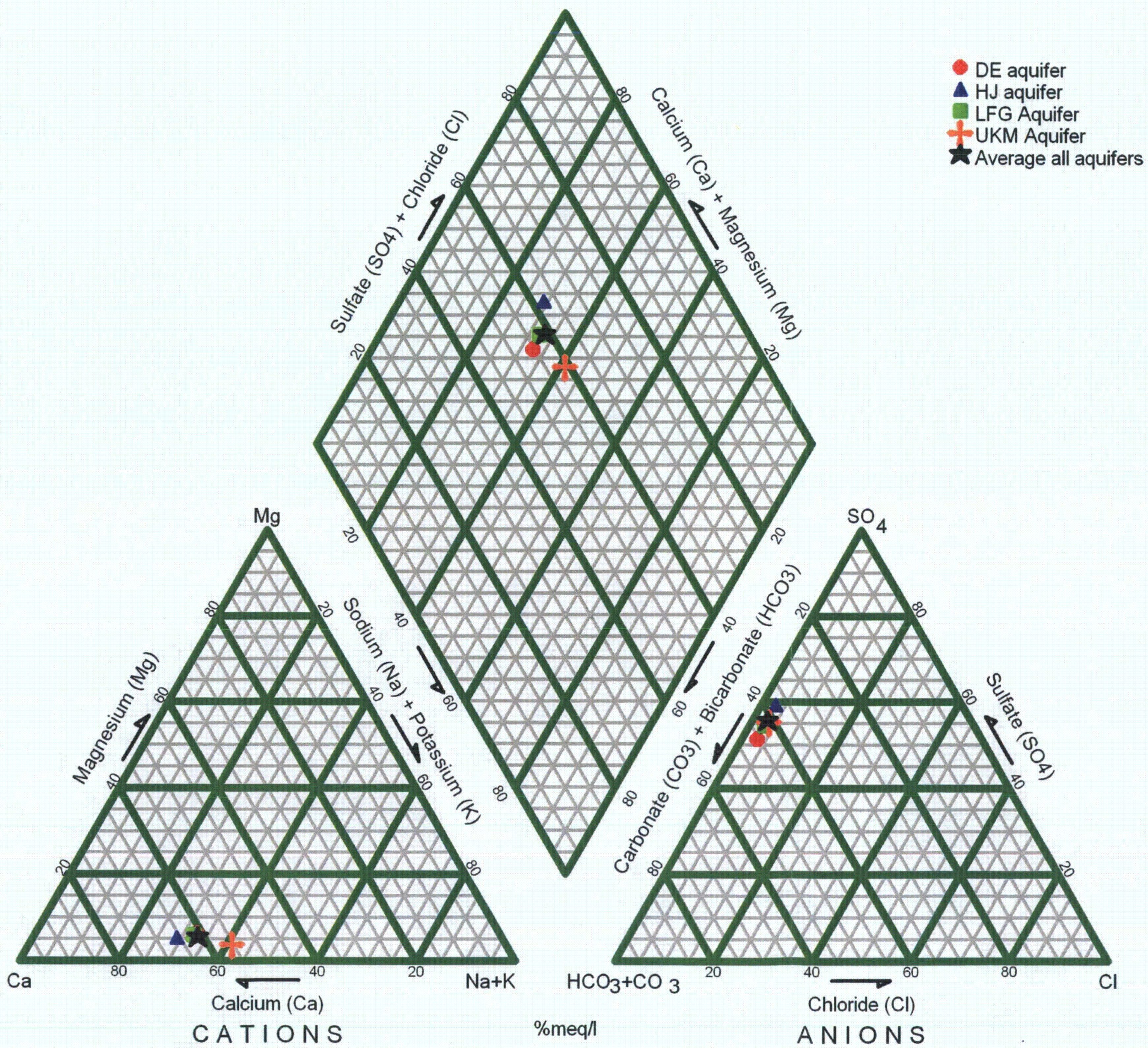

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FIGURE 2.7-22b

Piper Diagram - Average Water Quality in Aquifers of Interest

Lost Creek Permit Area

Issued For: NRC TR
Drawn By: JM
Issued/ Revised: 12.06.07
Drawing No.: WDEQ_LQD_FIG_D6-27b.mxd

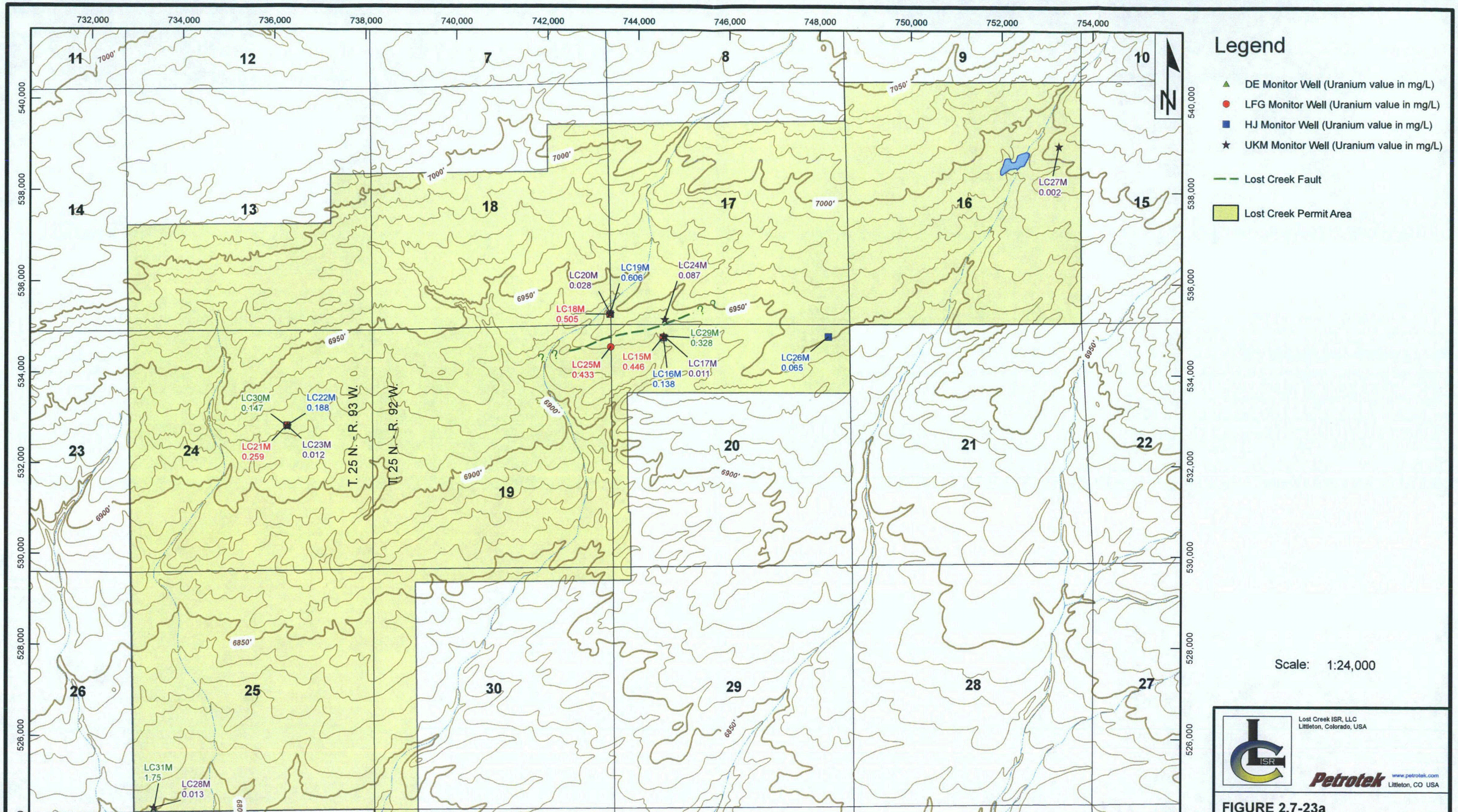


FIGURE 2.7-23a

Distribution of Average Uranium September 2006 to May 2007

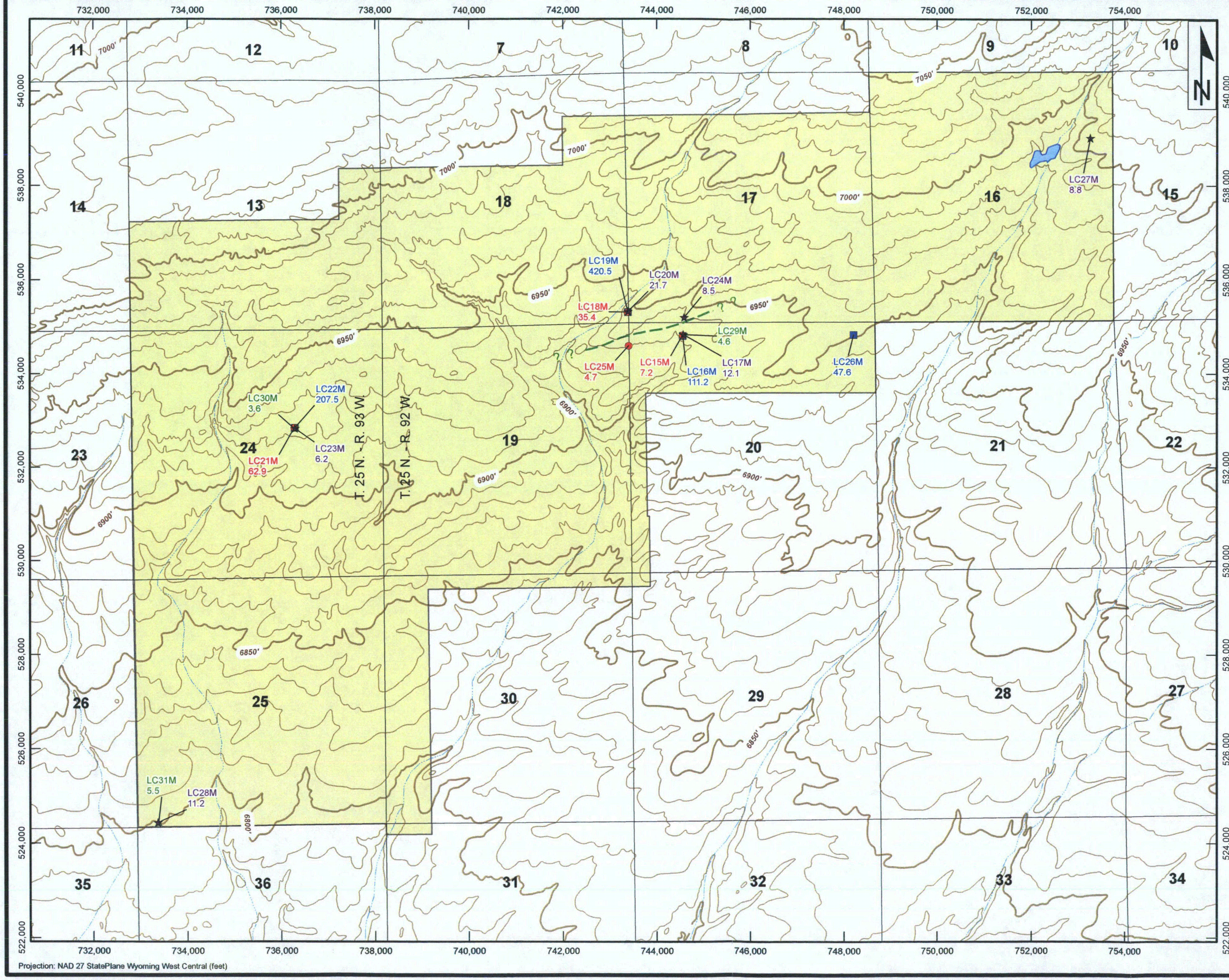
Lost Creek Permit Area

Issued For: WDEQ-LQD 1.0 | Drawn By: JM

Issued/ Revised: 04.13.09

Drawing No.: WDEQ_LQD_FIG_D6-28a.mxd

0 | 1,500 | 3,000 Feet



Legend

- ▲ DE Monitor Well (Radium value in pCi/L)
- ● LFG Monitor Well (Radium value in pCi/L)
- ■ HJ Monitor Well (Radium value in pCi/L)
- ★ UKM Monitor Well (Radium value in pCi/L)
- – – Lost Creek Fault
- ▭ Lost Creek Permit Area

Scale: 1:24,000

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FIGURE 2.7-23b

Distribution of Average Radium 226 + 228, September 2006 to May 2007

Lost Creek Permit Area

Issued For: WDEQ-LQD 1.0 | Drawn By: JM

Issued/ Revised: 04.13.09

Drawing No.: WDEQ_LQD_FIG_D6-28b.mxd

0 1,500 3,000 Feet

Table 2.7-1b Calculated Peak Flows for Three Principal Drainages

Watershed	Drainage Area (mi2)	Latitude (dec. deg)	2-Year (cfs)	5-Year (cfs)	10-Year (cfs)	25-Year (cfs)	50-Year (cfs)	100-Year (cfs)
Western Draw	2.9	42.1	16.9	45.0	73.9	123.0	169.3	224.6
West Battle Spring Draw	7.0	42.1	28.7	73.7	118.6	193.2	262.3	343.6
East Battle Spring Draw	5.1	42.1	23.6	61.3	99.5	163.3	222.8	293.3

Table 2.7-5 Monitor Well Date (Page 1 of 2)

Well ID [1]	Easting (feet)	Northing (feet)	Completion Zone (feet)	Ground Surface Elevation (ft amsl)	Measure Point Elevation (ft amsl)	Total Depth (ft bgs)	Top Under-Reamed Interval (ft bgs)	Bottom Under-Reamed Interval (ft bgs)	Total Under-Reamed Thickness (feet)
Lost Creek Wells [2]									
LC29M	744547	534837	DE	6935.11	6936.86	171	140	164	24
LC30M	736276	532836	DE	6925.10	6927.40	236	196	236	40
LC31M	733380	524434	DE	6856.52	6805.83	191	150	190	40
MB-1	736248	535851	DE	6984.39	6985.89	300	240	280	40
MB-7	753266	538981	DE	6983.38	6984.88	140	80	125	45
MB-10	743348	535293	DE	6939.20	6940.70	190	130	160	30
LC15M	744546	534823	LFG	6934.72	6936.57	350	286	340	54
LC18M	743368	535316	LFG	6948.43	6949.03	350	290	332	42
LC21M	736277	532850	LFG	-	6927.13	410	375	398	23
LC25M	743397	534601	LFG	6935.00	6936.52	380	316	369	53
MB-2	436298	535858	LFG	6985.42	6986.92	460	410	450	40
MB-5	733337	524466	LFG	6803.54	6805.04	330	305	325	20
MB-8	753316	538987	LFG	6984.00	6985.50	280	230	260	30
HJMP-104	742900	534900	HJ	6939.76	6941.01	430	405	430	25
HJMP-107	743700	534800	HJ	6937.13	6938.40	464	443	460	17
HJMP-110	743700	535200	HJ	6945.95	6947.14	476	430	475	45
HJMP-111	743850	535370	HJ	6948.98	6950.32	440	395	440	45
HJT-104	743660	534900	HJ	6938.78	6940.11	460	413	463	50
LC16M	744553	534811	HJ	6934.76	6936.38	472	410	467	57
LC19M	743383	535317	HJ	6949.32	6950.52	463	412	463	51
LC22M	736292	532850	HJ	6924.91	6926.06	592	504	585	81
LC26M	748203	534832	HJ	6952.96	6955.67	436	376	431	55
UKMO-101	744086	534943	HJ	6940.19	6942.28	487.4	465	485	20
UKMO-102	744205	535134	HJ	6940.24	6940.79	420	377	408	31
UKMO-103	744501	535556	HJ	6949.28	6950.53	438	417	445	28
MB-3B	736348	535854	HJ	6985.88	6987.38	600	540	552	12
							562	587	25
MB-6	733376	524466	HJ	6803.40	6804.90	440	380	405	25
MB-9	753281	539034	HJ	6984.82	6986.31	400	340	370	30

Table 2.7-5 Monitor Well Date (Page 2 of 2)

Well ID (1)	Easting (feet)	Northing (feet)	Completion Zone (feet)	Ground Surface Elevation (ft amsl)	Measure Point Elevation (ft amsl)	Total Depth (ft bgs)	Top Under-Reamed Interval (ft bgs)	Bottom Under-Reamed Interval (ft bgs)	Total Under-Reamed Thickness (feet)
LC17M	744562	534840	UKM	6935.13	6936.87	575	529	565	36
LC20M	743383	535331	UKM	6949.27	6950.64	543	511	543	32
LC23M	736292	532835	UKM	6924.41	6926.80	634	595	630	35
LC24M	744580	535203	UKM	6942.76	6944.63	542	478	531	53
LC27M	753260	539018	UKM	7010.00	7012.16	477	433	456	23
LC28M	733364	524437	UKM	6804.15	6805.19	563	502	557	55
HJMU-113	744277	534807	UKM	6935.16	6936.99	800	524	555	31
HJMU-114	744966	534678	UKM	6939.10	6940.43	557	525	553	28
UKMP-101	744100	534930	UKM	6940.26	6941.75	575	540	572	32
UKMP-102	744150	535150	UKM	6940.87	6942.03	498	485	505	20
MB-4	736398	535868	UKM	6985.77	6987.27	680	610	640	30
Conoco Wells (3)									
M-25-92-17-1S	745785	536224	LFG	UNK (4)	6966.20	UNK	UNK	UNK	UNK
M-25-92-18-1S	742648	535513	LFG	UNK	6939.30	UNK	UNK	UNK	UNK
M-25-92-20-1S	744998	534521	LFG	UNK	6934.50	UNK	UNK	UNK	UNK
M-25-92-17-1M	745813	536223	HJ	UNK	6966.70	UNK	UNK	UNK	UNK
M-25-92-18-1M	742623	535515	HJ	UNK	6940.00	UNK	UNK	UNK	UNK
M-25-92-20-1M	745023	534520	HJ	UNK	6934.90	UNK	UNK	UNK	UNK
M-25-92-19-1M	742622	534524	HJ	UNK	6926.10	UNK	UNK	UNK	UNK
M-25-92-19-2M	742623	534500	HJ	UNK	6925.50	UNK	UNK	UNK	UNK
M-25-92-19-3M	742623	534474	HJ	UNK	6923.90	UNK	UNK	UNK	UNK
M-25-92-17-1D	745837	536222	UKM	UNK	6967.40	UNK	UNK	UNK	UNK
M-25-92-18-1D	742596	535517	UKM	UNK	6938.70	UNK	UNK	UNK	UNK
M-25-92-20-1D	745048	534519	UKM	UNK	6935.00	UNK	UNK	UNK	UNK

(1) See Figure 2.7-9 for well locations.

(2) The Lost Creek wells installed for the 2006 and 2007 pump tests and baseline water quality sampling.

(3) The Conoco wells were installed by Conoco-TexasGulf in the 1980s and subsequently

(4) UNK = unknown

Table 2.7-9 1982 and 2006 Pump Test Results

Well ID	Completion Zone	Date of Test Startup	Pumping Well	Underreamed interval[6]	Pumping Rate	Length of Test	Max Drawdown	Transmissivity/Analytical Method: Cooper Jacobs[7]		Hantush		Jacob Recovery		Average	Average Hydraulic Conductivity	Storativity
				(feet)	(gpm)	(hr:min)	(feet)	(gpd/ft)	(ft2/d)	(gpd/ft)	(ft2/d)	(gpd/ft)	(ft2/d)	(ft2/d)	(ft/d)	
Multi-Well Tests																
LC16M[1]	HJ	11/8/2006	LC16M	57	15	19:50	21.8	818	109.4			769	102.8	106.1	1.9	
LC19M[2] 1st	HJ	10/26/2006	LC19M	51	17.6-18.8	10:42	26.4	553	73.9			719	96.1	85.0	1.7	
LC19M[2] 2nd	HJ	11/2/2006	LC19M	51	17.6-18.8	25:30	29.1	590	78.9			773	103.3	91.1	1.8	
LC22M[3]	HJ	11/15/2006	LC22M	81	11.75	45:00	36.3	3007	402.0			1605	214.6	308.3	3.8	
M-25-92-19-1M	HJ	8/17/1982	M-25-92-19-2M	~50	30	25:10	28.5	700	93.6	730	97.6	760	101.6	97.6	2.0	8.40E-04
M-25-92-19-2M	HJ	8/17/1982	M-25-92-19-2M	~50	30	25:10	49	730	97.6	580	77.5	620	82.9	86.0	1.7	
M-25-92-19-3M	HJ	8/17/1982	M-25-92-19-2M	~50	30	25:10	31.7	680	90.9	610	81.6	730	97.6	90.0	1.8	3.30E-04
M-25-92-20-1M[4]	HJ	8/19/1982	M-25-92-20-1M	~50	30	25:00	25	2000	267.4			1300	173.8	220.6	4.4	
Single Well Tests																
LC26M	HJ	11/17/2006		55	13.6-14.3	1:09	9.7	1821	243.4						4.4	
LC27M 1st	HJ	10/24/2006		23	12.8-13.0	2:05	12.5	1659	221.8						9.6	
LC27M 2nd[5]	HJ	11/16/2006		23	8.8	2:13	8.2	2013	269.1						11.7	
LC15M	LFG	11/26/2006		54	14.2	1:50	32.1	302	40.4						0.7	
LC18M 1st	LFG	9/20/2006		42	8.8-13.0	3:25	94	33	4.4						0.1	
LC18M 2nd	LFG	11/22/2006		42	'7.5 to 10	2:17	50.5	62	8.3						0.2	
LC21M	LFG	11/26/2006		23	13.1	3:45	50.2	303	40.5						1.8	
LC25M	LFG	11/17/2006		33	9.4-12.2	2:01	75	212	28.3						0.9	
LC17M	UKM	11/26/2006		36	13	2:15	26	195	26.1						0.7	
LC20M	UKM	11/22/2006		32	12-12.5	2:21	23.5	520	69.5						2.2	
LC23M	UKM	11/26/2006		35	9.9	3:56	25	583	77.9						2.2	
LC24M	UKM	11/26/2006		53	12.1	1:12	24	561	75.0						1.4	
LC29M	DE	9/20/2006		40	0.67	0:31	10.3	10	1.3						0.0	
LC30M 1st	DE	9/20/2006		40	2.7-3.3	5:02	13	231	30.9						0.8	
LC30M 2nd	DE	11/26/2006		40	7	2:55	24	573	76.6						1.9	
LC31M	DE	11/26/2006		40	7	1:34	14	1098	146.8						3.7	

[1] -No significant response from HJ observation wells LC19M (across fault 1,284 ft), LC22M (8,500 ft) or LC26M (3,640 ft) during the test

[2] -No significant response from HJ observation wells LC16M (1,284 ft), LC22M (7,500 ft) or LC26M (4,850 ft) (all located across the fault) during the test.

[3] -No significant response from HJ observation wells LC16M (8,502 ft) or LC28M (8908 ft) or from LFG well LC21M (15 ft) or UKM well LC23M (15 ft) during the test

[4] -No response from overlying (M-25-92-20S) or underlying (M25-92-20-D) observation wells during the test

[5] - Pump was shut off after 59 minutes for 10 minutes, then test was resumed

[6] - The underreamed interval in the M-25-92 series wells is estimated. These data not provided in Hydro-Search, Inc report (1982)

[7]- Hydro Engineering (2007) reported early and late time values for Cooper Jacobs analytical methods. Only late time data results are shown here.
Late time data provides better representation as much of the early time data is impacted by casing storage and later time date shows effects of fault

Table 2.7-13 Monitor Well Data (Page 1 of 16)

Major Cations and Anions												
Well ID	Completion Zone	Sample Date	Na (mg/L)	K (mg/L)	Ca (mg/L)	Mg (mg/L)	Cl (mg/L)	HCO_3 (mg/L)	CO_3 (mg/L)	SO_4 (mg/L)	SiO_2 (mg/L)	NO_3+NO_2 (mg/L)
LC29M	DE	9/20/06	26.0	2.0	57.0	4.0	6	137	ND	108	12.0	ND
LC29M	DE	11/26/06	26.0	3.0	64.0	4.0	4	98	ND	131	17.2	ND
LC29M	DE	3/1/07	24.0	2.0	57.0	3.0	4	205	ND	54	18.1	ND
LC29M	DE	5/4/07	27.0	2.0	47.0	3.0	10	183	ND	21	15.3	0.90
LC30M	DE	9/20/06	29.0	2.0	33.0	2.0	6	122	ND	31	14.7	1.40
LC30M	DE	11/26/06	25.0	1.0	31.0	2.0	5	124	ND	26	13.7	1.20
LC30M	DE	3/1/07	51.0	2.0	33.0	2.0	6	156	ND	51	17.4	0.60
LC30M	DE	5/3/07	62.0	2.0	28.0	2.0	6	176	ND	55	17.7	ND
LC31M	DE	9/21/06	40.0	3.0	140.0	9.0	7	140	ND	316	15.0	0.80
LC31M	DE	11/26/06	39.0	3.0	120.0	8.0	7	145	ND	280	13.9	0.40
LC31M	DE	2/28/07	64.0	3.0	108.0	7.0	8	156	ND	277	17.0	0.30
LC31M	DE	5/3/07	71.0	3.0	99.0	6.0	6	159	ND	279	15.9	0.20
MB-1	DE	8/27/09	22.0	3.0	10.0	ND	12	ND	18.0	22	15.7	1.55
MB-1	DE	1/4/10	23.0	2.0	11.0	ND	8	59	ND	21	14.4	1.60
MB-7	DE	8/26/09	Insufficient water to sample.									
MB-10	DE	8/26/09	Insufficient water to sample.									

Table 2.7-13 Monitor Well Data (Page 2 of 16)

			General Water Quality				Radionuclides					
Well ID	Completion Zone	Sample Date	TDS (mg/L)	Specific Conductivity	Lab pH (SU)	Alkalinity (mg/L)	Gross Alpha (pCi/L)	Gross Beta (pCi/L)	Ra-226 (pCi/L)	Ra-228 (pCi/L)	Ra-226 + Ra-228 (pCi/L)	Uranium (mg/L)
LC29M	DE	9/20/06	283			112	328.0	142.0	1.9	ND	1.9	0.499
LC29M	DE	11/26/06	298	491	7.68	80	158.0	54.0	1.7	4.7	6.4	0.246
LC29M	DE	3/1/07	265	385	7.77		265.0	86.1	4.0	ND	4.0	0.318
LC29M	DE	5/4/07	219	356	7.75		200.0	84.6	3.0	ND	3.0	0.251
LC30M	DE	9/20/06	184			100	129.0	41.5	1.0	ND	1.0	0.141
LC30M	DE	11/26/06	170	288	7.33	102	107.0	32.3	0.9	1.6	2.5	0.154
LC30M	DE	3/1/07	241	393	8.02		108.0	31.9	5.7	ND	5.7	0.162
LC30M	DE	5/3/07	260	440	8.07		109.0	40.0	2.1	ND	2.1	0.130
LC31M	DE	9/21/06	602	800	7.85	114	1120.0	405.0	2.0	1.7	3.7	1.890
LC31M	DE	11/26/06	528	838	7.79	119	1430.0	395.0	2.6	3.2	5.8	2.100
LC31M	DE	2/28/07	563	817	7.94		967.0	262.0	7.2	1.0	8.2	1.400
LC31M	DE	5/3/07	559	860	7.79		1030.0	319.0	1.9	2.4	4.3	1.610
MB-1	DE	8/27/09	121	186	10.10		21.4	10.1	0.7	0.9	1.6	0.011
MB-1	DE	1/4/10	95	183	9.27	55	74.7	18.9	0.3	1.6	1.9	0.063
MB-7	DE	8/26/09	Insufficient water to sample.									
MB-10	DE	8/26/09	Insufficient water to sample.									

Table 2.7-13 Monitor Well Data (Page 3 of 16)

Trace Parameters (Dissolved unless otherwise noted.)											
Well ID	Completion Zone	Sample Date	Al (mg/L)	NH_3-N (mg/L)	As (mg/L)	Ba (mg/L)	B (mg/L)	Cd (mg/L)	Cr (mg/L)	Cu (mg/L)	F (mg/L)
LC29M	DE	9/20/06	ND	1.07	0.002	ND	ND	ND	ND	ND	0.3
LC29M	DE	11/26/06	ND	0.57	0.003	ND	ND	ND	ND	ND	0.3
LC29M	DE	3/1/07	ND	0.26	0.005	ND	ND	ND	ND	ND	0.2
LC29M	DE	5/4/07	ND	0.18	ND	ND	ND	ND	ND	ND	0.2
LC30M	DE	9/20/06	ND	0.11	0.002	ND	ND	ND	ND	ND	0.5
LC30M	DE	11/26/06	ND	0.08	0.002	ND	ND	ND	ND	ND	0.5
LC30M	DE	3/1/07	ND	0.07	0.004	ND	ND	ND	ND	ND	0.5
LC30M	DE	5/3/07	ND	0.06	0.007	ND	ND	ND	ND	ND	0.5
LC31M	DE	9/21/06	ND	ND	ND	ND	ND	ND	ND	ND	ND
LC31M	DE	11/26/06	ND	0.07	ND	ND	ND	ND	ND	ND	0.2
LC31M	DE	2/28/07	ND	ND	ND	ND	ND	ND	ND	ND	0.2
LC31M	DE	5/3/07	ND	ND	ND	ND	ND	ND	ND	ND	0.2
MB-1	DE	8/27/09	ND	ND	0.002	ND	ND	ND	ND	ND	ND
MB-1	DE	1/4/10	ND	ND	0.002	ND	ND	ND	ND	ND	0.3
MB-7	DE	8/26/09	Insufficient water to sample.								
MB-10	DE	8/26/09	Insufficient water to sample.								

Table 2.7-13 Monitor Well Data (Page 4 of 16)

Trace Parameters (Dissolved unless otherwise noted.)														
Well ID	Completion Zone	Sample Date	Fe (mg/L)		Hg (mg/L)	Mn (mg/L)		Mo (mg/L)	Ni (mg/L)	Pb (mg/L)	Se (mg/L)	V (mg/L)	Zn (mg/L)
			Dissolved	Total		Dissolved	Total						
LC29M	DE	9/20/06	0.09	0.09	ND	0.12	0.11	ND	ND	ND	0.002	ND	ND
LC29M	DE	11/26/06	0.67	0.46	ND	0.48	0.32	ND	ND	ND	ND	ND	ND
LC29M	DE	3/1/07	0.40	0.40	ND	0.24	0.24	ND	ND	ND	ND	ND	ND
LC29M	DE	5/4/07	0.14	0.14	ND	0.04	0.04	ND	ND	ND	ND	ND	ND
LC30M	DE	9/20/06	ND	ND	ND	0.01	ND	ND	ND	ND	0.016	ND	ND
LC30M	DE	11/26/06	ND	ND	ND	0.01	0.01	ND	ND	ND	0.016	ND	ND
LC30M	DE	3/1/07	0.11	0.11	ND	0.08	0.08	ND	ND	ND	0.006	ND	ND
LC30M	DE	5/3/07	0.09	0.09	ND	0.07	0.07	ND	ND	ND	0.003	ND	ND
LC31M	DE	9/21/06	ND	ND	ND	0.01	ND	ND	ND	ND	0.215	ND	ND
LC31M	DE	11/26/06	ND	ND	ND	0.06	0.05	ND	ND	ND	0.211	ND	ND
LC31M	DE	2/28/07	0.10	0.10	ND	0.10	0.10	ND	ND	ND	0.151	ND	ND
LC31M	DE	5/3/07	0.07	0.07	ND	0.02	0.02	ND	ND	ND	0.111	ND	ND
MB-1	DE	8/27/09	0.40	0.42	ND	ND	ND	ND	ND	ND	0.003	ND	ND
MB-1	DE	1/4/10	0.03	0.10	ND	ND	ND	ND	ND	ND	0.004	ND	ND
MB-7	DE	8/26/09	Insufficient water to sample										
MB-10	DE	8/26/09	Insufficient water to sample										

Table 2.7-13 Monitor Well Data (Page 5 of 16)

Major Cations and Anions												
Well ID	Completion Zone	Sample Date	Na (mg/L)	K (mg/L)	Ca (mg/L)	Mg (mg/L)	Cl (mg/L)	HCO_3 (mg/L)	CO_3 (mg/L)	SO_4 (mg/L)	SiO_2 (mg/L)	NO_3+NO_2 (mg/L)
LC15M	LFG	9/12/06	31.0	4.0	86.0	4.0	8	127	ND	180	16.0	ND
LC15M	LFG	11/26/06	31.0	2.0	84.0	4.0	6	134	ND	157	14.3	ND
LC15M	LFG	3/1/07	33.0	3.0	89.0	5.0	1	130	ND	180	14.8	0.2
LC15M	LFG	5/4/07	34.0	9.0	46.0	3.0	6	85	ND	142	13.0	0.40
LC18M	LFG	9/20/06	35.0	3.0	61.0	3.0	5	122	ND	122	13.2	ND
LC18M	LFG	11/22/06	31.0	2.0	55.0	3.0	5	117	ND	117	12.4	ND
LC18M	LFG	3/1/07	33.0	2.0	60.0	3.0	5	120	ND	120	13.6	ND
LC18M	LFG	5/4/07	30.0	3.0	49.0	3.0	5	112	ND	119	12.6	ND
LC21M	LFG	9/20/06	33.0	2.0	46.0	3.0	6	121	5.0	62	15.8	1.00
LC21M	LFG	11/26/06	30.0	2.0	41.0	3.0	5	132	ND	59	13.9	0.8
LC21M	LFG	2/28/07	31.0	3.0	35.0	3.0	5	120	ND	60	15.2	1.0
LC21M	LFG	5/3/07	30.0	2.0	41.0	3.0	5	124	ND	58	13.7	1.0
LC25M	LFG	9/21/06	35.0	4.0	73.0	2.0	6	100	2.0	146	14.1	0.30
LC25M	LFG	11/17/06	34.0	2.0	70.0	4.0	6	120	ND	139	14.6	0.20
LC25M	LFG	3/1/07	32.0	2.0	72.0	4.0	6	126	ND	150	14.7	0.20
LC25M	LFG	5/3/07	34.0	4.0	34.0	3.0	4	36	ND	133	13.5	ND
MB-2	LFG	8/27/09	29.0	2.0	37.0	3.0	8	121	ND	53	16.1	1.2
MB-2	LFG	12/14/09	27.0	2.0	34.0	3.0	8	124	ND	58	14.7	1.10
MB-5	LFG	8/27/09	24.0	3.0	63.0	3.0	6	132	ND	105	17.2	ND
MB-5	LFG	12/14/09	24.0	2.0	61.0	3.0	7	134	ND	114	15.9	ND
MB-8	LFG	8/26/09	24.0	3.0	70.0	4.0	5	159	ND	121	16.9	0.01
MB-8	LFG	1/4/10	27.0	2.0	74.0	5.0	6	154	ND	129	17.5	ND

Table 2.7-13 Monitor Well Data (Page 6 of 16)

			General Water Quality				Radionuclides					
Well ID	Completion Zone	Sample Date	TDS (mg/L)	Specific Conductivity	Lab pH (SU)	Alkalinity (mg/L)	Gross Alpha (pCi/L)	Gross Beta (pCi/L)	Ra-226 (pCi/L)	Ra-228 (pCi/L)	Ra-226 + Ra-228 (pCi/L)	Uranium (mg/L)
LC15M	LFG	9/12/06	390				263.0	83.3	5.3	0.9	6.2	0.489
LC15M	LFG	11/26/06	370	605	7.84	110	334.0	116.0	3.8	4.8	8.6	0.472
LC15M	LFG	3/1/07	390	587	7.32		374.0	92.7	6.0	3.5	9.5	0.467
LC15M	LFG	5/4/07	296	492	8.27		236.0	92.1	3.6	ND	3.6	0.358
LC18M	LFG	9/20/06	303			100	518.0	192.0	43.0	2.8	45.8	0.523
LC18M	LFG	11/22/06	277	461	8.33	98	490.0	199.0	63.5	3.9	67.4	0.546
LC18M	LFG	3/1/07	296	460	7.86		439.0	148.0	ND	ND	0.0	0.533
LC18M	LFG	5/4/07	277	467	8.09		385.0	115.0	26.4	ND	26.4	0.419
LC21M	LFG	9/20/06	233			106	219.0	70.3	1.6	1.2	2.8	0.251
LC21M	LFG	11/26/06	219	373	8.17	108	205.0	49.2	1.2	12.0	13.2	0.278
LC21M	LFG	2/28/07	214	333	8.25		815.0	62.6	230.0	ND	230.0	0.270
LC21M	LFG	5/3/07	219	371	8.17		202.0	65.2	3.7	ND	3.7	0.236
LC25M	LFG	9/21/06	336	452	8.37	91	353.0	124.0	3.1	3.3	6.4	0.465
LC25M	LFG	11/17/06	330	516	8.28		301.0	138.0	3.1	ND	3.1	0.460
LC25M	LFG	3/1/07	344	519	7.97		369.0	107.0	2.3	2.3	4.6	0.517
LC25M	LFG	5/3/07	244	390	8.57		194.0	72.5	2.9	ND	2.9	0.289
MB-2	LFG	8/27/09	220	337	8.17		223.0	61.4	1.7	2.0	3.7	0.164
MB-2	LFG	12/14/09	195	345	8.07		175.0	61.9	1.5	1.3	2.8	0.172
MB-5	LFG	8/27/09	295	438	7.99		80.9	28.4	32.0	3.3	35.3	0.017
MB-5	LFG	12/14/09	298	449	7.92		70.2	30.9	29.0	2.8	31.8	0.018
MB-8	LFG	8/26/09	333	487	7.91		204.0	54.9	3.2	2.4	5.6	0.152
MB-8	LFG	1/4/10	306	501	7.94	126	261.0	60.6	1.8	3.0	4.8	0.190

Table 2.7-13 Monitor Well Data (Page 7 of 16)

Trace Parameters (Dissolved unless otherwise noted.)											
Well ID	Completion Zone	Sample Date	Al (mg/L)	NH_3-N (mg/L)	As (mg/L)	Ba (mg/L)	B (mg/L)	Cd (mg/L)	Cr (mg/L)	Cu (mg/L)	F (mg/L)
LC15M	LFG	9/12/06	ND	ND	ND	ND	ND	ND	ND	ND	0.2
LC15M	LFG	11/26/06	ND	ND	ND	ND	ND	ND	ND	ND	0.2
LC15M	LFG	3/1/07	ND	ND	ND	ND	ND	ND	ND	ND	0.2
LC15M	LFG	5/4/07	ND	ND	ND	ND	ND	ND	ND	ND	0.2
LC18M	LFG	9/20/06	ND	ND	0.004	ND	ND	ND	ND	ND	0.2
LC18M	LFG	11/22/06	ND	ND	0.002	ND	ND	ND	ND	ND	0.2
LC18M	LFG	3/1/07	ND	ND	0.002	ND	ND	ND	ND	ND	0.2
LC18M	LFG	5/4/07	ND	ND	ND	ND	ND	ND	ND	ND	0.2
LC21M	LFG	9/20/06	ND	0.08	ND	ND	ND	ND	ND	ND	0.3
LC21M	LFG	11/26/06	ND	ND	ND	ND	ND	ND	ND	ND	0.3
LC21M	LFG	2/28/07	ND	ND	ND	ND	ND	ND	ND	ND	0.2
LC21M	LFG	5/3/07	ND	ND	ND	ND	ND	ND	ND	ND	0.2
LC25M	LFG	9/21/06	ND	ND	0.00	ND	ND	ND	ND	ND	0.2
LC25M	LFG	11/17/06	ND	ND	ND	ND	ND	ND	ND	ND	0.2
LC25M	LFG	3/1/07	ND	ND	ND	ND	ND	ND	ND	ND	0.2
LC25M	LFG	5/3/07	ND	ND	ND	ND	ND	ND	ND	ND	0.2
MB-2	LFG	8/27/09	ND	0.14	0.001	ND	ND	ND	ND	ND	ND
MB-2	LFG	12/14/09	ND	ND	0.001	ND	ND	ND	ND	ND	0.2
MB-5	LFG	8/27/09	ND	0.08	ND	ND	ND	ND	ND	ND	ND
MB-5	LFG	12/14/09	298.00	ND	ND	ND	ND	ND	ND	ND	0.1
MB-8	LFG	8/26/09	ND	0.13	ND	ND	ND	ND	ND	ND	ND
MB-8	LFG	1/4/10	ND	ND	ND	ND	ND	ND	ND	ND	ND

Table 2.7-13 Monitor Well Data (Page 8 of 16)

Trace Parameters (Dissolved unless otherwise noted.)														
Well ID	Completion Zone	Sample Date	Fe (mg/L)		Hg (mg/L)	Mn (mg/L)		Mo (mg/L)	Ni (mg/L)	Pb (mg/L)	Se (mg/L)	V (mg/L)	Zn (mg/L)
			Dissolved	Total		Dissolved	Total						
LC15M	LFG	9/12/06	0.03	ND	ND	ND	ND	ND	ND	ND	0.019	ND	ND
LC15M	LFG	11/26/06	ND	ND	ND	ND	ND	ND	ND	ND	0.016	ND	ND
LC15M	LFG	3/1/07	ND	ND	ND	ND	ND	ND	ND	ND	0.017	ND	ND
LC15M	LFG	5/4/07	ND	ND	ND	ND	ND	ND	ND	ND	0.010	ND	ND
LC18M	LFG	9/20/06	0.53	0.53	ND	ND	ND	ND	ND	ND	0.024	ND	ND
LC18M	LFG	11/22/06	0.51	0.51	ND	ND	ND	ND	ND	ND	0.015	ND	ND
LC18M	LFG	3/1/07	0.67	0.67	ND	ND	ND	ND	ND	ND	0.016	ND	ND
LC18M	LFG	5/4/07	0.10	0.10	ND	ND	ND	ND	ND	ND	ND	ND	ND
LC21M	LFG	9/20/06	0.40	0.40	ND	0.02	0.02	ND	ND	ND	0.040	ND	ND
LC21M	LFG	11/26/06	ND	ND	ND	ND	ND	ND	ND	ND	0.039	ND	ND
LC21M	LFG	2/28/07	ND	ND	ND	ND	ND	ND	ND	ND	0.034	ND	ND
LC21M	LFG	5/3/07	ND	ND	ND	ND	ND	ND	ND	ND	0.032	ND	ND
LC25M	LFG	9/21/06	ND	ND	ND	ND	ND	ND	ND	ND	0.027	ND	ND
LC25M	LFG	11/17/06	ND	ND	ND	ND	ND	ND	ND	ND	0.027	ND	ND
LC25M	LFG	3/1/07	ND	ND	ND	ND	ND	ND	ND	ND	0.025	ND	ND
LC25M	LFG	5/3/07	ND	ND	ND	ND	ND	ND	ND	ND	0.015	ND	ND
MB-2	LFG	8/27/09	0.20	ND	ND	ND	ND	ND	ND	ND	0.013	ND	ND
MB-2	LFG	12/14/09	ND	ND	ND	ND	ND	ND	ND	ND	0.013	ND	ND
MB-5	LFG	8/27/09	0.10	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
MB-5	LFG	12/14/09	ND	ND	ND	ND	0.01	ND	ND	ND	ND	ND	ND
MB-8	LFG	8/26/09	0.10	0.42	ND	ND	ND	ND	ND	ND	0.003	ND	0.05
MB-8	LFG	1/4/10	ND	ND	ND	ND	ND	ND	ND	ND	0.003	ND	ND

Table 2.7-13 Monitor Well Data (Page 9 of 16)

Major Cations and Anions												
Well ID	Completion Zone	Sample Date	Na (mg/L)	K (mg/L)	Ca (mg/L)	Mg (mg/L)	Cl (mg/L)	HCO_3 (mg/L)	CO_3 (mg/L)	SO_4 (mg/L)	SiO_2 (mg/L)	NO_3+NO_2 (mg/L)
LC16M	HJ	9/12/06	27.0	2.0	77.0	4.0	5	134	ND	144	16.0	ND
LC16M	HJ	11/10/06	29.3	8.0	80.1	3.9	7	128	ND	136		ND
LC16M	HJ	3/1/07	30.0	2.0	74.0	4.0	4	132	ND	138	15.0	ND
LC16M	HJ	5/4/07	29.0	2.0	74.0	4.0	5	137	ND	139	14.8	ND
LC19M	HJ	9/20/06	35.0	3.0	66.0	3.0	6	103	2.0	139		ND
LC19M	HJ	11/3/06	32.8	2.1	72.9	3.2	6	132	ND	146	15.0	ND
LC19M	HJ	3/5/07	40.0	13.0	41.0	3.0	6	73	ND	124	14.5	ND
LC19M	HJ	5/4/07	33.0	8.0	45.0	3.0	5	93	ND	137	14.8	ND
LC19M	HJ	5/4/07	33.0	8.0	46.0	3.0	5	96	ND	137	14.6	ND
LC22M	HJ	9/21/06	40.0	2.0	74.0	3.0	5	113	ND	170	15.0	ND
LC22M	HJ	11/16/06	36.0	2.0	62.0	3.0	4	109	ND	154	12.8	ND
LC22M	HJ	3/1/07	37.0	4.0	60.0	3.0	6	110	ND	142	14.2	ND
LC22M	HJ	5/3/07	35.0	4.0	64.0	3.0	5	113	ND	137	13.0	ND
LC26M	HJ	9/21/06	35.0	4.0	133.0	6.0	6	168	ND	269	17.7	ND
LC26M	HJ	11/17/06	33.0	3.0	127.0	5.0	6	166	ND	256	17.0	ND
LC26M	HJ	3/1/07	33.0	3.0	125.0	5.0	5	159	ND	253	16.2	ND
LC26M	HJ	5/3/07	34.0	8.0	90.0	5.0	5	57	ND	259	17.5	ND
MB-3B	HJ	8/27/09	31.0	4.0	37.0	2.0	11	108	ND	66	17.2	0.91
MB-3B	HJ	12/14/09	30.0	3.0	37.0	2.0	10	112	ND	70	15.3	0.8
MB-6	HJ	8/27/09	38.0	3.0	38.0	1.0	4	77	ND	106	16.8	ND
MB-6	HJ	12/14/09	19.0	2.0	50.0	2.0	5	142	ND	71	16.7	ND
MB-9	HJ	8/27/09	24.0	3.0	70.0	4.0	5	159	ND	121	16.9	0.01
MB-9	HJ	12/15/09	21.0	6.0	47.0	2.0	5	117	ND	75	19.0	ND

Table 2.7-13 Monitor Well Data (Page 10 of 16)

			General Water Quality				Radionuclides					
Well ID	Completion Zone	Sample Date	TDS (mg/L)	Specific Conductivity	Lab pH (SU)	Alkalinity (mg/L)	Gross Alpha (pCi/L)	Gross Beta (pCi/L)	Ra-226 (pCi/L)	Ra-228 (pCi/L)	Ra-226 + Ra-228 (pCi/L)	Uranium (mg/L)
LC16M	HJ	9/12/06	330				299.0	109.0	166.0	4.3	170.3	0.164
LC16M	HJ	11/10/06	304	517			274.0	120.0	2.0	78.4	80.4	0.133
LC16M	HJ	3/1/07	333	509	7.92		290.0	79.7	65.1	3.8	68.9	0.134
LC16M	HJ	5/4/07	335	534	8.01		188.0	69.2	122.0	3.2	125.2	0.122
LC19M	HJ	9/20/06	319			87	985.0	540.0	366.0	4.8	370.8	0.336
LC19M	HJ	11/3/06	328	506	7.85	108	863.0	592.0	547.0	4.1	551.1	0.051
LC19M	HJ	3/5/07	278	432	8.02		1220.0	473.0	316.0	3.4	319.4	0.844
LC19M	HJ	5/4/07	266	482	8.11		1470.0	603.0	423.0	1.0	424.0	0.762
LC19M	HJ	5/4/07	264	487	8.09		1350.0	568.0	386.0	1.6	387.6	0.766
LC22M	HJ	9/21/06	366	511	8.14	93	810.0	358.0	261.0	3.2	264.2	0.342
LC22M	HJ	11/16/06	328	531	8.15		597.0	258.0	247.0	1.9	248.9	0.185
LC22M	HJ	3/1/07	319	483	7.87		86.5	97.9	1.7	3.6	5.3	0.129
LC22M	HJ	5/3/07	316	513	8.11		576.0	186.0	308.0	3.8	311.8	0.097
LC26M	HJ	9/21/06	554	741	8.16	138	306.0	111.0	87.7	4.6	92.3	0.107
LC26M	HJ	11/17/06	528	786	8.06		300.0	119.0	77.2	3.8	81.0	0.072
LC26M	HJ	3/1/07	519	745	7.85		30.5	46.1	ND	3.6	3.6	0.045
LC26M	HJ	5/3/07	449	653	8.44		50.2	23.4	12.4	ND	12.4	0.037
MB-3B	HJ	8/27/09	231	353	8.29		255.0	48.8	1.9	3.1	5.0	0.179
MB-3B	HJ	12/14/09	220	358	8.17		215.0	61.8	1.5	1.5	3.0	0.186
MB-6	HJ	8/27/09	256	374	8.79		10.2	8.9	3.4	3.8	7.2	0.000
MB-6	HJ	12/14/09	242	373	7.98		21.0	12.9	5.9	3.8	9.7	0.007
MB-9	HJ	8/27/09	333	487	7.91		204.0	54.9	3.2	2.4	5.6	0.152
MB-9	HJ	12/15/09	240	361	8.47		12.5	12.3	2.9	4.4	7.3	0.004

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Trace Parameters (Dissolved unless otherwise noted.)												
Well ID	Completion Zone	Sample Date	Al (mg/L)	NH_3-N (mg/L)	As (mg/L)	Ba (mg/L)	B (mg/L)	Cd (mg/L)	Cr (mg/L)	Cu (mg/L)	F (mg/L)
LC16M	HJ	9/12/06	ND	ND	0.002	ND	ND	ND	ND	ND	0.1
LC16M	HJ	11/10/06	ND	ND	ND	ND	ND	ND	ND	ND	0.1
LC16M	HJ	3/1/07	ND	ND	ND	ND	ND	ND	ND	ND	0.2
LC16M	HJ	5/4/07	ND	ND	ND	ND	ND	ND	ND	ND	0.2
LC19M	HJ	9/20/06	ND	ND	0.014	ND	ND	ND	ND	ND	ND
LC19M	HJ	11/3/06	ND	ND	0.002	ND	ND	ND	ND	ND	ND
LC19M	HJ	3/5/07	ND	0.06	0.008	ND	ND	ND	ND	ND	0.2
LC19M	HJ	5/4/07	ND	ND	0.01	ND	ND	ND	ND	ND	ND
LC19M	HJ	5/4/07	ND	ND	0.01	ND	ND	ND	ND	ND	ND
LC22M	HJ	9/21/06	ND	ND	0.00	ND	ND	ND	ND	ND	ND
LC22M	HJ	11/16/06	ND	ND	ND	ND	ND	ND	ND	ND	0.2
LC22M	HJ	3/1/07	ND	ND	0.00	ND	ND	ND	ND	ND	0.2
LC22M	HJ	5/3/07	ND	ND	0.002	ND	ND	ND	ND	ND	0.2
LC26M	HJ	9/21/06	ND	ND	0.003	ND	ND	ND	ND	ND	ND
LC26M	HJ	11/17/06	ND	ND	ND	ND	ND	ND	ND	ND	ND
LC26M	HJ	3/1/07	ND	0.07	ND	ND	ND	ND	ND	ND	ND
LC26M	HJ	5/3/07	ND	ND	ND	ND	ND	ND	ND	ND	0.2
MB-3B	HJ	8/27/09	ND	0.25	0.001	ND	ND	ND	ND	ND	ND
MB-3B	HJ	12/14/09	ND	ND	ND	ND	ND	ND	ND	ND	0.2
MB-6	HJ	8/27/09	ND	ND	0.00	ND	ND	ND	ND	ND	ND
MB-6	HJ	12/14/09	ND	ND	ND	ND	ND	ND	ND	ND	0.2
MB-9	HJ	8/27/09	ND	0.13	ND	ND	ND	ND	ND	ND	ND
MB-9	HJ	12/15/09	ND	ND	0.006	ND	ND	ND	ND	ND	0.2

Table 2.7-13 Monitor Well Data (Page 12 of 16)

Trace Parameters (Dissolved unless otherwise noted.)														
Well ID	Completion Zone	Sample Date	Fe (mg/L)		Hg (mg/L)	Mn (mg/L)		Mo (mg/L)	Ni (mg/L)	Pb (mg/L)	Se (mg/L)	V (mg/L)	Zn (mg/L)
			Dissolved	Total		Dissolved	Total						
LC16M	HJ	9/12/06	0.03	ND	ND	ND	0.01	ND	ND	ND	ND	ND	ND
LC16M	HJ	11/10/06	0.06	0.06	ND	ND	0.01	ND	ND	ND	ND	ND	ND
LC16M	HJ	3/1/07	ND	ND	ND	ND	0.01	ND	ND	ND	ND	ND	ND
LC16M	HJ	5/4/07	ND	ND	ND	ND	0.01	ND	ND	ND	ND	ND	ND
LC19M	HJ	9/20/06	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
LC19M	HJ	11/3/06	ND	ND	ND	ND	0.01	ND	ND	ND	ND	ND	ND
LC19M	HJ	3/5/07	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
LC19M	HJ	5/4/07	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
LC19M	HJ	5/4/07	ND	0.03	ND	ND	ND	ND	ND	ND	ND	ND	ND
LC22M	HJ	9/21/06	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
LC22M	HJ	11/16/06	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
LC22M	HJ	3/1/07	ND	ND	ND	0.02	0.01	ND	ND	ND	ND	ND	ND
LC22M	HJ	5/3/07	ND	0.03	ND	ND	0.01	ND	ND	ND	ND	ND	ND
LC26M	HJ	9/21/06	ND	ND	ND	0.02	0.02	ND	ND	ND	ND	ND	ND
LC26M	HJ	11/17/06	0.23	0.23	ND	0.03	0.03	ND	ND	ND	ND	ND	ND
LC26M	HJ	3/1/07	ND	ND	ND	0.02	0.02	ND	ND	ND	ND	ND	ND
LC26M	HJ	5/3/07	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
MB-3B	HJ	8/27/09	0.20	ND	ND	ND	ND	ND	ND	ND	0.016	ND	0.01
MB-3B	HJ	12/14/09	ND	ND	ND	ND	ND	ND	ND	ND	0.017	ND	ND
MB-6	HJ	8/27/09	0.10	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
MB-6	HJ	12/14/09	ND	0.04	ND	ND	0.01	ND	ND	ND	ND	ND	ND
MB-9	HJ	8/27/09	0.10	0.42	ND	ND	ND	ND	ND	ND	0.003	ND	0.05
MB-9	HJ	12/15/09	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

Table 2.7-13 Monitor Well Data (Page 13 of 16)

Major Cations and Anions												
Well ID	Completion Zone	Sample Date	Na (mg/L)	K (mg/L)	Ca (mg/L)	Mg (mg/L)	Cl (mg/L)	HCO_3 (mg/L)	CO_3 (mg/L)	SO_4 (mg/L)	SiO_2 (mg/L)	NO_3+NO_2 (mg/L)
LC17M	UKM	9/12/06	27.0	4.0	55.0	2.0	4	107	4.0	107	15.2	ND
LC17M	UKM	11/26/06	27.0	2.0	55.0	2.0	5	120	ND	94	15.1	ND
LC17M	UKM	3/1/07	29.0	2.0	62.0	3.0	5	124	ND	105	16.8	ND
LC17M	UKM	5/4/07	27.0	2.0	61.0	3.0	4	142	ND	108	15.9	ND
LC20M	UKM	9/21/06	32.0	3.0	56.0	2.0	6	113	2.0	102	17.2	ND
LC20M	UKM	11/22/06	32.0	5.0	38.0	ND	6	63	3.0	80	12.7	ND
LC20M	UKM	3/1/07	36.0	11.0	15.0	ND	5	39	ND	95	14.6	ND
LC20M	UKM	5/4/07	35.0	11.0	12.0	ND	6	34	2.0	91	14.1	ND
LC23M	UKM	9/21/06	44.0	8.0	58.0	ND	5	83	6.0	165	13.9	ND
LC23M	UKM	11/26/06	41.0	7.0	50.0	2.0	3	85	ND	150	14.1	ND
LC23M	UKM	3/1/07	64.0	48.0	52.0	ND	15	7	137.0	146	10.7	ND
LC23M	UKM	5/3/07	63.0	52.0	86.0	ND	5	4	66.0	126	9.4	ND
LC24M	UKM	9/21/06	32.0	3.0	68.0	4.0	5	109	ND	138	16.1	ND
LC24M	UKM	9/21/06	32.0	3.0	68.0	4.0	5	109	ND	138	16.1	ND
LC24M	UKM	11/26/06	29.0	2.0	66.0	3.0	4	126	2.0	121	14.7	ND
LC24M	UKM	3/1/07	31.0	7.0	43.0	3.0	5	73	ND	126	14.8	ND
LC24M	UKM	5/4/07	31.0	7.0	48.0	3.0	5	85	ND	126	14.6	ND
LC27M	UKM	9/26/06	19.5	4.1	29.5	0.6	4	93	1.0	29	15.3	ND
LC27M	UKM	11/16/06	21.0	4.0	27.0	ND	6	82	2.0	29	15.5	ND
LC27M	UKM	3/1/07	21.0	5.0	11.0	ND	4	38	ND	39	16.4	ND
LC27M	UKM	5/3/07	22.0	5.0	7.0	ND	4	33	5.0	32	17.8	ND
LC28M	UKM	9/21/06	27.0	3.0	60.0	3.0	6	125	ND	101	16.1	ND
LC28M	UKM	11/26/06	24.0	2.0	58.0	3.0	4	127	ND	88	15.7	ND
LC28M	UKM	2/28/07	25.0	2.0	59.0	3.0	6	127	ND	95	16.9	ND
LC28M	UKM	5/3/07	25.0	2.0	62.0	3.0	6	130	ND	96	15.0	ND
MB-4	UKM	8/31/09	32.0	8.0	32.0	ND	10	ND	23.0	61	19.5	0.46
MB-4	UKM	12/14/09	33.0	8.0	19.0	ND	32	15	10.0	66	14.0	0.70

Table 2.7-13 Monitor Well Data (Page 14 of 16)

			General Water Quality				Radionuclides					
Well ID	Completion Zone	Sample Date	TDS (mg/L)	Specific Conductivity	Lab pH (SU)	Alkalinity (mg/L)	Gross Alpha (pCi/L)	Gross Beta (pCi/L)	Ra-226 (pCi/L)	Ra-228 (pCi/L)	Ra-226 + Ra-228 (pCi/L)	Uranium (mg/L)
LC17M	UKM	9/12/06	262				28.4	13.7	10.6	1.1	11.7	0.014
LC17M	UKM	11/26/06	262	436	8.02	98	29.0	15.5	8.8	12.9	21.7	0.010
LC17M	UKM	3/1/07	284	433	7.88		26.8	11.5	5.5	ND	5.5	0.011
LC17M	UKM	5/4/07	291	467	8.11		17.3	9.1	7.2	1.5	8.7	0.009
LC20M	UKM	9/21/06	274	388	8.56	96	44.4	24.0	9.6	3.9	13.5	0.036
LC20M	UKM	11/22/06	216	362	8.91	56	38.7	19.5	9.3	3.4	12.7	0.025
LC20M	UKM	3/1/07	197	305	7.66		65.3	23.9	47.8	ND	47.8	0.024
LC20M	UKM	5/4/07	188	322	9.04		31.9	23.6	9.2	2.6	11.8	0.025
LC23M	UKM	9/21/06	341	451	8.87	76	32.8	17.5	3.3	ND	3.3	0.023
LC23M	UKM	11/26/06	303	498	7.97	70	35.0	14.9	4.7	6.7	11.4	0.019
LC23M	UKM	3/1/07	452	1180	11.60		5.3	34.8	1.9	1.0	2.9	0.002
LC23M	UKM	5/3/07	526	1720	11.60		15.1	44.7	4.7	1.5	6.2	0.002
LC24M	UKM	9/21/06	321	455	8.30	91	107.0	43.2	6.5	1.5	8.0	0.134
LC24M	UKM	9/21/06	321	455	8.30	91	107.0	43.2	6.5	1.5	8.0	0.134
LC24M	UKM	11/26/06	302	500	8.33	105	86.8	27.6	5.9	5.8	11.7	0.100
LC24M	UKM	3/1/07	266	410	7.99		48.6	22.6	1.8	2.0	3.8	0.062
LC24M	UKM	5/4/07	277	452	8.08		49.1	23.8	8.9	1.5	10.4	0.052
LC27M	UKM	9/26/06	136				10.7	9.7	1.1	0.4	1.5	0.003
LC27M	UKM	11/16/06	145	243	8.66		6.8	9.4	1.1	3.6	4.7	0.002
LC27M	UKM	3/1/07	117	171	8.74		77.7	4.1	26.6	ND	26.6	0.001
LC27M	UKM	5/3/07	111	178	9.51		2.9	3.9	0.4	ND	0.4	0.002
LC28M	UKM	9/21/06	276	394	8.14	103	30.7	19.4	8.1	3.4	11.5	0.017
LC28M	UKM	11/26/06	259	435	8.00	104	18.1	14.4	8.4	4.2	12.6	0.006
LC28M	UKM	2/28/07	269	400	8.15		27.0	13.0	7.7	2.1	9.8	0.007
LC28M	UKM	5/3/07	273	440	8.01		19.4	11.2	7.1	3.7	10.8	0.023
MB-4	UKM	8/31/09	209	474	11.10		49.8	22.4	0.5	1.7	2.2	0.017
MB-4	UKM	12/14/09	183	329	9.65		59.2	23.0	0.9	1.2	2.1	0.065

Table 2.7-13 Monitor Well Data (Page 15 of 16)

Trace Parameters (Dissolved unless otherwise noted.)											
Well ID	Completion Zone	Sample Date	Al (mg/L)	NH_3-N (mg/L)	As (mg/L)	Ba (mg/L)	B (mg/L)	Cd (mg/L)	Cr (mg/L)	Cu (mg/L)	F (mg/L)
LC17M	UKM	9/12/06	ND	ND	0.006	ND	ND	ND	ND	ND	0.2
LC17M	UKM	11/26/06	ND	ND	0.003	ND	ND	ND	ND	ND	0.2
LC17M	UKM	3/1/07	ND	0.06	0.002	ND	ND	ND	ND	ND	0.2
LC17M	UKM	5/4/07	ND	ND	0.00	ND	ND	ND	ND	ND	0.2
LC20M	UKM	9/21/06	ND	ND	0.012	ND	ND	ND	ND	ND	ND
LC20M	UKM	11/22/06	ND	ND	0.012	ND	ND	ND	ND	ND	0.2
LC20M	UKM	3/1/07	ND	ND	0.012	ND	ND	ND	ND	ND	0.2
LC20M	UKM	5/4/07	ND	ND	0.011	ND	ND	ND	ND	ND	0.2
LC23M	UKM	9/21/06	ND	ND	0.01	ND	ND	ND	ND	ND	ND
LC23M	UKM	11/26/06	ND	ND	0.00	ND	ND	ND	ND	ND	0.2
LC23M	UKM	3/1/07	ND	0.86	0.00	0.3	ND	ND	ND	ND	0.4
LC23M	UKM	5/3/07	0.20	0.75	0.00	0.3	ND	ND	ND	ND	0.2
LC24M	UKM	9/21/06	ND	0.13	0.00	ND	ND	ND	ND	ND	ND
LC24M	UKM	9/21/06	ND	0.13	0.003	ND	ND	ND	ND	ND	ND
LC24M	UKM	11/26/06	ND	0.08	ND	ND	ND	ND	ND	ND	0.2
LC24M	UKM	3/1/07	ND	0.08	ND	ND	ND	ND	ND	ND	ND
LC24M	UKM	5/4/07	ND	ND	ND	ND	ND	ND	ND	ND	0.2
LC27M	UKM	9/26/06	ND	ND	0.009	ND	ND	ND	ND	ND	0.2
LC27M	UKM	11/16/06	ND	ND	0.006	ND	ND	ND	ND	ND	0.3
LC27M	UKM	3/1/07	ND	ND	0.007	ND	ND	ND	ND	ND	0.3
LC27M	UKM	5/3/07	ND	ND	0.005	ND	ND	ND	ND	ND	0.3
LC28M	UKM	9/21/06	ND	ND	0.00	ND	ND	ND	ND	ND	ND
LC28M	UKM	11/26/06	ND	ND	ND	ND	ND	ND	ND	ND	0.2
LC28M	UKM	2/28/07	ND	ND	ND	ND	ND	ND	ND	ND	0.2
LC28M	UKM	5/3/07	ND	ND	ND	ND	ND	ND	ND	ND	0.2
MB-4	UKM	8/31/09	0.30	0.07	0.00	ND	ND	ND	ND	ND	ND
MB-4	UKM	12/14/09	ND	ND	0.008	ND	ND	ND	ND	ND	0.3

Table 2.7-13 Monitor Well Data (Page 16 of 16)

Trace Parameters (Dissolved unless otherwise noted.)														
Well ID	Completion Zone	Sample Date	Fe (mg/L)		Hg (mg/L)	Mn (mg/L)		Mo (mg/L)	Ni (mg/L)	Pb (mg/L)	Se (mg/L)	V (mg/L)	Zn (mg/L)
			Dissolved	Total		Dissolved	Total						
LC17M	UKM	9/12/06	0.03	0.03	ND	ND	ND	ND	ND	ND	ND	ND	ND
LC17M	UKM	11/26/06	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
LC17M	UKM	3/1/07	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
LC17M	UKM	5/4/07	0.05	0.05	ND	ND	0.01	ND	ND	ND	ND	ND	ND
LC20M	UKM	9/21/06	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
LC20M	UKM	11/22/06	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
LC20M	UKM	3/1/07	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
LC20M	UKM	5/4/07	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
LC23M	UKM	9/21/06	ND	ND	ND	ND	ND	ND	ND	ND	0.002	ND	ND
LC23M	UKM	11/26/06	ND	ND	ND	ND	ND	ND	ND	ND	0.002	ND	ND
LC23M	UKM	3/1/07	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
LC23M	UKM	5/3/07	ND	ND	ND	ND	ND	ND	ND	0.00	0.005	ND	ND
LC24M	UKM	9/21/06	0.32	0.32	ND	ND	ND	ND	ND	ND	0.002	ND	ND
LC24M	UKM	9/21/06	0.32	0.32	ND	ND	ND	ND	ND	ND	0.002	ND	ND
LC24M	UKM	11/26/06	0.16	0.16	ND	ND	ND	ND	ND	ND	0.002	ND	ND
LC24M	UKM	3/1/07	0.06	0.06	ND	ND	ND	ND	ND	ND	ND	ND	ND
LC24M	UKM	5/4/07	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
LC27M	UKM	9/26/06	0.15	0.15	ND	ND	ND	ND	ND	ND	ND	ND	ND
LC27M	UKM	11/16/06	0.08	0.08	ND	ND	ND	ND	ND	ND	ND	ND	ND
LC27M	UKM	3/1/07	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
LC27M	UKM	5/3/07	0.04	0.04	ND	ND	ND	ND	ND	ND	ND	ND	ND
LC28M	UKM	9/21/06	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
LC28M	UKM	11/26/06	0.04	0.04	ND	ND	ND	ND	ND	ND	ND	ND	ND
LC28M	UKM	2/28/07	ND	ND	ND	ND	0.01	ND	ND	ND	ND	ND	ND
LC28M	UKM	5/3/07	0.05	0.05	ND	ND	0.01	ND	ND	ND	0.002	ND	ND
MB-4	UKM	8/31/09	0.30	ND	ND	ND	ND	ND	ND	ND	0.016	ND	ND
MB-4	UKM	12/14/09	ND	ND	ND	ND	ND	ND	ND	ND	0.014	ND	ND

Attachment 2.7-1

Evaluation of Lost Creek Pump Tests - 2006

LOST CREEK
AQUIFER TEST ANALYSES

Prepared For:

Ur-Energy USA Inc

By:

Hydro-Engineering L.L.C.

March 2007

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APPENDICES

1.0 Introduction

A series of aquifer properties tests were conducted for the monitoring wells installed at the Lost Creek site. Three well groups were installed with: a well completed in the HJ ore sand, a well completed in the overlying LFG sand, and a well completed in the underlying UKM sand. In addition, shallow wells were completed in the DE sand at the east and west well groups, as well as the southeast corner of the permit area. Additional wells were completed in the HJ, LFG, and UKM sands to provide a distribution throughout the proposed mining area.

Single well tests were conducted by pumping individual wells while monitoring water levels within the well. The results and data for the single well tests are presented in Appendix A. Multi-well tests were conducted by pumping ore sand wells within each of the well groups while monitoring water levels within the pumping well and nearby observation wells. The results and data for the multi-well tests are presented in Appendix B.

The water levels were monitored using manual measurements with water-level meters and/or pressure transducers with recording by data loggers. Both submersible transducers attached to a surface data logger (vented INW, Druck, or Global transducers attached to a Starlogger data logger) or integrated transducer/logger combinations (Heron dipper-log) were used to monitor water levels within the well. The Heron dipper-log instruments are an absolute transducer and have an integrated correction for changes in barometric pressure using simultaneous barometric pressure monitoring with a companion instrument. The barometric pressure record was also used to correct the water level data during the multi-well tests for the confined aquifers and is included in Appendix C. For data collected prior to and between multi-well tests, an iterative adjustment in the barometric coefficient (in units of feet/inch Hg) was made to linearize the measured water level data as much as possible. In subsequent tabulations and figures, this barometric pressure adjusted data is indicated as corrected data. The convention utilized throughout this report is that drawdown is presented as a positive value in tables and figures, while water-level rise is presented as a negative number. The drawdown and recovery within the pumping well and observation wells was then evaluated to determine indicated aquifer properties by the techniques described in Appendix D.

2.0 Single Well Aquifer Test Results

Single well pump tests were conducted on selected FG, KM, and DE sand wells, as well as the HJ sand wells that were not included as the pumping well in a multi-well test. Both transducers and manual measurements were used to monitor water levels during single well tests. The straight-line method (see Appendix D) was used to determine the transmissivity of the aquifer during the testing.

2.1 HJ Sand Wells

Single well pump tests were conducted on HJ sand wells LC26M and LC27M. Well LC26M is located in the eastern mineralized area of the site, south of the fault, while LC27M is located in the northeastern corner of the site. Well LC26M is underreamed over an interval of approximately 55 feet and well LC27M is underreamed over an interval of approximately 23 feet.

2.1.1 Well LC26M

The results of the single well test of well LC26M are presented in Figure A.1-1 and Table A.1-1 of Appendix A. The straight-line method was used to determine transmissivity with both an early and late fit. The early discharge rate was 14.3 gpm with a resulting transmissivity of 1260 gal/day/ft. The late discharge rate declined slightly to 13.6 gpm with a resulting transmissivity of 1821 gal/day/ft. The late time transmissivity is thought to be the most representative. This transmissivity equates to a hydraulic conductivity of 4.4 feet/day. The downward deflection of the late time drawdown is thought to reflect contact with a higher transmissivity zone at a small distance from well LC26M.

2.1.2 Well LC27M

The results of the primary single well test of well LC27M are presented in Figure A.1-2 and Table A.1-2 of Appendix A. The straight-line method was used to determine transmissivity with both an early and late fit. The early discharge rate was 13 gpm with a resulting transmissivity of 2229 gal/day/ft. The late discharge rate declined slightly to 12.8 gpm with a resulting transmissivity of 1659 gal/day/ft. There was a minor slope inflection point at about 35 minutes after pump start that could reflect a minor boundary effect. However, the proximity of well LC27M to the fault and the offset of the fault in this area are unknown, so the impact of the fault on the aquifer properties is speculative. The late time transmissivity is thought to be the most representative. This transmissivity equates to a hydraulic conductivity of 9.6 feet/day.

2.1.3 Well LC27M – Alternate Test

The results of an earlier single well test of well LC27M are presented in Figure A.1-3 and Table A.1-3 of Appendix A. The discharge rate of 8.8 gpm was slightly smaller than that of the primary test, and the smaller stress rate gives slightly larger transmissivities. The early and late straight line fits give transmissivities of 2677 and 2013 gal/day/ft, respectively. The drawdown response also exhibited a slope inflection point similar to that described in Section 2.1.2.

2.2 LFG Sand Wells

Single well pump tests were conducted on LFG sand wells LC15M, LC18M, LC21M and LC25M. Wells LC15M, LC18M, and LC21M are located within the eastern, central and western well groups, respectively. Well LC25M is located approximately 700 feet south of the central well group.

2.2.1 Well LC15M

The results of the single well test of well LC15M are presented in Figure A.2-1 and Table A.2-1 of Appendix A. The straight-line method was used to determine transmissivity with fitting through the later data. With a discharge of 14.2 gpm, the calculated transmissivity is 302 gal/day/ft. With an underreamed interval of 54 feet, this transmissivity equates to a hydraulic conductivity of 0.75 feet/day.

2.2.2 Well LC18M – First Test

The results of the first single well test of well LC18M are presented in Figure A.2-2 and Table A.2-2 of Appendix A. The straight-line method was used to determine transmissivity with both an early and late fit. The early discharge rate was 13 gpm with a resulting transmissivity of 92 gal/day/ft. The late discharge rate was 8.8 gpm with a resulting transmissivity of 33 gal/day/ft. The small indicated transmissivity of the LFG sand in the vicinity of well LC18M resulted in rapid and dramatic drawdown that reduces the quality of the straight line fits. The early time transmissivity includes significant well storage effects, and the second test described in section 2.2.3 is considered a more reliable indicator of transmissivity.

2.2.3 Well LC18M – Second Test

The results of the second single well test of well LC18M are presented in Figure A.2-3 and Table A.2-3 of Appendix A. The straight-line method was used to determine transmissivity with a result of 62 gal/day/ft. This transmissivity is considered the best available value for well LC18M. With an underreamed interval of 42 feet, this transmissivity equates to a hydraulic conductivity of 0.20 feet/day.

2.2.4 Well LC21M

The results of the single well test of well LC21M are presented in Figure A.2-4 and Table A.2-4 of Appendix A. The straight-line method was used to determine transmissivity with both an early and late fit. The early discharge rate was 13.1 gpm with a resulting transmissivity of 174 gal/day/ft. The late discharge rate was also 13.1 gpm with a resulting transmissivity of 303 gal/day/ft. The slope of the early time straight line analysis is based on drawdown at two minutes and seventeen minutes after pump start, and the first point could be influenced by well storage. Therefore, the late time transmissivity is thought to be the most representative. With an underreamed interval of 23 feet, this transmissivity equates to a hydraulic conductivity of 1.76 feet/day.

2.2.5 Well LC25M

The results of the single well test of well LC25M are presented in Figure A.2-5 and Table A.2-5 of Appendix A. The straight-line method was used to determine transmissivity with both an early and late fit. The early discharge rate was 12 gpm with a resulting transmissivity of 117 gal/day/ft. The late discharge rate was 9.4 gpm with a resulting transmissivity of 212 gal/day/ft. The late time transmissivity is thought to be the most representative. With an underreamed interval of 33 feet, this transmissivity equates to a hydraulic conductivity of 0.86 feet/day.

2.3 UKM Sand Wells

Single well pump tests were conducted on UKM sand wells LC17M, LC20M, LC23M and LC24M. Wells LC17M, LC20M, and LC23M are located within the eastern, central and western well groups, respectively. Well LC24M is located approximately 384 feet north of the eastern well group.

2.3.1 Well LC17M

The results of the single well test of well LC17M are presented in Figure A.3-1 and Tables A.3-1 and A.3-2 of Appendix A. The straight-line method was used to determine transmissivity with both an early and late fit. The early discharge rate was 13 gpm with a resulting transmissivity of 679 gal/day/ft. The late discharge rate was 13 gpm with a resulting transmissivity of 195 gal/day/ft. There were a limited number of data points for the late time fit which makes it less reliable than the early time fit. With an underreamed interval of 36 feet, the early time transmissivity equates to a hydraulic conductivity of 2.5 feet/day.

2.3.2 Well LC20M

The results of the single well test of well LC20M are presented in Figure A.3-2 and Tables A.3-3 and A.3-4 of Appendix A. The straight-line method was used to determine transmissivity with both an early and late fit. The early discharge rate was 12.5 gpm with a resulting transmissivity of 858 gal/day/ft. The late discharge rate was 12 gpm with a resulting transmissivity of 520 gal/day/ft. The inflection point at approximately 60 minutes after pump start likely represents the boundary effect of the fault. The early time transmissivity is thought to be the most representative of aquifer properties, while the late time transmissivity reflects the boundary effect. With an underreamed interval of 32 feet, the early time transmissivity equates to a hydraulic conductivity of 3.6 feet/day.

2.3.3 Well LC23M

The results of the single well test of well LC23M are presented in Figure A.3-3 and Tables A.3-5 and A.3-6 of Appendix A. The straight-line method was used to determine transmissivity with a result of 583 gal/day/ft. With an underreamed interval of 35 feet, this transmissivity equates to a hydraulic conductivity of 2.2 feet/day.

2.3.4 Well LC24M

The results of the single well test of well LC24M are presented in Figure A.3-4 and Table A.3-7 of Appendix A. The straight-line method was used to determine transmissivity with a result of 561 gal/day/ft. With an underreamed interval of 53 feet, this transmissivity equates to a hydraulic conductivity of 1.4 feet/day.

2.4 DE Sand Wells

Single well pump tests were conducted on DE sand wells LC29M, LC30M, and LC31M. Wells LC29M and LC30M are located within the eastern and western well groups, respectively. Well LC31M is located in the southwest corner of the permit area.

2.4.1 Well LC29M

The results of the single well test of well LC29M are presented in Figure A.4-1 and Table A.4-1 of Appendix A. The straight-line method was used to determine transmissivity with a result of 10 gal/day/ft. The saturation at well LC29M is very limited and the production rate is very small. The sustainable pumping rate is a small fraction of a gpm.

2.4.2 Well LC30M – First Test

The results of the first single well test of well LC30M are presented in Figure A.4-2 and Table A.4-2 of Appendix A. The straight-line method was used to determine transmissivity with a result of 231 gal/day/ft and a discharge rate of 2.7 gpm. With a screened interval of 40 feet, this transmissivity equates to a hydraulic conductivity of 0.77 feet/day.

2.4.3 Well LC30M – Second Test

The results of the second single well test of well LC30M are presented in Figure A.4-3 and Table A.4-3 of Appendix A. The straight-line method was used to determine transmissivity with a result of 573 gal/day/ft and a discharge rate of 7 gpm. The transmissivity for the second test of well LC30M is considered more representative than the first test because of a higher stress rate. With a screened interval of 40 feet, this transmissivity equates to a hydraulic conductivity of 1.9 feet/day.

2.4.4 Well LC31M

The results of the single well test of well LC31M are presented in Figure A.4-4 and Table A.4-4 of Appendix A. The straight-line method was used to determine transmissivity with a result of 1098 gal/day/ft. With a screened interval of 40 feet, this transmissivity equates to a hydraulic conductivity of 3.7 feet/day.

3.0 Multi-Well Aquifer Test Results

Multi-well pump tests were conducted by pumping the HJ ore sand wells in each of the well groups while monitoring water levels in the pumping well and nearby observation wells. Both transducers and manual measurements were used to monitor water levels during multi-well tests. The straight-line method and Theis recovery method (see Appendix D) were used to determine the transmissivity of the aquifer during the testing. The observation wells included nearby HJ sand wells and adjacent aquifer wells (LFG and UKM sands). The radius to observation wells is an important factor in evaluating hydraulic communication between the pumping well and observation wells. Table 3-1 presents a composite tabulation of locations and radii between the pumping wells and other wells on the site.

Table 3-1. Lost Creek Well Locations and Distances

Well	Northing (feet)	Easting (feet)	Measuring Point Elevation (ft above MSL)	Radius to Well LC16M (feet)	Radius to Well LC19M (feet)	Radius to Well LC22M (feet)
LC15M	534823	744546	6890.27	16	1268	8487
LC16M	534820	744562	6890.13	0	1284	8502
LC17M	534840	744562	6890.61	20	1276	8505
LC18M	535318	743362	6902.80	1299	16	7489
LC19M	535317	743378	6903.75	1284	0	7503
LC20M	535332	743377	6904.14	1291	15	7507
LC21M	532850	736277	6880.78	8516	7517	15
LC22M	532850	736292	6879.68	8502	7503	0
LC23M	532835	736292	6880.42	8505	7508	15
LC24M	535203	744580	6898.07	384	1207	8615
LC25M	534621	743406	6890.15	1174	697	7331
LC26M	534832	748203	6908.97	3641	4849	12075
LC27M	539018	753260	6965.56	9657	10552	18054
LC28M	524437	733364	6758.59	15271	14787	8908
LC29M	534837	744547	6890.64	23	1264	8491
LC30M	532836	736276	6881.02	8520	7523	21
LC31M	524434	733380	6759.13	15262	14779	8906

With the installation of transducers in the drawdown tube of many wells, the reference water level measurements were taken relative to other locations such as the discharge pipe. It was also necessary to lift the caps on several wells to install transducers. Therefore, depth to water tabulations generally correspond to a point other than the surveyed measuring point elevation, and should only be used for evaluating relative water level changes.

There were significant barometric pressure changes during the multi-well tests. For the observation wells where there was no discernable drawdown response, it was necessary to make barometric pressure corrections to the water-level data to remove or mute the effects of barometric pressure changes. The method for determining the barometric pressure coefficient included plotting of transducer water-level data prior to and between multi-well tests. An interactive graphical program was then used to iteratively adjust the barometric pressure coefficient until the corrected data was linearized as much as possible. For those wells where appropriate transducer data was not available, a typical barometric pressure coefficient of 0.5 feet/inch Hg was used. Table 3-2 presents the barometric pressure coefficients for the multi-well tests.

Table 3-2. Barometric Pressure Coefficents

Well	Barometric Pressure Coefficient (feet/inch Hg)
LC15M	0.35
LC16M	0.40
LC17M	0.35
LC18M	0.50
LC19M	0.50
LC20M	0.50
LC21M	0.40
LC22M	0.40
LC23M	0.40
LC24M	0.50
LC25M	0.40
LC26M	0.40
LC28M	0.40

The recovery period for the multi-well tests was sufficient that there was over 98% recovery in the pumping well prior to the start of the next test.

3.1 Central Well Group Test #1

The first multi-well test of the central well group was conducted by pumping well LC19M for a period of approximately 10 hours and 42 minutes beginning at 14:28 on 10/26/06. The observation wells included: HJ sand wells LC16M, LC22M, and LC26M; LFG sand wells LC18M, LC25M, and LC15M; and UKM sand wells LC20M, LC17M, and LC24M. The data and analyses for this multi-well test are included in Section B.1 of Appendix B.

3.1.1 Pumping Well LC19M

The drawdown response in well LC19M is presented in Figure B.1-1 of Appendix B and the aquifer test data are presented in Tables B.1-1 and B.1-2 of Appendix B. The straight-line method was used to determine transmissivity with both an early and late fit as presented in Figure B.1-2. The early discharge rate was 18.8 gpm with a resulting transmissivity of 1039 gal/day/ft. The late discharge rate declined slightly to 17.6 gpm with a resulting transmissivity of 553 gal/day/ft. The slope inflection point at approximately 150 minutes after the pump start indicates that a boundary (the fault) was encountered and that the fault is generally acting as a barrier to flow. The early time transmissivity is more representative of formation hydraulic properties, while the late time transmissivity illustrates the impact of the fault with an approximate doubling of the straight-line slope. The early time transmissivity equates to a hydraulic conductivity of 2.7 feet/day for an underreamed interval of 51 feet.

The analysis of recovery data for pumping well LC19M is presented in Figure B.1-3. There was a gradual increase in slope that likely reflects the influence of the boundary imposed by the fault. A single fit was utilized to calculate an intermediate transmissivity of 719 gal/day/ft. The drawdown analysis is considered more reliable and more clearly indicates the presence of the boundary. While the recovery analysis is affected by the presence of the boundary, the calculated transmissivity generally supports the results of the drawdown analysis.

3.1.2 Observation Wells

The ore sand (HJ) observation wells included LC16M, LC22M and LC26M. The water-level changes during the first central well test for these three observation wells are presented in Appendix B Figure B.1-4 along with the barometric pressure during the test. The water-level data for observation well LC16M are presented in Tables B.1-3 and B.1-4. The water-level data for observation well LC22M are presented in Table B.1-5. The water-level data for observation well LC26M are presented in Tables B.1-6 and B.1-7.

The total magnitude of the corrected water-level changes in observation wells LC16M, LC22M and LC26M over the pre-test through recovery period was on the order of 0.1 feet or less. There was no discernable drawdown in the HJ sand observation wells during the test. Wells LC16M, LC22M and LC26M are located on the south side of the fault while pumping well LC19M is located north of the fault. Of the three HJ sand observation wells, only well LC16M is located close enough to the pumping well (1284 feet) to potentially show drawdown. No drawdown was observed in well LC16M and the drawdown response in the pumping well indicated that the fault was acting as a barrier.

The overlying sand (LFG) observation wells included LC18M, LC25M and LC15M. The water-level changes during the first central well test for these three observation wells are presented in Appendix B Figure B.1-5. The water-level data for observation well LC18M are presented in Tables B.1-8 and B.1-9. The water-level data for observation well LC25M are presented in Tables B.1-10 and B.1-11. The water-level data for observation well LC15M are presented in Tables B.1-12 and B.1-13.

The total magnitude of the corrected water-level changes in observation wells LC18M, LC25M and LC15M over the pre-test through recovery period was on the order of 0.2 feet or less. There was a very small inverted response (water-level rise – see Figure B.1-5) in well LC18M shortly after the pump start, and this was followed by a minor water-level drop near the pump stop time. Well LC18M is located approximately 16 feet from pumping well LC19M. The minor apparent inverted response is a phenomenon that has been observed during other aquifer properties testing at other sites, but, in this case, the magnitude is small enough that no analysis is warranted. Following the inverted response, the water level changes in the well appeared to revert to a small pre-existing trend of gradual water-level decline through late October. Water levels in observation wells LC25M and LC15M exhibited similar pre-existing trends with no discernable response to the pumping of well LC19M. Wells LC25M and LC15M are on the south side of the fault while pumping well LC19M is located north of the fault. The results indicate no significant hydraulic communication between the LFG sand and the HJ sand in the vicinity of the pumping and observation wells.

The underlying sand (UKM) observation wells included LC20M, LC17M and LC24M. The water-level changes during the first central well test for these three observation wells are presented in Appendix B Figure B.1-6. The water-level data for observation well LC20M are presented in Tables B.1-14 and B.1-15. The water-level data for observation well LC17M are presented in Table B.1-16. The water-level data for observation well LC24M are presented in Table B.1-17.

The total magnitude of the corrected water-level changes in observation wells LC20M, LC17M and LC24M over the pre-test through recovery period was on the order of 0.2 feet or less. Like well LC18M, there was a very small inverted response (water-level rise – see Figure B.1-6) in well LC20M shortly after the pump start, and this was followed by a minor water-level drop near the pump stop time. Well LC20M is located approximately 15 feet from pumping well LC19M. Like that of well LC18M, the magnitude of the response is so small no analysis is warranted.

Following the inverted response, the water-level changes in the well appeared to revert to relatively stable water level. Wells LC17M and LC24M are located across the fault from the pumping well and water levels did not respond to the pumping in well LC19M.

3.2 Central Well Group Test #2

The second multi-well test of the central well group was conducted by pumping well LC19M for a period of approximately 25 hours and 30 minutes beginning at 12:54 on 11/02/06. The observation wells included: HJ sand wells LC16M, LC22M, and LC26M; LFG sand wells LC18M, LC25M, and LC15M; and UKM sand wells LC20M, LC17M, and LC24M. The data and analyses for this multi-well test are included in Section B.2 of Appendix B.

3.2.1 Pumping Well LC19M

The drawdown response in well LC19M is presented in Figure B.2-1 of Appendix B and the aquifer test data are presented in Tables B.2-1 and B.2-2 of Appendix B. The straight-line method was used to determine transmissivity with both an early and late fit as presented in Figure B.2-2. The early discharge rate was 18.8 gpm with a resulting transmissivity of 1042 gal/day/ft. The late discharge rate declined slightly to 17.6 gpm with a resulting transmissivity of 590 gal/day/ft. Like the first central well group test, a slope inflection point occurred at approximately 150 minutes after the pump start and indicates that a boundary (the fault) was encountered and that the fault is generally acting as a barrier to flow. The early time transmissivity is more representative of formation hydraulic properties, while the late time transmissivity illustrates the impact of the fault with an approximate doubling of the straight-line slope. The early time transmissivity equates to a hydraulic conductivity of 2.7 feet/day for an underreamed interval of 51 feet.

The analysis of recovery data for pumping well LC19M is presented in Figure B.2-3. There was a gradual increase in slope that likely reflects the influence of the boundary imposed by the fault. Both a late and early recovery transmissivity (503 gal/day/ft and 773 gal/day/ft, respectively) were calculated with results that generally supported the transmissivities calculated in the drawdown analysis. The drawdown analysis is considered more reliable and more clearly indicates the presence of the boundary, while the recovery analysis also reflects the effects of the boundary.

3.2.2 Observation Wells

The ore sand (HJ) observation wells included LC16M, LC22M and LC26M. The water-level changes during the second central well test for these three observation wells are presented in Appendix B Figure B.2-4 along with the barometric pressure during the test. The water-level data for observation well LC16M are presented in Tables B.2-3 and B.2-4. The water-level data for observation well LC22M are presented in Table B.2-5. The water-level data for observation well LC26M are presented in Tables B.2-6 and B.2-7.

The total magnitude of the corrected water-level changes in observation wells LC16M, LC22M and LC26M over the pre-test through recovery period was on the order of 0.1 feet or less. There was no discernable drawdown in the HJ sand observation wells during the test. Wells LC16M, LC22M and LC26M are located on the south side of the fault while pumping well LC19M is located north of the fault. Of the three HJ sand observation wells, only well LC16M is located close enough to the pumping well (1284 feet) to potentially show drawdown. No drawdown was observed in well LC16M, but the duration of the pumping was sufficient to have caused drawdown at the observation well if there were no barrier present. The Theis equation was used to predict drawdown at observation well LC16M after 1540 minutes of pumping at well LC19M. This prediction presumes a homogenous, isotropic, and continuous aquifer and utilized a plausible range of storage coefficient ranging from 2.0E-04 to 5.0E-05. The predicted drawdown ranged from 0.9 feet to approximately 3.0 feet. This further illustrates that fault is acting as a barrier to ground-water flow.

The overlying sand (LFG) observation wells included LC18M, LC25M and LC15M. The water-level changes these three observation wells are presented in Appendix B Figure B.2-5. The water-level data for observation well LC18M are presented in Tables B.2-8 and B.2-9. The water-level data for observation well LC25M are presented in Tables B.2-10 and B.2-11. The water-level data for observation well LC15M are presented in Tables B.2-12 and B.2-13.

The total magnitude of the corrected water-level changes in observation wells LC18M, LC25M and LC15M over the pre-test through recovery period was on the order of 0.3 feet or less. Like the first central well group test, there was a very small inverted response (water-level rise – see Figure B.2-5) in well LC18M shortly after the pump start, and this was followed by a minor water-level drop near the pump stop time. Following the inverted response, the water level changes in the well appeared to revert to a small pre-existing trend of gradual water-level decline. The extended periods of relatively steady water levels before and after the pumping period indicate that there is very little hydraulic communication between the LFG sand and the HJ sand. This was also true for observation wells LC25M and LC15M.

The underlying sand (UKM) observation wells included LC20M, LC17M and LC24M. The water-level changes for these three observation wells are presented in Appendix B Figure B.2-6. The water-level data for observation well LC20M are presented in Tables B.2-14 and B.2-15. The water-level data for observation well LC17M are presented in Table B.2-16. The water-level data for observation well LC24M are presented in Table B.2-17.

The total magnitude of the corrected water-level changes in observation wells LC20M, LC17M and LC24M over the pre-test through recovery period was on the order of 0.2 feet or less. Like well LC18M, there was a very small inverted response (water-level rise – see Figure B.2-6) in well LC20M shortly after the pump start, and this was followed by a minor water-level drop near the pump stop time. Well LC20M is located approximately 15 feet from pumping well LC19M. Like that of well LC18M, the magnitude of the response is so small no analysis is warranted. Following the inverted response, the water-level changes in the well appeared to revert to a relatively stable water level. Wells LC17M and LC24M are located across the fault from the pumping well and water levels did not respond to the pumping in well LC19M.

3.3 East Well Group Test

The multi-well test of the east well group was conducted by pumping well LC16M for a period of approximately 19 hours and 50 minutes beginning at 15:10 on 11/08/06. There were some dramatic fluctuations in the pumping well water levels near the end of the test as a result of generator voltage fluctuations. Well LC16M was also pumped for 34 minutes on 11/09/06 to obtain a water sample. The observation wells included: HJ sand wells LC19M, LC26M, and LC22M; LFG sand wells LC18M, LC25M, and LC15M; and UKM sand wells LC20M, LC17M, and LC24M. The data and analyses for this multi-well test are included in Section B.3 of Appendix B.

3.3.1 Pumping Well LC16M

The drawdown response in well LC16M is presented in Figure B.3-1 of Appendix B and the aquifer test data are presented in Tables B.3-1 and B.3-2 of Appendix B. The straight-line method was used to determine transmissivity with both an early and late fit as presented in Figure B.3-2. The early discharge rate was 15 gpm with a resulting transmissivity of 594 gal/day/ft. The late discharge rate was also 15 gpm with a resulting transmissivity of 818 gal/day/ft. The inflection point between the two slope fits occurred between 100 and 200 minutes after pump start with a significant flattening of the late time slope. This indicates contact with a zone of higher transmissivity near the pumping well. This higher indicated transmissivity could reflect the presence of fractured or enhanced permeability materials adjacent to the fault. It could also reflect an increased sand thickness or more permeable HJ sand near the well. The early time transmissivity is more representative of aquifer properties in the immediate vicinity of the pumping well, while the late time transmissivity is more reflective of regional aquifer properties at a greater distance from the well. The early time transmissivity equates to a hydraulic conductivity of 1.4 feet/day for an underreamed interval of 57 feet.

The analysis of recovery data for pumping well LC16M is presented in Figure B.3-3. There was a fairly abrupt change in slope that likely reflects the influence of the boundary imposed by the fault. There were also some dramatic swings in drawdown that reflect the intermittent generator operation near the end of the test and the brief period of pumping for sample following the test. Both a late and early recovery transmissivity (365 gal/day/ft and 769 gal/day/ft, respectively) were calculated with results that generally supported the transmissivities calculated in the drawdown analysis. The drawdown analysis is considered more reliable than the recovery analysis.

3.3.2 Observation Wells

The ore sand (HJ) observation wells included LC19M, LC26M and LC22M. The water-level changes during the east test for these three observation wells are presented in Appendix B Figure B.3-4 along with the barometric pressure during the test. The water-level data for observation well LC16M are presented in Tables B.3-3 and B.3-4. The water-level data for observation well LC26M are presented in Tables B.3-5 and B.3-6. The water-level data for observation well LC22M are presented in Table B.3-7.

The total magnitude of the corrected water-level changes in observation wells LC26M and LC22M over the pre-test through recovery period was on the order of 0.2 feet or less. There was an ongoing recovery trend in well LC19M from the previous pumping. There was no discernable drawdown in the HJ sand observation wells during the test. Pumping well LC16M and observation wells LC22M and LC26M are located on the south side of the fault while observation well LC19M is located north of the fault. Of the three HJ sand observation wells, only well LC19M is located close enough to the pumping well (1284 feet) to potentially show drawdown. As with the second central well group test, no drawdown was observed in HJ sand well located across the fault. This supports the previous analyses that indicate the fault is acting generally as a barrier to ground-water flow.

The overlying sand (LFG) observation wells included LC18M, LC25M and LC15M. The water-level changes for these three observation wells are presented in Appendix B Figure B.3-5. The water-level data for observation well LC18M are presented in Tables B.3-8 and B.3-9. The water-level data for observation well LC25M are presented in Tables B.3-10 and B.3-11. The water-level data for observation well LC15M are presented in Tables B.3-12 and B.3-13.

The total magnitude of the corrected water-level changes in observation wells LC25M and LC15M over the pre-test through recovery period was on the order of 0.2 feet or less. Since well LC18M is located across the fault from the pumping well, monitoring of this well was discontinued. There was a very small inverted response (water-level rise – see Figure B.3-5) in well LC15M shortly after the pump start, and this was followed by a minor water-level drop near the pump stop time. This response is similar to that observed for nearby LFG sand wells during the first and second central well group tests. The extended periods of relatively steady water levels in wells LC25M and LC15M before and after the pumping period indicate that there is very little hydraulic communication between the LFG sand and the HJ sand.

The underlying sand (UKM) observation wells included LC20M, LC17M and LC24M. The water-level changes for these three observation wells are presented in Appendix B Figure B.3-6. The water-level data for observation well LC20M are presented in Tables B.3-14 and B.3-15. The water-level data for observation well LC17M are presented in Tables B.3-16 and B.3-17. The water-level data for observation well LC24M are presented in Tables B.3-18 and B.3-19.

The total magnitude of the corrected water-level changes in observation wells LC20M, LC17M and LC24M over the pre-test through recovery period was on the order of 0.2 feet or less. Well LC17M is located approximately 20 feet from pumping well LC16M, and there was no significant drawdown during the pumping. There was a gradual and minor water-level decline after the pumping period, but thereafter the corrected water level was relatively steady for several days. This is interpreted as no measurable response in well LC17M to the pumping in well LC16M. Water levels in wells LC17M and LC24M did not respond to the pumping in well LC19M.

3.4 West Well Group Test

The multi-well test of the west well group was conducted by pumping well LC22M for a period of approximately 45 hours beginning at 12:30 on 11/15/06. There were some minor fluctuations in the pumping well water levels near the end of the test as a result of discharge rate adjustments during sampling. The observation wells included: HJ sand wells LC16M and LC28M; LFG sand wells LC21M and LC15M; and UKM sand wells LC23M, LC17M, and LC20M. The data and analyses for this multi-well test are included in Section B.4 of Appendix B.

3.4.1 Pumping Well LC22M

The drawdown response in well LC22M is presented in Figure B.4-1 of Appendix B and the aquifer test data are presented in Tables B.4-1 and B.4-2 of Appendix B. The straight-line method was used to determine transmissivity with both an early and late fit as presented in Figure B.4-2. The early discharge rate was 12 gpm with a resulting transmissivity of 329 gal/day/ft. The late discharge rate was 11.5 gpm with a resulting transmissivity of 3007 gal/day/ft. There was not a distinct inflection point in the drawdown response, and the late time slope appears to indicate recharge or contact with a dramatically higher transmissivity zone. The gradual "laying over" of the drawdown curve is typical of a leaky aquifer response. However, there was no significant drawdown in adjacent LFG sand well LC21M or UKM sand well LC23M. The degree of leakage indicated by the drawdown response is also much greater than would be expected with a typical leaky aquitard. It is postulated that the internal confining layers within the HJ sand are discontinuous, more permeable, or absent in the vicinity of the west well group. This could produce the indicated recharge or leakage in the response in Figure B.4-2. It is also possible that there is a significantly more permeable material in the vicinity of the well that produced the observed response. The early time transmissivity is considered more representative of aquifer properties in the immediate vicinity of the pumping well, while the late time transmissivity is more reflective of regional aquifer properties at a greater distance from the well. The early time transmissivity equates to a hydraulic conductivity of 0.5 feet/day for an underreamed interval of 81 feet. However, the dramatically greater transimissivity for the late time fit should be more representative of the regional aquifer properties.

The analysis of recovery data for pumping well LC22M is presented in Figure B.4-3. The calculated recovery transmissivity of 1605 gal/day/ft falls between the values calculated in the drawdown analysis. The recovery analysis is compromised by the apparent recharge/leakage during pumping.

3.4.2 Observation Wells

The ore sand (HJ) observation wells included LC16M and LC28M. The water-level changes for these three observation wells are presented in Appendix B Figure B.4-4 along with the barometric pressure during the test. The water-level data for observation well LC16M are presented in Tables B.4-3 and B.4-4. The water-level data for observation well LC28M are presented in Tables B.4-5 and B.4-6.

There was no significant water-level change in wells LC16M and LC28M as a result of pumping in well LC22M. Well LC16M was still in recovery from the previous east well group test, but there was no significant change in the recovery trend. Both well LC16M and LC28M are located more than a mile from the pumping well, so the potential for measurable drawdown at these observation wells is extremely small.

The overlying sand (LFG) observation wells included LC21M and LC15M. The water-level changes for these observation wells are presented in Appendix B Figure B.4-5. The water-level data for observation well LC21M are presented in Tables B.4-7 and B.4-8. The water-level data for observation well LC15M are presented in Tables B.4-9 and B.4-10.

The total magnitude of the corrected water-level changes in observation wells LC21M and LC15M over the pre-test through pumping period was on the order of 0.2 feet or less. There was no significant water-level change in well LC21M as a result of pumping in adjacent well LC22M. The abrupt water-level change in well LC15M following the west well group test (see Figure B.4-5) was caused by an adjustment in the transducer setting in preparation for a single well test.

The underlying sand (UKM) observation wells included LC20M, LC17M and LC24M. The water-level changes for these three observation wells are presented in Appendix B Figure B.3-6. The water-level data for observation well LC20M are presented in Tables B.3-14 and B.3-15. The water-level data for observation well LC17M are presented in Tables B.3-16 and B.3-17. The water-level data for observation well LC24M are presented in Tables B.3-18 and B.3-19.

The total magnitude of the corrected water-level changes in observation wells LC23M, LC17M and LC20M over the pre-test through recovery period was on the order of 0.2 feet or less. Well LC23M is located approximately 15 feet from pumping well LC22M, and although there was a small water-level decline during the test that lasted several days after the test, the magnitude is so small that it is indistinguishable from pre-existing trends and natural fluctuations. No significant change in water level was observed in wells LC17M and LC20M.

4.0 Previous Testing

Multi-well pump tests were conducted by Hydro-Search, Inc. (1982). The primary tests were performed by pumping wells completed across the entire HJ sand for periods of approximately one day. The transmissivities determined from the testing in 1982 were generally similar to those produced with the 2006 testing with consideration of the completion intervals. The 1982 testing also indicated that no significant water-level changes occurred in the overlying (LFG) and underlying (UKM) sands with pumping in the HJ ore sand. The typical storage coefficient measured during this testing was 5E-04 for the expanded completion. Hydro-Search, Inc. (1982) indicates that the fault did not act as a boundary. However, the testing included ore sand observation wells on both sides of the fault, and there was no drawdown in the HJ sand observation well located on the opposite side of the fault despite the fact that it was closer to the pumping well. There was significant drawdown in the more distant HJ sand observation well on the same side of the fault as the pumping well. There were also indications of a boundary effect in the pumping well drawdown. This combination of factors indicates that the fault acted as a barrier during the 1982 testing.

5.0 Summary

The aquifer properties testing indicates that the HJ ore sand has a relatively high transmissivity and generally large potential well yields. The fault is generally acting as a barrier to ground-water flow and this has a profound effect on the apparent transmissivity for wells near the fault. Measured transmissivity of the HJ sand wells ranged from 302 to 3007 gal/day/ft, with a typical expected transmissivity of 1000 gal/day/ft in the central ore-bearing area. Table 5-1 presents a summary of the aquifer properties testing.

Table 5-1. Aquifer Properties Testing Summary

Well	Straight Line Transmissivity (gal/day/ft)	Early Straight Line Transmissivity (gal/day/ft)	Late Straight Line Transmissivity (gal/day/ft)	Theis Recovery Transmissivity (gal/day/ft)	Early Recovery Transmissivity (gal/day/ft)	Late Recovery Transmissivity (gal/day/ft)
HJ Sand						
LC16M	----	594	818	----	769	365
LC19M - 1st	----	1039	553	719	----	---
LC19M - 2nd	----	1042	590	----	773	503
LC22M	----	329	3007	1605	----	---
LC26M	----	1260	1821	----	----	---
LC27M -Primary	----	2229	1659	----	----	---
LC27M -Alternate	----	2677	2013	----	----	---
LFG Sand						
LC15M	302	----	----	----	----	---
LC18M - 1st	----	92	33	----	----	---
LC18M - 2nd	62	----	----	----	----	---
LC21M	----	174	303	----	----	---
LC25M	----	117	212	----	----	---
UKM Sand						
LC15M	----	679	195	----	----	---
LC18M - 1st	----	858	520	----	----	---
LC18M - 2nd	583	----	----	----	----	---
LC21M	561	----	----	----	----	---
UKM Sand						
LC15M	10	----	----	----	----	---
LC18M - 1st	231	----	----	----	----	---
LC18M - 2nd	573	----	----	----	----	---
LC21M	1098	----	----	----	----	---

There was a pattern observed during the testing of the HJ sand wells at the Lost Creek site. Wells north of the fault (LC19M and LC27M) exhibited an increase in the later straight-line slope which indicates a boundary effect. The increase in slope was more dramatic with proximity to the fault. Wells south of the fault (LC16M and LC26M) exhibited a decrease in the later straight-line slope which indicates contact with a higher transmissivity zone. This was attributed to a higher permeability zone south of the fault and paralleling the fault. For the areas adjacent to the fault, the boundary effect of the fault will produce a cone of depression that is elongated parallel to the fault when a pumping stress is applied. Appendix D presents a methodology for calculation of directional transmissivity. Future testing with additional HJ sand observation wells may allow evaluation of apparent directional transmissivity due to an enhanced permeability zone paralleling the fault.

Multi-well pump tests conducted by Hydro-Search, Inc. (1982) indicated a storage coefficient of 5E-04 for a completion across the HJ sand. When adjusted for the ore-zone completion, this corresponds to an expected storage coefficient of approximately 1.7E-04. A general rule of thumb for sandstone predicts the storage coefficient as the product of the completion interval in feet and 1E-06 with a result of 5E-05 for the typical Lost Creek completion. These storage coefficients are expected to bracket the expected storage coefficient for the site.

The transmissivity of the LFG sand is dramatically smaller than that of the HJ sand with a measured range of 33 to 303 gal/day/ft. There does not appear to be any significant vertical communication between the LFG sand and the HJ sand. The central well group multi-well tests utilized well LC25M as an LFG sand observation well on the opposite side of the fault to test potential communication between adjacent sands due to the offset in the fault. There was no measurable water-level change in the LFG sand well LC25M during these tests.

The transmissivity of the UKM sand is modestly smaller than that of the HJ sand with a measured range of 195 to 858 gal/day/ft. There was an indicated boundary effect due to the fault in the testing of well LC20M. There does not appear to be any significant vertical communication between the UKM sand and the HJ sand. The east well group multi-well test utilized wells LC24M and LC17M as UKM sand observation wells on the opposite side of the fault to test potential communication between adjacent sands due to the offset in the fault. There was no measurable water-level change in the UKM sand wells during this test.

The transmissivity of the DE sand appears to be primarily a function of the thickness of the saturation or the confining head. The thickness of saturation at the easternmost well LC29M is very small and the calculated transmissivity is very limited at 10 gal/day/ft. With increasing distance to the west and south, the degree of confinement increases and the measured transmissivity increases to 1098 gal/day/ft at well LC31M.

6.0 Reference

Hydro-Search Inc. 1982, 1982 Hydrogeology Program For The Conoco/Lost Creek Uranium Project. Consultant's report prepared for Texasgulf, Inc.

APPENDIX A

SINGLE WELL AQUIFER TEST RESULTS

Sections

A.1 HJ Sand Wells

A.2 LFG Sand Wells

A.3 UKM Sand Wells

A.4 DE Sand Wells

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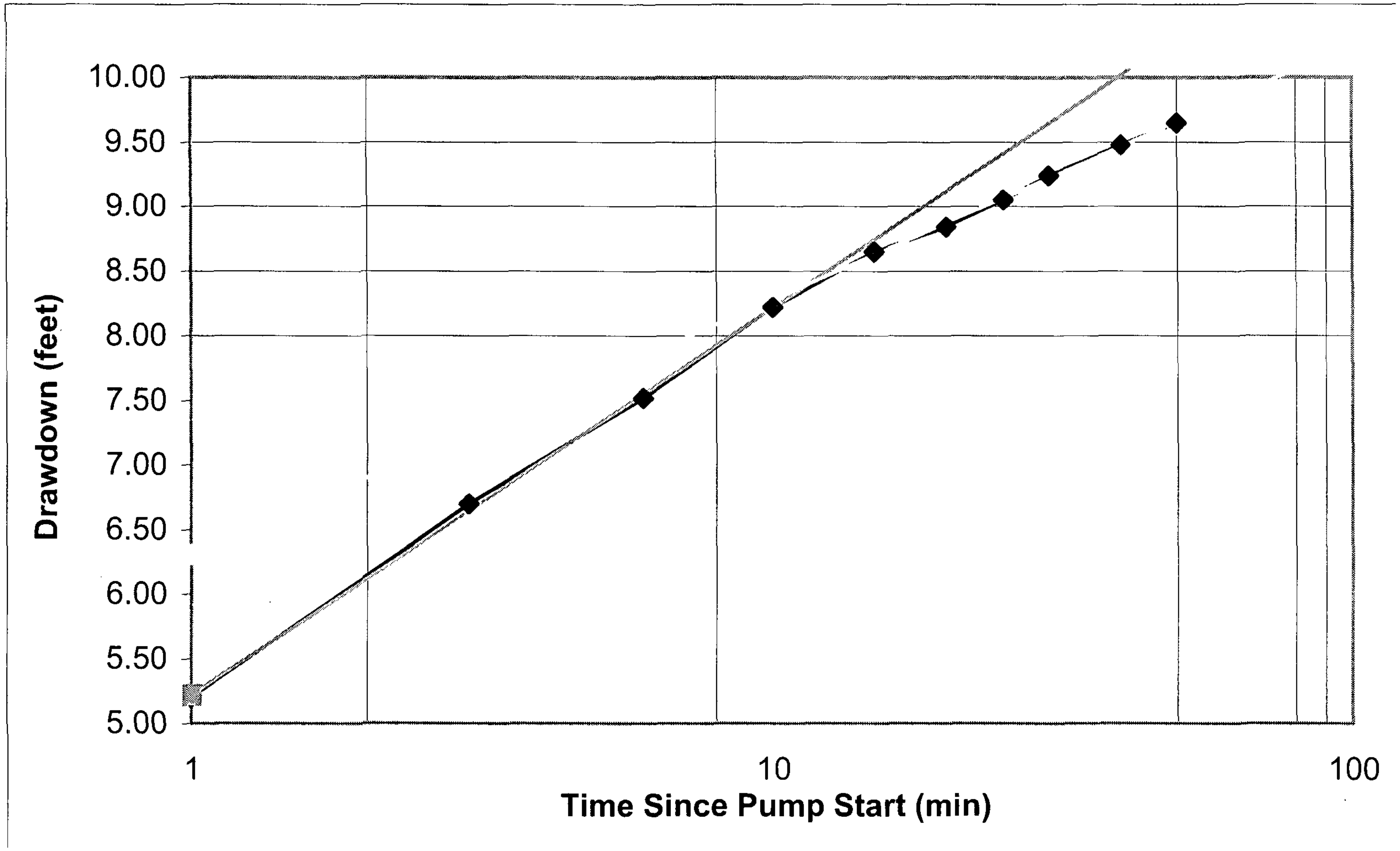
Section A.1 - HJ Sand Wells

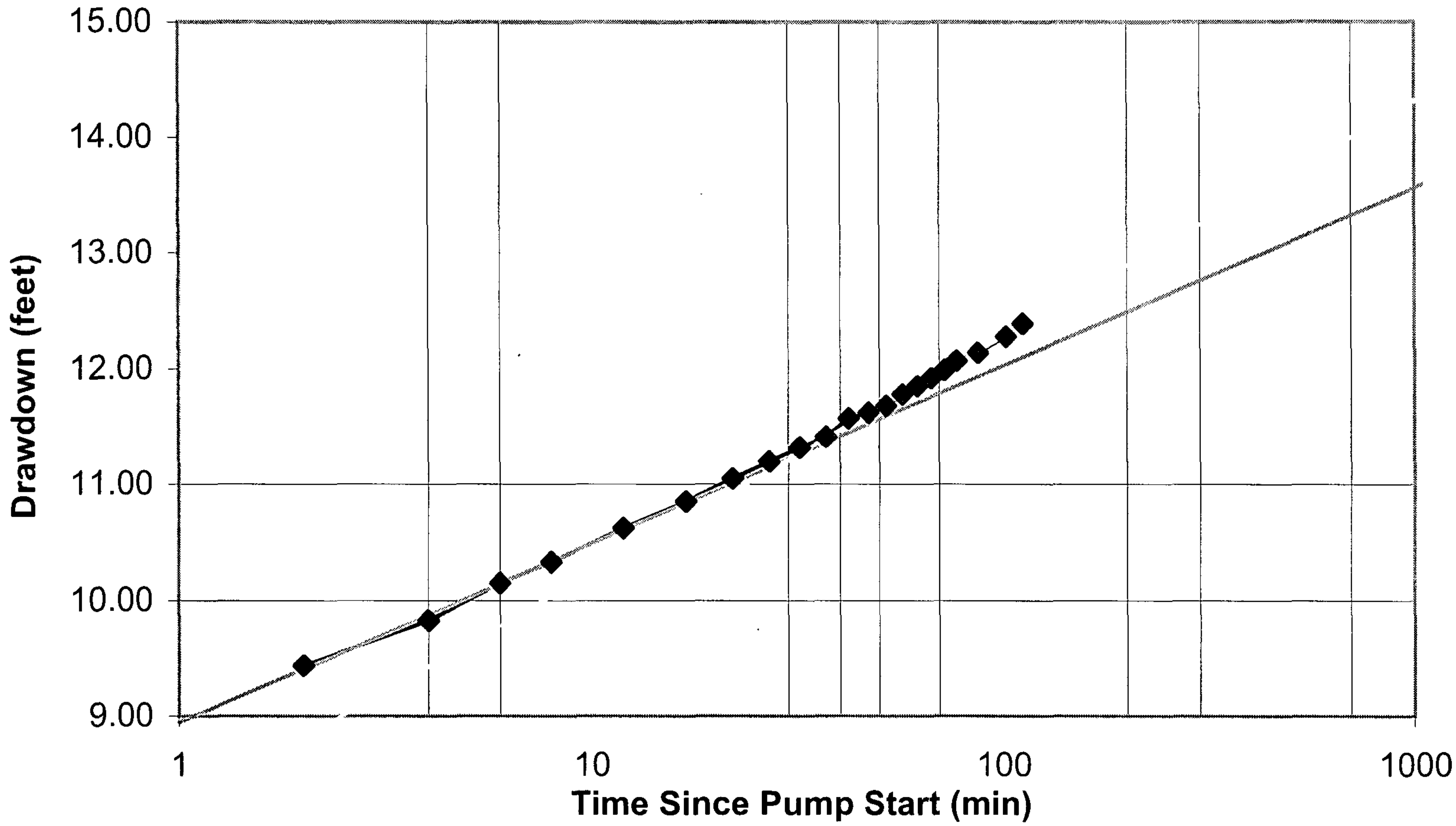
FIGURES

TABLES



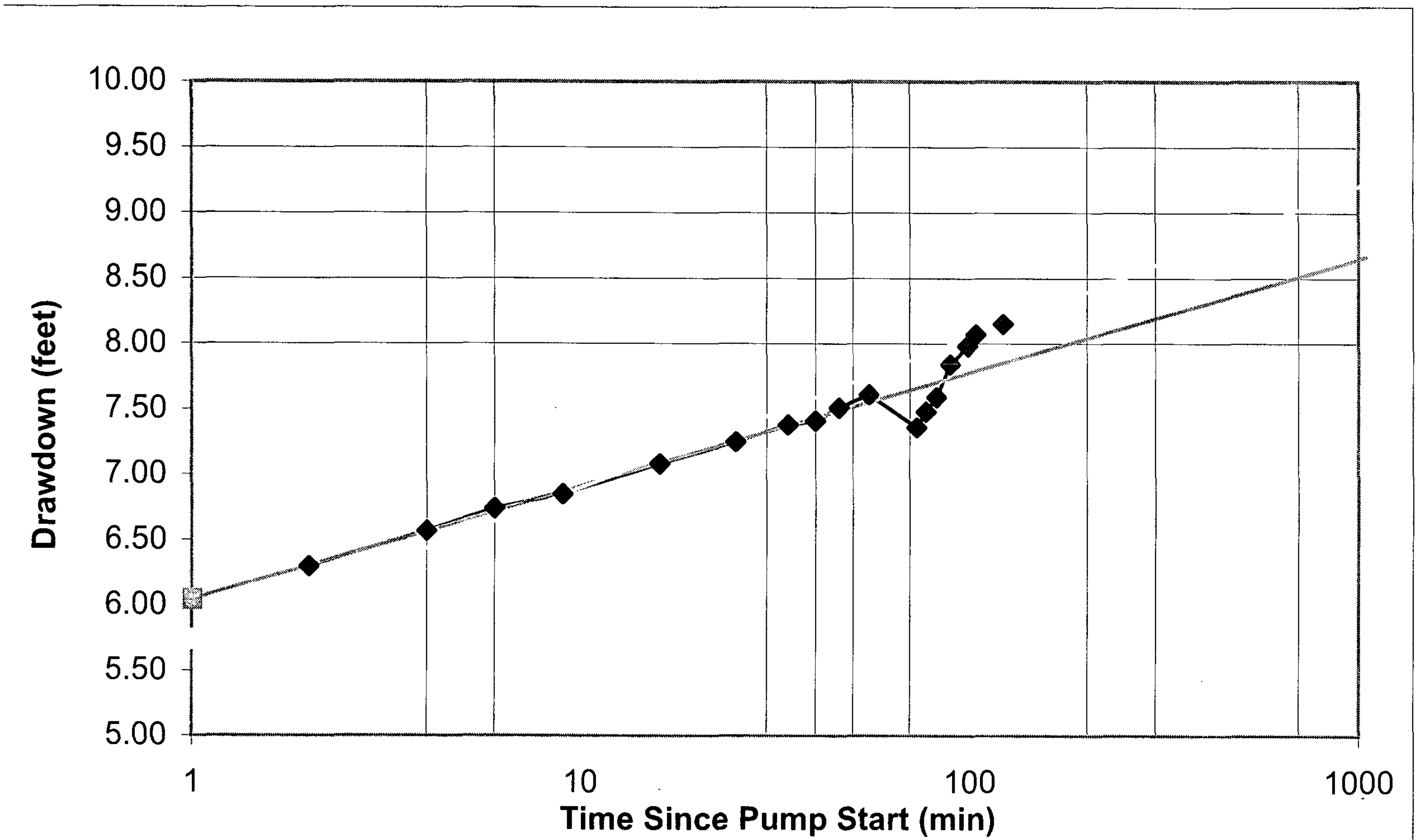
Early Fit		**Late Fit**	
Discharge (gpm)	14.3	Discharge (gpm)	13.6
Delta s (ft/log cycle time)	3.00	Delta s (ft/log cycle time)	1.97
Transmissivity (gal/day/ft)	1260	Transmissivity (gal/day/ft)	1821

Figure A.1-1. Semilog Analysis of HJ Sand Well LC26M



Early Fit		**Late Fit**	
Discharge (gpm)	13	Discharge (gpm)	12.8
Delta s (ft/log cycle time)	1.54	Delta s (ft/log cycle time)	2.04
Transmissivity (gal/day/ft)	2229	Transmissivity (gal/day/ft)	1659

Figure A.1-2. Semilog Analysis of HJ Sand Well LC27M



Early Fit

Discharge (gpm)	8.8
Delta s (ft/log cycle time)	0.87
Transmissivity (gal/day/ft)	2677

Late Fit

Discharge (gpm)	8.8
Delta s (ft/log cycle time)	1.15
Transmissivity (gal/day/ft)	2013

Figure A.1-3. Semilog Analysis of HJ Sand Well LC27M - Alternate Test

TABLE A.1-1. AQUIFER-TEST DATA FOR PUMPING WELL LC26M.

DATE	TIME	TIME SINCE PUMPING STARTED (t, min)	TIME SINCE PUMPING STOPPED (t', min)	t/t'	WATER LEVEL (ft below MP)	DRAWDOWN (ft)	DISCHARGE (gpm)	WATER TEMP. (deg C)	CONDUCTIVITY (umhos/cm @ 25 deg C)	pH (units)
11/17/06	11:08:00	-12	--	--	171.43	0.00	--	--	--	--
	11:20:00	PUMP ON								
	11:21:00	1	--	--	176.63	5.20	--	--	--	--
	11:22:00	2	--	--	--	--	14.30	--	--	--
	11:23:00	3	--	--	178.13	6.70	--	--	--	--
	11:26:00	6	--	--	178.95	7.52	--	9.2	--	11.56
	11:30:00	10	--	--	179.65	8.22	--	--	--	--
	11:31:00	11	--	--	--	--	13.60	--	--	--
	11:33:00	13	--	--	--	--	--	9.2	--	8.61
	11:35:00	15	--	--	180.08	8.65	--	--	--	--
	11:40:00	20	--	--	180.27	8.84	--	--	--	--
	11:45:00	25	--	--	180.48	9.05	13.60	--	--	--
	11:48:00	28	--	--	--	--	--	9.2	--	7.77
	11:50:00	30	--	--	180.67	9.24	--	--	--	--
	11:52:00	32	--	--	--	--	--	9.3	--	7.6
	12:00:00	40	--	--	180.91	9.48	--	--	--	--
	12:02:00	42	--	--	--	--	--	9.2	--	7.69
	12:06:00	46	--	--	--	--	--	9.3	--	7.64
	12:10:00	50	--	--	181.08	9.65	--	--	--	--
	12:15:00	55	--	--	--	--	--	9.2	--	7.68
	12:20:00	SAMPLE TAKEN								
	12:29:00	PUMP OFF								

TABLE A.1-2. AQUIFER-TEST DATA FOR PUMPING WELL LC27M.

DATE	TIME	TIME SINCE PUMPING STARTED (t, min)	TIME SINCE PUMPING STOPPED (t', min)	t/t'	WATER LEVEL (ft below MP)	DRAWDOWN (ft)	DISCHARGE (gpm)	WATER TEMP. (deg C)	CONDUCTIVITY (umhos/cm @ 25 deg C)	pH (units)
11/16/06	11:16:00	-2	--	--	189.79	0.00	--	--	--	--
	11:18:00	PUMP ON								
	11:20:00	2	--	--	199.23	9.44	--	--	--	--
	11:22:00	4	--	--	199.62	9.83	--	--	--	--
	11:23:00	5	--	--	--	--	13.00	--	--	--
	11:24:00	6	--	--	199.94	10.15	--	--	--	--
	11:26:00	8	--	--	200.12	10.33	--	--	--	--
	11:30:00	12	--	--	200.41	10.62	--	--	--	--
	11:31:00	13	--	--	--	--	12.80	--	--	--
	11:33:00	15	--	--	--	--	--	9.3	283	10.97
	11:35:00	17	--	--	200.64	10.85	--	--	--	--
	11:40:00	22	--	--	200.84	11.05	--	--	--	--
	11:43:00	25	--	--	--	--	--	9.3	229	9.88
	11:45:00	27	--	--	200.99	11.20	--	--	--	--
	11:50:00	32	--	--	201.11	11.32	--	--	--	--
	11:53:00	35	--	--	--	--	--	9.4	233	10.27
	11:55:00	37	--	--	201.20	11.41	--	--	--	--
	11:57:00	39	--	--	--	--	12.80	--	--	--
	12:00:00	42	--	--	201.36	11.57	--	--	--	--
	12:02:00	44	--	--	--	--	--	9.5	229	9.82
	12:05:00	47	--	--	201.41	11.62	--	--	--	--
	12:10:00	52	--	--	201.47	11.68	--	--	--	--
	12:12:00	54	--	--	--	--	--	9.5	232	9.64
	12:15:00	57	--	--	201.57	11.78	--	--	--	--
	12:17:00	59	--	--	--	--	--	9.5	228	9.53
	12:20:00	62	--	--	201.64	11.85	--	--	--	--
	12:25:00	67	--	--	201.71	11.92	--	9.5	232	9.42
	12:30:00	72	--	--	201.78	11.99	--	--	--	--
	12:35:00	77	--	--	201.86	12.07	--	9.6	242	9.31
	12:45:00	87	--	--	201.93	12.14	--	9.5	246	9.17
	13:00:00	102	--	--	202.07	12.28	--	9.5	247	9.08
	13:10:00	112	--	--	202.18	12.39	--	9.5	247	9
	13:15:00	117	--	--	--	--	--	9.5	248	9
	13:15:00	SAMPLE TAKEN								
	13:23:00	PUMP OFF								

TABLE A.1-3. AQUIFER-TEST DATA FOR PUMPING WELL LC27M (Alternate Test).

DATE	TIME	TIME SINCE PUMPING STARTED (t, min)	TIME SINCE PUMPING STOPPED (t', min)	t/t'	WATER LEVEL (ft below MP)	DRAWDOWN (ft)	DISCHARGE (gpm)	WATER TEMP. (deg C)	CONDUCTIVITY (umhos/cm @ 25 deg C)	pH (units)
10/24/06	16:40:00	-6	197	-0.030	189.84	0.00	--	--	--	--
	16:42:00	PUMP ON - Generator Stalled								
	16:46:00	PUMP ON								
	16:48:00	2	205	0.010	196.14	6.30	--	--	--	--
	16:50:00	4	207	0.019	196.41	6.57	--	--	--	--
	16:52:00	6	209	0.029	196.58	6.74	8.80	--	--	--
	16:55:00	9	212	0.042	196.69	6.85	--	--	--	--
	17:00:00	14	217	0.065	--	--	--	9.3	267	10.74
	17:02:00	16	219	0.073	196.92	7.08	--	--	--	--
	17:03:00	17	220	0.077	--	--	8.80	--	--	--
	17:11:00	25	228	0.110	197.09	7.25	--	--	--	--
	17:14:00	28	231	0.121	--	--	--	9.3	419	--
	17:20:00	34	237	0.143	197.22	7.38	--	--	--	--
	17:23:00	37	240	0.154	--	--	--	9.3	272	10.31
	17:26:00	40	243	0.165	197.25	7.41	--	--	--	--
	17:32:00	46	249	0.185	197.35	7.51	--	--	--	--
	17:36:00	50	253	0.198	--	--	--	9.3	347	11.1
	17:40:00	54	257	0.210	--	--	8.57	--	--	--
	17:41:00	55	258	0.213	197.45	7.61	--	--	--	--
	17:43:00	57	260	0.219	--	--	--	9.3	294	10.76
	17:45:00	Pump off - trading for 1 hp control box								
	17:50:00	1 hp control box won't work								
	17:54:00	PUMP ON - 3/4 hp control box								
	17:57:00	71	274	0.259	--	--	8.80	--	--	--
	17:59:00	73	276	0.264	197.20	7.36	--	--	--	--
	18:00:00	74	277	0.267	--	--	--	9.3	264	10.44
	18:03:00	77	280	0.275	197.32	7.48	--	--	--	--
	18:08:00	82	285	0.288	197.43	7.59	--	--	--	--
	18:10:00	84	287	0.293	--	--	--	9.3	259	10.25
	18:15:00	89	292	0.305	197.68	7.84	--	--	--	--
	18:17:00	91	294	0.310	--	--	--	9.3	251	10.12
	18:23:00	97	300	0.323	--	--	--	9.3	251	9.98
	18:25:00	99	302	0.328	197.82	7.98	--	--	--	--
	18:29:00	103	306	0.337	--	--	--	9.3	249	9.84
	18:30:00	104	307	0.339	197.91	8.07	--	--	--	--
	18:33:00	107	310	0.345	--	--	--	9.3	251	9.84
	18:46:00	120	323	0.372	--	--	--	9.3	247	9.42
	18:48:00	122	325	0.375	197.99	8.15	--	--	--	--
	18:52:00	126	329	0.383	--	--	--	9.3	250	9.5
	18:56:00	130	333	0.390	--	--	--	9.4	248	9.27
	19:03:00	137	340	0.403	--	--	--	9.3	232	9.36
	19:05:00	PUMP OFF								

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Section A.2 - LFG Sand Wells

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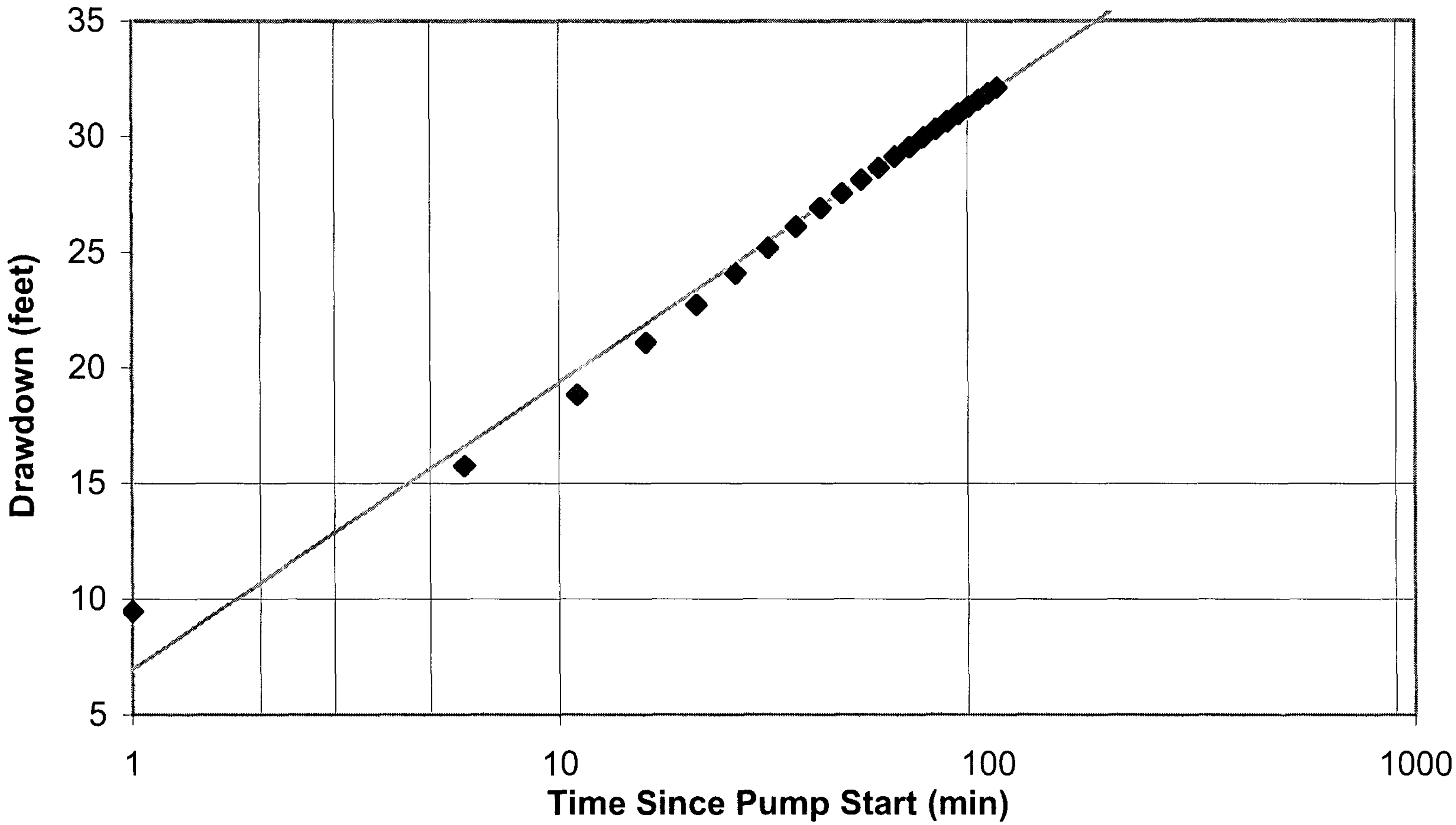
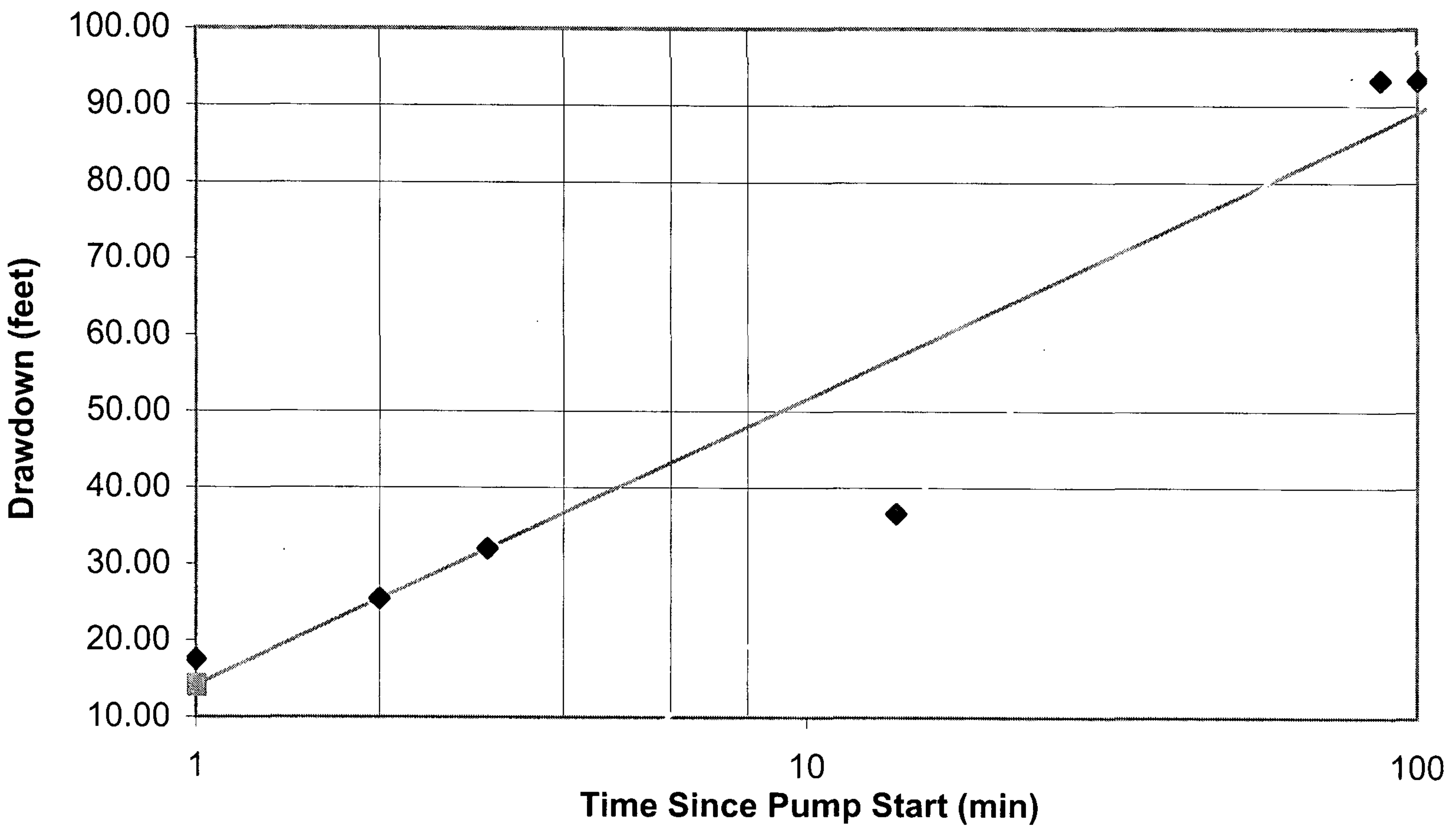


Straight Line Fit

Discharge (gpm)	14.2
Delta s (ft/log cycle time)	12.41
Transmissivity (gal/day/ft)	302

Figure A.2-1. Semilog Analysis of LFG Sand Well LC15M



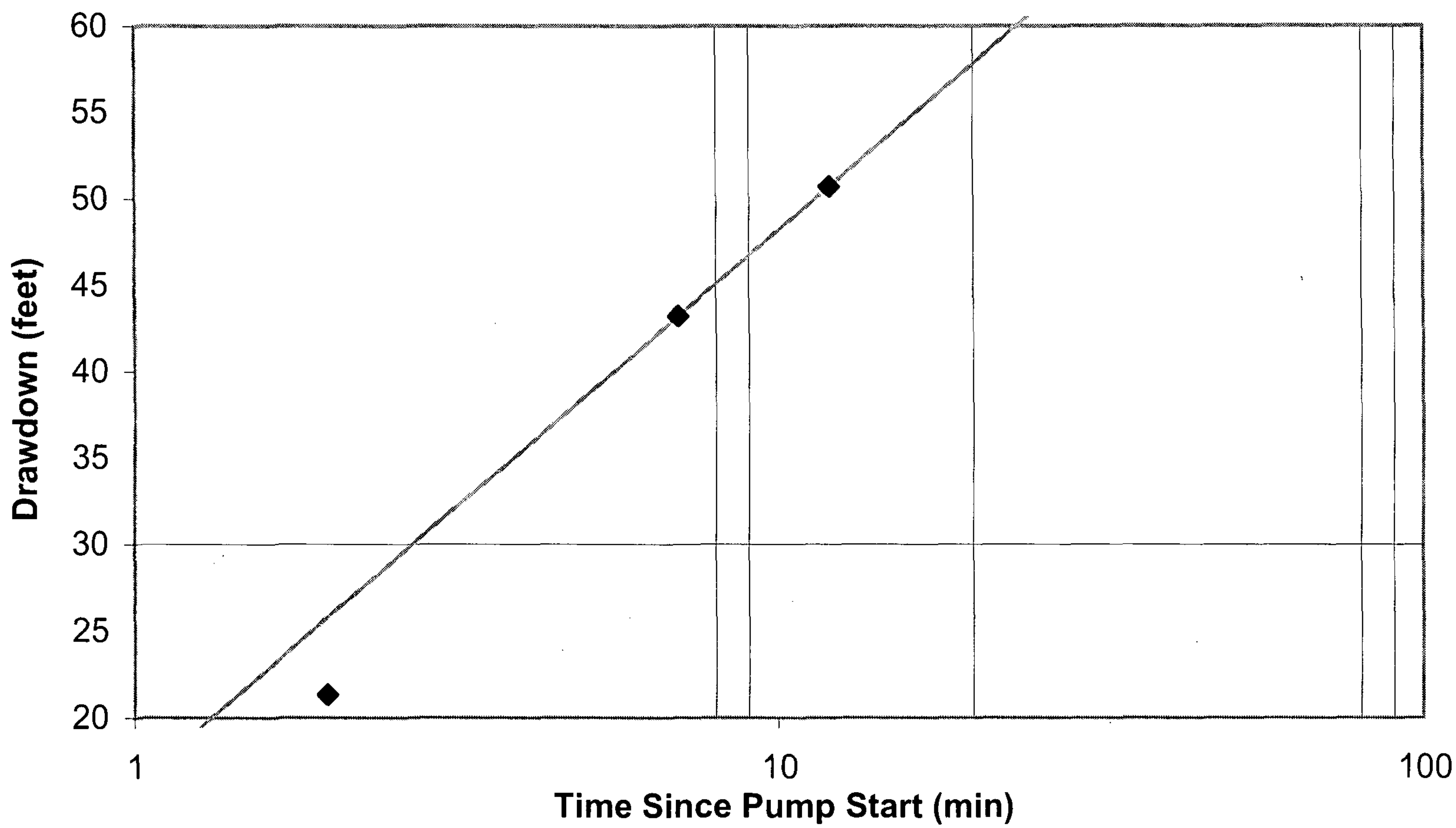
Early Fit

Discharge (gpm)	13
Delta s (ft/log cycle time)	37.48
Transmissivity (gal/day/ft)	92

Late Fit

Discharge (gpm)	8.8
Delta s (ft/log cycle time)	71.42
Transmissivity (gal/day/ft)	33

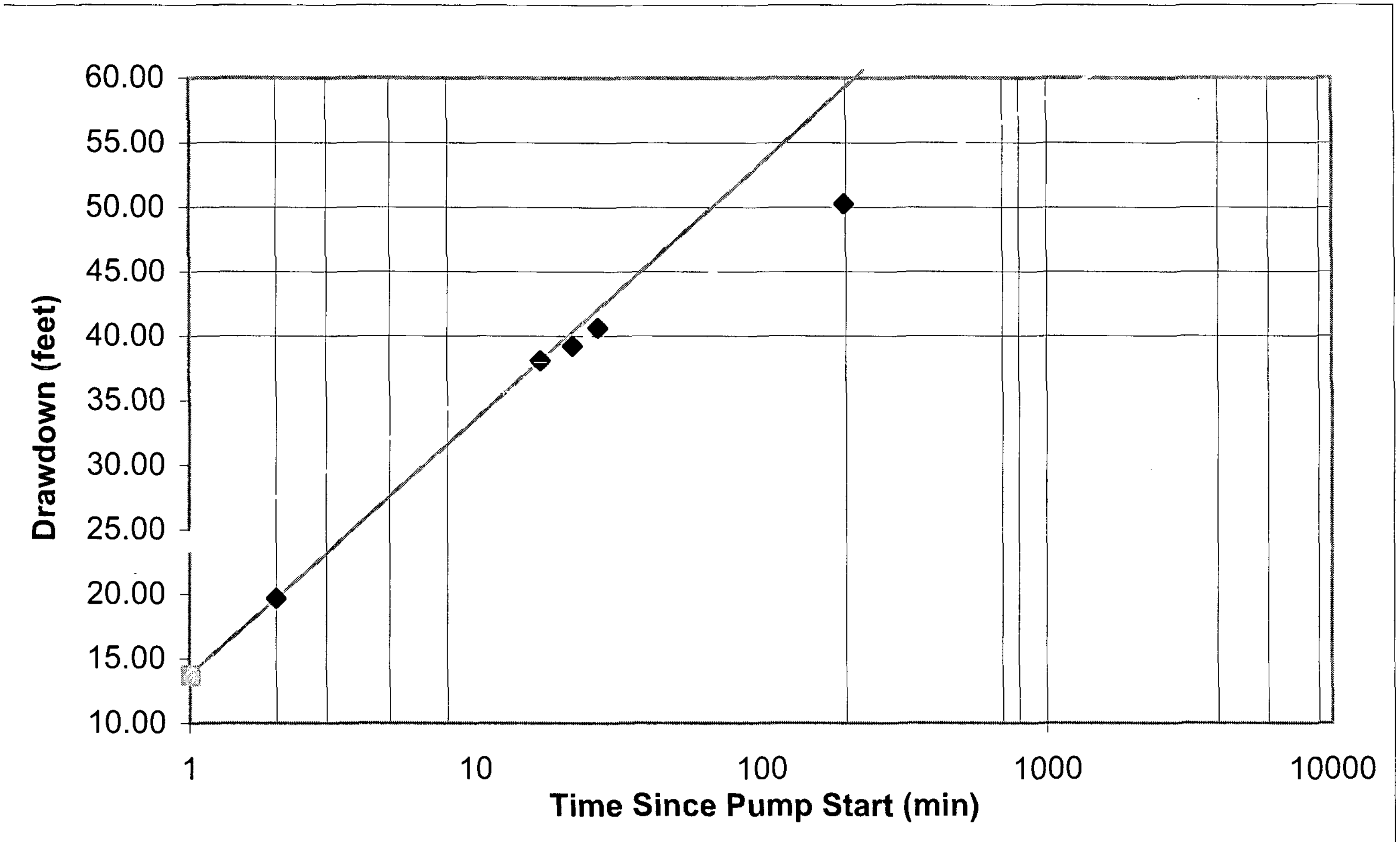
Figure A.2-2. Semilog Analysis of LFG Sand Well LC18M - First Test



Straight Line Fit

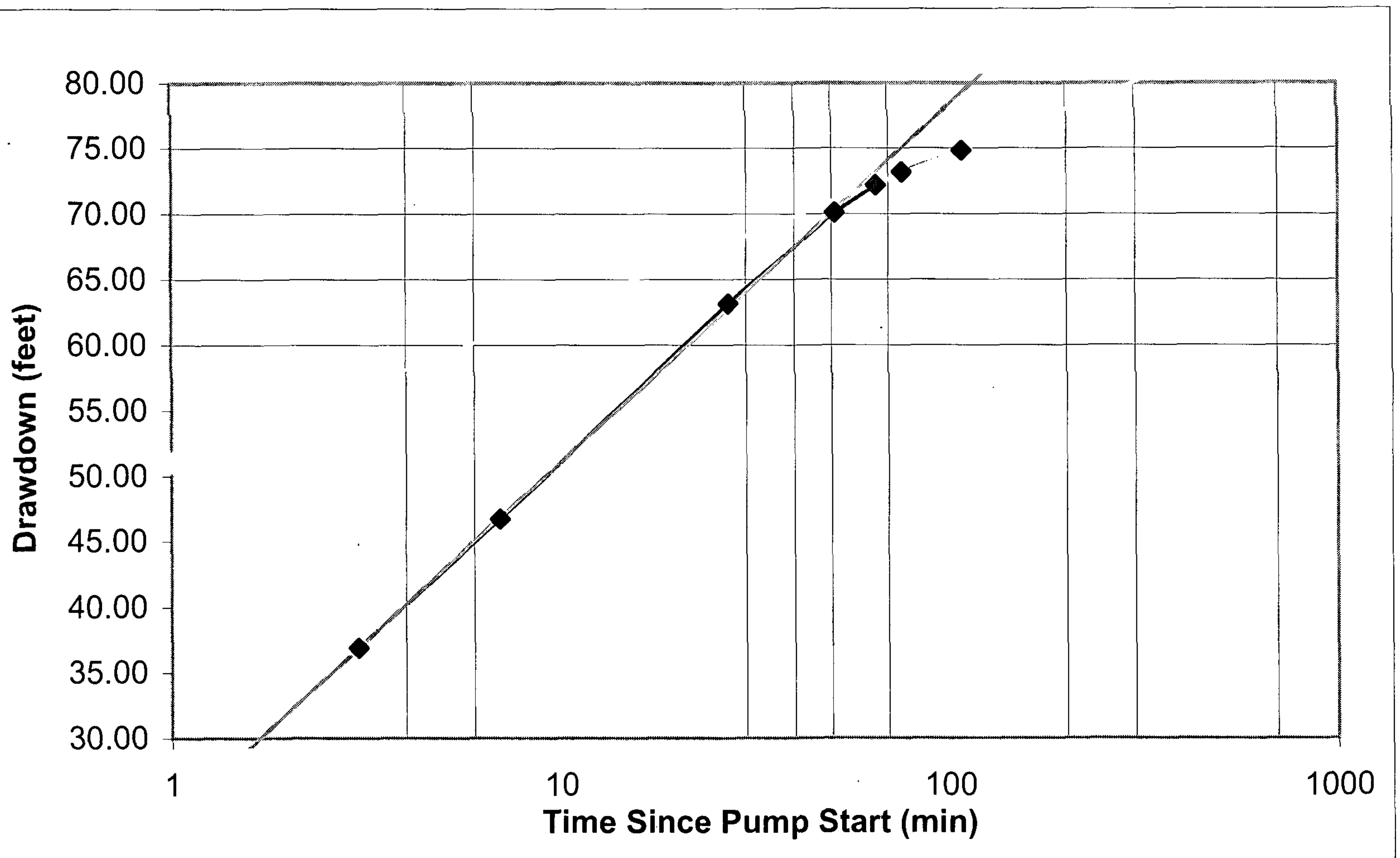
Discharge (gpm)	7.5
Delta s (ft/log cycle time)	31.97
Transmissivity (gal/day/ft)	62

Figure A.2-3. Semilog Analysis of LFG Sand Well LC18M - Second Test



Early Fit		**Late Fit**	
Discharge (gpm)	13.1	Discharge (gpm)	13.1
Delta s (ft/log cycle time)	19.83	Delta s (ft/log cycle time)	11.43
Transmissivity (gal/day/ft)	174	Transmissivity (gal/day/ft)	303

Figure A.2-4. Semilog Analysis of LFG Sand Well LC21M



Early Fit		**Late Fit**	
Discharge (gpm)	12	Discharge (gpm)	9.4
Delta s (ft/log cycle time)	27.18	Delta s (ft/log cycle time)	11.70
Transmissivity (gal/day/ft)	117	Transmissivity (gal/day/ft)	212

Figure A.2-5. Semilog Analysis of LFG Sand Well LC25M

TABLE A.2-1. AQUIFER-TEST DATA FOR PUMPING WELL LC15M.

DATE	TIME	TIME SINCE PUMPING STARTED (t, min)	TIME SINCE PUMPING STOPPED (t', min)	t/t'	WATER LEVEL (ft below MP)	DRAWDOWN (ft)	DISCHARGE (gpm)	WATER TEMP. (deg C)	CONDUCTIVITY (umhos/cm @ 25 deg C)	pH (units)
11/26/06	14:13:00	-4	--	--	160.54	0.00	--	--	--	--
	14:17:00	PUMP ON								
	14:25:00	8	--	--	--	--	14.20	--	--	--
	15:57:00	100	--	--	--	--	--	9.2	--	7.83
	15:59:00	102	--	--	--	--	--	9.2	--	7.84
	16:05:00	108	--	--	--	--	--	9.2	--	7.84
	16:05:00	SAMPLE TAKEN								
	16:07:00	PUMP OFF								

TRANSDUCER DATA FOR PUMPING WELL LC15M.

DATE	TIME	TIME SINCE PUMPING STARTED (t, min)	DRAWDOWN (ft)	DATE	TIME	TIME SINCE PUMPING STARTED (t, min)	DRAWDOWN (ft)
11/26/06	13:53:00	-24.0	0.02	11/26/06	15:23:00	66.0	29.54
11/26/06	13:58:00	-19.0	0.02	11/26/06	15:28:00	71.0	29.95
11/26/06	14:03:00	-14.0	0.02	11/26/06	15:33:00	76.0	30.32
11/26/06	14:08:00	-9.0	0.02	11/26/06	15:38:00	81.0	30.64
11/26/06	14:13:00	-4.0	0.00	11/26/06	15:43:00	86.0	30.97
11/26/06	14:18:00	1.0	9.47	11/26/06	15:48:00	91.0	31.27
11/26/06	14:23:00	6.0	15.76	11/26/06	15:53:00	96.0	31.58
11/26/06	14:28:00	11.0	18.85	11/26/06	15:58:00	101.0	31.85
11/26/06	14:33:00	16.0	21.08	11/26/06	16:03:00	106.0	32.10
11/26/06	14:38:00	21.0	22.73	11/26/06	16:08:00	111.0	20.10
11/26/06	14:43:00	26.0	24.08	11/26/06	16:13:00	116.0	16.69
11/26/06	14:48:00	31.0	25.19	11/26/06	16:18:00	121.0	14.10
11/26/06	14:53:00	36.0	26.10	11/26/06	16:23:00	126.0	12.27
11/26/06	14:58:00	41.0	26.92	11/26/06	16:28:00	131.0	10.92
11/26/06	15:03:00	46.0	27.54	11/26/06	16:33:00	136.0	9.83
11/26/06	15:08:00	51.0	28.14	11/26/06	16:38:00	141.0	8.97
11/26/06	15:13:00	56.0	28.64	11/26/06	16:43:00	146.0	8.25
11/26/06	15:18:00	61.0	29.14				

TABLE A.2-2. AQUIFER-TEST DATA FOR PUMPING WELL LC18M - First Test.

DATE	TIME	TIME SINCE PUMPING STARTED (t, min)	TIME SINCE PUMPING STOPPED (t', min)	t/t'	WATER LEVEL (ft below MP)	DRAWDOWN (ft)	DISCHARGE (gpm)	WATER TEMP. (deg C)	CONDUCTIVITY (umhos/cm @ 25 deg C)	pH (units)
09/20/06	8:24:00	-6	--	--	167.86	0.00	--	--	--	--
	8:30:00	PUMP ON								
	8:31:00	1	--	--	185.38	17.52	--	--	--	--
	8:32:00	2	--	--	193.29	25.43	13.00	--	--	--
	8:33:00	3	--	--	199.89	32.03	--	--	--	--
	8:44:00	14	--	--	204.49	36.63	--	--	--	--
	9:57:00	87	--	--	261.15	93.29	--	--	--	--
	10:10:00	100	--	--	261.20	93.34	--	--	--	--
	10:11:00	101	--	--	--	--	8.80	--	--	--
	10:42:00	132	--	--	261.18	93.32	--	9.2	436	8.78
	11:20:00	170	--	--	--	--	--	9.2	420	8.55
	11:42:00	192	--	--	--	--	--	9.3	399	8.63
	11:51:00	201	--	--	--	--	--	9.3	420	8.59
	11:52:00	SAMPLE TAKEN								

TABLE A.2-3. AQUIFER-TEST DATA FOR PUMPING WELL LC18M - Second Test.

DATE	TIME	TIME SINCE PUMPING STARTED (t, min)	TIME SINCE PUMPING STOPPED (t', min)	t/t'	WATER LEVEL (ft below MP)	DRAWDOWN (ft)	DISCHARGE (gpm)	WATER TEMP. (deg C)	CONDUCTIVITY (umhos/cm @ 25 deg C)	pH (units)
11/22/06	12:38:00	-65	--	--	168.26	0.00	--	--	--	--
	13:43:00	PUMP ON								
	13:49:00	6	--	--	--	--	10.00	--	--	--
	15:39:00	116	--	--	--	--	7.50	--	--	--
	15:42:00	119	--	--	--	--	--	9	--	7.91
	15:45:00	SAMPLE TAKEN								
	16:00:00	PUMP OFF								

TRANSDUCER DATA FOR PUMPING WELL LC18M.

DATE	TIME	TIME SINCE PUMPING STARTED (t, min)	DRAWDOWN (ft)
11/22/06	13:30:00	-13.0	-0.03
11/22/06	13:35:00	-8.0	0.00
11/22/06	13:40:00	-3.0	0.00
11/22/06	13:45:00	2.0	21.33
11/22/06	13:50:00	7.0	43.22
11/22/06	13:55:00	12.0	50.70

TABLE A.2-4. AQUIFER-TEST DATA FOR PUMPING WELL LC21M.

DATE	TIME	TIME SINCE PUMPING STARTED (t, min)	TIME SINCE PUMPING STOPPED (t', min)	t/t'	WATER LEVEL (ft below MP)	DRAWDOWN (ft)	DISCHARGE (gpm)	WATER TEMP. (deg C)	CONDUCTIVITY (umhos/cm @ 25 deg C)	pH (units)
11/26/06	8:23:00	-12	--	--	198.34	0.00	--	--	--	--
	8:35:00	PUMP ON								
	8:37:00	2	--	--	218.00	19.66	--	--	--	--
	8:46:00	11	--	--	--	--	13.10	--	--	--
	8:52:00	17	--	--	236.43	38.09	--	--	--	--
	8:57:00	22	--	--	237.57	39.23	--	--	--	--
	9:02:00	27	--	--	238.98	40.64	--	--	--	--
	11:52:00	197	--	--	248.62	50.28	--	--	--	--
	12:13:00	218	--	--	--	--	--	10.1	--	8.47
	12:15:00	220	--	--	--	--	--	9.9	--	8.46
	12:20:00	225	--	--	--	--	--	9.9	--	8.39
	12:20:00	SAMPLE TAKEN								

TABLE A.2-5. AQUIFER-TEST DATA FOR PUMPING WELL LC25M.

DATE	TIME	TIME SINCE PUMPING STARTED (t, min)	TIME SINCE PUMPING STOPPED (t', min)	t/t'	WATER LEVEL (ft below MP)	DRAWDOWN (ft)	DISCHARGE (gpm)	WATER TEMP. (deg C)	CONDUCTIVITY (umhos/cm @ 25 deg C)	pH (units)
11/17/06	12:48:00	-16	--	--	165.89	0.00	--	--	--	--
	12:50:00	-14	--	--	165.93	0.04	--	--	--	--
	13:04:00	PUMP ON								
	13:07:00	3	--	--	202.80	36.91	--	--	--	--
	13:09:00	5	--	--	--	--	12.00	--	--	--
	13:11:00	7	--	--	212.60	46.71	--	--	--	--
	13:31:00	27	--	--	229.05	63.16	--	--	--	--
	13:33:00	29	--	--	--	--	10.00	--	--	--
	13:55:00	51	--	--	235.99	70.10	--	--	--	--
	13:57:00	53	--	--	--	--	9.40	--	--	--
	14:09:00	65	--	--	238.08	72.19	--	--	--	--
	14:11:00	67	--	--	--	--	--	9.3	--	7.43
	14:17:00	73	--	--	--	--	--	9.1	--	7.35
	14:20:00	76	--	--	239.05	73.16	--	--	--	--
	14:22:00	78	--	--	--	--	--	9.2	--	7.98
	14:25:00	81	--	--	--	--	--	9.2	--	8.07
	14:52:00	108	--	--	240.70	74.81	--	--	--	--
	14:56:00	112	--	--	--	--	--	9.4	--	7.75
	14:58:00	SAMPLE TAKEN								
	15:05:00	PUMP OFF								

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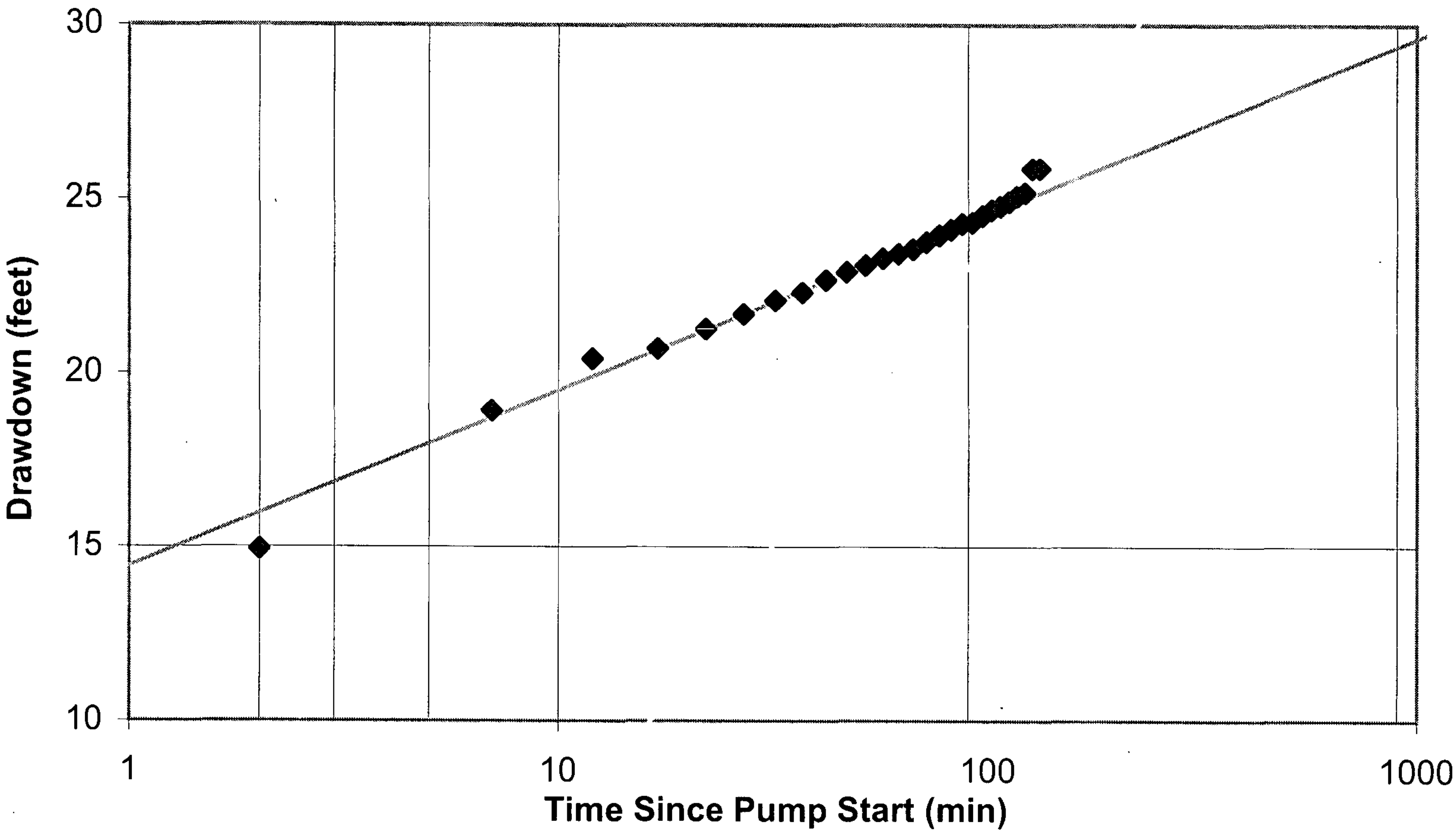


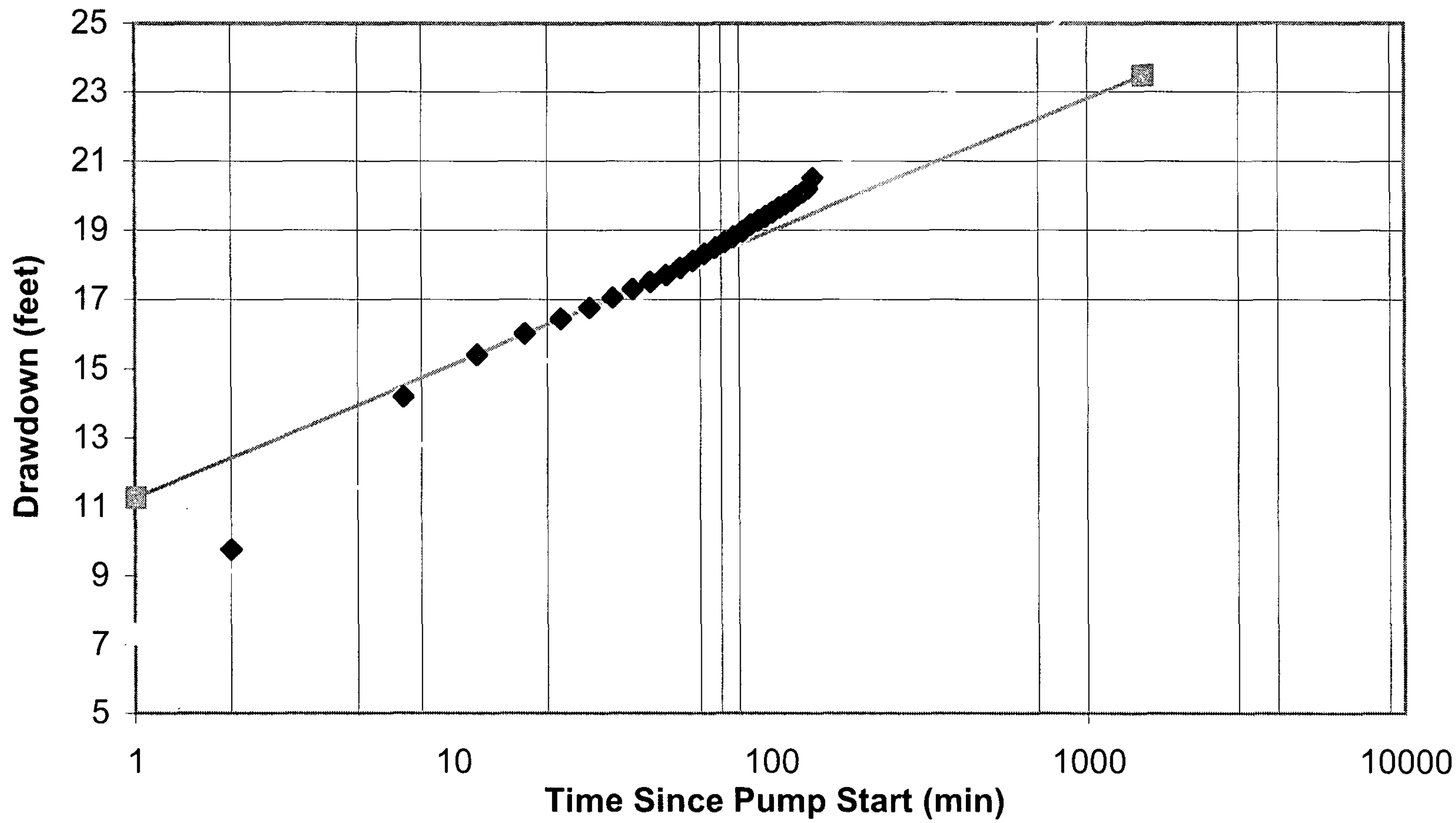
Early Fit

Discharge (gpm)	13
Delta s (ft/log cycle time)	5.06
Transmissivity (gal/day/ft)	679

Late Fit

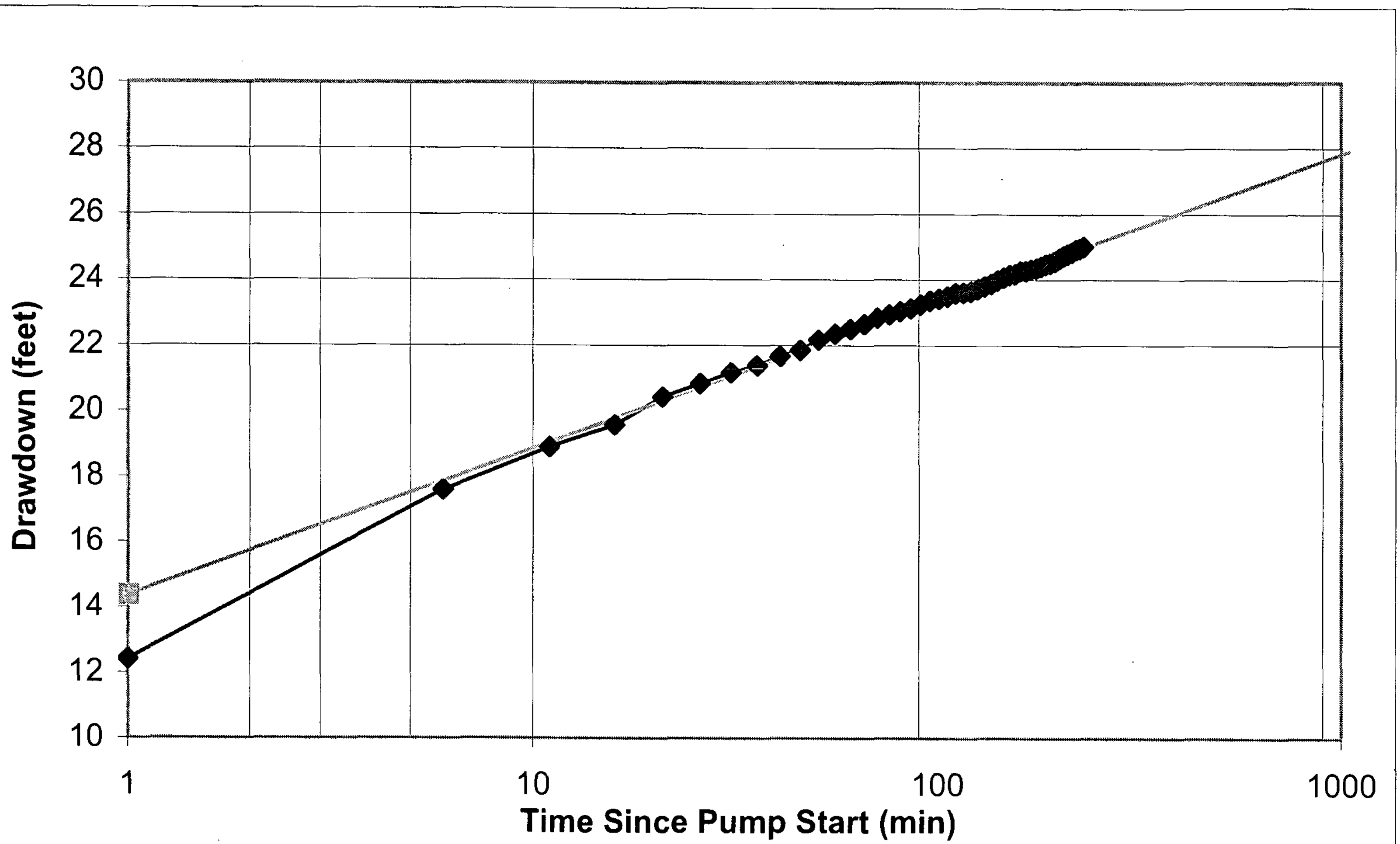
Discharge (gpm)	13
Delta s (ft/log cycle time)	17.59
Transmissivity (gal/day/ft)	195

Figure A.3-1. Semilog Analysis of UKM Sand Well LC17M



Early Fit		**Late Fit**	
Discharge (gpm)	12.5	Discharge (gpm)	12
Delta s (ft/log cycle time)	3.85	Delta s (ft/log cycle time)	6.09
Transmissivity (gal/day/ft)	858	Transmissivity (gal/day/ft)	520

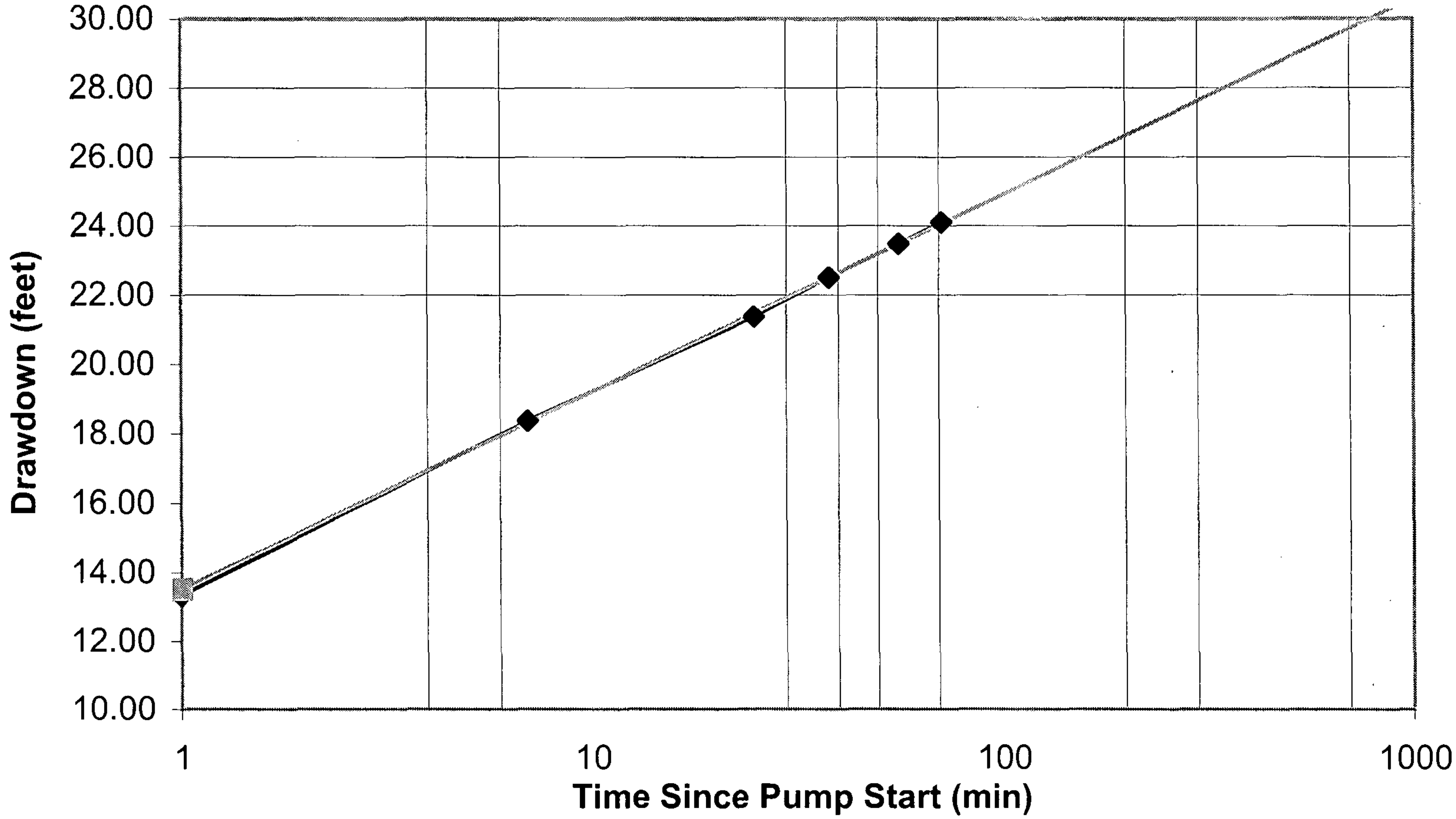
Figure A.3-2. Semilog Analysis of UKM Sand Well LC20M



Straight Line Fit

Discharge (gpm)	9.9
Delta s (ft/log cycle time)	4.48
Transmissivity (gal/day/ft)	583

Figure A.3-3. Semilog Analysis of UKM Sand Well LC23M



Straight Line Fit

Discharge (gpm)	12.1
Delta s (ft/log cycle time)	5.69
Transmissivity (gal/day/ft)	561

Figure A.3-4. Semilog Analysis of UKM Sand Well LC24M

TABLE A.3-1. AQUIFER-TEST DATA FOR PUMPING WELL LC17M.

DATE	TIME	TIME SINCE PUMPING STARTED (t, min)	TIME SINCE PUMPING STOPPED (t', min)	t/t'	WATER LEVEL (ft below MP)	DRAWDOWN (ft)	DISCHARGE (gpm)	WATER TEMP. (deg C)	CONDUCTIVITY (umhos/cm @ 25 deg C)	pH (units)
11/26/06	13:59:00	-4	--	--	185.50	0.00	--	--	--	--
	13:59:00	DTW IN DISCHARGE PIPE								
	14:03:00	PUMP ON								
	14:21:00	18	--	--	--	--	13.00	--	--	--
	16:08:00	125	--	--	--	--	--	10	--	7.93
	16:12:00	129	--	--	--	--	--	10	--	7.95
	16:15:00	132	--	--	--	--	--	10	--	7.95
	16:15:00	SAMPLE TAKEN								
	16:18:00	PUMP OFF								

TABLE A.3-2. TRANSDUCER DATA FOR PUMPING WELL LC17M.

DATE	TIME	TIME SINCE PUMPING STARTED (t, min)	DRAWDOWN (ft)
11/26/06	13:30:00	-33.0	0.00
11/26/06	13:35:00	-28.0	0.00
11/26/06	13:40:00	-23.0	0.00
11/26/06	13:45:00	-18.0	0.00
11/26/06	13:50:00	-13.0	0.00
11/26/06	13:55:00	-8.0	0.00
11/26/06	14:00:00	-3.0	0.00
11/26/06	14:05:00	2.0	14.94
11/26/06	14:10:00	7.0	18.92
11/26/06	14:15:00	12.0	20.41
11/26/06	14:20:00	17.0	20.70
11/26/06	14:25:00	22.0	21.26
11/26/06	14:30:00	27.0	21.69
11/26/06	14:35:00	32.0	22.09
11/26/06	14:40:00	37.0	22.32
11/26/06	14:45:00	42.0	22.68
11/26/06	14:50:00	47.0	22.91
11/26/06	14:55:00	52.0	23.11
11/26/06	15:00:00	57.0	23.31
11/26/06	15:05:00	62.0	23.44
11/26/06	15:10:00	67.0	23.57
11/26/06	15:15:00	72.0	23.77
11/26/06	15:20:00	77.0	23.97
11/26/06	15:25:00	82.0	24.13
11/26/06	15:30:00	87.0	24.30
11/26/06	15:35:00	92.0	24.33
11/26/06	15:40:00	97.0	24.53
11/26/06	15:45:00	102.0	24.69
11/26/06	15:50:00	107.0	24.79
11/26/06	15:55:00	112.0	24.92
11/26/06	16:00:00	117.0	25.09
11/26/06	16:05:00	122.0	25.19
11/26/06	16:10:00	127.0	25.88
11/26/06	16:15:00	132.0	25.88
11/26/06	16:20:00	137.0	9.76
11/26/06	16:25:00	142.0	7.52

TABLE A.3-3. AQUIFER-TEST DATA FOR PUMPING WELL LC20M.

DATE	TIME	TIME SINCE PUMPING STARTED (t, min)	TIME SINCE PUMPING STOPPED (t', min)	t/t'	WATER LEVEL (ft below MP)	DRAWDOWN (ft)	DISCHARGE (gpm)	WATER TEMP. (deg C)	CONDUCTIVITY (umhos/cm @ 25 deg C)	pH (units)
11/22/06	13:20:00	-27	--	--	203.50	0.00	--	--	--	--
	13:47:00	PUMP ON								
	13:50:00	3	--	--	--	--	12.50	--	--	--
	15:40:00	113	--	--	--	--	12.00	--	--	--
	15:45:00	118	--	--	--	--	--	9.9	--	9.17
	15:56:00	129	--	--	--	--	--	9.9	--	9.12
	16:00:00	SAMPLE TAKEN								
	16:08:00	PUMP OFF								

TABLE A.3-4. TRANSDUCER DATA FOR PUMPING WELL LC20M.

DATE	TIME	TIME SINCE PUMPING STARTED (t, min)	DRAWDOWN (ft)
11/22/06	13:39:00	-8.0	1.53
11/22/06	13:44:00	-3.0	0.00
11/22/06	13:49:00	2.0	9.76
11/22/06	13:54:00	7.0	14.20
11/22/06	13:59:00	12.0	15.41
11/22/06	14:04:00	17.0	16.02
11/22/06	14:09:00	22.0	16.44
11/22/06	14:14:00	27.0	16.76
11/22/06	14:19:00	32.0	17.05
11/22/06	14:24:00	37.0	17.31
11/22/06	14:29:00	42.0	17.51
11/22/06	14:34:00	47.0	17.71
11/22/06	14:39:00	52.0	17.92
11/22/06	14:44:00	57.0	18.12
11/22/06	14:49:00	62.0	18.32
11/22/06	14:54:00	67.0	18.49
11/22/06	14:59:00	72.0	18.66
11/22/06	15:04:00	77.0	18.81
11/22/06	15:09:00	82.0	18.97
11/22/06	15:14:00	87.0	19.15
11/22/06	15:19:00	92.0	19.27
11/22/06	15:24:00	97.0	19.39
11/22/06	15:29:00	102.0	19.51
11/22/06	15:34:00	107.0	19.64
11/22/06	15:39:00	112.0	19.75
11/22/06	15:44:00	117.0	19.85
11/22/06	15:49:00	122.0	19.98
11/22/06	15:54:00	127.0	20.09
11/22/06	15:59:00	132.0	20.20
11/22/06	16:04:00	137.0	20.51
11/22/06	16:09:00	142.0	10.54
11/22/06	16:14:00	147.0	6.05
11/22/06	16:19:00	152.0	4.97

TABLE A.3-5. AQUIFER-TEST DATA FOR PUMPING WELL LC23M.

DATE	TIME	TIME SINCE PUMPING STARTED (t, min)	TIME SINCE PUMPING STOPPED (t', min)	t/t'	WATER LEVEL (ft below MP)	DRAWDOWN (ft)	DISCHARGE (gpm)	WATER TEMP. (deg C)	CONDUCTIVITY (umhos/cm @ 25 deg C)	pH (units)
11/26/06	8:01:00	-13	--	--	220.76	-0.28	--	--	--	--
	8:14:00	PUMP ON								
	8:18:00	4	--	--	--	--	9.80	--	--	--
	8:34:00	20	--	--	--	--	10.40	--	--	--
	11:54:00	220	--	--	--	--	9.90	11	--	8.9
	11:57:00	223	--	--	--	--	--	11	--	9.13
	12:05:00	231	--	--	--	--	--	11	--	9.1
	12:05:00	SAMPLE TAKEN								
	12:10:00	PUMP OFF								

TABLE A.3-6. TRANSDUCER DATA FOR PUMPING WELL LC23M.

DATE	TIME	TIME SINCE PUMPING STARTED (t, min)	DRAWDOWN (ft)
11/26/06	7:30:00	-44.0	0.00
11/26/06	7:35:00	-39.0	0.00
11/26/06	7:40:00	-34.0	0.00
11/26/06	7:45:00	-29.0	0.00
11/26/06	7:50:00	-24.0	0.00
11/26/06	7:55:00	-19.0	0.00
11/26/06	8:00:00	-14.0	0.00
11/26/06	8:05:00	-9.0	0.00
11/26/06	8:10:00	-4.0	0.00
11/26/06	8:15:00	1.0	12.42
11/26/06	8:20:00	6.0	17.60
11/26/06	8:25:00	11.0	18.91
11/26/06	8:30:00	16.0	19.58
11/26/06	8:35:00	21.0	20.43
11/26/06	8:40:00	26.0	20.83
11/26/06	8:45:00	31.0	21.17
11/26/06	8:50:00	36.0	21.39
11/26/06	8:55:00	41.0	21.67
11/26/06	9:00:00	46.0	21.86
11/26/06	9:05:00	51.0	22.17
11/26/06	9:10:00	56.0	22.36
11/26/06	9:15:00	61.0	22.51
11/26/06	9:20:00	66.0	22.66
11/26/06	9:25:00	71.0	22.84
11/26/06	9:30:00	76.0	22.95
11/26/06	9:35:00	81.0	23.05
11/26/06	9:40:00	86.0	23.13
11/26/06	9:45:00	91.0	23.25
11/26/06	9:50:00	96.0	23.36
11/26/06	9:55:00	101.0	23.43
11/26/06	10:00:00	106.0	23.50
11/26/06	10:05:00	111.0	23.60
11/26/06	10:10:00	116.0	23.62
11/26/06	10:15:00	121.0	23.65
11/26/06	10:20:00	126.0	23.72
11/26/06	10:25:00	131.0	23.80
11/26/06	10:30:00	136.0	23.88
11/26/06	10:35:00	141.0	23.98
11/26/06	10:40:00	146.0	24.07
11/26/06	10:45:00	151.0	24.15
11/26/06	10:50:00	156.0	24.17
11/26/06	10:55:00	161.0	24.27
11/26/06	11:00:00	166.0	24.27
11/26/06	11:05:00	171.0	24.32
11/26/06	11:10:00	176.0	24.35
11/26/06	11:15:00	181.0	24.40
11/26/06	11:20:00	186.0	24.47
11/26/06	11:25:00	191.0	24.50
11/26/06	11:30:00	196.0	24.55
11/26/06	11:35:00	201.0	24.65
11/26/06	11:40:00	206.0	24.74
11/26/06	11:45:00	211.0	24.79
11/26/06	11:50:00	216.0	24.84
11/26/06	11:55:00	221.0	24.92
11/26/06	12:00:00	226.0	24.96

TABLE A.3-7. AQUIFER-TEST DATA FOR PUMPING WELL LC24M.

DATE	TIME	TIME SINCE PUMPING STARTED (t, min)	TIME SINCE PUMPING STOPPED (t', min)	t/t'	WATER LEVEL (ft below MP)	DRAWDOWN (ft)	DISCHARGE (gpm)	WATER TEMP. (deg C)	CONDUCTIVITY (umhos/cm @ 25 deg C)	pH (units)
11/26/06	14:33:00	-5	--	--	192.14	0.00	--	--	--	--
	14:38:00	PUMP ON								
	14:39:00	1	--	--	205.47	13.33	--	--	--	--
	14:44:00	6	--	--	--	--	12.10	--	--	--
	14:45:00	7	--	--	210.51	18.37	--	--	--	--
	15:03:00	25	--	--	213.51	21.37	--	--	--	--
	15:16:00	38	--	--	214.65	22.51	--	--	--	--
	15:34:00	56	--	--	215.62	23.48	--	--	--	--
	15:35:00	57	--	--	--	--	--	9.9	--	8.22
	15:38:00	60	--	--	--	--	--	9.9	--	8.22
	15:40:00	62	--	--	--	--	--	9.9	--	8.23
	15:40:00	SAMPLE TAKEN								
	15:49:00	71	--	--	216.24	24.10	--	--	--	--
	15:50:00	PUMP OFF								

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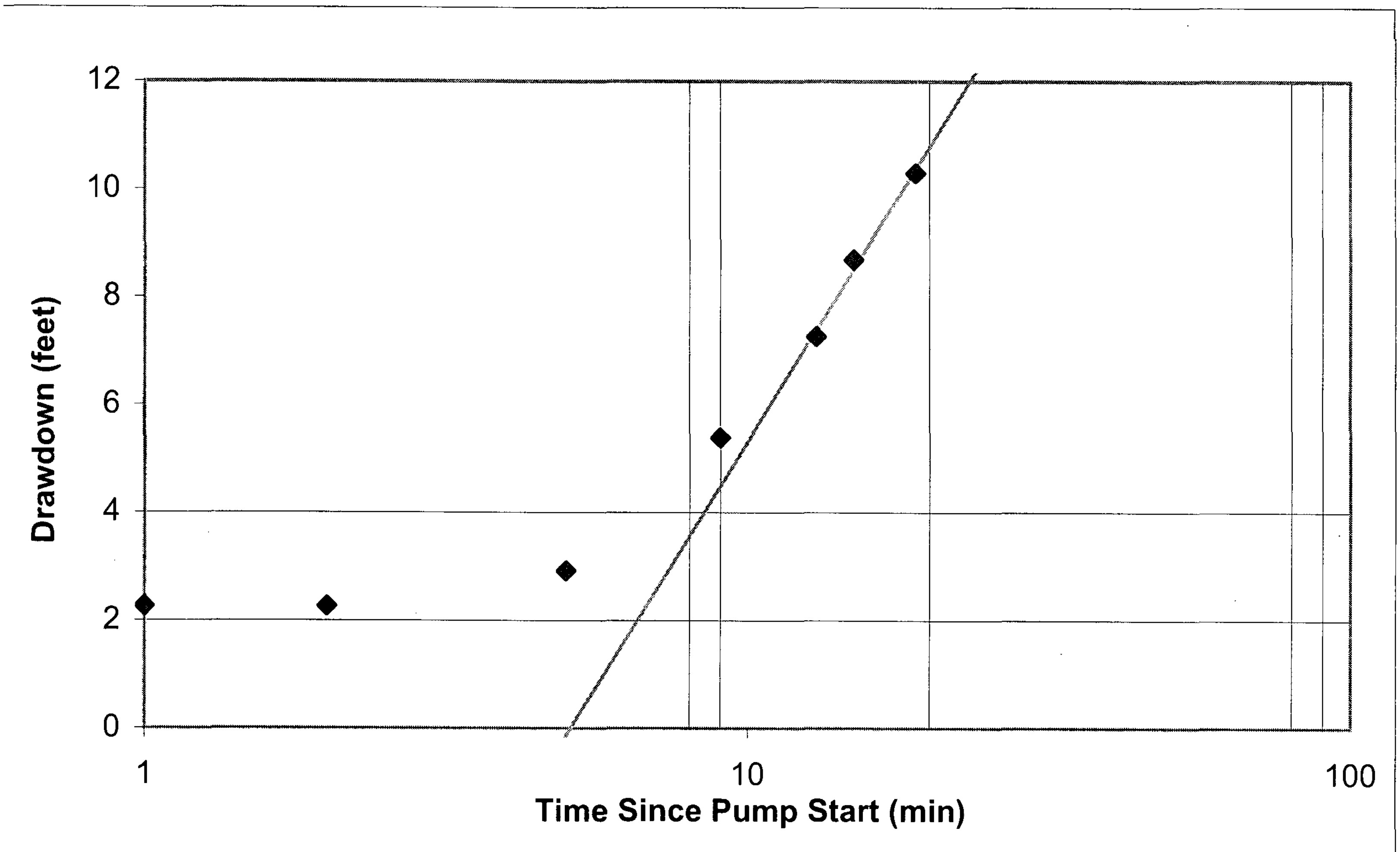
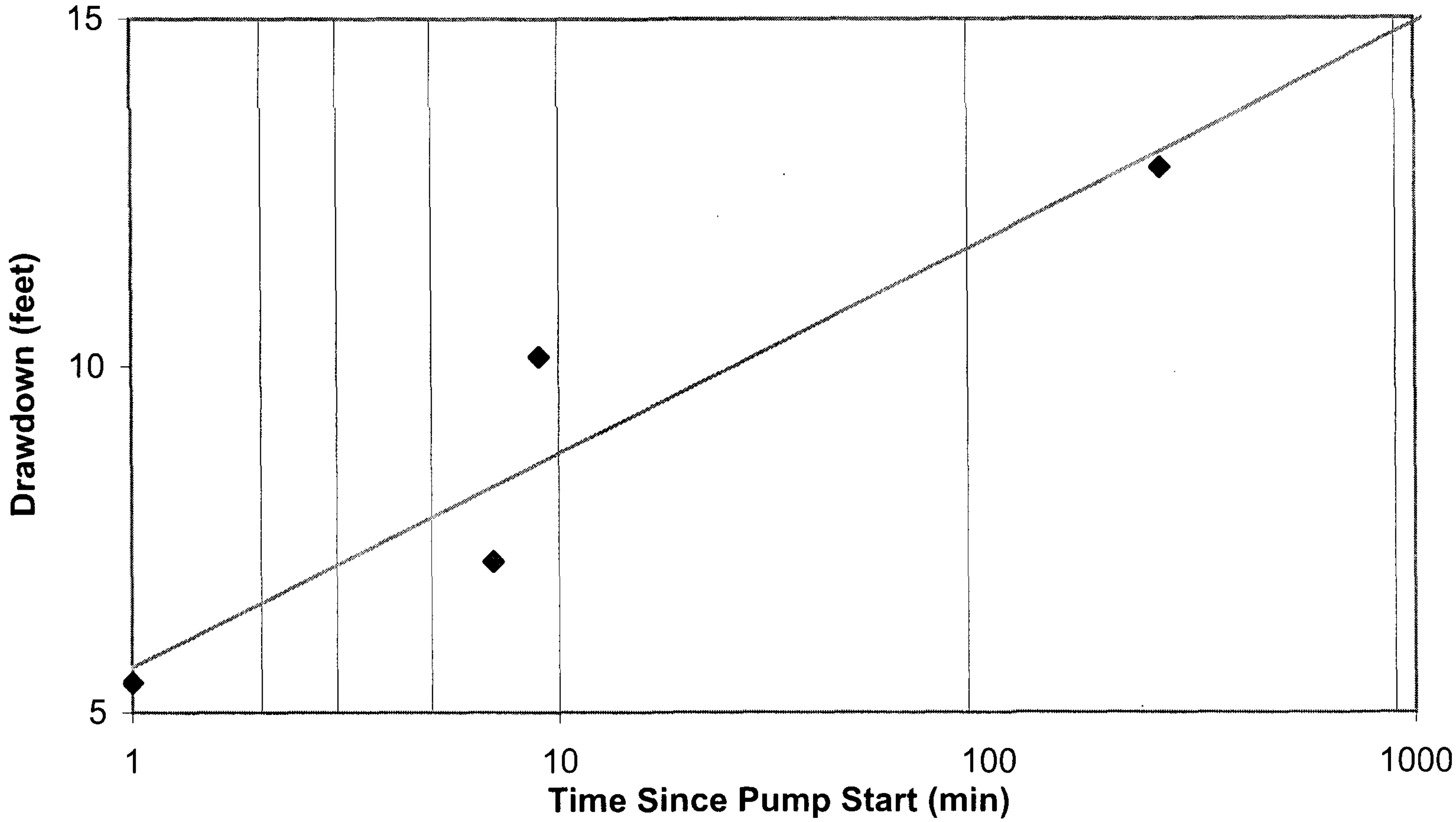


Straight Line Fit

Discharge (gpm)	0.67
Delta s (ft/log cycle time)	18.11
Transmissivity (gal/day/ft)	10

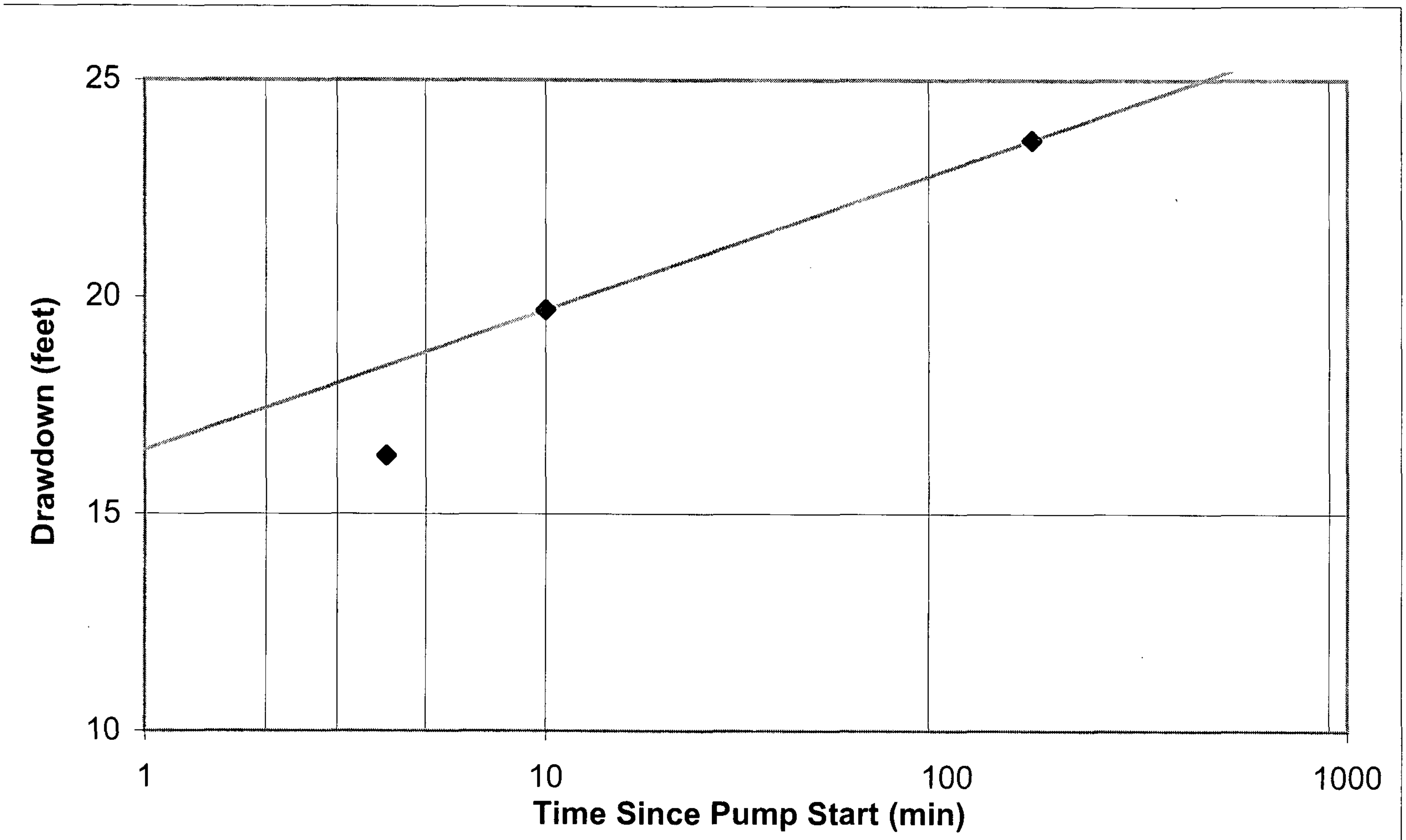
Figure A.4-1. Semilog Analysis of DE Sand Well LC29M



Straight Line Fit

Discharge (gpm)	2.7
Delta s (ft/log cycle time)	3.09
Transmissivity (gal/day/ft)	231

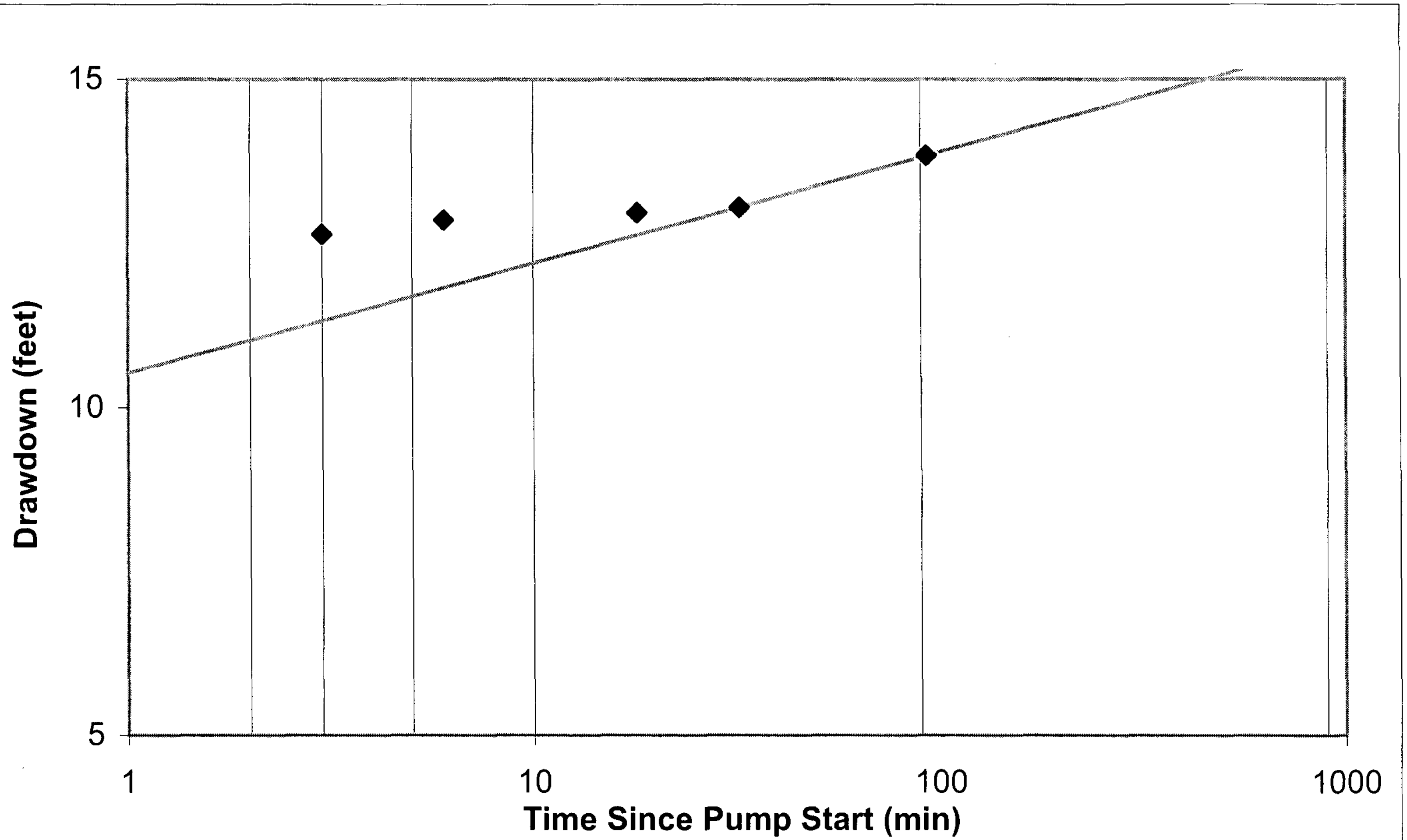
Figure A.4-2. Semilog Analysis of DE Sand Well LC30M - First Test



<u>Straight Line Fit</u>

Discharge (gpm)	7
Delta s (ft/log cycle time)	3.23
Transmissivity (gal/day/ft)	573

Figure A.4-3. Semilog Analysis of DE Sand Well LC30M - Second Test



Straight Line Fit

Discharge (gpm)	7
Delta s (ft/log cycle time)	1.68
Transmissivity (gal/day/ft)	1098

Figure A.4-4. Semilog Analysis of DE Sand Well LC31M

TABLE A.4-1. AQUIFER-TEST DATA FOR PUMPING WELL LC29M.

DATE	TIME	TIME SINCE PUMPING STARTED (t, min)	TIME SINCE PUMPING STOPPED (t', min)	t/t'	WATER LEVEL (ft below MP)	DRAWDOWN (ft)	DISCHARGE (gpm)	WATER TEMP. (deg C)	CONDUCTIVITY (umhos/cm @ 25 deg C)	pH (units)
09/20/06	13:50:00	-5	--	--	153.76	0.00	--	--	--	--
	13:55:00	PUMP ON								
	13:56:00	1	--	--	156.03	2.27	--	--	--	--
	13:57:00	2	--	--	156.03	2.27	--	--	--	--
	14:00:00	5	--	--	156.69	2.93	--	--	--	--
	14:02:00	7	--	--	--	--	0.67	--	--	--
	14:04:00	9	--	--	159.15	5.39	--	--	--	--
	14:08:00	13	--	--	161.03	7.27	--	--	--	--
	14:09:00	14	--	--	--	--	--	10.4	--	7.37
	14:10:00	15	--	--	162.45	8.69	--	--	--	--
	14:12:00	17	--	--	--	--	--	10.8	--	7.47
	14:14:00	19	--	--	164.06	10.30	--	--	--	--
	14:16:00	21	--	--	--	--	--	11	--	7.52
	14:17:00	SAMPLE TAKEN								
	14:26:00	PUMP OFF								

TABLE A.4-2. AQUIFER-TEST DATA FOR PUMPING WELL LC30M (First Test).

DATE	TIME	TIME SINCE PUMPING STARTED (t, min)	TIME SINCE PUMPING STOPPED (t', min)	t/t'	WATER LEVEL (ft below MP)	DRAWDOWN (ft)	DISCHARGE (gpm)	WATER TEMP. (deg C)	CONDUCTIVITY (umhos/cm @ 25 deg C)	pH (units)
09/20/06	9:43:00	-95	--	--	198.75	0.00	--	--	--	--
	11:18:00	PUMP ON								
	11:19:00	1	--	--	204.18	5.43	--	--	--	--
	11:24:00	6	--	--	--	--	3.30	--	--	--
	11:25:00	7	--	--	205.93	7.18	--	--	--	--
	11:27:00	9	--	--	208.89	10.14	--	--	--	--
	15:32:00	254	--	--	211.61	12.86	2.70	--	--	8.1
	15:49:00	271	--	--	--	--	--	9.9	--	7.96
	15:52:00	274	--	--	--	--	--	--	--	7.93
	15:56:00	278	--	--	--	--	--	--	--	8
	16:14:00	296	--	--	--	--	--	9.5	--	7.59
	16:20:00	302	--	--	--	--	--	9.9	--	8
	16:20:00	SAMPLE TAKEN								

TABLE A.4-3. AQUIFER-TEST DATA FOR PUMPING WELL LC30M (Second test).

DATE	TIME	TIME SINCE PUMPING STARTED (t, min)	TIME SINCE PUMPING STOPPED (t', min)	t/t'	WATER LEVEL (ft below MP)	DRAWDOWN (ft)	DISCHARGE (gpm)	WATER TEMP. (deg C)	CONDUCTIVITY (umhos/cm @ 25 deg C)	pH (units)
11/26/06	8:40:00	-10	--	--	199.24	0.00	--	--	--	--
	8:50:00	PUMP ON								
	8:54:00	4	--	--	215.58	16.34	6.00	--	--	--
	9:00:00	10	--	--	218.94	19.70	7.00	--	--	--
	11:33:00	163	--	--	222.85	23.61	--	9.8	--	7.86
	11:42:00	172	--	--	--	--	--	9.7	--	7.67
	11:45:00	175	--	--	--	--	--	9.7	--	7.67
	11:45:00	SAMPLE TAKEN								

TABLE A.4-4. AQUIFER-TEST DATA FOR PUMPING WELL LC31M.

DATE	TIME	TIME SINCE PUMPING STARTED (t, min)	TIME SINCE PUMPING STOPPED (t', min)	t/t'	WATER LEVEL (ft below MP)	DRAWDOWN (ft)	DISCHARGE (gpm)	WATER TEMP. (deg C)	CONDUCTIVITY (umhos/cm @ 25 deg C)	pH (units)
11/26/06	9:30:00	-5	--	--	144.00	0.00	--	--	--	--
	9:35:00	PUMP ON								
	9:38:00	3	--	--	156.65	12.65	--	--	--	--
	9:41:00	6	--	--	156.87	12.87	7.00	--	--	--
	9:53:00	18	--	--	156.98	12.98	--	--	--	--
	10:07:00	32	--	--	157.06	13.06	--	--	--	--
	10:28:00	53	--	--	--	--	--	9.6	--	7.09
	10:33:00	58	--	--	--	--	--	9.4	--	7.51
	10:36:00	61	--	--	--	--	--	9.4	--	7.51
	10:40:00	65	--	--	--	--	--	9.4	--	7.5
	10:40:00	SAMPLE TAKEN								
	11:08:00	93	--	--	157.84	13.84	--	--	--	--
	11:09:00	PUMP OFF								