Appendix B-1

Update to the Site Conceptual Hydrogeologic Model

(Compact Disk)

Appendix B-1: Update to the Site Conceptual Hydrogeologic Model

1.0 Draft Remedial Investigation Work Plan for Site-Wide Groundwater Information

Updates to the conceptual hydrogeologic and groundwater geochemical models for the Site include a general description of the geologic setting, and more detailed information on groundwater conditions based on recent field investigations. As described in the CSM, the Site is located in the Mason Valley, a structurally down-dropped basin surrounded by uplifted mountain ranges, which is typical of basin-and-range topography. The mountain blocks are primarily composed of granitic, metamorphic, and volcanic rocks with minor amounts of semi-consolidated to unconsolidated alluvial fan deposits. The Singatse Range is an area of regional metals mineralization and hydrothermal alteration and hosts the porphyry copper deposits mined from the Yerington and MacArthur open pits.

Other local areas of mineralization include the Blue Stone and Ann Mason mines, and the Bear copper porphyry deposit. The Bear ore deposit is located beneath the sulfide tailings at the Site, in a structurally uplifted segment of the Singatse Range (the "Singatse Spur"). The porphyry copper deposits and associated hydrothermal alteration haloes, near surface and at depth, have the potential to influence groundwater quality in the alluvial aquifer associated with the Site, both in the geologic past and in the present.

Groundwater flow within the alluvial fan, which is composed of transitional and fluvial sedimentary deposits in the vicinity of the Site, occurs within a wedge-shaped graben located beneath the Site and between the Singatse Range and Singatse Spur. The depth to bedrock in this graben increases from 0 feet to approximately 600 feet below ground surface (bgs) in a northward direction from the area of the open pit to approximately the area of Luzier Lane north of the Site. Figure B-1 presents a north-south hydrogeologic cross section through the Site, which extends from the southernmost (B/W-13) to the northernmost (B/W-10) groundwater monitor wells installed as part of the hydrogeologic framework assessment (HFA) program. This generalized cross section (10x vertical exaggeration) depicts the relationship between the bedrock and alluvial groundwater flow

systems, groundwater elevations (measured in July 2007) and the surface of the Yerington Pit Lake (surveyed in September 2007). Key elements of the cross-section include:

- The plane of the cross-section does not intercept a fault-contact relationship between the alluvium and the bedrock. The contacts illustrated are assumed to be depositional, and are more confidently known around the area of the open pit. Note that the precise geometry of the alluvial bedrock contact is unknown along most of the length of the cross-section, except at the pit walls, at B/W-13 and at B/W-11D3 where bedrock was recently intercepted at a depth of 226 feet bgs during Second-Step HFA investigations.
- The groundwater elevation for B/W-13 is higher than other alluvial groundwater elevations, and represents recharge from the Walker River to the Site. Alluvial groundwater elevations within the Site boundary from PAMW-3 to MW-5 decrease seven feet over a distance of 6,750 feet, a gradient of 0.001 feet per foot, indicating a relatively flat potentiometric surface (note that the monitor wells located north of the Site are constructed in the deeper portion of the alluvial aquifer).
- Groundwater elevations in the bedrock and alluvial aquifers around the Yerington Pit Lake appear to be consistent with a refilling pit lake recharged by the alluvial and bedrock flow systems. The majority of the recharge is conceptualized to occur from the Walker River. The dashed potentiometric surface from B/W-13 to the pit lake, and from alluvial well PAMW-3 to bedrock well WW-59 to the lake illustrates this concept. Note that the area of the pit lake is geologically and hydrologically complex, and groundwater conditions in this area will be evaluated further as part of a future Pit Lake RI Work Plan.

The majority of the unconsolidated alluvial deposits in the vicinity of the Site were derived by erosion of the uplifted mountain block of the Singatse Range, with minor deposition of fluvial sediments in the Walker River flood-plain. In addition, lacustrine deposits derived from ancestral Lake Lahontan occur north of the Site (Reheis, 1999). Uplift and erosion of the Singatse Range formed the east-dipping alluvial fan deposits, which include distal facies that extend into the transitional environment. Concurrent with the development of the alluvial fan, the Walker River laid flat-lying sand and gravel deposits in the transitional environment and the main fluvial channel. Flat-lying clay-rich deposits have been preserved in the transitional setting, and are interpreted to have formed within the ancestral Lake Lahontan depositional environment.

Historic reports (e.g., AHA, 1983 and Dalton, 1999) described three hydrostratigraphic zones or aquifers (shallow, intermediate, and deep zones within the alluvial aquifer) in the vicinity of the Evaporation Ponds. These zones were defined on the basis of the occurrence of discrete clay layers, referred to as the Shallow Clay and Deep Clay. Recent borehole information (Brown and Caldwell, 2006) indicates that most of the clay horizons are discontinuous, although a relatively continuous clay horizon may occur at an elevation of approximately 4,240 feet above mean sea level ("amsl") based on its occurrence in adjacent boreholes.

Recharge to bedrock groundwater beneath the Site is conceptualized to occur from Walker River seepage and, to a lesser degree, from the percolation of precipitation and runoff through the fractured bedrock of the Singatse Range. Recharge to the alluvial flow system beneath the Site occurs as a result of Walker River seepage and, to a limited degree, direct percolation of surface and meteoric water. Recharge from direct precipitation on the valley floor was considered to be negligible by Huxel (1969), who estimated the following distribution of recharge to the alluvial aquifers to the Mason Valley hydrographic basin: 3 percent from precipitation that falls on the surrounding mountain ranges; 97 percent from the river and associated agricultural diversions; and less than 0.1 percent from direct precipitation on the valley floor. Based on the results of recent HFA investigations, these relative contributions to groundwater recharge appear to be valid concepts. The pit lake currently has the potential to recharge the alluvial flow system at the western margin of the open pit. Finally, agricultural irrigation practices immediately north of the Site augment natural recharge to the alluvial aquifer. The following bullets summarize the hydrogeologic and groundwater flow aspects of the Site conceptual model:

- Regionally, alluvial groundwater in the Mason Valley flows approximately north near the Site (Nork, 1989). In the vicinity of the Site, the alluvial groundwater flow regime is locally affected by: 1) the Yerington Pit and Pit Lake; 2) bedrock outcrops on the eastern margin of the Site (the Singatse Spur); 3) irrigation and groundwater pumping associated with agricultural activities immediately north of the Site; and 4) groundwater extraction associated with the pumpback well system, which is located on the east and north sides of the Evaporation Ponds.

- Monitor wells installed relatively close to the Walker River southeast of the Site consistently yield the highest groundwater elevations, suggesting that the river is the major source of recharge to the Site, consistent with historic regional interpretations (Huxel, 1969; Seitz et al., 1982; Nork, 1989). Groundwater beneath the Process Areas flows northwesterly, based on groundwater elevation data obtained from monitor wells PA-MW-1 through PA-MW-3.
- Refilling of the Yerington Pit with groundwater derived from bedrock and alluvial flow systems will eventually reach a water balance condition with a range of lake levels influenced by natural recharge and discharge components on a seasonal basis (i.e., recharge from the alluvial and bedrock aquifers during the spring and discharge from the lake surface due to evaporation during the summer).
- The north-northwest groundwater flow direction beneath the Process Areas, and the Site in general (Figure B-2), results from recharge from the Walker River at the southeast margin of the Site (i.e., in the vicinity, and south, of the Yerington Mine open pit). Bedrock outcrops on the eastern margin of the Site (i.e., the Singatse Spur) and west of the Walker River may impede recharge from the river to the alluvial aquifer beneath the northern portion of the Site. Seepage from the West Campbell Ditch and the Walker River north of the Singatse Spur recharge the alluvial aquifer(s) north of the Site.
- The degree or potential for hydraulic communication between the bedrock and alluvial flow systems at various locations within and adjacent to the Site (e.g., Singatse Spur area and the area of the pit lake) is not completely known. Based on the hydrogeologic cross-section (Figure B-1), the two systems appear to be hydraulically connected in the area of the pit lake.
- Groundwater flow in the shallow and possibly the intermediate hydrostratigraphic zones north of the Site is affected by a groundwater mound that develops during the approximate six-to-seven month irrigation season. Mounding occurs when surface water diverted from the Walker River via West Campbell Ditch and a smaller amount of pumped groundwater are applied to the large agricultural area located immediately north of the Site (north of the sulfide tailings area). The geometry and duration of this mound throughout the year is unknown, but likely depends upon the relative amounts of applied surface water and extracted groundwater. During years when flood irrigation occurs for alfalfa crops, the mound is likely to persist for a longer period because of the higher volume of applied water.
- In the deep hydrostratigraphic zone beneath and north of the Site, groundwater flows to the northeast in response to groundwater pumping for agricultural irrigation. Beneath the Evaporation Ponds, the potentiometric surface of the deep hydrostratigraphic zone is relatively flat with a hydraulic gradient of approximately 0.0003 feet/foot (i.e., 0.03 percent). To the northeast of the mine, the hydraulic gradient steepens due to the cone of depression around the pumping irrigation well.

- Seasonal pumping of groundwater from beneath the agricultural area and the distribution of groundwater and surface water conveyed from the Walker River via West Campbell Ditch results in a complex pattern of vertical re-distribution and mixing of water types. These processes affect groundwater flow directions, groundwater chemical quality and geochemical conditions in the alluvial aquifer(s) around the northwest and northwestern margins of the Site.
- Where aquitards (i.e., clay-rich sediments) are not present in the area immediately north of the Site, as noted at the location of MW-2002-1 (shallow well with a screen interval from 19 to 29 feet bgs) and B/W-2D (deep well with a screen interval from 125 to 145 feet bgs), a slight downward vertical gradient (1.63 feet) has been observed.
- The spatial relationship between the bedrock outcrops northwest of the Site, along the eastern margin of the Singatse Range, and the agricultural recharge on the northeast margin of the Site, suggests an approximate mile-wide zone north of the Site for the potential migration of mine-related groundwater. This concept is supported by limited recharge from the Singatse Range (i.e., three percent or less), and the potential for the recharge mound beneath the agricultural area not to completely dissipate.
- The 11 groundwater pumpback wells located on the northern portion of the Site appear to have limited capture zones (approximately 100-foot radius in plan view), based on a limited assessment conducted as part of the First-Step HFA. During the irrigation season, and during those years when the mound persists after the irrigation season ends, groundwater flows to the west in the area of the pumpback wells. This condition would further limit the effectiveness of the system in capturing mine-related groundwater along the northern array of pumpback wells oriented in an east-west direction.
- The groundwater flow velocity in the alluvial aquifer was estimated by Sietz et al. (1982) to be 0.2 feet per day (ft/day), or about 75 feet per year (ft/yr) based on a correlation of aquifer transmissivity to specific capacity, well drilling data for the deeper Anaconda wells located north of the Site, and standard assumptions regarding well efficiencies (e.g., fully efficient) and aquifer characteristics (e.g., homogeneity and isotropy). Based on (unspecified) geotechnical investigations, Nork (1989) reported hydraulic conductivity values ranging from 0.35 to 0.50 feet per day for older alluvial fan deposits and 0.23 to 1.5 ft/day for weathered intrusive rocks, and calculated that the groundwater flow velocity ranged from 16 to 82 ft/yr assuming a porosity of 0.20 and a hydraulic gradient of 0.03 equivalent to the slope of the land surface.
- Hydraulic conductivity was calculated (AHA, 1999) from reported transmissivity values determined from aquifer testing in five shallow hydrostratigraphic zone wells (PW-6, PW-7, PW-9, PW-10 and PW-11) associated with the pumpback well system. Based on an aquifer thickness of 50 feet, the hydraulic conductivity values in the five wells ranged from 6.4 to 32.5 feet/day (see Appendix B-1), and had a geometric mean of 16 feet/day.

- Inactive OUs (i.e., oxide and sulfide tailings, evaporation ponds, waste rock areas, process areas, and the Wabuska Drain) are not likely to be a source of continuous, long-term chemical loading to groundwater given that the low average precipitation and high evaporation on the valley floor would limit infiltration and provide no hydraulic head to allow percolation of chemicals through the vadose zone.
- Deep percolation and chemical loading to groundwater may occur locally (e.g., in topographic depressions) or temporarily (e.g., during larger precipitation events). Such conditions will be characterized during the OU-specific RIs, as appropriate (e.g., vadose zone characterization described in the Process Areas RI Work Plan). Given that ongoing fluid management operations are associated with the Arimetco Facilities, sourcing of chemicals to the vadose zone, and potentially to groundwater, may continue to occur from these operations.

Geochemical aspects of the conceptual model for the Site are preliminary and general in nature, and will be further refined based on data collected pursuant to the Second-Step HFA field investigations. Selected wells and chemicals discussed below represent geochemical conditions associated with Site-wide locations that have been subjected to initial HFA investigations, and are not intended to be comprehensive. The term 'elevated', as used below, is based on empirical observations and must be subjected to a more rigorous evaluation, including a statistical analysis of background groundwater chemical conditions up-gradient and down-gradient of the Site. Information supporting the conceptual geochemical model elements for the Site described below include hydrographs and time-concentration plots (Appendix B-2), trilinear diagrams illustrating the major ion compositions of identified groundwater types (Appendix B-3), maps illustrating the distribution of chemicals in groundwater beneath the Process Areas (Appendix B-4) and box and whisker plots for selected chemicals in monitor wells at the Site (Appendix B-5).

Preliminary chemical concentration contour maps illustrating the distribution of selected chemicals (sulfate, uranium and total alkalinity), and distribution maps (without contours) of iron and pH values in the shallow, intermediate and deep hydrostratigraphic zones at the Site are provided in Figures B-3 through B-17. These maps have been developed using data from existing monitor wells, domestic wells with documented screen intervals,

zonal groundwater samples collected during the First-Step HFA, and available zonal groundwater samples collected during the ongoing Second-Step HFA. Upon completion of the Second-Step HFA activities, the chemical and parameter contour maps will be revised using concurrent data from monitor wells and domestic wells with known screen intervals. The following bullets summarize the geochemical aspects of the Site conceptual model:

- Potential groundwater quality end members include: 1) background waters in both mineralized and non-mineralized geologic settings; 2) mine-related groundwater; and 3) irrigation water composed of pumped groundwater and Walker River water (relative volumes of each may change during the course of an irrigation season). Background waters include areas where chemical compositions appear to be directly related to surface water recharge from the Walker River (e.g., B/W-14 and-15) and irrigation conveyances (e.g., the West Campbell Ditch), and areas where groundwater composition may be influenced by mineralization and hydrothermal alteration (e.g., down-gradient of the MacArthur Mine or in contact with the alteration halo associated with the Bear porphyry copper deposit beneath the sulfide tailings at the Site).
- Aquifer geochemical processes include: 1) chemical reactions associated with mixing of different water types having different chemical compositions, oxidation-reduction potential ("ORP"), ionic strengths and/or chemical activities that may result in precipitation and/or dissolution of various mineral phases; 2) sorption and/or desorption of metals and metalloids on aquifer solids; and 3) potential evapo-concentration of constituents due to groundwater recycling and enrichment of chemicals during operation of the pumpback well system. Other processes affecting chemical fate and transport include advection/dispersion and, possibly, colloid transport.
- Groundwater quality in the three hydraulically up-gradient monitor wells (B/W-13, -14 and -15), recharged by the Walker River, indicates: 1) circum-neutral pH with average values of 7.83 to 7.57; 2) relatively low TDS concentrations of 383, 275 and 180 milligrams per liter (mg/L) in B/W-13, B/W-14 and B/W-15, respectively; and 3) relatively low concentrations of major ions, metals/metalloids and radiochemicals with minor exceptions (e.g., elevated arsenic concentrations in B/W-14 and elevated sulfate concentrations in B/W-13).
- Groundwater quality data in the area of the Singatse Range alluvial fan, as represented by B/W-13, indicate: 1) circum-neutral pH that averaged 7.86 s.u.; 2) a mixed major ion water composition with average sulfate and total alkalinity concentrations of 107 and 122.5 mg/L, respectively; and 3) low concentrations of major ions, metals/metalloids and radiochemicals.
- Mine-related groundwater compositions are variable depending on the nature of the historic mineral processing activity at various locations throughout the Site,

and/or ongoing fluid management operations associated with the Arimetco Facilities. Irrigation water composition appears to vary temporally and exhibit a complex pattern of vertical re-distribution and mixing of water types that include ambient groundwater north of the Site pumped from the agricultural wells and surface water.

- Data from Process Areas borehole grab samples and monitor wells PAMW-1, -2 and -3 indicate: circum-neutral pH (7.2 to 7.8); locally elevated concentrations of major ions (sulfate, calcium, magnesium, sodium and potassium), metals/metalloids (aluminum, beryllium, cadmium, chromium, copper, cobalt, iron, mercury, nickel, lead, selenium, thallium and zinc) and uranium; elevated chemicals in groundwater grab samples from PA-GW18, PA-GW19 and PA-GW23 associated with the inactive iron launders; and elevated concentrations from grab samples PA-GW7 and PA-GW4, which appear to have resulted from historic ore processing activities located to the south of the Process Areas.
- Data from beneath the remainder of the Site, as represented by shallow monitor wells near the Oxide Tailings (e.g., MW-2 and UW-1), Phase IV – VLT Heap Leach Pad (e.g., MW-5) and pumpback wells in the area of the Lined and Pumpback Evaporation Ponds (e.g., PW-1 through PW-11) indicate: 1) acidic to slightly acidic pH with values ranging from approximately 3.7 to 5.0 in groundwater near the Oxide Tailings, Phase IV – VLT Heap Leach Pad, unlined Evaporation Ponds and extreme southeastern portion of the pumpback well system (e.g., PW01 to PW-03); 2) elevated major ions, especially sulfate; 3) depressed or non-detectable total alkalinity beneath the unlined Evaporation Ponds; 4) elevated alkalinity (e.g., >500 mg/L) near the pumpback well system, especially down-gradient of the Weed Heights Sewage Lagoons; and 5) elevated metals/metalloids (e.g., aluminum, copper, iron, manganese, nickel, vanadium and zinc) and uranium.
- Beneath the unlined Evaporation Ponds and Phase IV – VLT Heap Leach Pad, where the most elevated chemical concentrations in groundwater occur in existing monitor wells, concentrations generally decrease from the shallow to deeper hydrostratigraphic zones. Concentrations of sulfate and uranium decrease by approximately one order of magnitude, iron decreases by approximately three orders of magnitude, total alkalinity increases by approximately three orders of magnitude, and pH increases by approximately two standard units (s.u.), between the shallow and deep hydrostratigraphic zones. Elevated chemical concentrations in groundwater beneath the unlined Evaporation Ponds and Phase IV – VLT Heap Leach Pad also decrease laterally by varying orders of magnitude as a result of various attenuation processes. For example, sulfate decreases from 23,250 mg/L in shallow well MW-5 to 535 mg/L in the shallow zonal samples at B/W-4, and uranium decreases from 4,750 ug/L in well MW-5 to approximately 100 ug/L approximately 3,000 feet north of the Evaporation Ponds.
- Groundwater data in the areas located to the west, northwest and north of the Site (as represented by monitor wells B/W-1 through B/W-10 and domestic wells DW-2, -4, -10, -18, -36, -38, -39, -40, -41, -43, -45, -46, -47, -48, -49, -50, and -

52) indicate: 1) a circum-neutral pH ranging from approximately 7.0 to slightly less than 8.0 s.u.; 2) variable but generally low concentrations of major ions, metals/metalloids and radionuclides; 3) an area with elevated salt concentrations (e.g., sodium, potassium and chloride) and sulfate located west and northwest of the inactive Lined Evaporation Ponds and west of the western margin of the Sunset Hills development; and 4) an area of groundwater dominated by calcium located north of the Sulfide Tailings and east of the western margin of the Sunset Hills development.

- The preliminary sulfate contour map for the shallow aquifer (Figure B-3) indicates that: 1) elevated concentrations (in excess of 1,000 mg/L) underlie most of the evaporation ponds and a portion of the sulfide tailings, and appear to extend north of the Site by approximately 3,000 feet; 2) concentrations in excess of 10,000 mg/L occur in the area of the pumpback wells and the evaporation ponds; 3) west of the pumpback wells, lower sulfate concentrations may result from the seepage of treated sewage into groundwater, potentially reducing sulfate to sulfides; 4) the geometry of the contours north of the Site suggests that sulfate concentrations are affected by agricultural applications; and 5) the lateral occurrence of sulfate north of the Site is generally consistent with electrical geophysical survey results performed by the BLM (Lewis, 2000).
- The preliminary sulfate contour map for the intermediate aquifer (Figure B-4) indicates that: 1) the lateral extent of data is limited relative to that for the shallow aquifer, and is being addressed during the ongoing Second-Step HFA; 2) elevated concentrations (in excess of 1,000 mg/L) occur in the area of the evaporation ponds and along the northern margin of the sulfide tailings; and 3) a limited number of locations with concentrations in excess of 100 mg/L occur north of the Site, which do not appear to be continuous with the elevated concentrations beneath the northern portion of the Site.
- The preliminary sulfate contour map for the deep aquifer (Figure B-5) indicates: 1) the lateral extent of data is very limited relative to the shallow aquifer; 2) elevated concentrations (in excess of 1,000 mg/L) occur in the area of the evaporation ponds and along the northern margin of the sulfide tailings; and 3) no concentrations in excess of 100 mg/L occur north of the Site.
- The preliminary uranium contour map for the shallow aquifer (Figure B-6) indicates that: 1) elevated concentrations (in excess of 100 ug/L) underlie most of the evaporation ponds and a portion of the sulfide tailings, and appear to extend north of the pumpback wells by approximately 3,000 feet (uranium concentrations further north exhibit a potentially random distribution with values up to 100 ug/L); 2) two locations with concentrations in excess of 1,000 ug/L occur in the area of the evaporation ponds; and 3) several locations in the Process Areas exceed 50 ug/L.

- The preliminary uranium contour map for the intermediate aquifer (Figure B-7) indicates that: 1) concentrations in excess of 50 ug/L randomly occur beneath the evaporation ponds and along the northern margin of the sulfide tailings; and 2) uranium values further north exhibit a potentially random distribution with values up to 50 ug/L.
- The preliminary uranium contour map for the deep aquifer (Figure B-8) indicates that: 1) concentrations in excess of 50 ug/L sporadically occur beneath the evaporation ponds and along the northern margin of the sulfide tailings; and 2) uranium concentrations further north exhibit a potentially random distribution with values up to 42 ug/L.
- The preliminary alkalinity contour map for the shallow aquifer (Figure B-9) indicates that: 1) elevated concentrations in excess of 250 mg/L occur beneath the Process Areas and the Lined Evaporation Ponds, in a small area below the west side of the Peri agricultural area, and north of the Site by approximately 1,500 feet (alkalinity values further north exhibit a potentially random distribution with values up to 200 mg/L); 2) the highest concentrations occur in pumpwells PW-9 through PW-11, considered to be hydraulically down-gradient of the Sewage Lagoons; and 3) very low values (<1 mg/L) occur beneath the Unlined Evaporation Pond and the west side of the sulfide tailings.
- The preliminary alkalinity contour map for the intermediate aquifer (Figure B-10) indicates: 1) elevated values in excess of 250 mg/L beneath the lined evaporation ponds, and along the northern margin of the sulfide tailings; and 2) concentrations beneath the Site, up-gradient of the Site and north of the Site vary from 50 to 170 mg/L.
- The preliminary alkalinity contour map for the deep aquifer (Figure B-11) indicates that: 1) one location of 2,000 mg/L at the northwest corner of the Unlined Evaporation Pond, and one location of 250 mg/L north of the sulfide tailings; and 2) concentrations beneath the Site, up-gradient of the Site and north of the Site vary from 70 to 165 mg/L.
- The preliminary iron distribution map for the shallow aquifer (Figure B-12) indicates that: 1) elevated concentrations in excess of 100 mg/L occur along or adjacent to the western margin of the unlined evaporation ponds and the northwestern portion of sulfide tailings extending along the Pumpback System Evaporation Ponds, and concentrations of about 30 mg/L occur at two other locations beneath the sulfide tailings; and 2) the remaining concentrations beneath the Site, up-gradient of the Site and north of the Site are low, generally less than 0.1 mg/L.
- The preliminary iron distribution map for the intermediate aquifer (Figure B-13) indicates that: 1) a single very high concentration (2,505 mg/L) occurs at a single location near the northwest corner of the unlined evaporation ponds and an elevated concentration in excess of 250 mg/L occurs near the northwest corner of the sulfide tailings; and 2) the remaining concentrations beneath the Site, up-gradient of the Site and north of the Site are low, generally less than 0.1 mg/L.

- The preliminary iron distribution map for the deep aquifer (Figure B-14) indicates that, with the exception of a single 5.3 mg/L value near the northwest corner of the unlined evaporation ponds, concentrations beneath the Site, up-gradient of the Site and north of the Site are less than 0.1 mg/L.
- The preliminary distribution map for pH values for the shallow aquifer (Figure B-15) indicates that: 1) values less than 6 s.u. occur in the area of the evaporation ponds and the northern margin of the sulfide tailings, including a number of locations with values less than 4 s.u. near the northwest corner of the sulfide tailings extending along the Pumpback System Evaporation Ponds; 2) values west of the Site equal to or greater than 8 s.u.; and 3) circum-neutral values for locations up-gradient and north of the Site, and portions of the site south of the sulfide tailings, including the Process Areas.
- The preliminary distribution map for pH values for the intermediate aquifer (Figure B-16) indicates that: 1) relative to the shallow aquifer, a greater number of values at locations west and north of the Site are equal to or greater than 8 s.u.; and 2) all remaining locations exhibit circum-neutral values, with the exception of one location near the northwest corner of the unlined evaporation pond that has a value less than 6 s.u.
- The preliminary distribution map for pH values for the deep aquifer (Figure B-17) indicates it is very similar to that of the intermediate aquifer, with the location near the northwest corner of the unlined evaporation pond exhibiting a value between 6 and 7 s.u., and one location in the Process Areas with a value between 6 and 7 s.u.

The information provided in the sulfate, uranium and other contour maps indicates that a combination of both mine-related and naturally occurring groundwater has migrated off the Site to the north, primarily in the shallow zone of the alluvial flow system, and that active geochemical processes are effectively attenuating the chemicals both laterally and vertically in the alluvial flow system. Also, the chemical distribution maps provide the basis for evaluating background concentrations for the Site.

2.0 Draft Remedial Investigation Work Plan for Yerington Pit Lake Information

A conceptual model of the Yerington Pit Lake is provided in Figure B-18. The pit lake hydrograph, including the projected "steady-state" lake elevation, is shown in Figure B-19. Gill (1951) summarized groundwater conditions in the proposed open pit area (e.g., groundwater inflow and dewatering rate estimates), as summarized below:

- Pumping tests for 10 months in 1945 in the range of 1,000 to 1,400 gpm indicated that: 1) inflows from outside the basin (i.e., derived from the Walker River) would be in the 1,200 to 1,400 gpm range and account for 85 percent of the pumped water, and 2) the remainder of the pumped water would be derived from within the basin (i.e., derived from Singatse Range recharge, 200 gpm if the pit floor was lowered 50 feet per year);
- The recovery of groundwater after test pumping ceased indicated that the major source of water inflows was located south and east of the proposed open pit, and little water from the west;
- The Walker River was considered to be the major source of inflows, and the concept of intercepting these inflows at a location east of the pit was proposed to reduce pumping costs and potential interruptions to mining;
- Ultimately, the largest degree of uncertainty associated with pit dewatering focused on the permeability of the fractured bedrock associated with the orebody, and its connection to recharge from the river;
- Specific locations (i.e., 'fissures') within the orebody were identified as being 'permeable'

Dewatering of the Yerington Pit to support mining operations beneath the pre-mining potentiometric surface of approximately 4,350 to 4,375 feet amsl (Seegmiller, 1979) required the use of perimeter wells. Although little information is available for individual wells used to dewater the pit, the combined average production rate of up to 2,100 gpm was adequate to allow open pit mining to advance to the 3,800-foot elevation.

The range of reported pre-mining groundwater elevations is not uncommon in fractured bedrock flow systems where clay-filled faults can compartmentalize groundwater flow into discrete hydrogeologic blocks. Seegmiller (1979) noted that perched groundwater was a common occurrence in most of the pit slopes. Although, on the scale of the pit, the fractured granitic bedrock transmits groundwater as an effective porous media, discrete structural elements in the Yerington Pit will likely influence groundwater inflows. Typically, groundwater flow is: 1) impeded across clay-bearing or clay-rich faults and flow is enhanced along the strike of structures that exhibit brittle fracture (with open spaces); and 2) enhanced along brittle fracture or fault zones characterized by open spaces. The concept of groundwater being locally compartmentalized is supported by the map of pit structural elements (Figure B-20).

Figure B-21 depicts a conceptualized cone-of-depression around the pit lake, based on July 2007 groundwater elevation measurements in nearby monitor wells and the September 2007 surveyed elevation of the pit lake surface. The geometry of the conceptualized cone-of-depression infers that isotropic rock mass and hydraulic conductivity conditions occur in the fractured bedrock aquifer around the pit (isotropic conditions are not expected because of compartmentalized groundwater flow in the fractured and altered bedrock).

In summary, the area of the pit lake is geologically and hydrologically complex, although groundwater elevations in the bedrock and alluvium surrounding the Yerington Pit Lake generally appear to be consistent with a refilling pit lake recharged by the alluvial and bedrock flow systems. The majority of the recharge is conceptualized to occur from the Walker River to the east of the pit, as indicated by the dashed potentiometric surface from B/W-13 to the pit lake. The dashed potentiometric surface from alluvial well PAMW-3 to bedrock well WW-59 to the lake in Figure B-3 suggests that a hydraulic connection between the alluvium and bedrock exists in this area, and that a groundwater divide, at least in the alluvium and potentially in the bedrock, may exist north of the pit lake.

3.0 References

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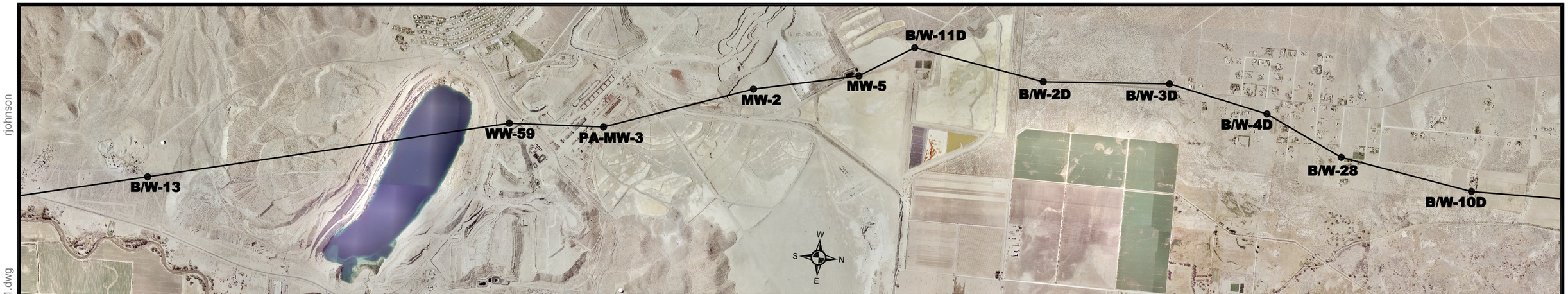
SCS, 1984, *Soil Survey of Lyon County Area, Nevada*, Soil Conservation Service, U.S. Department of Agriculture.

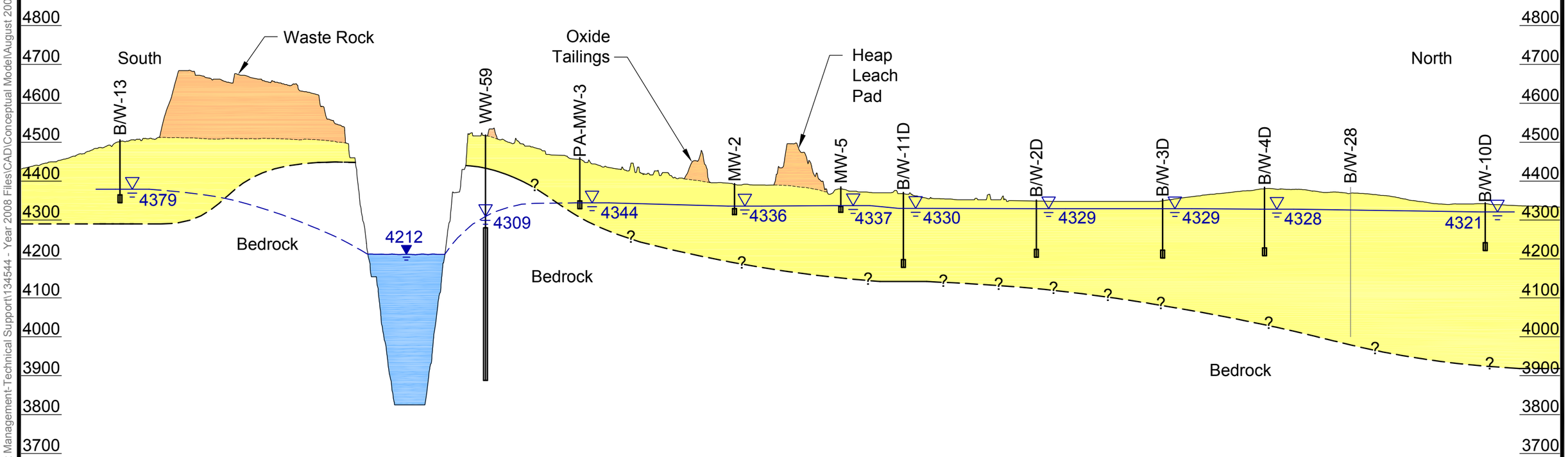
Appendix B-1

Figures

(Compact Disk)



PLAN
SCALE: 1"=2500'



PROFILE
HORIZONTAL SCALE: 1"=2500' VERTICAL SCALE: 1"=250'
10X VERTICAL EXAGGERATION

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BROWN AND CALDWELL

Date: August 2008

Atlantic Richfield Company

Project: 134544

1,250 0 1,250 2,500 FEET

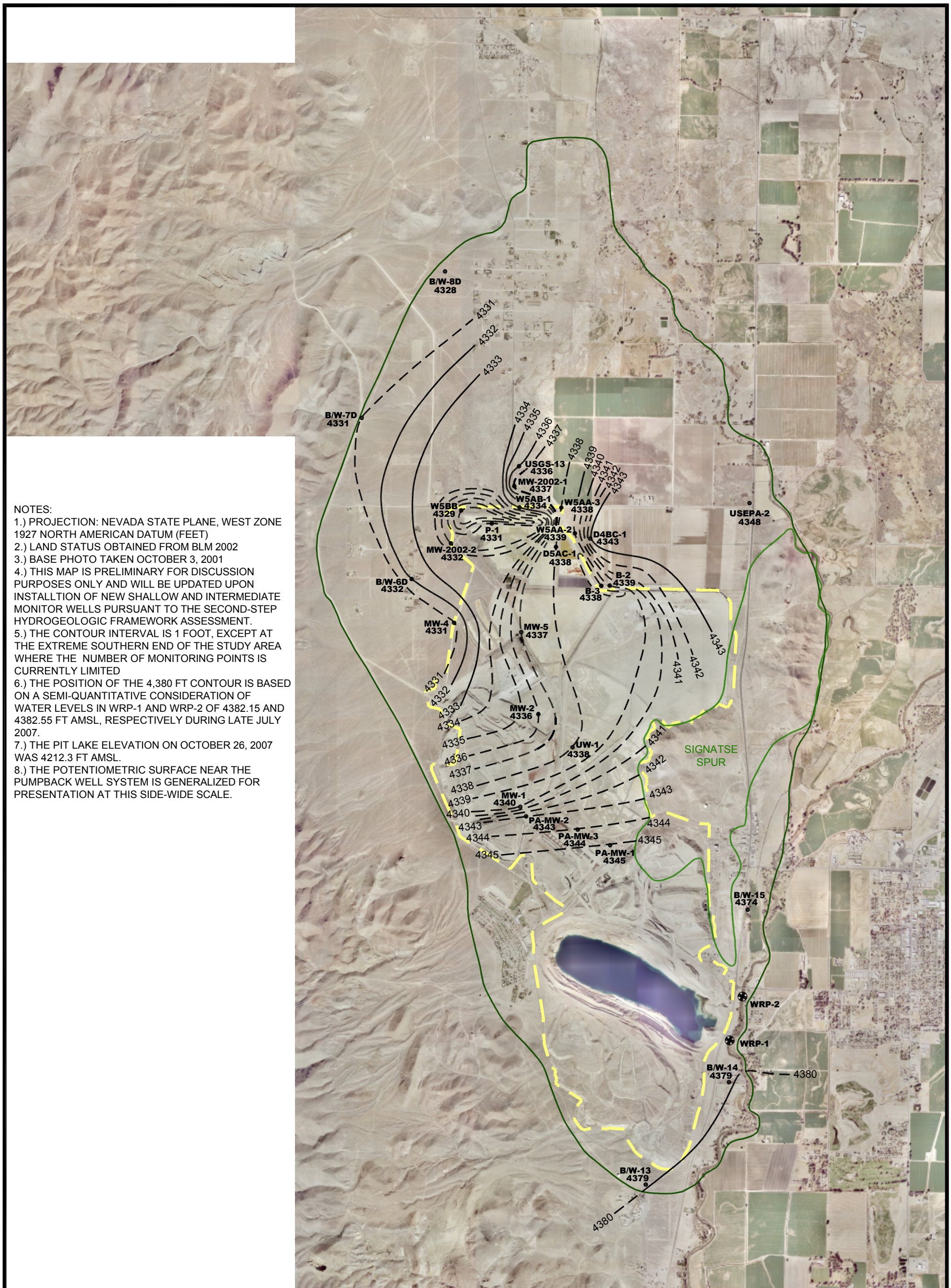
Explanation
- Mine Waste
- Alluvium

Notes:
1. Groundwater Level Measurements from July 2007.
2. Pit Lake Level Measured on October 26, 2007.
3. Bedrock Encountered while Drilling at B/W-11D3 during November 2007.

Figure B-1

Generalized Hydrogeologic Cross Section (South to North)

rjohnson
P:\Arco-Yerington\Project Management-Technical Support\134544 - Year 2008 Files\CAD\Conceptual Model\August 2008\Appendix B\Figure B-1.dwg



NOTES:
1.) PROJECTION: NEVADA STATE PLANE, WEST ZONE 1927 NORTH AMERICAN DATUM (FEET)
2.) LAND STATUS OBTAINED FROM BLM 2002
3.) BASE PHOTO TAKEN OCTOBER 3, 2001
4.) THIS MAP IS PRELIMINARY FOR DISCUSSION PURPOSES ONLY AND WILL BE UPDATED UPON INSTALLTION OF NEW SHALLOW AND INTERMEDIATE MONITOR WELLS PURSUANT TO THE SECOND-STEP HYDROGEOLOGIC FRAMEWORK ASSESSMENT.
5.) THE CONTOUR INTERVAL IS 1 FOOT, EXCEPT AT THE EXTREME SOUTHERN END OF THE STUDY AREA WHERE THE NUMBER OF MONITORING POINTS IS CURRENTLY LIMITED
6.) THE POSITION OF THE 4,380 FT CONTOUR IS BASED ON A SEMI-QUANTITATIVE CONSIDERATION OF WATER LEVELS IN WRP-1 AND WRP-2 OF 4382.15 AND 4382.55 FT AMSL, RESPECTIVELY DURING LATE JULY 2007.
7.) THE PIT LAKE ELEVATION ON OCTOBER 26, 2007 WAS 4212.3 FT AMSL.
8.) THE POTENTIOMETRIC SURFACE NEAR THE PUMPBACK WELL SYSTEM IS GENERALIZED FOR PRESENTATION AT THIS SIDE-WIDE SCALE.

EXPLANATION

WRP-1 Piezometer

Site Boundary

Study Area

B/W-13 4379 — Well Name and Location; July 2007 Water Elevation (Feet, AMSL)

4330 — Water Elevation Contour (Feet, AMSL) Dashed Where Inferred

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BROWN AND CALDWELL

Date: August 2008

Atlantic Richfield Company

Project: 134544

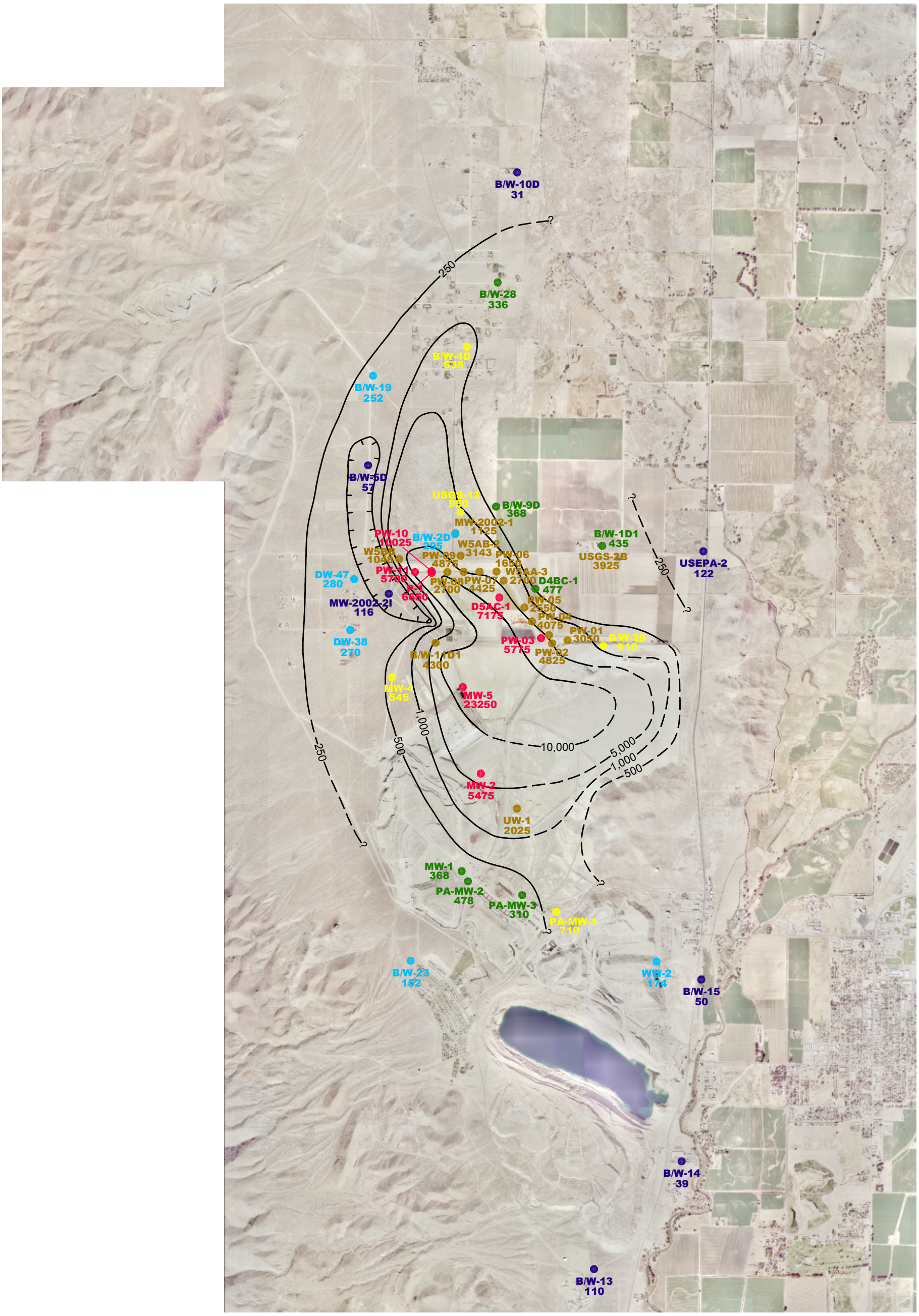
N W E S

1,500 0 1,500 3,000 FEET

Figure B-2

Preliminary Potentiometric Surface Map Combined Shallow and Intermediate Hydrostratigraphic Zones (July 2007)

P:\Arco-Yerington\Project Management-Technical Support\134544 - Year 2008 Files\CAD\Conceptual Model\August 2008\Appendix B\Figure B-2.dwg Aug 26, 2008 - 2:00pm rjohnson



NOTES:
1.) PROJECTION: NEVADA STATE PLANE, WEST ZONE 1927 NORTH AMERICAN DATUM (FEET)
2.) BASE PHOTO TAKEN OCTOBER 3, 2001
3.) AMSL = ABOVE MEAN SEA LEVEL
4.) DATASET INCLUDES ALKALINITY MEASUREMENTS COLLECTED DURING SAMPLING AT SHALLOW MONITORING WELLS AND ZONAL SAMPLING CONDUCTED IN CONJUNCTION WITH MONITORING WELL INSTALLATION
5.) DOMESTIC WELLS IDENTIFIED ON THIS FIGURE WERE SELECTED BASED ON THE AVAILABILITY OF WELL CONSTRUCTION DATA AND SCREEN POSITION RELATIVE TO THE GROUNDWATER DEPTH INTERVALS EVALUATED.
6.) GROUNDWATER DEPTH INTERVAL DEFINITION:
SHALLOW - DATA COLLECTED ABOVE 4,300 FEET AMSL,
INTERMEDIATE - DATA COLLECTED BETWEEN 4,240 AND 4,300 FEET AMSL,
DEEP - DATA COLLECTED BELOW 4,240 FEET AMSL.

EXPLANATION

- <150
- 150.1 to 300
- 300.1 to 500
- 500.1 to 1,000
- 1,000.1 to 5,000
- >5,000.1

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BROWN AND CALDWELL

Date: August 2008

Atlantic Richfield Company

Project: 134544

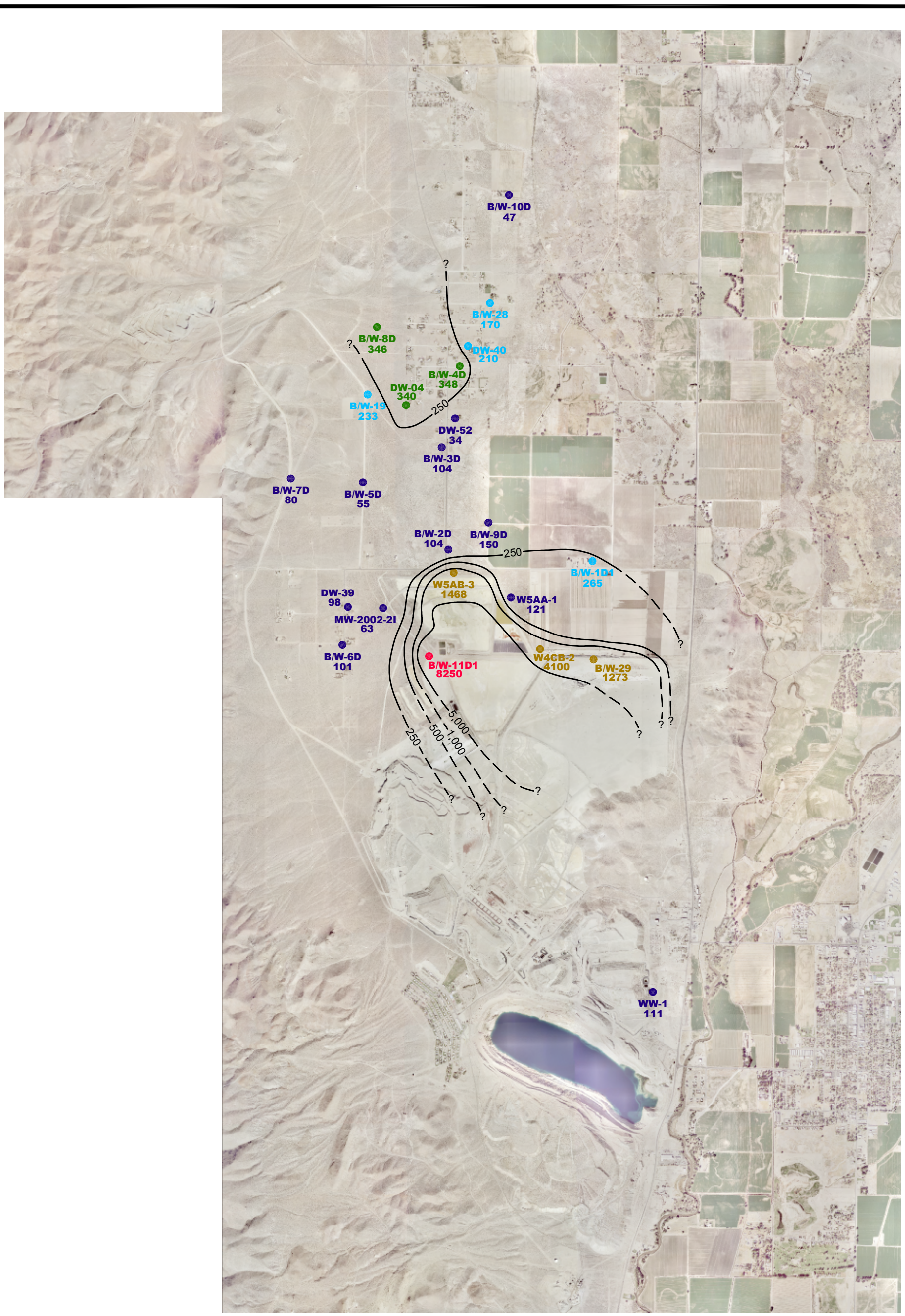
N W E S

1,500 0 1,500 3,000 FEET

Figure B-3

Preliminary Sulfate Concentration Contour Map for the Shallow Aquifer

P:\Arco-Yerington\Project Management-Technical Support\134544 - Year 2008 Files\CAD\Conceptual Model\August 2008\Appendix B\Figure B-3.dwg Aug 26, 2008 - 1:55pm rjohnson



NOTES:
1.) PROJECTION: NEVADA STATE PLANE, WEST ZONE 1927 NORTH AMERICAN DATUM (FEET)
2.) BASE PHOTO TAKEN OCTOBER 3, 2001
3.) AMSL = ABOVE MEAN SEA LEVEL
4.) DATASET INCLUDES ALKALINITY MEASUREMENTS COLLECTED DURING SAMPLING AT SHALLOW MONITORING WELLS AND ZONAL SAMPLING CONDUCTED IN CONJUNCTION WITH MONITORING WELL INSTALLATION
5.) DOMESTIC WELLS IDENTIFIED ON THIS FIGURE WERE SELECTED BASED ON THE AVAILABILITY OF WELL CONSTRUCTION DATA AND SCREEN POSITION RELATIVE TO THE GROUNDWATER DEPTH INTERVALS EVALUATED.
6.) GROUNDWATER DEPTH INTERVAL DEFINITION:
SHALLOW - DATA COLLECTED ABOVE 4,300 FEET AMSL,
INTERMEDIATE - DATA COLLECTED BETWEEN 4,240 AND 4,300 FEET AMSL,
DEEP - DATA COLLECTED BELOW 4,240 FEET AMSL.

EXPLANATION

- <150
- 150.1 to 300
- 300.1 to 500
- 500.1 to 1,000
- 1,000.1 to 5,000
- >5,000.1

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BROWN AND CALDWELL

Date: August 2008

Atlantic Richfield Company

Project: 134544

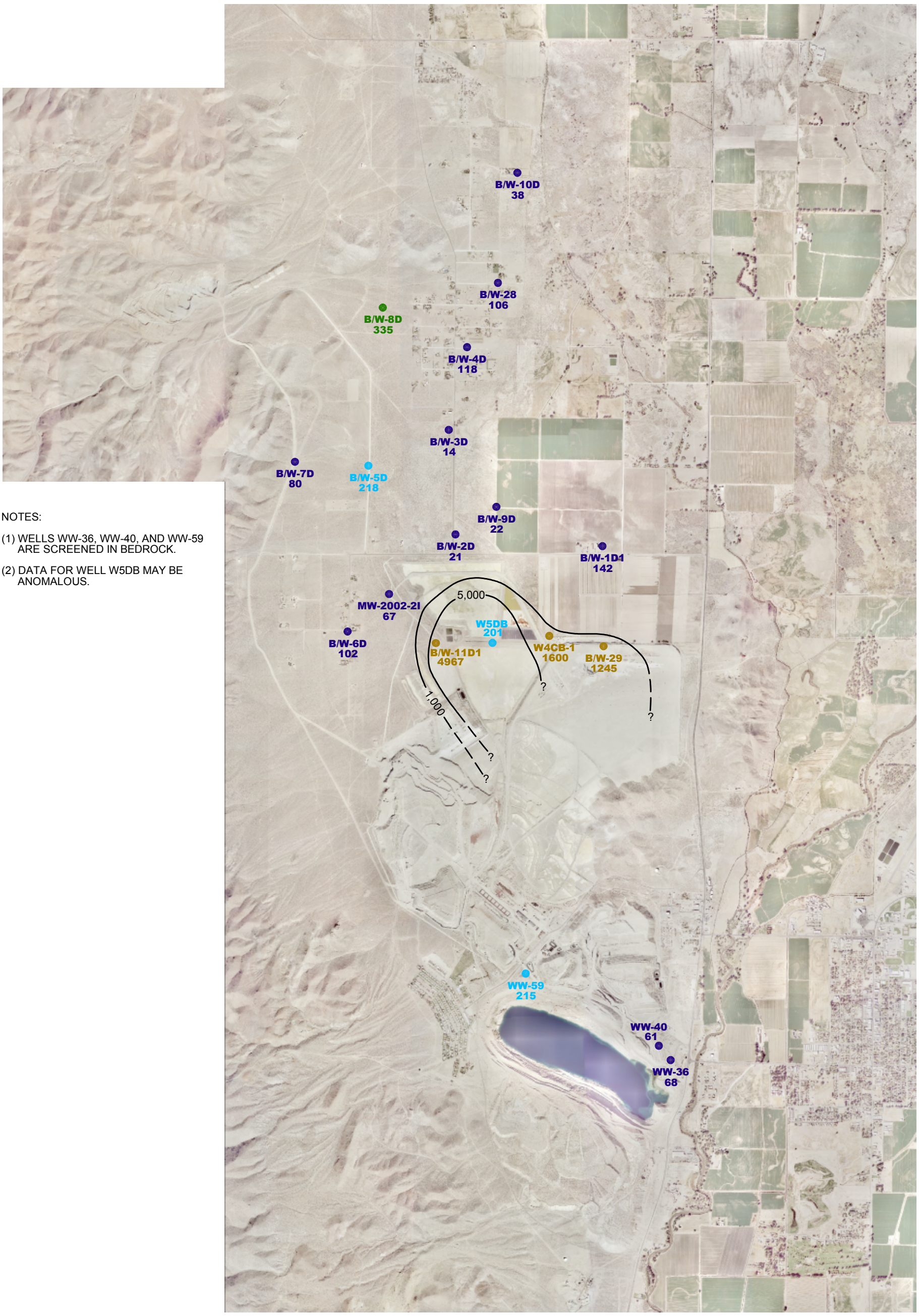
N W E S

1,500 0 1,500 3,000 FEET

Figure B-4

Preliminary Sulfate Concentration Contour Map for the Intermediate Aquifer

P:\Arco-Yerington\Project Management-Technical Support\134544 - Year 2008 Files\CAD\Conceptual Model\August 2008\Appendix B\Figure B-4.dwg Aug 26, 2008 - 1:52pm rjohnson



NOTES:

(1) WELLS WW-36, WW-40, AND WW-59 ARE SCREENED IN BEDROCK.

(2) DATA FOR WELL W5DB MAY BE ANOMALOUS.

NOTES:
1.) PROJECTION: NEVADA STATE PLANE, WEST ZONE 1927 NORTH AMERICAN DATUM (FEET)
2.) BASE PHOTO TAKEN OCTOBER 3, 2001
3.) AMSL = ABOVE MEAN SEA LEVEL
4.) DATASET INCLUDES ALKALINITY MEASUREMENTS COLLECTED DURING SAMPLING AT SHALLOW MONITORING WELLS AND ZONAL SAMPLING CONDUCTED IN CONJUNCTION WITH MONITORING WELL INSTALLATION
5.) DOMESTIC WELLS IDENTIFIED ON THIS FIGURE WERE SELECTED BASED ON THE AVAILABILITY OF WELL CONSTRUCTION DATA AND SCREEN POSITION RELATIVE TO THE GROUNDWATER DEPTH INTERVALS EVALUATED.
6.) GROUNDWATER DEPTH INTERVAL DEFINITION:
SHALLOW - DATA COLLECTED ABOVE 4,300 FEET AMSL,
INTERMEDIATE - DATA COLLECTED BETWEEN 4,240 AND 4,300 FEET AMSL,
DEEP - DATA COLLECTED BELOW 4,240 FEET AMSL.

EXPLANATION

- <150
- 150.1 to 300
- 300.1 to 500
- 500.1 to 1,000
- 1,000.1 to 5,000
- >5,000.1

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BROWN AND CALDWELL

Date: August 2008

Atlantic Richfield Company

Project: 134544

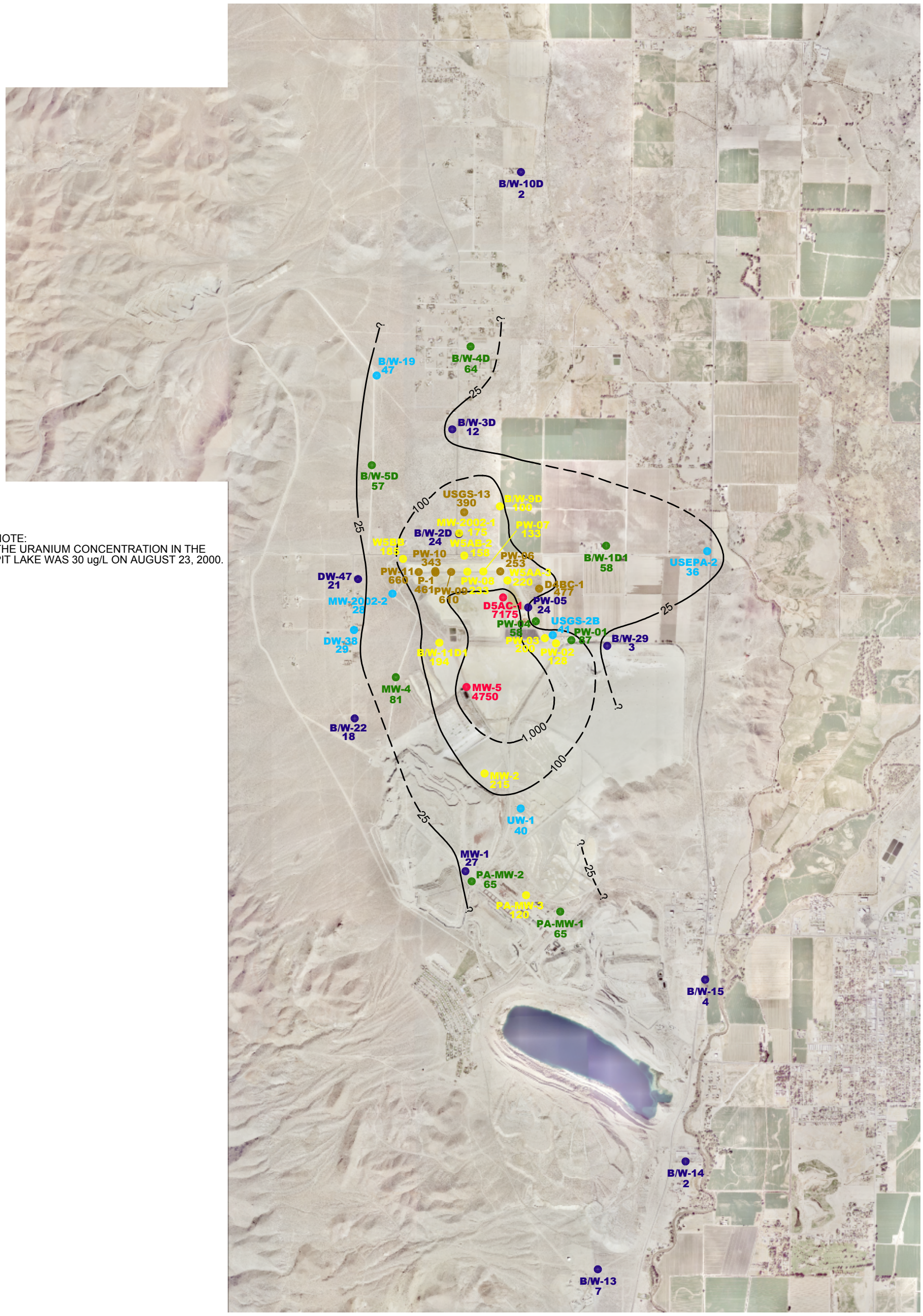
N W E S

1,500 0 1,500 3,000 FEET

Figure B-5

Preliminary Sulfate Concentration Contour Map for the Deep Aquifer

P:\Arco-Yerington\Project Management-Technical Support\134544 - Year 2008 Files\CAD\Conceptual Model\August 2008\Appendix B\Figure B-5.dwg Aug 26, 2008 - 2:09pm rjohnson



NOTE:
THE URANIUM CONCENTRATION IN THE PIT LAKE WAS 30 ug/L ON AUGUST 23, 2000.

NOTES:
1.) PROJECTION: NEVADA STATE PLANE, WEST ZONE 1927 NORTH AMERICAN DATUM (FEET)
2.) BASE PHOTO TAKEN OCTOBER 3, 2001
3.) AMSL = ABOVE MEAN SEA LEVEL
4.) DATASET INCLUDES ALKALINITY MEASUREMENTS COLLECTED DURING SAMPLING AT SHALLOW MONITORING WELLS AND ZONAL SAMPLING CONDUCTED IN CONJUNCTION WITH MONITORING WELL INSTALLATION
5.) DOMESTIC WELLS IDENTIFIED ON THIS FIGURE WERE SELECTED BASED ON THE AVAILABILITY OF WELL CONSTRUCTION DATA AND SCREEN POSITION RELATIVE TO THE GROUNDWATER DEPTH INTERVALS EVALUATED.
6.) GROUNDWATER DEPTH INTERVAL DEFINITION:
SHALLOW - DATA COLLECTED ABOVE 4,300 FEET AMSL,
INTERMEDIATE - DATA COLLECTED BETWEEN 4,240 AND 4,300 FEET AMSL,
DEEP - DATA COLLECTED BELOW 4,240 FEET AMSL.

EXPLANATION

- <25
- 25.1 to 50
- 50.1 to 100
- 100.1 to 250
- 250.1 to 1,000
- >1,000.1

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Date: August 2008

Atlantic Richfield Company

Project: 134544

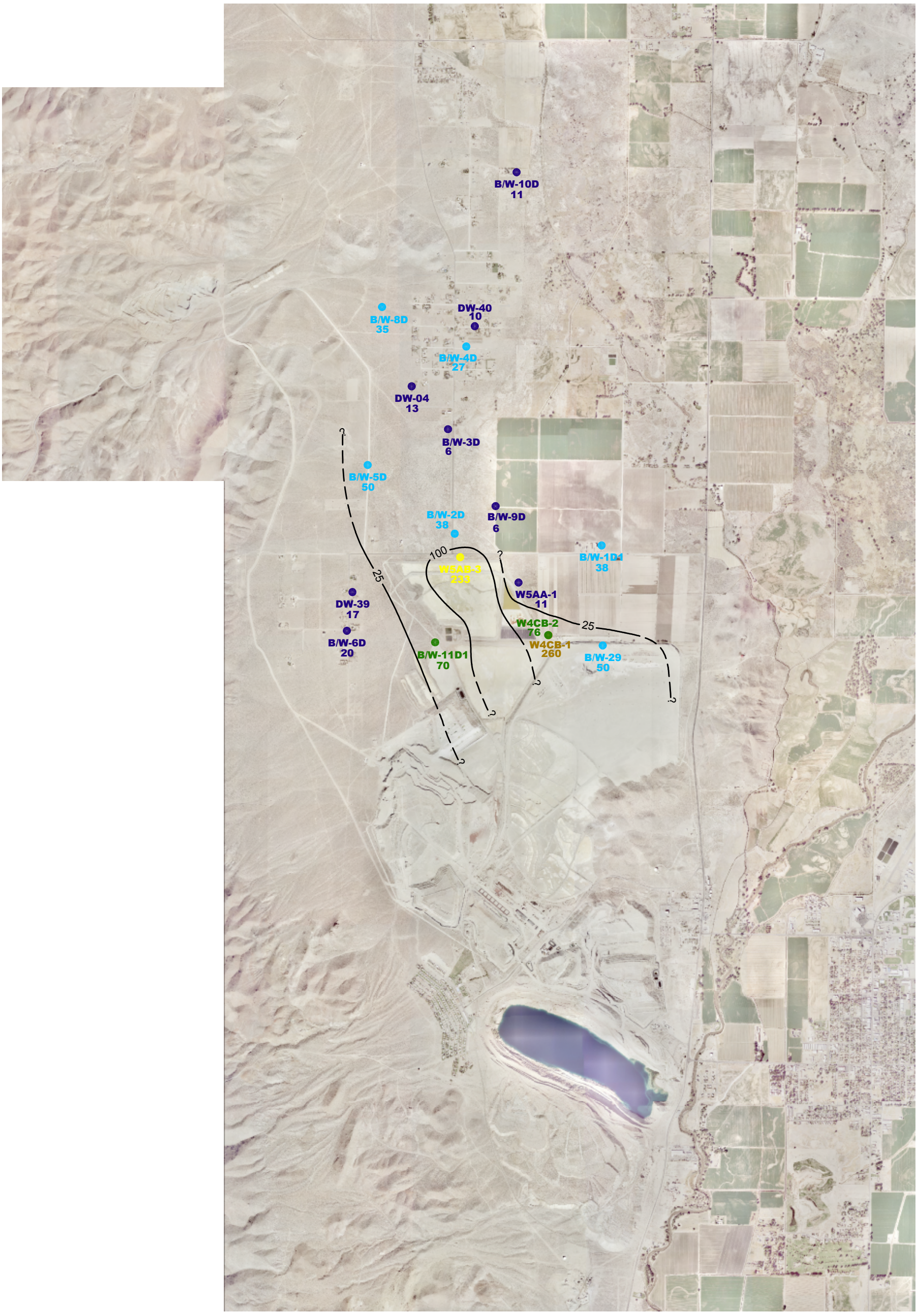
N W E S

1,500 0 1,500 3,000 FEET

Figure B-6

Preliminary Uranium Concentration Contour Map for the Shallow Aquifer

P:\Arco-Yerington\Project Management-Technical Support\134544 - Year 2008 Files\CAD\Conceptual Model\August 2008\Appendix B\Figure B-6.dwg Aug 26, 2008 - 2:13pm rjohnson



NOTES:
1.) PROJECTION: NEVADA STATE PLANE, WEST ZONE 1927 NORTH AMERICAN DATUM (FEET)
2.) BASE PHOTO TAKEN OCTOBER 3, 2001
3.) AMSL = ABOVE MEAN SEA LEVEL
4.) DATASET INCLUDES ALKALINITY MEASUREMENTS COLLECTED DURING SAMPLING AT SHALLOW MONITORING WELLS AND ZONAL SAMPLING CONDUCTED IN CONJUNCTION WITH MONITORING WELL INSTALLATION
5.) DOMESTIC WELLS IDENTIFIED ON THIS FIGURE WERE SELECTED BASED ON THE AVAILABILITY OF WELL CONSTRUCTION DATA AND SCREEN POSITION RELATIVE TO THE GROUNDWATER DEPTH INTERVALS EVALUATED.
6.) GROUNDWATER DEPTH INTERVAL DEFINITION:
SHALLOW - DATA COLLECTED ABOVE 4,300 FEET AMSL,
INTERMEDIATE - DATA COLLECTED BETWEEN 4,240 AND 4,300 FEET AMSL,
DEEP - DATA COLLECTED BELOW 4,240 FEET AMSL.

EXPLANATION

- <25
- 25.1 to 50
- 50.1 to 100
- 100.1 to 250
- 250.1 to 1,000
- >1,000.1

integral consulting inc.

BROWN AND CALDWELL

Date: August 2008

Atlantic Richfield Company

Project: 134544

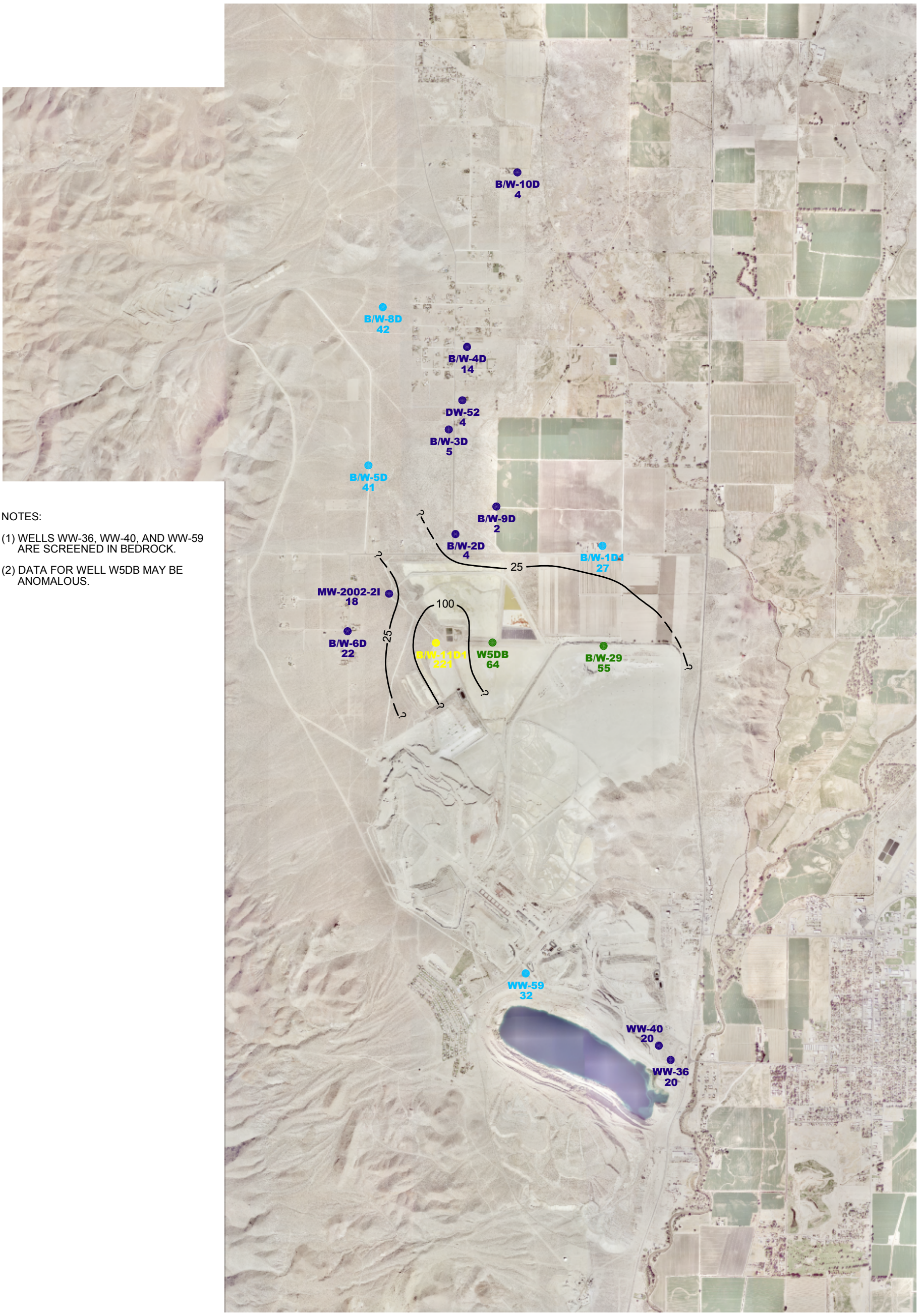
N W E S

1,500 0 1,500 3,000 FEET

Figure B-7

Preliminary Uranium Concentration Contour Map for the Intermediate Aquifer

P:\Arco-Yerington\Project Management-Technical Support\134544 - Year 2008 Files\CAD\Conceptual Model\August 2008\Appendix B\Figure B-7.dwg Aug 26, 2008 - 2:13pm rjohnson



NOTES:

(1) WELLS WW-36, WW-40, AND WW-59 ARE SCREENED IN BEDROCK.

(2) DATA FOR WELL W5DB MAY BE ANOMALOUS.

NOTES:
1.) PROJECTION: NEVADA STATE PLANE, WEST ZONE 1927 NORTH AMERICAN DATUM (FEET)
2.) BASE PHOTO TAKEN OCTOBER 3, 2001
3.) AMSL = ABOVE MEAN SEA LEVEL
4.) DATASET INCLUDES ALKALINITY MEASUREMENTS COLLECTED DURING SAMPLING AT SHALLOW MONITORING WELLS AND ZONAL SAMPLING CONDUCTED IN CONJUNCTION WITH MONITORING WELL INSTALLATION
5.) DOMESTIC WELLS IDENTIFIED ON THIS FIGURE WERE SELECTED BASED ON THE AVAILABILITY OF WELL CONSTRUCTION DATA AND SCREEN POSITION RELATIVE TO THE GROUNDWATER DEPTH INTERVALS EVALUATED.
6.) GROUNDWATER DEPTH INTERVAL DEFINITION:
SHALLOW - DATA COLLECTED ABOVE 4,300 FEET AMSL,
INTERMEDIATE - DATA COLLECTED BETWEEN 4,240 AND 4,300 FEET AMSL,
DEEP - DATA COLLECTED BELOW 4,240 FEET AMSL.

EXPLANATION

- <25
- 25.1 to 50
- 50.1 to 100
- 100.1 to 250
- 250.1 to 1,000
- >1,000.1

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Date: August 2008

Atlantic Richfield Company

Project: 134544

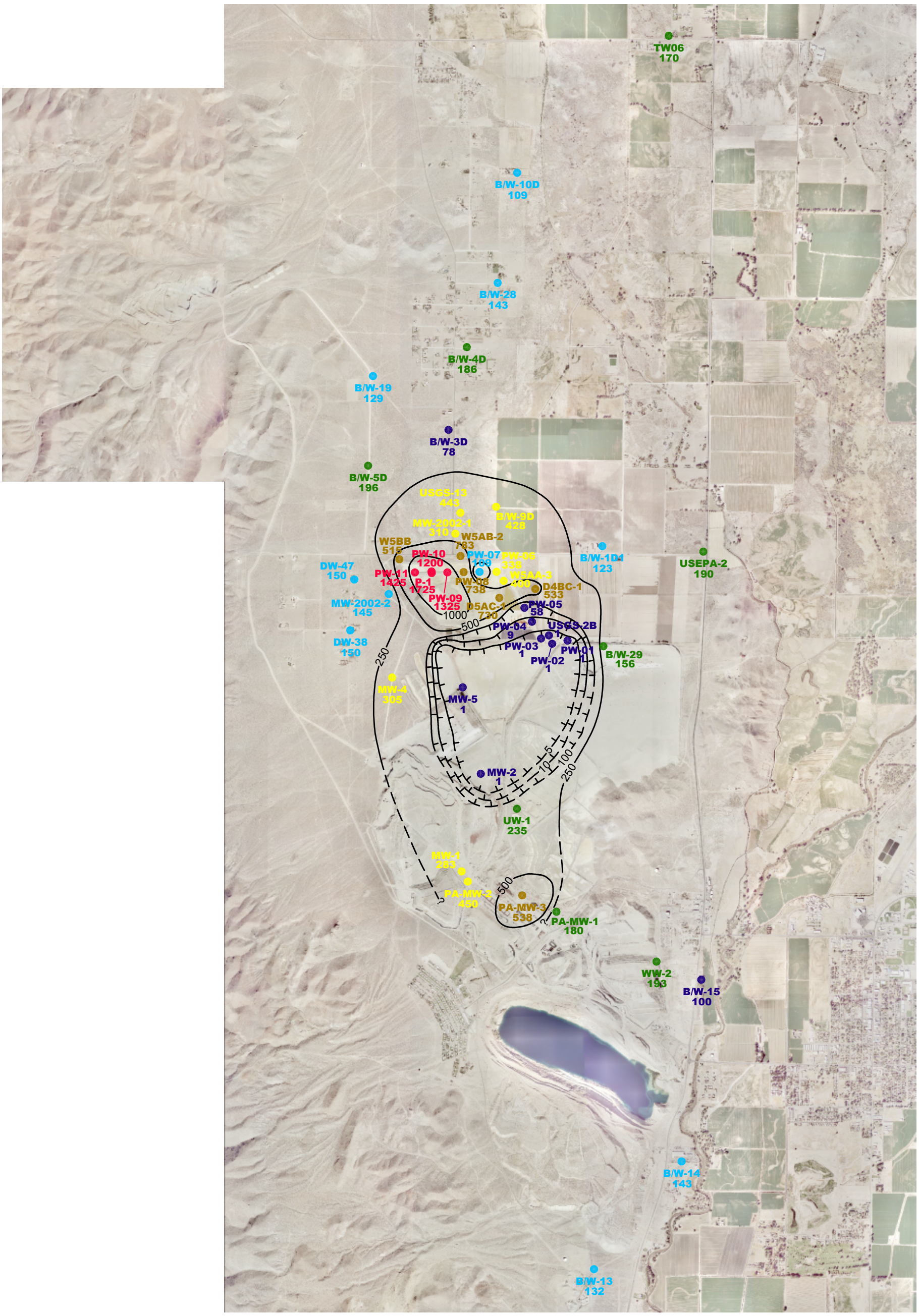
N W E S

1,500 0 1,500 3,000 FEET

Figure B-8

Preliminary Uranium Concentration Contour Map for the Deep Aquifer

P:\Arco-Yerington\Project Management-Technical Support\134544 - Year 2008 Files\CAD\Conceptual Model\August 2008\Appendix B\Figure B-8.dwg Aug 26, 2008 - 2:16pm rjohnson



NOTES:
1.) PROJECTION: NEVADA STATE PLANE, WEST ZONE 1927 NORTH AMERICAN DATUM (FEET)
2.) BASE PHOTO TAKEN OCTOBER 3, 2001
3.) AMSL = ABOVE MEAN SEA LEVEL
4.) DATASET INCLUDES ALKALINITY MEASUREMENTS COLLECTED DURING SAMPLING AT SHALLOW MONITORING WELLS AND ZONAL SAMPLING CONDUCTED IN CONJUNCTION WITH MONITORING WELL INSTALLATION
5.) DOMESTIC WELLS IDENTIFIED ON THIS FIGURE WERE SELECTED BASED ON THE AVAILABILITY OF WELL CONSTRUCTION DATA AND SCREEN POSITION RELATIVE TO THE GROUNDWATER DEPTH INTERVALS EVALUATED.
6.) GROUNDWATER DEPTH INTERVAL DEFINITION:
SHALLOW - DATA COLLECTED ABOVE 4,300 FEET AMSL,
INTERMEDIATE - DATA COLLECTED BETWEEN 4,240 AND 4,300 FEET AMSL,
DEEP - DATA COLLECTED BELOW 4,240 FEET AMSL.

EXPLANATION

- <100
- 100.1 to 150
- 150.1 to 250
- 250.1 to 500
- 500.1 to 1,000
- >1,000.1

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BROWN AND CALDWELL

Date: August 2008

Atlantic Richfield Company

Project: 134544

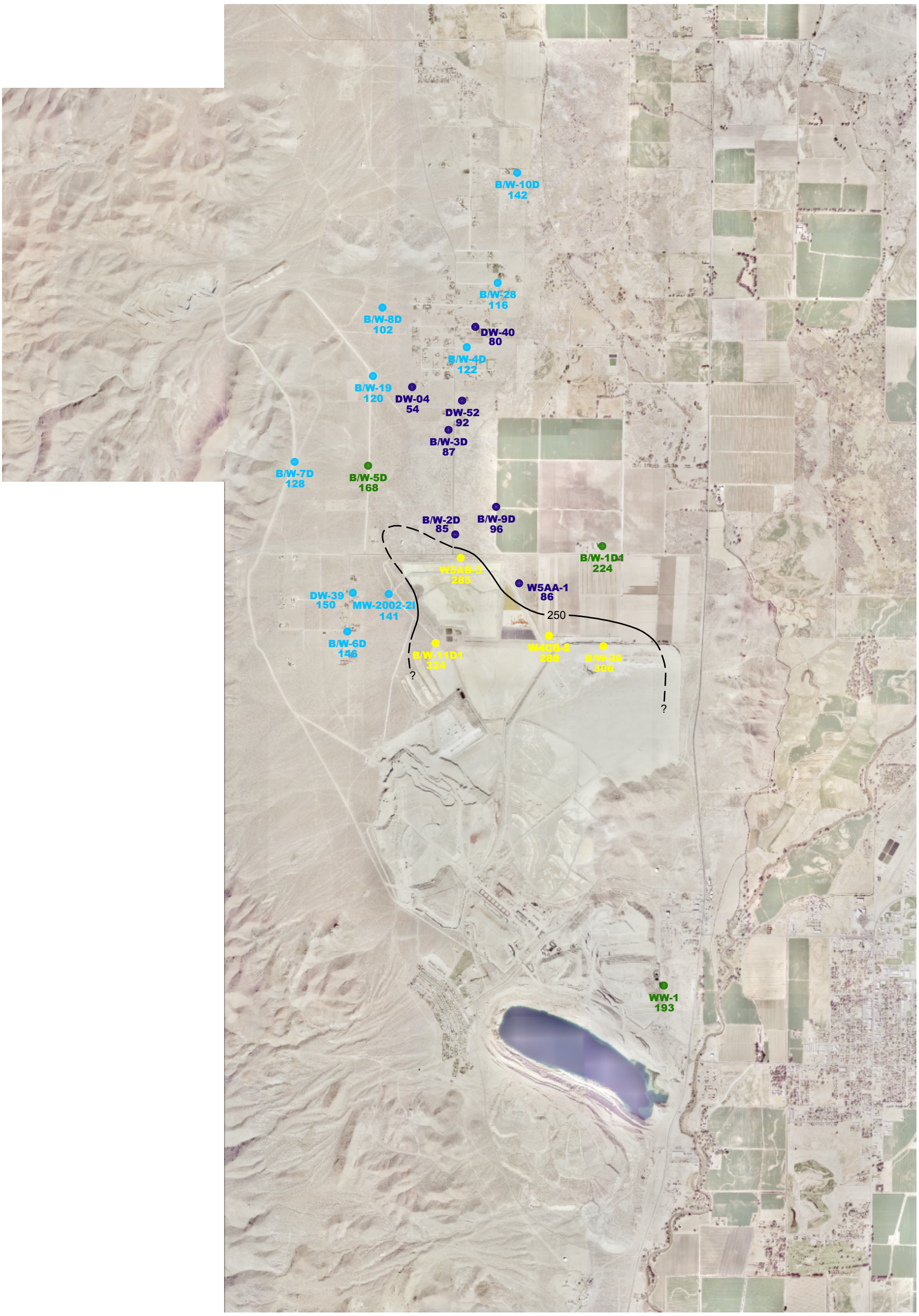
N W E S

1,500 0 1,500 3,000 FEET

Figure B-9

Preliminary Alkalinity Concentration Contour Map for the Shallow Aquifer

P:\Arco-Yerington\Project Management-Technical Support\134544 - Year 2008 Files\CAD\Conceptual Model\August 2008\Appendix B\Figure B-9.dwg Aug 26, 2008 - 2:18pm rjohnson



NOTES:
1.) PROJECTION: NEVADA STATE PLANE, WEST ZONE 1927 NORTH AMERICAN DATUM (FEET)
2.) BASE PHOTO TAKEN OCTOBER 3, 2001
3.) AMSL = ABOVE MEAN SEA LEVEL
4.) DATASET INCLUDES ALKALINITY MEASUREMENTS COLLECTED DURING SAMPLING AT SHALLOW MONITORING WELLS AND ZONAL SAMPLING CONDUCTED IN CONJUNCTION WITH MONITORING WELL INSTALLATION
5.) DOMESTIC WELLS IDENTIFIED ON THIS FIGURE WERE SELECTED BASED ON THE AVAILABILITY OF WELL CONSTRUCTION DATA AND SCREEN POSITION RELATIVE TO THE GROUNDWATER DEPTH INTERVALS EVALUATED.
6.) GROUNDWATER DEPTH INTERVAL DEFINITION:
SHALLOW - DATA COLLECTED ABOVE 4,300 FEET AMSL,
INTERMEDIATE - DATA COLLECTED BETWEEN 4,240 AND 4,300 FEET AMSL,
DEEP - DATA COLLECTED BELOW 4,240 FEET AMSL.

EXPLANATION

- <100
- 100.1 to 150
- 150.1 to 250
- 250.1 to 500
- 500.1 to 1,000
- >1,000.1

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BROWN AND CALDWELL

Date: August 2008

Atlantic Richfield Company

Project: 134544

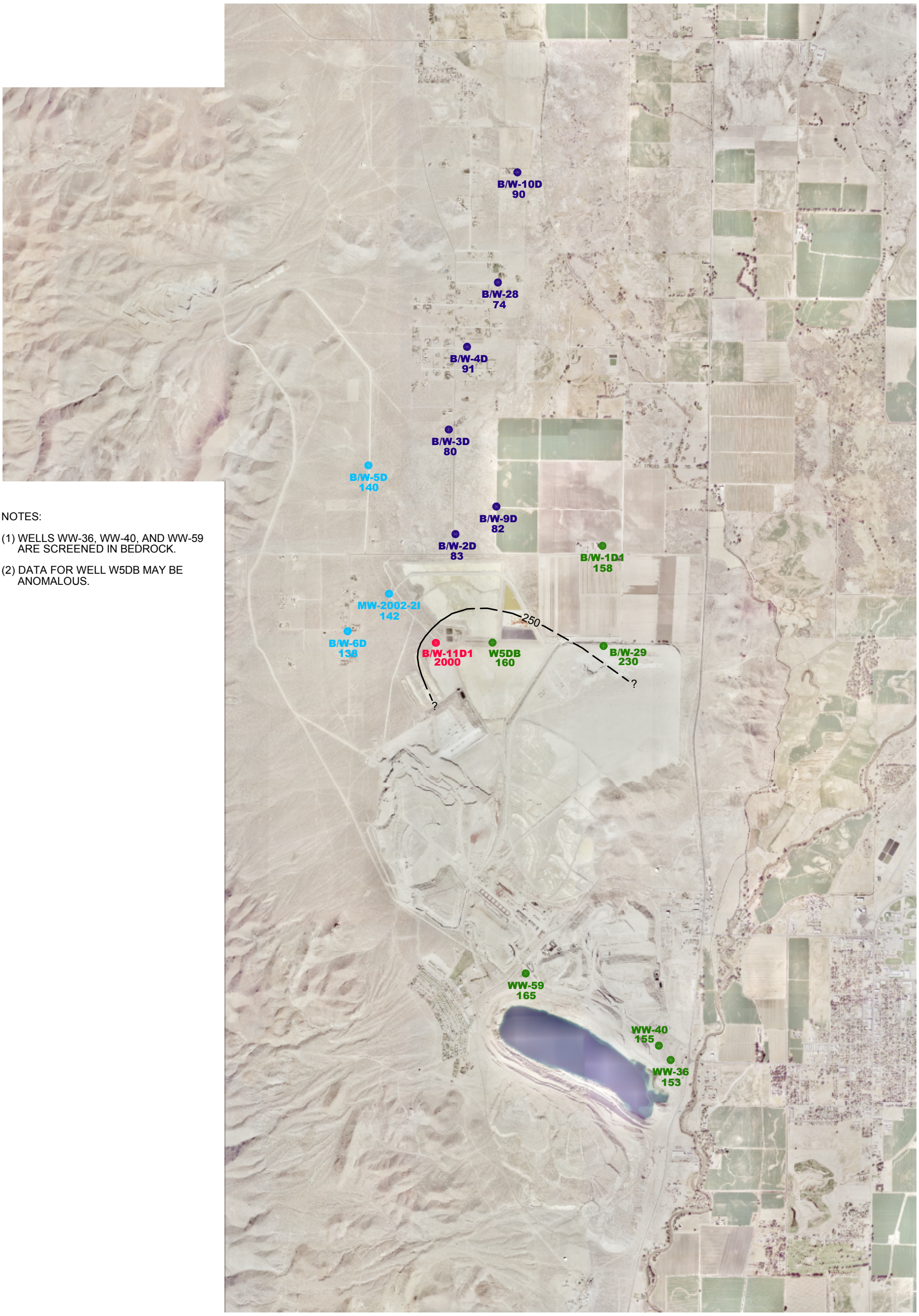
N W E S

1,500 0 1,500 3,000 FEET

Figure B-10

Preliminary Alkalinity Concentration Contour Map for the Intermediate Aquifer

P:\Arco-Yerington\Project Management-Technical Support\134544 - Year 2008 Files\CAD\Conceptual Model\August 2008\Appendix B\Figure B-10.dwg Aug 26, 2008 - 2:19pm rjohnson



NOTES:

(1) WELLS WW-36, WW-40, AND WW-59 ARE SCREENED IN BEDROCK.

(2) DATA FOR WELL W5DB MAY BE ANOMALOUS.

NOTES:
1.) PROJECTION: NEVADA STATE PLANE, WEST ZONE 1927 NORTH AMERICAN DATUM (FEET)
2.) BASE PHOTO TAKEN OCTOBER 3, 2001
3.) AMSL = ABOVE MEAN SEA LEVEL
4.) DATASET INCLUDES ALKALINITY MEASUREMENTS COLLECTED DURING SAMPLING AT SHALLOW MONITORING WELLS AND ZONAL SAMPLING CONDUCTED IN CONJUNCTION WITH MONITORING WELL INSTALLATION
5.) DOMESTIC WELLS IDENTIFIED ON THIS FIGURE WERE SELECTED BASED ON THE AVAILABILITY OF WELL CONSTRUCTION DATA AND SCREEN POSITION RELATIVE TO THE GROUNDWATER DEPTH INTERVALS EVALUATED.
6.) GROUNDWATER DEPTH INTERVAL DEFINITION:
SHALLOW - DATA COLLECTED ABOVE 4,300 FEET AMSL,
INTERMEDIATE - DATA COLLECTED BETWEEN 4,240 AND 4,300 FEET AMSL,
DEEP - DATA COLLECTED BELOW 4,240 FEET AMSL.

EXPLANATION

- <100
- 100.1 to 150
- 150.1 to 250
- 250.1 to 500
- 500.1 to 1,000
- >1,000.1

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BROWN AND CALDWELL

Date: August 2008

Atlantic Richfield Company

Project: 134544

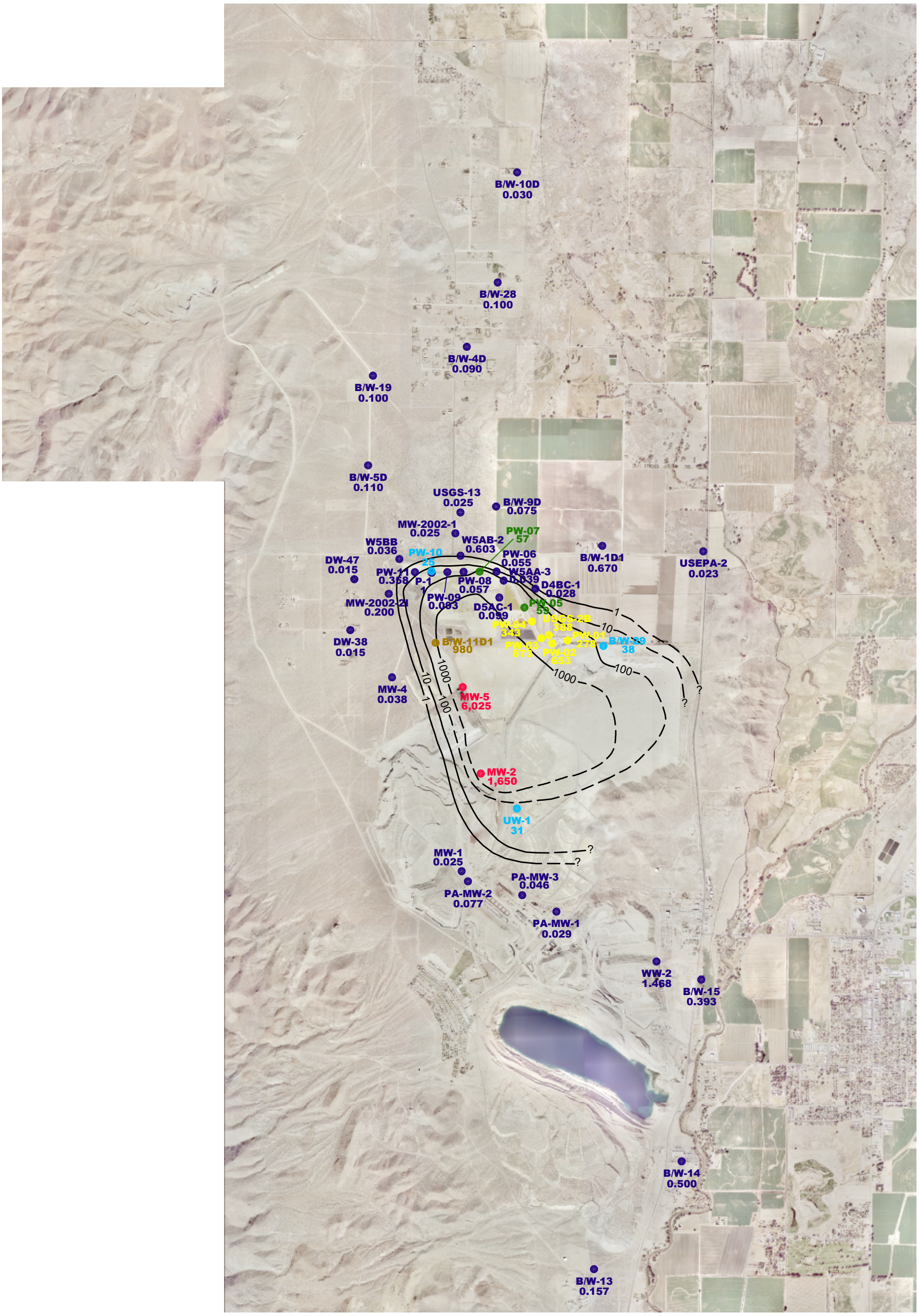
N W E S

1,500 0 1,500 3,000 FEET

Figure B-11

Preliminary Alkalinity Concentration Contour Map for the Deep Aquifer

P:\Arco-Yerington\Project Management-Technical Support\134544 - Year 2008 Files\CAD\Conceptual Model\August 2008\Appendix B\Figure B-11.dwg Aug 26, 2008 - 2:20pm rjohnson



NOTES:
1.) PROJECTION: NEVADA STATE PLANE, WEST ZONE 1927 NORTH AMERICAN DATUM (FEET)
2.) BASE PHOTO TAKEN OCTOBER 3, 2001
3.) AMSL = ABOVE MEAN SEA LEVEL
4.) DATASET INCLUDES ALKALINITY MEASUREMENTS COLLECTED DURING SAMPLING AT SHALLOW MONITORING WELLS AND ZONAL SAMPLING CONDUCTED IN CONJUNCTION WITH MONITORING WELL INSTALLATION
5.) DOMESTIC WELLS IDENTIFIED ON THIS FIGURE WERE SELECTED BASED ON THE AVAILABILITY OF WELL CONSTRUCTION DATA AND SCREEN POSITION RELATIVE TO THE GROUNDWATER DEPTH INTERVALS EVALUATED.
6.) GROUNDWATER DEPTH INTERVAL DEFINITION:
SHALLOW - DATA COLLECTED ABOVE 4,300 FEET AMSL,
INTERMEDIATE - DATA COLLECTED BETWEEN 4,240 AND 4,300 FEET AMSL,
DEEP - DATA COLLECTED BELOW 4,240 FEET AMSL.

EXPLANATION

- <5
- 5.1 to 50
- 50.1 to 250
- 250.1 to 900
- 900.1 to 1,500
- >1,500.1

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BROWN AND CALDWELL

Date: August 2008

Atlantic Richfield Company

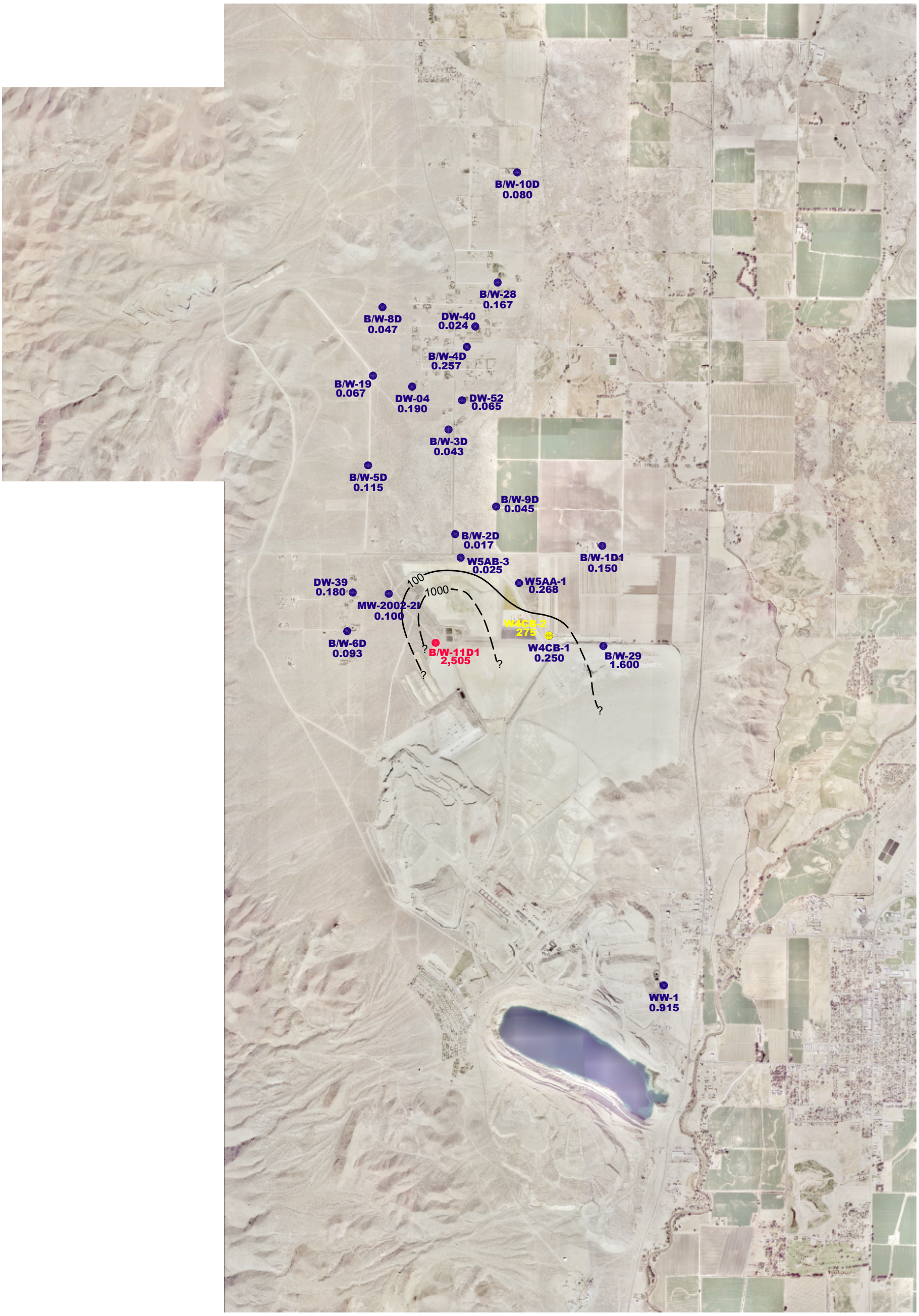
Project: 134544

N W E S

1,500 0 1,500 3,000 FEET

Figure B-12
Preliminary Iron Concentration Contour Map for the Shallow Aquifer

P:\Arco-Yerington\Project Management-Technical Support\134544 - Year 2008 Files\CAD\Conceptual Model\August 2008\Appendix B\Figure B-12.dwg Aug 26, 2008 - 2:21pm rjohnson



NOTES:
1.) PROJECTION: NEVADA STATE PLANE, WEST ZONE 1927 NORTH AMERICAN DATUM (FEET)
2.) BASE PHOTO TAKEN OCTOBER 3, 2001
3.) AMSL = ABOVE MEAN SEA LEVEL
4.) DATASET INCLUDES ALKALINITY MEASUREMENTS COLLECTED DURING SAMPLING AT SHALLOW MONITORING WELLS AND ZONAL SAMPLING CONDUCTED IN CONJUNCTION WITH MONITORING WELL INSTALLATION
5.) DOMESTIC WELLS IDENTIFIED ON THIS FIGURE WERE SELECTED BASED ON THE AVAILABILITY OF WELL CONSTRUCTION DATA AND SCREEN POSITION RELATIVE TO THE GROUNDWATER DEPTH INTERVALS EVALUATED.
6.) GROUNDWATER DEPTH INTERVAL DEFINITION:
SHALLOW - DATA COLLECTED ABOVE 4,300 FEET AMSL,
INTERMEDIATE - DATA COLLECTED BETWEEN 4,240 AND 4,300 FEET AMSL,
DEEP - DATA COLLECTED BELOW 4,240 FEET AMSL.

EXPLANATION

- <5
- 5.1 to 50
- 50.1 to 250
- 250.1 to 900
- 900.1 to 1,500
- >1,500.1

integral consulting inc.

BROWN AND CALDWELL

Date: August 2008

Atlantic Richfield Company

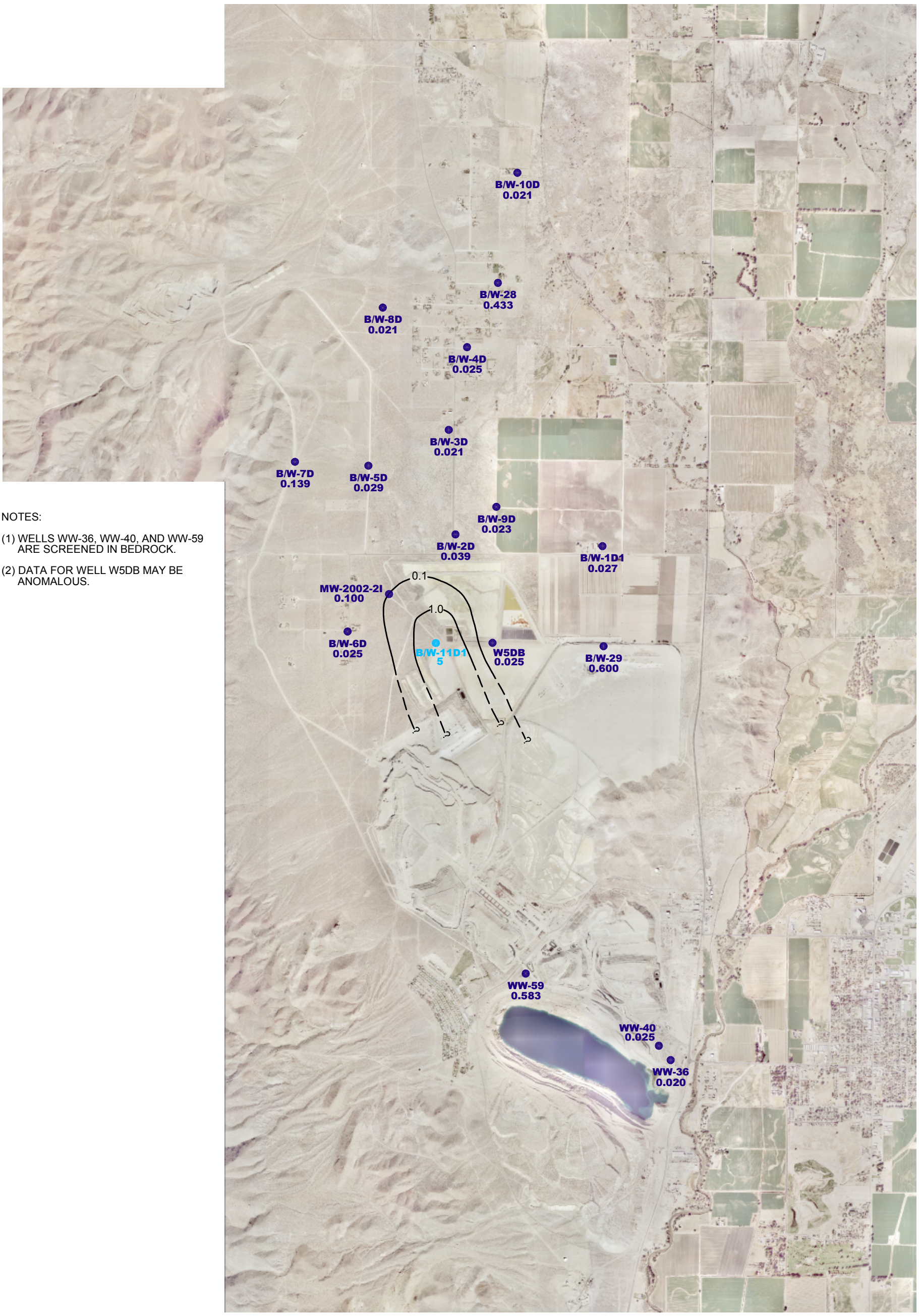
Project: 134544

N W E S

1,500 0 1,500 3,000 FEET

Figure B-13
Preliminary Iron Concentration Contour Map for the Intermediate Aquifer

P:\Arco-Yerington\Project Management-Technical Support\134544 - Year 2008 Files\CAD\Conceptual Model\August 2008\Appendix B\Figure B-13.dwg Aug 26, 2008 - 2:22pm rjohnson



NOTES:

(1) WELLS WW-36, WW-40, AND WW-59 ARE SCREENED IN BEDROCK.

(2) DATA FOR WELL W5DB MAY BE ANOMALOUS.

NOTES:
1.) PROJECTION: NEVADA STATE PLANE, WEST ZONE 1927 NORTH AMERICAN DATUM (FEET)
2.) BASE PHOTO TAKEN OCTOBER 3, 2001
3.) AMSL = ABOVE MEAN SEA LEVEL
4.) DATASET INCLUDES ALKALINITY MEASUREMENTS COLLECTED DURING SAMPLING AT SHALLOW MONITORING WELLS AND ZONAL SAMPLING CONDUCTED IN CONJUNCTION WITH MONITORING WELL INSTALLATION
5.) DOMESTIC WELLS IDENTIFIED ON THIS FIGURE WERE SELECTED BASED ON THE AVAILABILITY OF WELL CONSTRUCTION DATA AND SCREEN POSITION RELATIVE TO THE GROUNDWATER DEPTH INTERVALS EVALUATED.
6.) GROUNDWATER DEPTH INTERVAL DEFINITION:
SHALLOW - DATA COLLECTED ABOVE 4,300 FEET AMSL,
INTERMEDIATE - DATA COLLECTED BETWEEN 4,240 AND 4,300 FEET AMSL,
DEEP - DATA COLLECTED BELOW 4,240 FEET AMSL.

EXPLANATION

- <5
- 5.1 to 50
- 50.1 to 250
- 250.1 to 900
- 900.1 to 1,500
- >1,500.1

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Date: August 2008

Atlantic Richfield Company

Project: 134544

N W E S

1,500 0 1,500 3,000 FEET

Figure B-14

Preliminary Iron Concentration Contour Map for the Deep Aquifer

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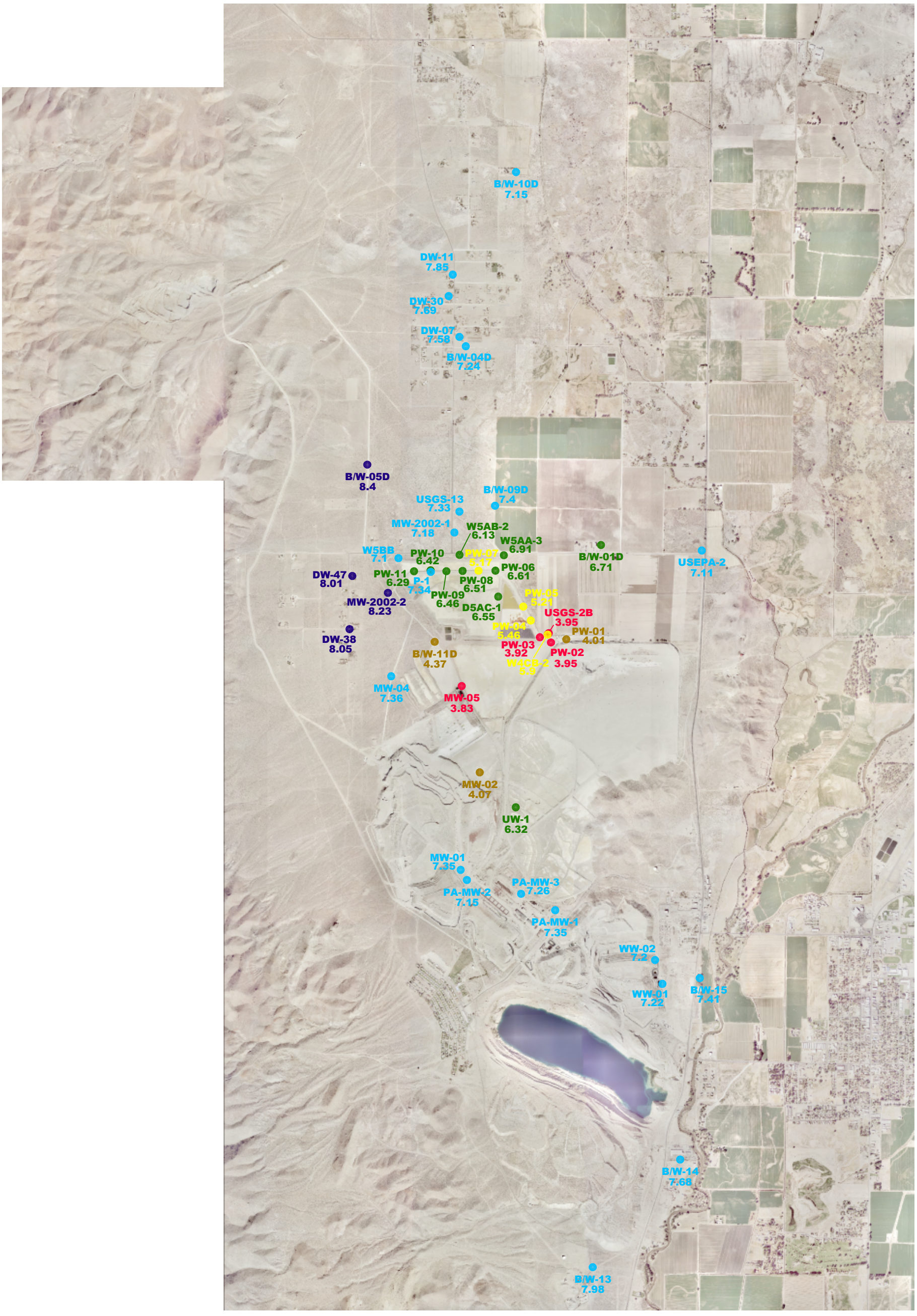

NOTES:
1.) PROJECTION: NEVADA STATE PLANE, WEST ZONE 1927 NORTH AMERICAN DATUM (FEET)
2.) BASE PHOTO TAKEN OCTOBER 3, 2001
3.) AMSL = ABOVE MEAN SEA LEVEL
4.) DATASET INCLUDES ALKALINITY MEASUREMENTS COLLECTED DURING SAMPLING AT SHALLOW MONITORING WELLS AND ZONAL SAMPLING CONDUCTED IN CONJUNCTION WITH MONITORING WELL INSTALLATION
5.) DOMESTIC WELLS IDENTIFIED ON THIS FIGURE WERE SELECTED BASED ON THE AVAILABILITY OF WELL CONSTRUCTION DATA AND SCREEN POSITION RELATIVE TO THE GROUNDWATER DEPTH INTERVALS EVALUATED.
6.) GROUNDWATER DEPTH INTERVAL DEFINITION:
SHALLOW - DATA COLLECTED ABOVE 4,300 FEET AMSL,
INTERMEDIATE - DATA COLLECTED BETWEEN 4,240 AND 4,300 FEET AMSL,
DEEP - DATA COLLECTED BELOW 4,240 FEET AMSL.

EXPLANATION

- 3.0 to 3.99
- 4.0 to 4.99
- 5.0 to 5.99
- 6.0 to 6.99
- 7.0 to 7.99
- >8.0

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Date: August 2008

Atlantic Richfield Company

Project: 134544

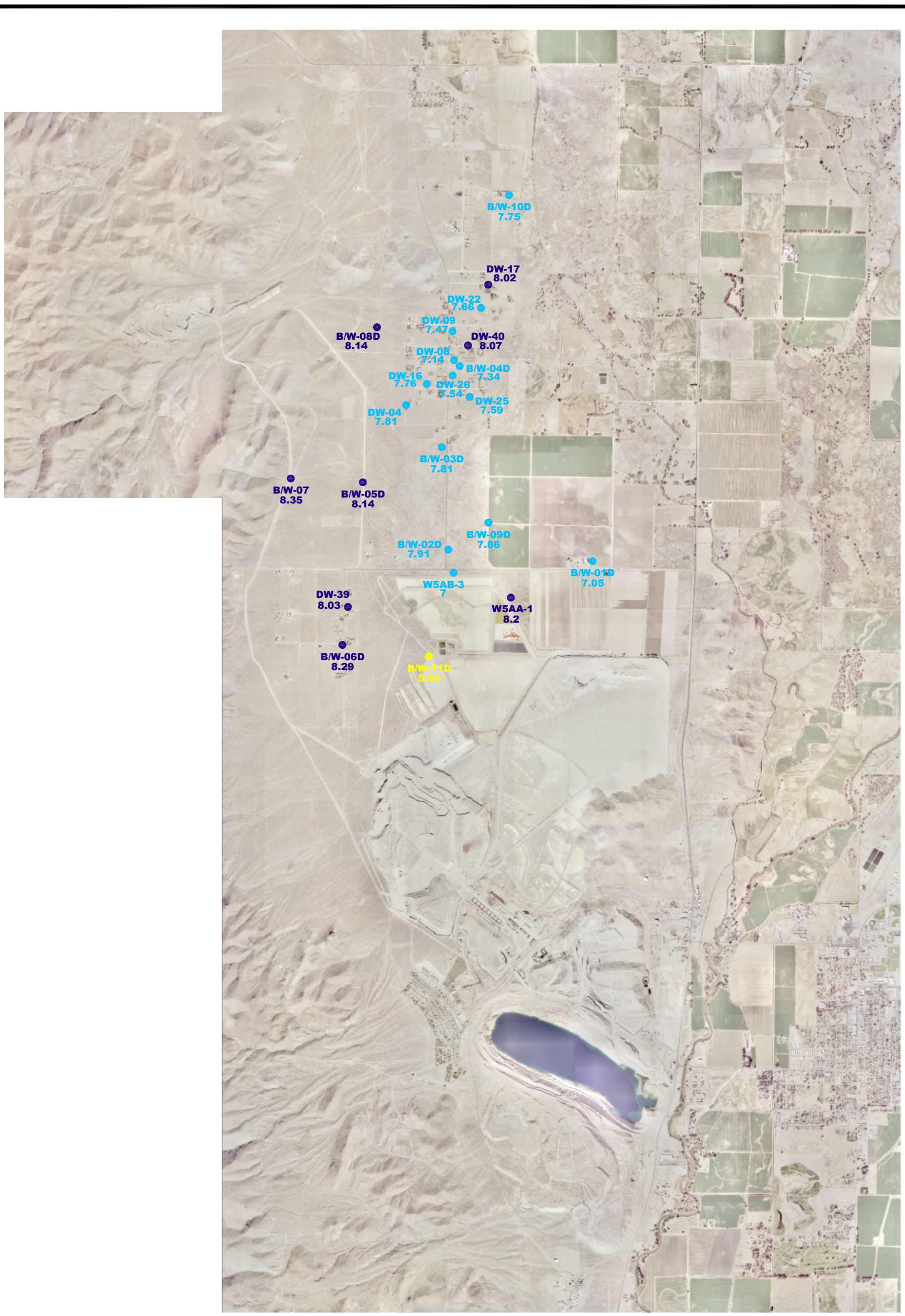
N W E S

1,500 0 1,500 3,000 FEET

Figure B-15

Preliminary pH Distribution for the Shallow Aquifer

P:\Arco-Yerington\Project Management-Technical Support\134544 - Year 2008 Files\CAD\Conceptual Model\August 2008\Appendix B\Figure B-15.dwg Aug 26, 2008 - 2:24pm rjohnson



NOTES:
1.) PROJECTION: NEVADA STATE PLANE, WEST ZONE 1927 NORTH AMERICAN DATUM (FEET)
2.) BASE PHOTO TAKEN OCTOBER 3, 2001
3.) AMSL = ABOVE MEAN SEA LEVEL
4.) DATASET INCLUDES ALKALINITY MEASUREMENTS COLLECTED DURING SAMPLING AT SHALLOW MONITORING WELLS AND ZONAL SAMPLING CONDUCTED IN CONJUNCTION WITH MONITORING WELL INSTALLATION
5.) DOMESTIC WELLS IDENTIFIED ON THIS FIGURE WERE SELECTED BASED ON THE AVAILABILITY OF WELL CONSTRUCTION DATA AND SCREEN POSITION RELATIVE TO THE GROUNDWATER DEPTH INTERVALS EVALUATED.
6.) GROUNDWATER DEPTH INTERVAL DEFINITION:
SHALLOW - DATA COLLECTED ABOVE 4,300 FEET AMSL,
INTERMEDIATE - DATA COLLECTED BETWEEN 4,240 AND 4,300 FEET AMSL,
DEEP - DATA COLLECTED BELOW 4,240 FEET AMSL.

EXPLANATION

- 3.0 to 3.99
- 4.0 to 4.99
- 5.0 to 5.99
- 6.0 to 6.99
- 7.0 to 7.99
- >8.0

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Atlantic Richfield Company

Project: 134544

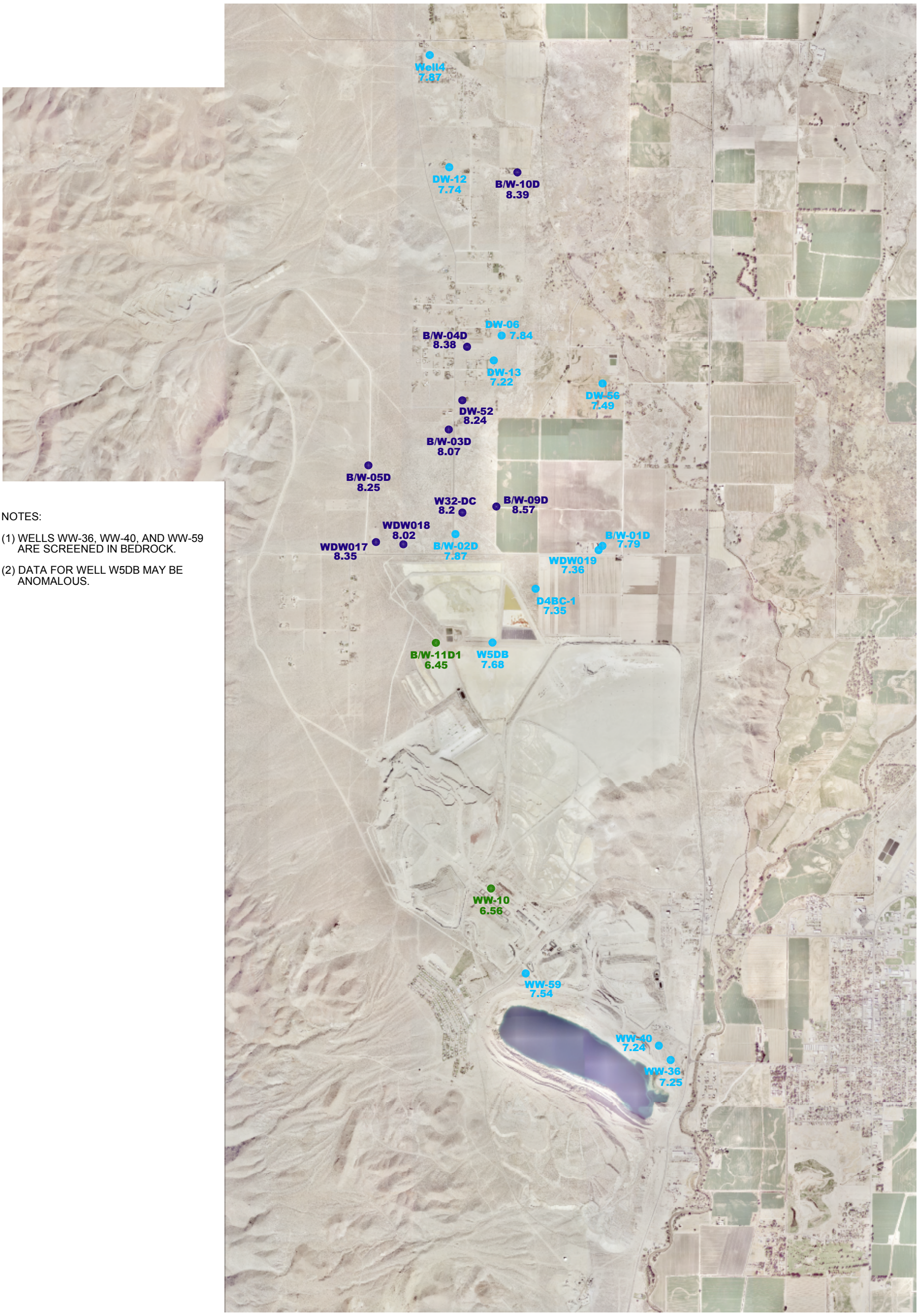
N W E S

1,500 0 1,500 3,000 FEET

Figure B-16

Preliminary pH Distribution for the Intermediate Aquifer

P:\Arco-Yerington\Project Management-Technical Support\134544 - Year 2008 Files\CAD\Conceptual Model\August 2008\Appendix B\Figure B-16.dwg Aug 26, 2008 - 2:25pm rjohnson



NOTES:

(1) WELLS WW-36, WW-40, AND WW-59 ARE SCREENED IN BEDROCK.

(2) DATA FOR WELL W5DB MAY BE ANOMALOUS.

NOTES:
1.) PROJECTION: NEVADA STATE PLANE, WEST ZONE 1927 NORTH AMERICAN DATUM (FEET)
2.) BASE PHOTO TAKEN OCTOBER 3, 2001
3.) AMSL = ABOVE MEAN SEA LEVEL
4.) DATASET INCLUDES ALKALINITY MEASUREMENTS COLLECTED DURING SAMPLING AT SHALLOW MONITORING WELLS AND ZONAL SAMPLING CONDUCTED IN CONJUNCTION WITH MONITORING WELL INSTALLATION
5.) DOMESTIC WELLS IDENTIFIED ON THIS FIGURE WERE SELECTED BASED ON THE AVAILABILITY OF WELL CONSTRUCTION DATA AND SCREEN POSITION RELATIVE TO THE GROUNDWATER DEPTH INTERVALS EVALUATED.
6.) GROUNDWATER DEPTH INTERVAL DEFINITION:
SHALLOW - DATA COLLECTED ABOVE 4,300 FEET AMSL,
INTERMEDIATE - DATA COLLECTED BETWEEN 4,240 AND 4,300 FEET AMSL,
DEEP - DATA COLLECTED BELOW 4,240 FEET AMSL.

EXPLANATION

- 3.0 to 3.99
- 4.0 to 4.99
- 5.0 to 5.99
- 6.0 to 6.99
- 7.0 to 7.99
- >8.0

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Atlantic Richfield Company

Project: 134544

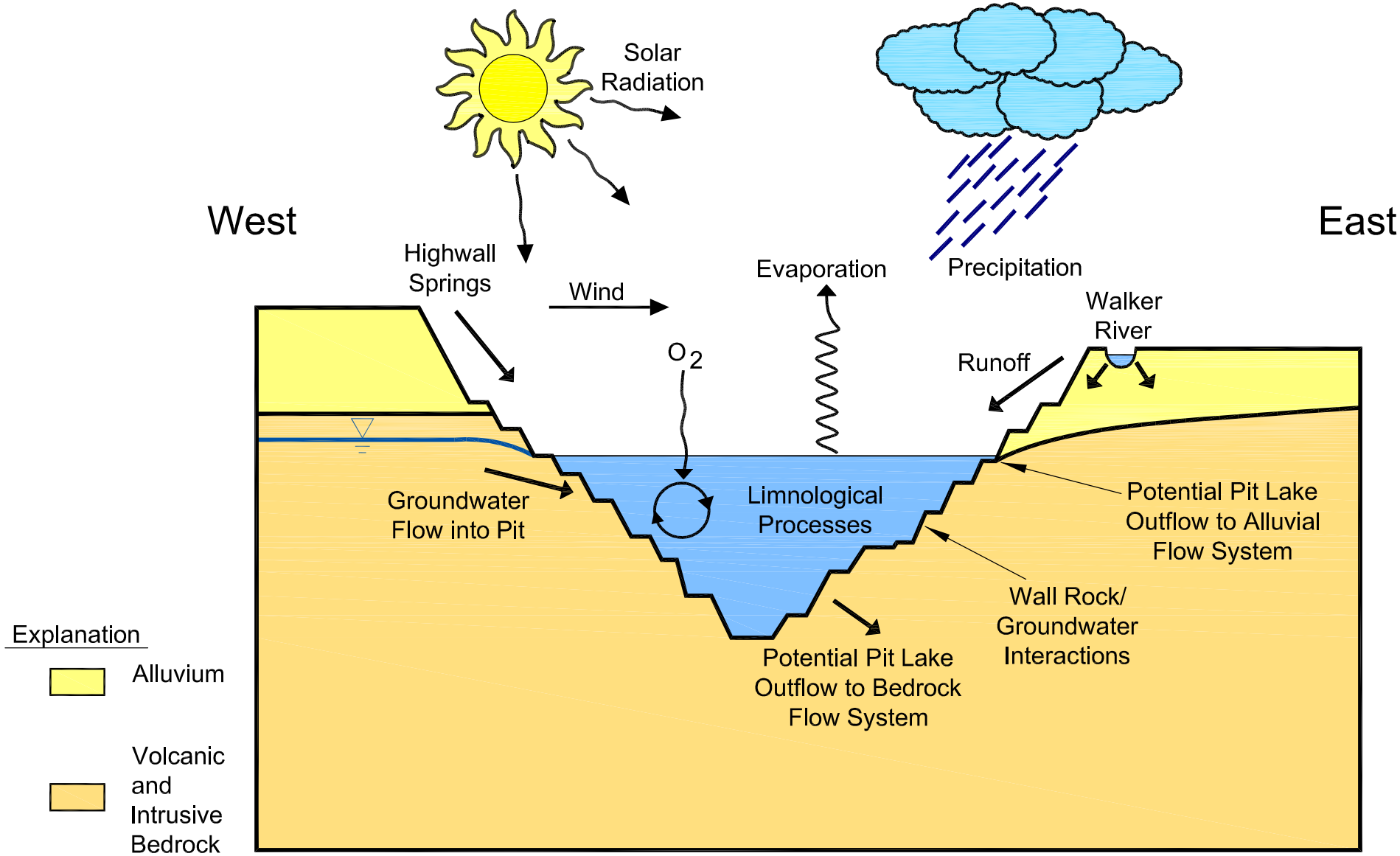
N W E S

1,500 0 1,500 3,000 FEET

Figure B-17

Preliminary pH Distribution for the Deep Aquifer

P:\Arco-Yerington\Project Management-Technical Support\134544 - Year 2008 Files\CAD\Conceptual Model\August 2008\Appendix B\Figure B-17.dwg Aug 26, 2008 - 2:28pm rjohnson



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Date: August 2008

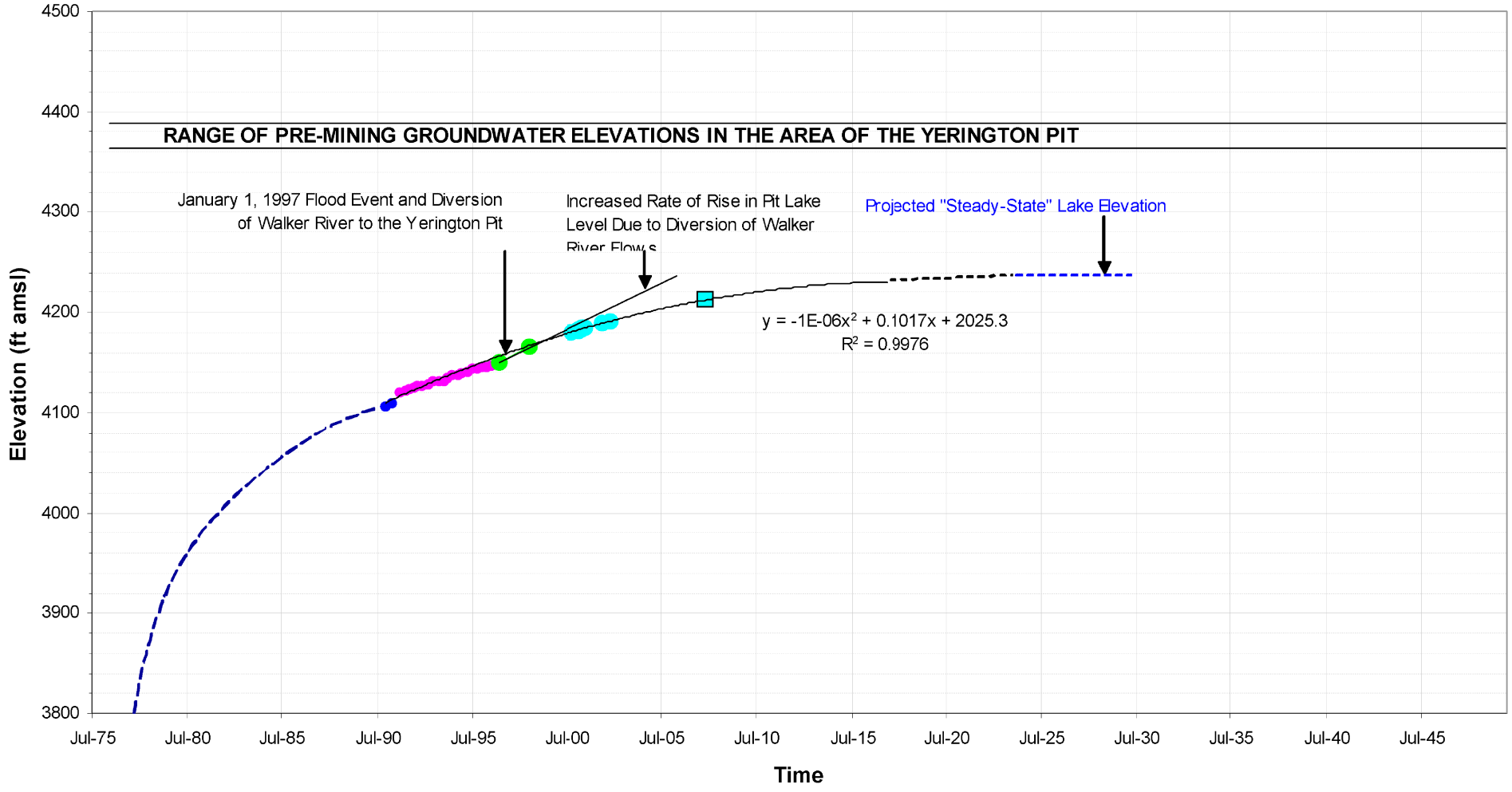
Atlantic Richfield Company

Project: 134544

Figure B-18

Pit Lake Conceptual Model

P:\Arco-Yerington\Project Management-Technical Support\134544 - Year 2008 Files\CAD\Conceptual Site Model\August\20080827A\2006ch3BMFigure3-18.dwg



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Date: August 2008

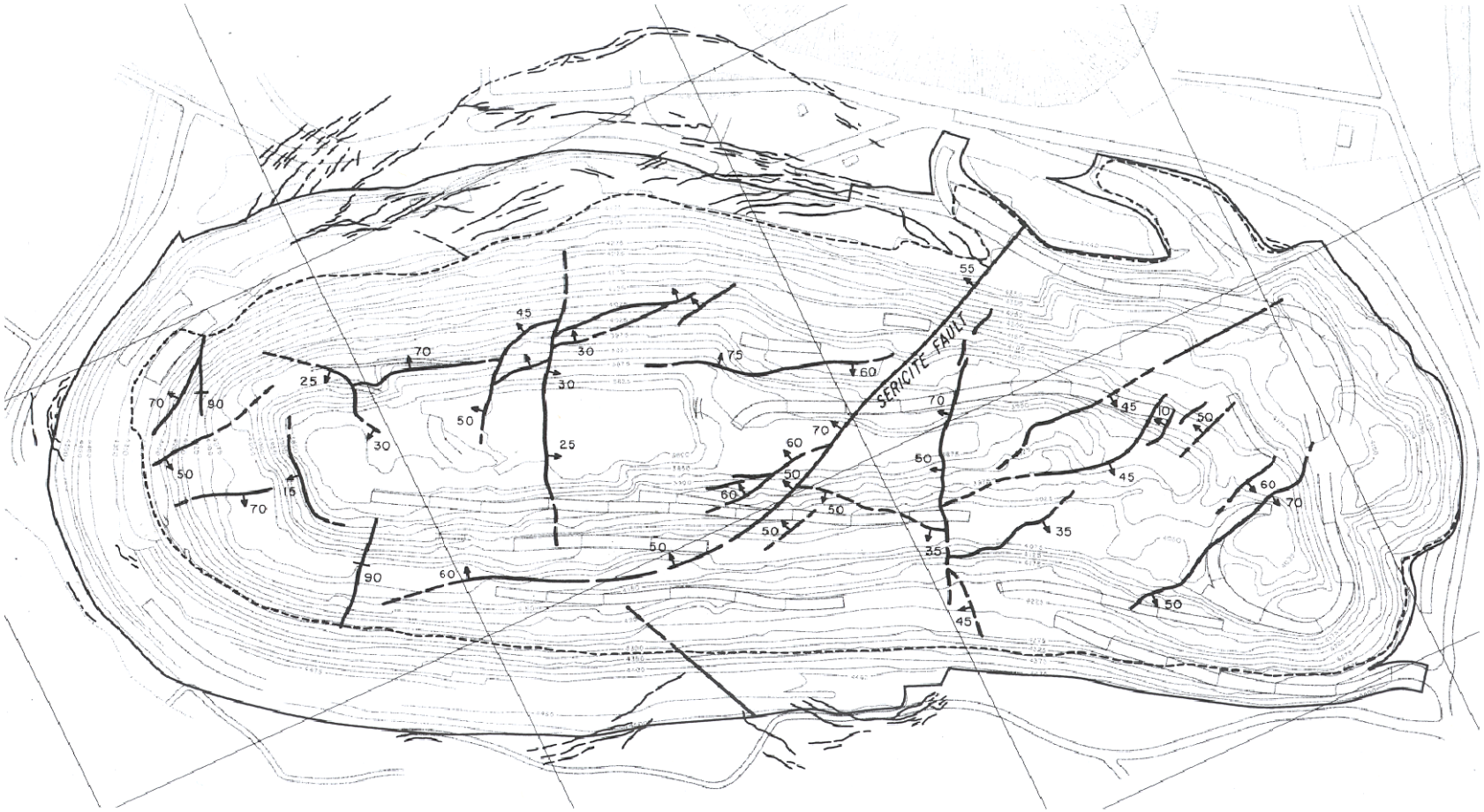
Atlantic Richfield Company

Project: 134544

Figure B-19

Pit Lake Hydrograph

P:\Arco-Yerington\Project Management-Technical Support\134544 - Year 2008 Files\CAD\Conceptual Site Model\August\A2008\A2008-CSM-Figures-B-19.dwg



Note: From Seegmiller Associates (1979), *Slope Stability Affects of Pit Water Storage, Yerington Mine, Lyon County, Nevada*, prepared for the Anaconda Company, June, 1979.

EXPLANATION

FAULTS

TENSION CRACKS

ALLUVIUM / BEDROCK CONTACT

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Date: August 2008

Atlantic Richfield Company

Project: 134544

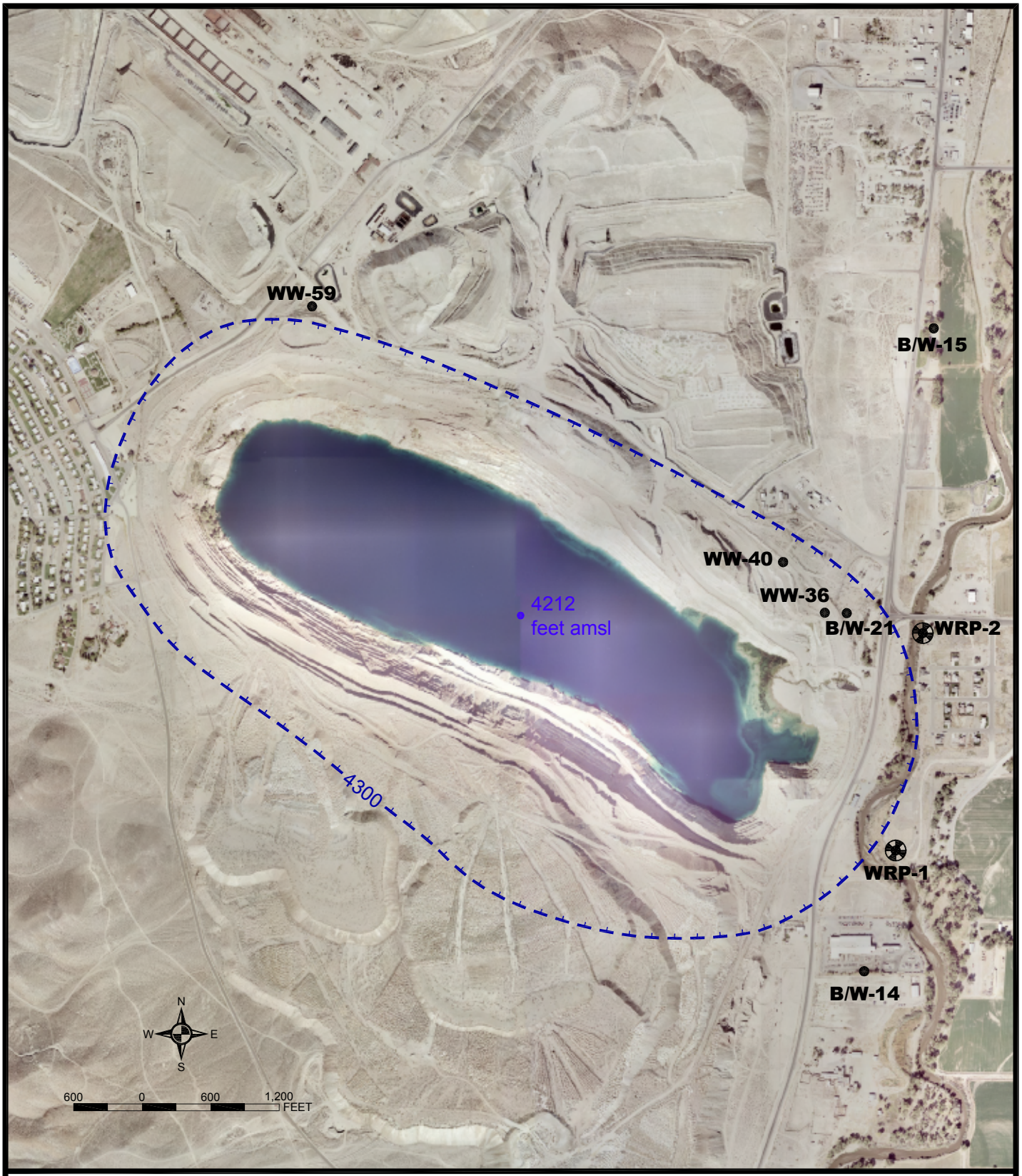
N E S W

400 0 400 800 FEET

Figure B-20

Pit Structural Elements

P:\Arco-Yerington\Project Management-Technical Support\134544 - Year 2008 Files\CAD\Conceptual Site Model\August\A2008\27\A2008\27\Figure B-20.dwg



NOTES:
1.) PROJECTION: NEVADA STATE PLANE, WEST ZONE 1927 NORTH AMERICAN DATUM (FEET)
2.) BASE PHOTO TAKEN OCTOBER 3, 2001
3.) WELL "WW-40" FORMERLY REFERRED TO AS "PWELL 4" AND "PIT EDGE"

EXPLANATION

PIT LAKE ELEVATION AS OF SEPTEMBER 2007

OUTLINE OF CONE-OF-DEPRESSION IN BEDROCK FLOW SYSTEM BASED ON JULY 2007 GROUNDWATER ELEVATION MEASUREMENTS.

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Date: Nov 2007

Atlantic Richfield Company

Project: 133765

Figure B-21

Cone-of-Depression in Bedrock Flow System

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