Technical Memorandum on
Predictive Solute Transport Simulations
BMI Upper and Lower Ponds Area

Submitted to:

May 28, 2010

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I hereby certify that I am responsible for the services described in this document and for the preparation of this document. The services described in this document have been provided in a manner consistent with the current standards of the profession and, to the best of my knowledge, comply with all applicable federal, state, and local statutes, regulations, and ordinances.

May 28, 2010

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1. Introduction

The Basic Remediation Company (BRC) Eastside groundwater model documented by Daniel B. Stephens & Associates, Inc. (DBS&A, 2009a), was approved by the Nevada Division of Environmental Protection (NDEP) on July 24, 2009, with the condition that simulated recharge beneath developed and undeveloped areas be adjusted prior to application of the model for additional purposes, such as solute transport. DBS&A (2009c) documented the incorporation of the NDEP comments concerning recharge in the groundwater flow model. The updated groundwater flow model documented in DBS&A (2009c), modified with finer vertical discretization, was subsequently used for solute transport modeling as proposed in the NDEP-approved solute transport modeling work plan (DBS&A, 2009b). This technical memorandum presents the results of the predictive transport simulations completed by DBS&A on behalf of BRC. It reflects the discussions between NDEP and BRC during the past several months relating to the modeling.

A site map that illustrates the model domain and key geographic features is provided in Figure 1. Also provided in Figure 1 are the locations of three selected observation (monitor) wells (PC12, AA-20, and AA-18) for which this memorandum presents simulated solute concentrations as a function of time. As discussed with the NDEP, predictive solute transport simulations have been conducted for perchlorate, arsenic, chromium VI (hexavalent chromium), and selenium. Perchlorate is a highly mobile constituent in groundwater, whereas the migration of arsenic, chromium VI, and selenium are retarded (reduced) relative to the groundwater flow velocity. During previous discussions regarding preliminary solute transport simulation results, NDEP requested that alpha-BHC and selenium (dependent on wash loading computations) also be simulated. However, transport simulations for alpha-BHC were not conducted because there are insufficient amounts of this constituent on the BMI property within the model domain to warrant simulation. Isoconcentration plots of alpha-BHC in groundwater can be found in DBS&A (2010b).

2. Groundwater Flow Model Update

Preliminary analysis and exploratory model runs conducted by DBS&A indicated that the simulated migration of solute between model layers 1 and 2 is a key component that affects predictive simulation solute concentrations. Based on this observation, the bottom layer (model layer 2) in the groundwater flow model, which represents the upper 50 feet of the Upper Muddy Creek Formation (UMCf), was subdivided into 10 model layers, each with a thickness of 5 feet (Figure 2), resulting in 11 total model layers. This finer vertical discretization was implemented in order to better simulate the transport of solutes between model layers to avoid undue numerical dispersion in the model simulation results. The simulated water levels and groundwater flow budgets for the 2-layer model (DBS&A, 2009c) and the updated 11-layer model were checked against each other and are identical. The updated 11-layer model was used to conduct the predictive transport simulations presented in this technical memorandum.

3. Predictive Solute Transport Simulation

In accordance with the completed BRC Site groundwater flow model (DBS&A, 2009c), the MODFLOW-SURFACT code developed by HydroGeoLogic, Inc. of Herndon, Virginia (1996) was used to simulate saturated zone solute transport. DBS&A simulated the transport of a relatively conservative solute (perchlorate) and three solutes that are subject to significant retardation (arsenic, chromium VI, and selenium). As such, BRC believes that the behavior of other constituents will lie somewhere in between perchlorate and arsenic. Two sets of predictive transport simulations were conducted for the selected constituents (except for selenium), as outlined below. Conducting the solute transport simulations in this manner allows for the comparison of the two sets of simulation results, thereby allowing evaluation of the potential maximum effects of the on-site sources on solute concentrations in groundwater.

3.1 Base Case Simulation

The base case simulation considered the predictive migration of each selected constituent that already exists in groundwater. Groundwater data used to make base case plume maps for the BRC Eastside site are from the 2009 sampling event. Off-site data used to make the portions of the plume maps in the AMPAC and the Plants areas are from various dates between 2006 and 2009, as available (DBS&A, 2010a and 2010b). This approach assumed that inputs of additional contaminants due to recharge from the surface are zero, although mass input does occur at various model boundaries for perchlorate, arsenic, and chromium VI based on observed data and some assumptions regarding the change in mass through future time. Mass input does not occur at the model boundaries for selenium because the groundwater concentration maps (Section 5.4) indicate zero or low concentration at the model boundaries where groundwater inflow occurs.

3.2 Source Area Simulation

The source area simulation as presented in the work plan (DBS&A, 2009c) consists of the base case simulation discussed above plus impacts from potential soil contaminant sources leaching to groundwater due to recharge added through time. The potential soil source areas were identified by BRC for vadose zone leaching model runs completed for Eastside sub-area investigations (ERM, 2000).

However, the vadose zone models have not yet been completed for all of the source areas; vadose zone transport models have currently only been completed for the Mohawk source area (Jones, 2010a). Therefore, a series of “worst case” scenarios were developed wherein the maximum amount of soil contaminant mass is added to saturated zone groundwater over a short period of time. In these scenarios, a maximum potential amount of mass of each simulated constituent, calculated based on soil sampling data, is assumed to entirely flush through the vadose zone and reach groundwater within the first 3.5 years of the predictive simulation period. This initial 3.5-year period represents the assumed time that will occur prior to site buildout, and the source mass is distributed within the recharge that occurs during this period. These worst case source area simulations do not include existing groundwater concentrations and boundary inflows included in the base case simulations. The results of the base case simulations are plotted on separate figures from the results of the source area simulations. However, the simulated concentrations from each scenario could be added together if a total concentration is desired.

4. Solute Transport Hydrogeologic Properties

Hydrogeologic inputs required for solute transport modeling include effective porosity and longitudinal, lateral, and vertical dispersion coefficients. The effective porosity of model layer 1 (Quaternary alluvium [Qal]) was assumed to be 0.2. The effective porosity of model layers 2 through 11 (UMCf) was set to 0.1 (Driscoll, 1986). These effective porosity values are used in all of the predictive transport simulations.

Note that in the previous groundwater flow modeling (DBS&A 2009c), the specific yield (sometimes assumed to be the same as effective porosity) was set to 0.1 for both model layers. This approach was conservative for the predictive groundwater flow simulations with regard to analysis of the potential for a rising water table to intersect the land surface, as a lower than expected specific yield for model layer 1 would lead to a greater rise in the water table for a given change in recharge, all other factors being equal. For the solute transport simulations, however, a more reasonable value for specific yield and effective porosity of 0.2 for the Qal is appropriate.

As described in the work plan (DBS&A, 2009c), a longitudinal dispersivity of 50 feet (based on the Xu and Eckstein [1995] equation) is used in all of the predictive transport simulations. The transverse and vertical dispersivity used for all of the simulations are 5 feet (one-tenth of longitudinal dispersivity) and 0.5 foot (one-hundredth of longitudinal dispersivity), respectively.

Simulation of the transport of relatively conservative constituents, such as perchlorate (IT&RC, 2005; Tipton et al., 2003), does not require consideration of the retardation coefficient (R). For conservative constituents, solute transport occurs at the same rate as the seepage velocity of the groundwater. For constituents that exhibit transport velocities less than that of groundwater, such as arsenic and chromium VI, the simulation approach requires consideration of R. R is constituent dependent, and is calculated using the retardation equation incorporating distribution coefficients (K_d) from published scientific literature values (Table 1), as follows:

$$R = 1 + \frac{\rho * Kd}{n_e} \qquad \text{(Equation 1)}$$

where ρ = the dry bulk density of the soil in grams per cubic centimeter (g/cm^3) (1.3 g/cm^3)

K_d = the distribution coefficient in cubic centimeters per gram (cm^3/g)

n_e = the effective porosity (unitless)

Essentially, R relates the velocity of contaminant migration to that of the groundwater. For example, if an R value of 2 is applied, the solute will migrate through the aquifer at one-half the rate of groundwater seepage. For the K_d values provided in Table 1, the corresponding R values for model layer 1 (Qal) for perchlorate, arsenic, and chromium VI are 0 (no retardation), 13.9 and 8.8, respectively. The R values for model layers 2 through 11 (UMCf) for perchlorate, arsenic, and chromium VI are 0 (no retardation), 26.9, and 16.6, respectively. The R values vary with model layer due to the varying effective porosity term in the denominator of Equation 1.

Table 1. Distribution Coefficients

Solute	K_d (L/kg)	Literature Source
Perchlorate	0	IT&RC, 2005; Tipton et al., 2003
Arsenic	1.99	Low range value from Allison and Allison, 2005
Chromium (VI)	1.2	Low range value from Dragun, 1988
Selenium	1.2	Low range value from Dragun, 1988

L/kg = Liters per kilogram

As indicated in Table 1, the R for selenium will be the same as that for chromium VI. Selenium is most mobile under reduced groundwater conditions and less mobile under oxidized conditions (Allison and Allison, 2005). Available field notes recorded during groundwater sampling indicate that groundwater at the site primarily occurs under oxidized conditions. Therefore, a K_d value at the low end of those expected to be applicable for selenium under oxidized conditions (specifically selenium IV) was selected for application in the solute transport model. We believe that this is a very conservative assumption.

5. Base Case Simulations

The base case predictive transport simulations were completed for perchlorate, arsenic, chromium VI, and selenium as outlined above. The mass inputs of the solute in the base case simulations consist of the initial concentrations of the solute present in groundwater and the mass input from the lateral model boundaries (inflow of groundwater with a prescribed solute concentration). The initial concentrations for each solute for each model layer were determined based on solute concentration contour maps and the associated data points constructed for the Qal (model layer 1) and the upper part of the UMCf (model layers 2 through 11) (DBS&A, 2010a and 2010b). The initial solute concentrations were interpolated to the center point of the model grids based on the contour maps. For model layers 2 through 11, the same initial concentrations were applied to each of the layers. It should be noted that this approach conservatively assumes that the solute concentration observed in a monitor well with a limited screen interval (often 20 feet) is representative of the entire saturated thickness of the UMCf simulated in the model (50 feet at most locations).

It was difficult to determine any consistent trends in the observed groundwater solute concentrations for observation wells near the model boundaries. Therefore, three sets of predictive transport simulations were conducted for each of the three solutes to provide a range of simulation results based on the selected boundary conditions, as described below.

- *Initial Concentration Only.* In this case there is no solute mass input from the lateral model boundaries. The only source of solute mass is the initial solute concentration present in groundwater within the model domain. As noted earlier, boundary concentrations for selenium are assumed to be zero based on the observed concentration distribution in groundwater. Consequently, this simulation is the only one run for selenium.

- *Initial Concentration and Constant Boundary Concentration.* The mass input from the boundaries where groundwater inflow occurs is assumed to be constant for the entire predictive simulation period of 100 years by prescribing a concentration along the boundaries equal to the initial concentration. The source of solute during the simulation is the initial solute concentration present in groundwater along with the prescribed mass flux that occurs through the lateral model boundaries from upgradient sources.

- *Initial Concentration and Declining Boundary Solute Concentration.* In this scenario, the mass input from the boundaries is assumed to decline at a prescribed percentage of the initial concentration along the boundaries. The source of solute mass is the initial concentration present in groundwater along with the prescribed declining mass flux through the lateral boundaries. For perchlorate, boundary concentrations are assumed to decline as follows:

  – 10 years: same as the initial concentration along the boundary cells
  – 10 to 20 years: 50 percent of the initial concentration value
  – 20 to 100 years: 5 percent of the initial concentration value

  For arsenic and chromium VI, boundary concentrations are assumed to decline as follows:

  – 10 years: same as the initial concentration along the boundary cells
  – 10 to 100 years: 5 percent of the initial concentration value

  The reductions in boundary solute concentrations are merely assumptions, based on the fact that groundwater remediation is occurring (for perchlorate and chromium VI) or will be occurring (for arsenic) for impacted groundwater upgradient of the model domain. Many alternative scenarios could be simulated, but the selected scenarios are sufficient in BRC’s view to provide a range of simulation results for the NDEP to consider.

The simulated concentration at the end of 100 years is presented as contours of the solute concentration for the above sets of simulations for model layers 1, 2, and 11. In addition, time-series plots for selected well locations shown in Figure 1 are also presented for all of the predictive transport simulations to provide an illustration of how simulated solute concentrations change with time.

5.1 Perchlorate Transport Simulations

The contoured initial perchlorate concentration as of 2009 is shown in Figure 3 for layer 1 and Figure 4 for layers 2 through 11. Table 2 summarizes the different predictive base case transport simulations for perchlorate and provides the corresponding figure numbers.

Table 2. Perchlorate Base Case 100-Year Transport Simulations

Figure Numbers	Perchlorate Simulation Description
5a through 5f	Initial concentration only simulation
6a through 6f	Initial concentration and constant boundary concentration simulation
7a through 7f	Initial concentration and declining boundary concentration simulation

Figure 5a shows that elevated perchlorate concentrations persist in the Qal in the Western Hook area and in the northern part of the Upper Ponds area, as well as north of the Upper Ponds area between Tuscany and former City of Henderson (CoH) Northern rapid infiltration basins (RIBs). Review of Figures 5b and 5c indicates that perchlorate concentrations increase with depth, with the highest perchlorate concentrations in model layer 11, the bottom layer of the UMCf (Figure 5c).

As is more fully explained later in this section, simulated 100-year perchlorate concentrations in the Qal are primarily a function of concentrations in the UMCf. This behavior can be observed in Figures 5d through 5f. For example, Figure 5d illustrates that at well PC12, which is located in a zone of relatively high Qal hydraulic conductivity, the majority of the initial mass of perchlorate is flushed from the system in less than 10 years. Although difficult to tell from the figure due to the scale, the simulated perchlorate concentration at depth (layer 11) is greater than that in layers 1 or 2 for the majority of the simulation period. A similar result is observed for well locations AA-20 (Figure 5e) and AA-18 (Figure 5f). At both of these locations, the simulated perchlorate concentration in the Qal (layer 1) and upper portion of the UMCf (layer 2) declines relatively quickly, while the simulated concentration deeper in the UMCf (layer 11) persists for significant periods of time. Essentially, perchlorate can more readily migrate by advection and hydrodynamic dispersion from the UMCf to the Qal from the uppermost layers of the UMCf, as opposed to the deeper portions of the UMCf.

Figures 6a through 6f and 7a through 7f illustrate the simulation results for the cases where boundary perchlorate concentrations are held constant through time and reduced according to an assumed schedule, respectively. One notable result from these simulations is that the simulated perchlorate concentration in the Upper Ponds area is similar to that in the previous scenario (Figure 5), where the boundary concentrations were assumed to be zero. For example, comparison of Figures 5e and 5f with Figures 6e and 6f and Figures 7e and 7f shows similar results. Therefore, in the Upper Ponds area, the simulation results are not sensitive to the assumed boundary condition for influx of perchlorate. The simulation results are substantially different, however, in the large paleochannel area that leads from the Plants area north toward the Lower Ponds area. Boundary perchlorate concentrations are very high along this model boundary; consequently, accounting for these concentrations leads to a more persistent, high-concentration plume in this area. As expected, the simulation where the boundary concentration is reduced through time leads to reduced concentrations relative to the constant concentration simulation (e.g., compare Figures 6a and 7a).

Apart from the three sets of simulations discussed above, two additional perchlorate transport scenarios were conducted to illustrate some key aspects of the solute transport indicated by the model. Specifically, one simulation was run where the only source of perchlorate in the model is the initial concentration prescribed for layer 1. A second simulation was run where the only source of perchlorate in the model is the initial concentration prescribed for model layers 2 through 11.

Figures 8a through 8c illustrate the simulated concentration after 100 years where the only source of perchlorate mass in the model is the initial concentration present in model layer 1 at the beginning of the simulation. Figures 8d through 8f illustrate the corresponding time-series results at the three selected monitor well locations. Figure 8a shows that almost all of the perchlorate gets flushed through the alluvium, and Figures 8d through 8f illustrate that this flushing occurs within a period of one to two decades. However, a small fraction of perchlorate mass in the alluvium migrates into the UMCf model layers, and once there persists until the end of the simulation due to the low hydraulic conductivity and correspondingly low advection and hydrodynamic dispersion (Figures 8b and 8c). The perchlorate mass in model layer 2 acts as a continuing source of perchlorate to model layer 1 once simulated concentrations on model layer 1 subside; eventually simulated perchlorate concentrations in model layer 2 subside, while simulated concentrations in model layer 11 remain relatively high until the end of the simulation period.

Figures 9a through 9c illustrate the simulated concentration after 100 years where the only source of perchlorate mass in the model is the initial concentration present in model layers 2 through 11 at the beginning of the simulation. Figures 9d through 9f illustrate the corresponding time-series results at the three selected monitor well locations.

Figure 9a shows that model layer 2 and deeper layers serve as sources of perchlorate to model layer 1. The simulated perchlorate concentration present in model layer 2 (Figure 9b) is less than that in model layer 11 (Figure 9c). Essentially, a portion of the perchlorate in model layer 2 migrates upward to model layer 1, where it is flushed out of the system due to the higher rate of groundwater flow in the Qal. It is more difficult for perchlorate in the deeper portions of the UMCf (e.g., layer 11) to migrate to shallower layers, thereby causing the pattern of increased perchlorate concentrations at depth.

5.2 Arsenic Transport Simulations

The contoured initial arsenic concentration as of 2009 is shown in Figure 10 for layer 1 and Figure 11 for layers 2 through 11. Table 3 summarizes the different predictive 100-year transport simulations for arsenic and provides the corresponding figure numbers.

Table 3. Arsenic Predictive 100-Year Transport Simulations

Figure Numbers	Arsenic Simulation Description
12a through 12f	Initial concentration only simulation
13a through 13f	Initial concentration and constant boundary concentration simulation
14a through 14f	Initial concentration and declining boundary concentration simulation

Review of Figures 12a through 14f indicates that the simulated behavior of arsenic is substantially different from that of perchlorate. The reason for this difference is the significant retardation coefficient (Section 4) which leads to reduced transport velocity and hydrodynamic dispersion. Review of the arsenic concentration plots indicates that the simulated distribution at 100 years is strongly influenced by the initial concentration. Review of the time-series plots for well locations AA-20 and AA-18 (Figures 12e, 12f, 13e, 13f, 14e, and 14f) indicates nearly identical results among simulations, illustrating the importance of the initial arsenic concentration condition. Some trends are evident at well location PC12 (Figures 12d, 13d, and 14d) depending on the assumed boundary condition, but they are not significant and occur over extended periods of time. The zero concentration boundary case (Figure 12d) and the reduced concentration boundary case (Figure 14d) are nearly identical.

Note that the retardation factor selected for arsenic is on the low end of potential values that are reported in the scientific literature. In reality, arsenic transport rates even lower than those simulated are likely to occur.

5.3 Chromium VI Transport Simulations

The contoured initial chromium VI concentration as of 2009 is shown in Figure 15 for layer 1 and Figure 16 for layers 2 through 11. Table 4 summarizes the different predictive transport simulations for chromium VI and provides the corresponding figure numbers.

Table 4. Chromium VI Predictive 100-Year Transport Simulations

Figure Numbers	Chromium VI Simulation Description
17a through 17f	Chromium VI initial concentration only simulation
18a through 18f	Chromium VI initial concentration and constant boundary concentration simulation
19a through 19f	Chromium VI initial concentration and declining boundary concentration simulation

Review of Figures 17a through 19f indicates that the simulated behavior of chromium VI, like that of arsenic, is also substantially different from that of perchlorate. As with arsenic, the primary reason for this difference is the significant retardation coefficient (Section 4) applied for chromium VI, which leads to reduced transport velocity and hydrodynamic dispersion relative to the perchlorate simulations. Review of the chromium VI concentration plots indicates that the simulated distribution at 100 years is strongly influenced by the initial concentration. Review of the time-series plots for well locations AA-20 and AA-18 (Figures 17e, 17f, 18e, 18f, 19e, and 19f) indicates nearly identical results among simulations, illustrating the importance of the initial chromium VI concentration condition. Some trends are evident at well location PC12 (Figures 17d, 18d, and 19d) depending on the assumed boundary condition, but they are not significant and occur over extended periods of time. The zero concentration boundary case (Figure 17d) and the reduced concentration boundary case (Figure 19d) are nearly identical, again the same result as observed for the arsenic simulations.

Note that the retardation factor selected for chromium VI is on the low end of potential values that are reported in the scientific literature. In reality, chromium VI transport rates even lower than those simulated are likely to occur.

5.4 Selenium Transport Simulations

This section presents the results of approximate Las Vegas Wash loading calculations for selenium based on gauge data, and the solute transport predictions made using the groundwater model.

5.4.1 Overview of Wash Loading Evaluation

Selenium was simulated at the suggestion of the NDEP because Las Vegas Wash loading calculations indicate that some potential loading may occur at the northern boundary of the BRC Eastside property. A simple and conservative selenium loading calculation (Appendix A) was completed using water quality data from the Southern Nevada Water Authority (SNWA) (SNWA, 2009) and wash flow data from the U.S. Geological Survey (USGS) (USGS, 2009) (Table A-1). For 11 months in 2009, SNWA collected water samples for selenium and other metals analysis from eight locations in the wash (Figure A-1). The 11 data points were used to estimate a 2009 average selenium concentration for each sampling location.

The USGS collected wash flow rate data from four stations near the SNWA sampling points (Figure A-1), and combined the 2009 flow rate data with data from previous sampling dates to compile a long-term mean flow rate as of January 19, 2009 (period unspecified). The long-term mean flow rates and the specific flow rate data for January 19, 2009 were used with the SNWA data to calculate two estimates of wash discharge for selenium (in pounds per day [lb/d]) at each SNWA sampling point.

SNWA samples contained the highest selenium concentration (13.4 micrograms per liter [µg/L]) at sample point LW10.75, located northwest of the BRC Eastside property (about 2 miles northeast of the CoH wastewater treatment facility). Using this methodology, the estimated selenium loading at this location is 13.2 lb/d (Table A-1). In five SNWA sampling points downstream from LW10.75 (between LW8.85 and LWLW4.95), the detected selenium concentrations are less (ranging from 2.6 to 4.3 µg/L). As a result, the estimated discharge ("loading") to the wash is less at each sampling location downstream from LW10.75 (ranging from 1.7 to 2.6 lb/d).

At SNWA sample point LW3.1, the detected selenium concentration was 3.1 µg/L, which is broadly comparable to the selenium concentrations detected at the other sampling stations. The measured flow near this location, however, increases to 244 cubic feet per day (ft^3/d). As a result, the calculated selenium loading increases from 1.8 lb/d at station LW4.95 to 4.1 lb/d at station LW3.1. There is a calculated increase of 2.3 lb/d between these stations. The estimated loading declines by 1.7 lb/d (to 2.3 lb/d) at the next downstream station (LW0.8). A similar increase in flow rate and loading between these stations is also evident in the calculations using January 19, 2009 flow data (Table A-1).

In summary, the data and analysis discussed above, although fairly rough computations and subject to varying interpretation, indicate that selenium loading to the Las Vegas Wash north of the site could be potentially significant enough to warrant conducting solute transport simulations for selenium. The simulation results are discussed in the next section.

5.4.2 Selenium Transport Simulation Results

The contoured initial selenium concentration as of 2009 is shown in Figure 20 for layer 1 and Figure 21 for layers 2 through 11. Figure 20 illustrates that the highest concentrations of selenium in the Qal (about 100 µg/L) are observed within the north end of the site between the CoH Water Treatment Facility and the former CoH Northern RIBs. In the UMCf, the observed selenium concentrations are much more diffuse, reaching 100 µg/L in only one monitor well southeast of the CoH Northern RIBs (Figure 21). Figures 20 and 21 indicate that selenium concentrations in groundwater at the model boundaries are small or zero.

Review of Figures 22a through 22f indicates that the simulated behavior of selenium, like that of arsenic and chromium VI, is also substantially different from that of perchlorate. Again, the primary reason for this difference is the retardation coefficient (Section 4) applied for selenium, which leads to reduced transport velocity and hydrodynamic dispersion relative to the perchlorate simulations. Figure 22a indicates that selenium persists in the Qal throughout the simulation period, although maximum concentrations are reduced due to flushing and dilution. Simulated selenium concentrations in the top 5 feet of the UMCf are similar to those in the Qal, with the exception of a zone of higher concentration of 50 µg/L north of the site boundary and southeast of the former CoH Northern RIBs (Figure 22b). This zone of higher concentration appears to be related to a zone of higher selenium concentration at depth (Figure 22c), which exists due to migration of the initial zone of 100 µg/L assigned to the UMCf (Figure 21). Figures 22d through 22f illustrate the general behavior that simulated selenium concentrations are predicted to be similar and generally declining in the Qal (layer 1) and the upper part of the UMCf (layer 2), while simulated concentrations at depth (layer 11) are generally fairly steady.

Note that the retardation factor selected for selenium is on the low end of potential values for oxidizing conditions that are reported in the scientific literature. In reality, selenium transport rates, as with those of arsenic and chromium VI, are likely lower than those simulated. For the predictive selenium transport simulation discussed above, the simulated selenium loading to the Las Vegas Wash from groundwater water is about 0.02 lb/d for current conditions. These calculations assume that all groundwater that exists at the northern boundary of the groundwater flow model (either Qal or UMCf) enters the Las Vegas Wash.

5.5 Simulated Solute Mass

The simulated total mass for each constituent for each of the four base case scenarios is provided in Table 5, divided by Qal (model layer 1) and UMCf (model layers 2 through 11). The values in Table 5 indicate that each constituent is persistent within the UMCf due to the initial concentrations and the low hydraulic conductivity of this unit. Constituent mass is removed from the groundwater system by flushing in various amounts, depending on the applied boundary conditions. For example, if upgradient inflow of solute mass for perchlorate could be eliminated (zero concentration boundary), the perchlorate mass would be reduced by over 99 percent in the Qal and 74 percent in the UMCf. However, if boundary concentrations remain constant through time, the perchlorate mass in the Qal will only be reduced by about 43 percent, while the perchlorate mass in the UMCf will remain about the same (Table 5).

Perchlorate mass values are also provided in Table 5 for the cases where initial perchlorate concentrations are prescribed in the Qal or the UMCf only, with no mass input at the model boundaries (last two columns). The results of these simulations underscore the importance that the UMCf plays in terms of serving as a long-term source of perchlorate to the Qal. For example, for the case where initial perchlorate concentration is prescribed for the UMCf only, the Qal and UMCf mass values at the end of the simulation are very similar to the "Boundary Concentration at Zero" case, indicating that the initial perchlorate concentration in the Qal has been entirely removed, and simulated long-term perchlorate concentrations in the Qal persist because of the perchlorate in the UMCf.

Table 5. Summary of Constituent Mass from Transport Simulations

Geologic Unit	Initial Mass (kilograms)	Mass at the End of 100 Years (kilograms)				
		Boundary Concentration at Zero	Boundary Concentration Held Constant at Initial Values	Boundary Concentration Reduced through Time	Initial Concentration in Layer 1 Only, Boundary Concentration at Zero	Initial Concentration in Layer 2 Only, Boundary Concentration at Zero
Perchlorate						
Qal	143,092	834	81,805	4,957	14	820
UMCf	136,413	35,075	134,268	44,165	667	34,413
Arsenic						
Qal	1,371	211	321	224	—	—
UMCf	2,103	1,972	2,007	1,979	—	—
Chromium VI						
Qal	630	122	259	134	—	—
UMCf	872	843	909	851	—	—
Selenium IV						
Qal	310	42	—	—	—	—
UMCf	249	243	—	—	—	—

Qal = Quaternary alluvium
UMCf = Upper Muddy Creek Formation
— = Not applicable

Table 6 provides a summary of initial mass and cumulative mass inflow over the 100-year simulation period for perchlorate, the most mobile constituent simulated. The corresponding values in Table 5 and 6 can be compared to better understand the simulated mass flux over the long term. For example, for the reduced boundary concentration case, Table 5 indicates that about 10 percent of the total remaining mass occurs in the Qal (4,957 kilograms out of 49,122 kilograms for the Qal and UMCf combined) and about 90 percent resides in the UMCf. However, of the cumulative mass inflow for this scenario, about 99.6 percent is to the Qal, and only 0.4 percent is to the UMCf (Table 6).

Table 6. Summary of Simulated Perchlorate Mass Input Through Time

Geologic Unit	Initial Mass (kilograms)	Cumulative Mass Input Over 100-Year Simulation Period (kilograms)	
		Boundary Concentration Held Constant at Initial Values	Boundary Concentration Reduced Through Time
Qal	143,092	3,788,381	719,792
UMCf	136,413	14,289	2,694
Total	279,505	3,802,669	722,487

Qal = Quaternary alluvium
UMCf = Upper Muddy Creek Formation

6. Source Area Simulations

Worst case source area predictive transport simulations were conducted for perchlorate, arsenic, and chromium VI. Source area simulations were not conducted for selenium because sitewide vadose zone modeling and soil source zone evaluations are not yet complete. The source area designations are provided in Figure 23, along with the status of source area data availability.

Because complete soil sampling results and vadose zone transport modeling results are not available for most of the source areas, worst case source area simulations where simulated solute concentrations in groundwater are much higher than expected were derived as follows:

- The area, the maximum depth of detection in the vadose zone for each constituent, and the average concentration in soil for each source area were determined or estimated as outlined in Table 7. For source areas where data were incomplete or not available (1st 8 Rows-Phase II, Upper Ponds, Spray Wheel, TIMET Ponds and Staging [see Figure 20]), data from adjacent source areas were applied as indicated in Table 7. The data for Table 7 were supplied by Jones (2009 and 2010b).

- A total estimated mass of each constituent within each source area was estimated based on the above values (area, maximum depth of detection, and average concentration in soil) and an assumed bulk density of 1.3 g/cm^3, which is consistent with available data.

- The entire constituent mass obtained as outlined above was assumed to migrate nearly instantaneously to model layer 1 cells that are saturated in the model. This approach was implemented in the model by prescribing an equivalent solute concentration to the areal recharge applied to each source area for stress period 2, which has a duration of 3.5 years and represents the period of time from current conditions to assumed site buildout.

This approach represents a worst case simulation where the total estimated mass of a given constituent in soil is flushed to groundwater over a short period of time. If and when the actual vadose zone solute transport simulation results are implemented into the model, the simulated solute concentrations in the saturated zone will be substantially less than those indicated in the simulation results provided in this section. The relative effects of the source areas simulated in this fashion can be observed by referring to the appropriate constituent figures in the previous section. The simulated solute concentrations are additive between runs.

The simulated perchlorate concentration for the maximum source area scenario as described above is illustrated in Figures 24a through 24f. Figures 24a through 24c indicate that perchlorate concentrations as high as 250 µg/L persist north of the Upper Ponds area site boundary beneath Tuscany in model layer 1. Simulated perchlorate concentrations persist in this region due to perchlorate that migrates into the UMCf (Figures 24b and 24c) and then

Table 7. Source Area Data Used to Determine Mass Input

Source Area	Acres	Perchlorate		Arsenic		Chromium VI		Comments
		Maximum Depth (feet bgs)	Average Concentration (mg/kg)	Maximum Depth (feet bgs)	Average Concentration (mg/kg)	Maximum Depth (feet bgs)	Average Concentration (mg/kg)	
Utility Corridor	8.4	60	1.0	60	6.8	20	1.1	
Mohawk	54.7	19	0.44	19	5.86	19	1.20	
Parcel 4A	243.7	NA	NA	NA	2.8	NA	NA	
Parcel 4B	278.4	NA	NA	NA	5.14	NA	NA	
Western Hook	226.9	17	1.0	17	9.5	13	0.3	
Southern RIBs	84.2	21	0.41	21	4.14	18	0.62	
Galleria North	143.7	20	2.2	20	5.9	20	0.5	
SN Commercial	43.8	17	2.3	17	6.5	17	0.7	
Open Space	151.3	20	6.4	20	10.1	20	0.4	
1st 8 Rows-Phase I	77.1	21	0.39	21	7.89	21	1.41	
1st 8 Rows-Phase II	124.4	21	0.39	21	7.89	21	1.41	Assumed maximum depths and average concentrations of 1st 8 Rows Phase I
Upper Ponds	281.6	20	2.2	20	5.9	20	0.5	Assumed maximum depths and average concentrations of Galleria North
Spray Wheel	125.6	20	2.2	20	5.9	20	0.5	Assumed maximum depths and average concentrations of Galleria North
TIMET Ponds	209.9	21	0.41	21	4.14	21	0.62	Assumed maximum depths and average concentrations of Southern RIBs
Staging	84.2	21	0.41	21	4.14	21	0.62	Assumed maximum depths and average concentrations of Southern RIBs

Source: Jones, 2009 and 2010b bgs = Below ground surface mg/kg = Milligrams per kilogram NA = Not available continues to diffuse upward through time. Note that along this northern boundary, first groundwater occurs in the UMCf at many locations. Figures 24d through 24f indicate that maximum perchlorate concentrations at the selected monitor well locations occur within about 10 years or less, and are substantially reduced within about 20 years or less.

The simulated arsenic concentration for the maximum source area scenario as described above is illustrated in Figures 25a through 25f, and the simulated chromium VI concentration for the maximum source area scenario is illustrated in Figures 26a through 26f. The simulation results for these two constituents are very similar due to the significant retardation coefficients, which lead to very limited transport and dispersion. Differences between the two simulations are attributable primarily to the different source area strengths. Each simulation shows significant groundwater concentrations that persist on-site for the full 100-year simulation period, with highest concentrations in model layer 1 (Figures 25a and 26a), and lowest simulated concentrations in model layer 11 (Figures 25c and 26c). In addition, at the monitor well locations considered, simulated solute concentrations tend to persist at relatively constant values or grow slowly through time (Figures 25e, 25f, 26e, and 26f).

For the most part, simulated arsenic and chromium VI from the BMI source areas remains on-site over the 100-year predictive simulation period, with the exception of the area beneath the former CoH Northern RIBs immediately east of the Western Hook area. Arsenic and chromium VI migrate through the paleochannel in this region, and impacted water in the paleochannel also impacts groundwater in model layer 2, the upper 5 feet of the UMCf. This result is not observed in the perchlorate source area simulation because the migration of perchlorate is not retarded and perchlorate that enters this paleochannel area is flushed from the groundwater system.

7. Sensitivity Analysis

A series of sensitivity runs were conducted for two sets of solute transport model input parameters, effective porosity, and dispersion coefficients. The results of these sensitivity runs are summarized below. The sensitivity simulations were conducted for the boundary concentration of zero case, where the only source of mass in the groundwater system is from the initial concentrations assigned to model layers 1 through 11. In addition, perchlorate was the constituent selected for evaluation because its mobility is substantially greater than that of arsenic and chromium VI. Sensitivity simulations were not conducted for arsenic or chromium VI. The results of the sensitivity simulations are provided for comparison with the base case in terms of time-series concentrations at the selected monitor wells PC12, AA-20, and AA-18. Therefore, the base case referred to in the sensitivity plots corresponds to Figures 5d through 5f.

7.1 Effective Porosity

For the sensitivity simulations where effective porosity was adjusted, the specific yield of the aquifer was also adjusted to be consistent with the requirements of the MODFLOW-SURFACT computer code, where specific yield cannot be greater than effective porosity. As noted in Section 4, for the base case model runs, the selected effective porosity for the Qal (model layer 1) is 0.2 and the effective porosity of the UMCf (model layers 2 through 11) is 0.1. The specific yield for both geologic units is assumed to be the same as the effective porosity. For the sensitivity runs, the effective porosity and specific yield for model layer 1 were increased to 0.3 and decreased to 0.1 (base case is 0.2), while at the same time the effective porosity and specific yield for model layers 2 through 11 were increased to 0.15 and decreased to 0.05 (base case is 0.1).

Figures 27a through 27c illustrate the sensitivity simulation results for well PC12 for model layers 1, 2, and 11, respectively. As would be expected, the simulation with the lower effective porosity leads to earlier (faster) solute arrival at the well, while the simulation with the higher effective porosity illustrates delayed solute arrival compared with the base case. The overall response, or shape, of the solute concentration curves is similar among simulations. The same conclusions can be drawn from the simulation results for wells AA-20 (Figures 28a through 28c) and AA-18 (Figures 29a through 29c).

7.2 Dispersivity

For the base case simulation, the longitudinal, transverse, and vertical dispersivities of 50 feet, 5 feet, and 0.5 feet, respectively, were used based on the solute transport modeling work plan (DBS&A, 2009c). For the sensitivity run where dispersivity was increased, longitudinal, transverse, and vertical dispersivities of 75 feet, 7.5 feet, and 0.75 feet, respectively, were used. For the sensitivity run where dispersivity was decreased, longitudinal, transverse, and vertical dispersivities of 25 feet, 2.5 feet, and 0.25 feet, respectively, were used.

The results of these sensitivity simulations are provided in Figures 30a through 30c, 31a through 31c, and 32a through 32c for wells PC12, AA-20, and AA-18, respectively. For wells PC12 and AA-20, the change in assumed dispersivity, either higher or lower than the base case value, leads to very minimal differences in the simulation results (Figures 30a through 30c and 31a through 31c). For well AA-18 (Figure 32a through 32c), the adjusted dispersivity values have a greater effect, but are still not significant.

8. Summary and Conclusions

A series of predictive solute transport simulations were conducted for perchlorate, arsenic, chromium VI, and selenium. Simulation results indicate that perchlorate is readily flushed from the Qal within a period of 10 to 20 years, depending on the value of Qal hydraulic conductivity. However, perchlorate in the UMCf that exists under current observed conditions or that enters the UMCf during the predictive simulation period is less easily flushed and serves as a long-term continuing source of perchlorate mass transfer to the Qal. For this reason, long-term simulated concentrations of perchlorate are lowest in the Qal, and increase with depth through the UMCf. In addition, the geographic distribution of simulated future perchlorate concentration in the Qal is closely correlated with regions of significant perchlorate concentration in the UMCf.

Simulations with three assumed groundwater inflow boundary conditions were run for each constituent (except for selenium, which has boundary concentrations that are small or zero). The simulations are (1) assumed boundary concentrations of zero (no mass inflow), (2) assumed boundary concentration equal to current conditions (current scenario assumed for

100 years), and (3) assumed reductions in constituent concentrations through time. For perchlorate, simulated values within and south of the Western Hook area are sensitive to the assumed perchlorate concentration of groundwater inflow. However, simulated perchlorate concentrations in the Upper Ponds area are similar among the three simulations conducted, indicating that simulation results in this area are not significantly influenced by assumed boundary concentrations. This result is due primarily to the limited volume of groundwater inflow that occurs to the Upper Ponds portion of the model domain.

Predicted solute concentrations for arsenic, chromium VI, and selenium are influenced more by the initial concentration than by the assumed boundary conditions. Due to retardation processes, simulated changes in these constituents through time are much slower (take more time) as compared to perchlorate. Even with the effects of retardation, however, trends in simulated concentrations for these constituents are observed over time periods of 40 to 50 years. Selenium is of concern due to potential loading to Las Vegas Wash. The simulation results indicate that the selenium loading to the wash is about 0.02 lb/d. As noted earlier in the report, the selected retardation factors for each of these constituents (arsenic, chromium VI, and selenium) are on the low end of possible values based on the literature; therefore, in reality the migration of these constituents may be significantly slower than that simulated herein.

The simulation results summarized above, in addition to providing some insights about potential future constituent concentrations and solute transport behavior, have significant implications regarding site conceptual model issues. Specifically, the simulation results indicate that the magnitude and extent of current observed solute concentrations in the aquifer system beneath the site are likely a highly complex result of historical source locations and strengths, historical groundwater flow conditions, and the degree of hydraulic communication between the Qal and the UMCf. For example, the observed distribution of various constituents in the UMCf at many locations is likely a product of historical groundwater flowpaths in the Qal, rather than the direct migration of constituents from a given source area along groundwater flowpaths within the UMCf itself.

Finally, it should be noted that observed constituent concentrations from UMCf monitor wells with limited screen lengths (generally 20 feet, all of which may not be saturated) were used to estimate initial solute concentrations across the entire simulated thickness of UMCf in the model of 50 feet. This approach likely increases the assumed mass of a given constituent within the simulated portion of the UMCf, since observed data indicate that the concentrations of solutes in the UMCf generally decrease with increasing depth. Consequently, simulated mass in the UMCf for the constituents considered in this report are in all likelihood greater than that which actually exists.

In addition to the base case simulations summarized above, a series of worst case source area leaching scenarios were considered for perchlorate, arsenic, and chromium VI. In these model runs, the entire estimated mass of the given constituent in each source area was assumed to enter groundwater in the Qal over a 3.5-year period at the beginning of the predictive simulation. For source areas that have not yet been characterized, constituent mass was estimated based on the soil concentrations measured for adjacent areas. For arsenic and chromium VI, it is likely that a significant portion of the mass in soil will never reach groundwater. For perchlorate it is likely that the mass that leaches to groundwater will do so over an extended period of time much longer than 3.5 years.

The results of these simulations indicate that for perchlorate, elevated solute concentrations are concentrated along the northern site boundary of the Upper Ponds area, in the former CoH Northern RIBs area, and west of Tuscany Village. As noted for previous perchlorate simulations, simulated concentrations are lowest in the Qal and increase with depth through the UMCf. For arsenic and chromium VI, the greatest simulated long-term concentrations in groundwater occur in the Upper Ponds area and beneath the former CoH Northern RIBs (there is a paleochannel that passes beneath the former RIBs area). In the vertical dimension, the simulated long-term concentrations are significantly different than those of perchlorate in that there is less mass (lower concentrations) in the top of the UMCf, and almost no constituent mass that reaches the base of the UMCf that is simulated in the model (depth of 50 feet). This result is due to the significant retardation factors applied for these constituents, which tends to limit vertical migration (as compared to perchlorate) due to the smaller magnitude of advection and hydrodynamic dispersion, which is velocity dependent. BRC expects to conduct more detailed source area simulations in the future based on the results of leaching models completed for each source area. The results of these future source area simulations will likely indicate substantially lower predicted solute concentrations than those presented in this report.

References

Allison, J. and T. Allison. 2005. *Partition coefficients for metals in surface water, soil, and waste.* EPA/600/R-05/074. July 2005.

Daniel B. Stephens & Associates, Inc. (DBS&A). 2009a. *Updated groundwater flow model calibration, BMI Upper and Lower Ponds Area*. Prepared for Basic Remediation Company, Henderson, Nevada. May 14, 2009.

DBS&A. 2009b. *Solute transport modeling work plan, BMI Upper and Lower Ponds Area*. Prepared for Basic Remediation Company, Henderson, Nevada. October 2, 2009.

DBS&A. 2009c. *Summary report for updated groundwater flow model calibration, BMI Upper and Lower Ponds Area, Nevada*. Prepared for Basic Remediation Company, Henderson, Nevada. November 2009.

DBS&A. 2010a. *Revised 2009 report, BMI Common Areas (Eastside) Clark County, Nevada*. Prepared for Basic Remediation Company, Henderson, Nevada. May 12, 2010.

DBS&A. 2010b. *Revised upgradient wells report, BMI Common Areas (Eastside) Clark County, Nevada*. Prepared for Basic Remediation Company, Henderson, Nevada. May 14, 2010.

Dragun, J. 1988. *The soil chemistry of hazardous materials.* Hazardous Materials Control Research Institute, Silver Spring, Maryland, 458 p.

Driscoll, F. 1986. *Groundwater and wells*, 2nd Edition. H.M. Smyth Company, Inc. p. 67.

Environmental Resources Management (ERM). 2000. *Mohawk Area interim remedial measure completion report, BMI Common Areas, Henderson, Nevada.* Prepared for Basic Remediation Company. May 19, 2000.

HydroGeoLogic, Inc. 1996. *MODFLOW-SURFACT software (Version 3.0) overview: Installation, registration and running procedures.*

Interstate Technology & Regulatory Council (IT&RC). 2005. *Perchlorate: Overview of issues, status, and remedial options.* Prepared by Perchlorate Team, September 2005.

Jones, M. 2009. E-mail communication between Mark Jones, ERM, and Neil Blandford, DBS&A. December 7, 2009.

Jones, M. 2010a. E-mail communication between Mark Jones, ERM, and Neil Blandford, DBS&A. April 30, 2010.

Jones, M. 2010b. E-mail communication between Mark Jones, ERM, and Muthu Kuchanur, DBS&A. May 12, 2010.

Tipton, D., D. Rolston, and K. Scow. 2003. Transport and biodegradation of perchlorate in soils. *Journal of Environmental Quality* 32: 40-46.

Xu, M. and Y. Eckstein. 1995. Use of weighted least-squares method in evaluation of the relationship between dispersivity and field scale. *Ground Water* 33(6):905-908.

Figures

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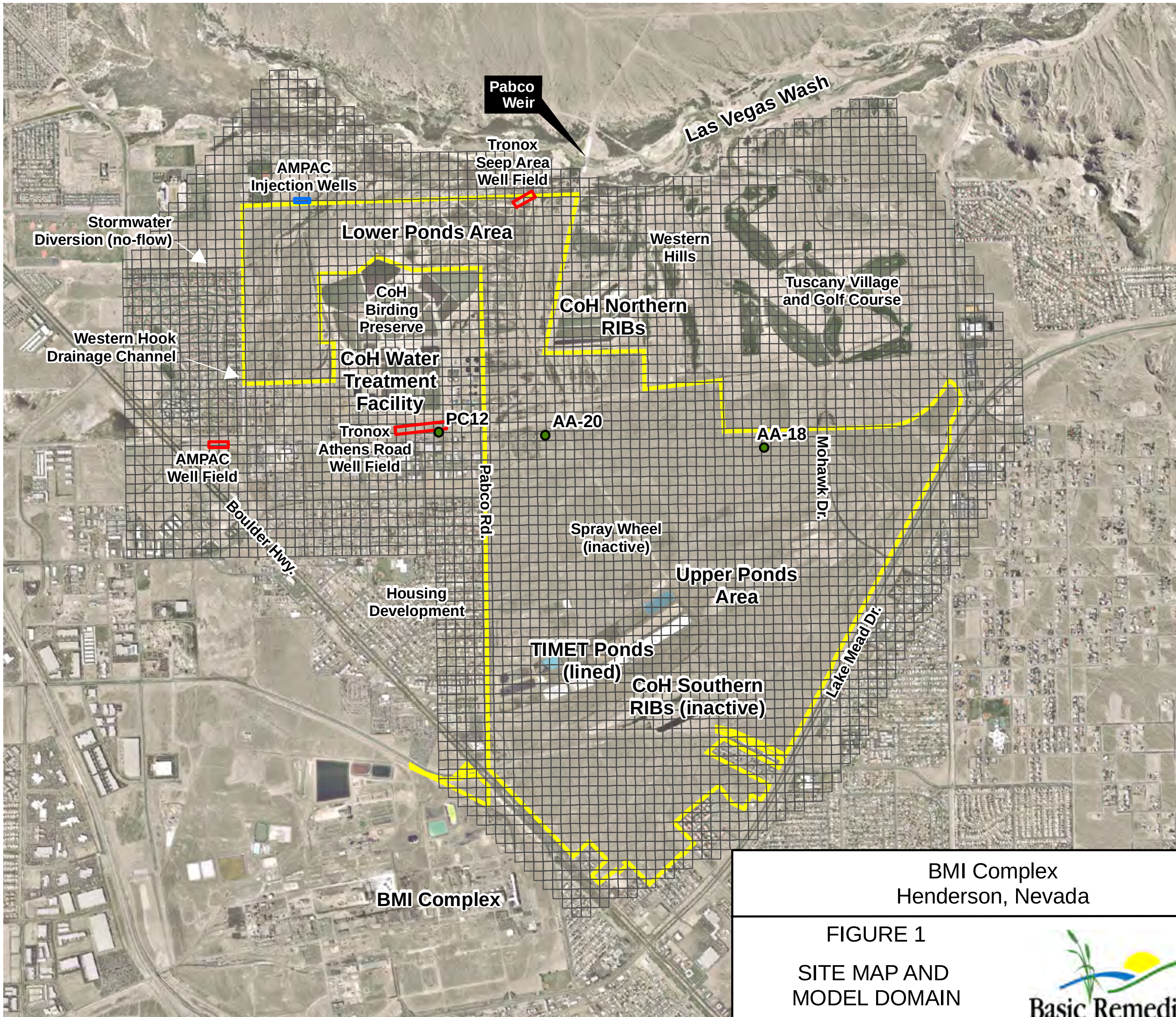

Source: Aerial photograph, April 2004

Explanation

- Monitor well
- Extraction well field
- Injection well field
- Model grid
- Site boundary

N

0 1,750 3,500 Feet

BMI Complex
Henderson, Nevada

FIGURE 1

SITE MAP AND MODEL DOMAIN

Basic Remediation COMPANY

Prepared by: DBS&A BGT

Date 05-27-2010

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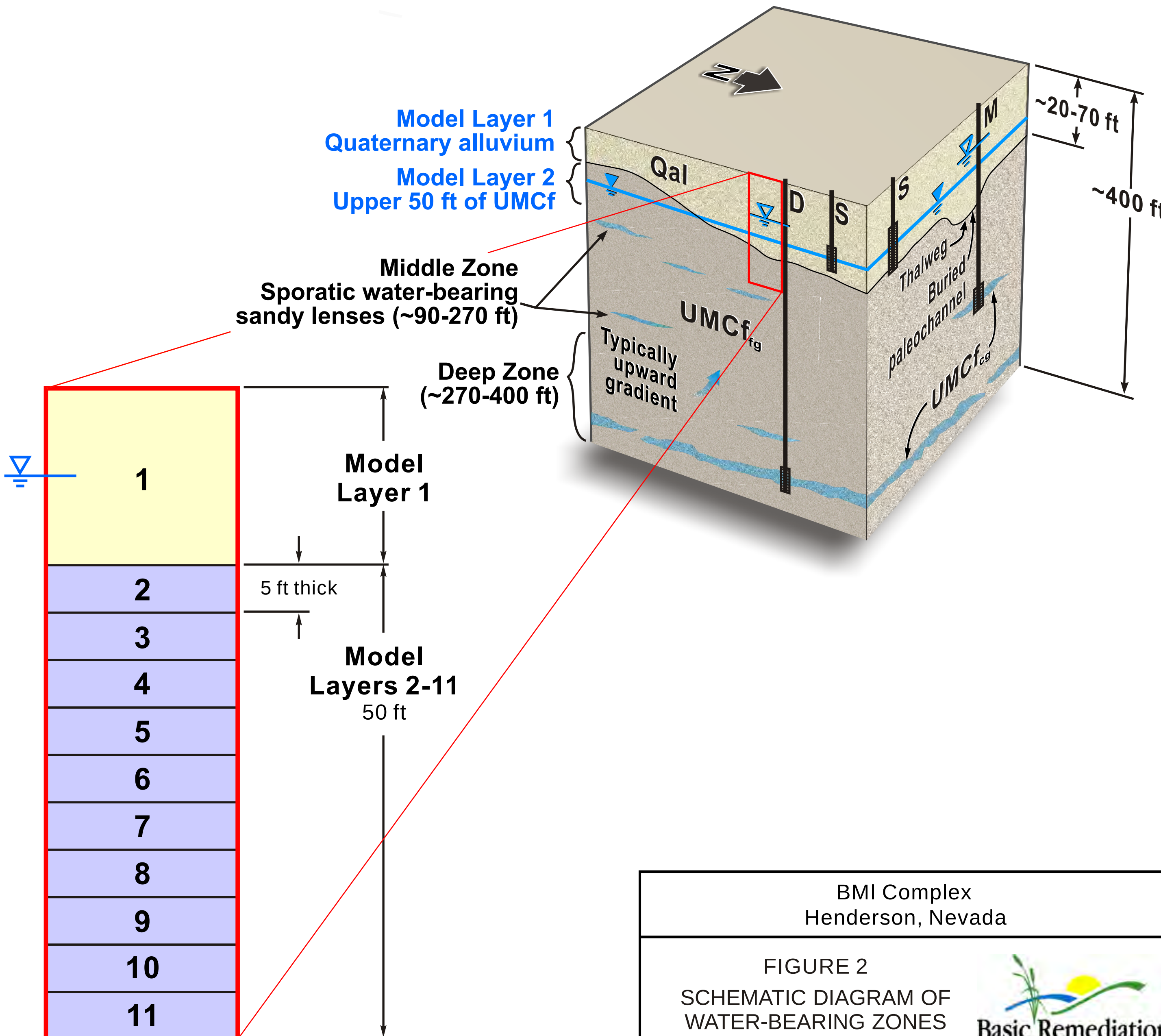

Note: Not to scale

Explanation

Qal	Quaternary alluvium
$UMCf_{cg}$	Upper Muddy Creek formation (coarse-grained facies)
$UMCf_{fg}$	Upper Muddy Creek formation (fine-grained facies)
(well symbol)	Example well and screen **S** = Shallow Zone well **M** = Middle Zone well **D** = Deep Zone well
(open triangle symbol)	Deep or Middle Zone groundwater level
(filled triangle symbol)	Shallow Zone groundwater level

BMI Complex
Henderson, Nevada

FIGURE 2

SCHEMATIC DIAGRAM OF WATER-BEARING ZONES AND MODEL LAYERS

Basic Remediation COMPANY

Prepared by: DBS&A MNW | Date 5/27/10 | S:/PROJECTS/BRC/ES10.0042_BRC_TRANSPORT_MODEL_RUNS/VDR_DRAWINGS\FIG_02_SCHEM_DIAG_WATER-BEARING_ZONES_MODEL_LAYERS.CDR

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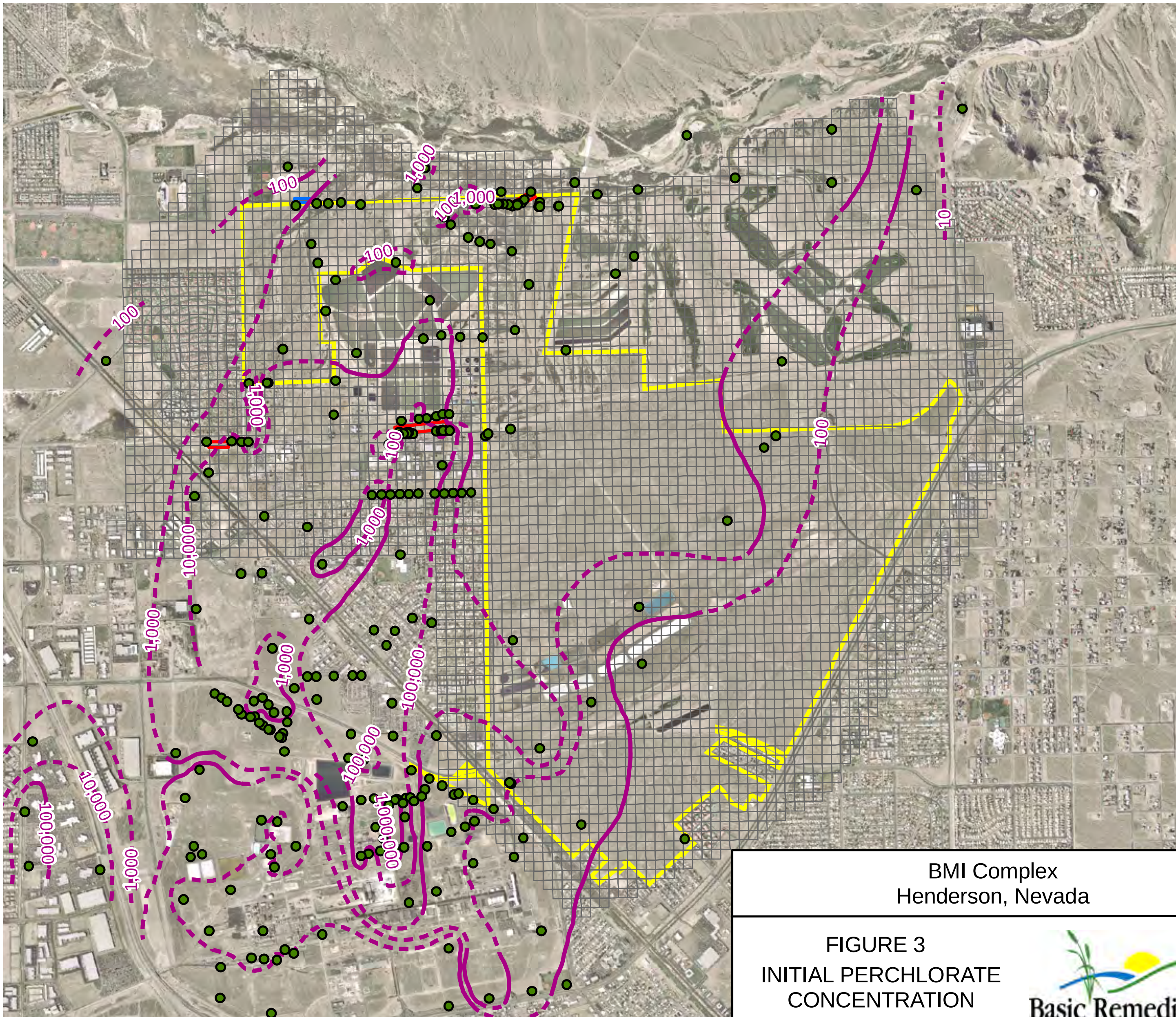

Source: Aerial photograph, April 2004

Explanation

- Monitor well
- Concentration contour (µg/L) (dashed where inferred) from DBS&A (2010a,b)
- Extraction well field
- Injection well field
- Model grid
- Site boundary

N

0 1,750 3,500 Feet

BMI Complex
Henderson, Nevada

FIGURE 3
INITIAL PERCHLORATE CONCENTRATION
LAYER 1

Basic Remediation COMPANY

Prepared by: DBS&A BGT

Date 05-27-2010

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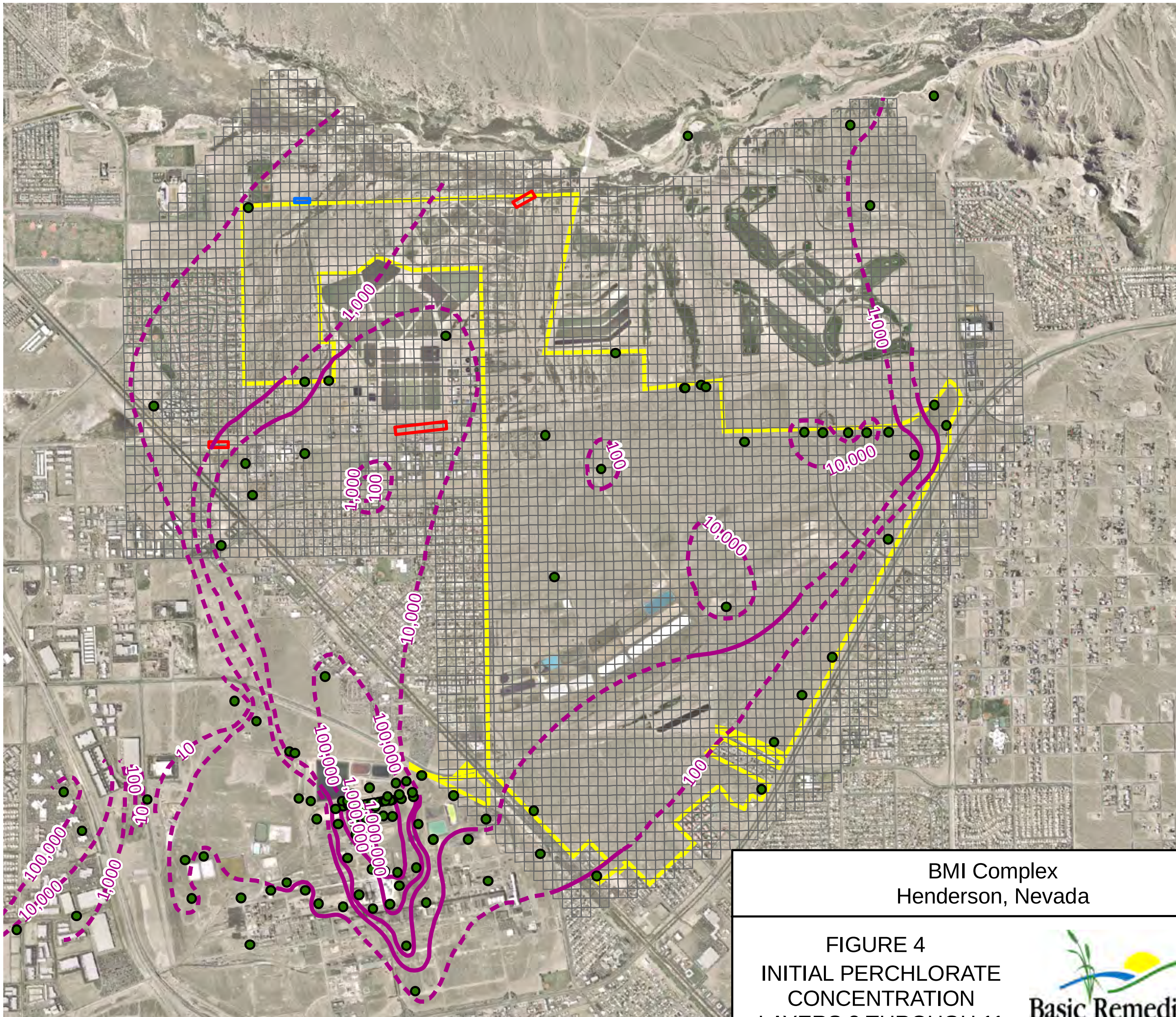

Source: Aerial photograph, April 2004

Explanation

- Monitor well
- Concentration contour (µg/L) (dashed where inferred) from DBS&A (2010a,b)
- Extraction well field
- Injection well field
- Model grid
- Site boundary

N

0 1,750 3,500 Feet

BMI Complex
Henderson, Nevada

FIGURE 4
INITIAL PERCHLORATE CONCENTRATION
LAYERS 2 THROUGH 11

Basic Remediation COMPANY

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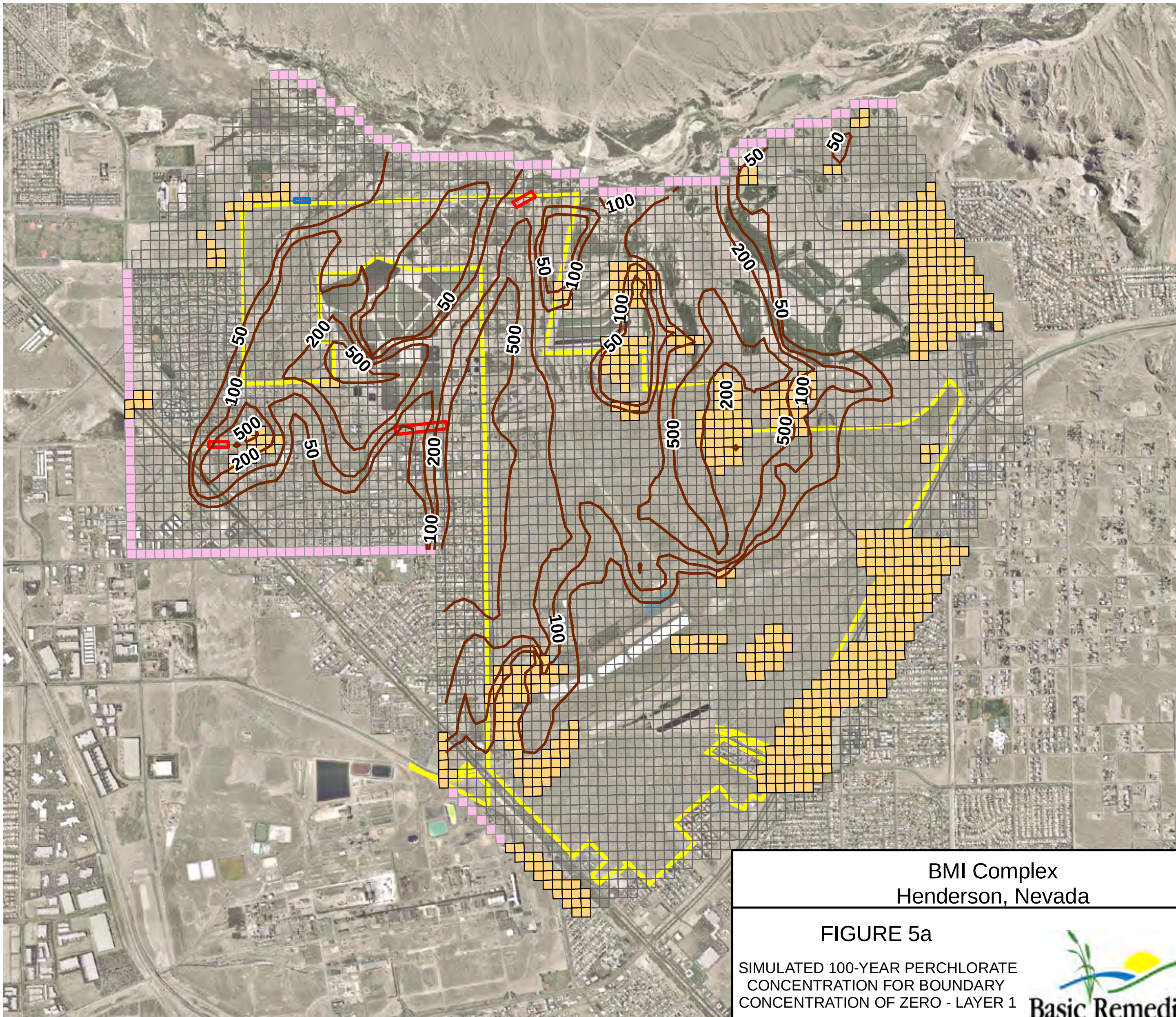

Source: Aerial photograph, April 2004

Explanation

- Simulated concentration (µg/L)
- Dry cell
- Boundary cell
- Extraction well field
- Injection well field
- Model grid
- Site boundary

N

0 1,750 3,500 Feet

BMI Complex
Henderson, Nevada

FIGURE 5a

SIMULATED 100-YEAR PERCHLORATE CONCENTRATION FOR BOUNDARY CONCENTRATION OF ZERO - LAYER 1

Basic Remediation COMPANY

Prepared by: DBS&A BGT

Date 05-27-2010

Daniel B. Stephens & Associates, Inc.
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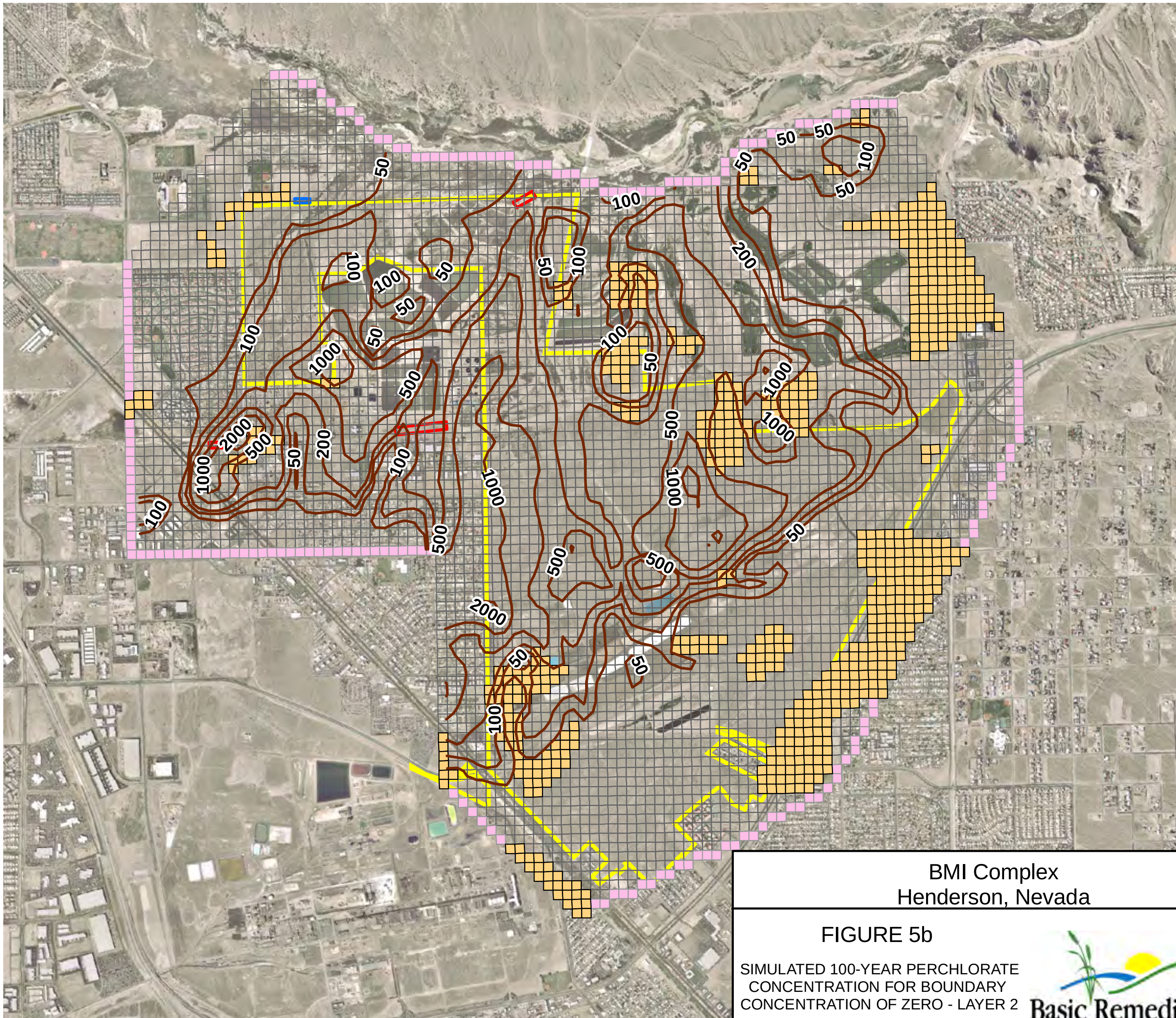

Source: Aerial photograph, April 2004

Explanation

- Simulated concentration (µg/L)
- Dry cell
- Boundary cell
- Extraction well field
- Injection well field
- Model grid
- Site boundary

N

0 1,750 3,500 Feet

BMI Complex
Henderson, Nevada

FIGURE 5b

SIMULATED 100-YEAR PERCHLORATE CONCENTRATION FOR BOUNDARY CONCENTRATION OF ZERO - LAYER 2

Basic Remediation COMPANY

Prepared by:	Date
DBS&A BGT	05-27-2010

Daniel B. Stephens & Associates, Inc.
JN ES10.0042

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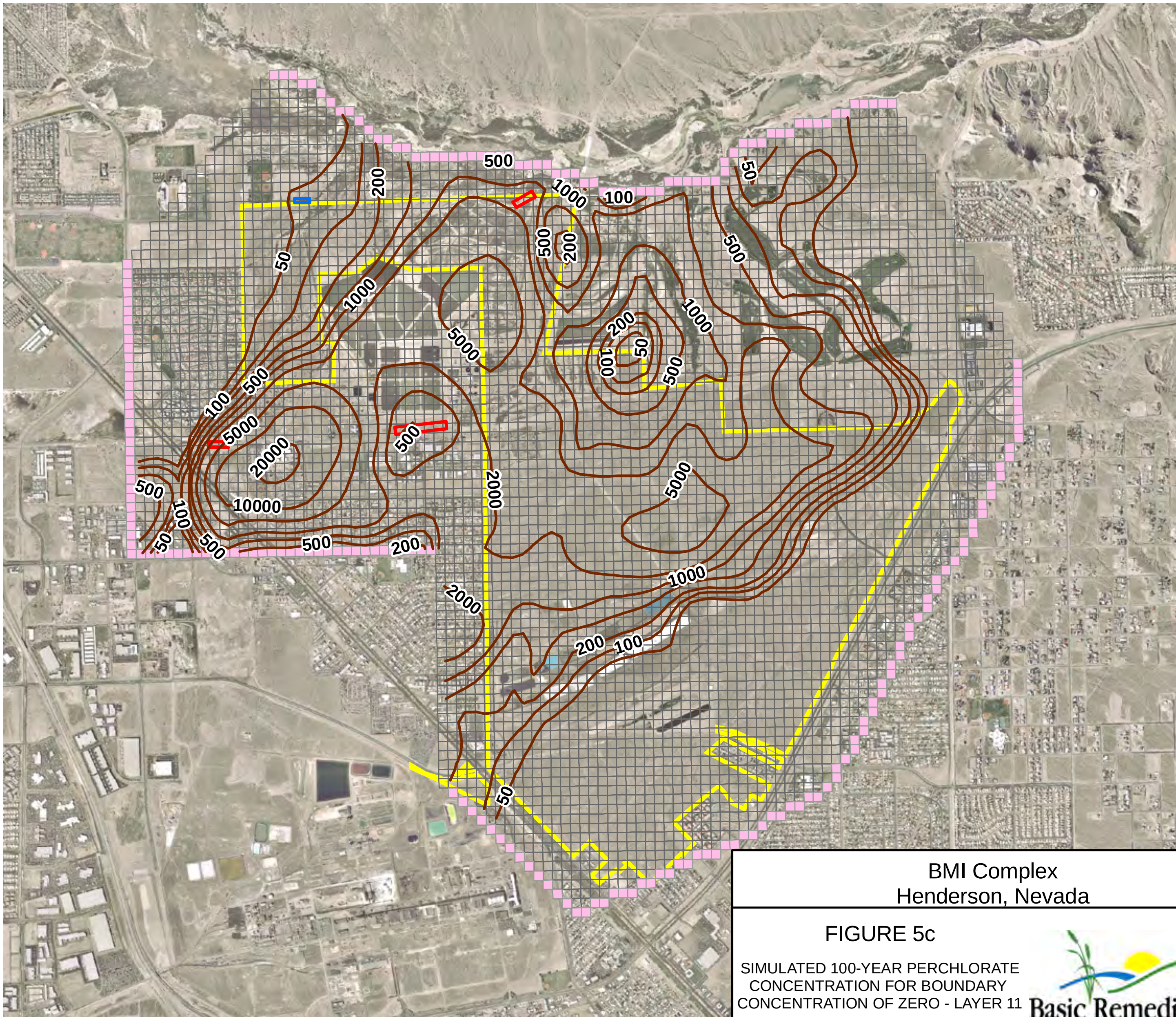

Source: Aerial photograph, April 2004

Explanation

- Simulated concentration (μg/L)
- Boundary cell
- Extraction well field
- Injection well field
- Model grid
- Site boundary

N

0 1,750 3,500 Feet

BMI Complex
Henderson, Nevada

FIGURE 5c

SIMULATED 100-YEAR PERCHLORATE CONCENTRATION FOR BOUNDARY CONCENTRATION OF ZERO - LAYER 11

Basic Remediation COMPANY

Prepared by: DBS&A BGT

Date 05-27-2010

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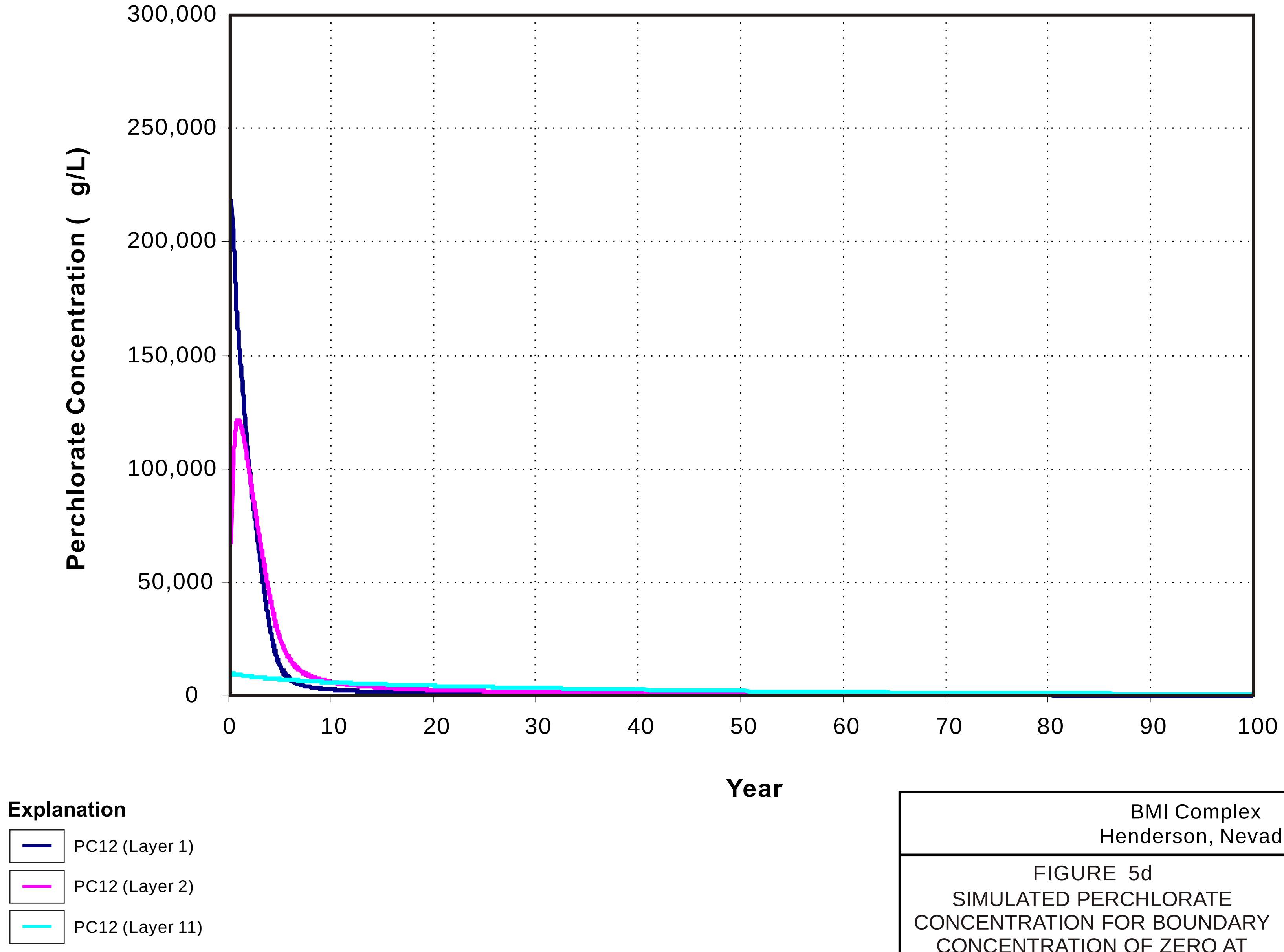

BMI Complex
Henderson, Nevada

FIGURE 5d
SIMULATED PERCHLORATE CONCENTRATION FOR BOUNDARY CONCENTRATION OF ZERO AT WELL PC12 LOCATION

Basic Remediation COMPANY

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Daniel B. Stephens & Associates, Inc.
JN ES10.0042

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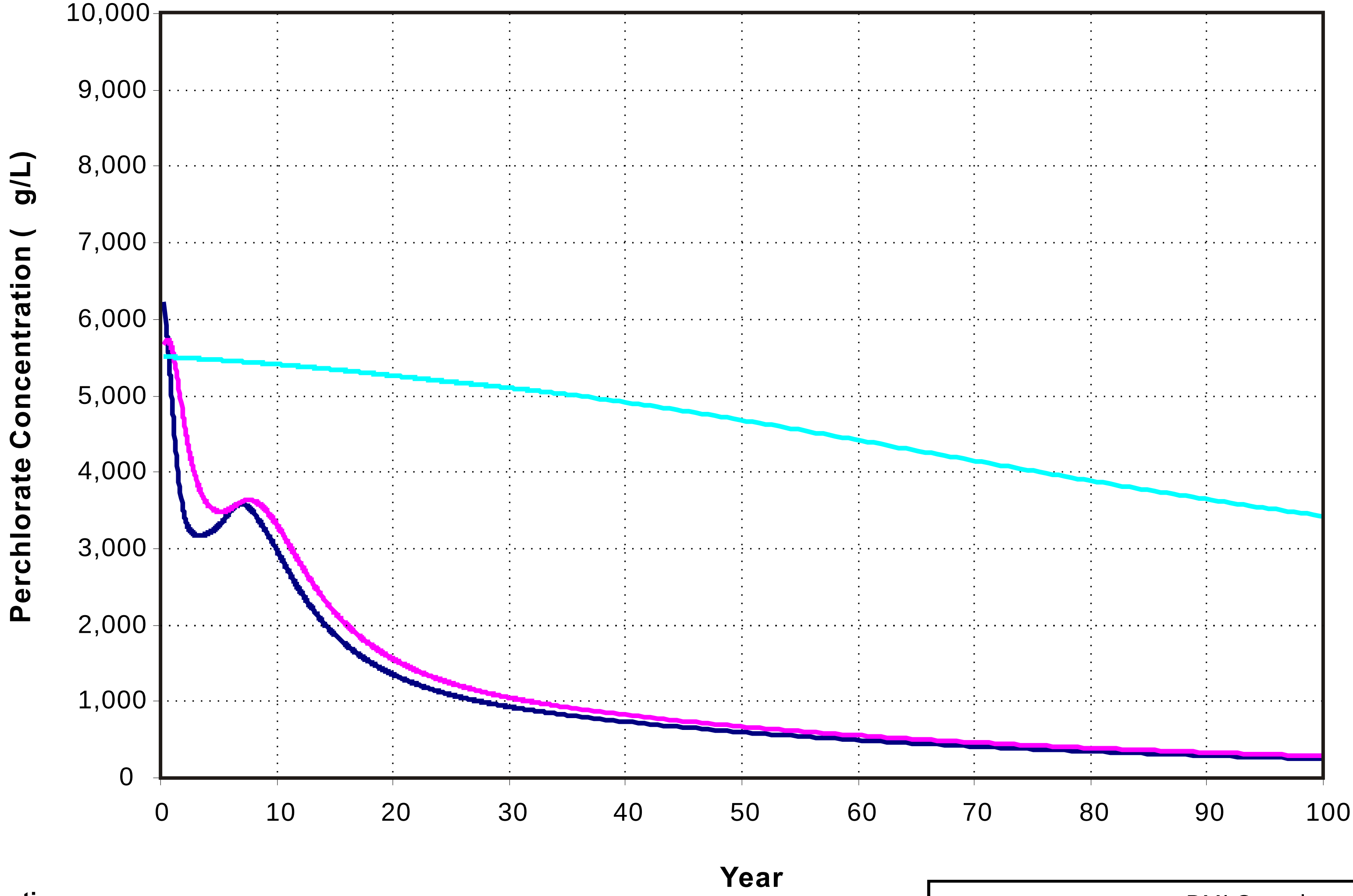

Explanation

- AA-20 (Layer 1)
- AA-20 (Layer 2)
- AA-20 (Layer 11)

BMI Complex
Henderson, Nevada

FIGURE 5e
SIMULATED PERCHLORATE CONCENTRATION FOR BOUNDARY CONCENTRATION OF ZERO AT WELL AA-20 LOCATION

Basic Remediation COMPANY

Prepared by: DBS&A GHS	Date 5/24/10	S:\Projects\BRC\ES10.0042_BRC_Transport_Model_Runs\VR_Drawings\Fig_5d_Simulated_Pchl_conc_0_Layer1_5D.cdr

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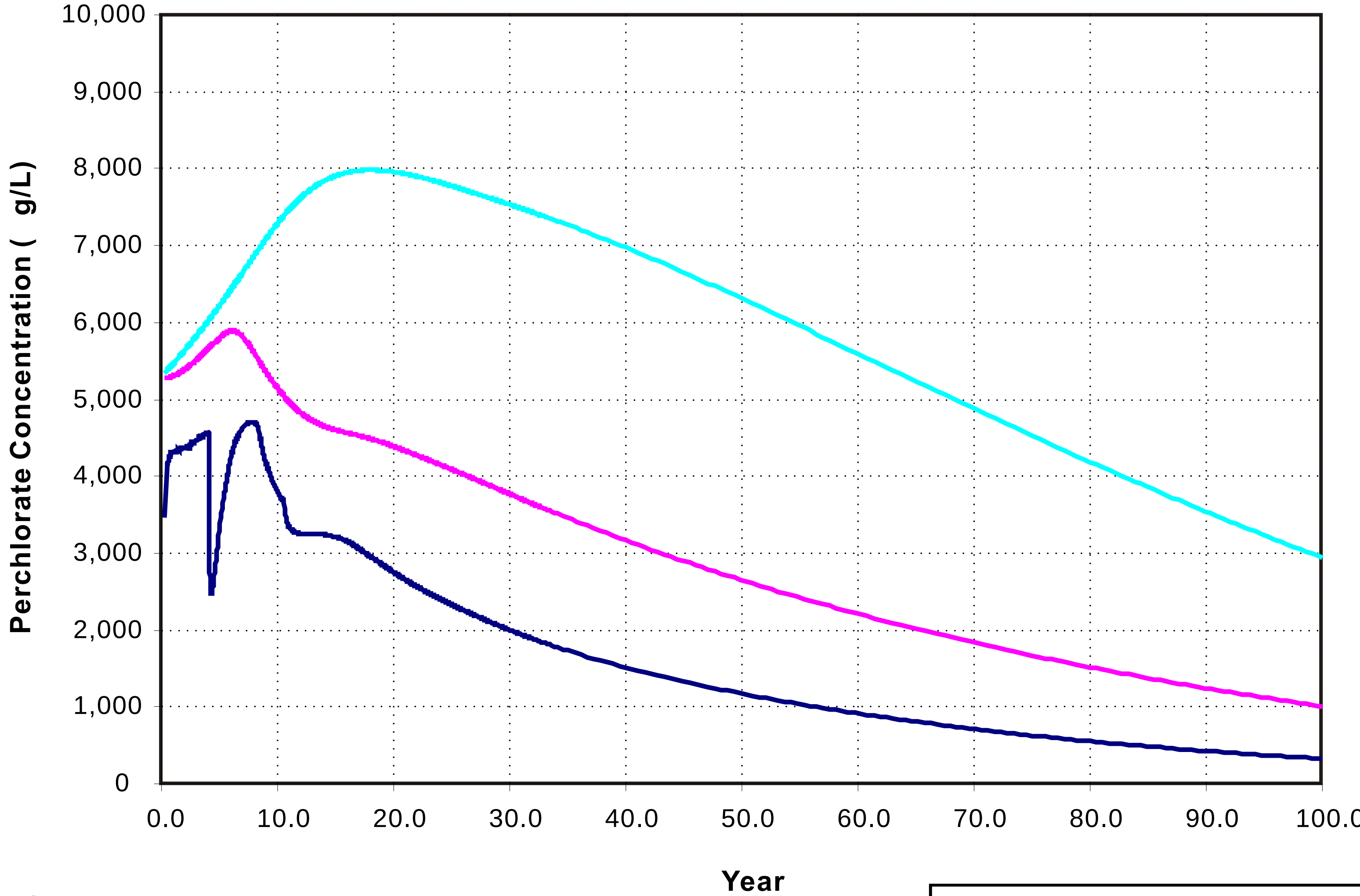

Explanation

- AA-18 (Layer 1)
- AA-18 (Layer 2)
- AA-18 (Layer 11)

BMI Complex
Henderson, Nevada

FIGURE 5f
SIMULATED PERCHLORATE CONCENTRATION FOR BOUNDARY CONCENTRATION OF ZERO AT WELL AA-18 LOCATION

Basic Remediation COMPANY

Prepared by: DBS&A GHS | Date 5/24/10 | S:\Projects\BRC\ES10.0042_BRC_Transport_Model_Runs\VR_Drawings\Fig_5d_Simulated_Pchl_conc_0_Layer1_5D.cdr

Daniel B. Stephens & Associates, Inc.
JN ES10.0042

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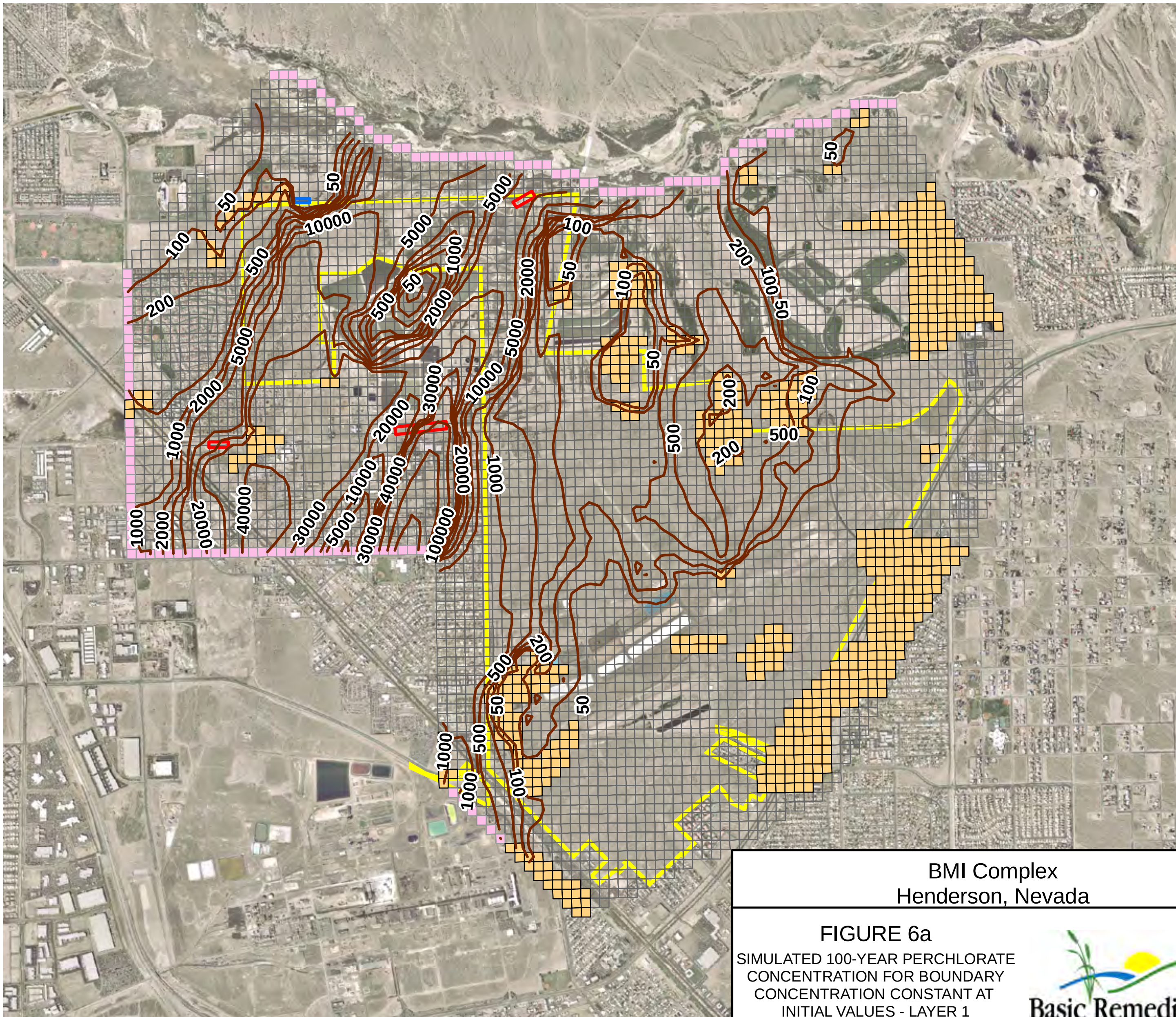

Source: Aerial photograph, April 2004

Explanation

- Simulated concentration (µg/L)
- Dry cell
- Boundary cell
- Extraction well field
- Injection well field
- Model grid
- Site boundary

N

0 1,750 3,500 Feet

BMI Complex
Henderson, Nevada

FIGURE 6a

SIMULATED 100-YEAR PERCHLORATE CONCENTRATION FOR BOUNDARY CONCENTRATION CONSTANT AT INITIAL VALUES - LAYER 1

Basic Remediation COMPANY

Prepared by: DBS&A BGT

Date 05-27-2010

Daniel B. Stephens & Associates, Inc.

JN ES10.0042

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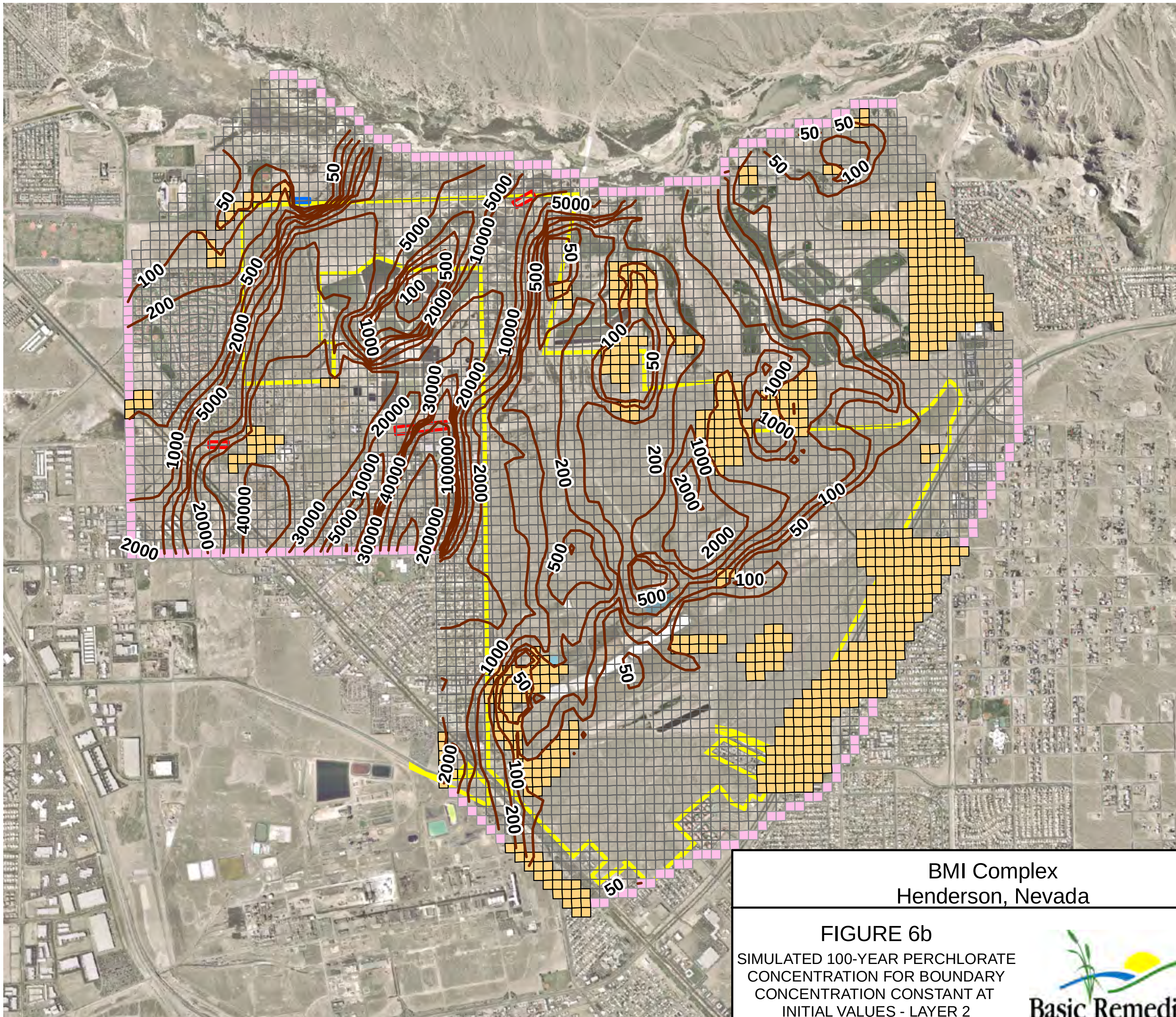

Source: Aerial photograph, April 2004

Explanation

- Simulated concentration (µg/L)
- Dry cell
- Boundary cell
- Extraction well field
- Injection well field
- Model grid
- Site boundary

N

0 1,750 3,500 Feet

BMI Complex
Henderson, Nevada

FIGURE 6b

SIMULATED 100-YEAR PERCHLORATE CONCENTRATION FOR BOUNDARY CONCENTRATION CONSTANT AT INITIAL VALUES - LAYER 2

Basic Remediation COMPANY

Prepared by: DBS&A BGT

Date 05-27-2010

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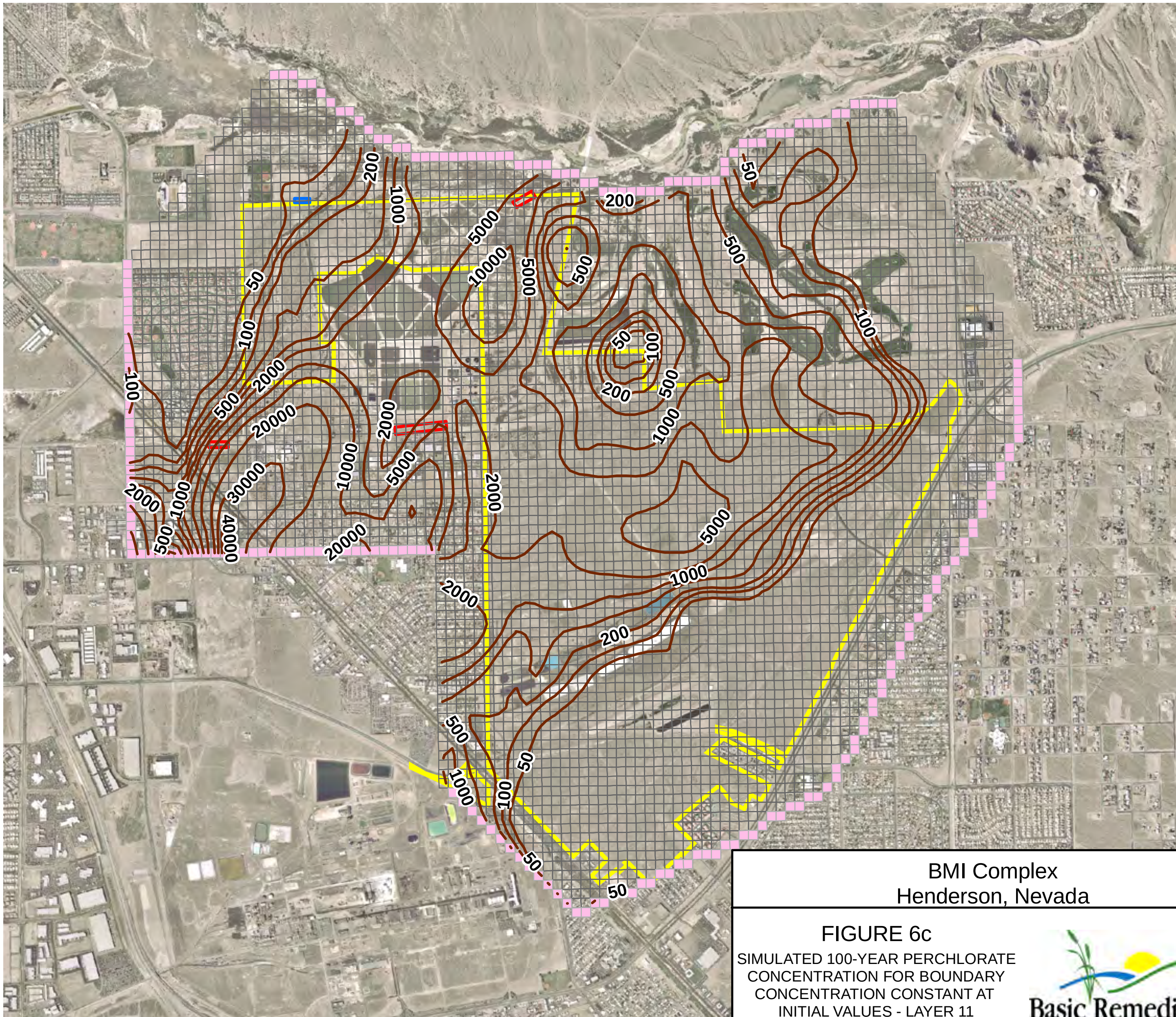

Source: Aerial photograph, April 2004

Explanation

- Simulated concentration (µg/L)
- Boundary cell
- Extraction well field
- Injection well field
- Model grid
- Site boundary

N

0 1,750 3,500 Feet

BMI Complex
Henderson, Nevada

FIGURE 6c

SIMULATED 100-YEAR PERCHLORATE CONCENTRATION FOR BOUNDARY CONCENTRATION CONSTANT AT INITIAL VALUES - LAYER 11

Basic Remediation COMPANY

Prepared by: DBS&A BGT

Date 05-27-2010

Daniel B. Stephens & Associates, Inc.

JN ES10.0042

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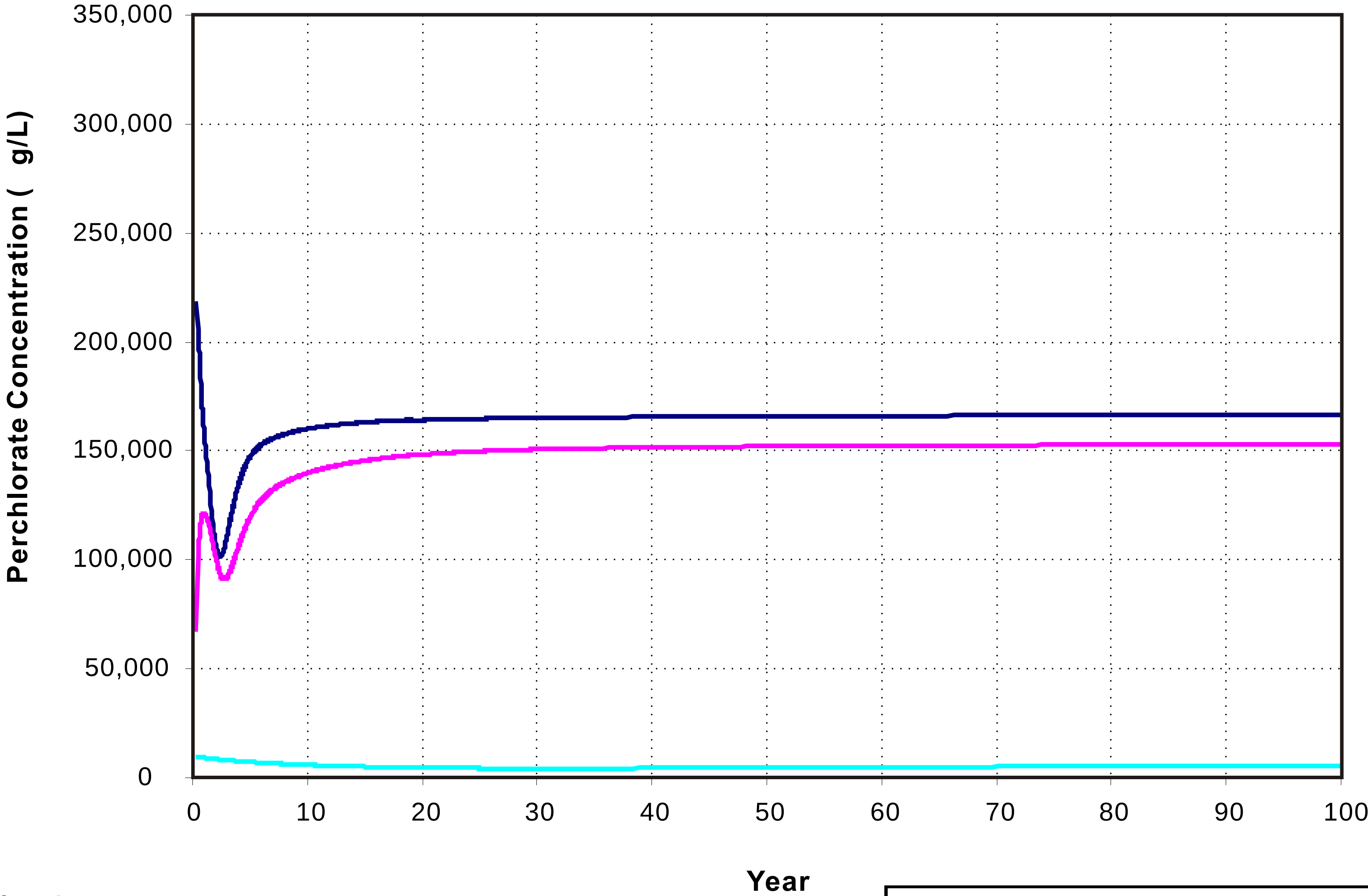

Explanation

- PC12 (Layer 1)
- PC12 (Layer 2)
- PC12 (Layer 11)

BMI Complex
Henderson, Nevada

FIGURE 6d
SIMULATED PERCHLORATE CONCENTRATION
FOR BOUNDARY CONCENTRATION
CONSTANT AT INITIAL VALUES
WELL PC12 LOCATION

Basic Remediation COMPANY

Prepared by: DBS&A GHS | Date 5/24/10 | S:\Projects\BRC\ES10.0042_BRC_Transport_Model_Runs\VR_Drawings\Fig_6d_Simulated_Pchl_conc_0_Layer1_6D.cdr

Daniel B. Stephens & Associates, Inc.
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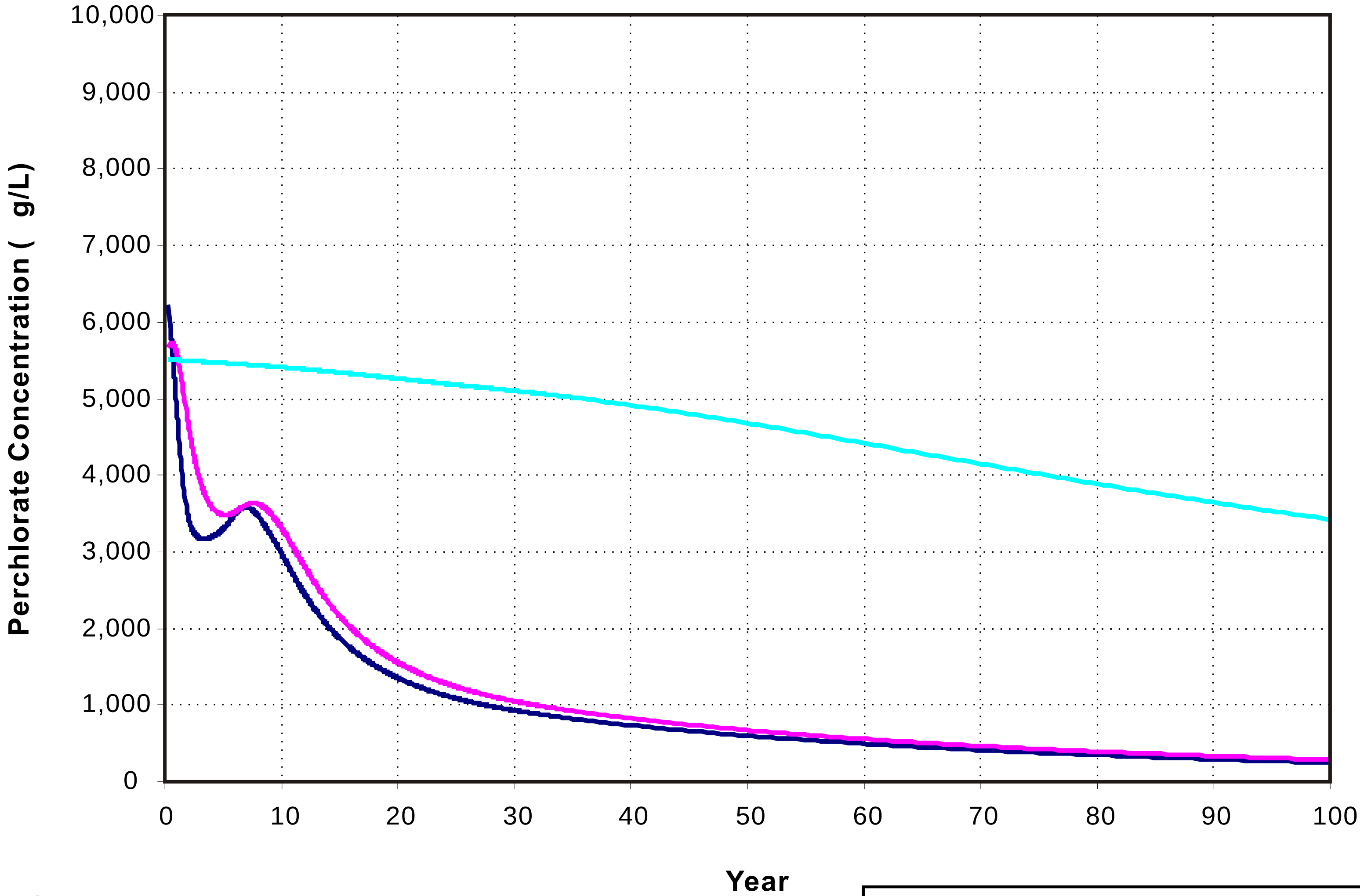

Explanation

- AA-20 (Layer 1)
- AA-20 (Layer 2)
- AA-20 (Layer 11)

BMI Complex
Henderson, Nevada

FIGURE 6e
SIMULATED PERCHLORATE CONCENTRATION
FOR BOUNDARY CONCENTRATION
CONSTANT AT INITIAL VALUES
WELL AA-20 LOCATION

Basic Remediation COMPANY

Prepared by: DBS&A GHS	Date 5/24/10	S:\Projects\BRC\ES10.0042_BRC_Transport_Model_Runs\VR_Drawings\Fig_6d_Simulated_Pchl_conc_0_Layer1_6D.cdr

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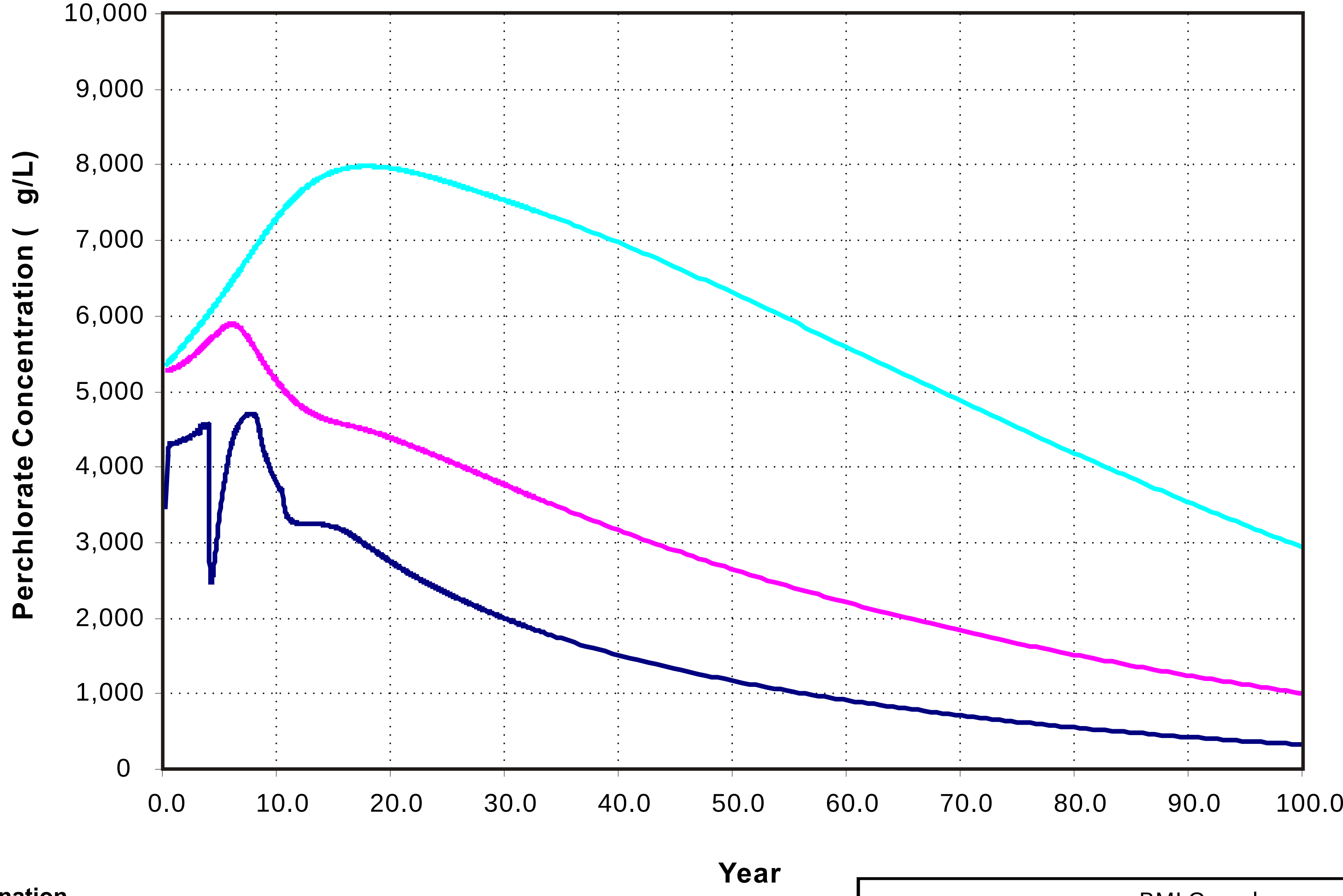
JN ES10.0042



Explanation

AA-18 (Layer 1)

AA-18 (Layer 2)

AA-18 (Layer 11)

BMI Complex
Henderson, Nevada

FIGURE 6f
SIMULATED PERCHLORATE CONCENTRATION FOR BOUNDARY CONCENTRATION CONSTANT AT INITIAL VALUES WELL AA-18 LOCATION

Basic Remediation COMPANY

Prepared by: DBS&A GHS

Date 5/24/10

S:\Projects\BRC\ES10.0042_BRC_Transport_Model_Runs\VR_Drawings\Fig_6d_Simulated_Pchl_conc_0_Layer1_6D.cdr

Daniel B. Stephens & Associates, Inc.

JN ES10.0042

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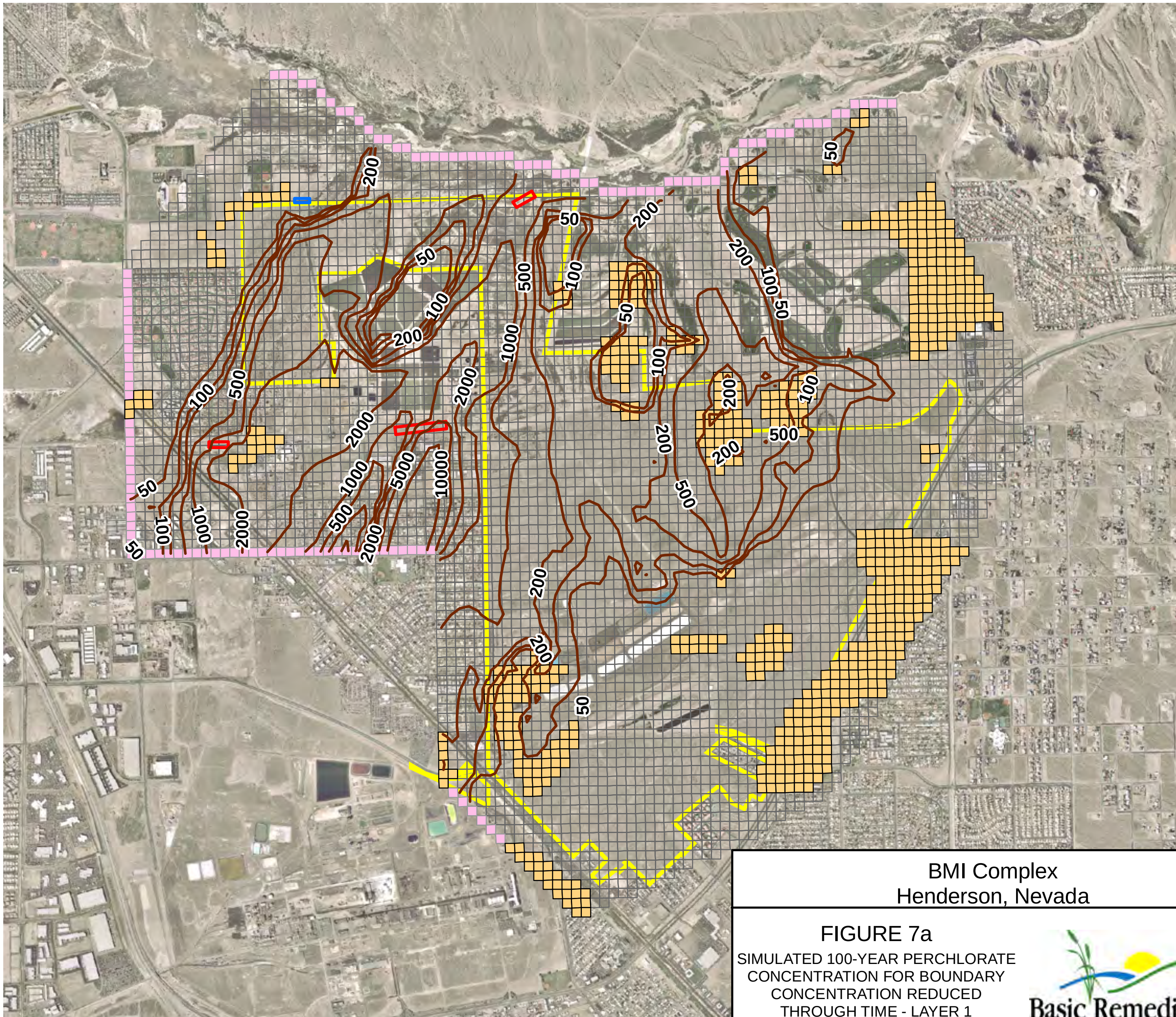

Source: Aerial photograph, April 2004

Explanation

- Simulated concentration (µg/L)
- Dry cell
- Boundary cell
- Extraction well field
- Injection well field
- Model grid
- Site boundary

N

0 1,750 3,500 Feet

BMI Complex
Henderson, Nevada

FIGURE 7a

SIMULATED 100-YEAR PERCHLORATE CONCENTRATION FOR BOUNDARY CONCENTRATION REDUCED THROUGH TIME - LAYER 1

Basic Remediation COMPANY

Prepared by:	Date
DBS&A BGT	05-27-2010

Daniel B. Stephens & Associates, Inc.
JN ES10.0042

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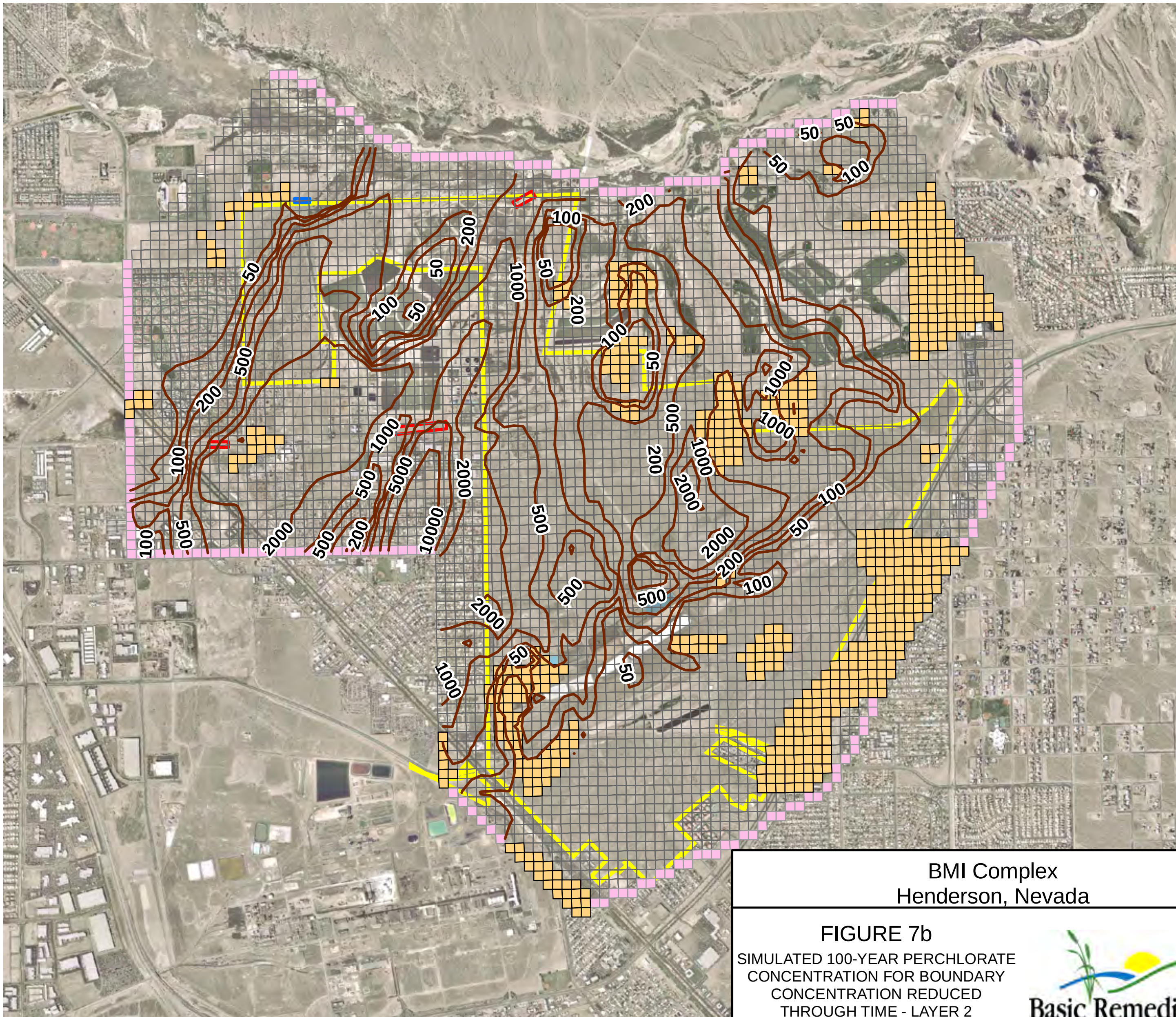


Source: Aerial photograph, April 2004

Explanation

- Simulated concentration (µg/L)
- Dry cell
- Boundary cell
- Extraction well field
- Injection well field
- Model grid
- Site boundary

N

0 1,750 3,500 Feet

BMI Complex
Henderson, Nevada

FIGURE 7b

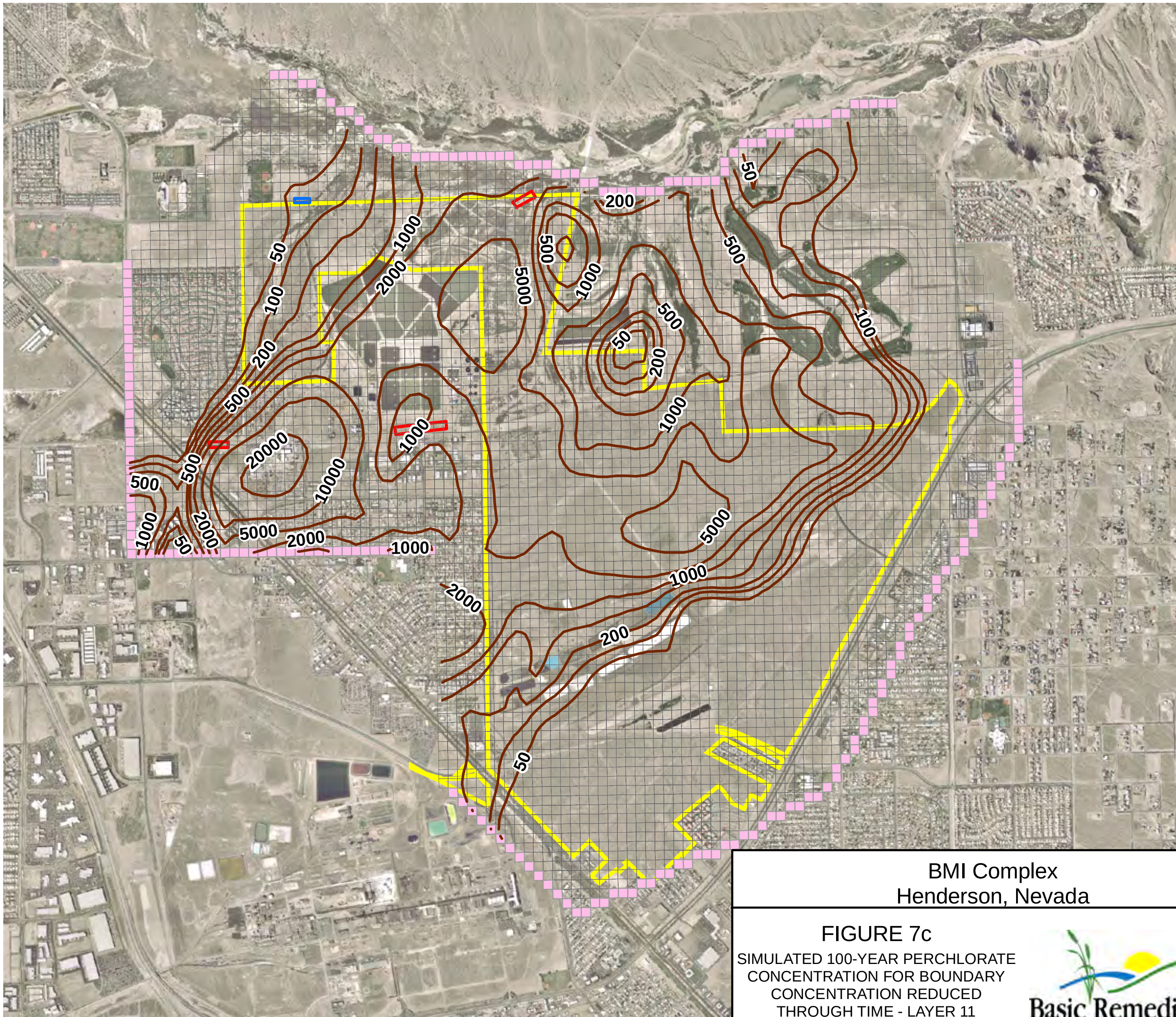
SIMULATED 100-YEAR PERCHLORATE CONCENTRATION FOR BOUNDARY CONCENTRATION REDUCED THROUGH TIME - LAYER 2

Basic Remediation COMPANY

Prepared by:	Date
DBS&A BGT	05-27-2010

Daniel B. Stephens & Associates, Inc.
JN ES10.0042

S:/PROJECTS/BRC/ES10.0042_BRC_TRANSPORT_MODEL_RUNS/GIS/MXDS/PERCHLORATE/FIGURE7C_11LAYER_RUN5A_L11_ALL.MXD 017250



Source: Aerial photograph, April 2004

Explanation

- Simulated concentration (µg/L)
- Boundary cell
- Extraction well field
- Injection well field
- Model grid
- Site boundary

N

0 1,750 3,500 Feet

BMI Complex
Henderson, Nevada

FIGURE 7c

SIMULATED 100-YEAR PERCHLORATE CONCENTRATION FOR BOUNDARY CONCENTRATION REDUCED THROUGH TIME - LAYER 11

Basic Remediation COMPANY

Prepared by: DBS&A BGT

Date 05-27-2010

Daniel B. Stephens & Associates, Inc.

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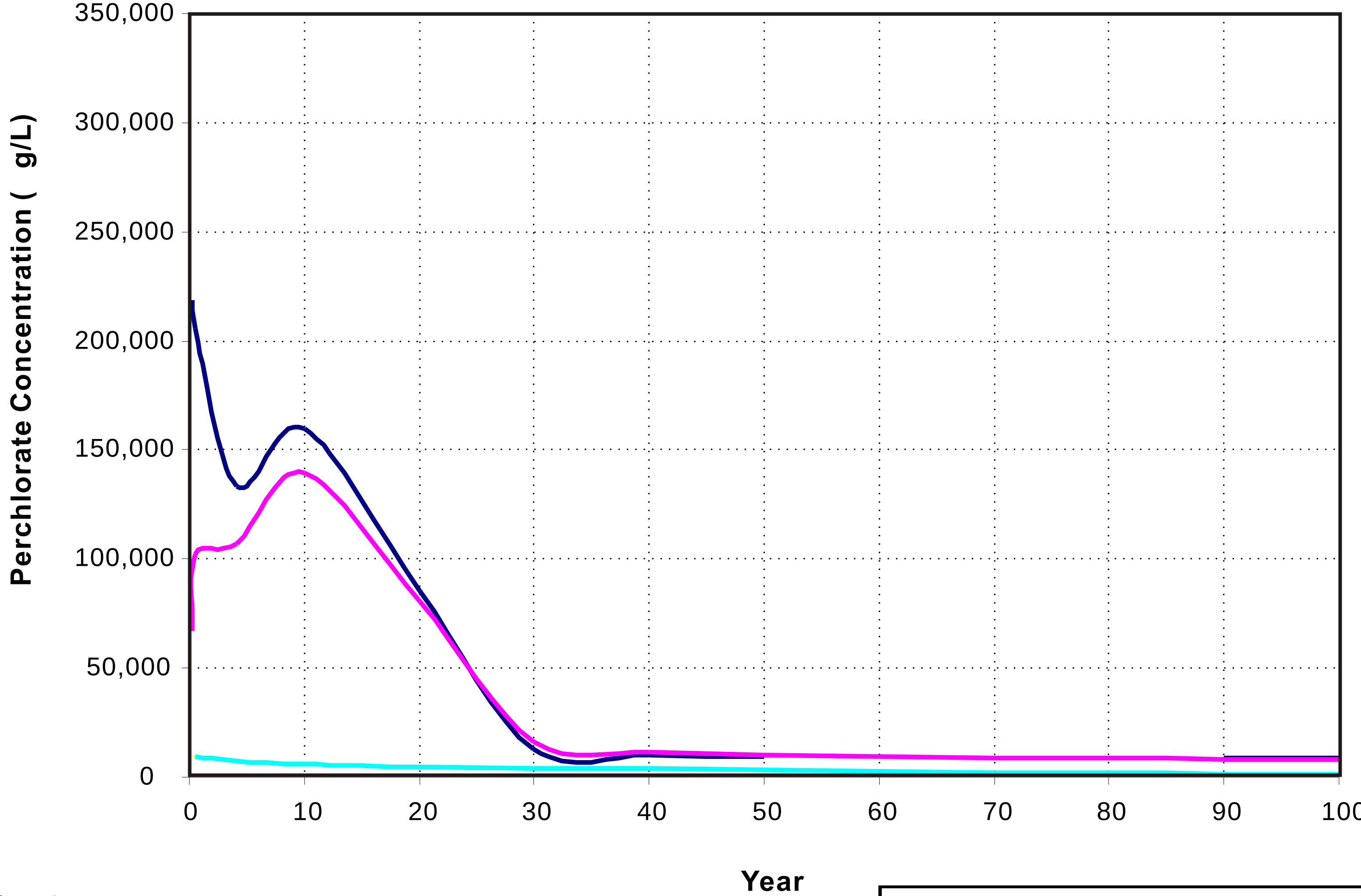

Explanation

- PC12 (Layer 1)
- PC12 (Layer 2)
- PC12 (Layer 11)

BMI Complex
Henderson, Nevada

FIGURE 7d
SIMULATED PERCHLORATE CONCENTRATION
FOR BOUNDARY CONCENTRATION
REDUCED THROUGH TIME
WELL PC12 LOCATION

Basic Remediation COMPANY

Prepared by: DBS&A GHS

Date 5/24/10

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JN ES10.0042

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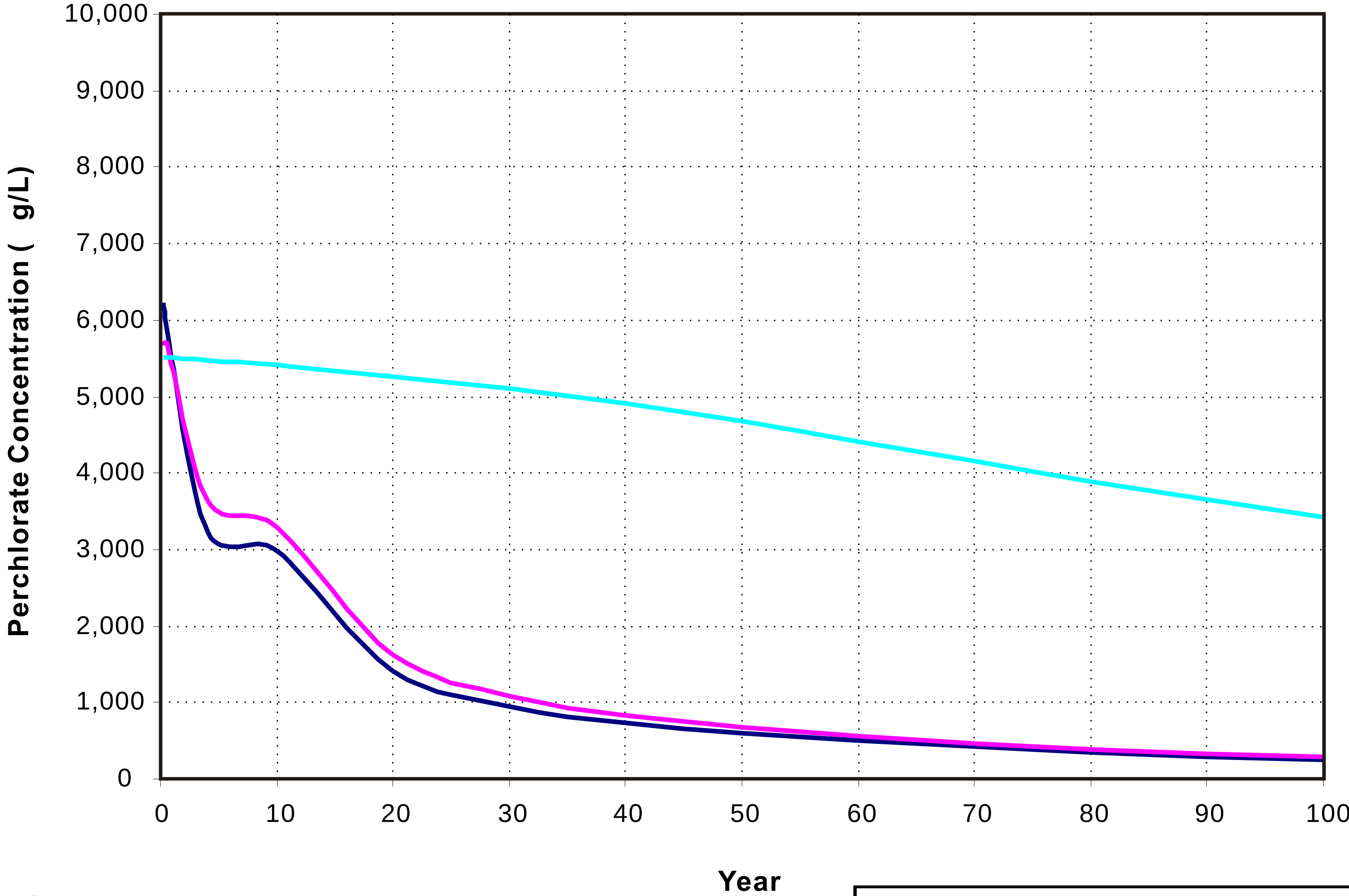

Explanation

- AA-20 (Layer 1)
- AA-20 (Layer 2)
- AA-20 (Layer 11)

BMI Complex
Henderson, Nevada

FIGURE 7e
SIMULATED PERCHLORATE CONCENTRATION
FOR BOUNDARY CONCENTRATION
REDUCED THROUGH TIME
WELL AA-20 LOCATION

Basic Remediation
COMPANY

Prepared by:
DBS&A GHS

Date
5/24/10

S:\Projects\BRC\ES10.0042_BRC_Transport_Model_Runs\VR_Drawings\Fig_7d_Simulated_Pchl_conc_0_Layer1_7D.cdr

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JN ES10.0042

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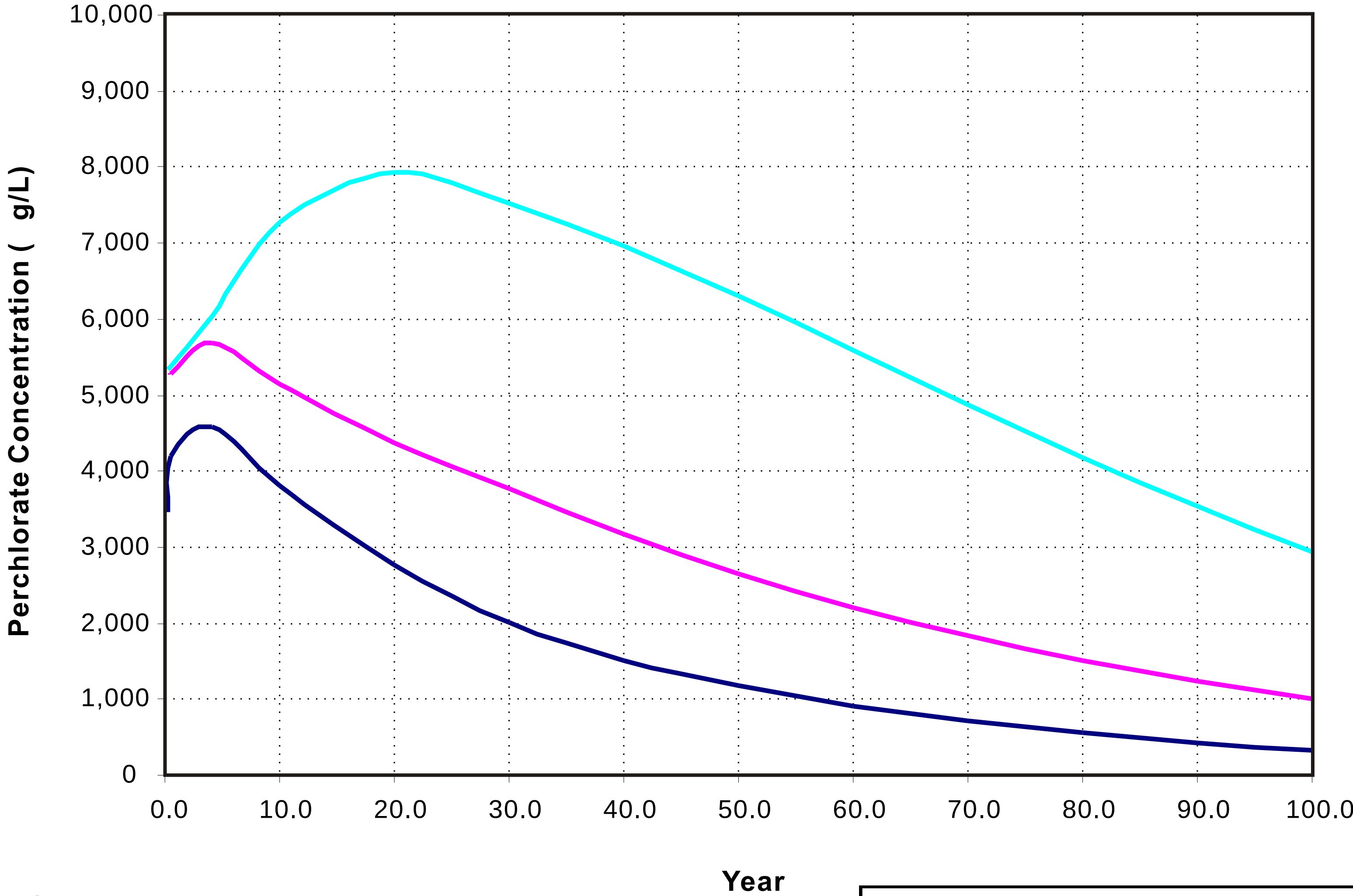

Explanation

- AA-18 (Layer 1)
- AA-18 (Layer 2)
- AA-18 (Layer 11)

BMI Complex
Henderson, Nevada

FIGURE 7f
SIMULATED PERCHLORATE CONCENTRATION FOR BOUNDARY CONCENTRATION REDUCED THROUGH TIME WELL AA-18 LOCATION

Basic Remediation COMPANY

Prepared by: DBS&A GHS	Date 5/24/10	S:\Projects\BRC\ES10.0042_BRC_Transport_Model_Runs\VR_Drawings\Fig_7d_Simulated_Pchl_conc_0_Layer1_7D.cdr

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JN ES10.0042

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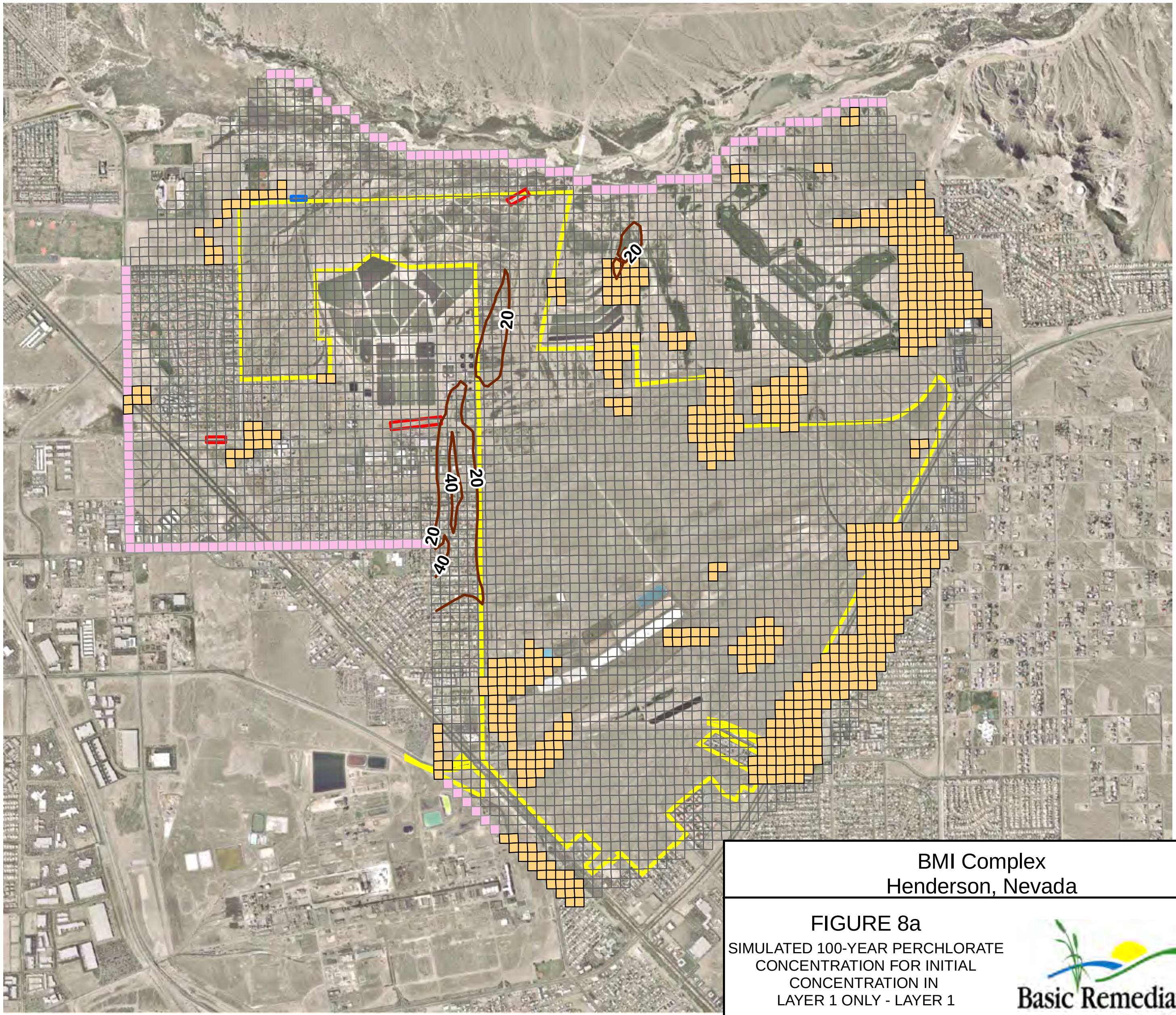


Source: Aerial photograph, April 2004

Explanation

- Simulated concentration (µg/L)
- Dry cell
- Boundary cell
- Extraction well field
- Injection well field
- Model grid
- Site boundary

N

0 1,750 3,500 Feet

BMI Complex
Henderson, Nevada

FIGURE 8a

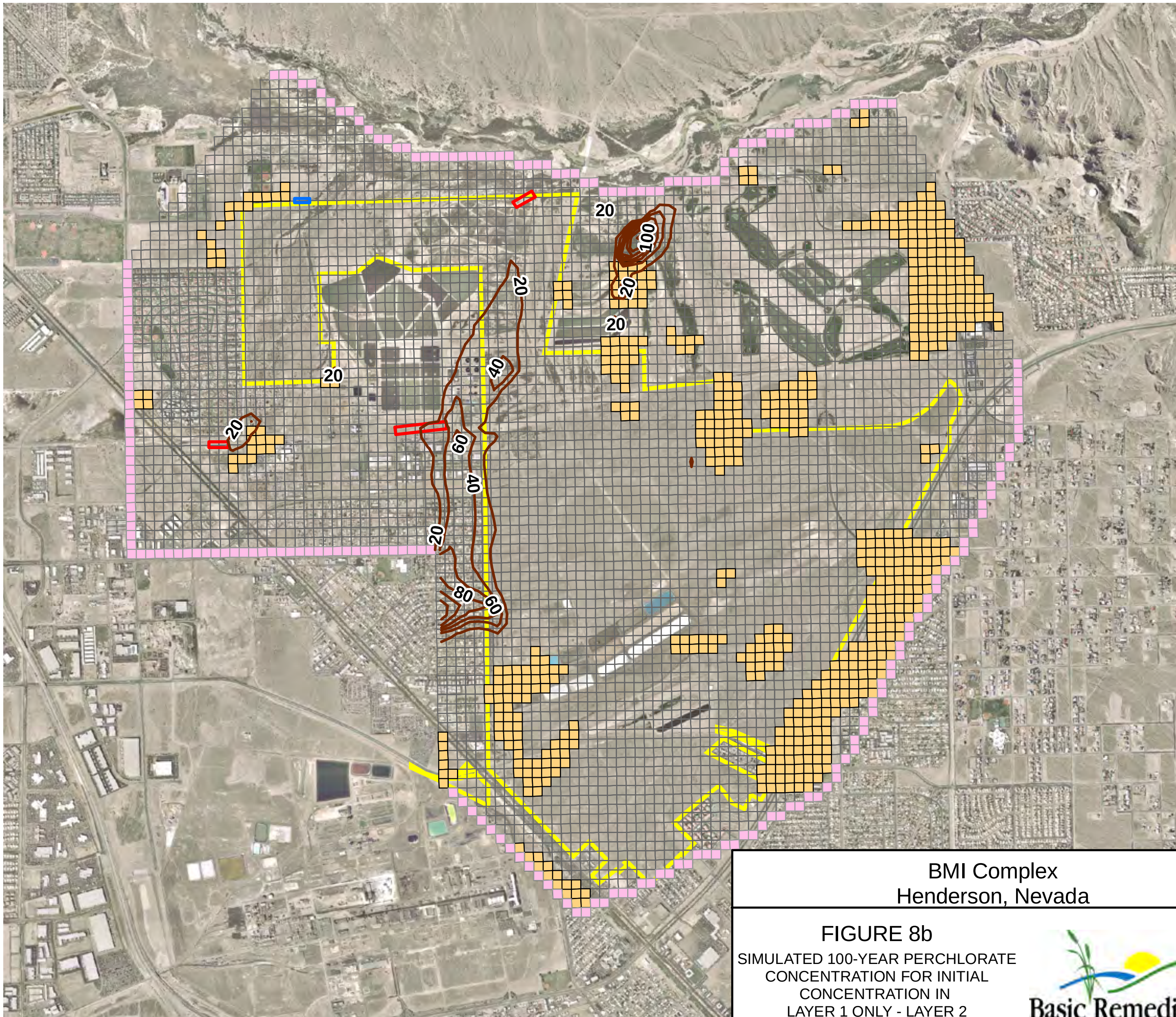
SIMULATED 100-YEAR PERCHLORATE CONCENTRATION FOR INITIAL CONCENTRATION IN LAYER 1 ONLY - LAYER 1

Basic Remediation COMPANY

Prepared by:	Date
DBS&A BGT	05-27-2010

Daniel B. Stephens & Associates, Inc.
JN ES10.0042

S:/PROJECTS/BRC/ES10.0042_BRC_TRANSPORT_MODEL_RUNS/GIS/MXDS/PERCHLORATE/FIGURE8B_11LAYER_RUN1_L2.MXD 017250



Source: Aerial photograph, April 2004

Explanation

- Simulated concentration (µg/L)
- Dry cell
- Boundary cell
- Extraction well field
- Injection well field
- Model grid
- Site boundary

N

0 1,750 3,500 Feet

BMI Complex
Henderson, Nevada

FIGURE 8b

SIMULATED 100-YEAR PERCHLORATE CONCENTRATION FOR INITIAL CONCENTRATION IN LAYER 1 ONLY - LAYER 2

Basic Remediation COMPANY

Prepared by: DBS&A BGT

Date 05-27-2010

Daniel B. Stephens & Associates, Inc.

JN ES10.0042

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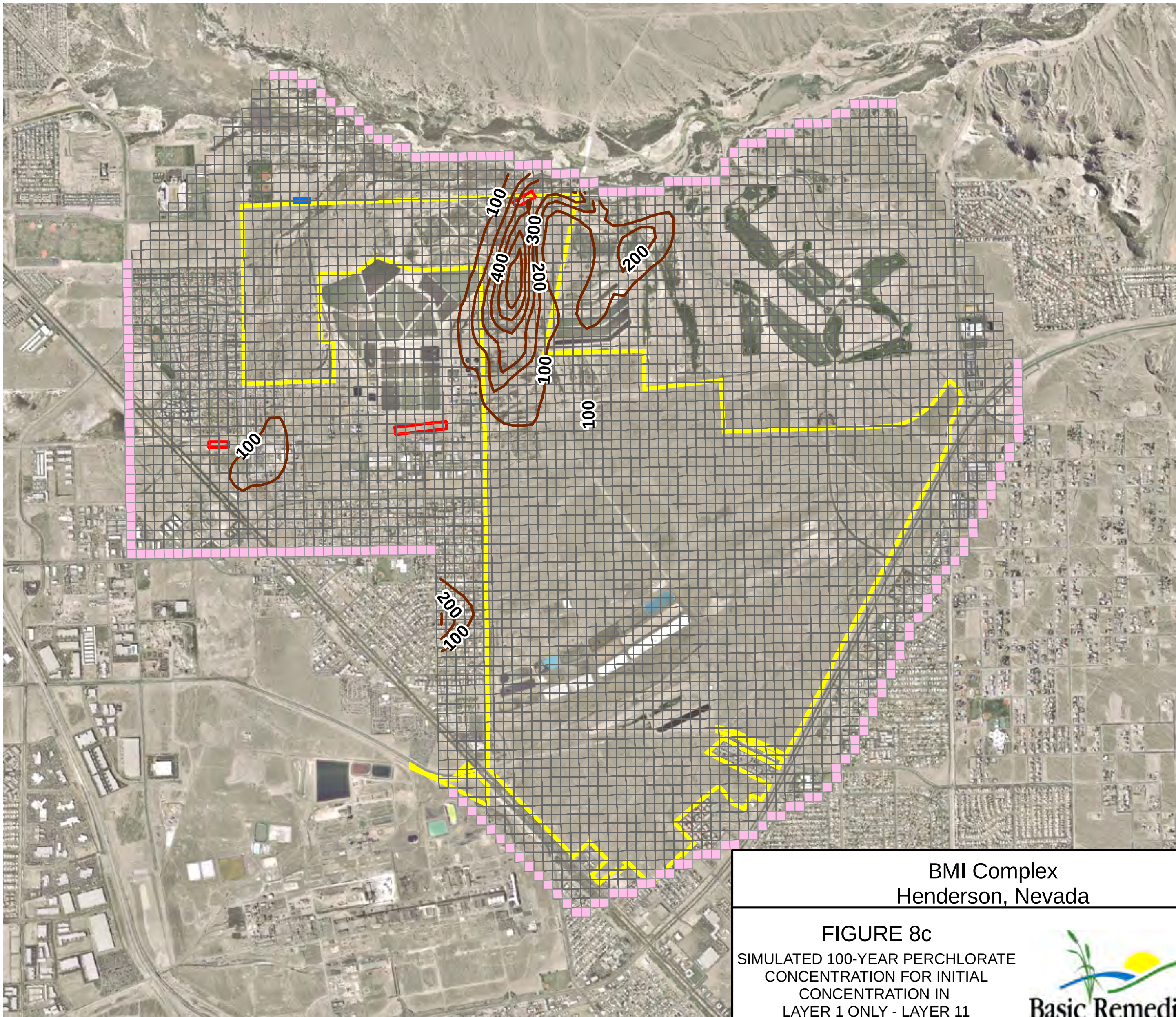

Source: Aerial photograph, April 2004

Explanation

Simulated concentration (µg/L)

Boundary cell

Extraction well field

Injection well field

Model grid

Site boundary

N

0 1,750 3,500 Feet

BMI Complex
Henderson, Nevada

FIGURE 8c

SIMULATED 100-YEAR PERCHLORATE CONCENTRATION FOR INITIAL CONCENTRATION IN LAYER 1 ONLY - LAYER 11

Basic Remediation COMPANY

Prepared by: DBS&A BGT

Date 05-27-2010

Daniel B. Stephens & Associates, Inc.

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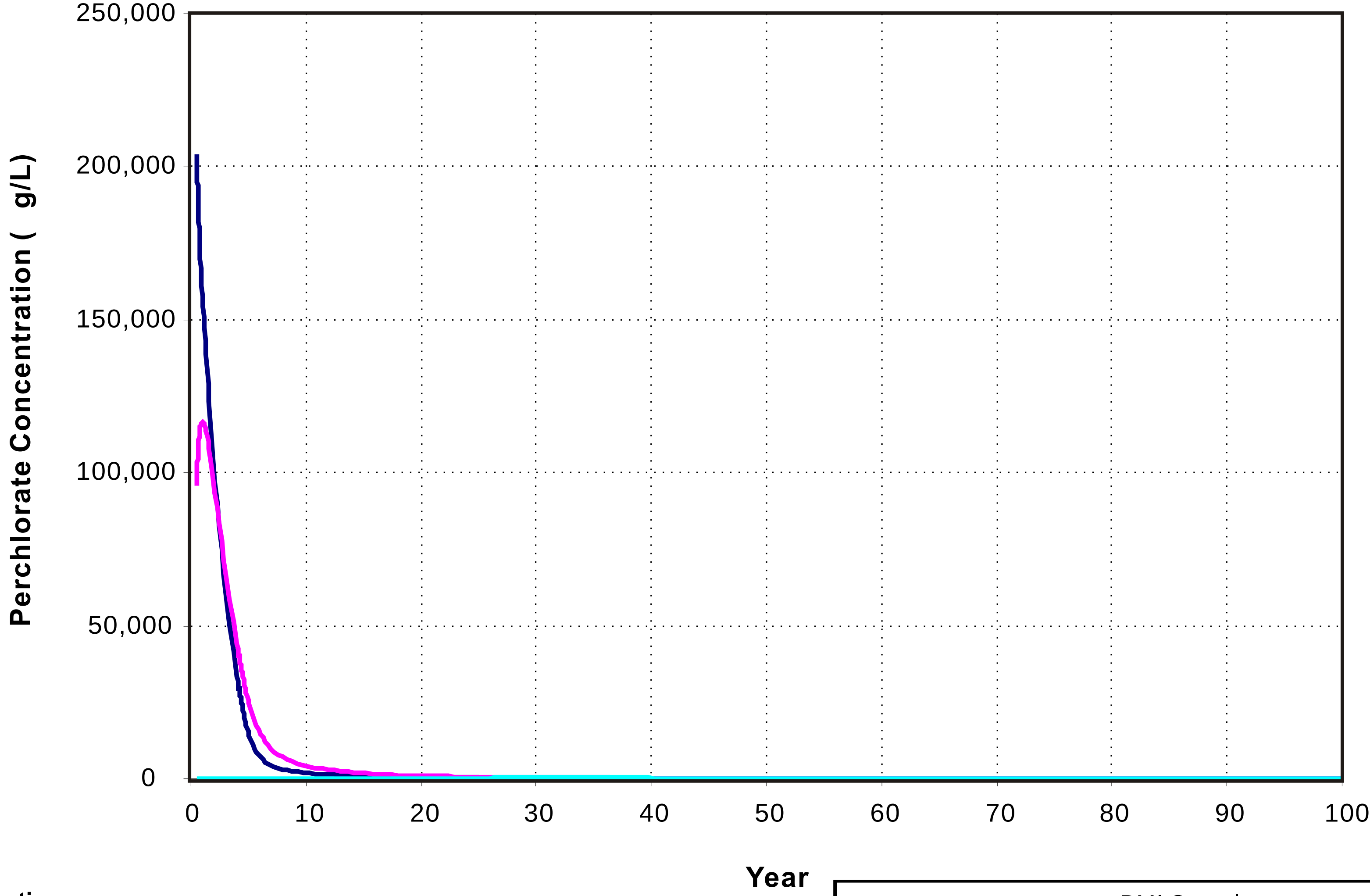

Explanation

- PC12 (Layer 1)
- PC12 (Layer 2)
- PC12 (Layer 11)

BMI Complex
Henderson, Nevada

FIGURE 8d
SIMULATED PERCHLORATE CONCENTRATION
FOR INITIAL CONCENTRATION
IN LAYER 1 ONLY
WELL PC12 LOCATION

Basic Remediation COMPANY

Prepared by: DBS&A GHS

Date 5/24/10

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Daniel B. Stephens & Associates, Inc.
JN ES10.0042

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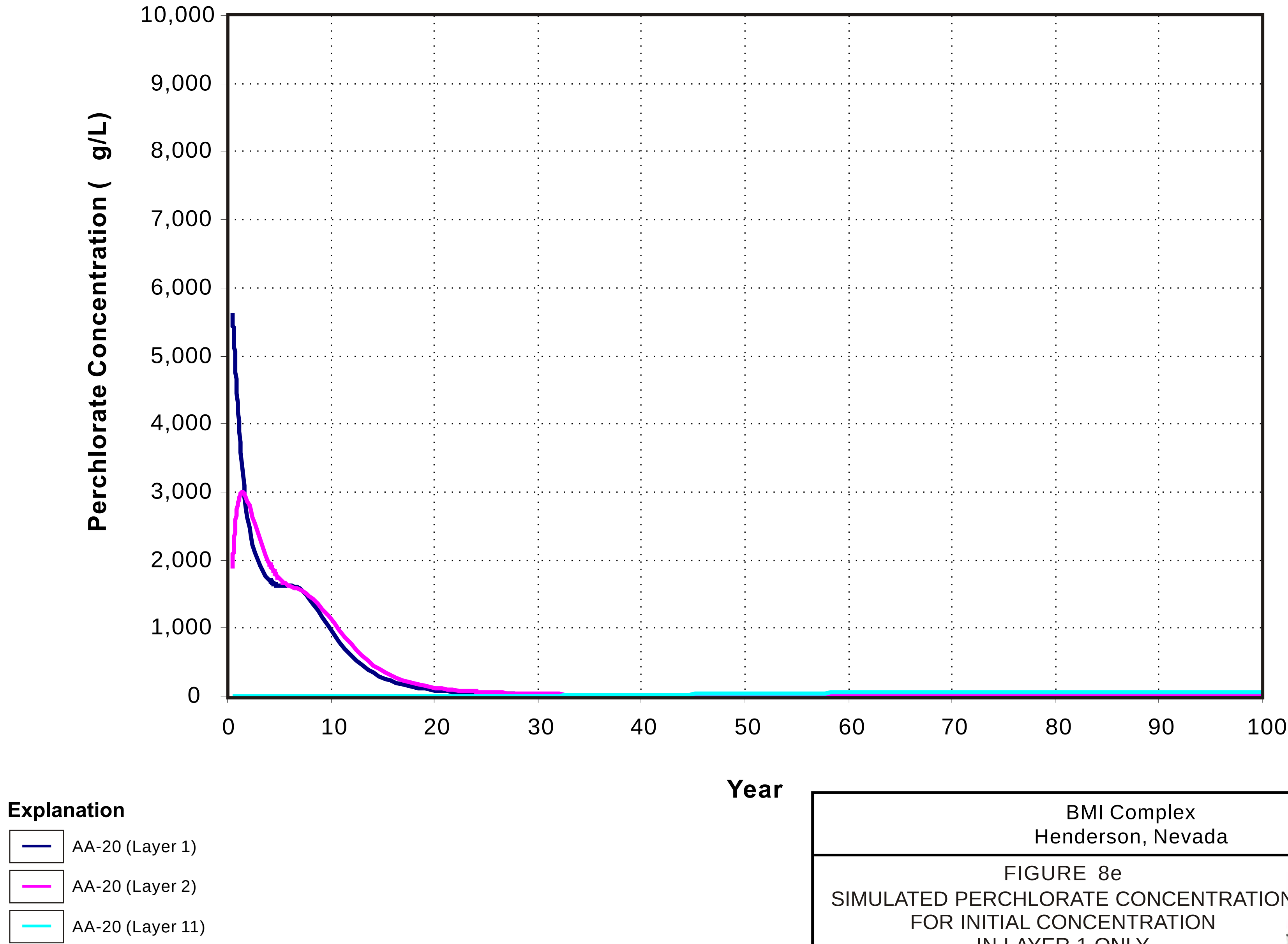

BMI Complex
Henderson, Nevada

FIGURE 8e
SIMULATED PERCHLORATE CONCENTRATION
FOR INITIAL CONCENTRATION
IN LAYER 1 ONLY
WELL AA-20 LOCATION

Basic Remediation COMPANY

Prepared by: DBS&A GHS

Date 5/24/10

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JN ES10.0042

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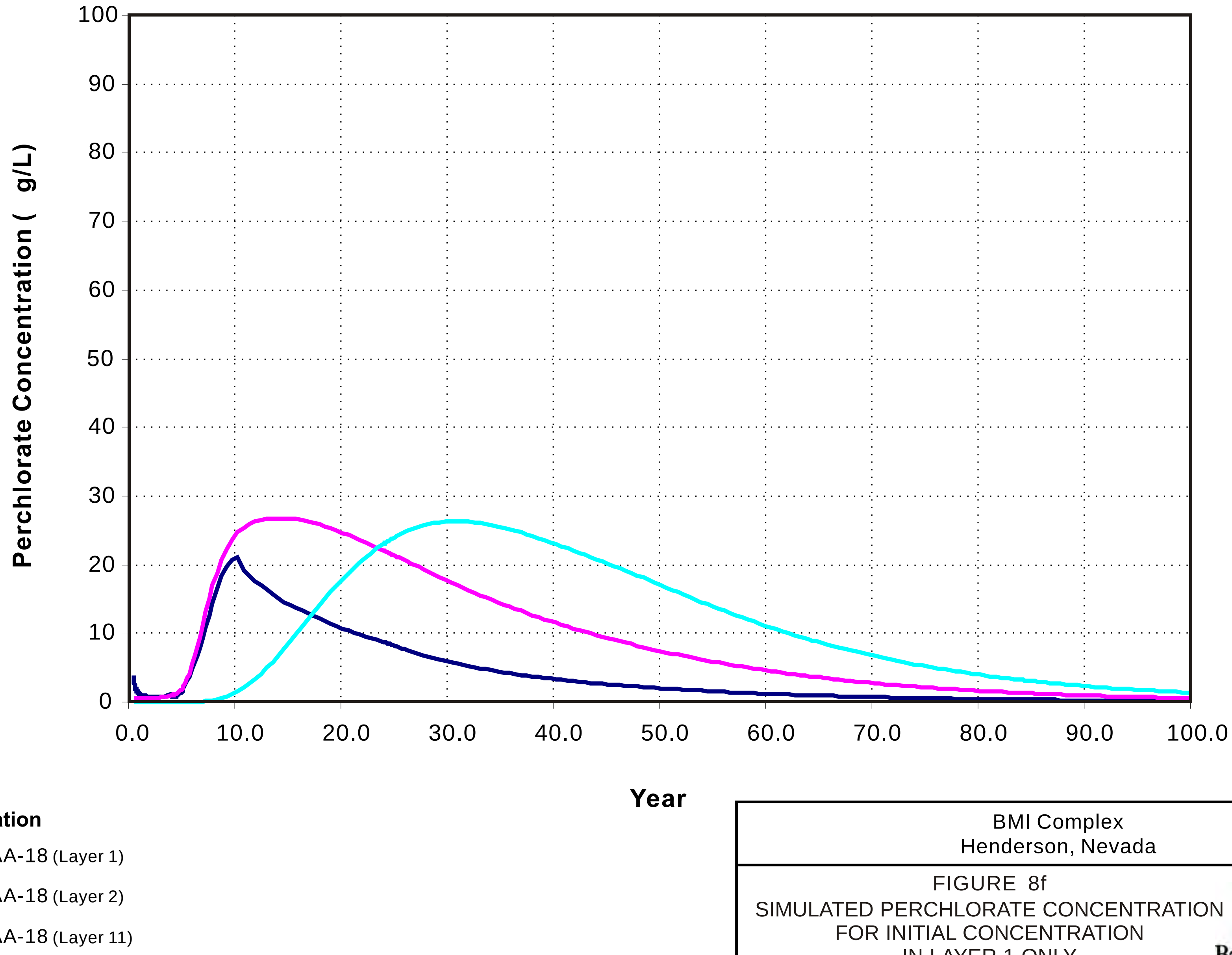

BMI Complex
Henderson, Nevada

FIGURE 8f
SIMULATED PERCHLORATE CONCENTRATION
FOR INITIAL CONCENTRATION
IN LAYER 1 ONLY
WELL AA-18 LOCATION

Basic Remediation COMPANY

Prepared by: DBS&A GHS

Date 5/24/10

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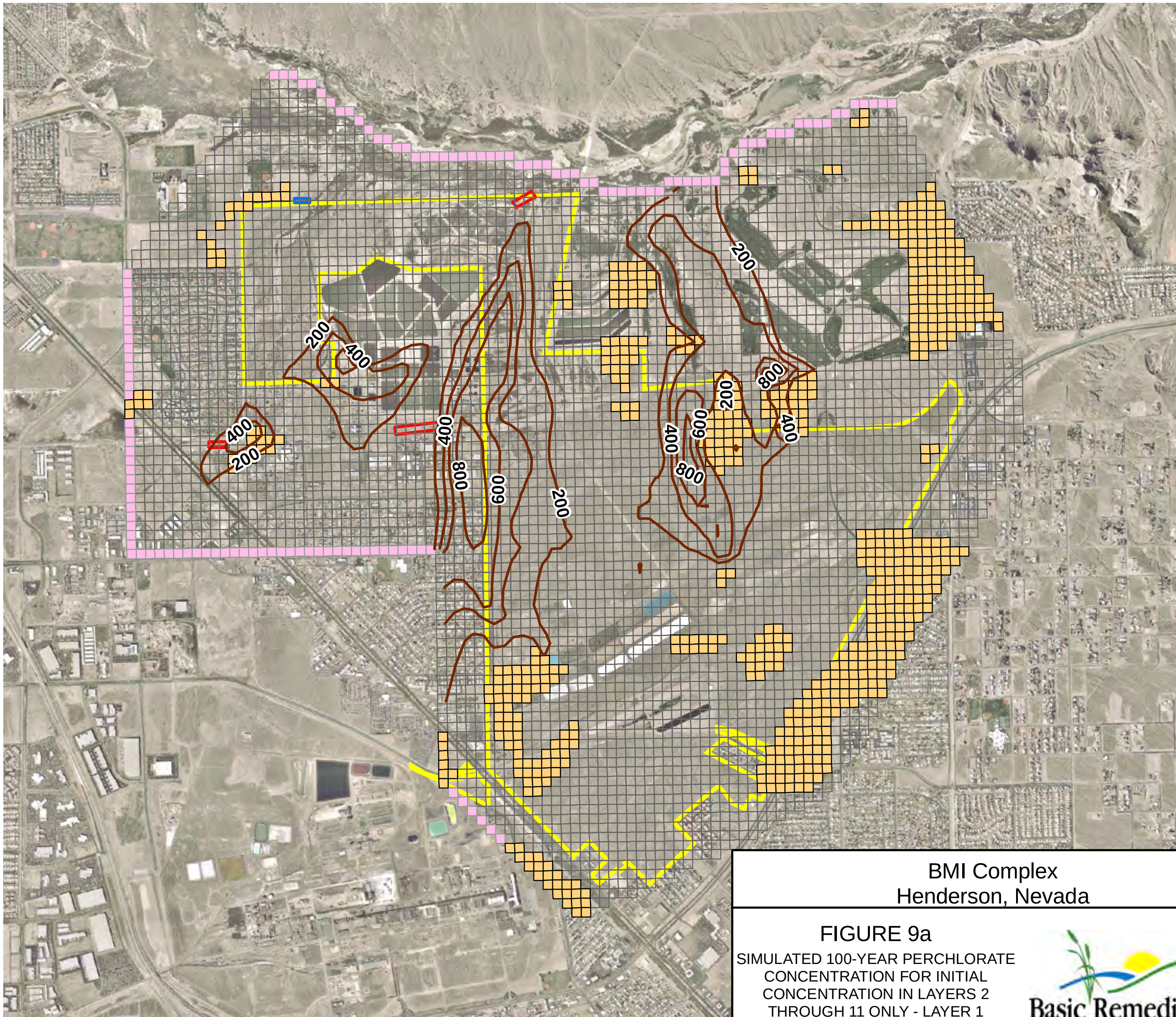

Source: Aerial photograph, April 2004

Explanation

- Simulated concentration (µg/L)
- Dry cell
- Boundary cell
- Extraction well field
- Injection well field
- Model grid
- Site boundary

N

0 1,750 3,500 Feet

BMI Complex
Henderson, Nevada

FIGURE 9a

SIMULATED 100-YEAR PERCHLORATE CONCENTRATION FOR INITIAL CONCENTRATION IN LAYERS 2 THROUGH 11 ONLY - LAYER 1

Basic Remediation COMPANY

Prepared by: DBS&A BGT

Date 05-27-2010

Daniel B. Stephens & Associates, Inc.

JN ES10.0042

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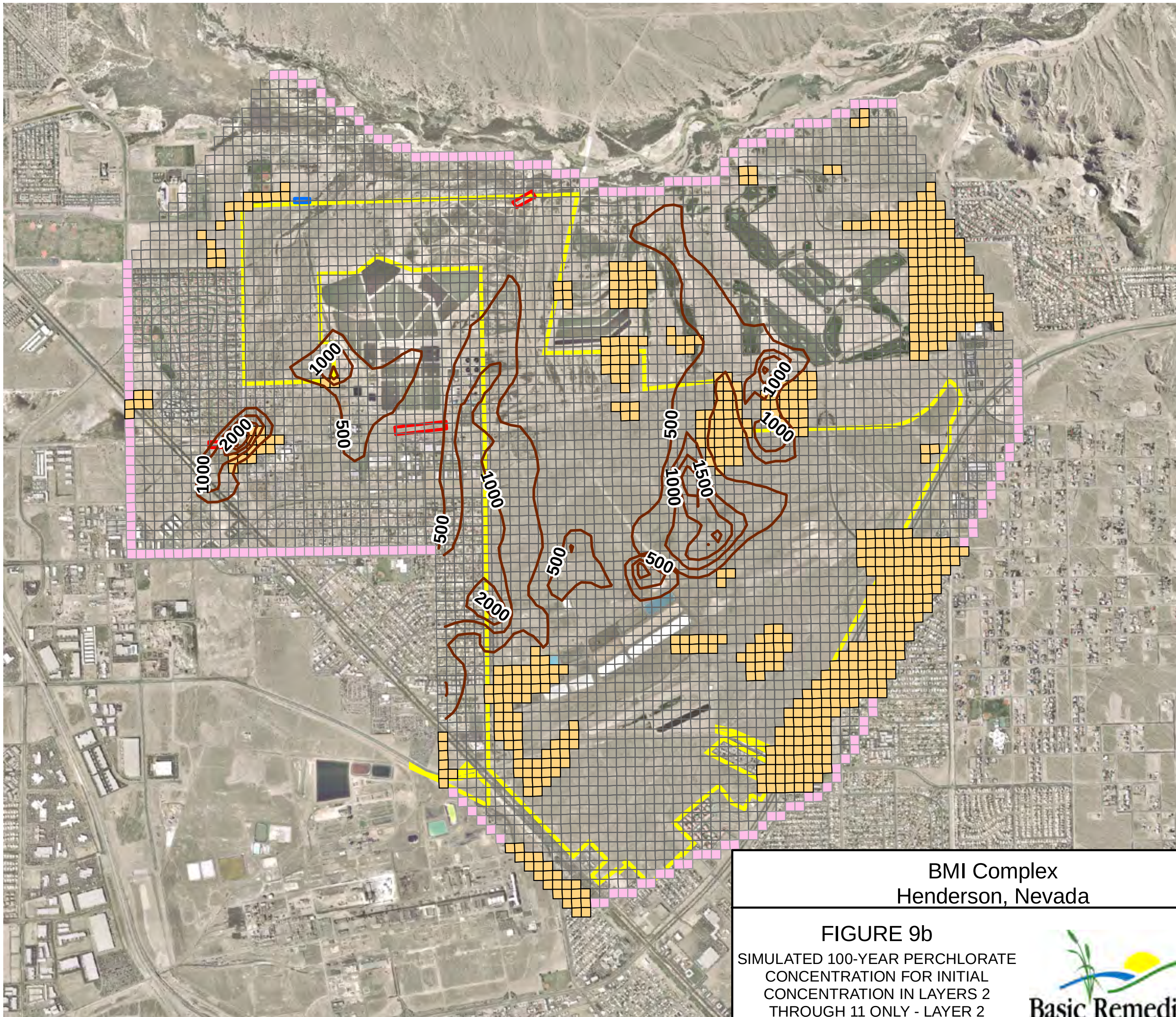

Source: Aerial photograph, April 2004

Explanation

- Simulated concentration (µg/L)
- Dry cell
- Boundary cell
- Extraction well field
- Injection well field
- Model grid
- Site boundary

N

0 1,750 3,500 Feet

BMI Complex
Henderson, Nevada

FIGURE 9b

SIMULATED 100-YEAR PERCHLORATE CONCENTRATION FOR INITIAL CONCENTRATION IN LAYERS 2 THROUGH 11 ONLY - LAYER 2

Basic Remediation COMPANY

Prepared by: DBS&A BGT

Date 05-27-2010

Daniel B. Stephens & Associates, Inc.

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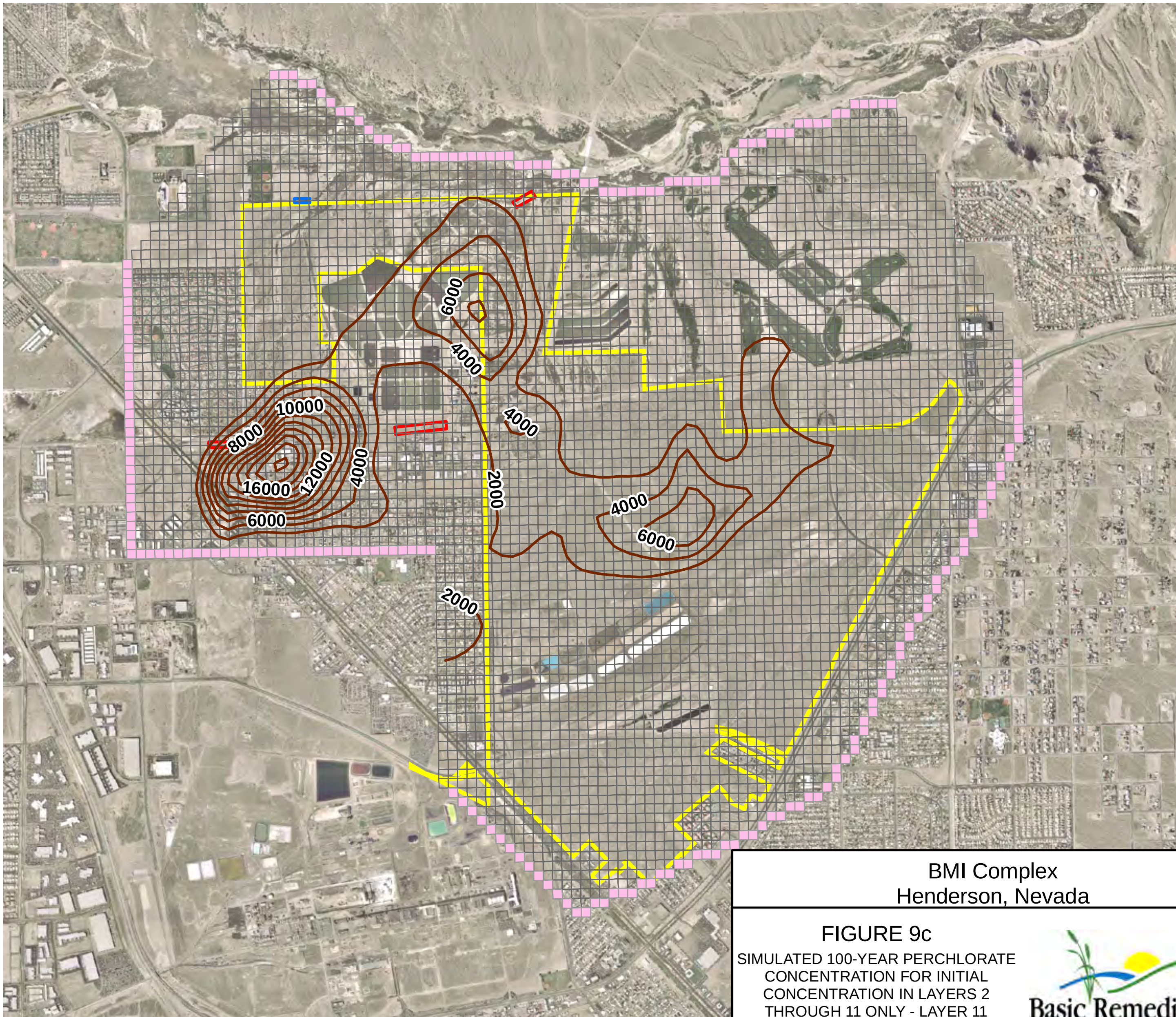

Source: Aerial photograph, April 2004

Explanation

- Simulated concentration (µg/L)
- Boundary cell
- Extraction well field
- Injection well field
- Model grid
- Site boundary

N

0 1,750 3,500 Feet

BMI Complex
Henderson, Nevada

FIGURE 9c
SIMULATED 100-YEAR PERCHLORATE CONCENTRATION FOR INITIAL CONCENTRATION IN LAYERS 2 THROUGH 11 ONLY - LAYER 11

Basic Remediation COMPANY

Prepared by: DBS&A BGT
Date 05-27-2010

Daniel B. Stephens & Associates, Inc.
JN ES10.0042

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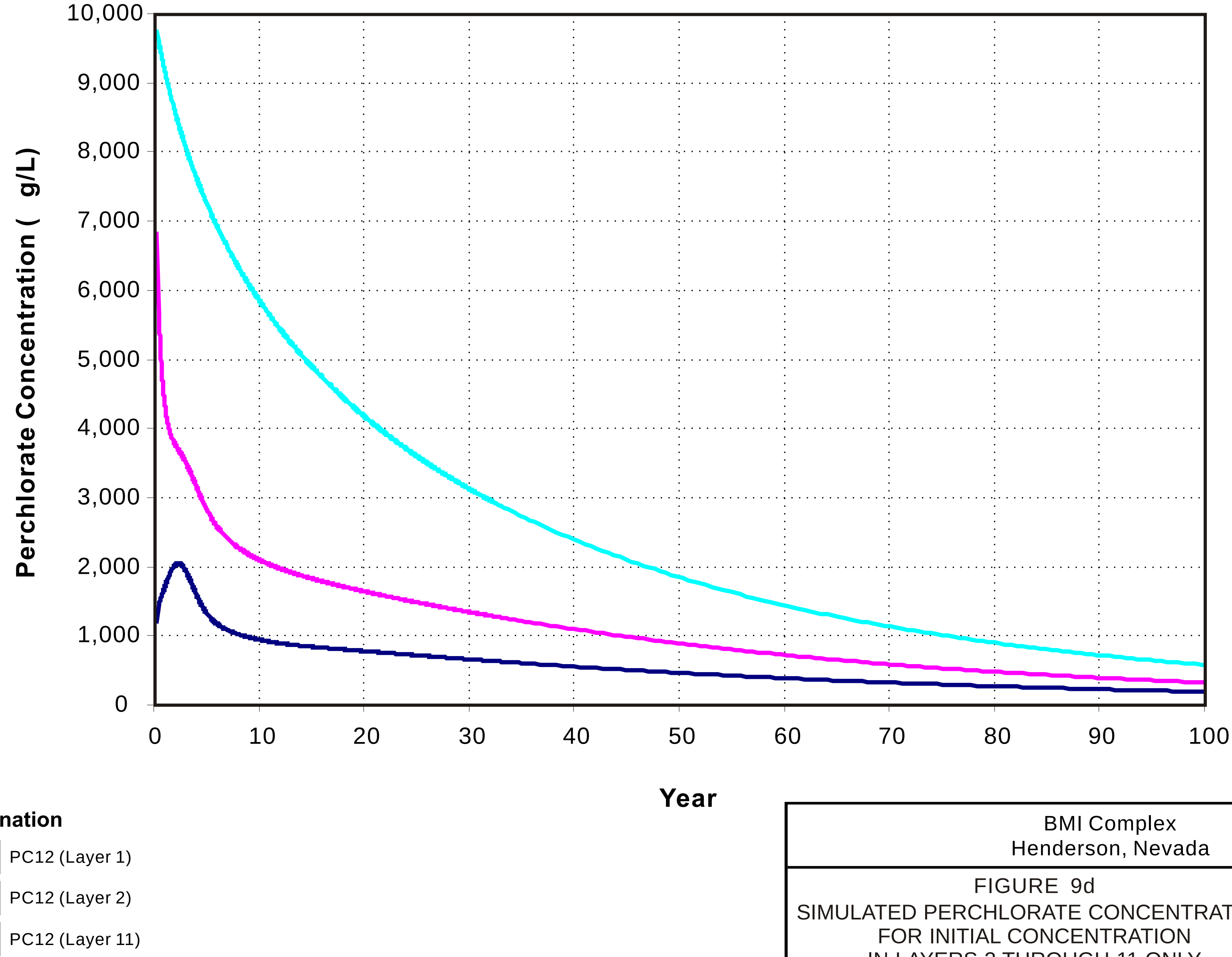

BMI Complex
Henderson, Nevada

FIGURE 9d
SIMULATED PERCHLORATE CONCENTRATION
FOR INITIAL CONCENTRATION
IN LAYERS 2 THROUGH 11 ONLY
WELL PC12 LOCATION

Basic Remediation COMPANY

Prepared by: DBS&A GHS

Date 5/24/10

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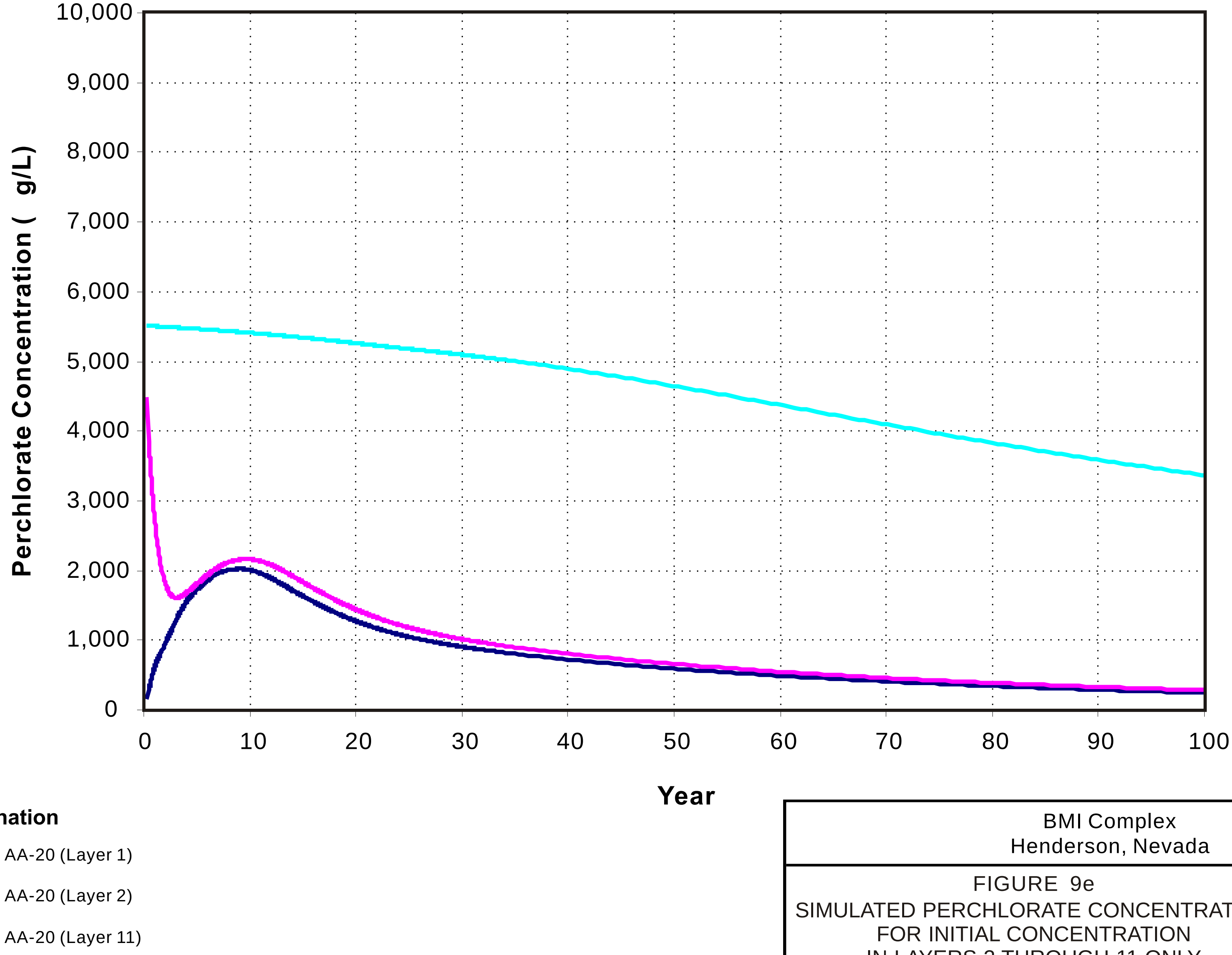

BMI Complex
Henderson, Nevada

FIGURE 9e
SIMULATED PERCHLORATE CONCENTRATION
FOR INITIAL CONCENTRATION
IN LAYERS 2 THROUGH 11 ONLY
WELL AA-20 LOCATION

Basic Remediation COMPANY

Prepared by: DBS&A GHS

Date 5/24/10

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JN ES10.0042

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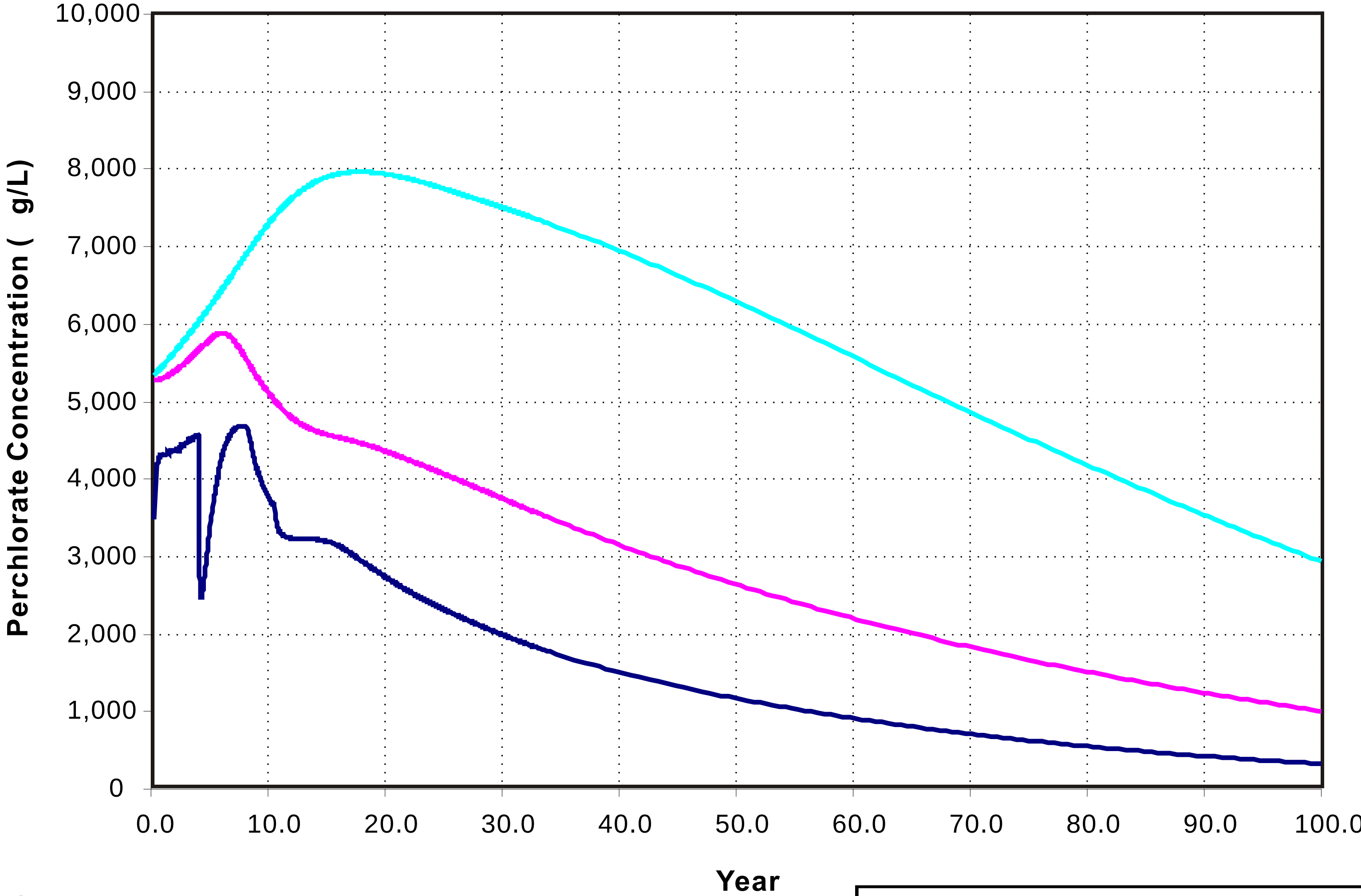

Explanation

- AA-18 (Layer 1)
- AA-18 (Layer 2)
- AA-18 (Layer 11)

BMI Complex
Henderson, Nevada

FIGURE 9f
SIMULATED PERCHLORATE CONCENTRATION
FOR INITIAL CONCENTRATION
IN LAYERS 2 THROUGH 11 ONLY
WELL AA-18 LOCATION

Basic Remediation COMPANY

Prepared by: DBS&A GHS

Date 5/24/10

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JN ES10.0042

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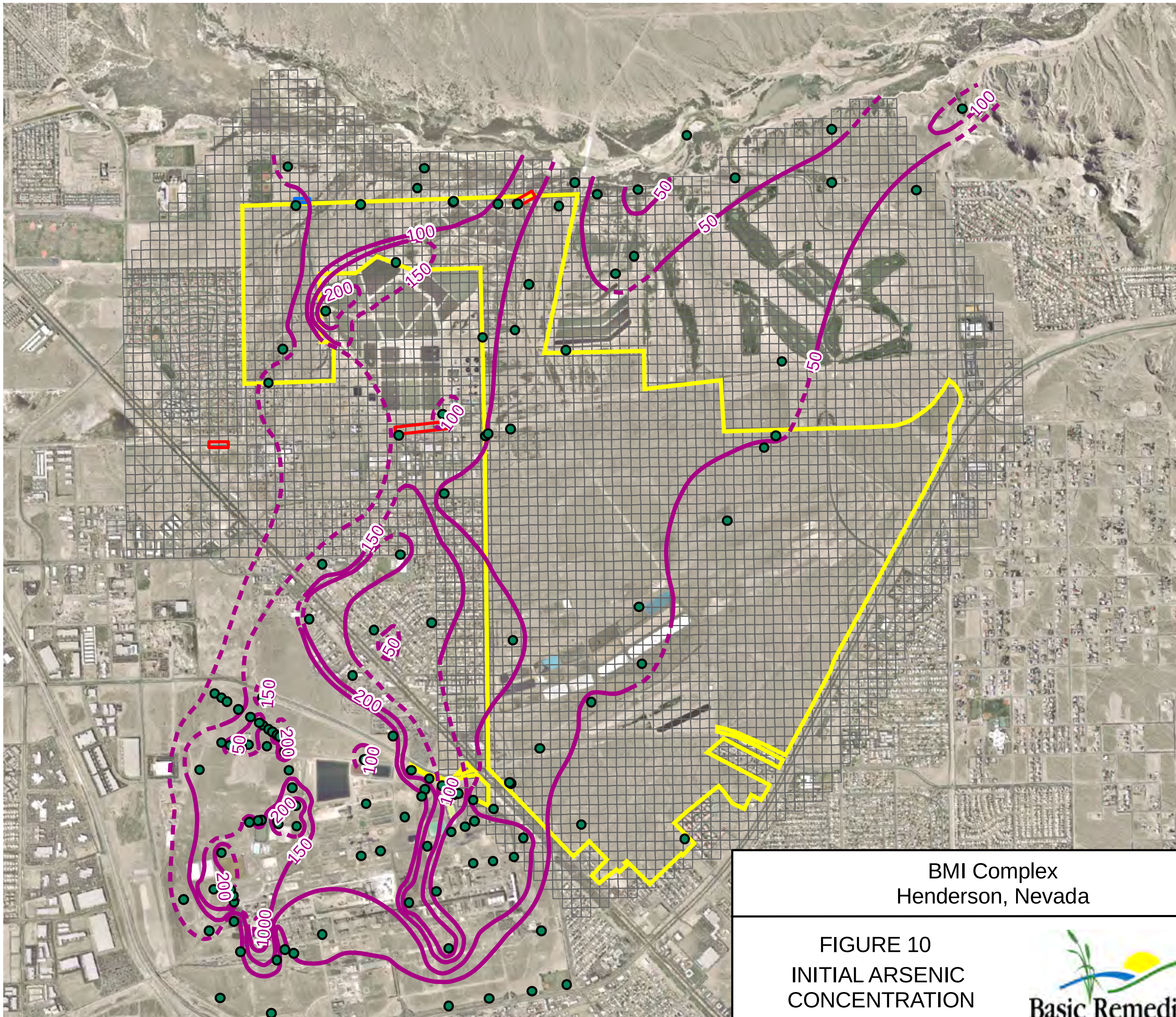

Source: Aerial photograph, April 2004

Explanation

- Monitor well
- Concentration contour (µg/L) (dashed where inferred) from DBS&A (2010a,b)
- Extraction well field
- Injection well field
- Model grid
- Site boundary

N

0 1,750 3,500 Feet

BMI Complex
Henderson, Nevada

FIGURE 10
INITIAL ARSENIC CONCENTRATION
LAYER 1

Basic Remediation COMPANY

Prepared by: DBS&A BGT

Date 05-27-2010

Daniel B. Stephens & Associates, Inc.
JN ES10.0042

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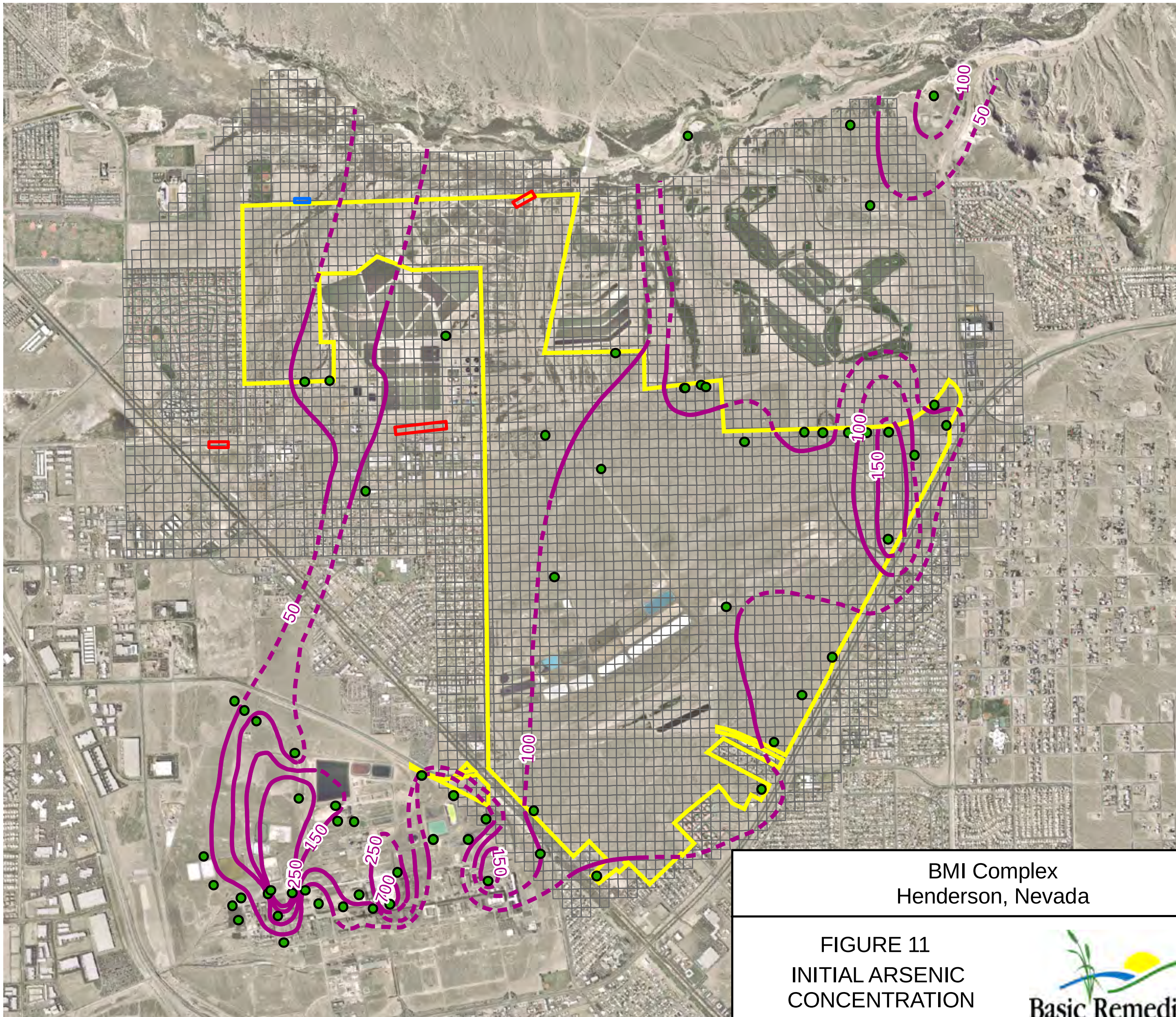

Source: Aerial photograph, April 2004

Explanation

- Monitor well
- Concentration contour (µg/L) (dashed where inferred) from DBS&A (2010a,b)
- Extraction well field
- Injection well field
- Model grid
- Site boundary

N

0 1,750 3,500 Feet

BMI Complex
Henderson, Nevada

FIGURE 11
INITIAL ARSENIC CONCENTRATION
LAYERS 2 THROUGH 11

Basic Remediation COMPANY

Prepared by: DBS&A BGT

Date 05-27-2010

Daniel B. Stephens & Associates, Inc.
JN ES10.0042

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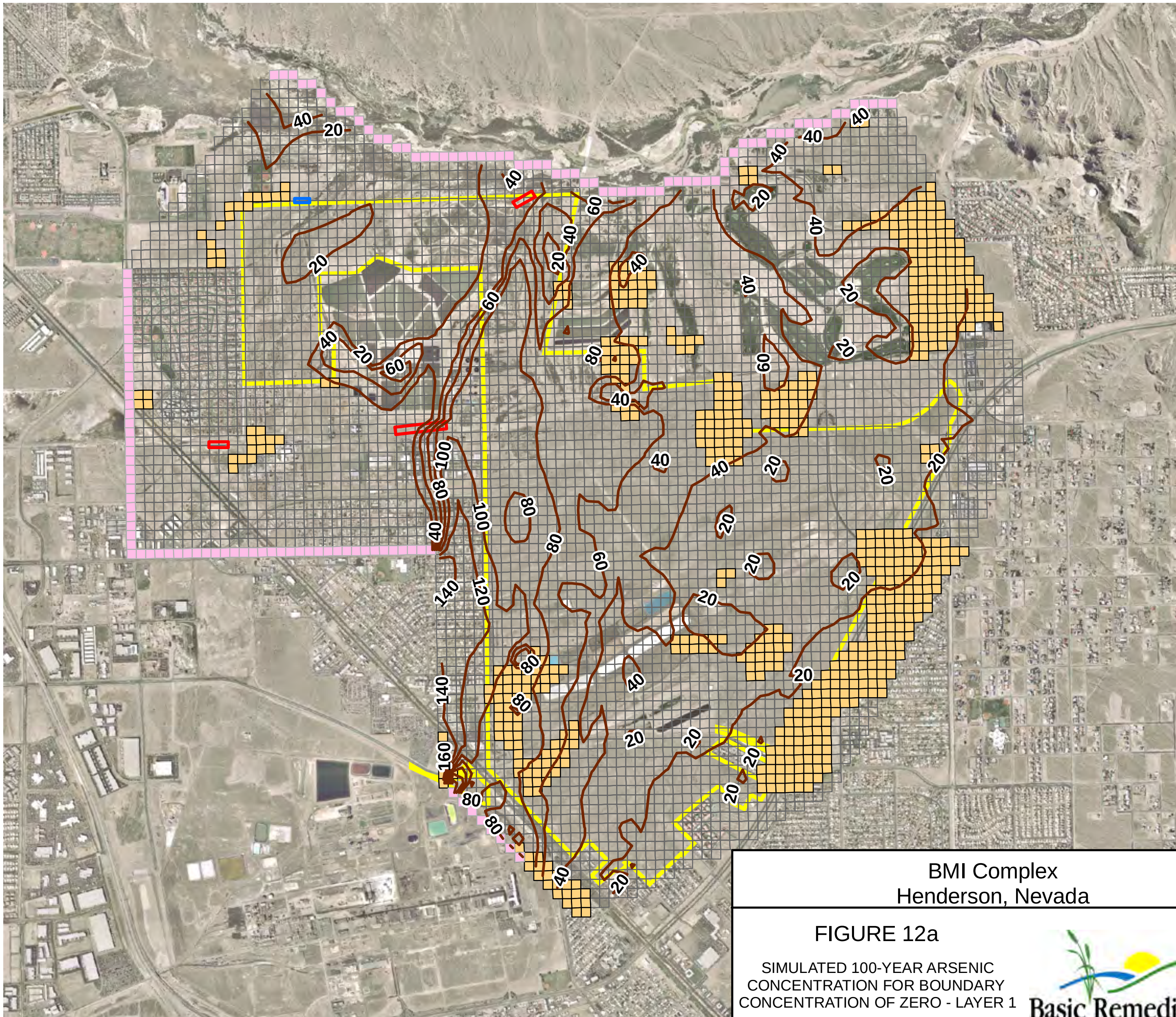


Source: Aerial photograph, April 2004

Explanation

- Simulated concentration (µg/L)
- Dry cell
- Boundary cell
- Extraction well field
- Injection well field
- Model grid
- Site boundary

N

0 1,750 3,500 Feet

BMI Complex
Henderson, Nevada

FIGURE 12a

SIMULATED 100-YEAR ARSENIC CONCENTRATION FOR BOUNDARY CONCENTRATION OF ZERO - LAYER 1

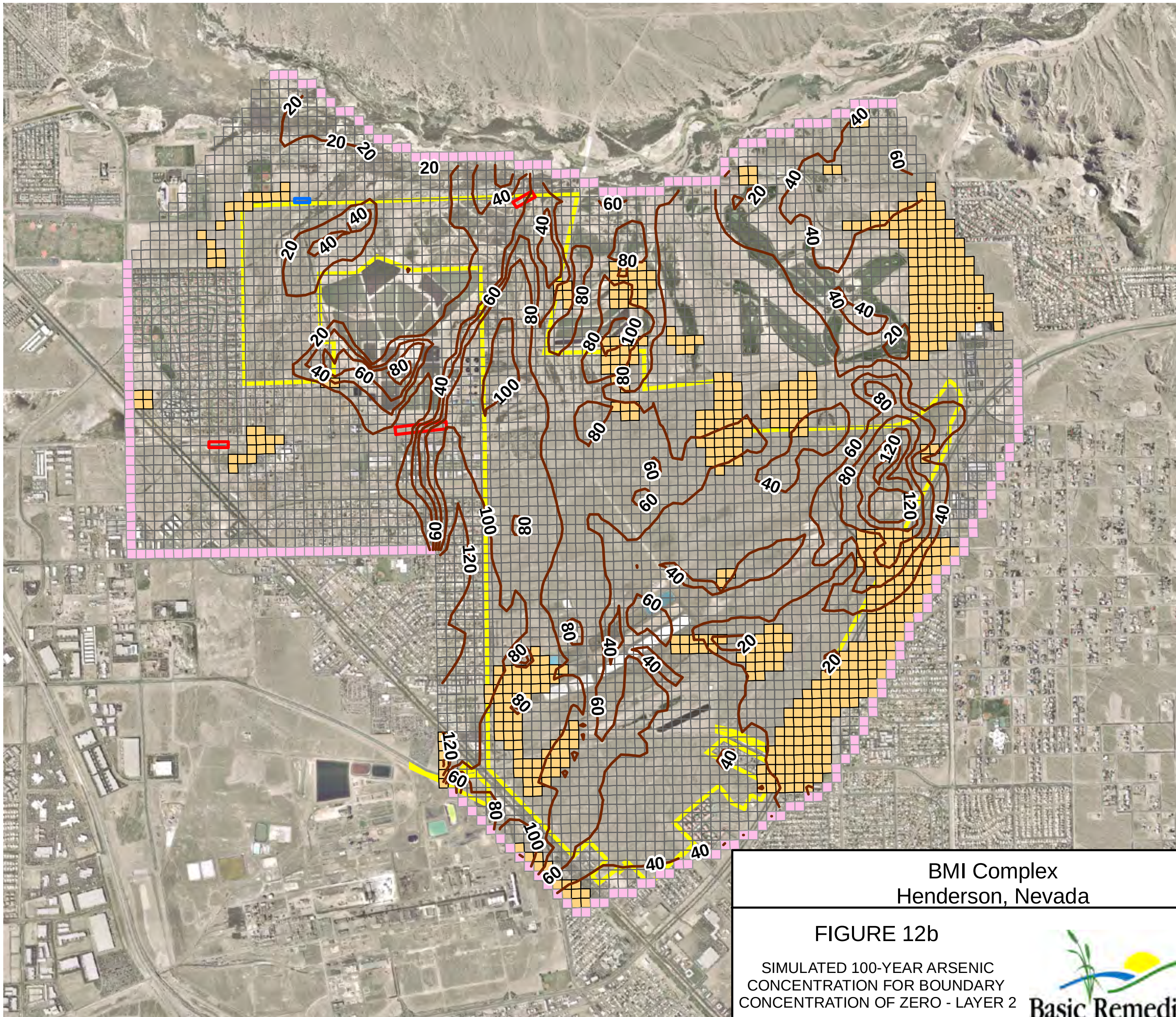
Basic Remediation COMPANY

Prepared by: DBS&A BGT

Date 05-27-2010

Daniel B. Stephens & Associates, Inc.
JN ES10.0042

S:/PROJECTS/BRC/ES10.0042_BRC_TRANSPORT_MODEL_RUNS/GIS/MXDS/ARSENIC/FIGURE12B_INITC_NOBDRY_L2.MXD 017250



Source: Aerial photograph, April 2004

Explanation

- Simulated concentration (µg/L)
- Dry cell
- Boundary cell
- Extraction well field
- Injection well field
- Model grid
- Site boundary

N

0 1,750 3,500 Feet

BMI Complex
Henderson, Nevada

FIGURE 12b

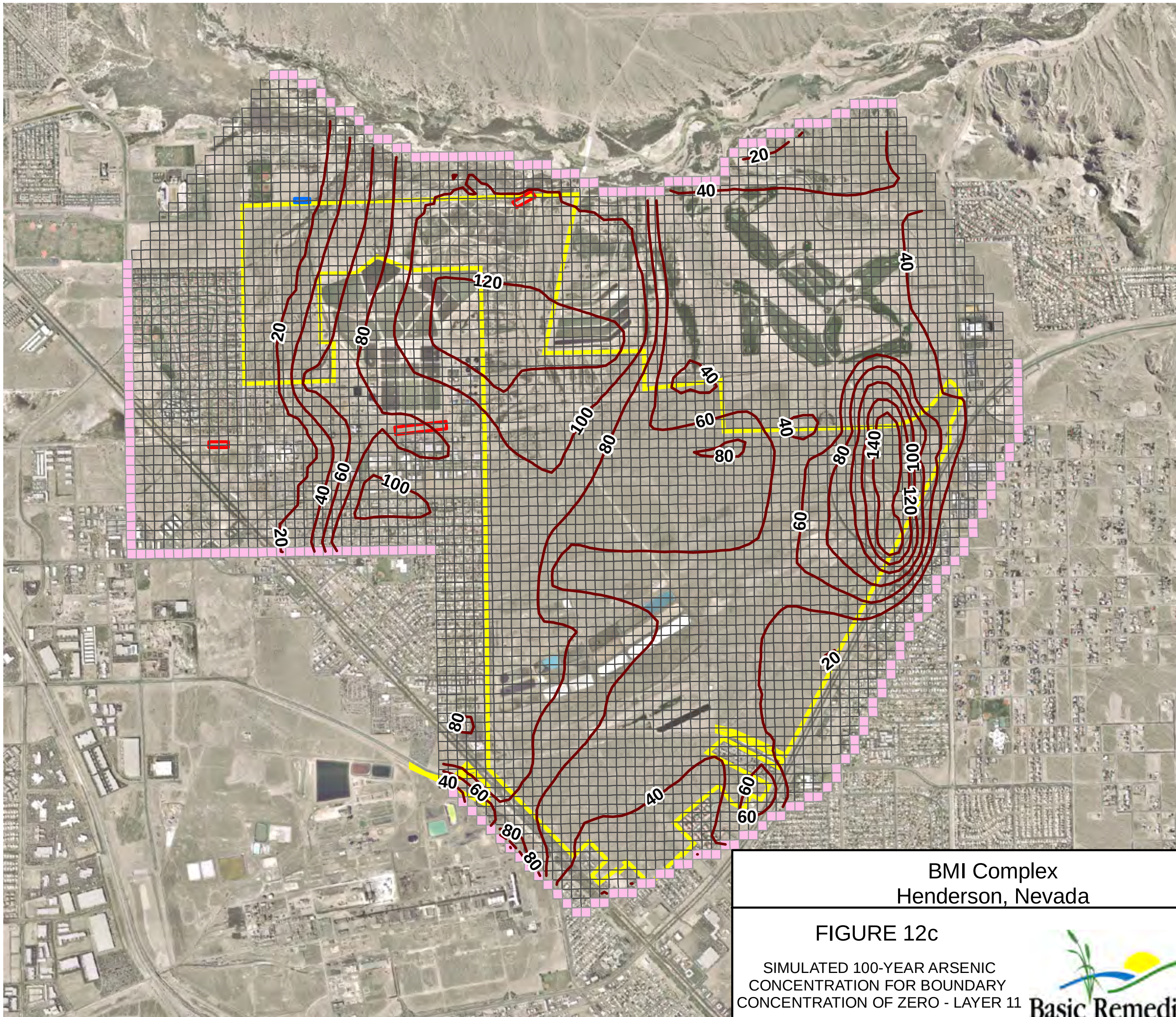
SIMULATED 100-YEAR ARSENIC CONCENTRATION FOR BOUNDARY CONCENTRATION OF ZERO - LAYER 2

Basic Remediation COMPANY

Prepared by:	Date
DBS&A BGT	05-27-2010

Daniel B. Stephens & Associates, Inc.
JN ES10.0042

S:/PROJECTS/BRC/ES10.0042_BRC_TRANSPORT_MODEL_RUNS/GIS/MXDS/ARSENIC/FIGURE12C_INITC_NOBDRY_L11.MXD 017250



Source: Aerial photograph, April 2004

Explanation

- Simulated concentration (μg/L)
- Boundary cell
- Extraction well field
- Injection well field
- Model grid
- Site boundary

N

0 1,750 3,500 Feet

BMI Complex
Henderson, Nevada

FIGURE 12c

SIMULATED 100-YEAR ARSENIC CONCENTRATION FOR BOUNDARY CONCENTRATION OF ZERO - LAYER 11

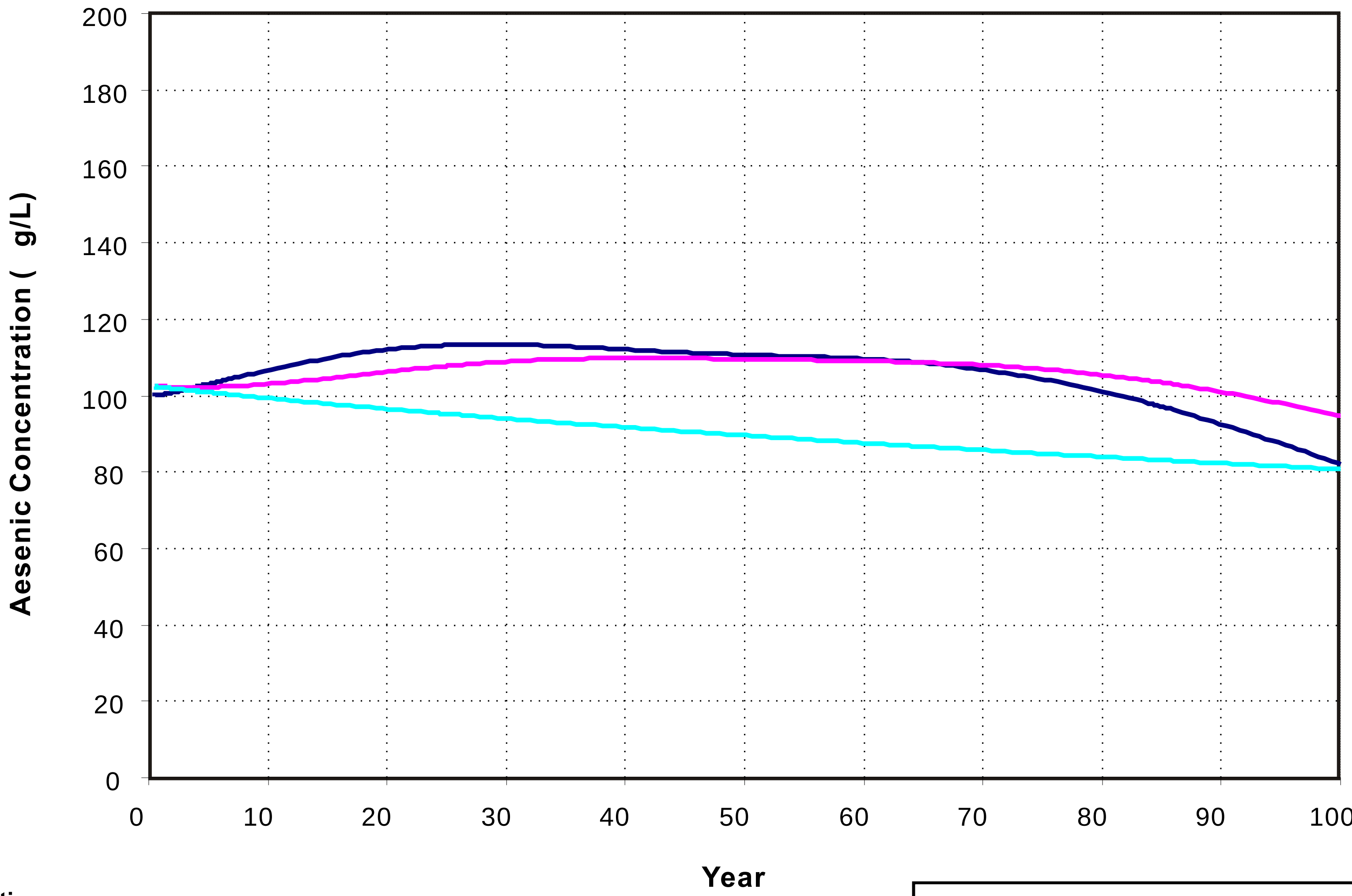
Basic Remediation COMPANY

Prepared by: DBS&A BGT

Date 05-27-2010

Daniel B. Stephens & Associates, Inc.
JN ES10.0042

S:\Projects\BRC\ES10.0042_BRC_Transport_Model_Runs\VR_Drawings\Fig_12d_Simulated_As_conc_0_Layer1_12D.cdr



Explanation

- PC12 (Layer 1)
- PC12 (Layer 2)
- PC12 (Layer 11)

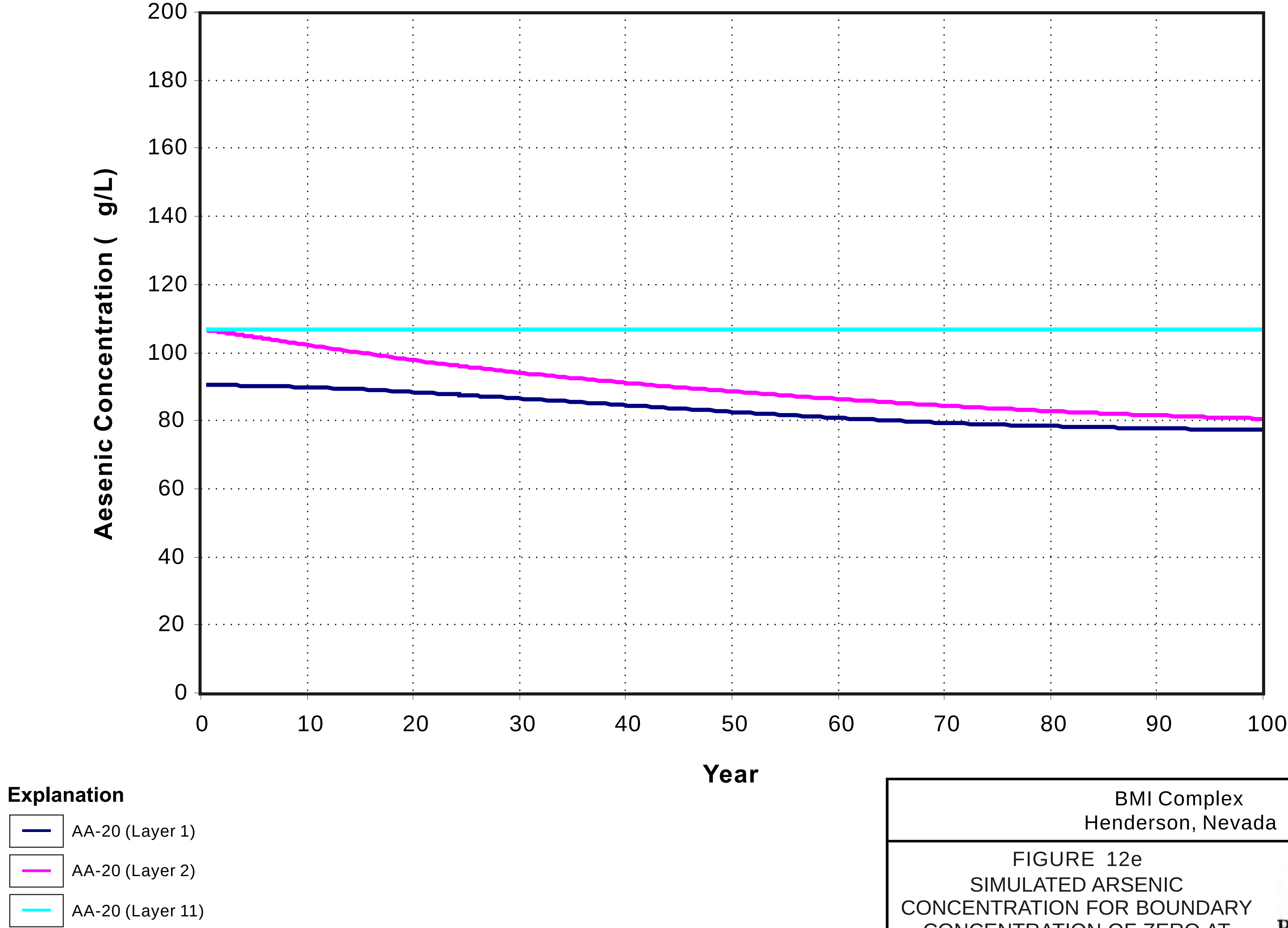
BMI Complex
Henderson, Nevada

FIGURE 12d
SIMULATED ARSENIC CONCENTRATION FOR BOUNDARY CONCENTRATION OF ZERO AT WELL PC12 LOCATION

Basic Remediation COMPANY

Prepared by:	Date	
DBS&A GHS	5/24/10	S:\Projects\BRC\ES10.0042_BRC_Transport_Model_Runs\VR_Drawings\Fig_12d_Simulated_As_conc_0_Layer1_12D.cdr

Daniel B. Stephens & Associates, Inc.
JN ES10.0042



BMI Complex
Henderson, Nevada

FIGURE 12e
SIMULATED ARSENIC CONCENTRATION FOR BOUNDARY CONCENTRATION OF ZERO AT WELL AA-20 LOCATION

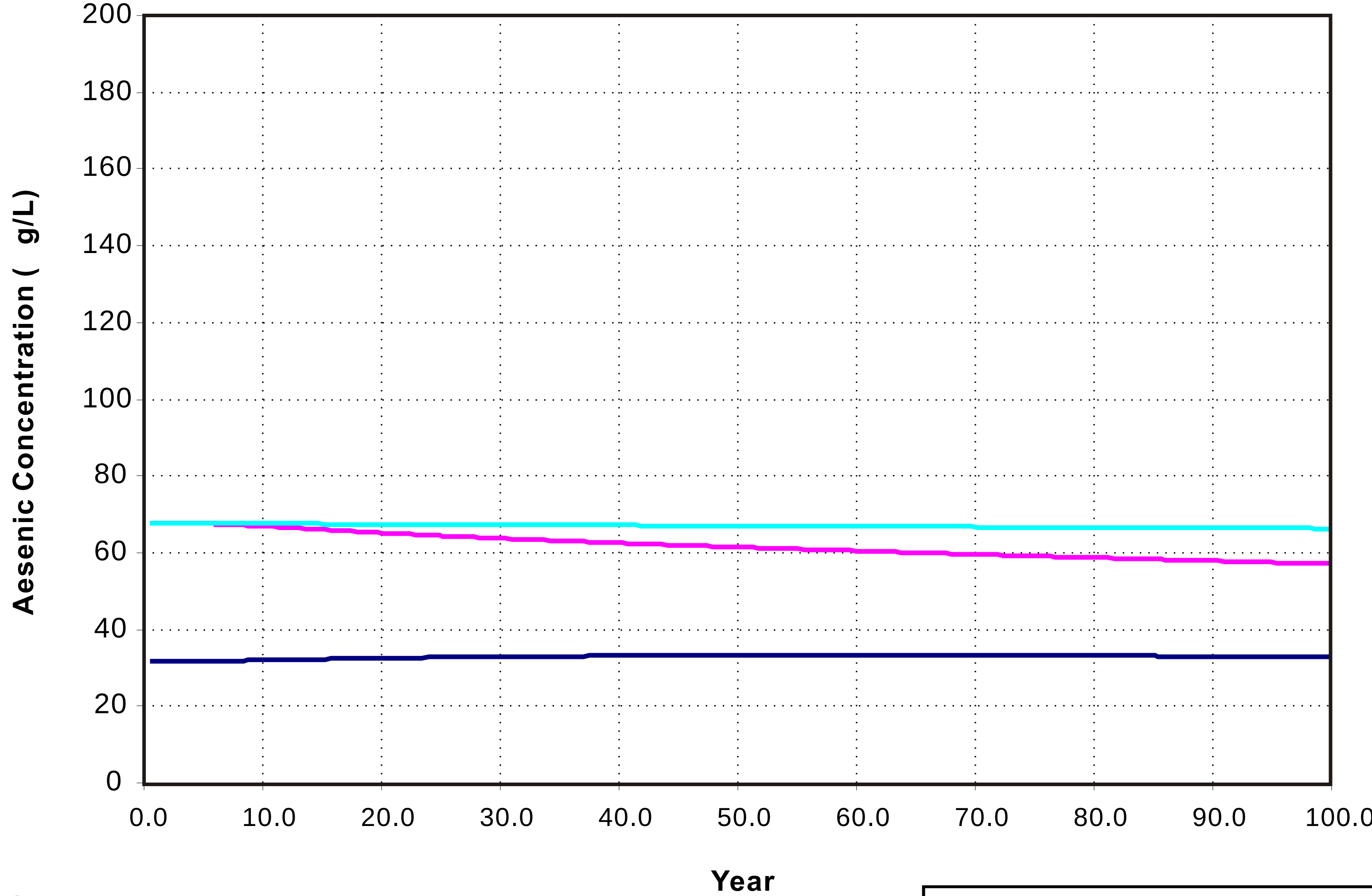
Basic Remediation COMPANY

Prepared by: DBS&A GHS

Date 5/24/10

S:\Projects\BRC\ES10.0042_BRC_Transport_Model_Runs\VR_Drawings\Fig_12d_Simulated_As_conc_0_Layer1_12D.cdr

Daniel B. Stephens & Associates, Inc.
JN ES10.0042



Explanation

- AA-18 (Layer 1)
- AA-18 (Layer 2)
- AA-18 (Layer 11)

BMI Complex
Henderson, Nevada

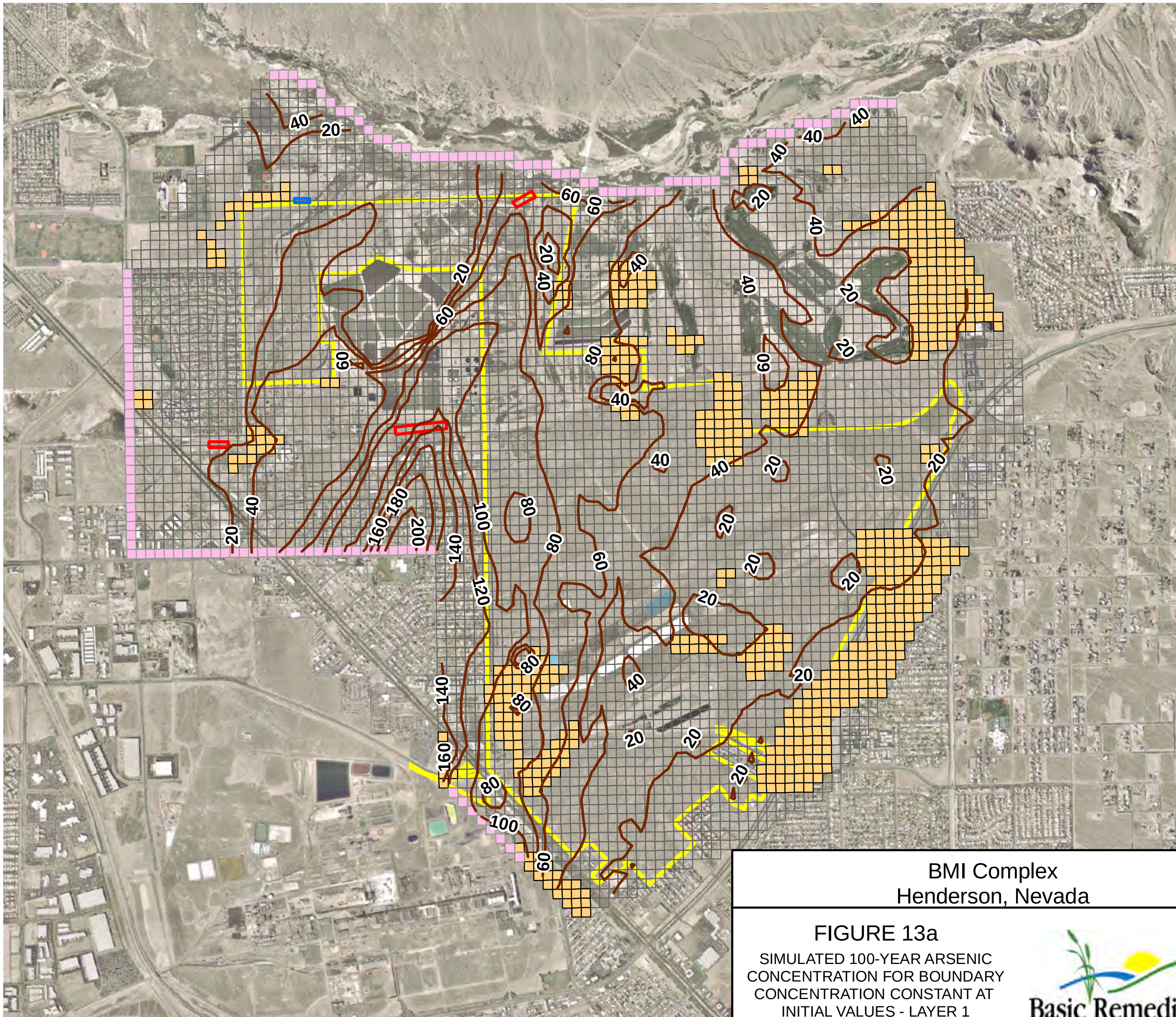
FIGURE 12f
SIMULATED ARSENIC CONCENTRATION FOR BOUNDARY CONCENTRATION OF ZERO AT WELL AA-18 LOCATION

Basic Remediation COMPANY

Prepared by: DBS&A GHS | Date 5/24/10 | S:\Projects\BRC\ES10.0042_BRC_Transport_Model_Runs\VR_Drawings\Fig_12d_Simulated_As_conc_0_Layer1_12D.cdr

Daniel B. Stephens & Associates, Inc.
JN ES10.0042

S:/PROJECTS/BRC/ES10.0042_BRC_TRANSPORT_MODEL_RUNS/GIS/MXDS/ARSENIC/FIGURE13A_INITC_CONSTBDRY_L1.MXD 017250



Source: Aerial photograph, April 2004

Explanation

- Simulated concentration (µg/L)
- Dry cell
- Boundary cell
- Extraction well field
- Injection well field
- Model grid
- Site boundary

N

0 1,750 3,500 Feet

BMI Complex
Henderson, Nevada

FIGURE 13a

SIMULATED 100-YEAR ARSENIC CONCENTRATION FOR BOUNDARY CONCENTRATION CONSTANT AT INITIAL VALUES - LAYER 1

Basic Remediation COMPANY

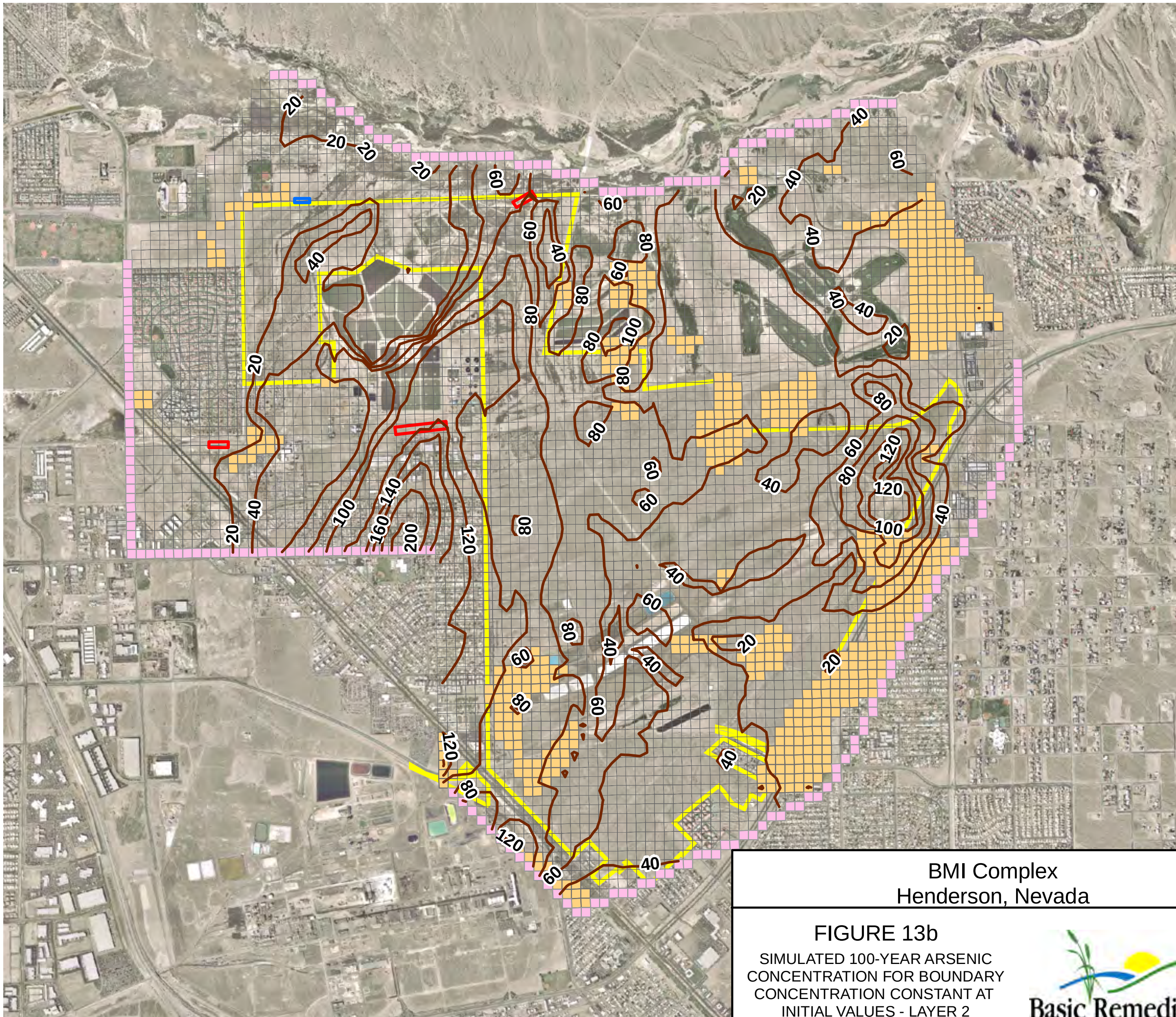
Prepared by: DBS&A BGT

Date 05-27-2010

Daniel B. Stephens & Associates, Inc.

JN ES10.0042

S:/PROJECTS/BRC/ES10.0042_BRC_TRANSPORT_MODEL_RUNS/GIS/MXDS/ARSENIC/FIGURE13B_INITC_CONSTBDRY_L2.MXD 017250



Source: Aerial photograph, April 2004

Explanation

- Simulated concentration (µg/L)
- Dry cell
- Boundary cell
- Extraction well field
- Injection well field
- Model grid
- Site boundary

N

0 1,750 3,500 Feet

BMI Complex
Henderson, Nevada

FIGURE 13b

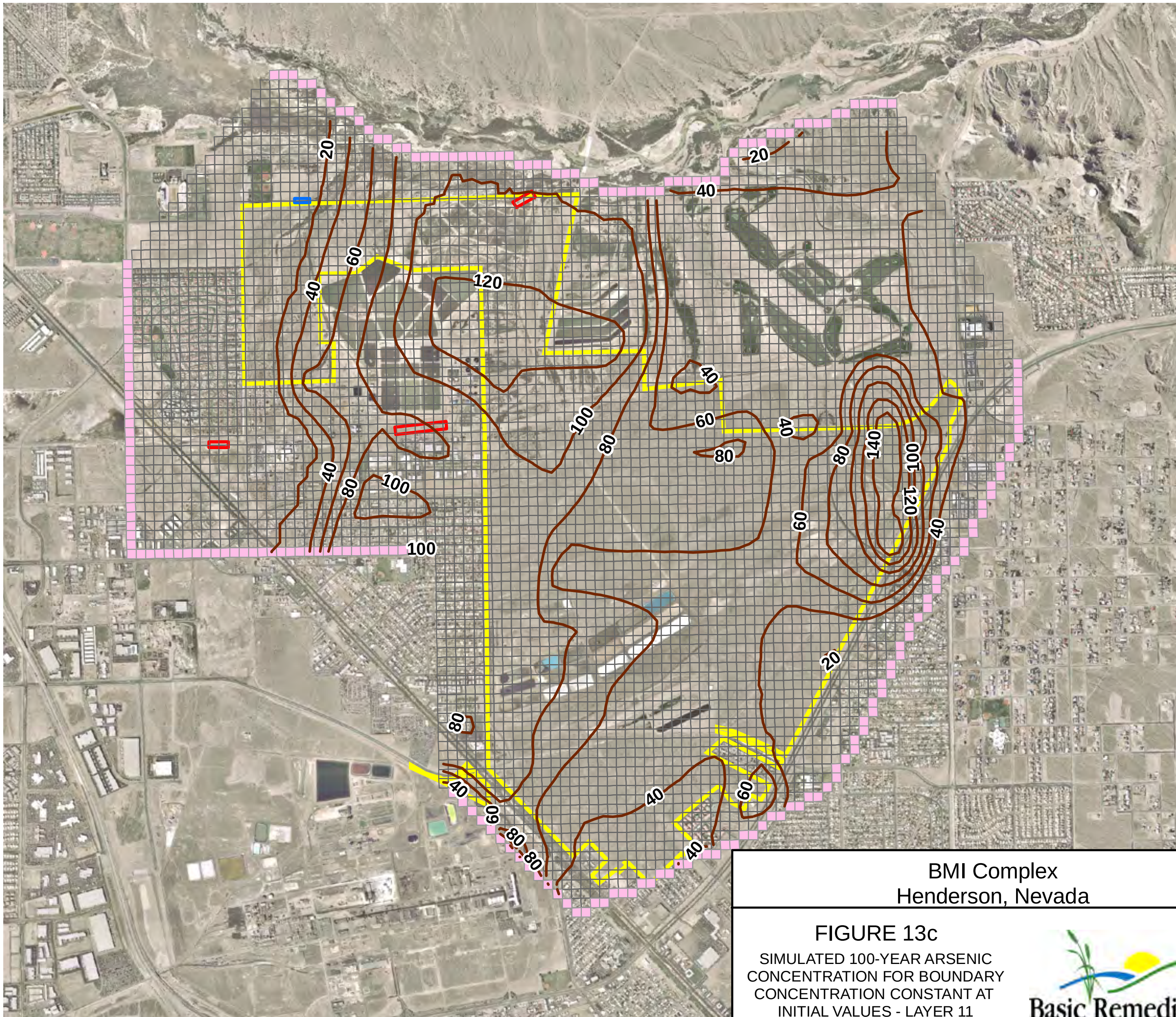
SIMULATED 100-YEAR ARSENIC CONCENTRATION FOR BOUNDARY CONCENTRATION CONSTANT AT INITIAL VALUES - LAYER 2

Basic Remediation COMPANY

Prepared by:	Date
DBS&A BGT	05-27-2010

Daniel B. Stephens & Associates, Inc.
JN ES10.0042

S:/PROJECTS/BRC/ES10.0042_BRC_TRANSPORT_MODEL_RUNS/GIS/MXDS/ARSENIC/FIGURE13C_INITC_CONSTBDRY_L11.MXD 017250



Source: Aerial photograph, April 2004

Explanation

- Simulated concentration (µg/L)
- Boundary cell
- Extraction well field
- Injection well field
- Model grid
- Site boundary

N

0 1,750 3,500 Feet

BMI Complex
Henderson, Nevada

FIGURE 13c

SIMULATED 100-YEAR ARSENIC CONCENTRATION FOR BOUNDARY CONCENTRATION CONSTANT AT INITIAL VALUES - LAYER 11

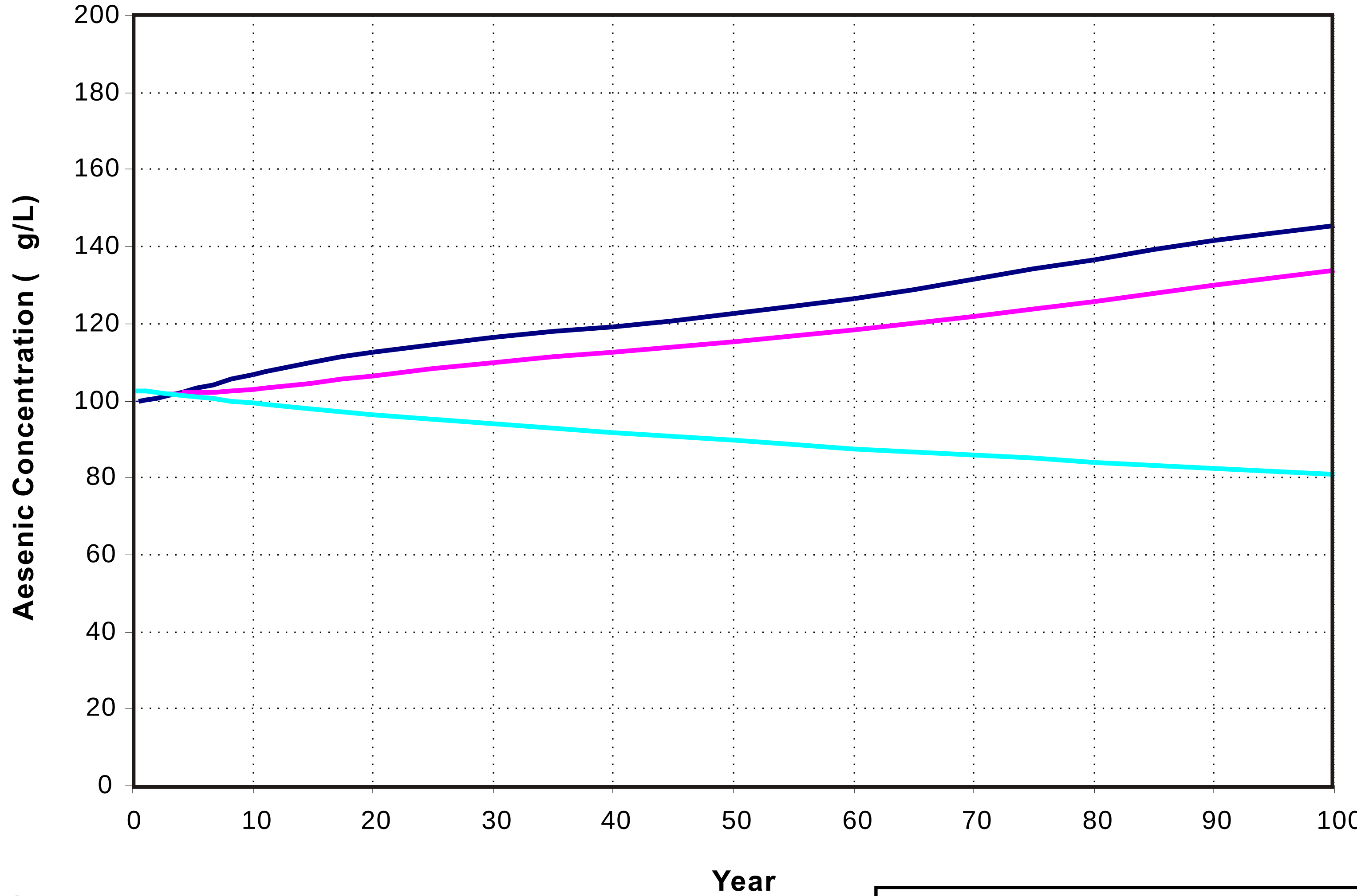
Basic Remediation COMPANY

Prepared by:	Date
DBS&A BGT	05-27-2010

Daniel B. Stephens & Associates, Inc.

JN ES10.0042

S:\Projects\BRC\ES10.0042_BRC_Transport_Model_Runs\VR_Drawings\Fig_13d_Simulated_As_conc_0_Layer1_13D.cdr



Explanation

- PC12 (Layer 1)
- PC12 (Layer 2)
- PC12 (Layer 11)

BMI Complex
Henderson, Nevada

FIGURE 13d
SIMULATED ARSENIC CONCENTRATION
FOR BOUNDARY CONCENTRATION
CONSTANT AT INITIAL VALUES
WELL PC12 LOCATION

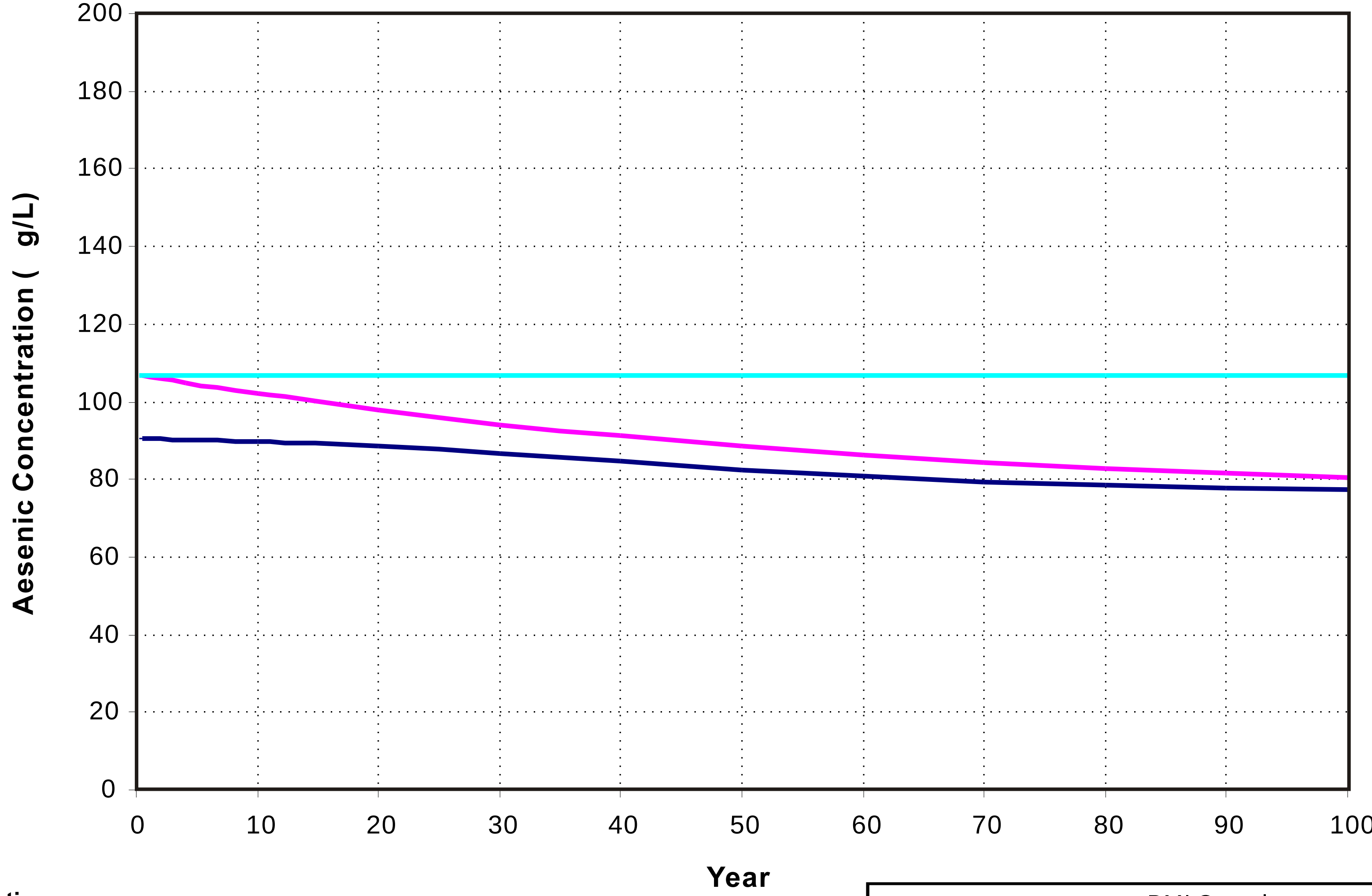
Basic Remediation COMPANY

Prepared by: DBS&A GHS

Date 5/24/10

S:\Projects\BRC\ES10.0042_BRC_Transport_Model_Runs\VR_Drawings\Fig_13d_Simulated_As_conc_0_Layer1_13D.cdr

Daniel B. Stephens & Associates, Inc.
JN ES10.0042



Explanation

- AA-20 (Layer 1)
- AA-20 (Layer 2)
- AA-20 (Layer 11)

BMI Complex
Henderson, Nevada

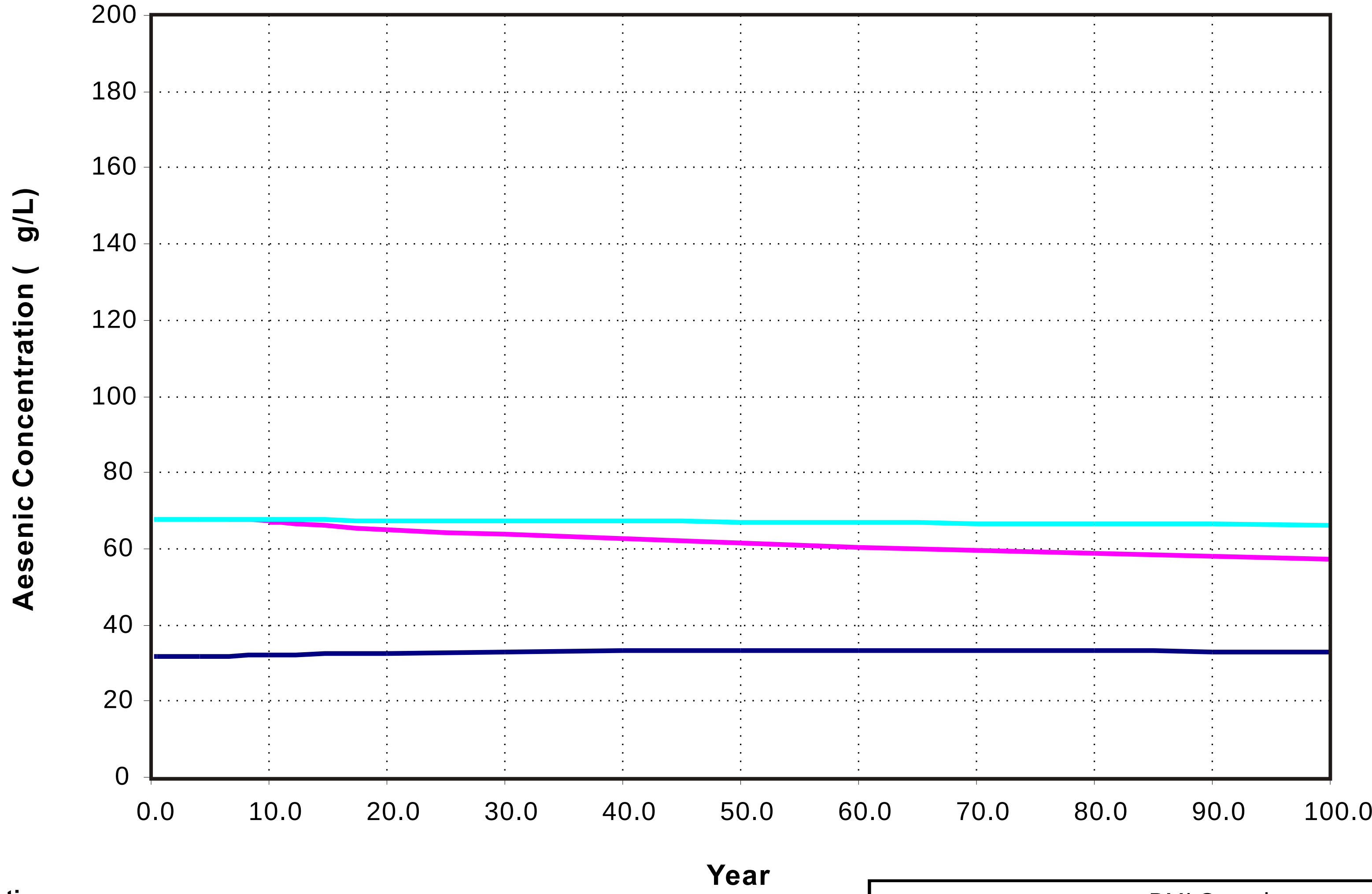
FIGURE 13e
SIMULATED ARSENIC CONCENTRATION
FOR BOUNDARY CONCENTRATION
CONSTANT AT INITIAL VALUES
WELL AA-20 LOCATION

Basic Remediation COMPANY

Prepared by: DBS&A GHS
Date 5/24/10

S:\Projects\BRC\ES10.0042_BRC_Transport_Model_Runs\VR_Drawings\Fig_13d_Simulated_As_conc_0_Layer1_13D.cdr

Daniel B. Stephens & Associates, Inc.
JN ES10.0042



Explanation

- AA-18 (Layer 1)
- AA-18 (Layer 2)
- AA-18 (Layer 11)

BMI Complex
Henderson, Nevada

FIGURE 13f
SIMULATED ARSENIC CONCENTRATION
FOR BOUNDARY CONCENTRATION
CONSTANT AT INITIAL VALUES
WELL AA-18 LOCATION

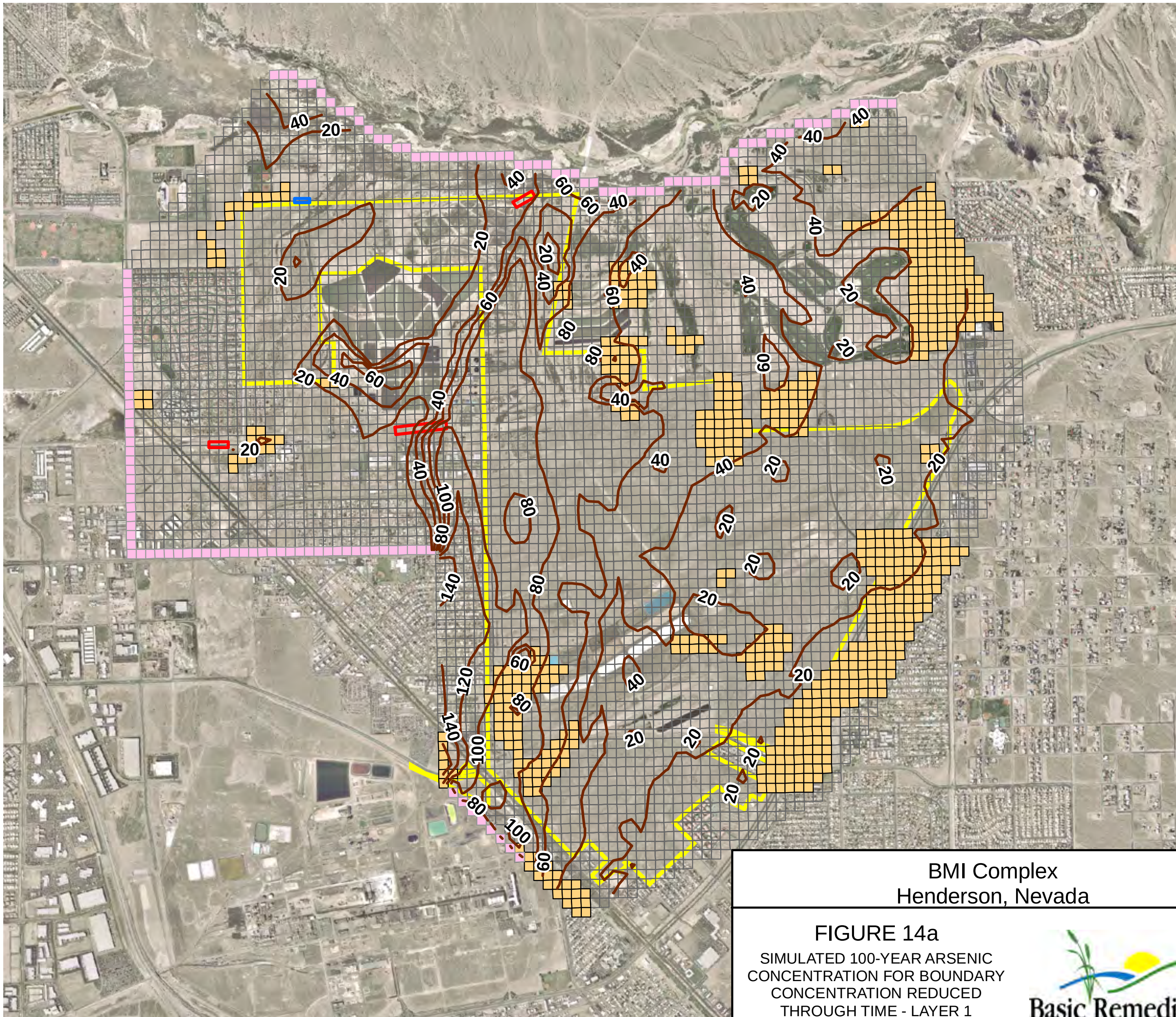
Basic Remediation COMPANY

Prepared by: DBS&A GHS

Date 5/24/10

S:\Projects\BRC\ES10.0042_BRC_Transport_Model_Runs\VR_Drawings\Fig_13d_Simulated_As_conc_0_Layer1_13D.cdr

Daniel B. Stephens & Associates, Inc.
JN ES10.0042



Source: Aerial photograph, April 2004

Explanation

- Simulated concentration (µg/L)
- Dry cell
- Boundary cell
- Extraction well field
- Injection well field
- Model grid
- Site boundary

N

0 1,750 3,500 Feet

BMI Complex
Henderson, Nevada

FIGURE 14a

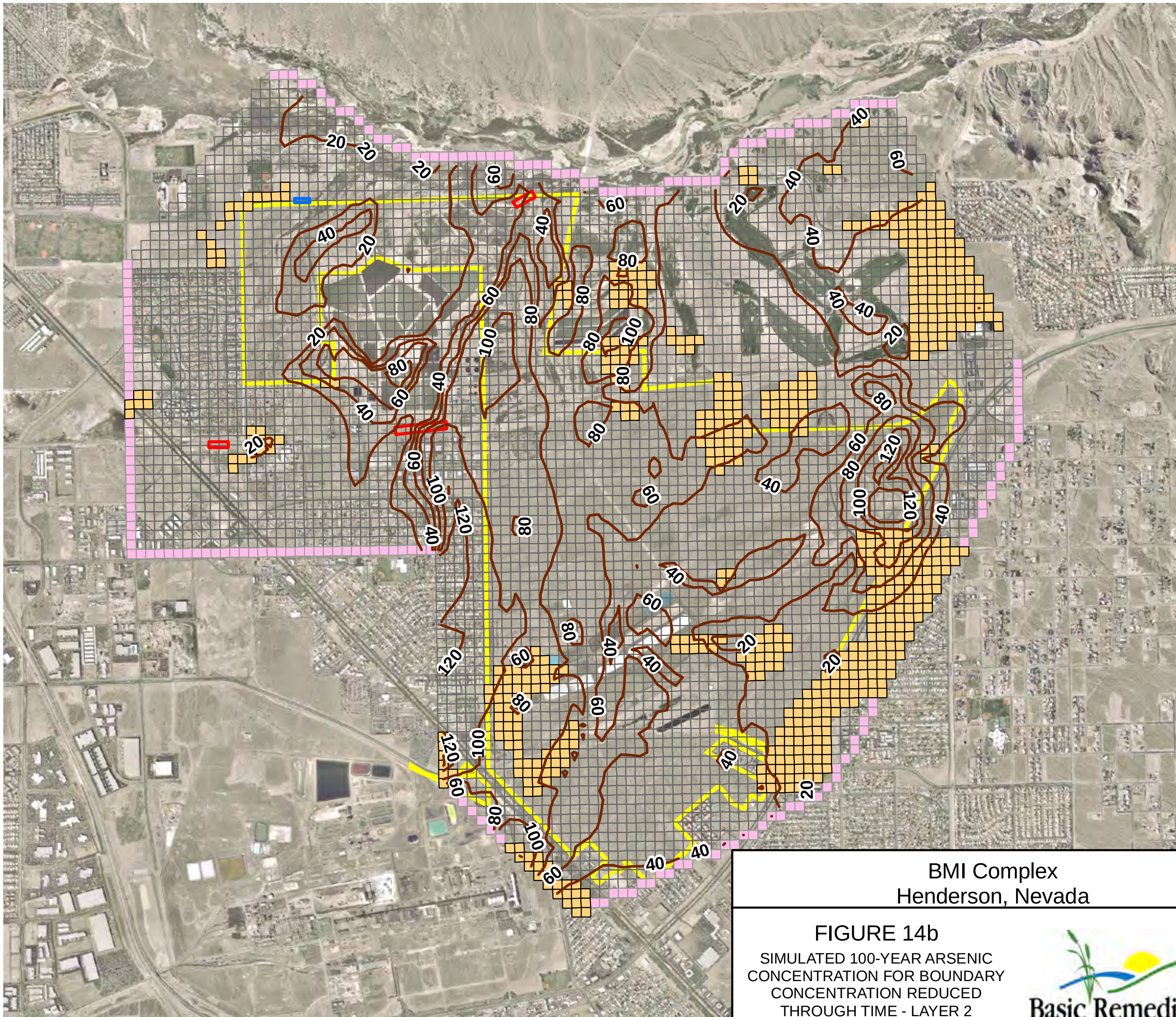
SIMULATED 100-YEAR ARSENIC CONCENTRATION FOR BOUNDARY CONCENTRATION REDUCED THROUGH TIME - LAYER 1

Basic Remediation COMPANY

Prepared by:	Date
DBS&A BGT	05-27-2010

Daniel B. Stephens & Associates, Inc.
JN ES10.0042

S:/PROJECTS/BRC/ES10.0042_BRC_TRANSPORT_MODEL_RUNS/GIS/MXDS/ARSENIC/FIGURE14B_INITC_DECBDRY_L2.MXD 016250



Source: Aerial photograph, April 2004

Explanation

- Simulated concentration (µg/L)
- Dry cell
- Boundary cell
- Extraction well field
- Injection well field
- Model grid
- Site boundary

N

0 1,750 3,500 Feet

BMI Complex
Henderson, Nevada

FIGURE 14b

SIMULATED 100-YEAR ARSENIC CONCENTRATION FOR BOUNDARY CONCENTRATION REDUCED THROUGH TIME - LAYER 2

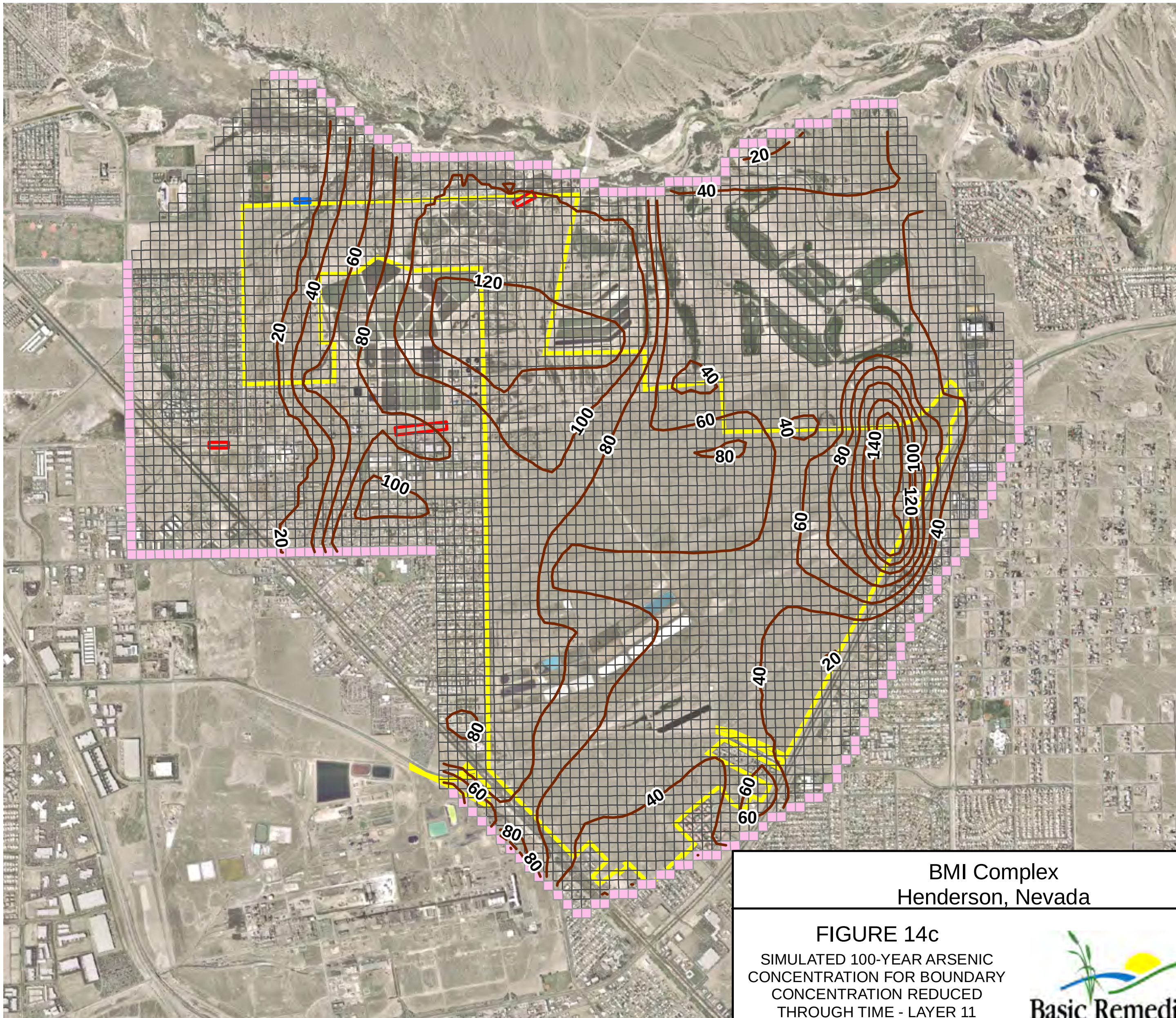
Basic Remediation COMPANY

Prepared by: DBS&A BGT

Date 05-27-2010

Daniel B. Stephens & Associates, Inc.
JN ES10.0042

S:/PROJECTS/BRC/ES10.0042_BRC_TRANSPORT_MODEL_RUNS/GIS/MXDS/ARSENIC/FIGURE14C_INITC_DECBDRY_L11.MXD 017250



Source: Aerial photograph, April 2004

Explanation

- Simulated concentration (µg/L)
- Boundary cell
- Extraction well field
- Injection well field
- Model grid
- Site boundary

N

0 1,750 3,500 Feet

BMI Complex
Henderson, Nevada

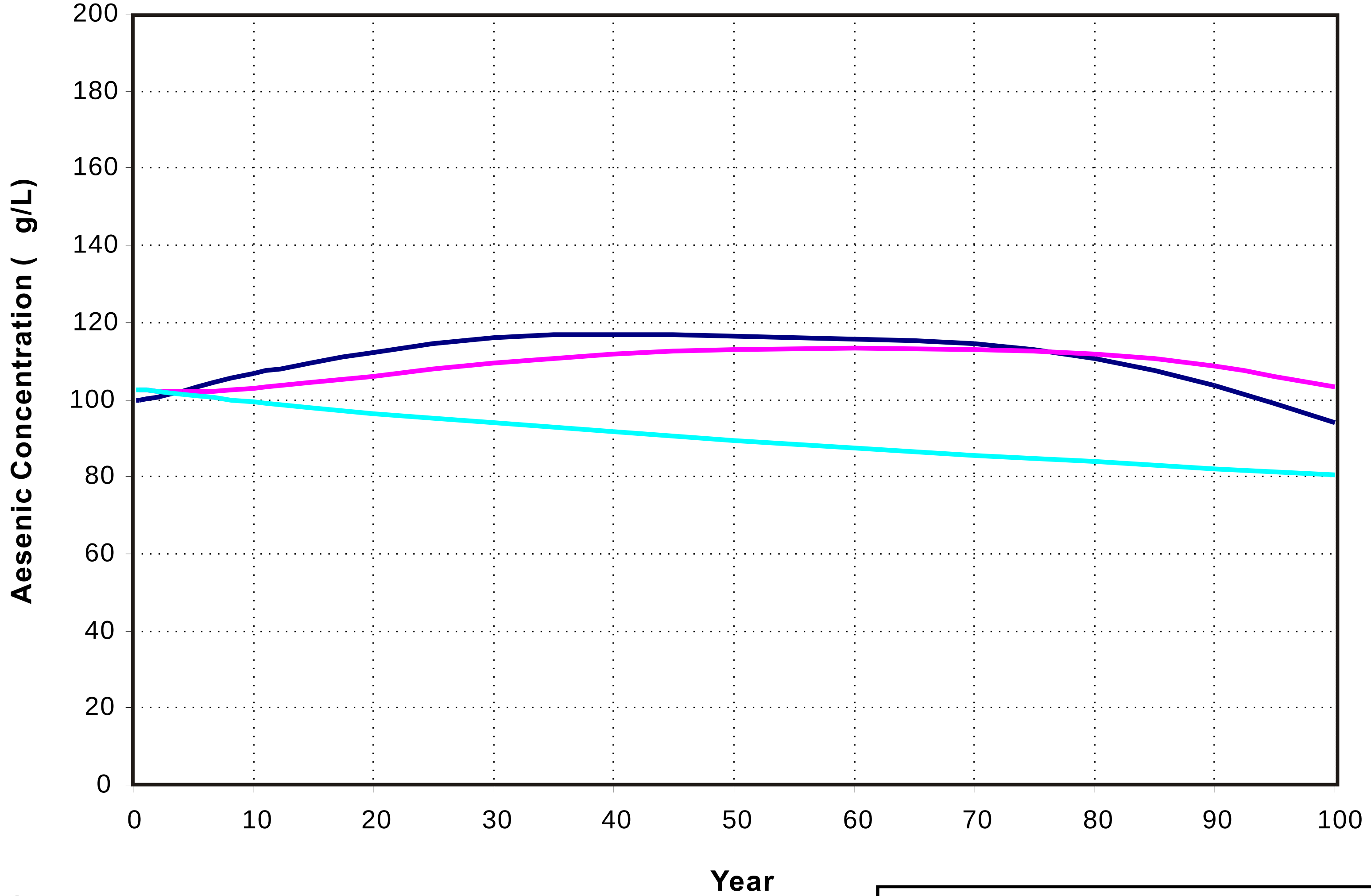
FIGURE 14c

SIMULATED 100-YEAR ARSENIC CONCENTRATION FOR BOUNDARY CONCENTRATION REDUCED THROUGH TIME - LAYER 11

Basic Remediation COMPANY

Prepared by:	Date
DBS&A BGT	05-27-2010

Daniel B. Stephens & Associates, Inc.
JN ES10.0042



Explanation

- PC12 (Layer 1)
- PC12 (Layer 2)
- PC12 (Layer 11)

BMI Complex
Henderson, Nevada

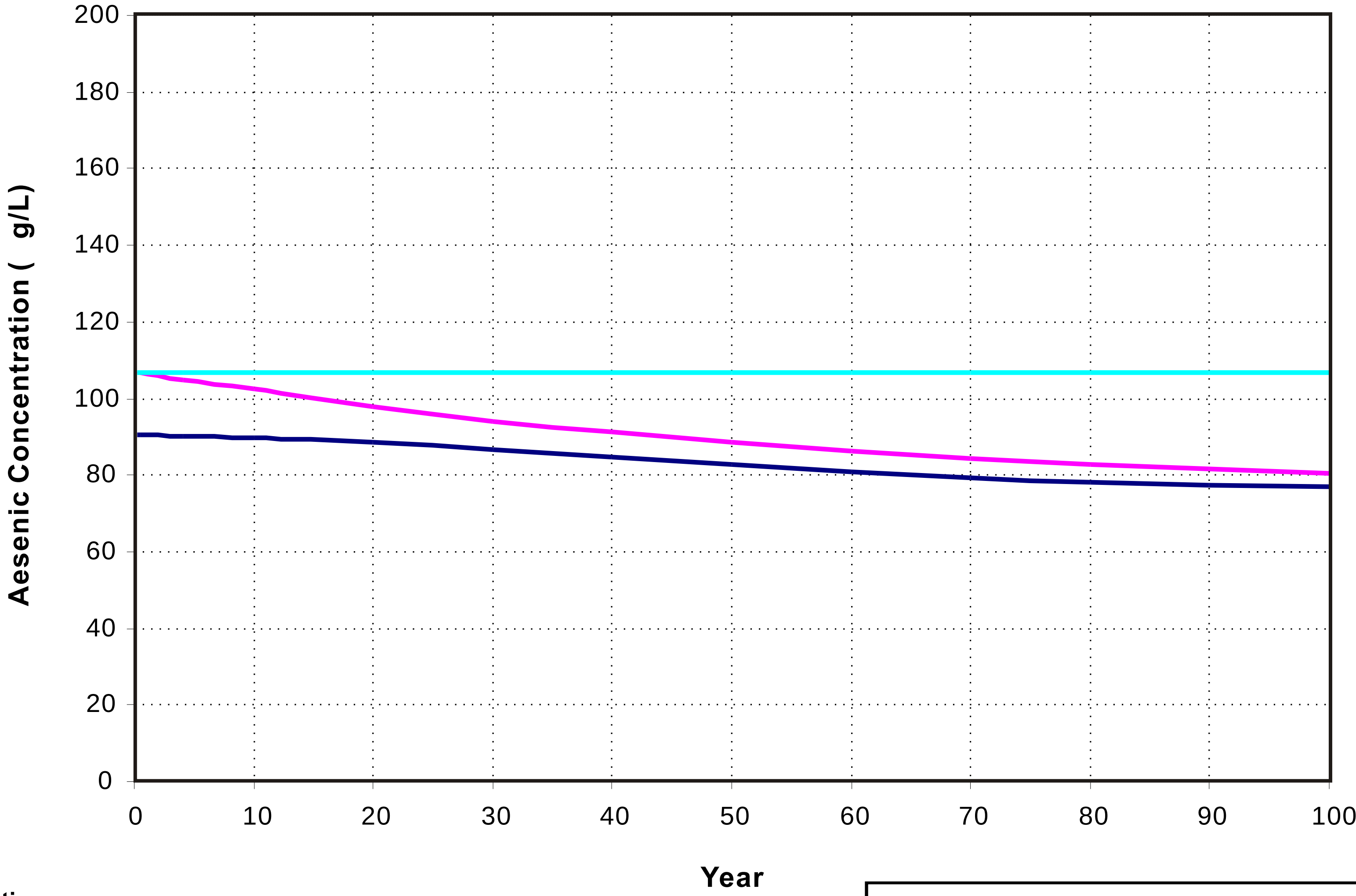
FIGURE 14d
SIMULATED ARSENIC CONCENTRATION
FOR BOUNDARY CONCENTRATION
REDUCED THROUGH TIME
WELL PC12 LOCATION

Basic Remediation COMPANY

Prepared by: DBS&A GHS | Date 5/24/10

S:\Projects\BRC\ES10.0042_BRC_Transport_Model_Runs\VR_Drawings\Fig_14d_Simulated_As_conc_0_Layer1_14D.cdr

Daniel B. Stephens & Associates, Inc.
JN ES10.0042



Explanation

- AA-20 (Layer 1)
- AA-20 (Layer 2)
- AA-20 (Layer 11)

BMI Complex
Henderson, Nevada

FIGURE 14e
SIMULATED ARSENIC CONCENTRATION
FOR BOUNDARY CONCENTRATION
REDUCED THROUGH TIME
WELL AA-20 LOCATION

Basic Remediation COMPANY

Prepared by: DBS&A GHS

Date 5/24/10

S:\Projects\BRC\ES10.0042_BRC_Transport_Model_Runs\VR_Drawings\Fig_14d_Simulated_As_conc_0_Layer1_14D.cdr

Daniel B. Stephens & Associates, Inc.

JN ES10.0042

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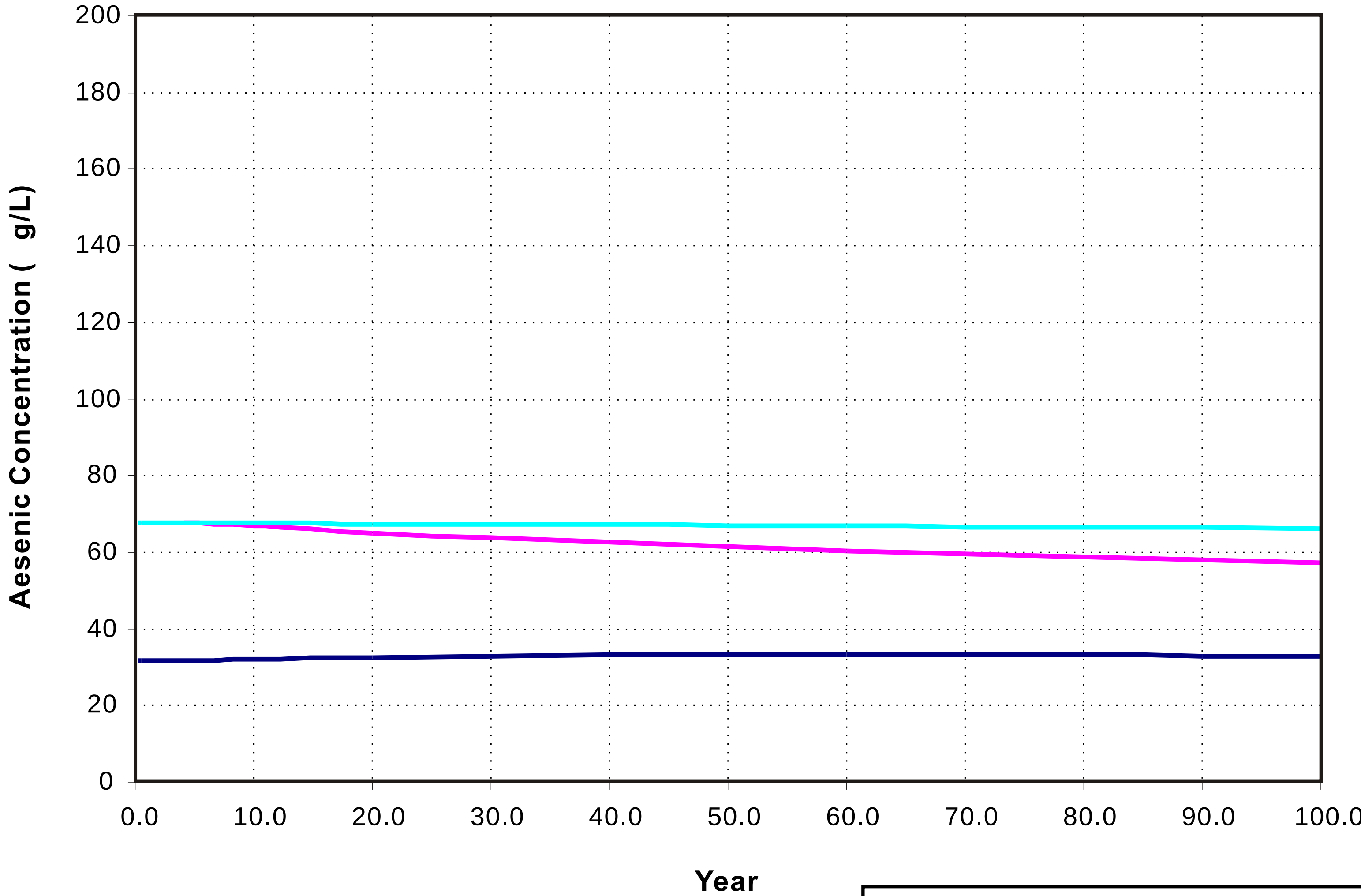


Explanation

- AA-18 (Layer 1)
- AA-18 (Layer 2)
- AA-18 (Layer 11)

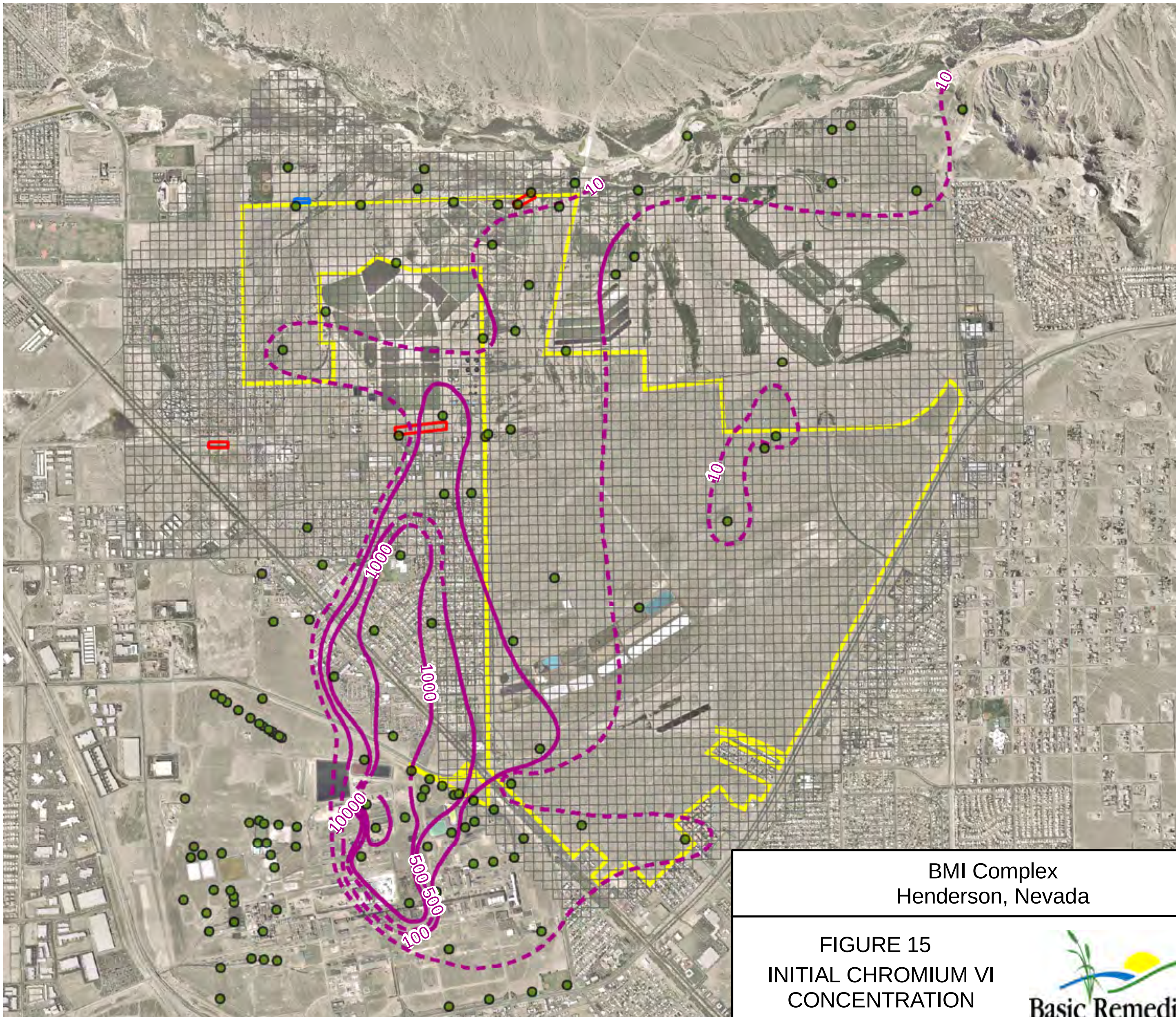
BMI Complex
Henderson, Nevada

FIGURE 14f
SIMULATED ARSENIC CONCENTRATION
FOR BOUNDARY CONCENTRATION
REDUCED THROUGH TIME
WELL AA-18 LOCATION

Basic Remediation COMPANY

Prepared by: DBS&A GHS | Date 5/24/10 | S:\Projects\BRC\ES10.0042_BRC_Transport_Model_Runs\VR_Drawings\Fig_14d_Simulated_As_conc_0_Layer1_14D.cdr

Daniel B. Stephens & Associates, Inc.
JN ES10.0042



Source: Aerial photograph, April 2004

Explanation

- Monitor well
- Concentration contour (µg/L) (dashed where inferred) from DBS&A (2010a,b)
- Extraction well field
- Injection well field
- Model grid
- Site boundary

N

0 1,750 3,500 Feet

BMI Complex
Henderson, Nevada

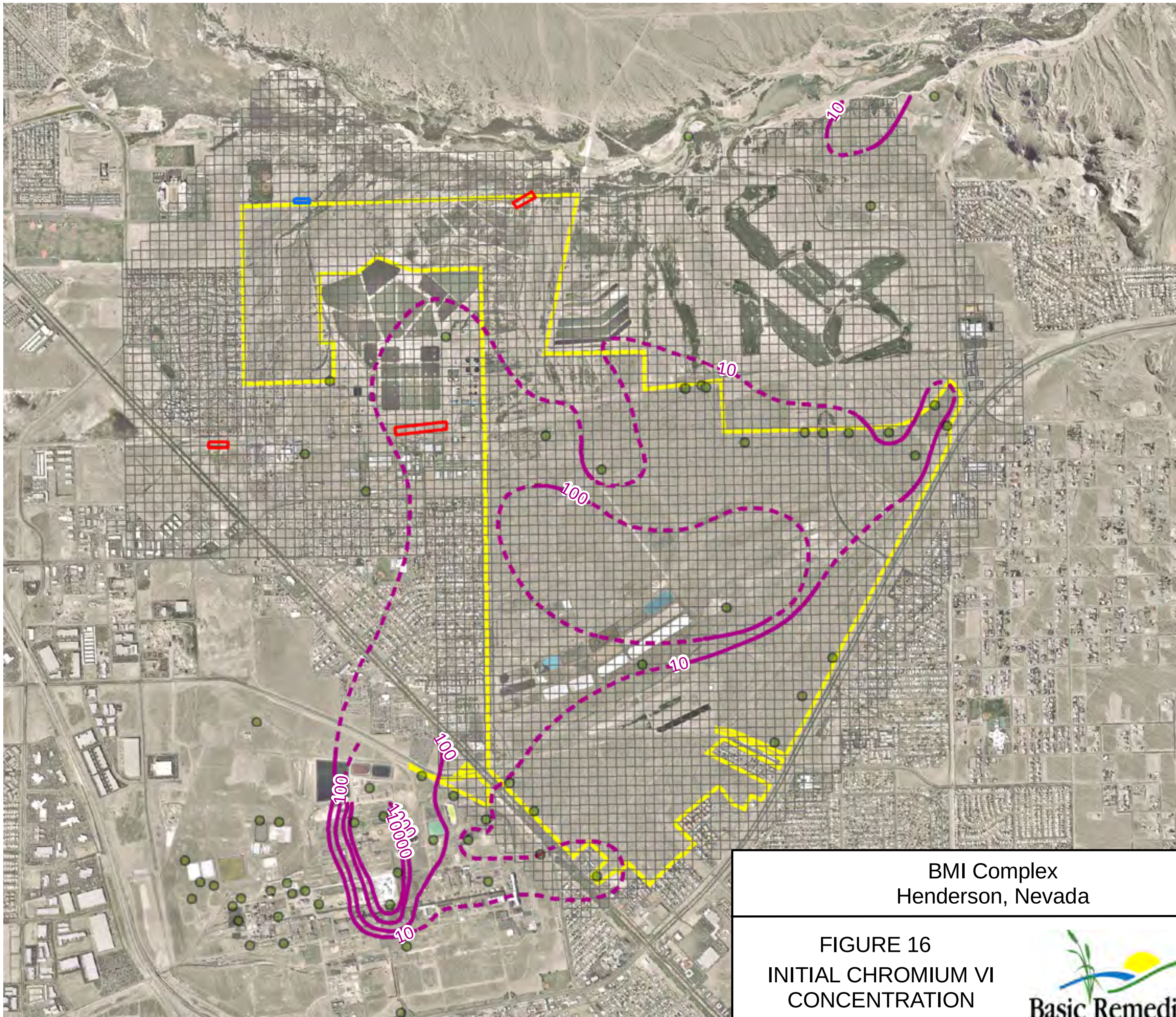
FIGURE 15
INITIAL CHROMIUM VI CONCENTRATION
LAYER 1

Basic Remediation COMPANY

Prepared by:	Date
DBS&A BGT	05-27-2010

Daniel B. Stephens & Associates, Inc.
JN ES10.0042

S:/PROJECTS/BRC/ES10.0042_BRC_TRANSPORT_MODEL_RUNS/GIS/MXDS/CHROMIUM_VI/FIGURE16_CHROMIUMVI_INITC_LAYER2.MXD 017250



Source: Aerial photograph, April 2004

Explanation

- Monitor well
- Concentration contour (µg/L) (dashed where inferred) from DBS&A (2010a,b)
- Extraction well field
- Injection well field
- Model grid
- Site boundary

N

0 1,750 3,500 Feet

BMI Complex
Henderson, Nevada

FIGURE 16
INITIAL CHROMIUM VI CONCENTRATION
LAYERS 2 THOUGH 11

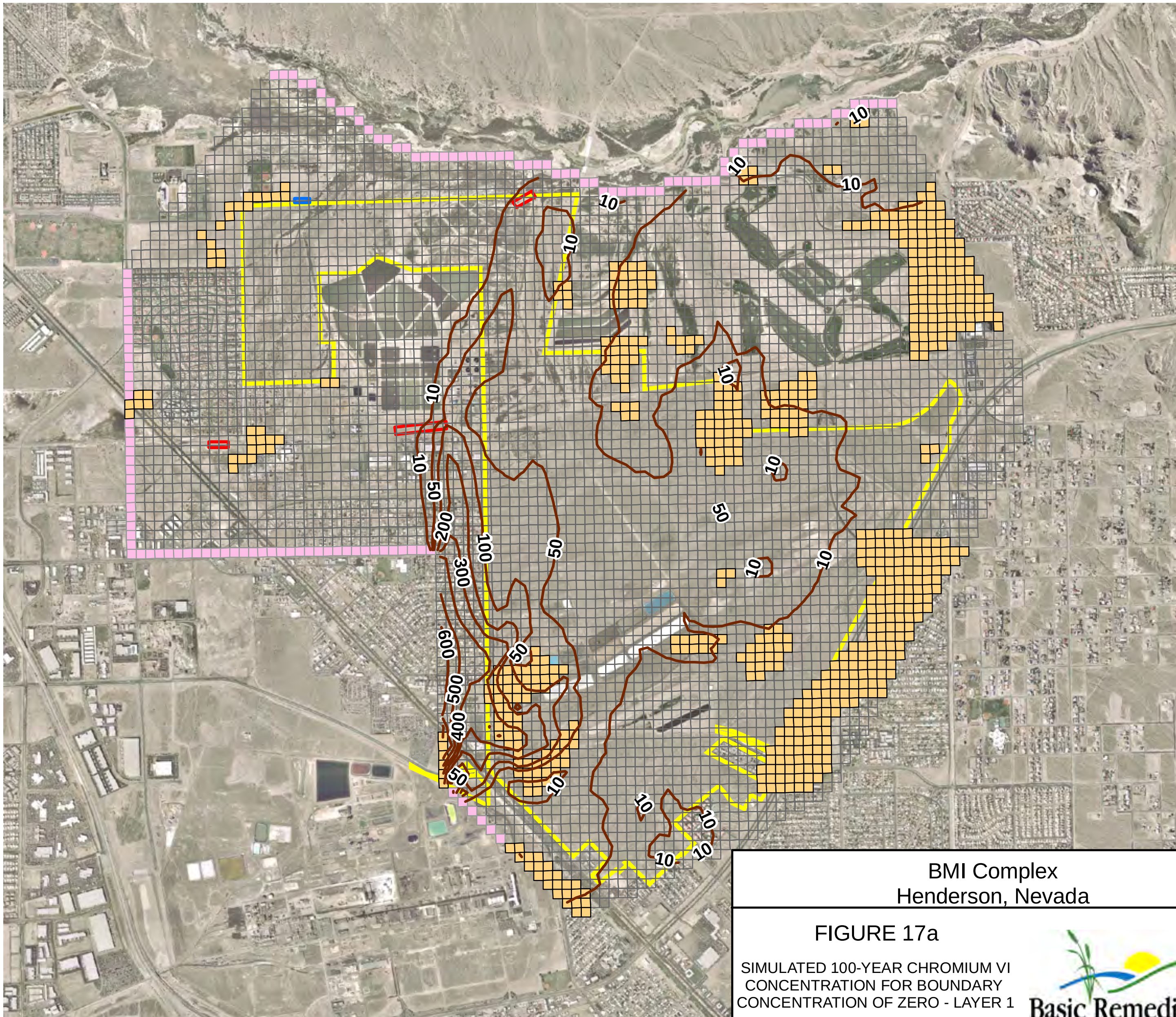
Basic Remediation COMPANY

Prepared by: DBS&A BGT

Date 05-27-2010

Daniel B. Stephens & Associates, Inc.
JN ES10.0042

S:/PROJECTS/BRC/ES10.0042_BRC_TRANSPORT_MODEL_RUNS/GIS/MXDS/CHROMIUM_VI/FIGURE17A_11LAYER_RUN2_L1_NOBDRY.MXD 017250



Source: Aerial photograph, April 2004

Explanation

- Simulated concentration (µg/L)
- Dry cell
- Boundary cell
- Extraction well field
- Injection well field
- Model grid
- Site boundary

N

0 1,750 3,500 Feet

BMI Complex
Henderson, Nevada

FIGURE 17a

SIMULATED 100-YEAR CHROMIUM VI CONCENTRATION FOR BOUNDARY CONCENTRATION OF ZERO - LAYER 1

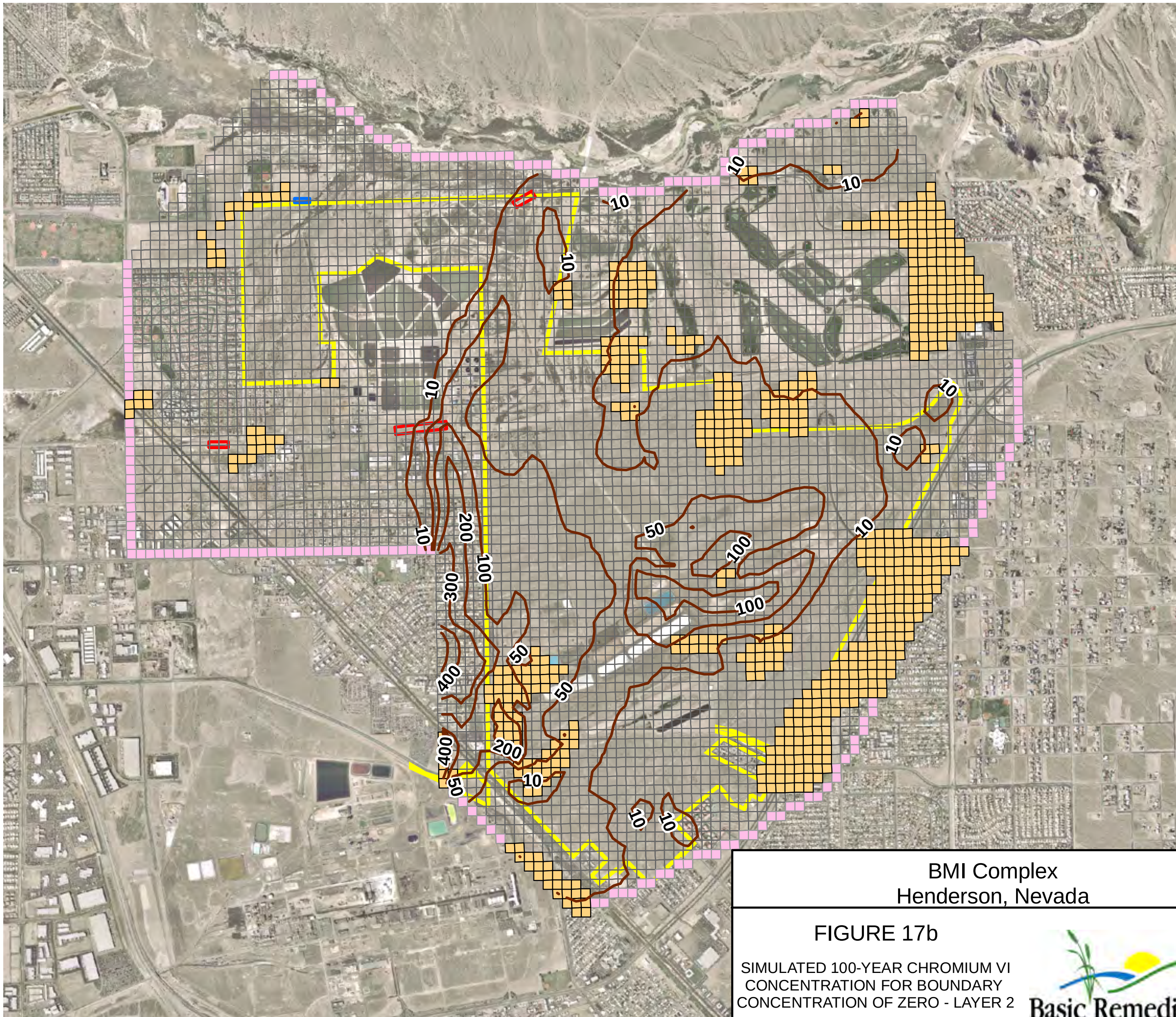
Basic Remediation COMPANY

Prepared by: DBS&A BGT

Date 05-27-2010

Daniel B. Stephens & Associates, Inc.
JN ES10.0042

S:/PROJECTS/BRC/ES10.0042_BRC_TRANSPORT_MODEL_RUNS/GIS/MXDS/CHROMIUM_VI/FIGURE17B_11LAYER_RUN2_L2_NOBDRY.MXD 017250



Source: Aerial photograph, April 2004

Explanation

- Simulated concentration (µg/L)
- Dry cell
- Boundary cell
- Extraction well field
- Injection well field
- Model grid
- Site boundary

N

0 1,750 3,500 Feet

BMI Complex
Henderson, Nevada

FIGURE 17b

SIMULATED 100-YEAR CHROMIUM VI CONCENTRATION FOR BOUNDARY CONCENTRATION OF ZERO - LAYER 2

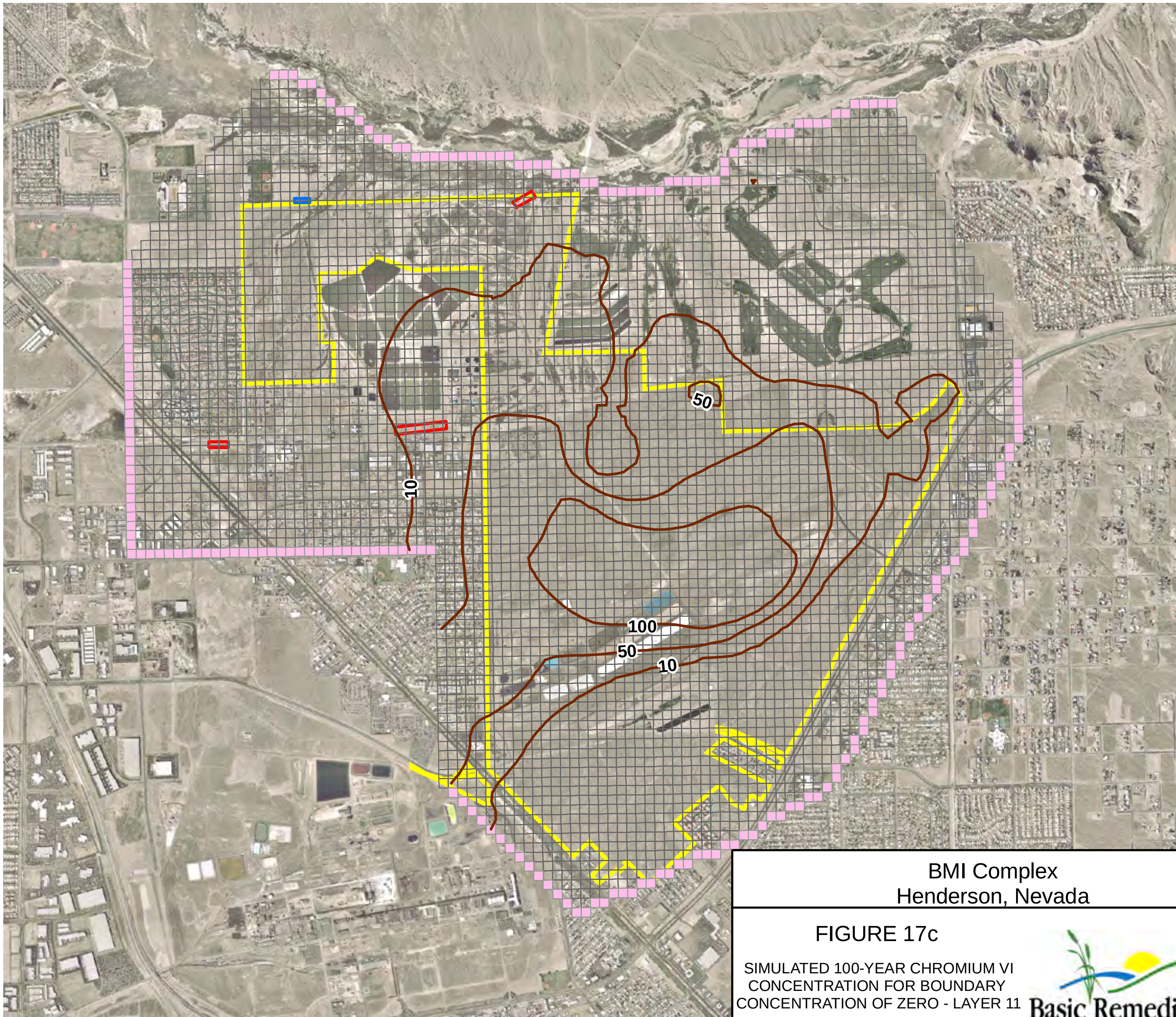
Basic Remediation Company

Prepared by: DBS&A BGT

Date 05-27-2010

Daniel B. Stephens & Associates, Inc.
JN ES10.0042

S:/PROJECTS/BRC/ES10.0042_BRC_TRANSPORT_MODEL_RUNS/GIS/MXDS/CHROMIUM_VI/FIGURE17C_11LAYER_RUN2_L11_NOBDRY.MXD 017250



Source: Aerial photograph, April 2004

Explanation

- Simulated concentration (µg/L)
- Boundary cell
- Extraction well field
- Injection well field
- Model grid
- Site boundary

N

0 1,750 3,500 Feet

BMI Complex
Henderson, Nevada

FIGURE 17c

SIMULATED 100-YEAR CHROMIUM VI CONCENTRATION FOR BOUNDARY CONCENTRATION OF ZERO - LAYER 11

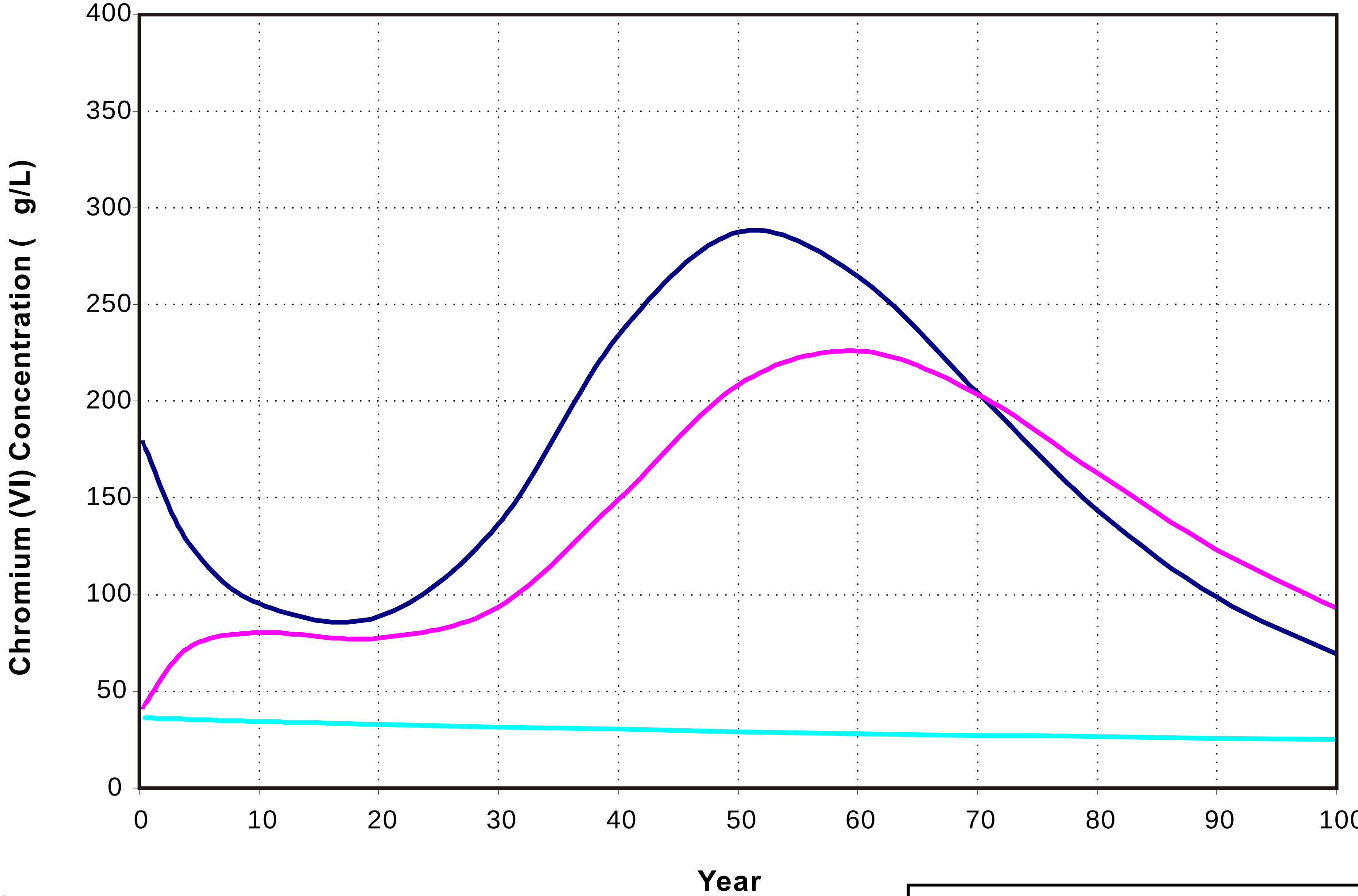
Basic Remediation COMPANY

Prepared by: DBS&A BGT

Date 05-27-2010

Daniel B. Stephens & Associates, Inc.
JN ES10.0042

S:\Projects\BRC\ES10.0042_BRC_Transport_Model_Runs\VR_Drawings\Fig_17d_Simulated_Cr_VI_conc_0_Layer1_17D.cdr



Explanation

- PC12 (Layer 1)
- PC12 (Layer 2)
- PC12 (Layer 11)

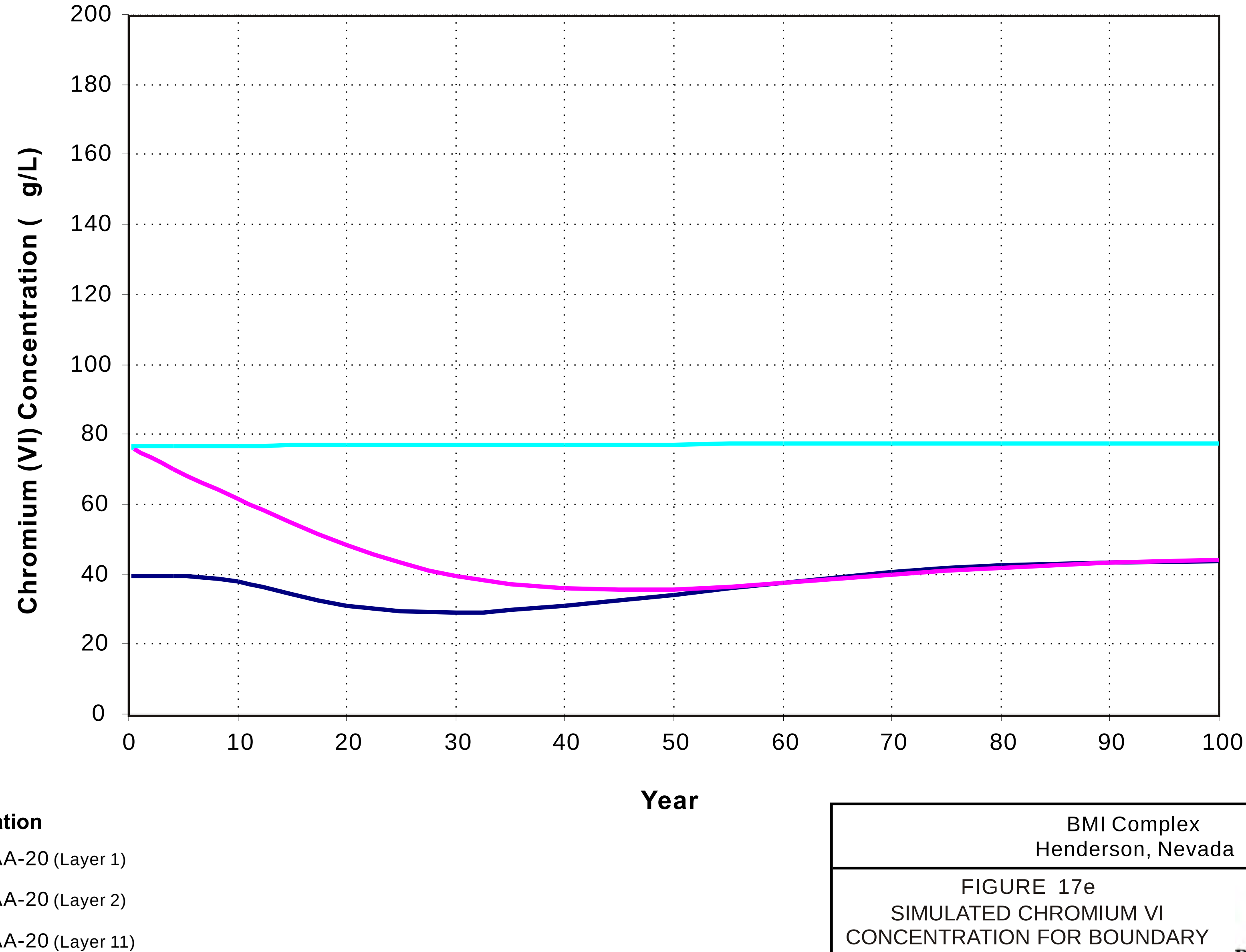
Daniel B. Stephens & Associates, Inc.
JN ES10.0042

BMI Complex
Henderson, Nevada

FIGURE 17d
SIMULATED CHROMIUM VI CONCENTRATION FOR BOUNDARY CONCENTRATION OF ZERO AT WELL PC12 LOCATION

Basic Remediation COMPANY

Prepared by: DBS&A GHS	Date 5/24/10	S:\Projects\BRC\ES10.0042_BRC_Transport_Model_Runs\VR_Drawings\Fig_17d_Simulated_Cr_VI_conc_0_Layer1_17D.cdr



BMI Complex
Henderson, Nevada

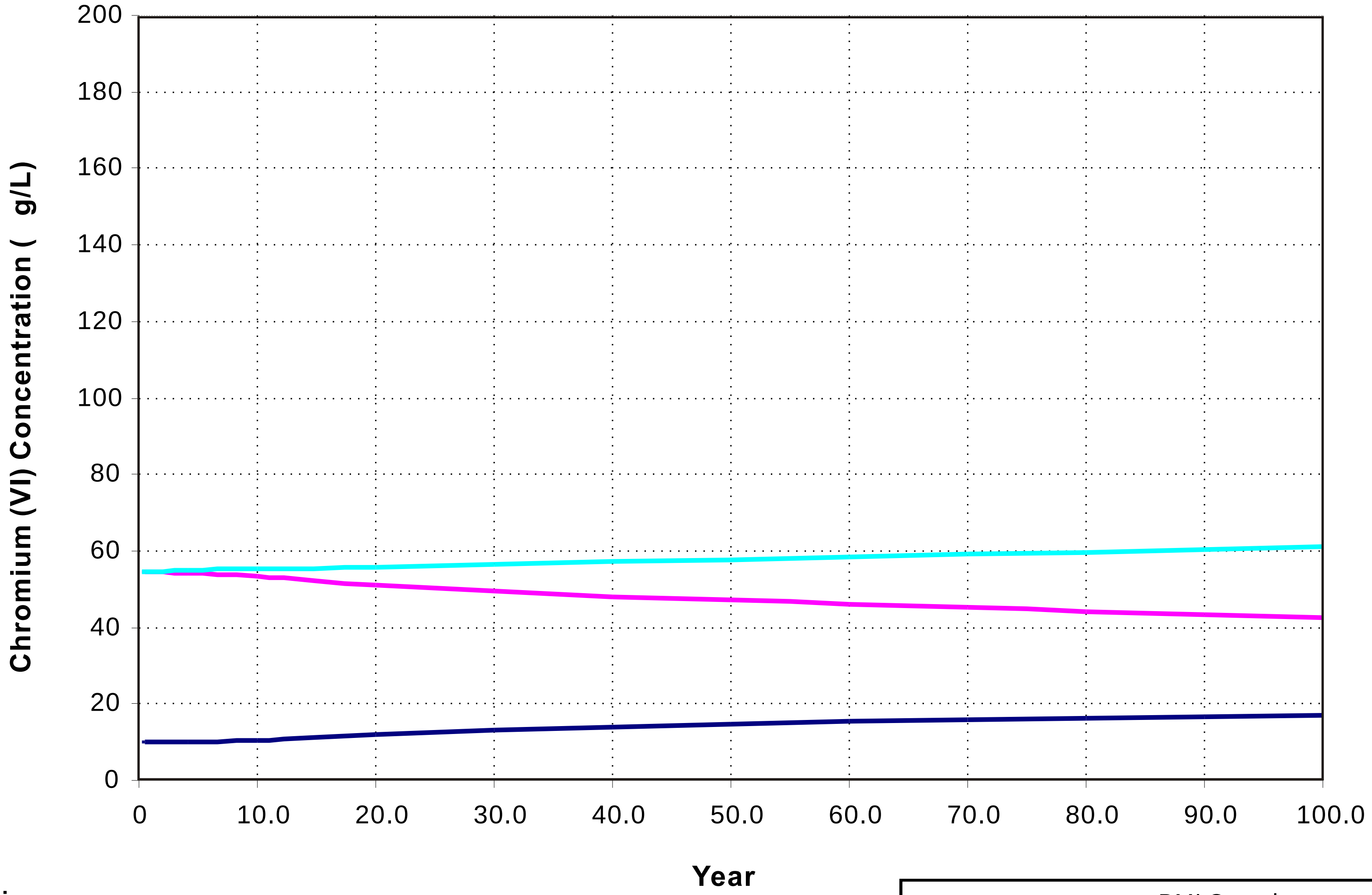
FIGURE 17e
SIMULATED CHROMIUM VI CONCENTRATION FOR BOUNDARY CONCENTRATION OF ZERO AT WELL AA-20 LOCATION

Basic Remediation COMPANY

Prepared by: DBS&A GHS	Date 5/24/10	S:\Projects\BRC\ES10.0042_BRC_Transport_Model_Runs\VR_Drawings\Fig_17d_Simulated_Cr_VI_conc_0_Layer1_17D.cdr

Daniel B. Stephens & Associates, Inc.
JN ES10.0042

S:\Projects\BRC\ES10.0042_BRC_Transport_Model_Runs\VR_Drawings\Fig_17d_Simulated_Cr_VI_conc_0_Layer1_17D.cdr



Explanation

- AA-18 (Layer 1)
- AA-18 (Layer 2)
- AA-18 (Layer 11)

BMI Complex
Henderson, Nevada

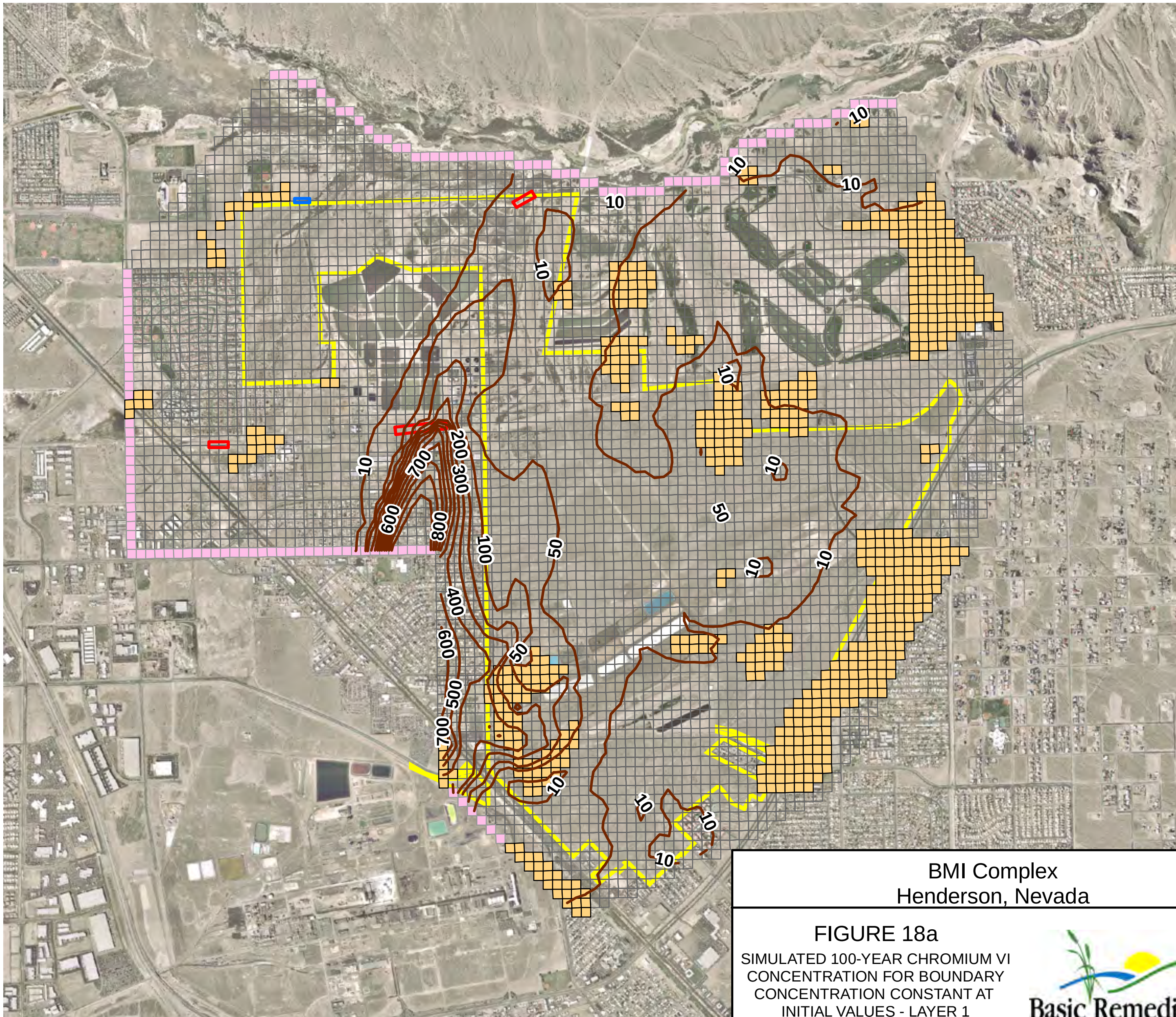
FIGURE 17f
SIMULATED CHROMIUM VI CONCENTRATION FOR BOUNDARY CONCENTRATION OF ZERO AT WELL AA-18 LOCATION

Basic Remediation COMPANY

Prepared by: DBS&A GHS | Date 5/24/10 | S:\Projects\BRC\ES10.0042_BRC_Transport_Model_Runs\VR_Drawings\Fig_17d_Simulated_Cr_VI_conc_0_Layer1_17D.cdr

Daniel B. Stephens & Associates, Inc.
JN ES10.0042

S:/PROJECTS/BRC/ES10.0042_BRC_TRANSPORT_MODEL_RUNS/GIS/MXDS/CHROMIUM_VI/FIGURE18A_11LAYER_RUN2_L1_ALL.MXD 017250



Source: Aerial photograph, April 2004

Explanation

- Simulated concentration (µg/L)
- Dry cell
- Boundary cell
- Extraction well field
- Injection well field
- Model grid
- Site boundary

N

0 1,750 3,500 Feet

BMI Complex
Henderson, Nevada

FIGURE 18a

SIMULATED 100-YEAR CHROMIUM VI CONCENTRATION FOR BOUNDARY CONCENTRATION CONSTANT AT INITIAL VALUES - LAYER 1

Basic Remediation COMPANY

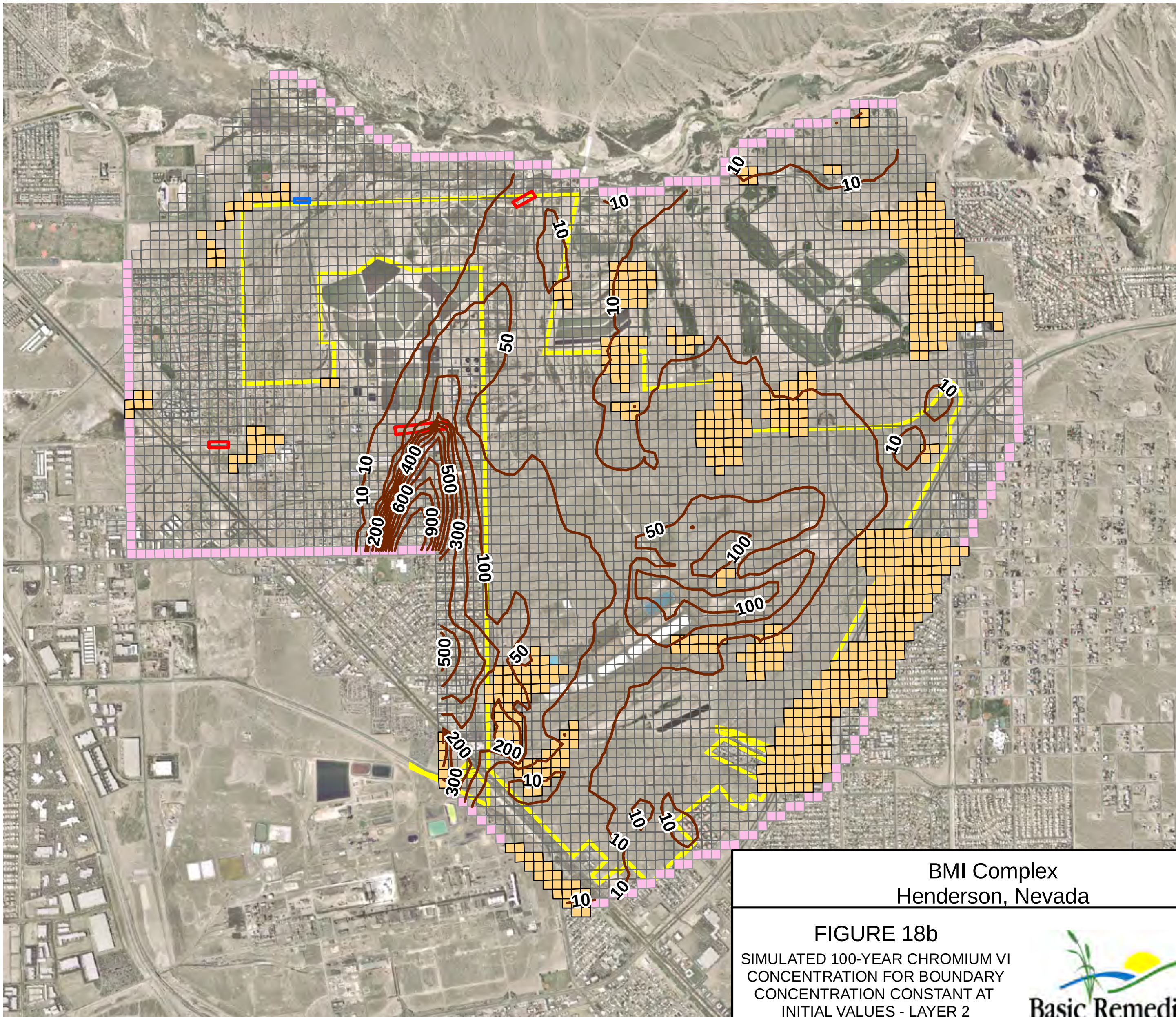
Prepared by: DBS&A BGT

Date 05-27-2010

Daniel B. Stephens & Associates, Inc.

JN ES10.0042

S:/PROJECTS/BRC/ES10.0042_BRC_TRANSPORT_MODEL_RUNS/GIS/MXDS/CHROMIUM_VI/FIGURE18B_11LAYER_RUN2_L2_ALL.MXD 017250



Source: Aerial photograph, April 2004

Explanation

- Simulated concentration (µg/L)
- Dry cell
- Boundary cell
- Extraction well field
- Injection well field
- Model grid
- Site boundary

N

0 1,750 3,500 Feet

BMI Complex
Henderson, Nevada

FIGURE 18b

SIMULATED 100-YEAR CHROMIUM VI CONCENTRATION FOR BOUNDARY CONCENTRATION CONSTANT AT INITIAL VALUES - LAYER 2

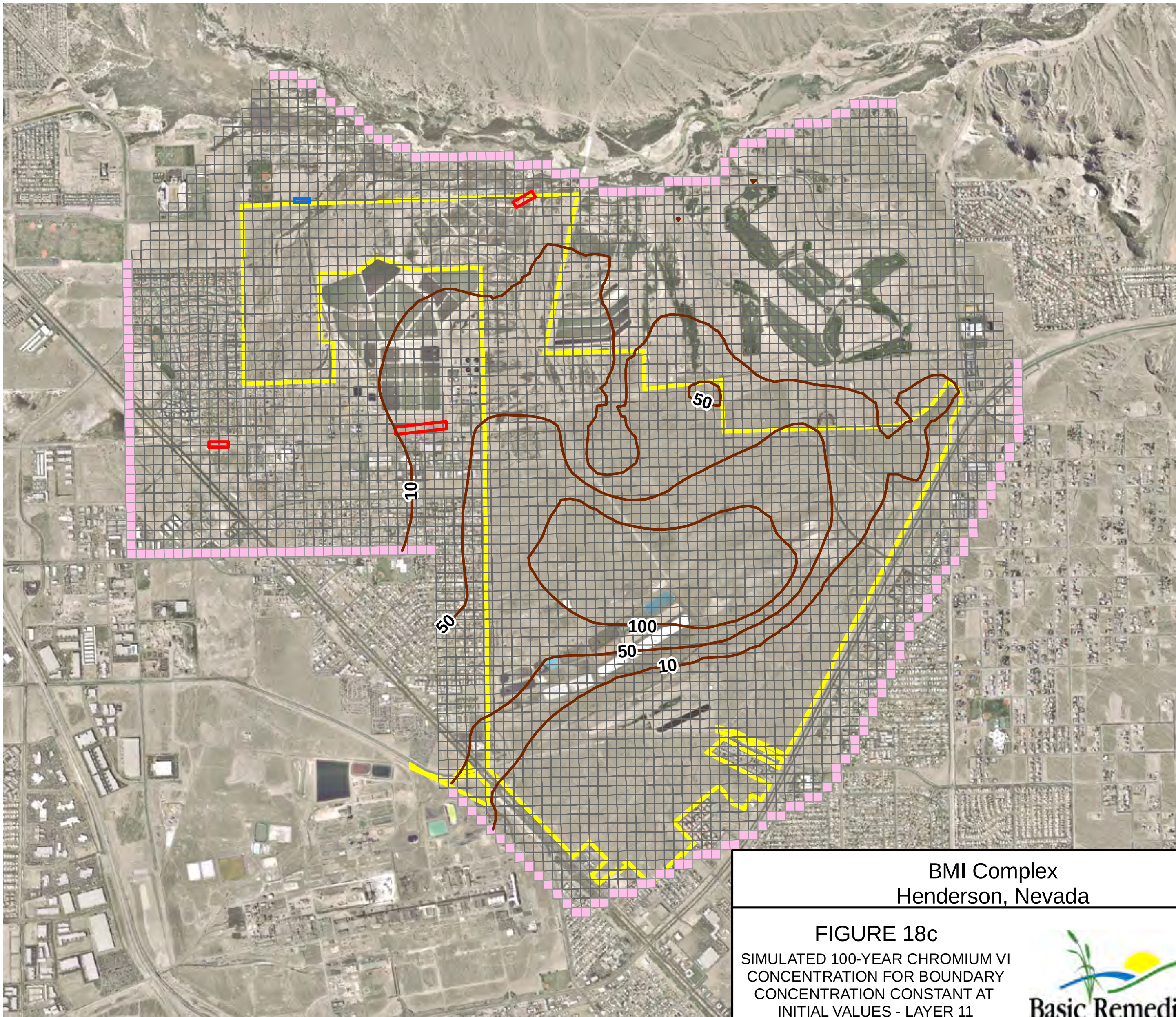
Basic Remediation COMPANY

Prepared by: DBS&A BGT

Date 05-27-2010

Daniel B. Stephens & Associates, Inc.
JN ES10.0042

S:/PROJECTS/BRC/ES10.0042_BRC_TRANSPORT_MODEL_RUNS/GIS/MXDS/CHROMIUM_VI/FIGURE18C_11LAYER_RUN2_L11_ALL.MXD 017250



Source: Aerial photograph, April 2004

Explanation

- Simulated concentration (µg/L)
- Boundary cell
- Extraction well field
- Injection well field
- Model grid
- Site boundary

N

0 1,750 3,500 Feet

BMI Complex
Henderson, Nevada

FIGURE 18c

SIMULATED 100-YEAR CHROMIUM VI CONCENTRATION FOR BOUNDARY CONCENTRATION CONSTANT AT INITIAL VALUES - LAYER 11

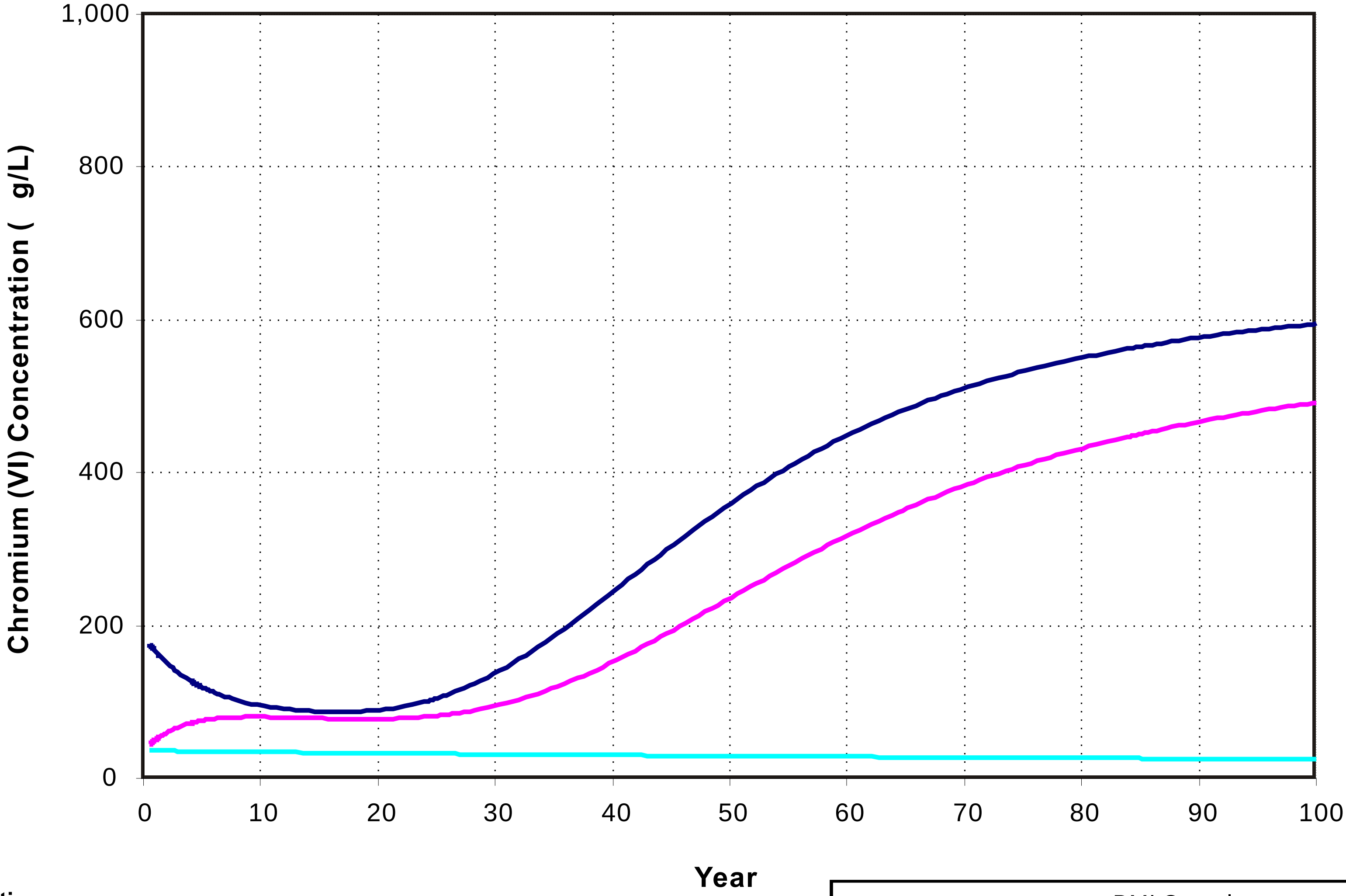
Basic Remediation COMPANY

Prepared by: DBS&A BGT

Date 05-27-2010

Daniel B. Stephens & Associates, Inc.
JN ES10.0042

S:\Projects\BRC\ES10.0042_BRC_Transport_Model_Runs\VR_Drawings\Fig_18d_Simulated_Cr_VI_conc_0_Layer1_18D.cdr



Explanation

- PC12 (Layer 1)
- PC12 (Layer 2)
- PC12 (Layer 11)

BMI Complex
Henderson, Nevada

FIGURE 18d
SIMULATED CHROMIUM VI CONCENTRATION
FOR BOUNDARY CONCENTRATION
CONSTANT AT INITIAL VALUES
WELL PC12 LOCATION

Basic Remediation COMPANY

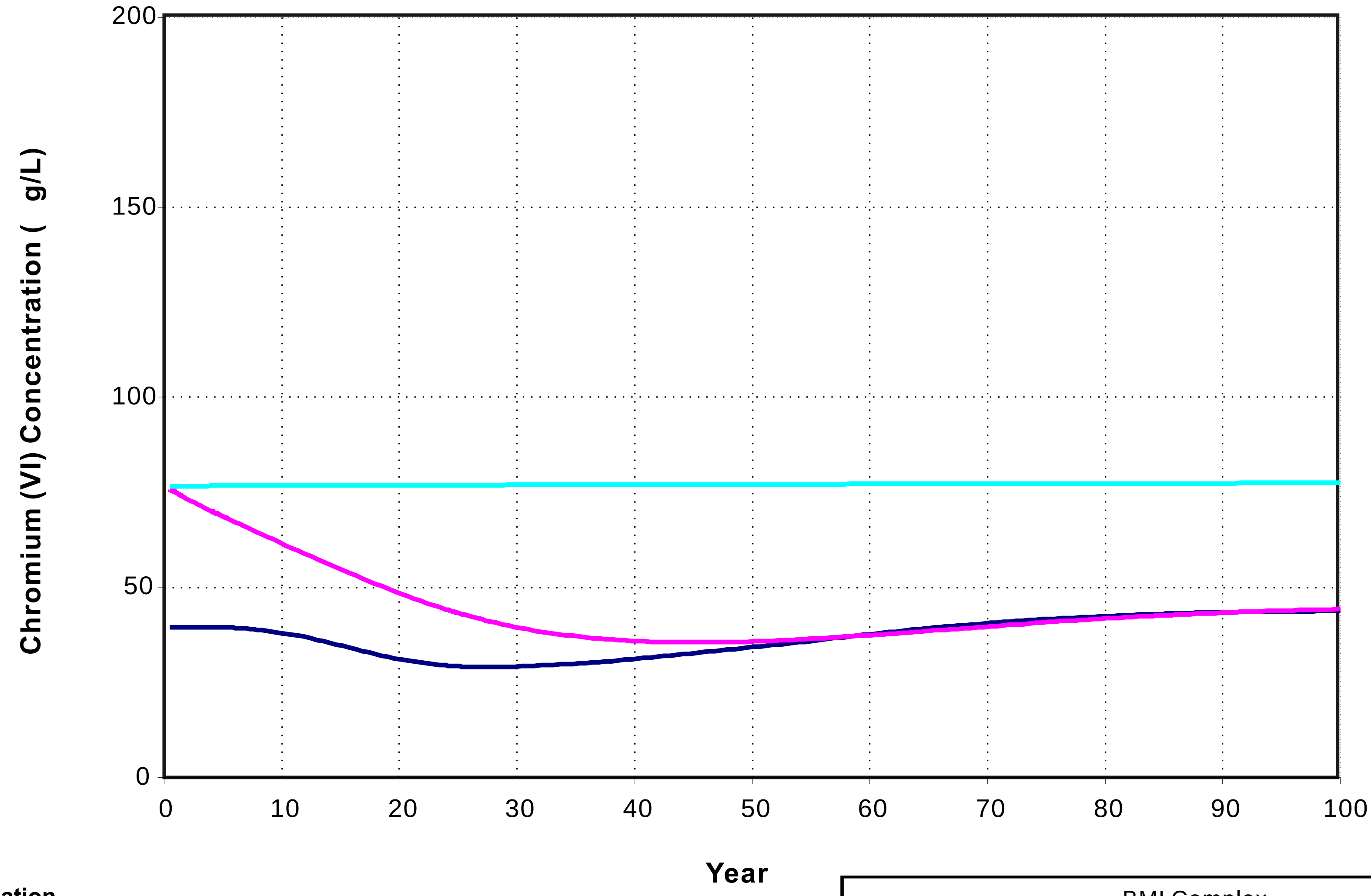
Prepared by: DBS&A GHS

Date 5/24/10

S:\Projects\BRC\ES10.0042_BRC_Transport_Model_Runs\VR_Drawings\Fig_18d_Simulated_Cr_VI_conc_0_Layer1_18D.cdr

Daniel B. Stephens & Associates, Inc.

JN ES10.0042



Explanation

- AA-20 (Layer 1)
- AA-20 (Layer 2)
- AA-20 (Layer 11)

BMI Complex
Henderson, Nevada

FIGURE 18e
SIMULATED CHROMIUM VI CONCENTRATION
FOR BOUNDARY CONCENTRATION
CONSTANT AT INITIAL VALUES
WELL AA-20 LOCATION

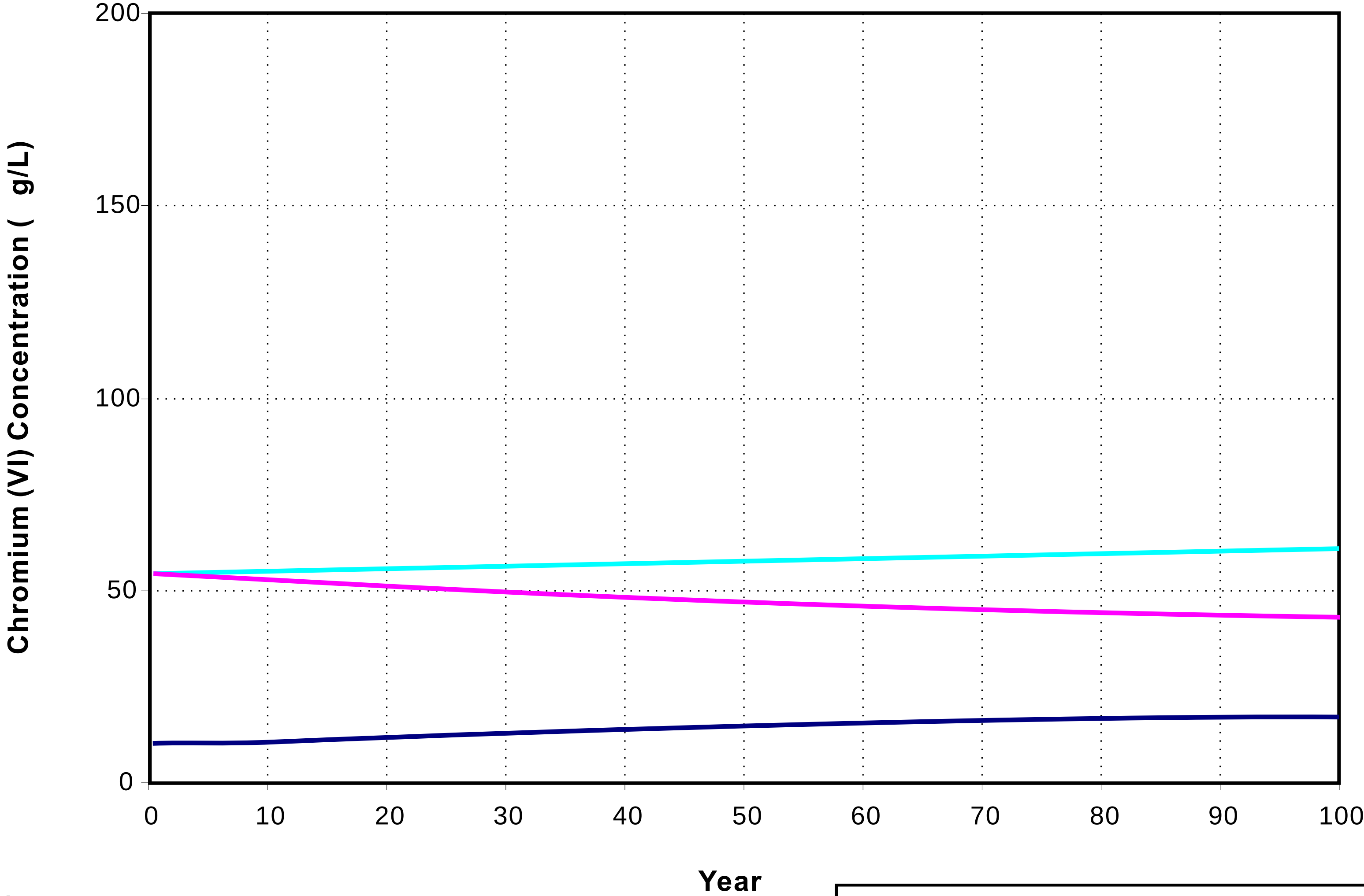
Basic Remediation COMPANY

Prepared by: DBS&A GHS

Date 5/24/10

S:\Projects\BRC\ES10.0042_BRC_Transport_Model_Runs\VR_Drawings\Fig_18d_Simulated_Cr_VI_conc_0_Layer1_18D.cdr

Daniel B. Stephens & Associates, Inc.
JN ES10.0042



Explanation

- AA-18 (Layer 1)
- AA-18 (Layer 2)
- AA-18 (Layer 11)

BMI Complex
Henderson, Nevada

FIGURE 18f
SIMULATED CHROMIUM VI CONCENTRATION
FOR BOUNDARY CONCENTRATION
CONSTANT AT INITIAL VALUES
WELL AA-18 LOCATION

Basic Remediation COMPANY

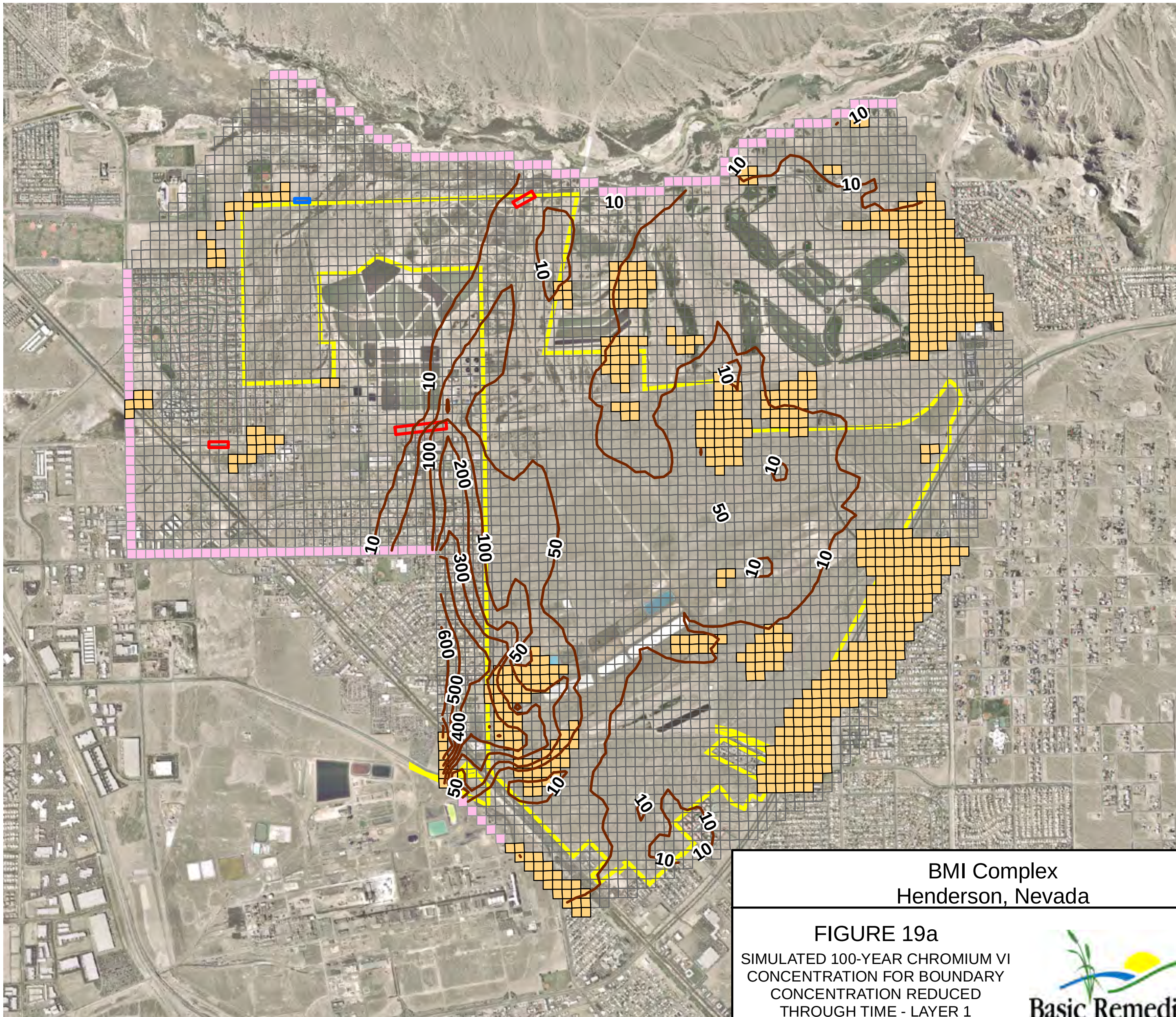
Prepared by: DBS&A GHS

Date 5/24/10

S:\Projects\BRC\ES10.0042_BRC_Transport_Model_Runs\VR_Drawings\Fig_18d_Simulated_Cr_VI_conc_0_Layer1_18D.cdr

Daniel B. Stephens & Associates, Inc.
JN ES10.0042

S:/PROJECTS/BRC/ES10.0042_BRC_TRANSPORT_MODEL_RUNS/GIS/MXDS/CHROMIUM_VI/FIGURE19A_11LAYER_RUN3_L1_BDRYDECREASE.MXD 017250



Source: Aerial photograph, April 2004

Explanation

- Simulated concentration (µg/L)
- Dry cell
- Boundary cell
- Extraction well field
- Injection well field
- Model grid
- Site boundary

N

0 1,750 3,500 Feet

BMI Complex
Henderson, Nevada

FIGURE 19a

SIMULATED 100-YEAR CHROMIUM VI CONCENTRATION FOR BOUNDARY CONCENTRATION REDUCED THROUGH TIME - LAYER 1

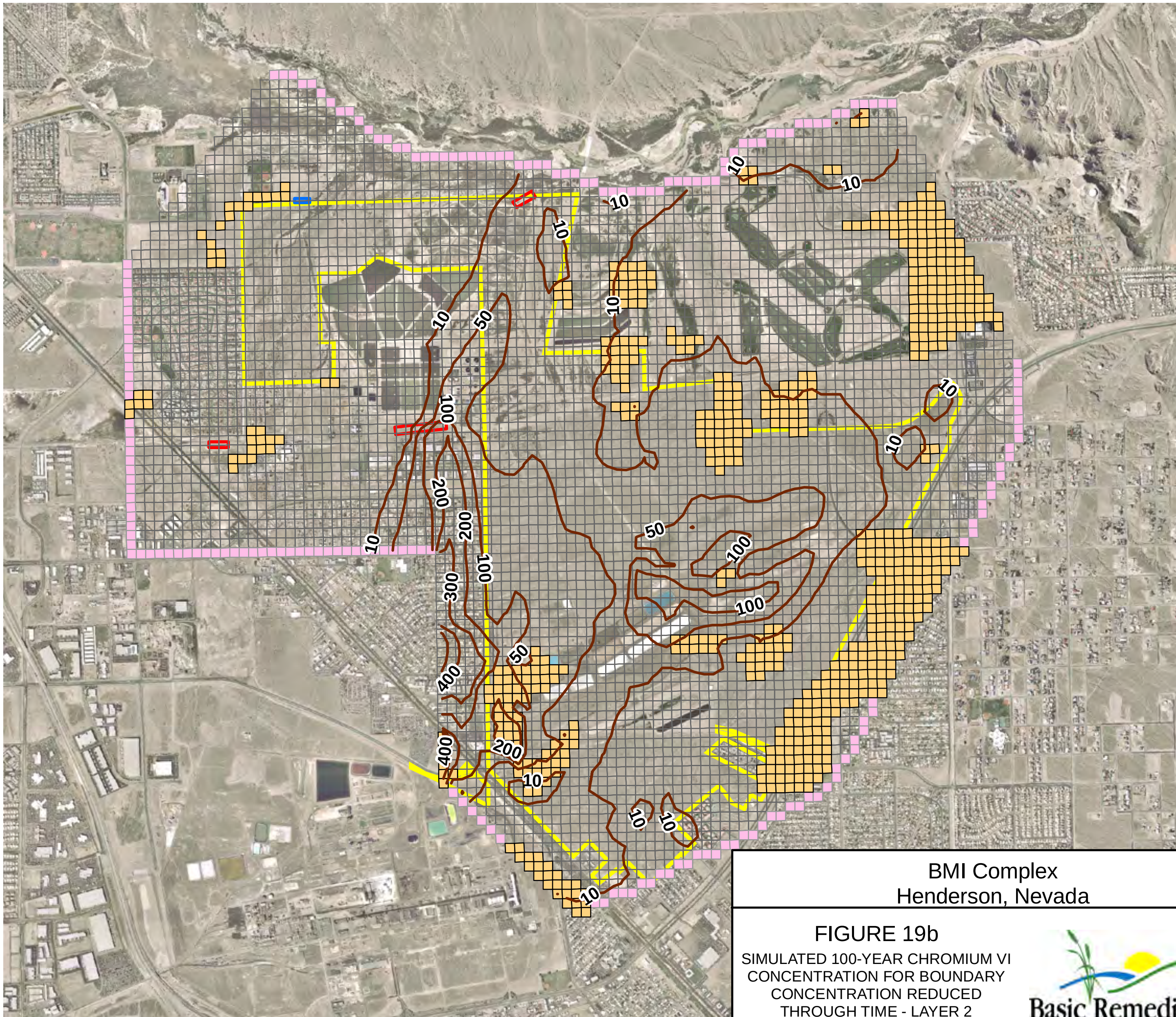
Basic Remediation COMPANY

Prepared by:	Date
DBS&A BGT	05-27-2010

Daniel B. Stephens & Associates, Inc.

JN ES10.0042

S:/PROJECTS/BRC/ES10.0042_BRC_TRANSPORT_MODEL_RUNS/GIS/MXDS/CHROMIUM_VI/FIGURE19B_11LAYER_RUN3_L2_BDRYDECREASE.MXD 017250



Source: Aerial photograph, April 2004

Explanation

- Simulated concentration (µg/L)
- Dry cell
- Boundary cell
- Extraction well field
- Injection well field
- Model grid
- Site boundary

N

0 1,750 3,500 Feet

BMI Complex
Henderson, Nevada

FIGURE 19b

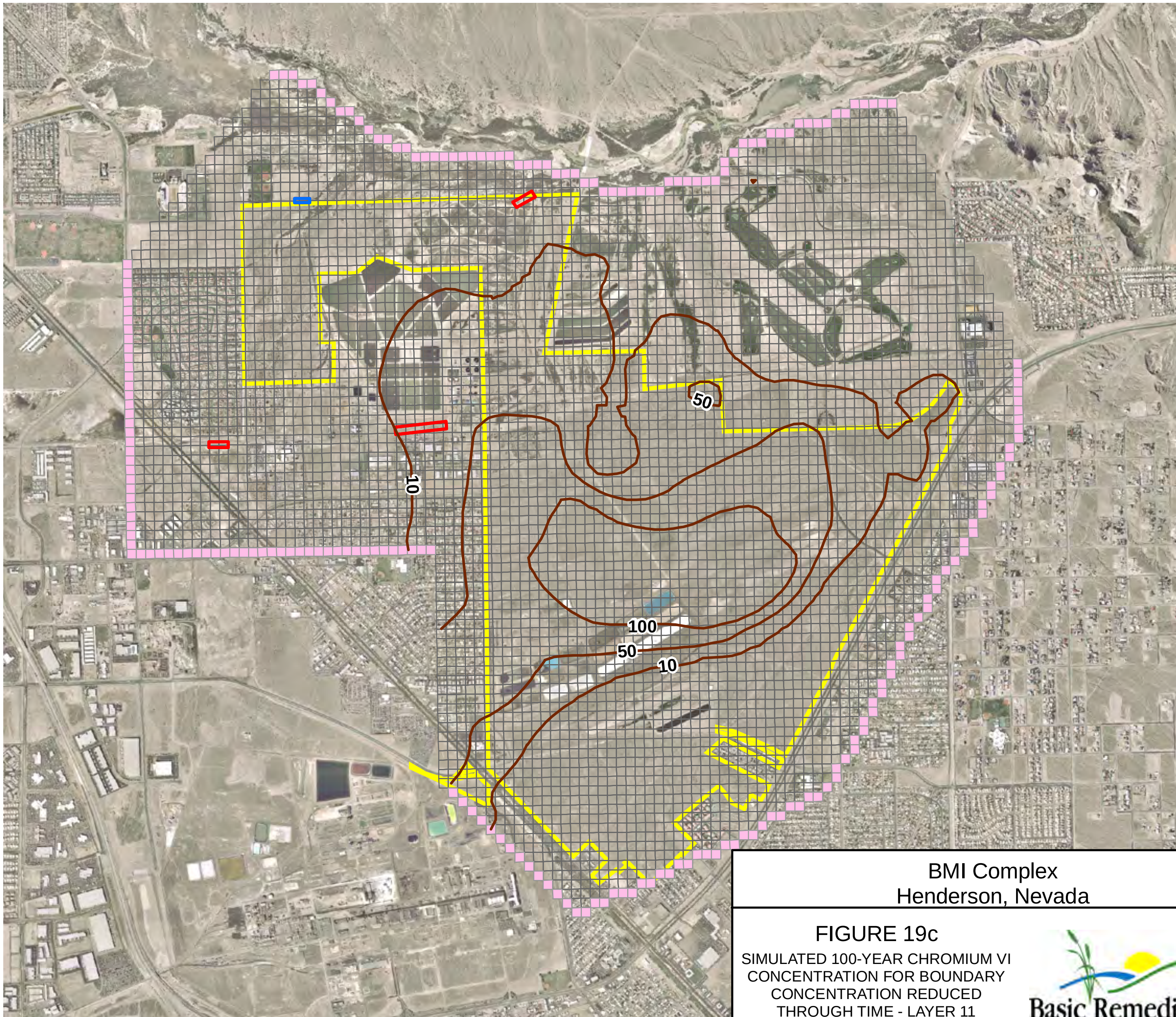
SIMULATED 100-YEAR CHROMIUM VI CONCENTRATION FOR BOUNDARY CONCENTRATION REDUCED THROUGH TIME - LAYER 2

Basic Remediation COMPANY

Prepared by:	Date
DBS&A BGT	05-27-2010

Daniel B. Stephens & Associates, Inc.
JN ES10.0042

S:/PROJECTS/BRC/ES10.0042_BRC_TRANSPORT_MODEL_RUNS/GIS/MXDS/CHROMIUM_VI/FIGURE19C_11LAYER_RUN3_L11_BDRYDECREASE.MXD 017250



Source: Aerial photograph, April 2004

Explanation

- Simulated concentration (µg/L)
- Boundary cell
- Extraction well field
- Injection well field
- Model grid
- Site boundary

N

0 1,750 3,500 Feet

BMI Complex
Henderson, Nevada

FIGURE 19c

SIMULATED 100-YEAR CHROMIUM VI CONCENTRATION FOR BOUNDARY CONCENTRATION REDUCED THROUGH TIME - LAYER 11

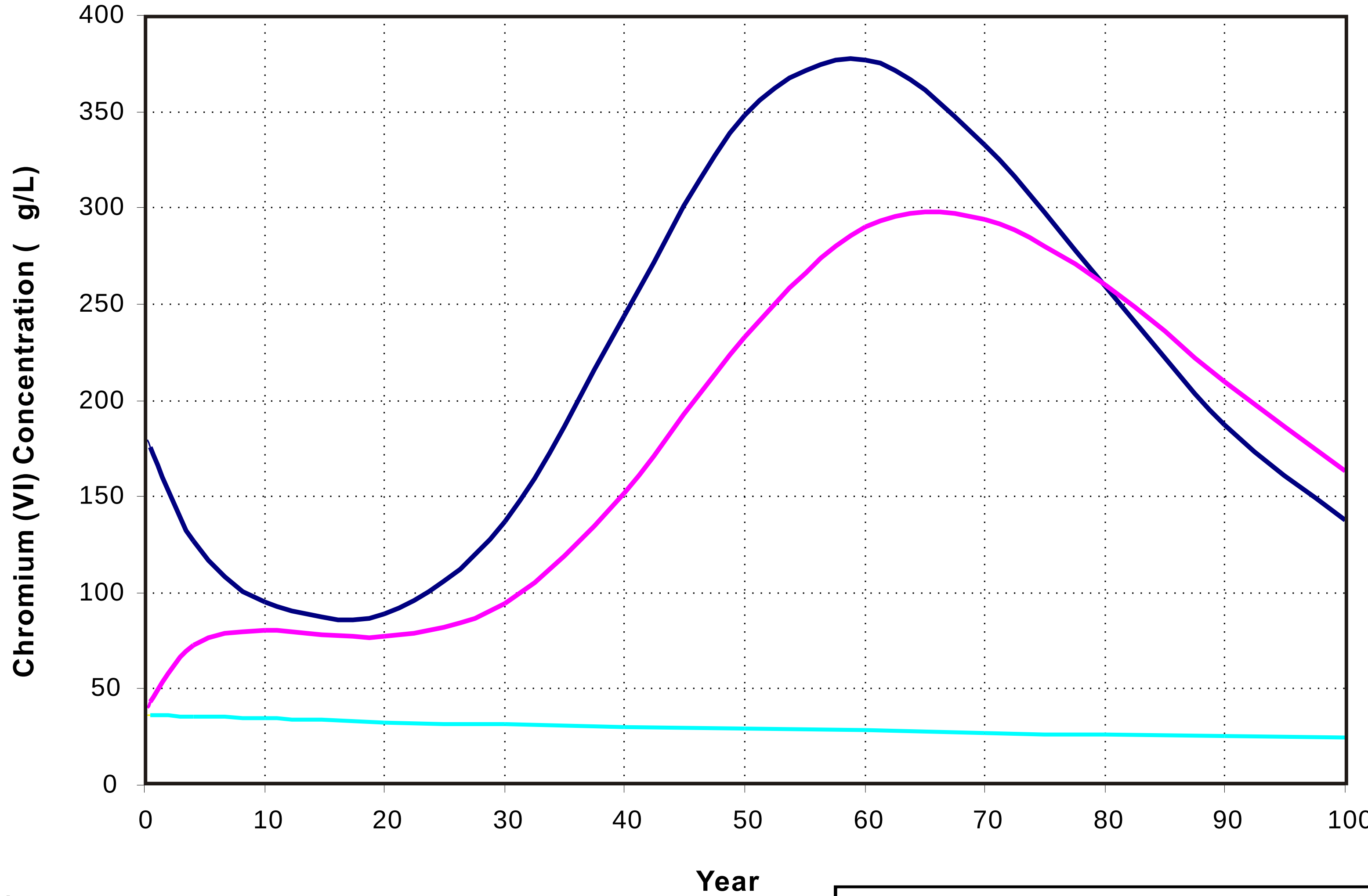
Basic Remediation Company

Prepared by: DBS&A BGT

Date 05-27-2010

Daniel B. Stephens & Associates, Inc.
JN ES10.0042

S:\Projects\BRC\ES10.0042_BRC_Transport_Model_Runs\VR_Drawings\Fig_19d_Simulated_Cr_VI_conc_0_Layer1_19D.cdr



Explanation

- PC12 (Layer 1)
- PC12 (Layer 2)
- PC12 (Layer 11)

Daniel B. Stephens & Associates, Inc.
JN ES10.0042

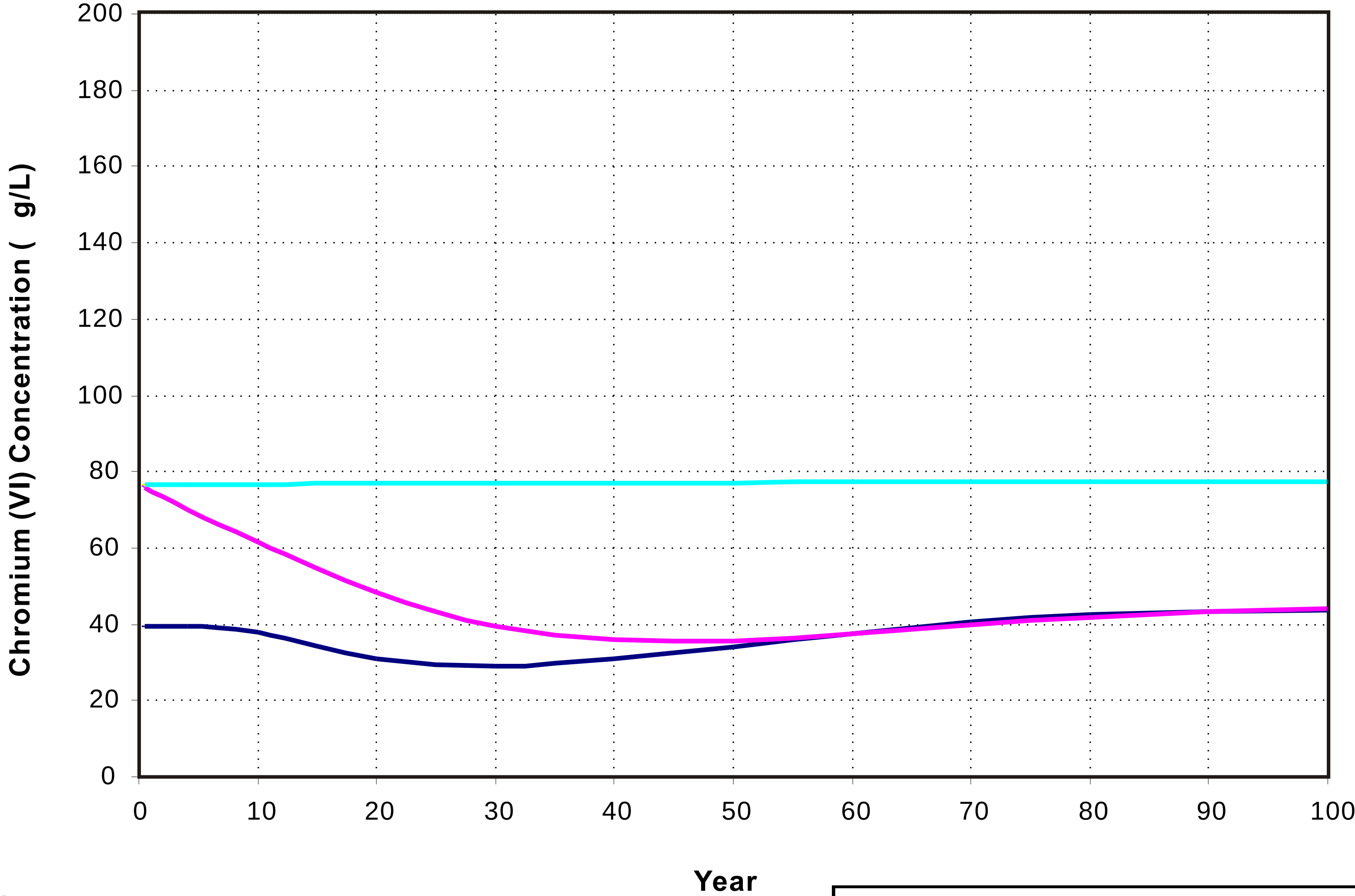
BMI Complex
Henderson, Nevada

FIGURE 19d
SIMULATED CHROMIUM VI CONCENTRATION
FOR BOUNDARY CONCENTRATION
REDUCED THROUGH TIME
WELL PC12 LOCATION

Basic Remediation
COMPANY

Prepared by: DBS&A GHS
Date 5/24/10
S:\Projects\BRC\ES10.0042_BRC_Transport_Model_Runs\VR_Drawings\Fig_19d_Simulated_Cr_VI_conc_0_Layer1_19D.cdr

S:\Projects\BRC\ES10.0042_BRC_Transport_Model_Runs\VR_Drawings\Fig_19d_Simulated_Cr_VI_conc_0_Layer1_19D.cdr



Explanation

- AA-20 (Layer 1)
- AA-20 (Layer 2)
- AA-20 (Layer 11)

BMI Complex
Henderson, Nevada

FIGURE 19e
SIMULATED CHROMIUM VI CONCENTRATION
FOR BOUNDARY CONCENTRATION
REDUCED THROUGH TIME
WELL AA-20 LOCATION

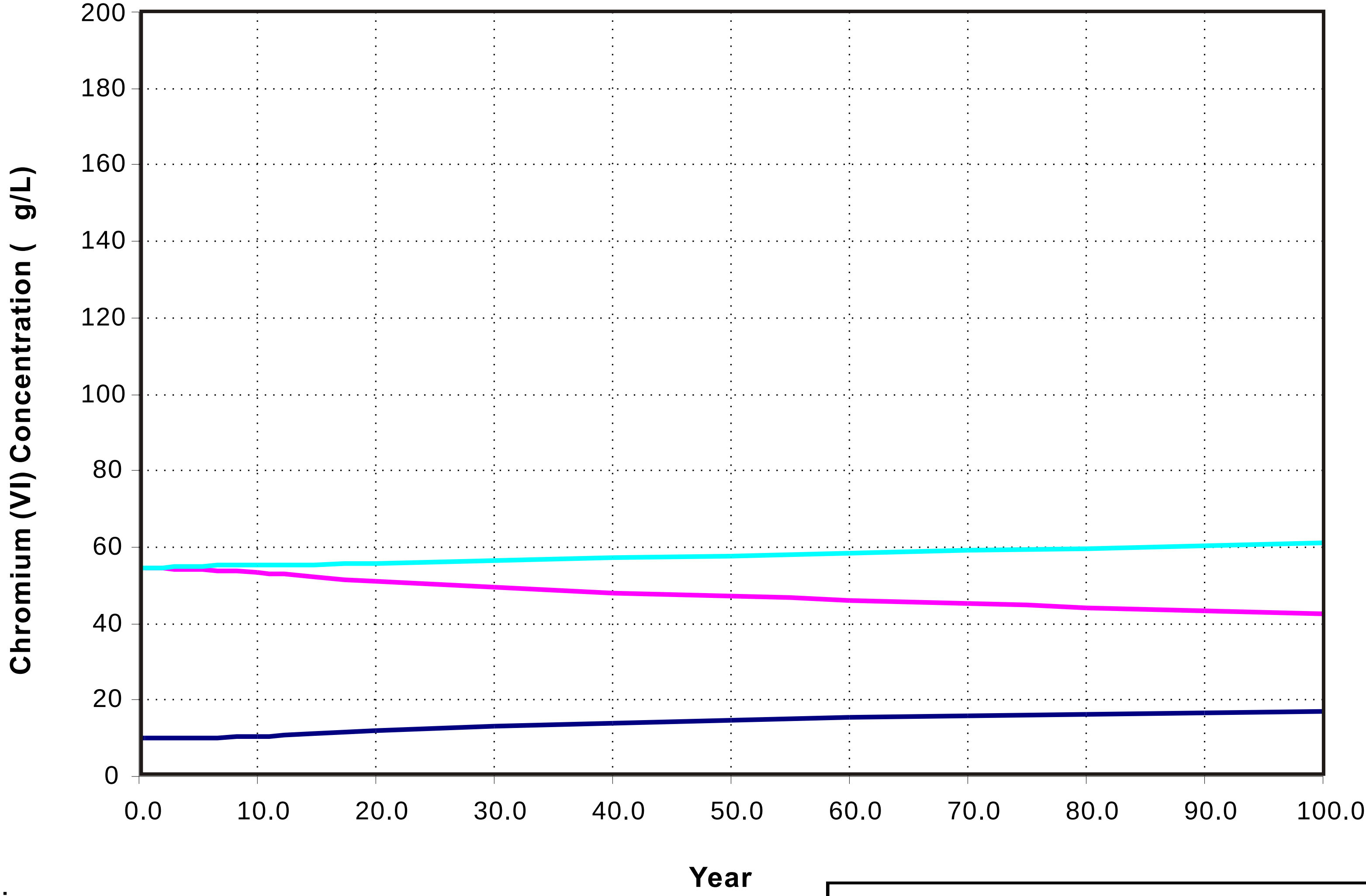
Basic Remediation COMPANY

Prepared by: DBS&A GHS

Date 5/24/10

S:\Projects\BRC\ES10.0042_BRC_Transport_Model_Runs\VR_Drawings\Fig_19d_Simulated_Cr_VI_conc_0_Layer1_19D.cdr

Daniel B. Stephens & Associates, Inc.
JN ES10.0042



Explanation

- AA-18 (Layer 1)
- AA-18 (Layer 2)
- AA-18 (Layer 11)

BMI Complex
Henderson, Nevada

FIGURE 19f
SIMULATED CHROMIUM VI CONCENTRATION
FOR BOUNDARY CONCENTRATION
REDUCED THROUGH TIME
WELL AA-18 LOCATION

Basic Remediation COMPANY

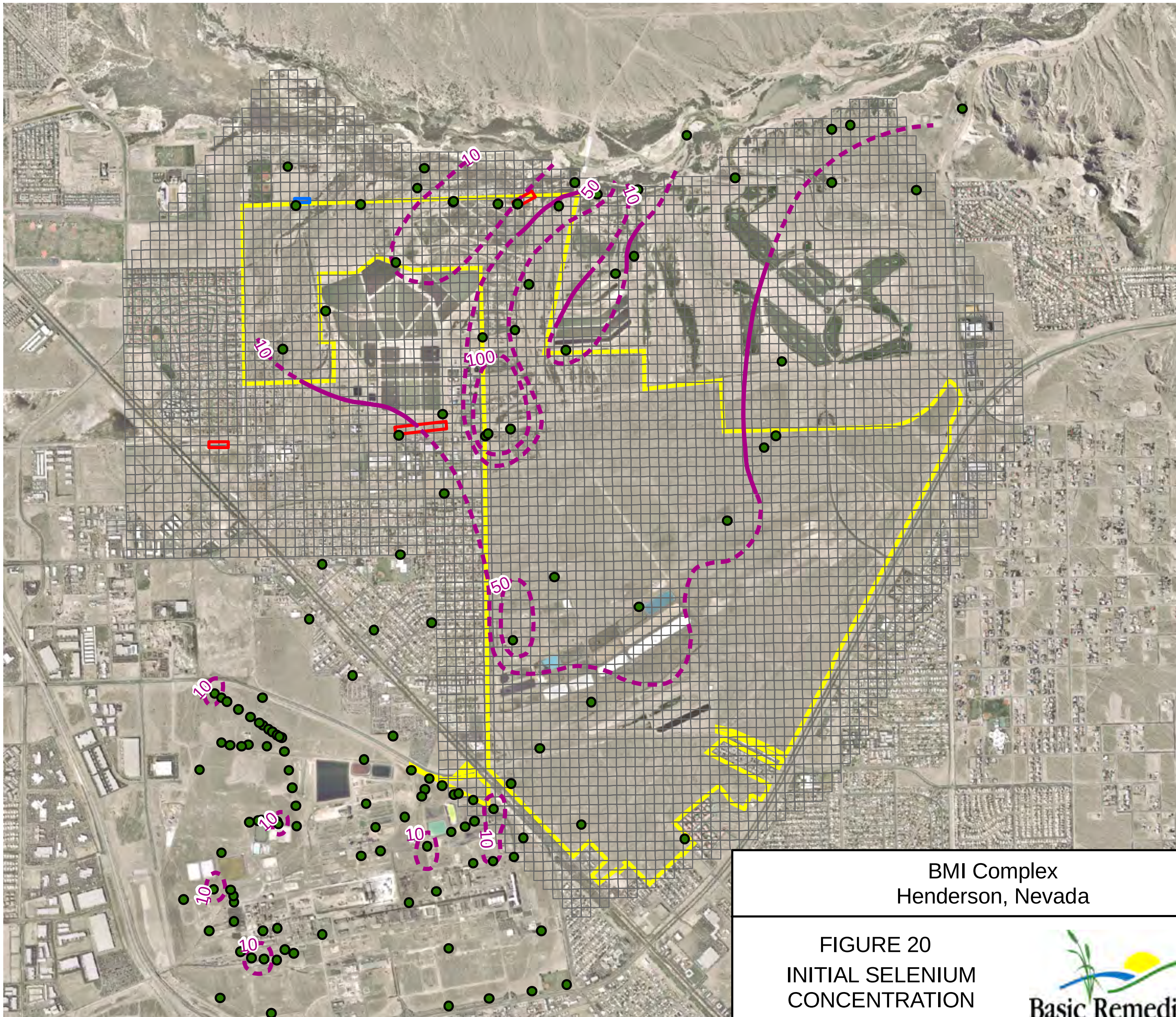
Prepared by: DBS&A GHS

Date 5/24/10

S:\Projects\BRC\ES10.0042_BRC_Transport_Model_Runs\VR_Drawings\Fig_19d_Simulated_Cr_VI_conc_0_Layer1_19D.cdr

Daniel B. Stephens & Associates, Inc.
JN ES10.0042

S:/PROJECTS/BRC/ES10.0042_BRC_TRANSPORT_MODEL_RUNS/GIS/MXDS/SELENIUM/FIGURE20_SELENIUM_INITC_LAYER1.MXD 016250



Source: Aerial photograph, April 2004

Explanation

- Monitor well
- Concentration contour (µg/L) (dashed where inferred) from DBS&A (2010a,b)
- Extraction well field
- Injection well field
- Model grid
- Site boundary

N

0 1,750 3,500 Feet

BMI Complex
Henderson, Nevada

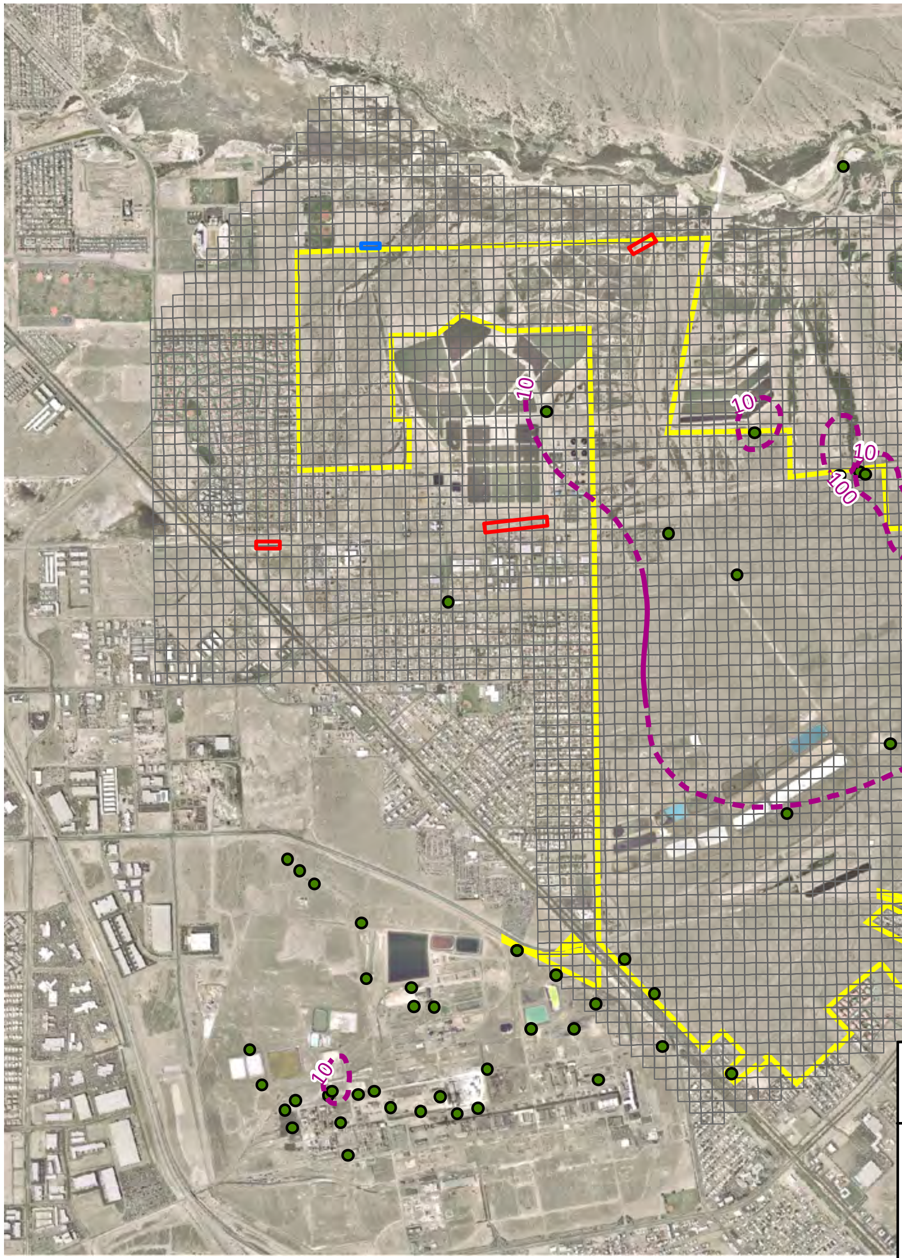
FIGURE 20
INITIAL SELENIUM CONCENTRATION
LAYER 1

Basic Remediation COMPANY

Prepared by:	Date
DBS&A BGT	05-27-2010

Daniel B. Stephens & Associates, Inc.
JN ES10.0042

S:/PROJECTS/BRC/ES10.0042_BRC_TRANSPORT_MODEL_RUNS/GIS/MXDS/SELENIUM/FIGURE21_SELENIUM_INITC_LAYER2.MXD 016250



Source: Aerial photograph, April 2004

Explanation

- Monitor well
- Concentration contour (µg/L) (dashed where inferred) from DBS&A (2010a,b)
- Extraction well field
- Injection well field
- Model grid
- Site boundary

N

0 1,750 3,500 Feet

BMI Complex
Henderson, Nevada

FIGURE 21
INITIAL SELENIUM CONCENTRATION
LAYERS 2 THOUGH 11

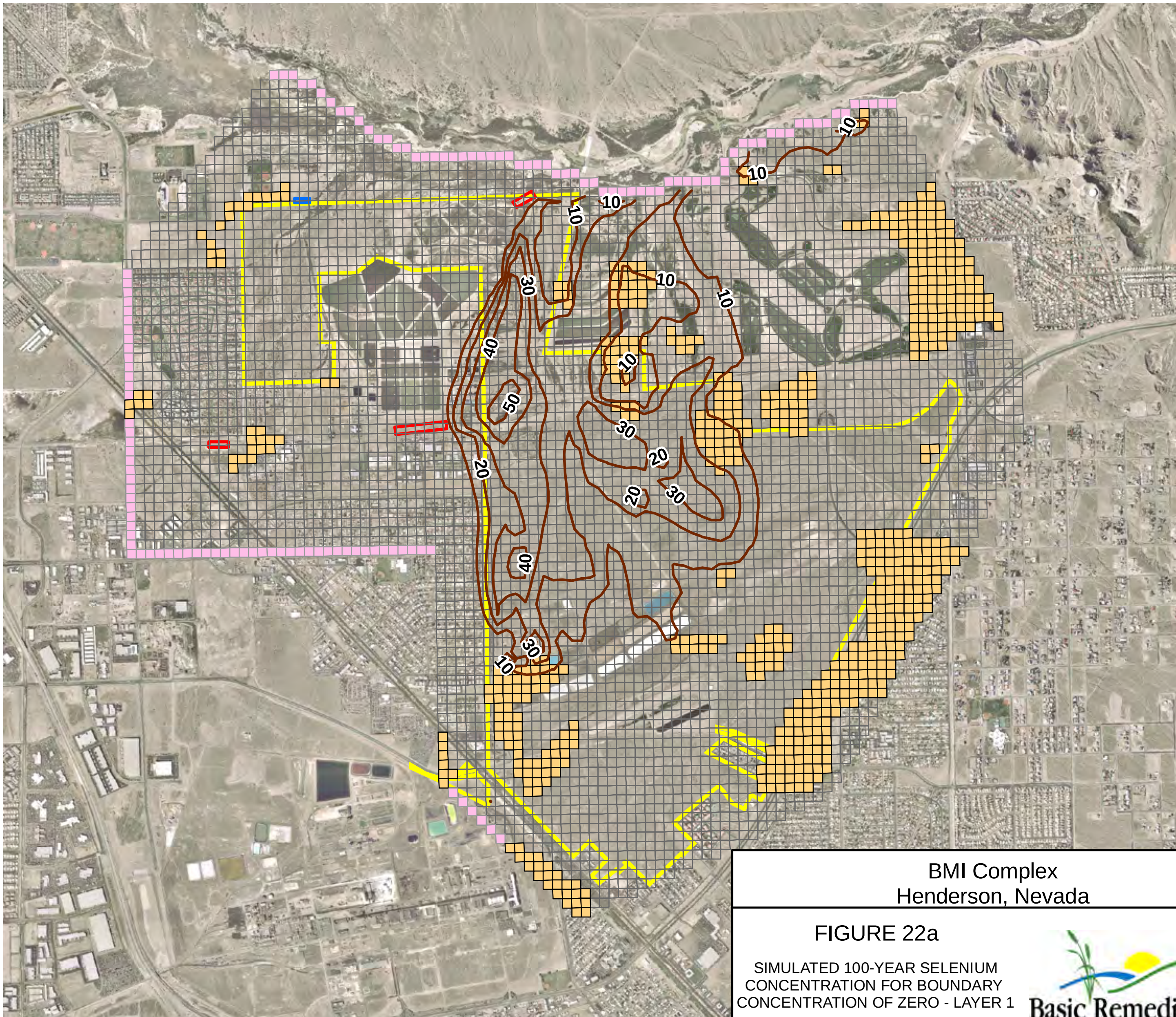
Basic Remediation COMPANY

Prepared by: DBS&A BGT

Date 05-27-2010

Daniel B. Stephens & Associates, Inc.
JN ES10.0042

S:/PROJECTS/BRC/ES10.0042_BRC_TRANSPORT_MODEL_RUNS/GIS/MXDS/SELENIUM/FIGURE22A_SELENIUM_L1_NOBDRY.MXD 017250



Source: Aerial photograph, April 2004

Explanation

- Simulated concentration (µg/L)
- Dry cell
- Boundary cell
- Extraction well field
- Injection well field
- Model grid
- Site boundary

N

0 1,750 3,500 Feet

BMI Complex
Henderson, Nevada

FIGURE 22a

SIMULATED 100-YEAR SELENIUM CONCENTRATION FOR BOUNDARY CONCENTRATION OF ZERO - LAYER 1

Basic Remediation COMPANY

Prepared by: DBS&A BGT

Date 05-27-2010

Daniel B. Stephens & Associates, Inc.

JN ES10.0042

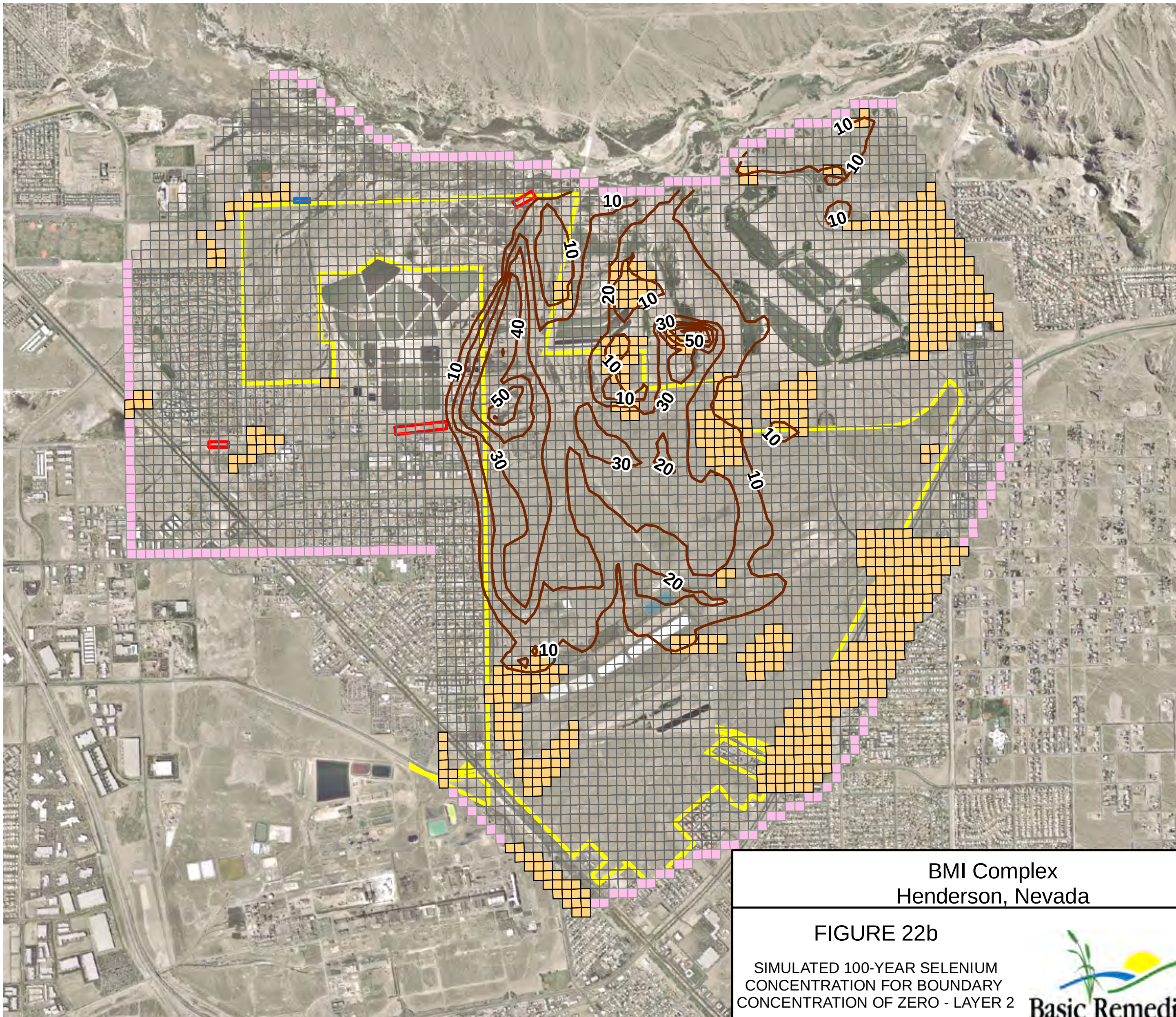
S:/PROJECTS/BRC/ES10.0042_BRC_TRANSPORT_MODEL_RUNS/GIS/MXDS/SELENIUM/FIGURE22B_SELENIUM_L2_NOBDRY.MXD 017250

Explanation

- Simulated concentration (µg/L)
- Dry cell
- Boundary cell
- Extraction well field
- Injection well field
- Model grid
- Site boundary

N

0 1,750 3,500 Feet



Source: Aerial photograph, April 2004

BMI Complex
Henderson, Nevada

FIGURE 22b

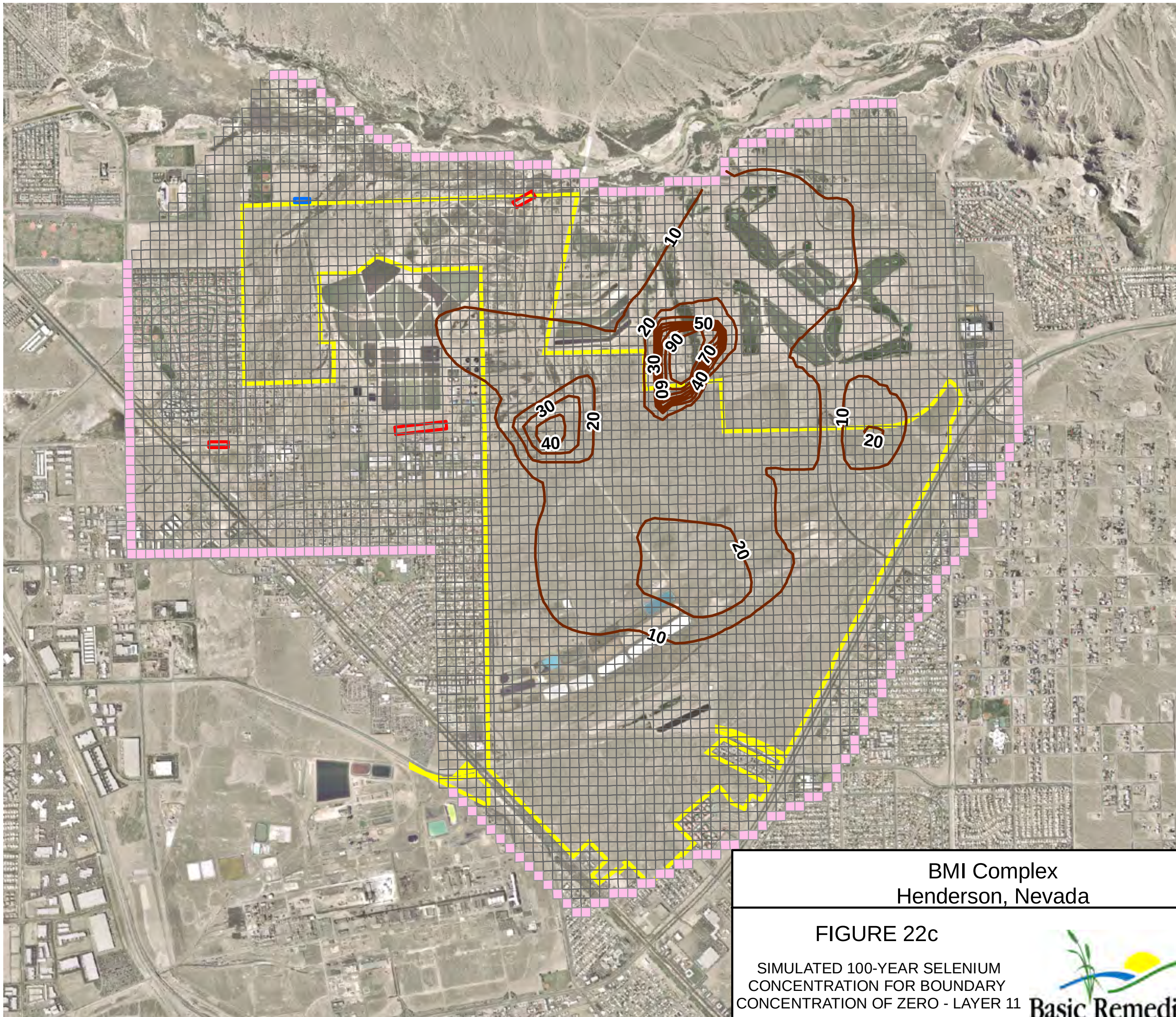
SIMULATED 100-YEAR SELENIUM CONCENTRATION FOR BOUNDARY CONCENTRATION OF ZERO - LAYER 2

Basic Remediation COMPANY

Prepared by:	Date
DBS&A BGT	05-27-2010

Daniel B. Stephens & Associates, Inc.
JN ES10.0042

S:/PROJECTS/BRC/ES10.0042_BRC_TRANSPORT_MODEL_RUNS/GIS/MXDS/SELENIUM/FIGURE22C_SELENIUM_L11_NOBDRY.MXD 017250



Source: Aerial photograph, April 2004

Explanation

- Simulated concentration (µg/L)
- Boundary cell
- Extraction well field
- Injection well field
- Model grid
- Site boundary

N

0 1,750 3,500 Feet

BMI Complex
Henderson, Nevada

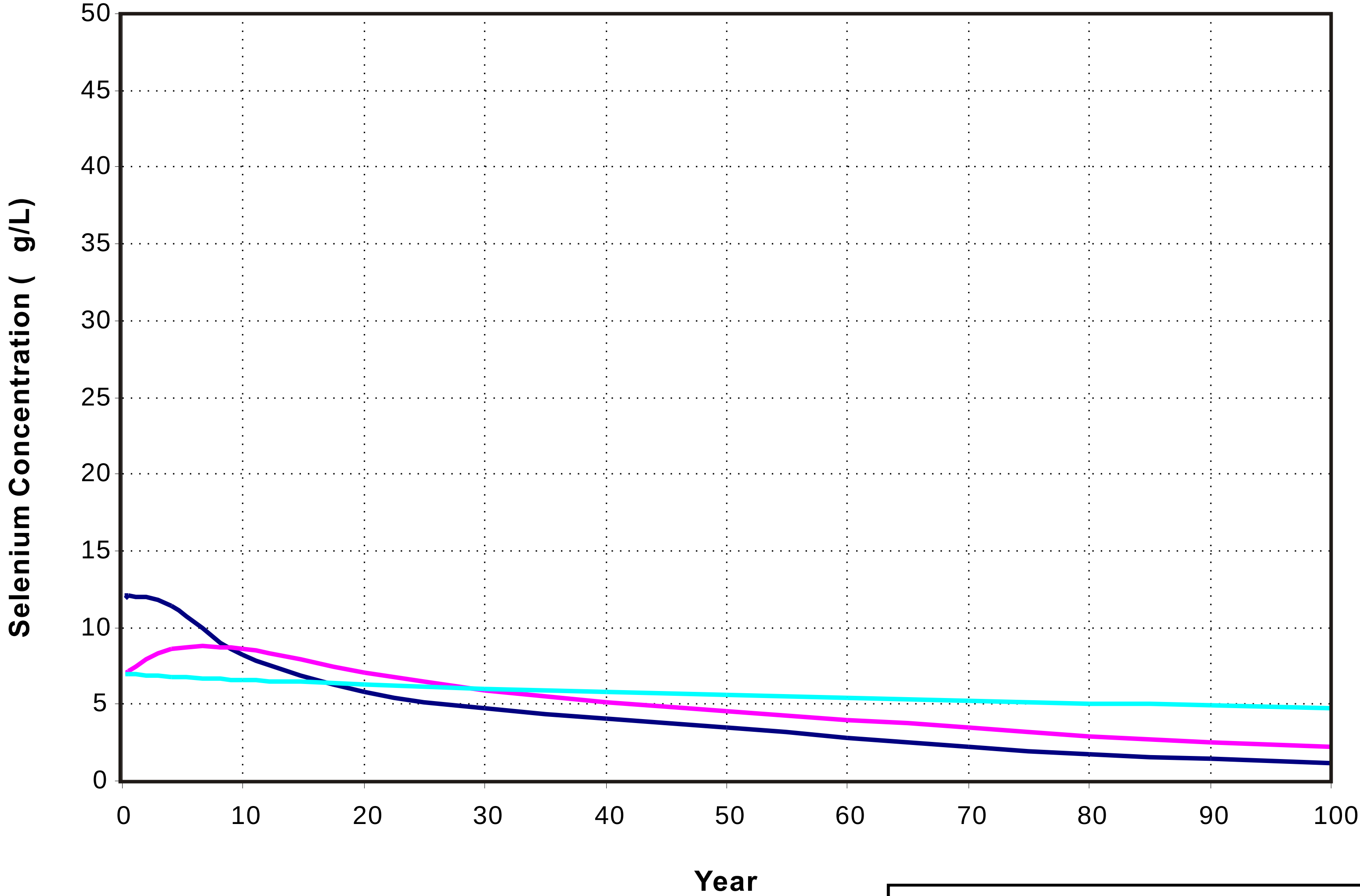
FIGURE 22c

SIMULATED 100-YEAR SELENIUM CONCENTRATION FOR BOUNDARY CONCENTRATION OF ZERO - LAYER 11

Basic Remediation COMPANY

Prepared by:	Date
DBS&A BGT	05-27-2010

Daniel B. Stephens & Associates, Inc.
JN ES10.0042



Explanation

- PC12 (Layer 1)
- PC12 (Layer 2)
- PC12 (Layer 11)

BMI Complex
Henderson, Nevada

FIGURE 22d
SIMULATED SELENIUM CONCENTRATION FOR BOUNDARY CONCENTRATION OF ZERO AT WELL PC12 LOCATION

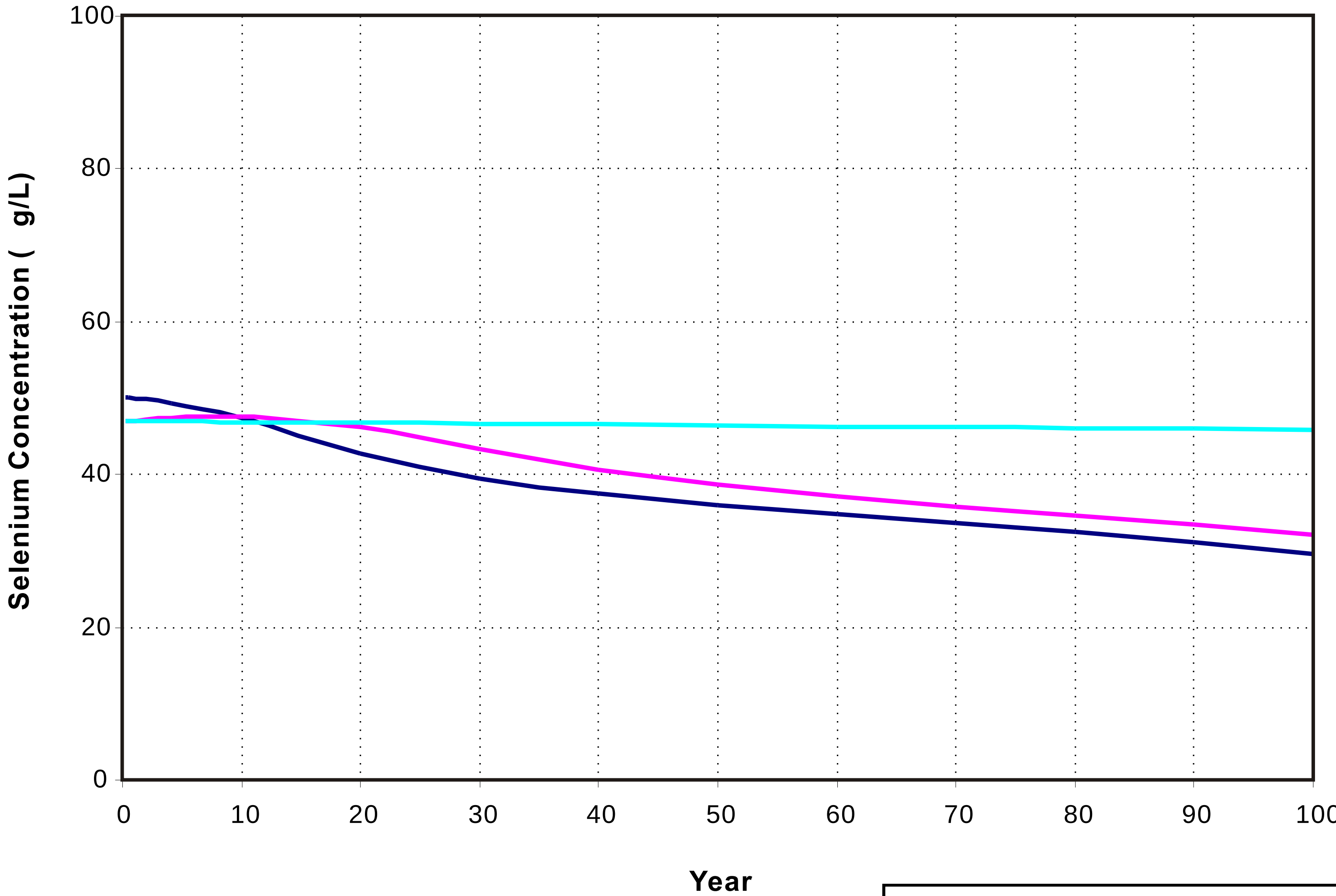
Basic Remediation COMPANY

Prepared by: DBS&A GHS

Date 5/26/10

S:\Projects\BRC\ES10.0042_BRC_Transport_Model_Runs\VR_Drawings\Fig_22d_Simulated_Se_conc_0_Layer1_22D.cdr

Daniel B. Stephens & Associates, Inc.
JN ES10.0042



Explanation

—	AA-20 (Layer 1)
—	AA-20 (Layer 2)
—	AA-20 (Layer 11)

BMI Complex
Henderson, Nevada

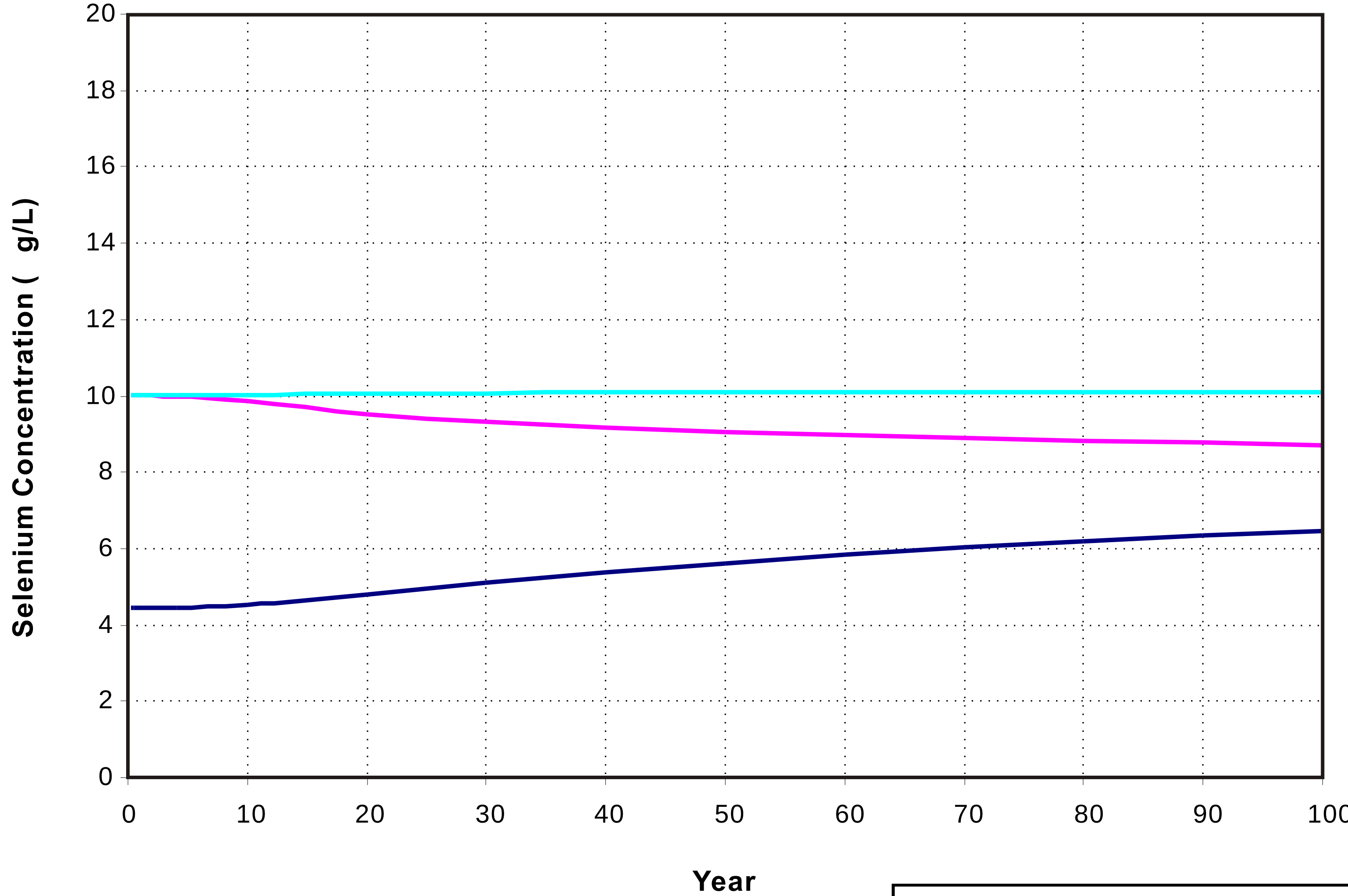
FIGURE 22e
SIMULATED SELENIUM CONCENTRATION FOR BOUNDARY CONCENTRATION OF ZERO AT WELL AA-20 LOCATION

Basic Remediation COMPANY

Prepared by: DBS&A GHS | Date 5/26/10 | S:\Projects\BRC\ES10.0042_BRC_Transport_Model_Runs\VR_Drawings\Fig_22d_Simulated_Se_conc_0_Layer1_22D.cdr

Daniel B. Stephens & Associates, Inc.
JN ES10.0042

S:\Projects\BRC\ES10.0042_BRC_Transport_Model_Runs\VR_Drawings\Fig_22d_Simulated_Se_conc_0_Layer1_22D.cdr



Explanation

AA-18 (Layer 1)

AA-18 (Layer 2)

AA-18 (Layer 11)

BMI Complex
Henderson, Nevada

FIGURE 22f
SIMULATED SELENIUM CONCENTRATION FOR BOUNDARY CONCENTRATION OF ZERO AT WELL AA-18 LOCATION

Basic Remediation COMPANY

Prepared by: DBS&A GHS

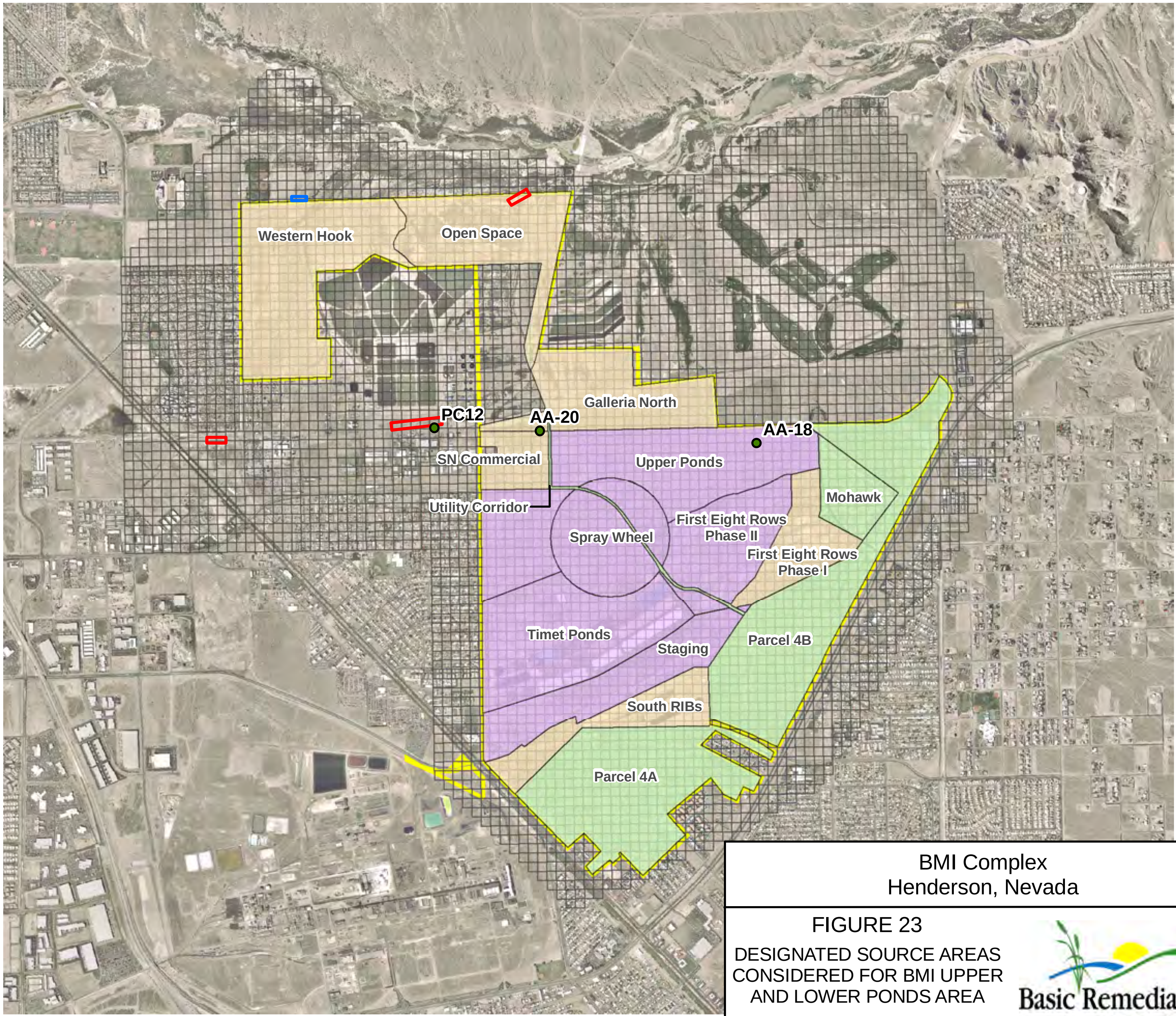
Date 5/26/10

S:\Projects\BRC\ES10.0042_BRC_Transport_Model_Runs\VR_Drawings\Fig_22d_Simulated_Se_conc_0_Layer1_22D.cdr

Daniel B. Stephens & Associates, Inc.

JN ES10.0042

S:/PROJECTS/BRC/ES10.0042_BRC_TRANSPORT_MODEL_RUNS/GIS/MXDS/FIGURE23_DESIGNATED_SOURCE_AREAS_FOR_BMI_UPPER_AND_LOWER_PONDS_AREA.MXD 016250



Source: Aerial photograph, April 2004

Explanation

- Monitor well

Data status

- Data complete
- Data incomplete
- Data pending
- Extraction well field
- Injection well field
- Model grid
- Site boundary

N

0 1,750 3,500 Feet

BMI Complex
Henderson, Nevada

FIGURE 23

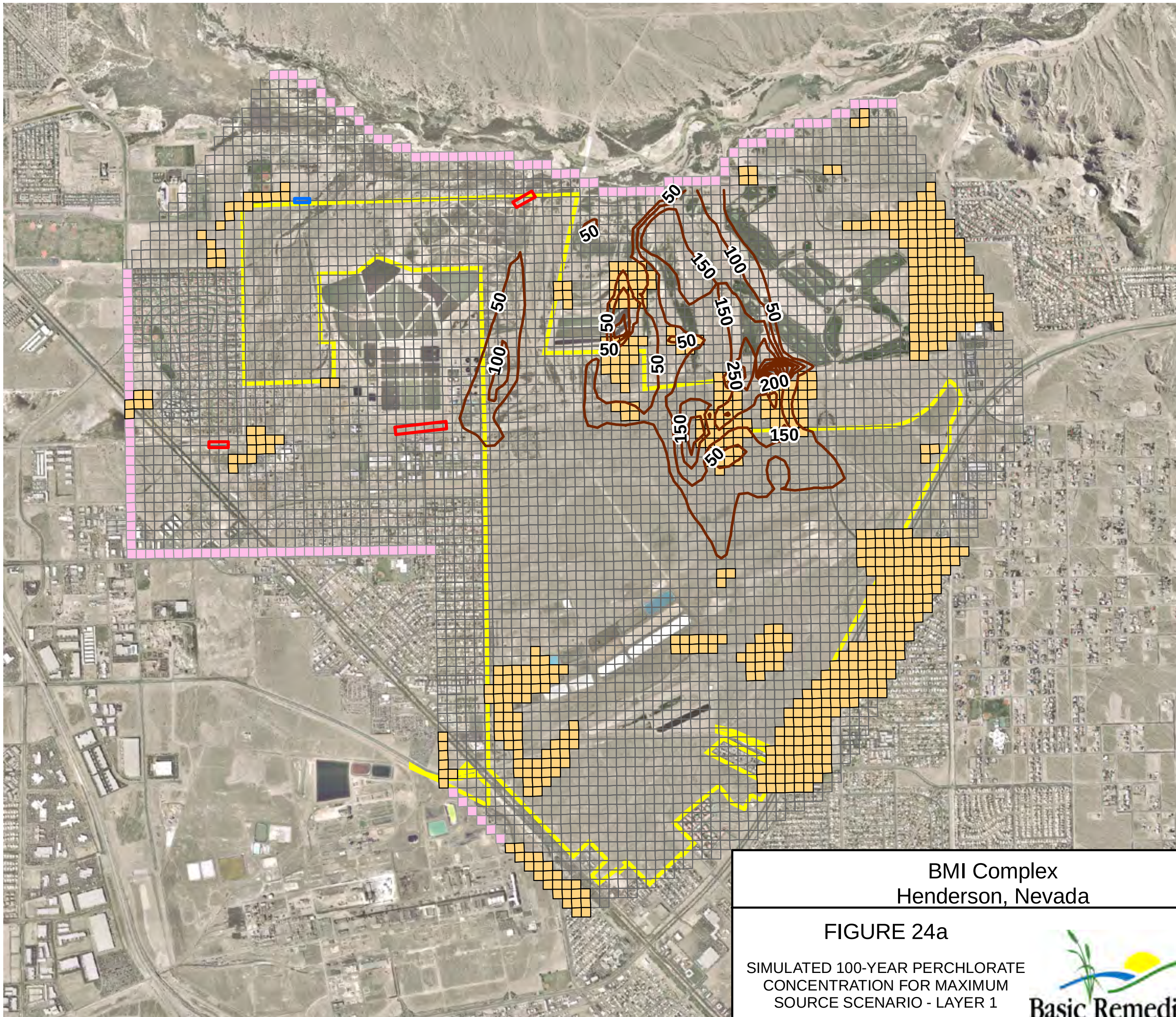
DESIGNATED SOURCE AREAS CONSIDERED FOR BMI UPPER AND LOWER PONDS AREA

Basic Remediation COMPANY

Prepared by:	Date
DBS&A BGT	05-26-2010

Daniel B. Stephens & Associates, Inc.

S:/PROJECTS/BRC/ES10.0042_BRC_TRANSPORT_MODEL_RUNS/GIS/MXDS/SOURCE_AREA/FIGURE24A_11LAYER_L1_PERCHLORATE.MXD 017250



Source: *Aerial photograph, April 2004*

Explanation

- Simulated concentration (μg/L)
- Dry cell
- Boundary cell
- Extraction well field
- Injection well field
- Model grid
- Site boundary

N

0 1,750 3,500 Feet

BMI Complex
Henderson, Nevada

FIGURE 24a

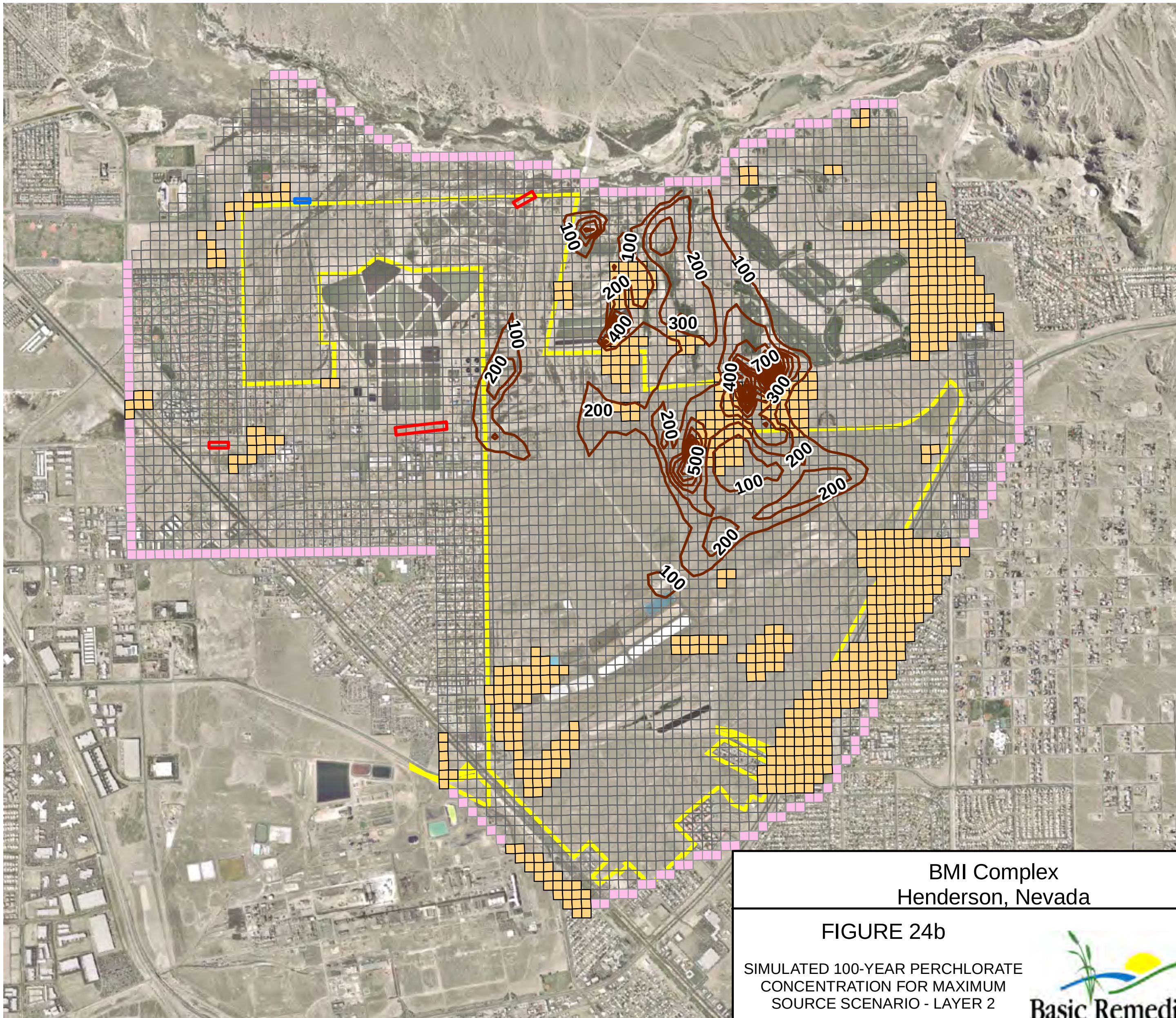
SIMULATED 100-YEAR PERCHLORATE CONCENTRATION FOR MAXIMUM SOURCE SCENARIO - LAYER 1

Basic Remediation COMPANY

Prepared by:	Date
DBS&A BGT	05-27-2010

Daniel B. Stephens & Associates, Inc.
JN ES10.0042

S:/PROJECTS/BRC/ES10.0042_BRC_TRANSPORT_MODEL_RUNS/GIS/MXDS/SOURCE_AREA/FIGURE24B_11LAYER_L2_PERCHLORATE.MXD 017250



Source: Aerial photograph, April 2004

Explanation

- Simulated concentration (µg/L)
- Dry cell
- Boundary cell
- Extraction well field
- Injection well field
- Model grid
- Site boundary

N

0 1,750 3,500 Feet

BMI Complex
Henderson, Nevada

FIGURE 24b

SIMULATED 100-YEAR PERCHLORATE CONCENTRATION FOR MAXIMUM SOURCE SCENARIO - LAYER 2

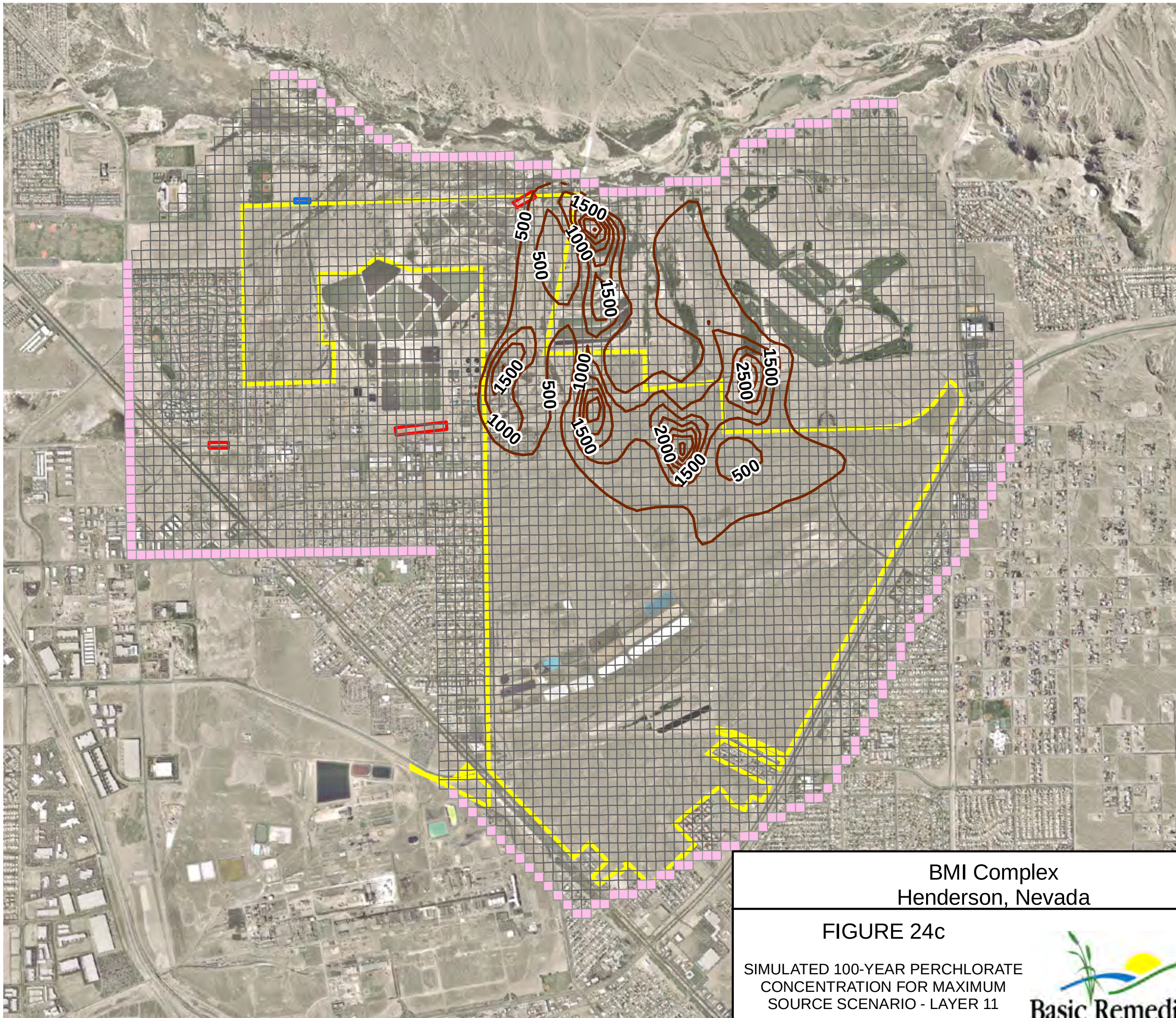
Basic Remediation COMPANY

Prepared by: DBS&A BGT

Date 05-27-2010

Daniel B. Stephens & Associates, Inc.
JN ES10.0042

S:/PROJECTS/BRC/ES10.0042_BRC_TRANSPORT_MODEL_RUNS/GIS/MXDS/SOURCE_AREA/FIGURE24C_11LAYER_L11_PERCHLORATE.MXD 017250



Source: Aerial photograph, April 2004

Explanation

- Simulated concentration (µg/L)
- Boundary cell
- Extraction well field
- Injection well field
- Model grid
- Site boundary

N

0 1,750 3,500 Feet

BMI Complex
Henderson, Nevada

FIGURE 24c

SIMULATED 100-YEAR PERCHLORATE CONCENTRATION FOR MAXIMUM SOURCE SCENARIO - LAYER 11

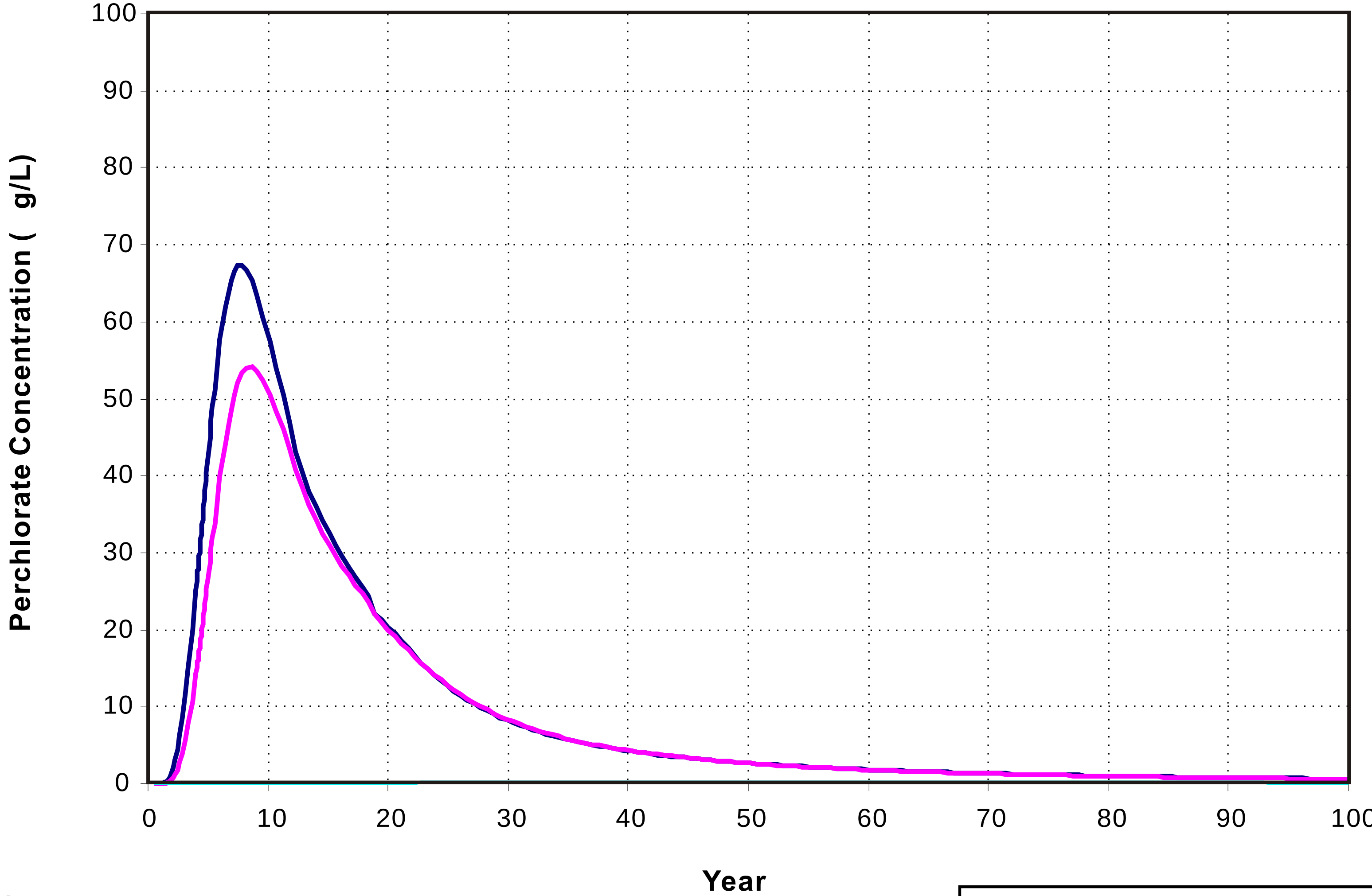
Basic Remediation COMPANY

Prepared by: DBS&A BGT

Date 05-27-2010

Daniel B. Stephens & Associates, Inc.
JN ES10.0042

S:\Projects\BRC\ES10.0042_BRC_Transport_Model_Runs\VR_Drawings\Fig_24d_Simulated_sourceareas_conc_0_Layer1_24D.cdr



Explanation

- PC12 (Layer 1)
- PC12 (Layer 2)
- PC12 (Layer 11)

BMI Complex
Henderson, Nevada

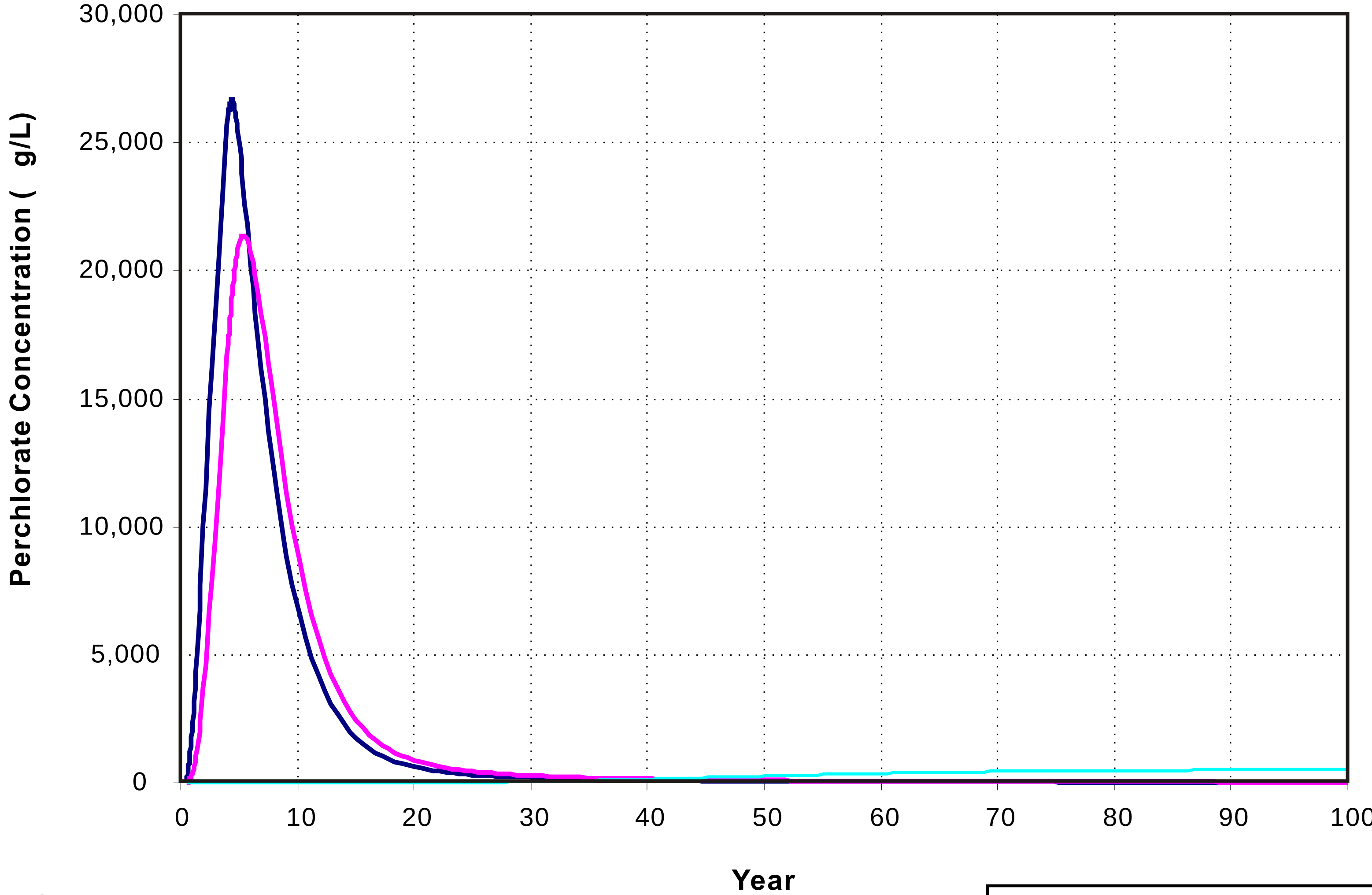
FIGURE 24d
SIMULATED PERCHLORATE CONCENTRATION FOR MAXIMUM SOURCE SCENARIO
WELL PC12 LOCATION

Basic Remediation COMPANY

Prepared by:		Date
DBS&A	GHS	5/26/10

S:\Projects\BRC\ES10.0042_BRC_Transport_Model_Runs\VR_Drawings\Fig_24d_Simulated_sourceareas_conc_0_Layer1_24D.cdr

Daniel B. Stephens & Associates, Inc.
JN ES10.0042



Explanation

- AA-20 (Layer 1)
- AA-20 (Layer 2)
- AA-20 (Layer 11)

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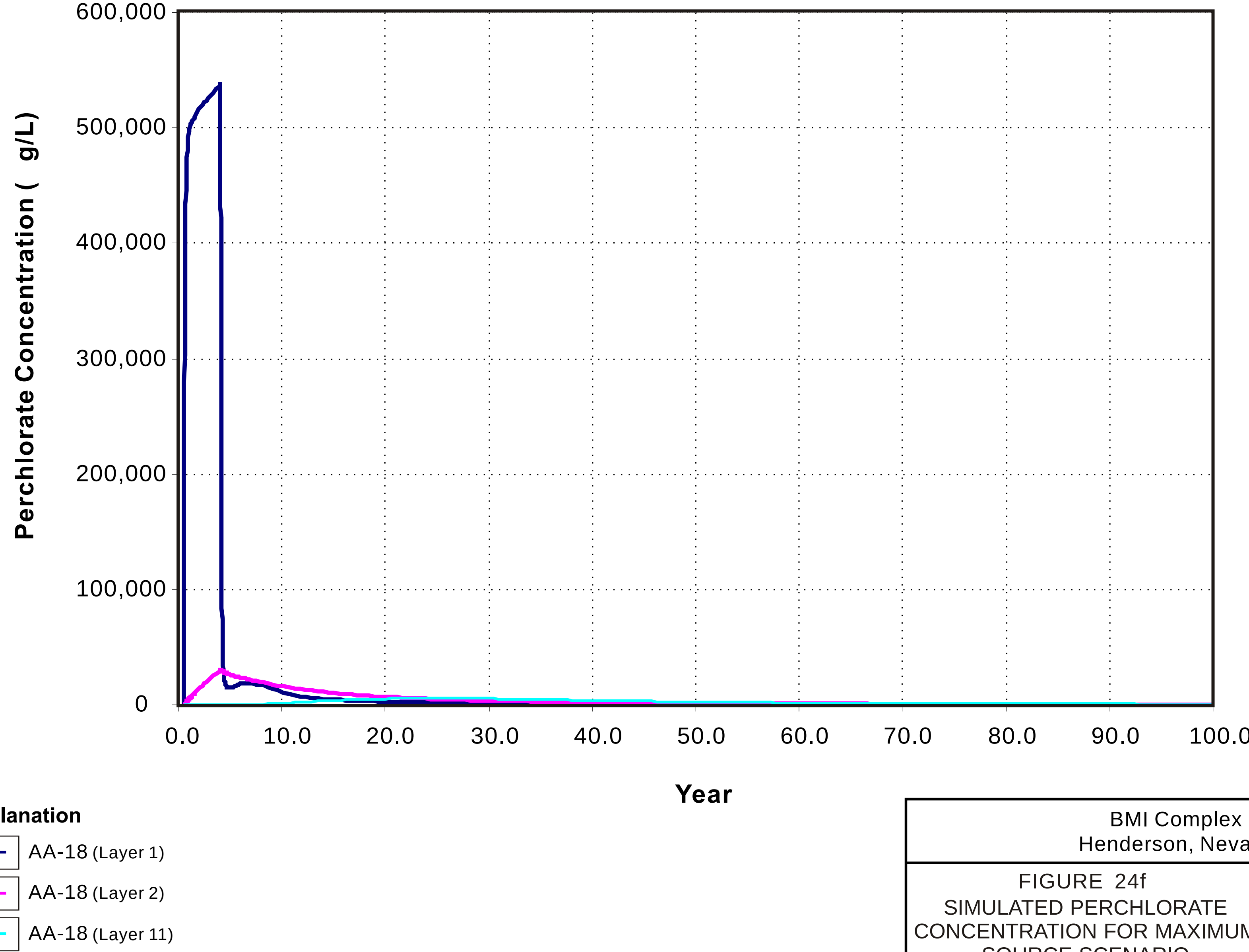
JN ES10.0042

BMI Complex
Henderson, Nevada

FIGURE 24e
SIMULATED PERCHLORATE CONCENTRATION FOR MAXIMUM SOURCE SCENARIO WELL AA-20 LOCATION

Basic Remediation COMPANY

Prepared by:		Date	
DBS&A	GHS	5/26/10	S:\Projects\BRC\ES10.0042_BRC_Transport_Model_Runs\VR_Drawings\Fig_24d_Simulated_sourceareas_conc_0_Layer1_24D.cdr



BMI Complex
Henderson, Nevada

FIGURE 24f
SIMULATED PERCHLORATE CONCENTRATION FOR MAXIMUM SOURCE SCENARIO WELL AA-18 LOCATION

Basic Remediation COMPANY

Prepared by: DBS&A GHS

Date 5/26/10

S:\Projects\BRC\ES10.0042_BRC_Transport_Model_Runs\VR_Drawings\Fig_24d_Simulated_sourceareas_conc_0_Layer1_24D.cdr

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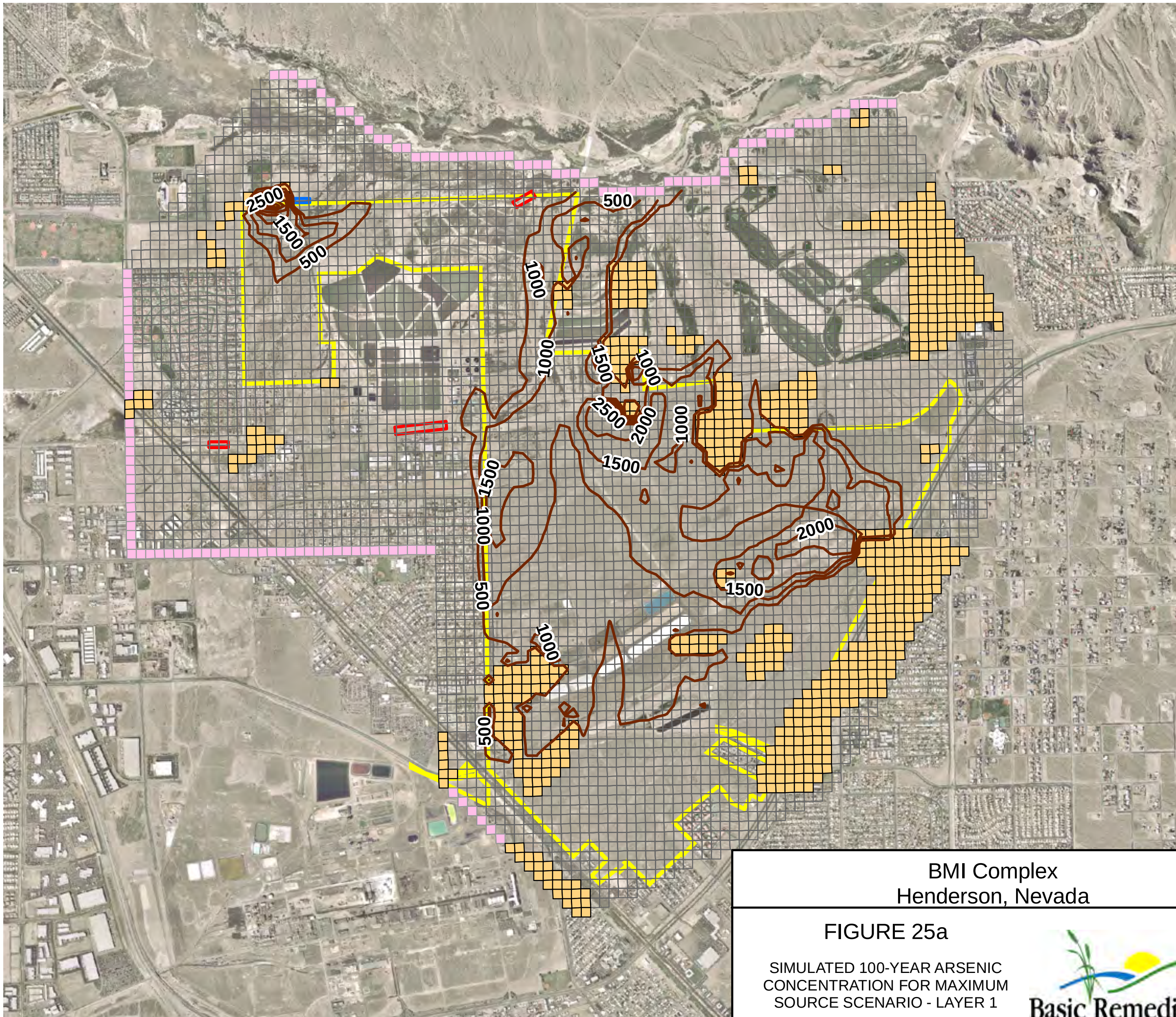
S:/PROJECTS/BRC/ES10.0042_BRC_TRANSPORT_MODEL_RUNS/GIS/MXDS/SOURCE_AREA/FIGURE25A_11LAYER_L1_ARSENIC.MXD 017250



Source: Aerial photograph, April 2004

Explanation

- Simulated concentration (µg/L)
- Dry cell
- Boundary cell
- Extraction well field
- Injection well field
- Model grid
- Site boundary

N

0 1,750 3,500 Feet

BMI Complex
Henderson, Nevada

FIGURE 25a

SIMULATED 100-YEAR ARSENIC CONCENTRATION FOR MAXIMUM SOURCE SCENARIO - LAYER 1

Basic Remediation COMPANY

Prepared by: DBS&A BGT

Date 05-27-2010

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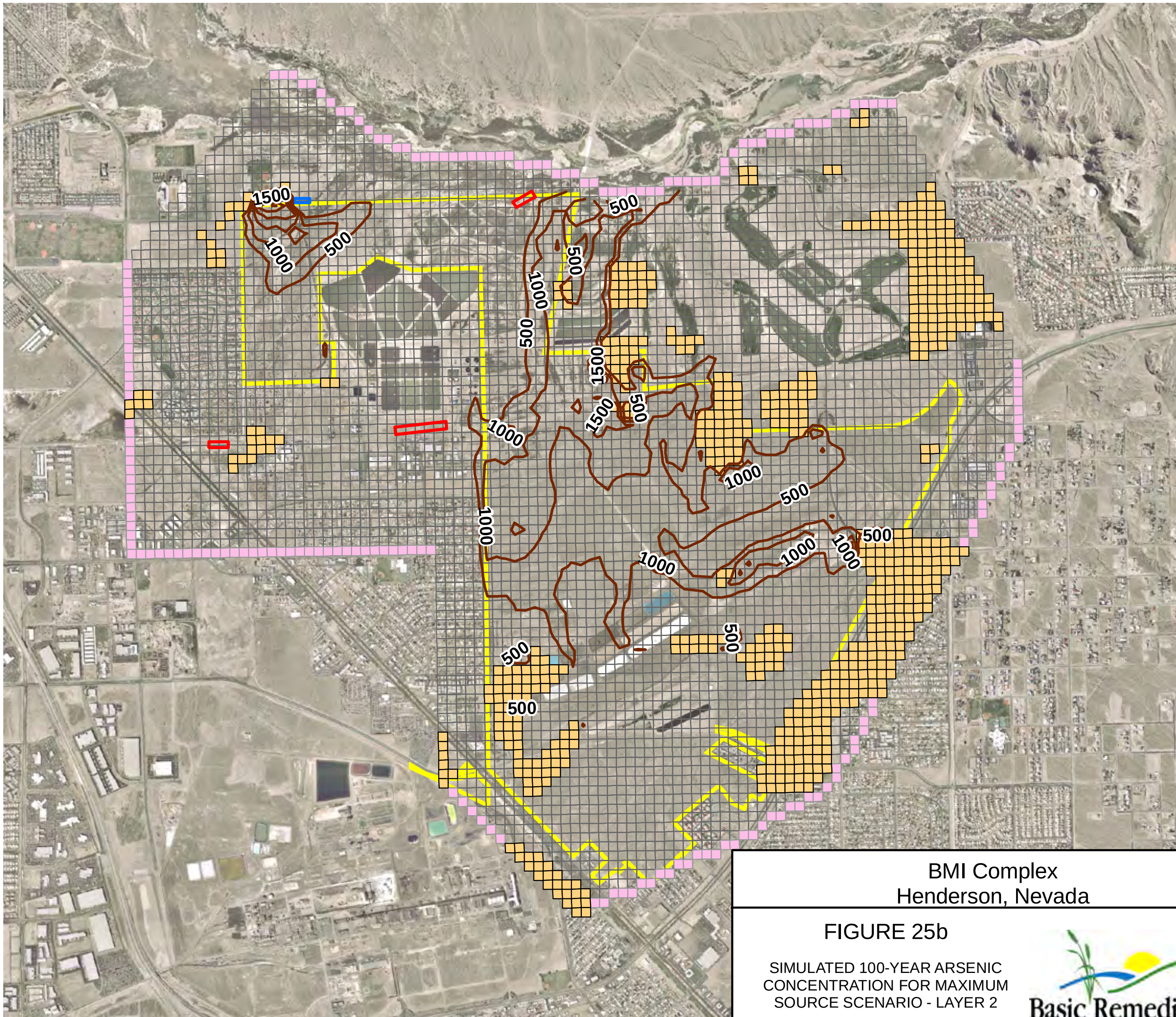
S:/PROJECTS/BRC/ES10.0042_BRC_TRANSPORT_MODEL_RUNS/GIS/MXDS/SOURCE_AREA/FIGURE25B_11LAYER_L2_ARSENIC.MXD 017250



Source: Aerial photograph, April 2004

Explanation

- Simulated concentration (µg/L)
- Dry cell
- Boundary cell
- Extraction well field
- Injection well field
- Model grid
- Site boundary

N

0 1,750 3,500 Feet

BMI Complex
Henderson, Nevada

FIGURE 25b

SIMULATED 100-YEAR ARSENIC CONCENTRATION FOR MAXIMUM SOURCE SCENARIO - LAYER 2

Basic Remediation COMPANY

Prepared by: DBS&A BGT

Date 05-27-2010

Daniel B. Stephens & Associates, Inc.
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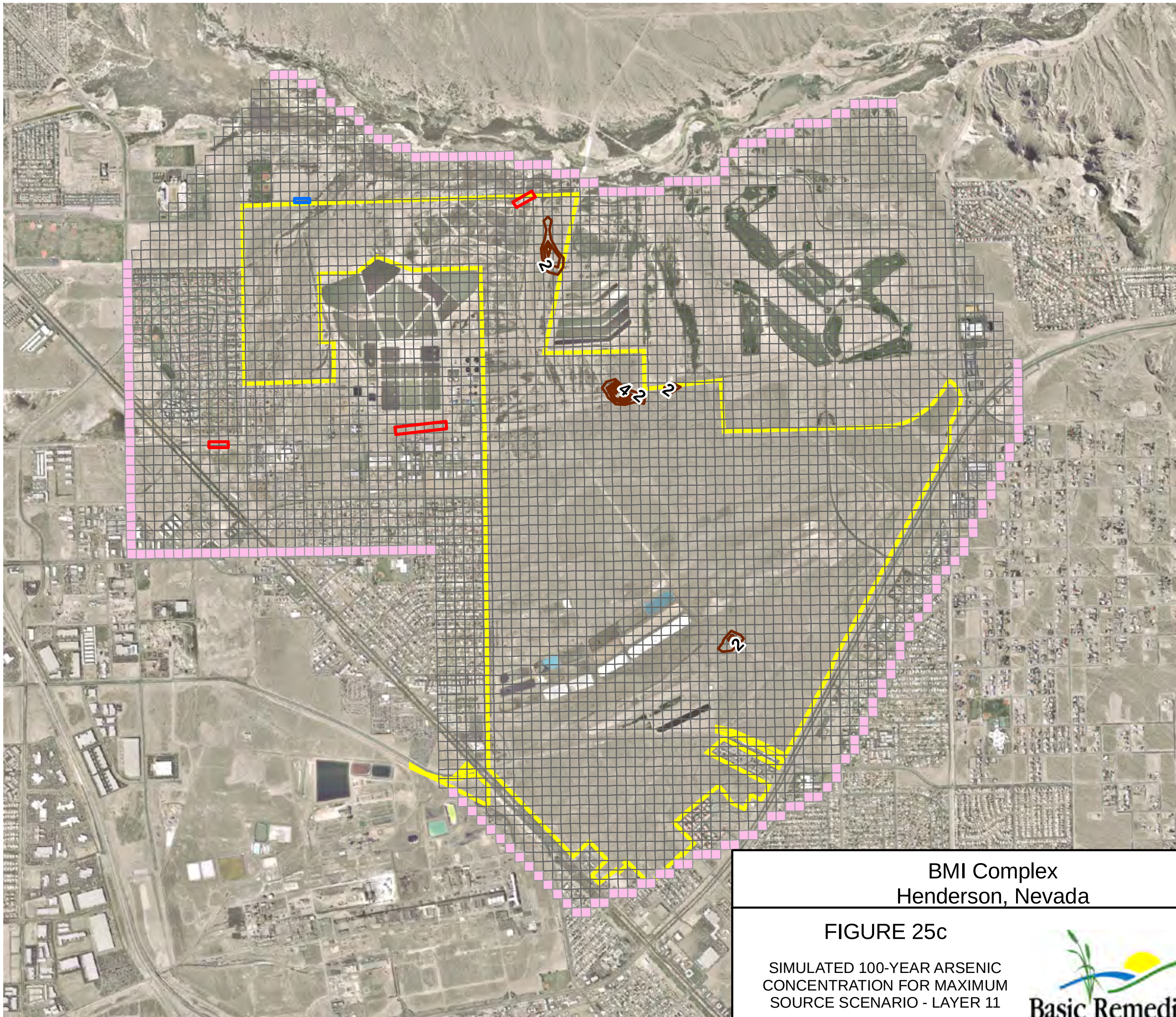
S:/PROJECTS/BRC/ES10.0042_BRC_TRANSPORT_MODEL_RUNS/GIS/MXDS/SOURCE_AREA/FIGURE25C_11LAYER_L11_ARSENIC.MXD 017250



Source: Aerial photograph, April 2004

Explanation

- Simulated concentration (µg/L)
- Boundary cell
- Extraction well field
- Injection well field
- Model grid
- Site boundary

N

0 1,750 3,500 Feet

BMI Complex
Henderson, Nevada

FIGURE 25c

SIMULATED 100-YEAR ARSENIC CONCENTRATION FOR MAXIMUM SOURCE SCENARIO - LAYER 11

Basic Remediation COMPANY

Prepared by:	Date
DBS&A BGT	05-27-2010

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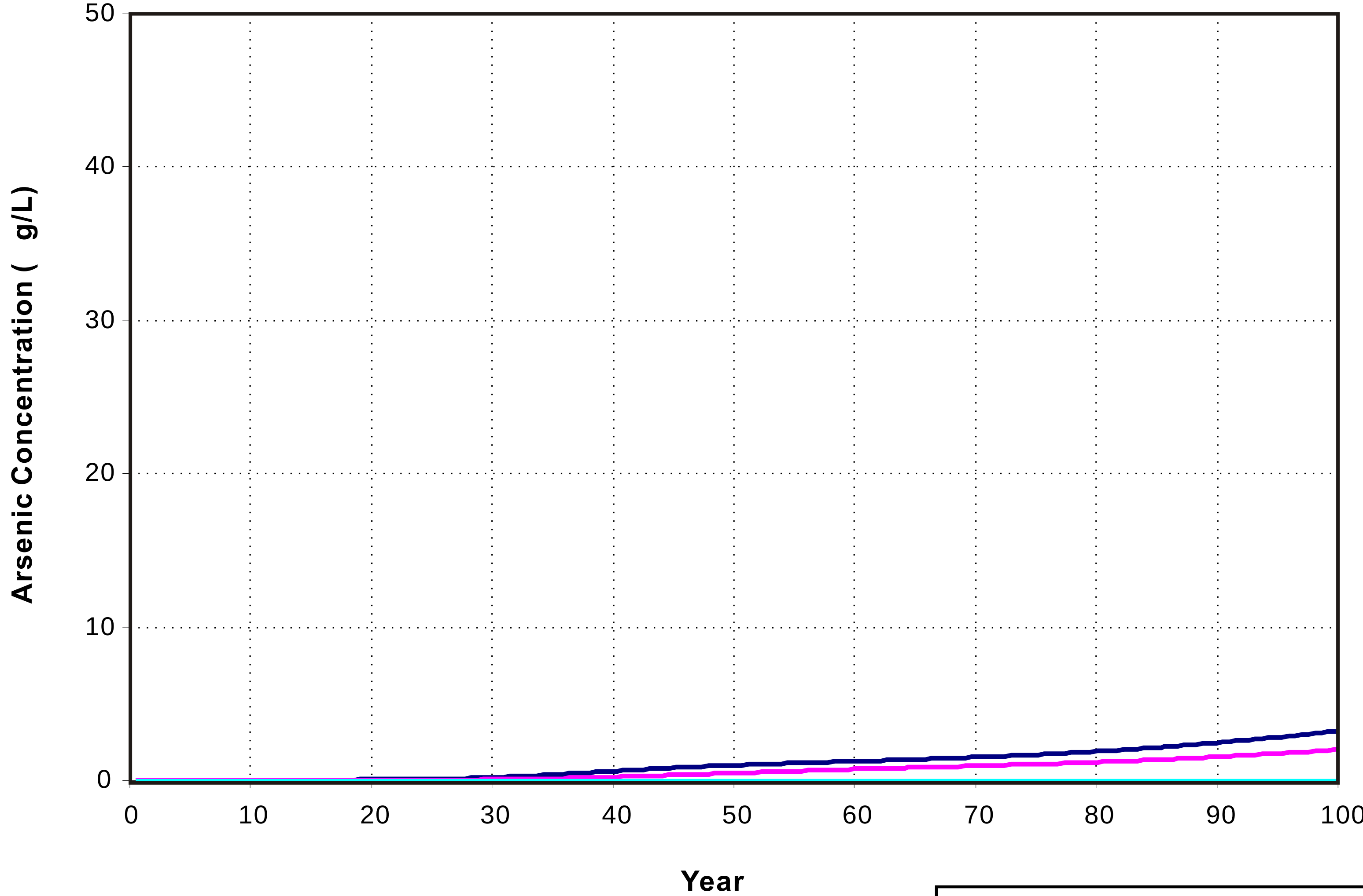

Explanation

- PC12 (Layer 1)
- PC12 (Layer 2)
- PC12 (Layer 11)

BMI Complex
Henderson, Nevada

FIGURE 25d
SIMULATED ARSENIC
CONCENTRATION FOR MAXIMUM
SOURCE SCENARIO
WELL PC12 LOCATION

Basic Remediation COMPANY

Prepared by: DBS&A GHS | Date 5/26/10

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Daniel B. Stephens & Associates, Inc.
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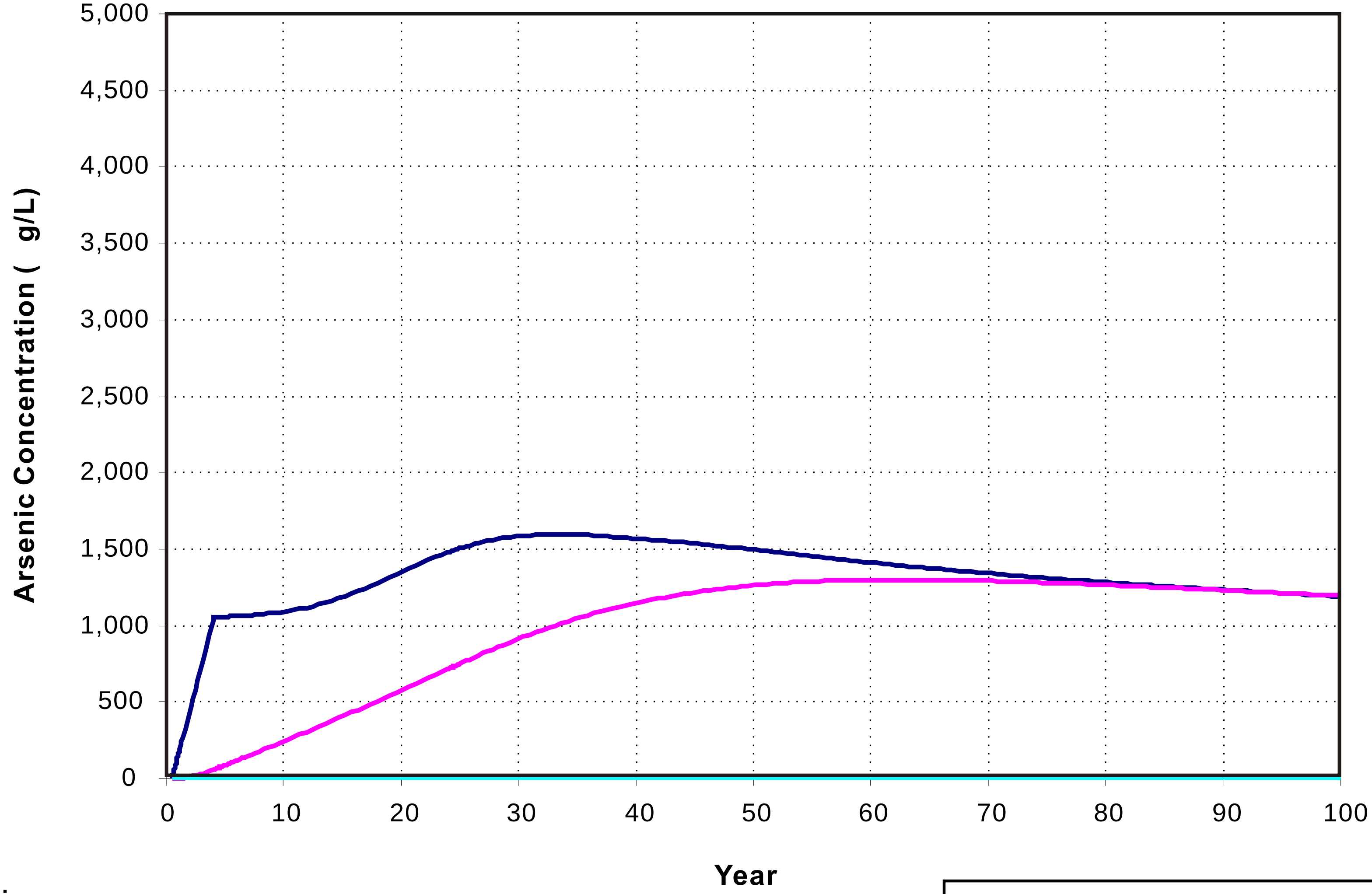

Explanation

- AA-20 (Layer 1)
- AA-20 (Layer 2)
- AA-20 (Layer 11)

BMI Complex
Henderson, Nevada

FIGURE 25e
SIMULATED ARSENIC
CONCENTRATION FOR MAXIMUM
SOURCE SCENARIO
WELL AA-20 LOCATION

Basic Remediation
COMPANY

Prepared by:		Date
DBS&A	GHS	5/26/10

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Daniel B. Stephens & Associates, Inc.
JN ES10.0042

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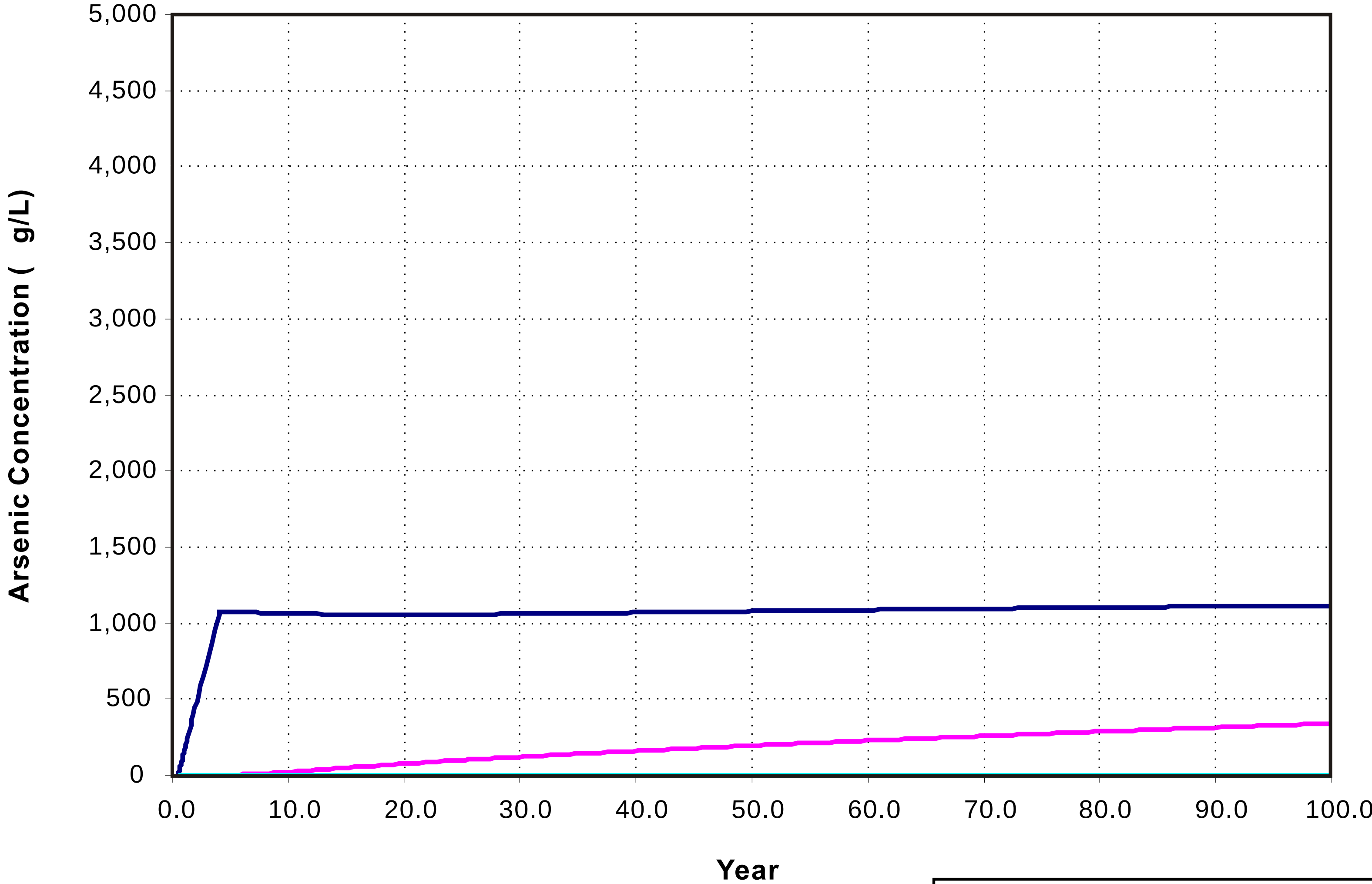

Explanation

- AA-18 (Layer 1)
- AA-18 (Layer 2)
- AA-18 (Layer 11)

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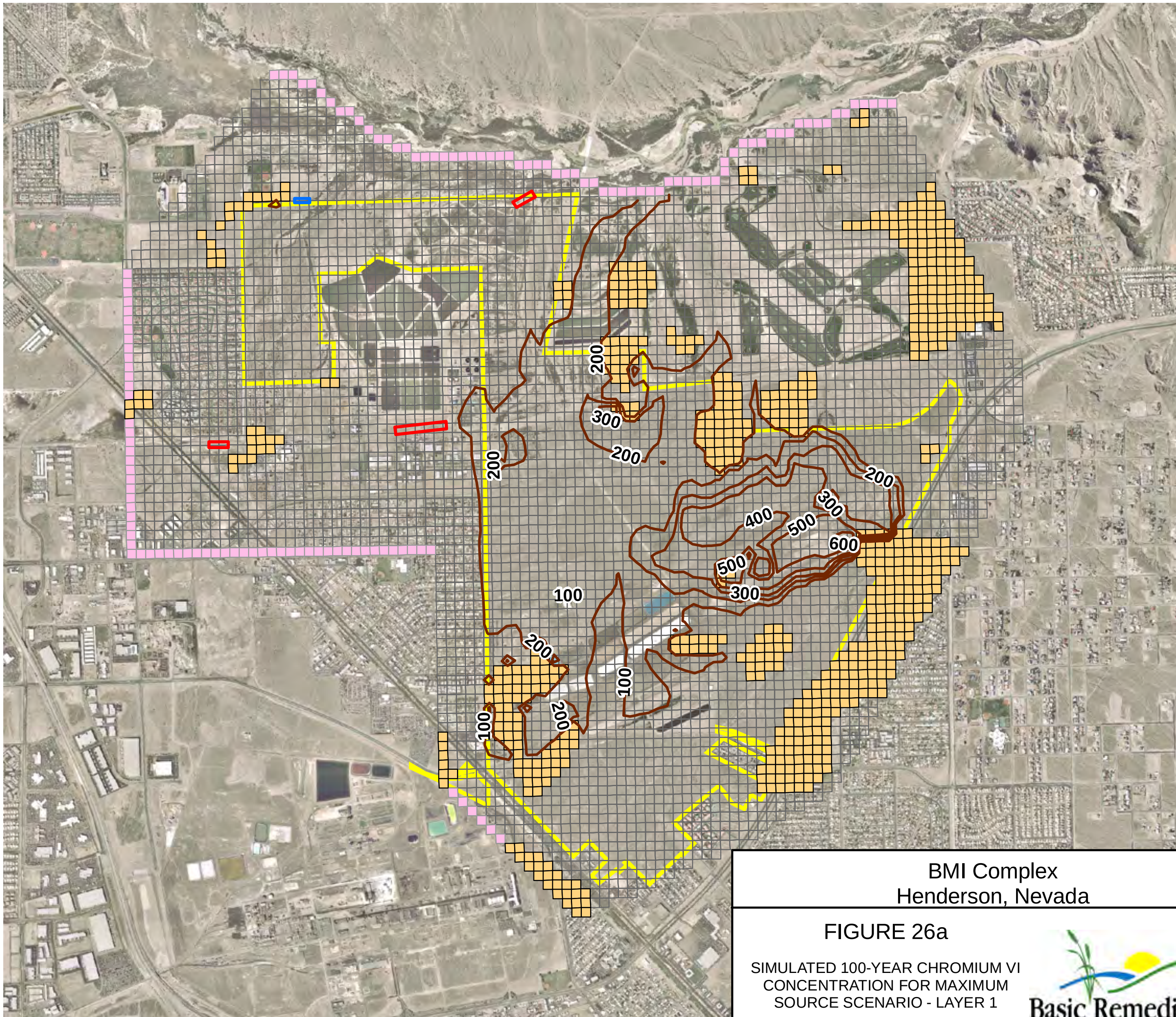
BMI Complex
Henderson, Nevada

FIGURE 25f
SIMULATED ARSENIC CONCENTRATION FOR MAXIMUM SOURCE SCENARIO
WELL AA-18 LOCATION

Basic Remediation COMPANY

Prepared by: DBS&A GHS	Date 5/26/10	S:\Projects\BRC\ES10.0042_BRC_Transport_Model_Runs\VR_Drawings\Fig_25d_Simulated_sourceareas_conc_0_Layer1_25D.cdr

S:/PROJECTS/BRC/ES10.0042_BRC_TRANSPORT_MODEL_RUNS/GIS/MXDS/SOURCE_AREA/FIGURE26A_11LAYER_L1_CHROMIUMVI.MXD 017250



Source: Aerial photograph, April 2004

Explanation

- Simulated concentration (µg/L)
- Dry cell
- Boundary cell
- Extraction well field
- Injection well field
- Model grid
- Site boundary

N

0 1,750 3,500 Feet

BMI Complex
Henderson, Nevada

FIGURE 26a

SIMULATED 100-YEAR CHROMIUM VI CONCENTRATION FOR MAXIMUM SOURCE SCENARIO - LAYER 1

Basic Remediation COMPANY

Prepared by:	Date
DBS&A BGT	05-27-2010

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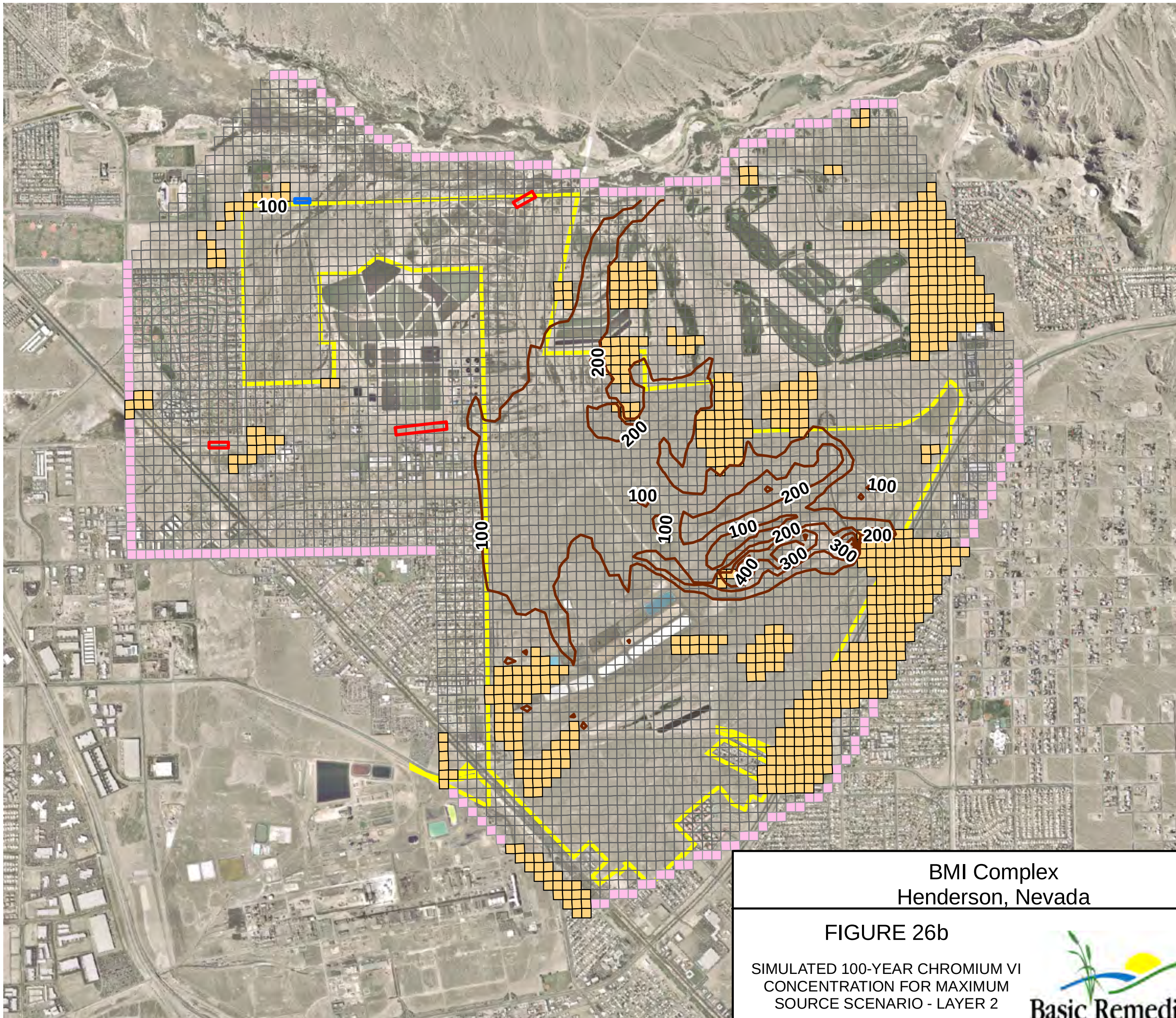


Source: Aerial photograph, April 2004

Explanation

- Simulated concentration (μg/L)
- Dry cell
- Boundary cell
- Extraction well field
- Injection well field
- Model grid
- Site boundary

N

0 1,750 3,500 Feet

BMI Complex
Henderson, Nevada

FIGURE 26b

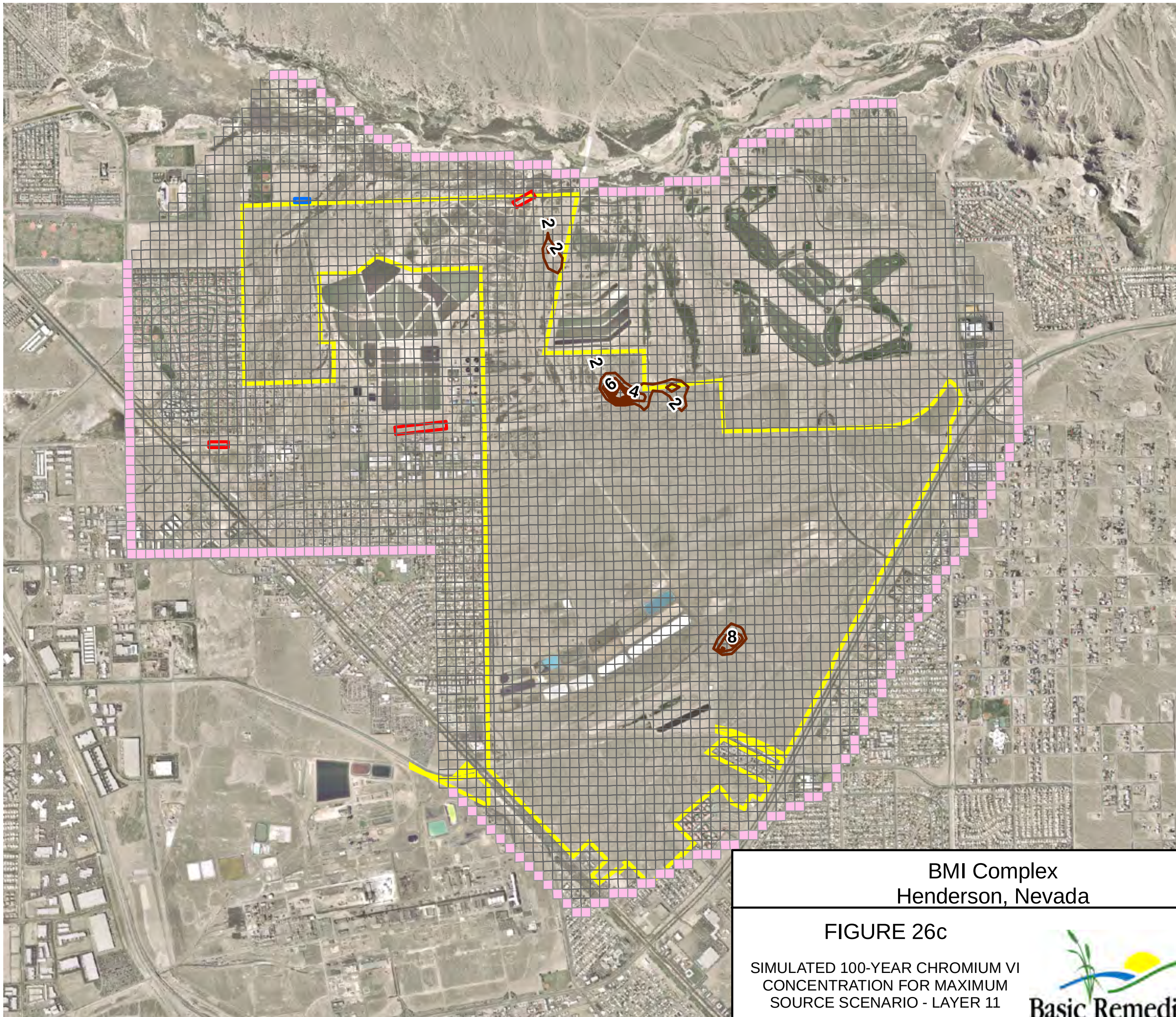
SIMULATED 100-YEAR CHROMIUM VI CONCENTRATION FOR MAXIMUM SOURCE SCENARIO - LAYER 2

Basic Remediation COMPANY

Prepared by: DBS&A BGT

Date 05-27-2010

Daniel B. Stephens & Associates, Inc.
JN ES10.0042



Source: *Aerial photograph, April 2004*

Explanation

- Simulated concentration (µg/L)
- Boundary cell
- Extraction well field
- Injection well field
- Model grid
- Site boundary

N

0 1,750 3,500 Feet

BMI Complex
Henderson, Nevada

FIGURE 26c

SIMULATED 100-YEAR CHROMIUM VI CONCENTRATION FOR MAXIMUM SOURCE SCENARIO - LAYER 11

Basic Remediation COMPANY

Prepared by: DBS&A BGT

Date 05-27-2010

Daniel B. Stephens & Associates, Inc.
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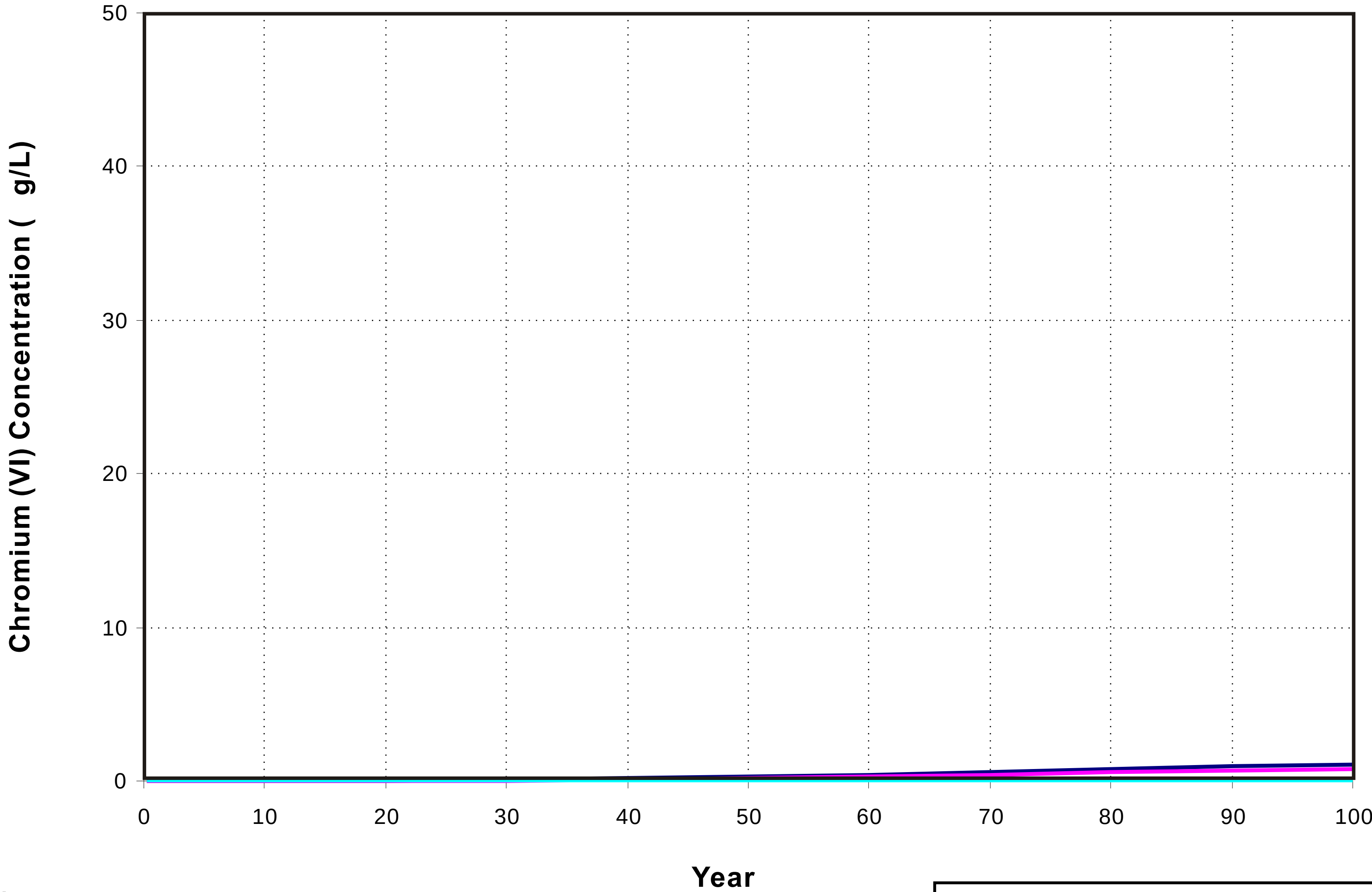


Explanation

- PC12 (Layer 1)
- PC12 (Layer 2)
- PC12 (Layer 11)

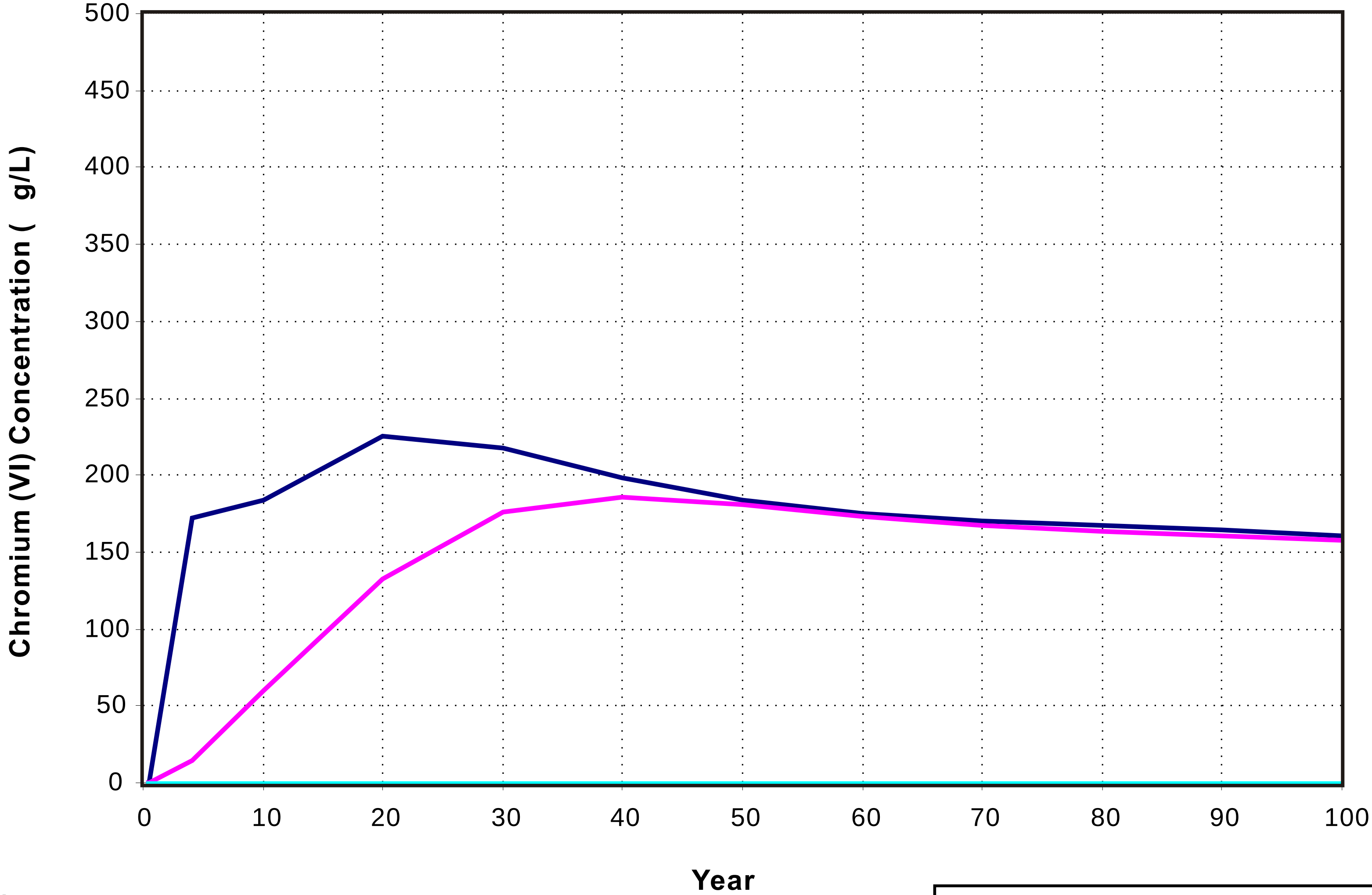
BMI Complex
Henderson, Nevada

FIGURE 26d
SIMULATED CHROMIUM VI CONCENTRATION FOR MAXIMUM SOURCE SCENARIO WELL PC12 LOCATION

Basic Remediation COMPANY

Prepared by:		Date	
DBS&A	GHS	5/26/10	S:\Projects\BRC\ES10.0042_BRC_Transport_Model_Runs\VR_Drawings\Fig_26d_Simulated_sourceareas_conc_0_Layer1_26D.cdr

Daniel B. Stephens & Associates, Inc.
JN ES10.0042



Explanation

- AA-20 (Layer 1)
- AA-20 (Layer 2)
- AA-20 (Layer 11)

BMI Complex
Henderson, Nevada

FIGURE 26e
SIMULATED CHROMIUM VI
CONCENTRATION FOR MAXIMUM
SOURCE SCENARIO
WELL AA-20 LOCATION

Basic Remediation
COMPANY

Prepared by: DBS&A GHS | Date 5/26/10

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Daniel B. Stephens & Associates, Inc.
JN ES10.0042

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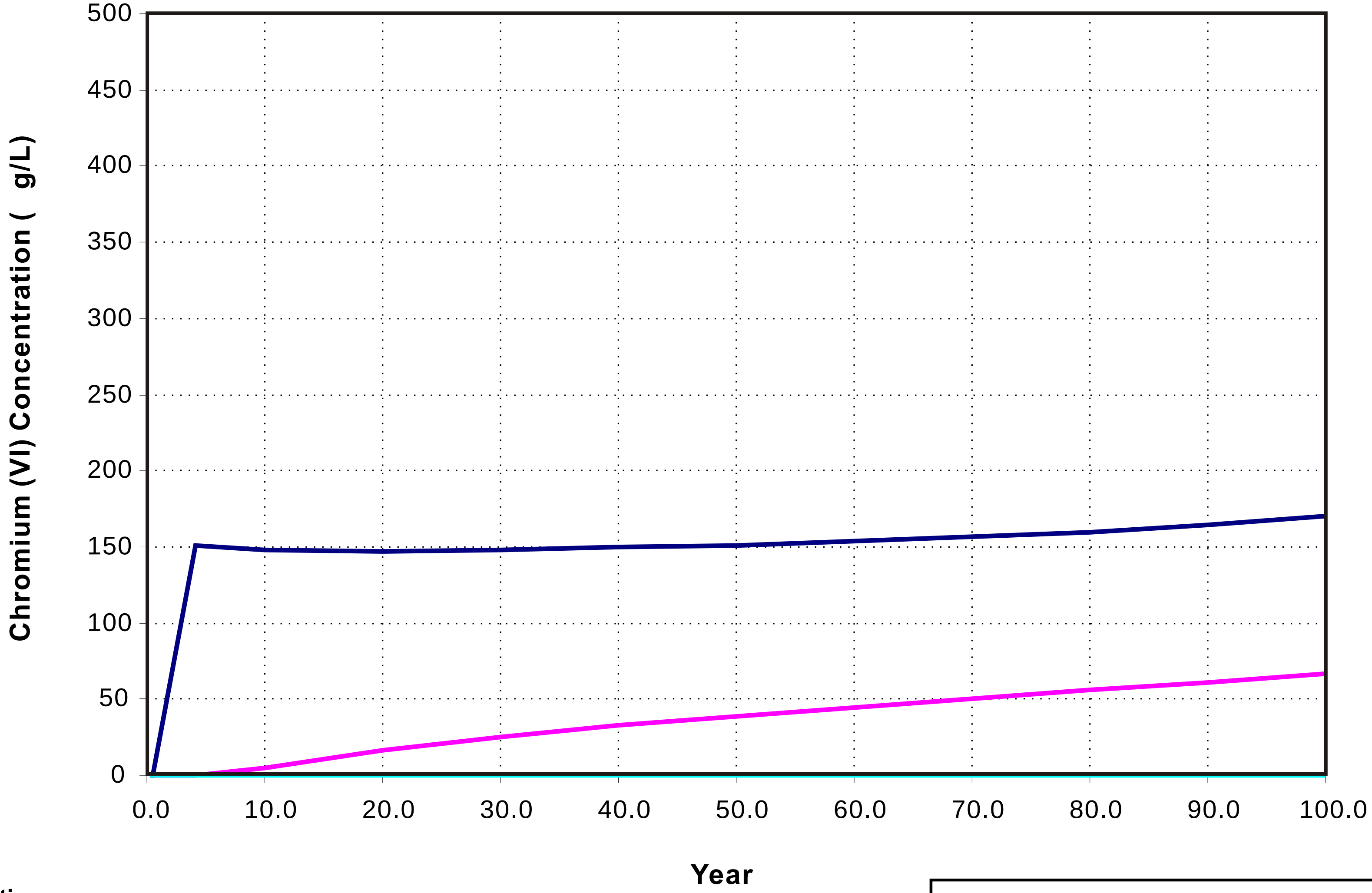

Explanation

- AA-18 (Layer 1)
- AA-18 (Layer 2)
- AA-18 (Layer 11)

BMI Complex
Henderson, Nevada

FIGURE 26f
SIMULATED CHROMIUM VI CONCENTRATION FOR MAXIMUM SOURCE SCENARIO WELL AA-18 LOCATION

Basic Remediation COMPANY

Prepared by: DBS&A GHS | Date 5/26/10 | S:\Projects\BRC\ES10.0042_BRC_Transport_Model_Runs\VR_Drawings\Fig_26d_Simulated_sourceareas_conc_0_Layer1_26D.cdr

Daniel B. Stephens & Associates, Inc.
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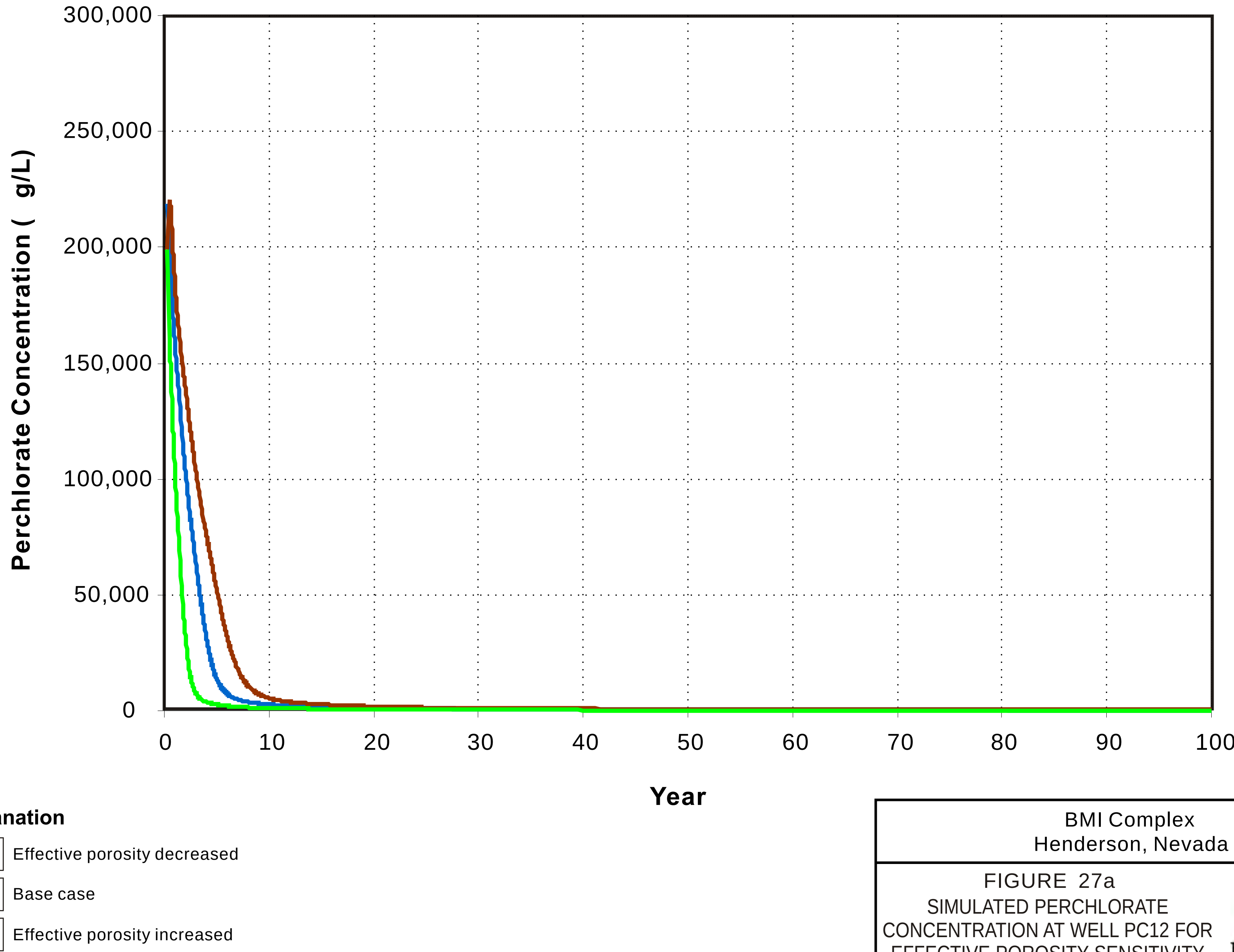


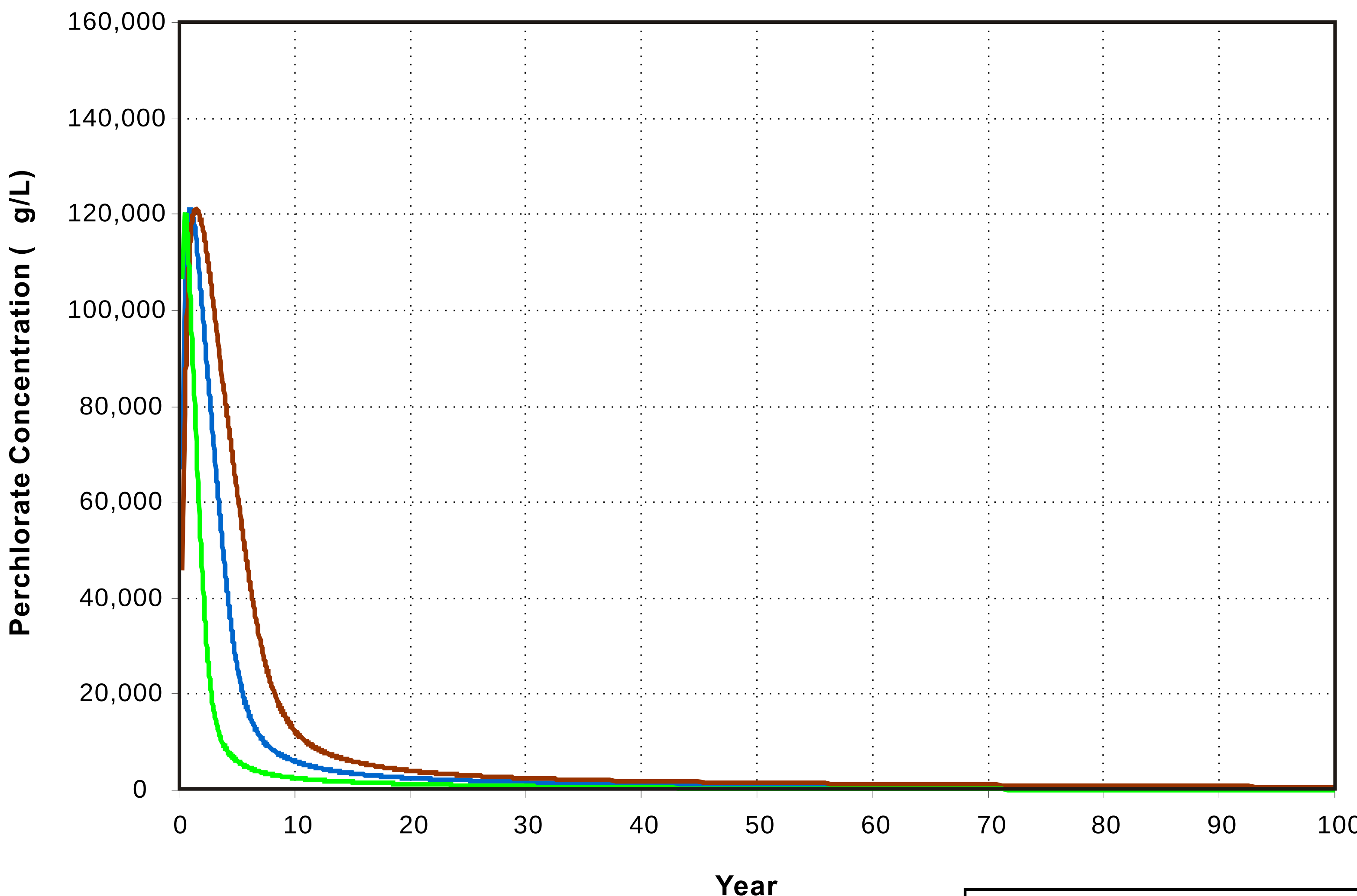
BMI Complex
Henderson, Nevada

FIGURE 27a
SIMULATED PERCHLORATE CONCENTRATION AT WELL PC12 FOR EFFECTIVE POROSITY SENSITIVITY
LAYER 1

Basic Remediation COMPANY

Prepared by:		Date	S:\Projects\BRC\ES10.0042_BRC_Transport_Model_Runs\VR_Drawings\Fig_Sensitivity_Summary_Porosity.cdr
DBS&A	GHS	5/26/10	

Daniel B. Stephens & Associates, Inc.
JN ES10.0042



Explanation

- Effective porosity decreased
- Base case
- Effective porosity increased

BMI Complex
Henderson, Nevada

FIGURE 27b
SIMULATED PERCHLORATE CONCENTRATION AT WELL PC12 FOR EFFECTIVE POROSITY SENSITIVITY
LAYER 2

Basic Remediation COMPANY

Prepared by: DBS&A GHS | Date 5/26/10

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Daniel B. Stephens & Associates, Inc.
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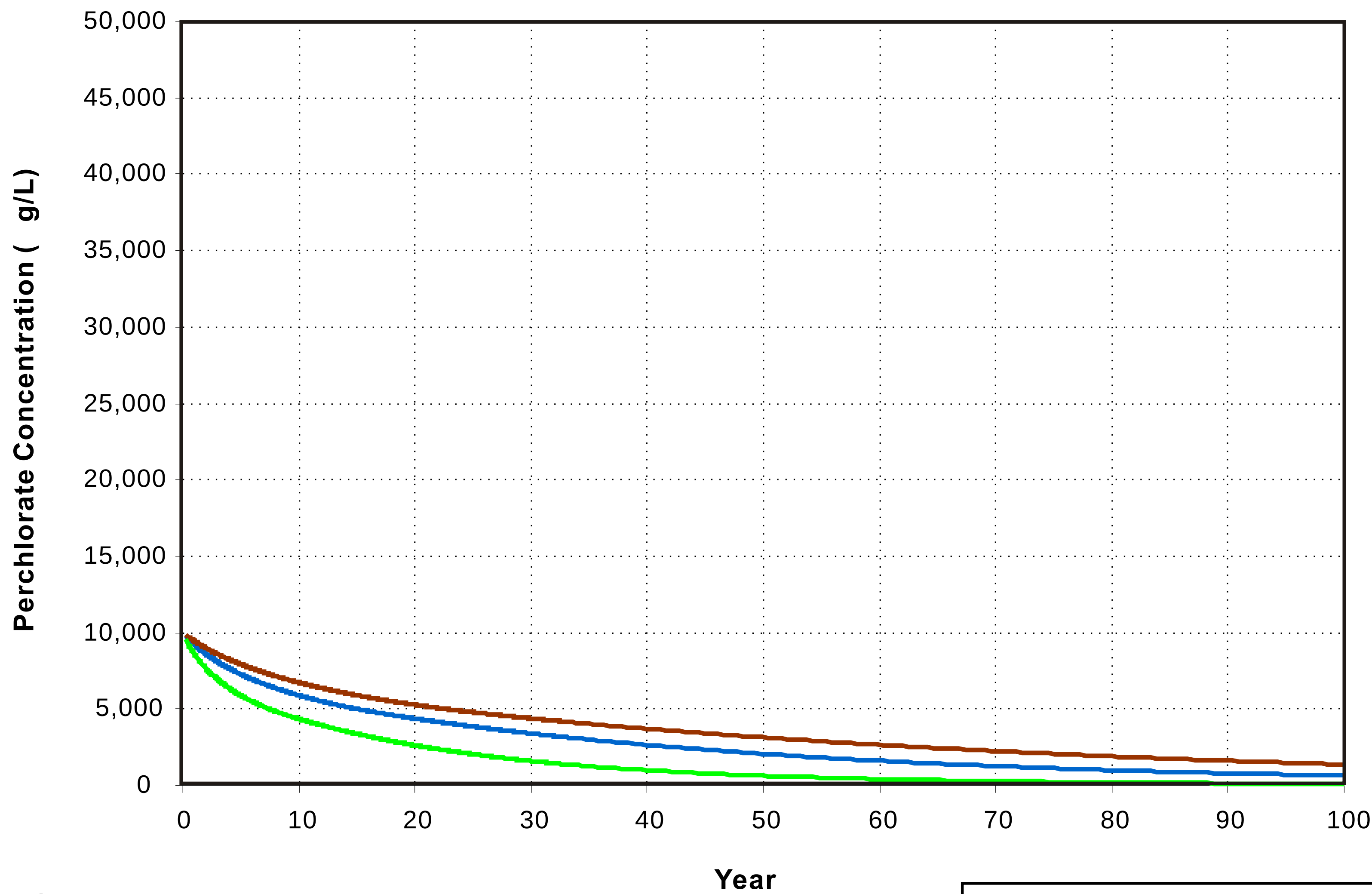

Explanation

- Effective porosity decreased
- Base case
- Effective porosity increased

Daniel B. Stephens & Associates, Inc.
JN ES10.0042

BMI Complex
Henderson, Nevada

FIGURE 27c
SIMULATED PERCHLORATE CONCENTRATION AT WELL PC12 FOR EFFECTIVE POROSITY SENSITIVITY
LAYER 11

Basic Remediation COMPANY

Prepared by:		Date	
DBS&A	GHS	5/26/10	S:\Projects\BRC\ES10.0042_BRC_Transport_Model_Runs\VR_Drawings\Fig_Sensitivity_Summary_Porosity.cdr

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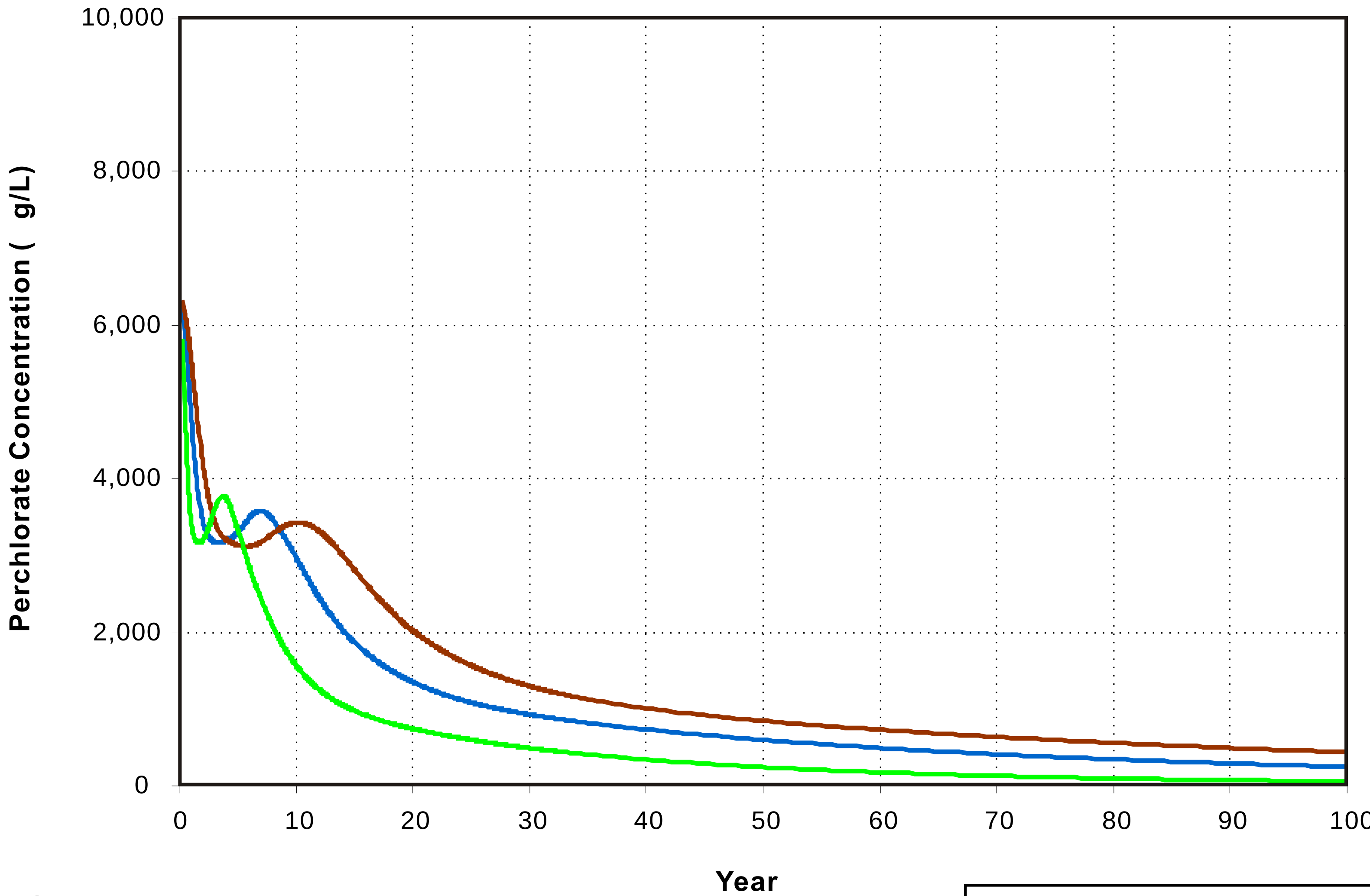


Explanation

- Effective porosity decreased
- Base case
- Effective porosity increased

Daniel B. Stephens & Associates, Inc.

JN ES10.0042

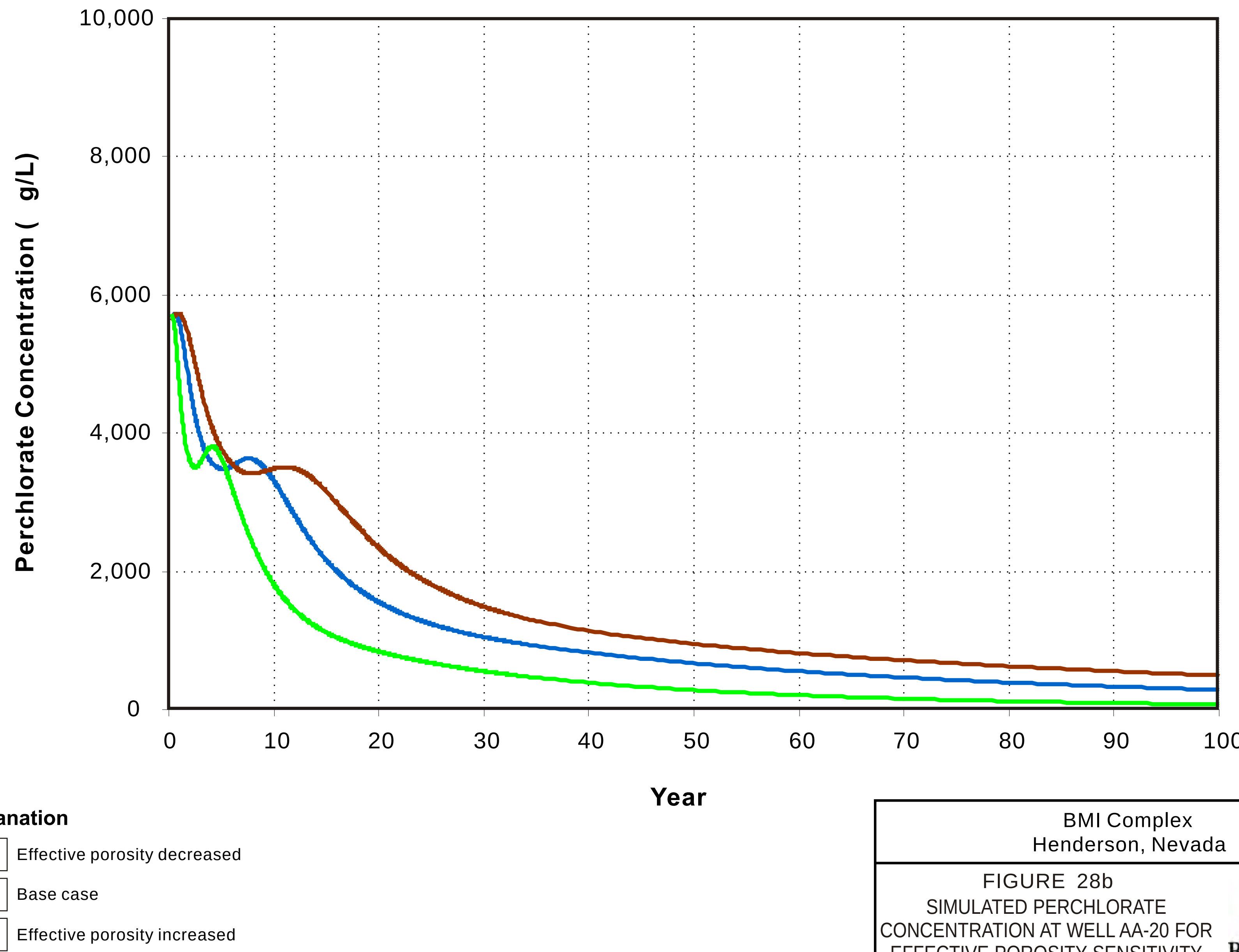
BMI Complex
Henderson, Nevada

FIGURE 28a
SIMULATED PERCHLORATE CONCENTRATION AT WELL AA-20 FOR EFFECTIVE POROSITY SENSITIVITY
LAYER 1

Basic Remediation COMPANY

Prepared by:		Date
DBS&A	GHS	5/26/10

S:\Projects\BRC\ES10.0042_BRC_Transport_Model_Runs\VR_Drawings\Fig_Sensitivity_Summary_Porosity.cdr



BMI Complex
Henderson, Nevada

FIGURE 28b
SIMULATED PERCHLORATE CONCENTRATION AT WELL AA-20 FOR EFFECTIVE POROSITY SENSITIVITY
LAYER 2

Basic Remediation COMPANY

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Daniel B. Stephens & Associates, Inc.
JN ES10.0042

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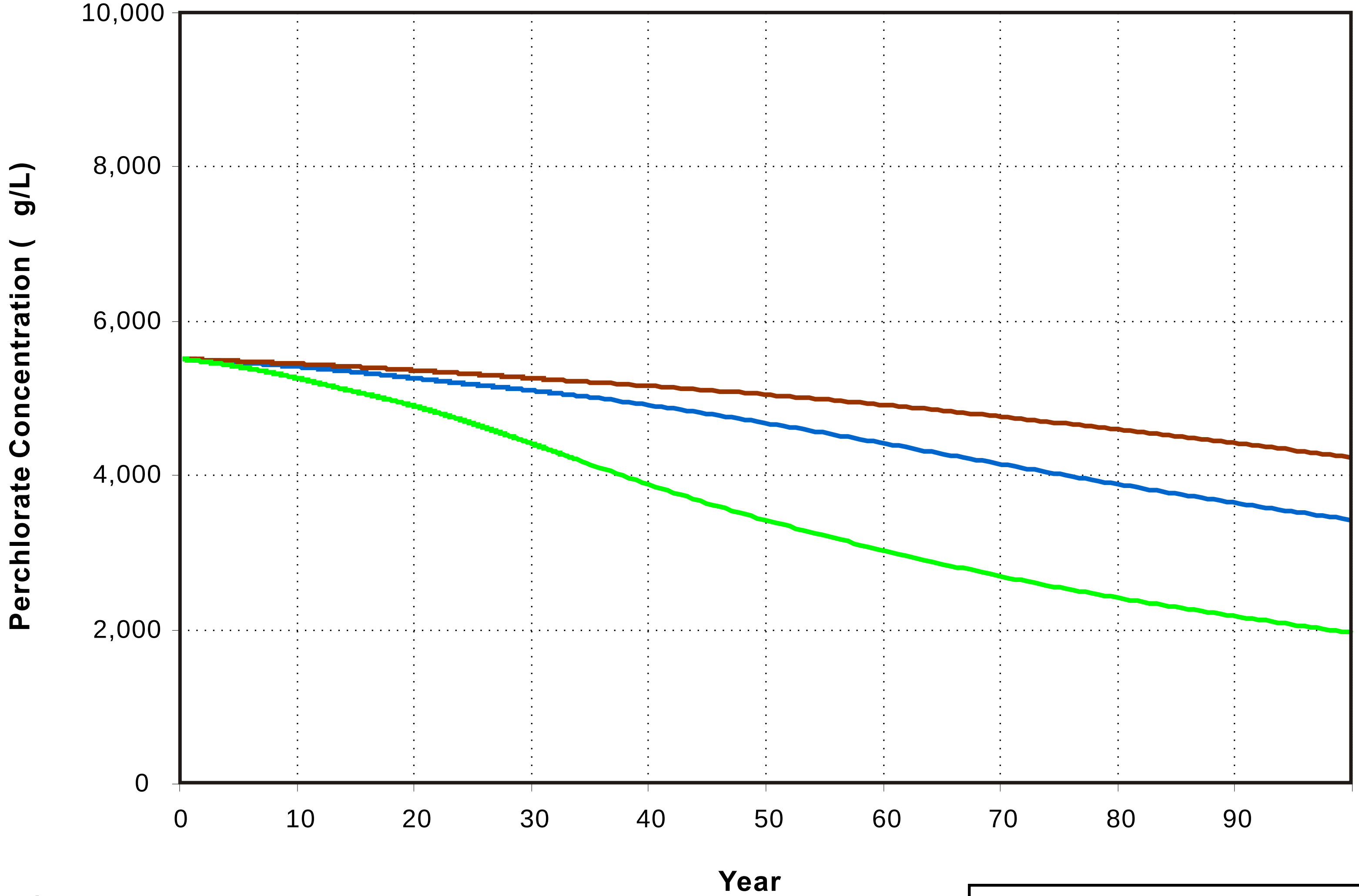

Explanation

- Effective porosity decreased
- Base case
- Effective porosity increased

BMI Complex
Henderson, Nevada

FIGURE 28c
SIMULATED PERCHLORATE CONCENTRATION AT WELL AA-20 FOR EFFECTIVE POROSITY SENSITIVITY LAYER 11

Basic Remediation COMPANY

Prepared by: DBS&A GHS | Date 5/26/10 | S:\Projects\BRC\ES10.0042_BRC_Transport_Model_Runs\VR_Drawings\Fig_Sensitivity_Summary_Porosity.cdr

Daniel B. Stephens & Associates, Inc.
JN ES10.0042

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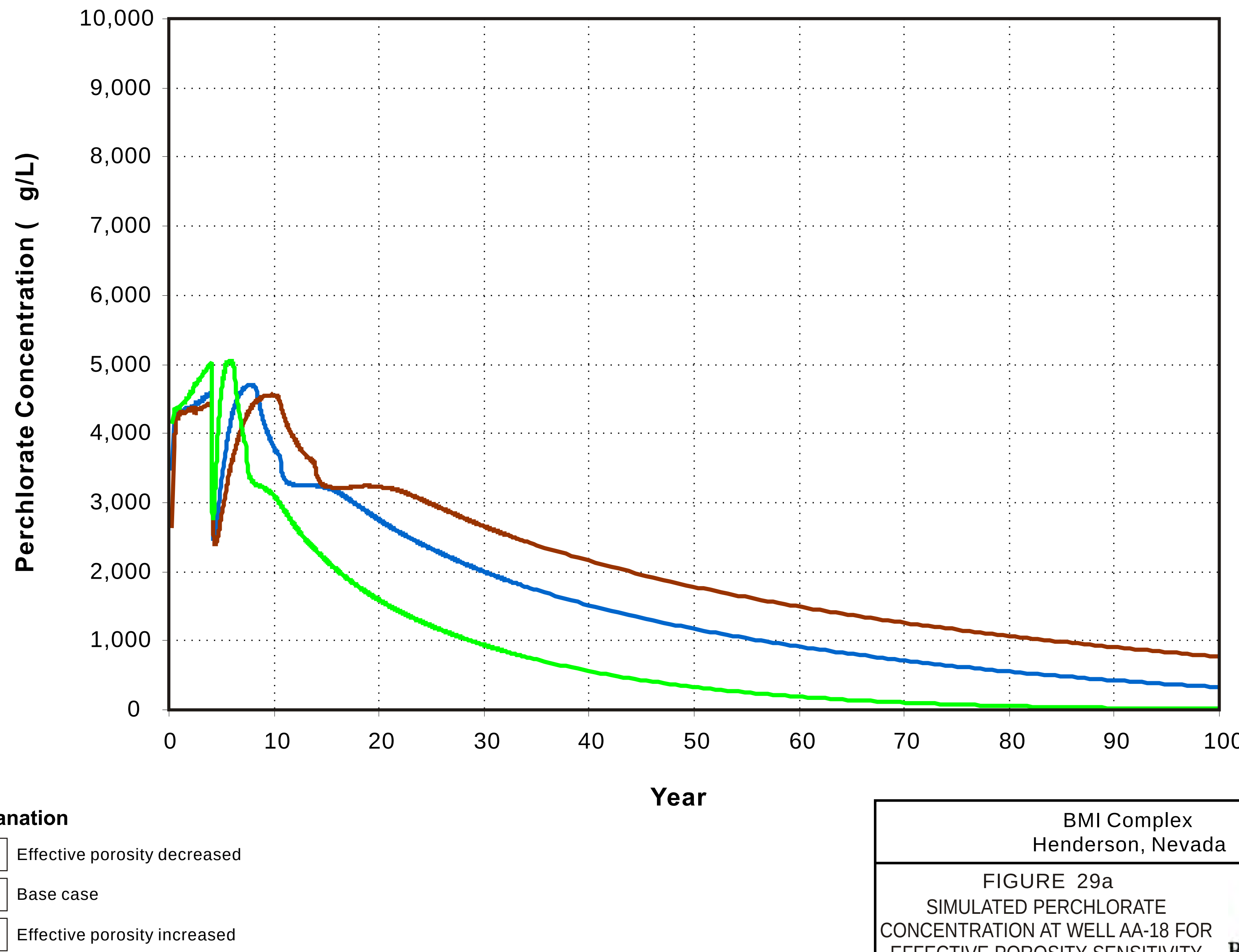

BMI Complex
Henderson, Nevada

FIGURE 29a
SIMULATED PERCHLORATE CONCENTRATION AT WELL AA-18 FOR EFFECTIVE POROSITY SENSITIVITY
LAYER 1

Basic Remediation COMPANY

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Daniel B. Stephens & Associates, Inc.
JN ES10.0042

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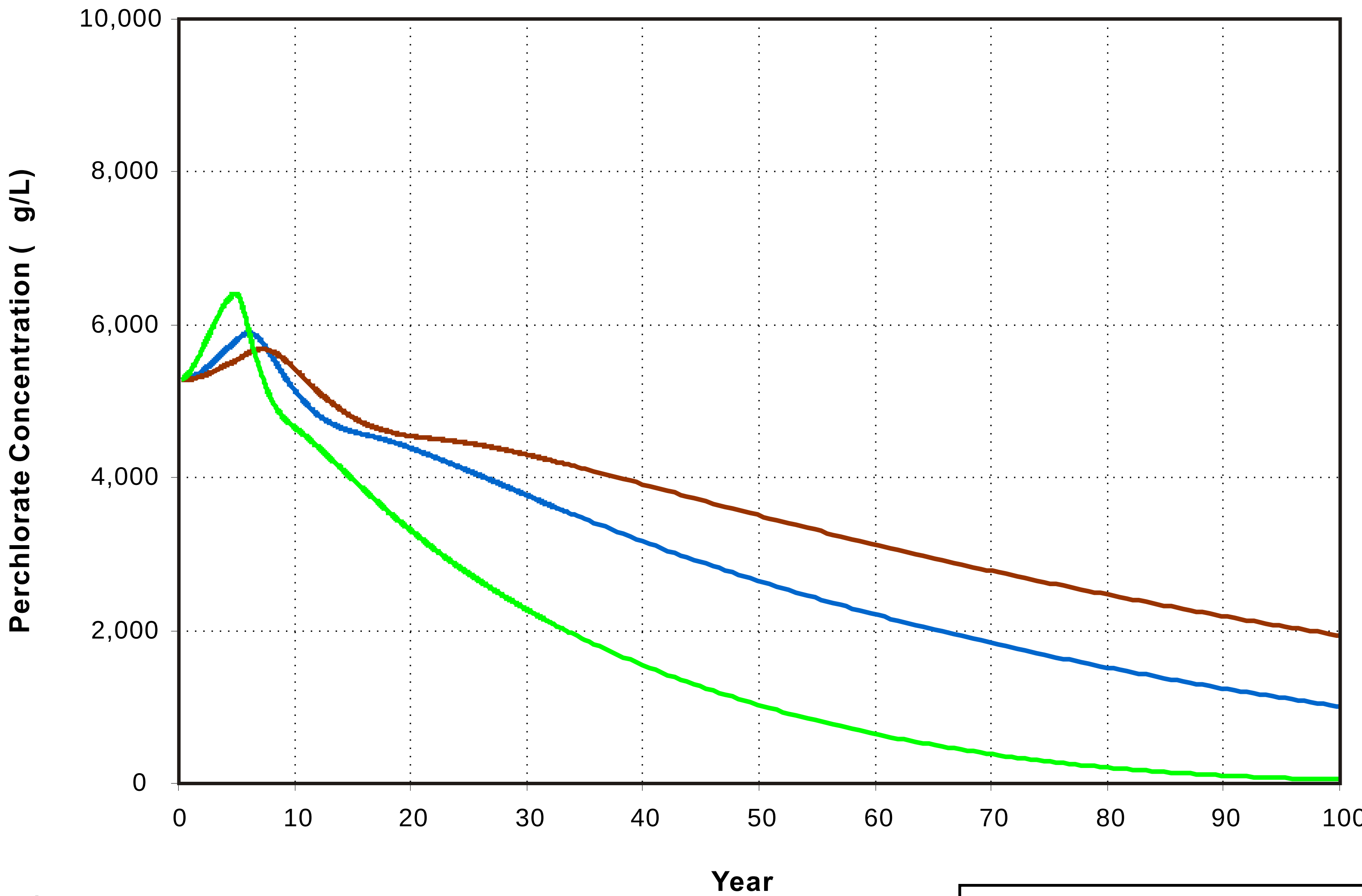


Explanation

- Effective porosity decreased
- Base case
- Effective porosity increased

Daniel B. Stephens & Associates, Inc.
JN ES10.0042

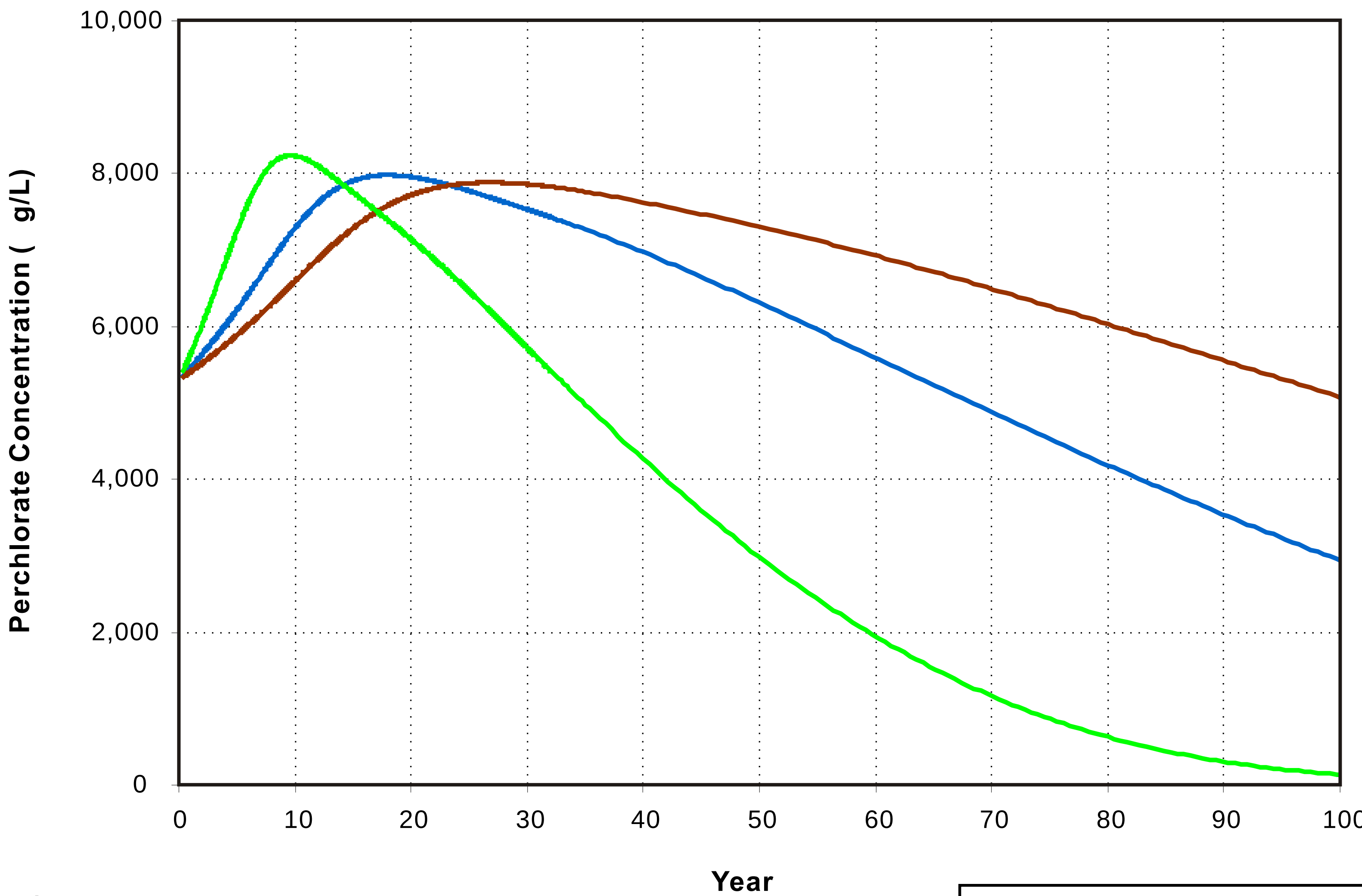
BMI Complex
Henderson, Nevada

FIGURE 29b
SIMULATED PERCHLORATE CONCENTRATION AT WELL AA-18 FOR EFFECTIVE POROSITY SENSITIVITY
LAYER 2

Basic Remediation COMPANY

Prepared by: DBS&A GHS | Date 5/26/10 | S:\Projects\BRC\ES10.0042_BRC_Transport_Model_Runs\VR_Drawings\Fig_Sensitivity_Summary_Porosity.cdr

S:\Projects\BRC\ES10.0042_BRC_Transport_Model_Runs\VR_Drawings\Fig_Sensitivity_Summary_Porosity.cdr



Explanation

- Effective porosity decreased
- Base case
- Effective porosity increased

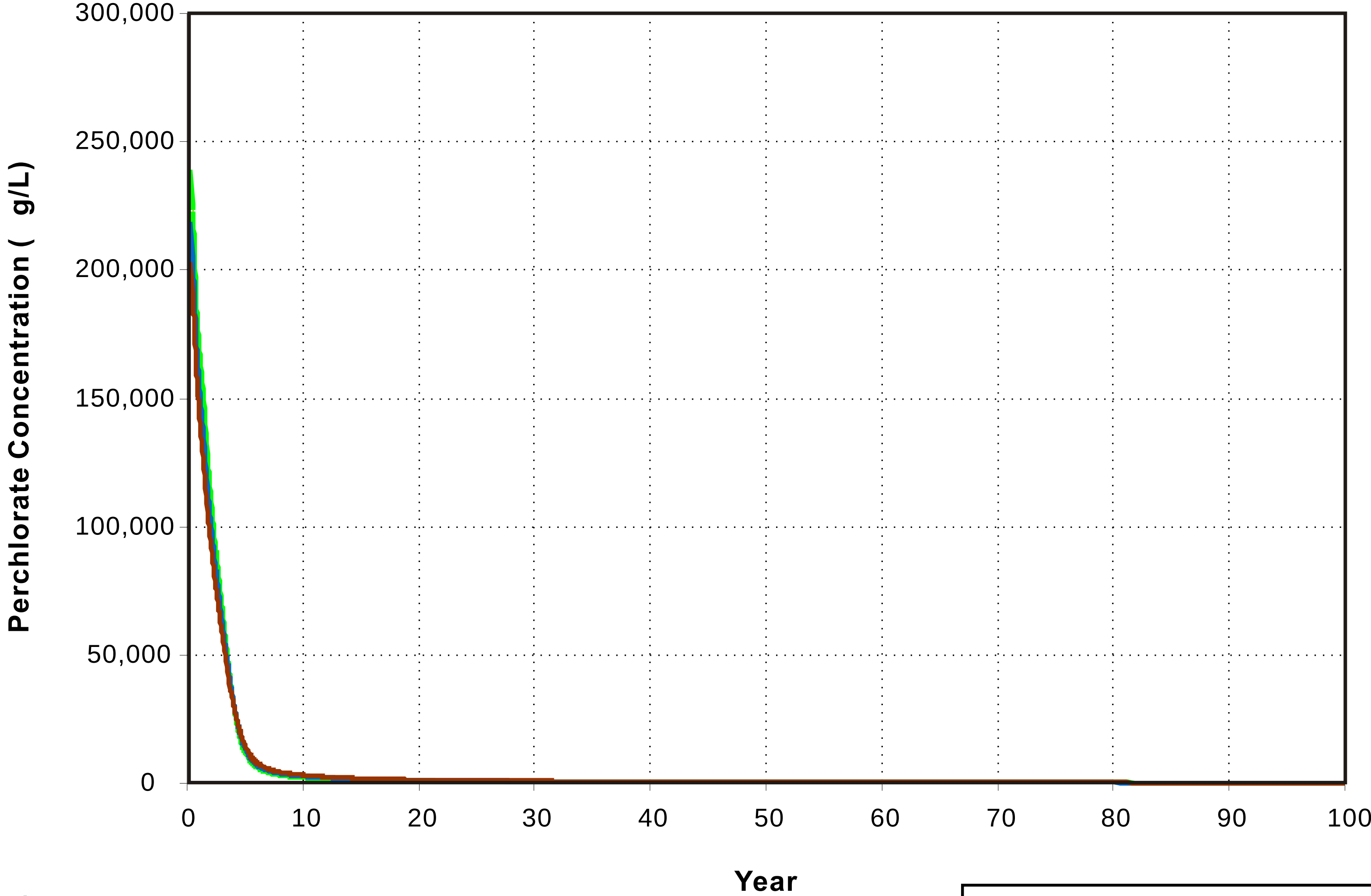
BMI Complex
Henderson, Nevada

FIGURE 29c
SIMULATED PERCHLORATE CONCENTRATION AT WELL AA-18 FOR EFFECTIVE POROSITY SENSITIVITY LAYER 11

Basic Remediation COMPANY

Prepared by: DBS&A GHS | Date 5/26/10 | S:\Projects\BRC\ES10.0042_BRC_Transport_Model_Runs\VR_Drawings\Fig_Sensitivity_Summary_Porosity.cdr

Daniel B. Stephens & Associates, Inc.
JN ES10.0042



Explanation

- Dispersivity decreased
- Base case
- Dispersivity increased

BMI Complex
Henderson, Nevada

FIGURE 30a
SIMULATED PERCHLORATE CONCENTRATION AT WELL PC12 FOR DISPERSIVITY SENSITIVITY
LAYER 1

Basic Remediation COMPANY

Prepared by: DBS&A GHS

Date 5/26/10

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Daniel B. Stephens & Associates, Inc.
JN ES10.0042

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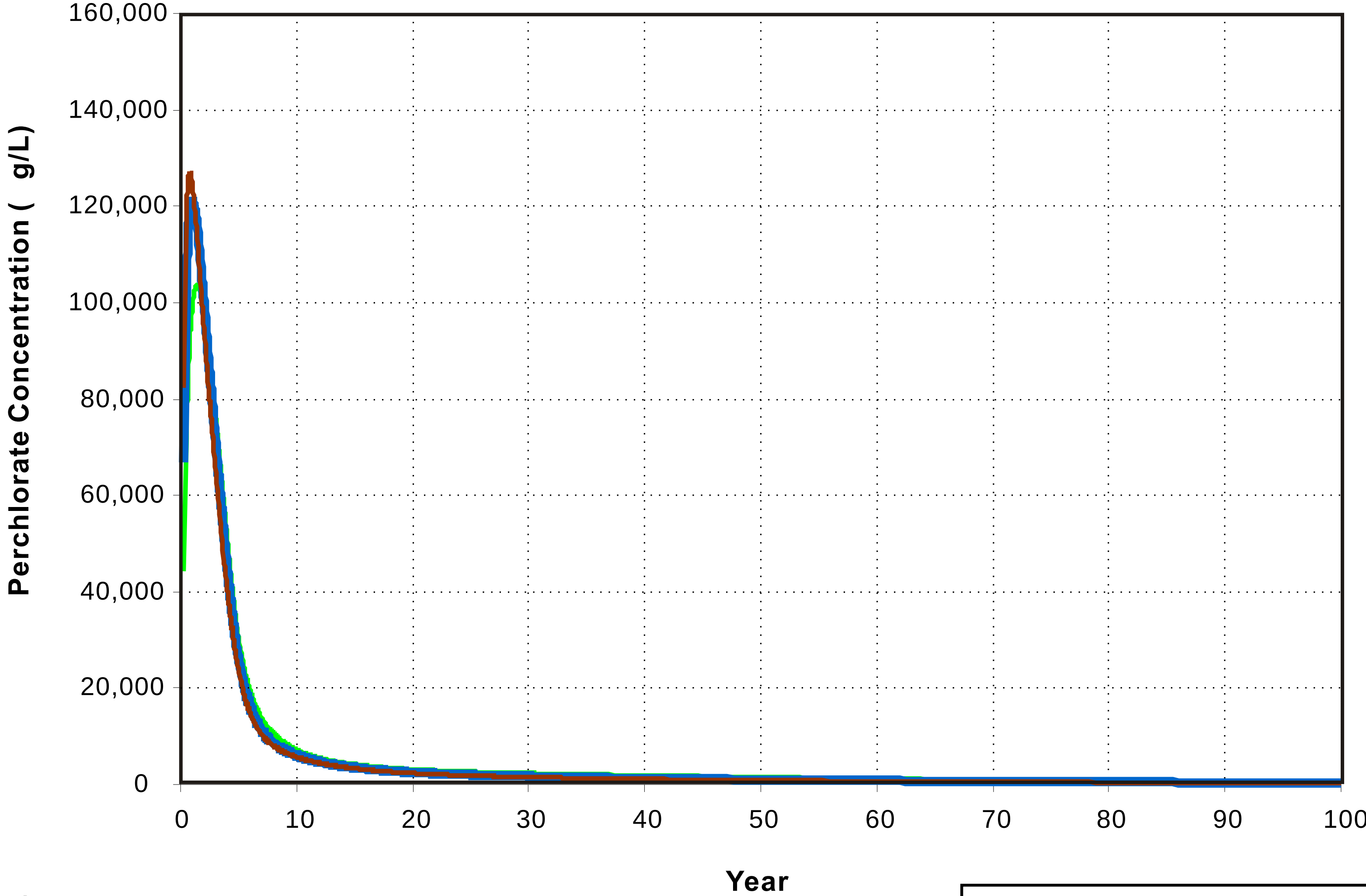

Explanation

- Dispersivity decreased
- Base case
- Dispersivity increased

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JN ES10.0042

BMI Complex
Henderson, Nevada

FIGURE 30b
SIMULATED PERCHLORATE CONCENTRATION AT WELL PC12 FOR DISPERSIVITY SENSITIVITY
LAYER 2

Basic Remediation COMPANY

Prepared by: DBS&A GHS
Date 5/26/10

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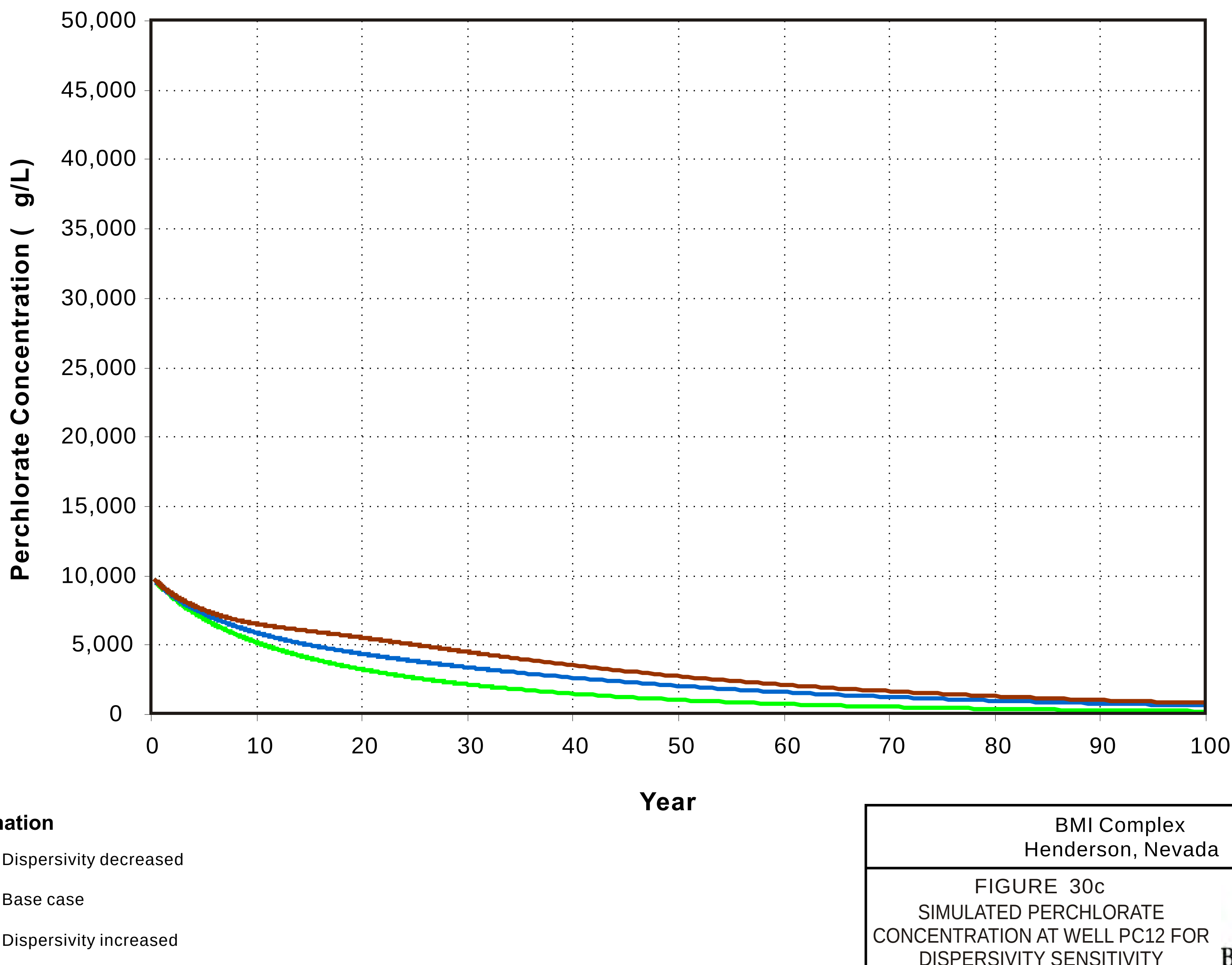
S:\Projects\BRC\ES10.0042_BRC_Transport_Model_Runs\VR_Drawings\Fig_Sensitivity_Summary_Dispersivity.cdr



BMI Complex
Henderson, Nevada

FIGURE 30c
SIMULATED PERCHLORATE CONCENTRATION AT WELL PC12 FOR DISPERSIVITY SENSITIVITY
LAYER 11

Basic Remediation COMPANY

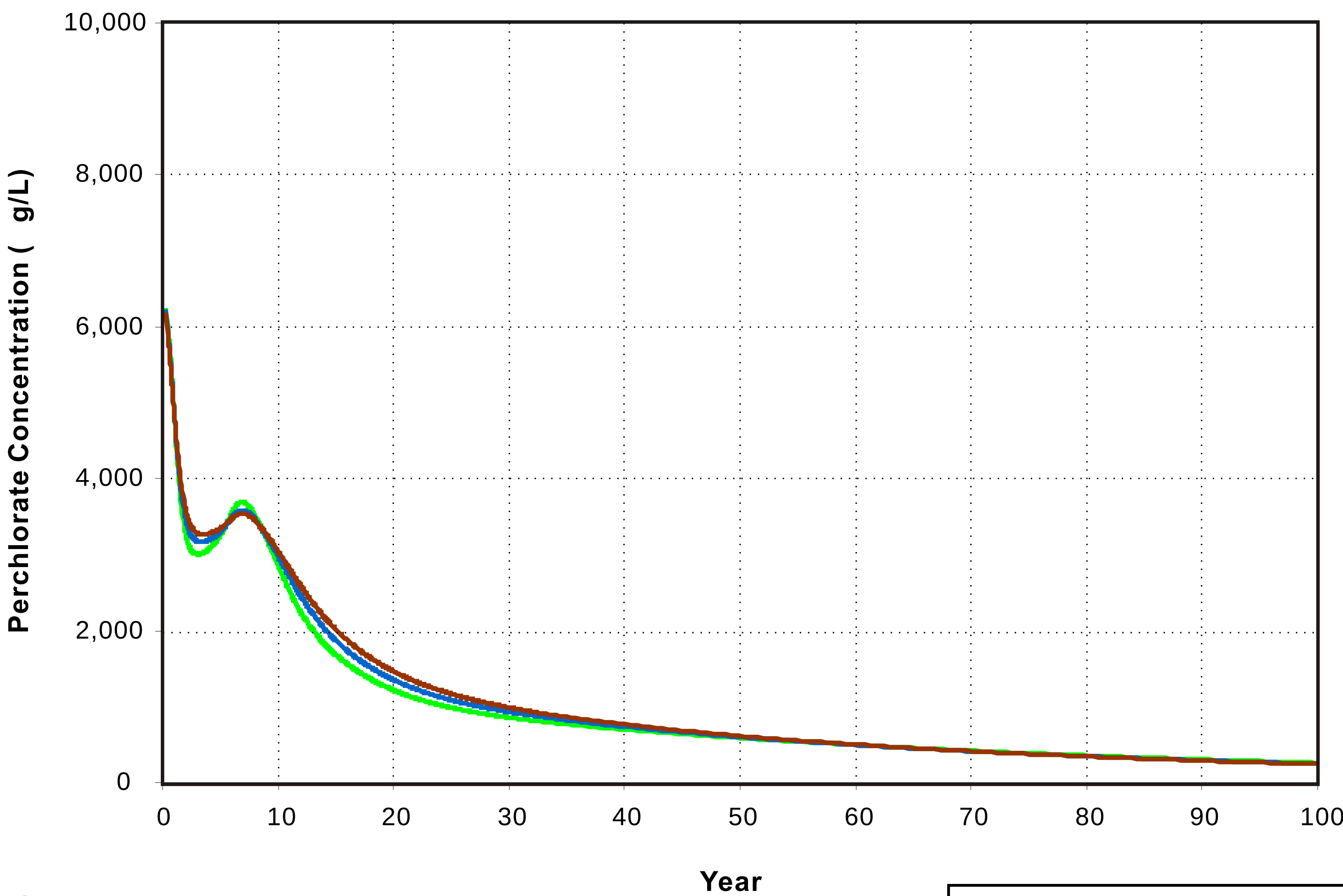
Prepared by: DBS&A GHS

Date 5/26/10

S:\Projects\BRC\ES10.0042_BRC_Transport_Model_Runs\VR_Drawings\Fig_Sensitivity_Summary_Dispersivity.cdr

Daniel B. Stephens & Associates, Inc.

JN ES10.0042



Explanation

- Dispersivity decreased
- Base case
- Dispersivity increased

BMI Complex
Henderson, Nevada

FIGURE 31a
SIMULATED PERCHLORATE CONCENTRATION AT WELL AA-20 FOR DISPERSIVITY SENSITIVITY
LAYER 1

Basic Remediation COMPANY

Prepared by:		Date	
DBS&A	GHS	5/26/10	S:\Projects\BRC\ES10.0042_BRC_Transport_Model_Runs\VR_Drawings\Fig_Sensitivity_Summary_Dispersivity.cdr

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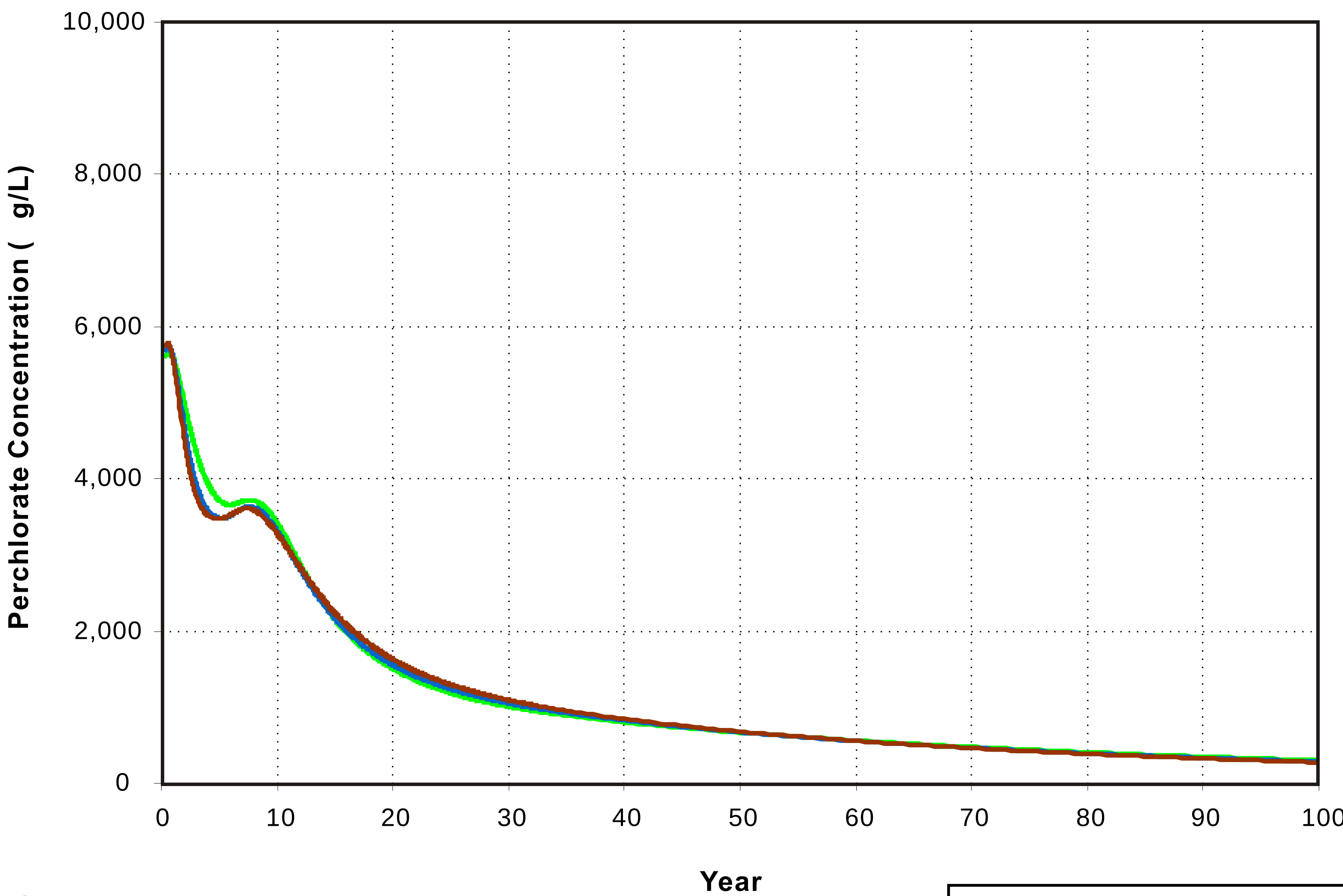

Explanation

- Dispersivity decreased
- Base case
- Dispersivity increased

BMI Complex
Henderson, Nevada

FIGURE 31b
SIMULATED PERCHLORATE CONCENTRATION AT WELL AA-20 FOR DISPERSIVITY SENSITIVITY
LAYER 2

Basic Remediation COMPANY

Prepared by:		Date
DBS&A	GHS	5/26/10

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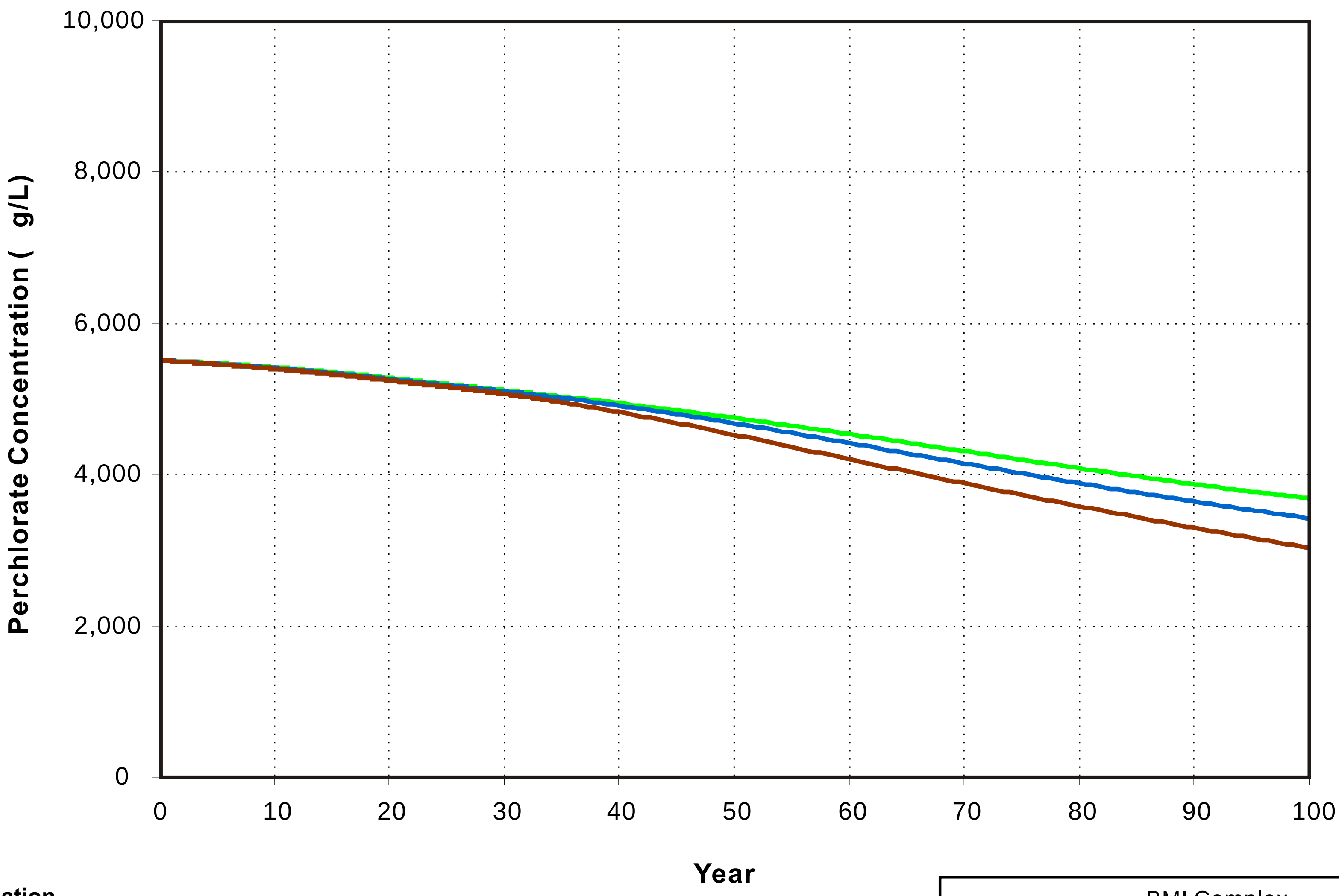

Explanation

- Dispersivity decreased
- Base case
- Dispersivity increased

BMI Complex
Henderson, Nevada

FIGURE 31c
SIMULATED PERCHLORATE CONCENTRATION AT WELL AA-20 FOR DISPERSIVITY SENSITIVITY
LAYER 11

Basic Remediation COMPANY

Prepared by: DBS&A GHS | Date 5/26/10

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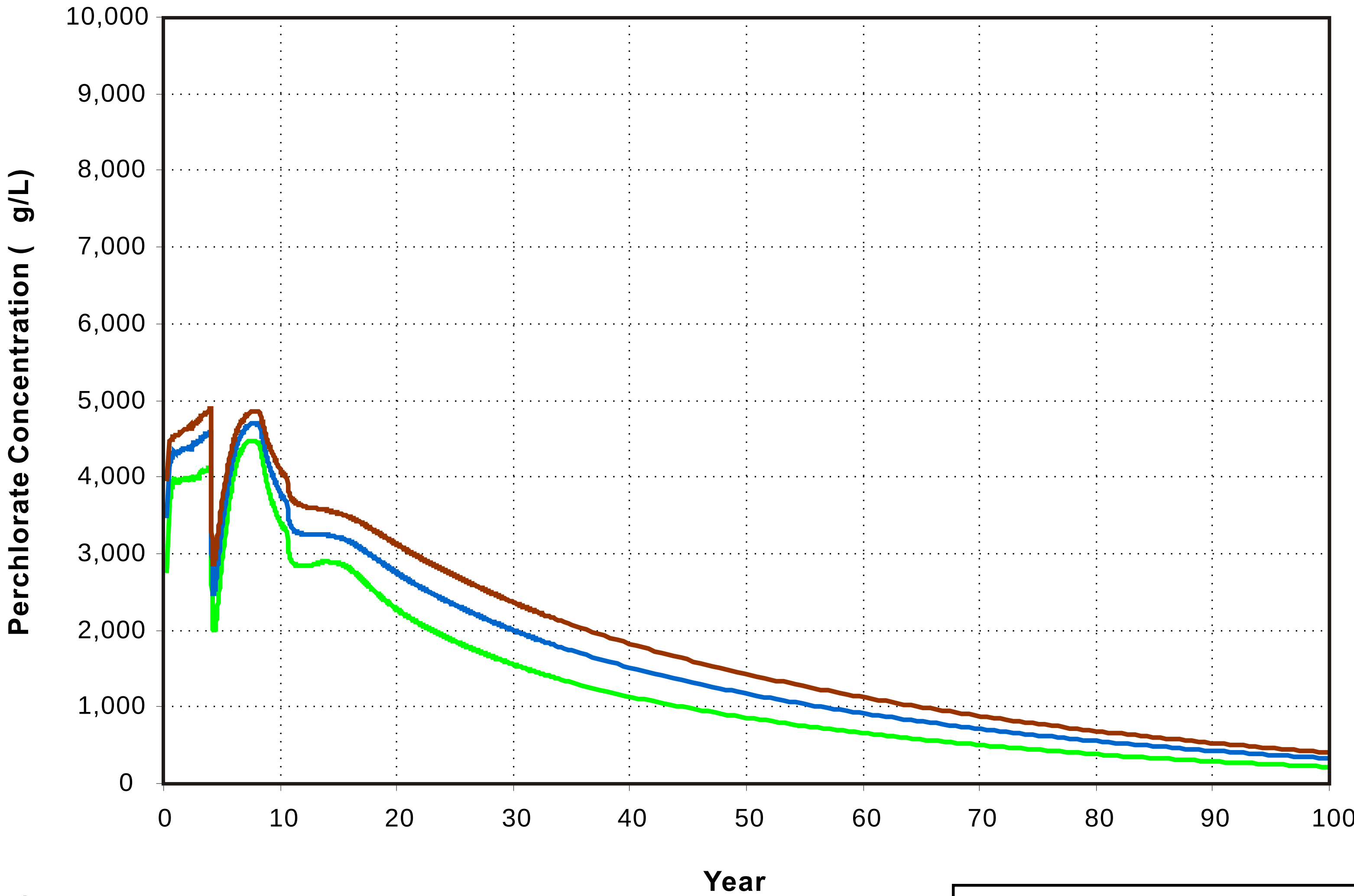

Explanation

- Dispersivity decreased
- Base case
- Dispersivity increased

BMI Complex
Henderson, Nevada

FIGURE 32a
SIMULATED PERCHLORATE CONCENTRATION AT WELL AA-18 FOR DISPERSIVITY SENSITIVITY
LAYER 1

Basic Remediation COMPANY

Prepared by:		Date	
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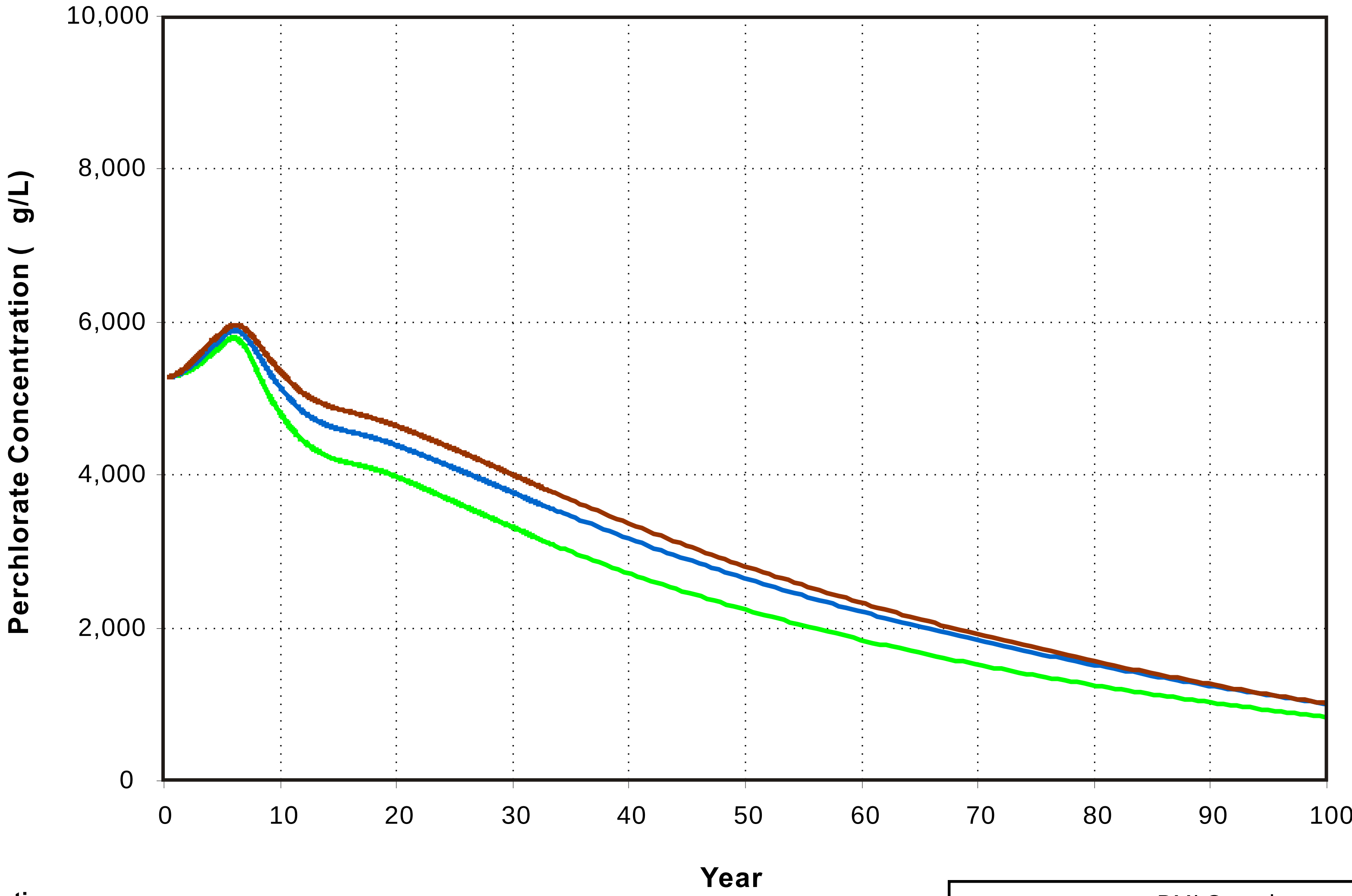

Explanation

- Dispersivity decreased
- Base case
- Dispersivity increased

BMI Complex
Henderson, Nevada

FIGURE 32b
SIMULATED PERCHLORATE CONCENTRATION AT WELL AA-18 FOR DISPERSIVITY SENSITIVITY
LAYER 2

Basic Remediation COMPANY

Prepared by: DBS&A GHS | Date 5/26/10

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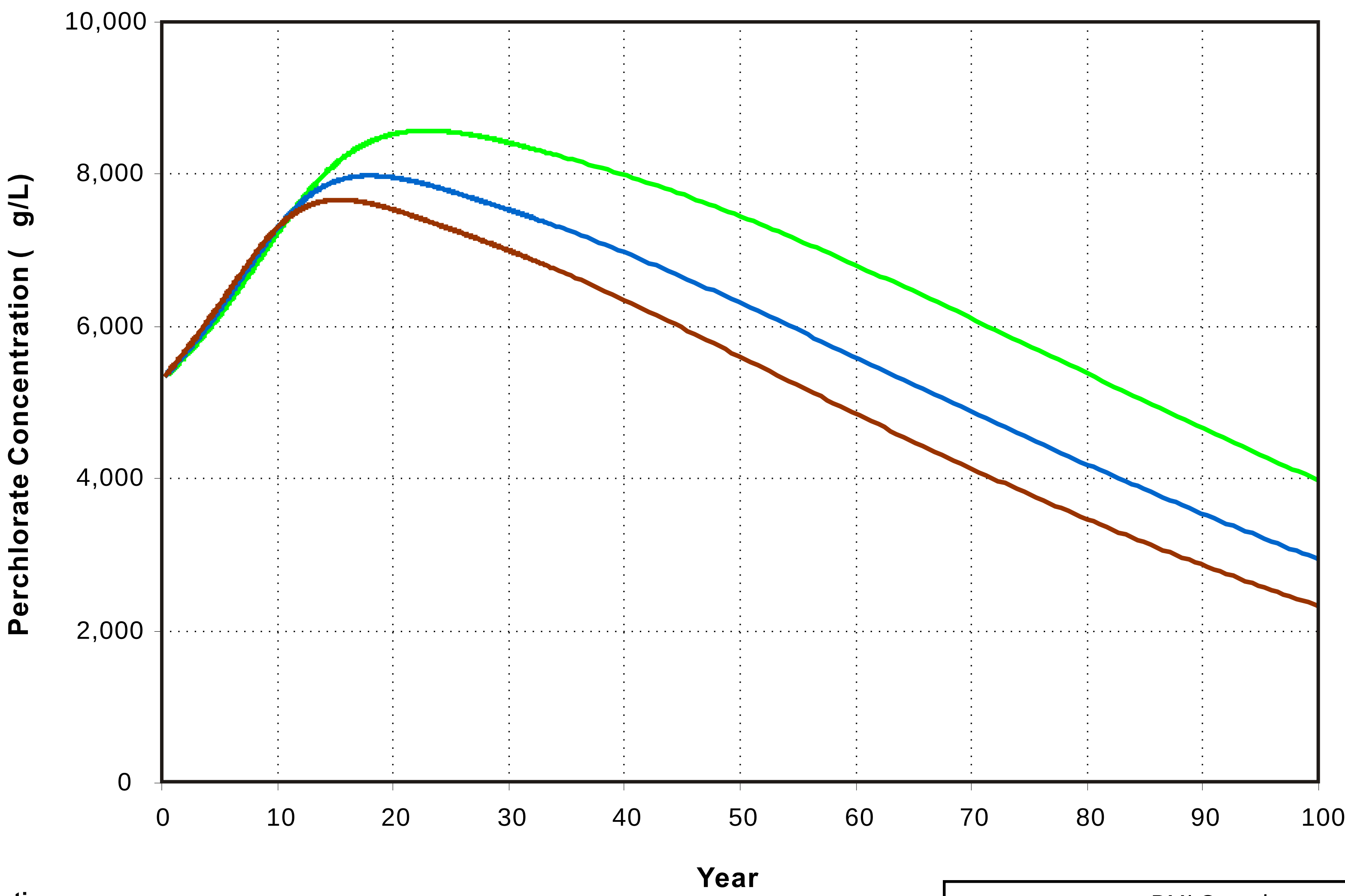

Explanation

- Dispersivity decreased
- Base case
- Dispersivity increased

BMI Complex
Henderson, Nevada

FIGURE 32c
SIMULATED PERCHLORATE CONCENTRATION AT WELL AA-18 FOR DISPERSIVITY SENSITIVITY
LAYER 11

Basic Remediation COMPANY

Prepared by:		Date	
DBS&A	GHS	5/26/10	S:\Projects\BRC\ES10.0042_BRC_Transport_Model_Runs\VR_Drawings\Fig_Sensitivity_Summary_Dispersivity.cdr

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Appendix A

Selenium Loading Calculations

N

0 0.5 1 Miles

Base Map Source: Aerial photograph, April 2006-2009
Source: SNWA (2009); USGS (2009)

Explanation

SNWA LW 8.85 SNWA water sampling station
USGS 9419679 USGS flow gauge
BRC Eastside property boundary

Notes:
1. SNWA – Southern Nevada Water Authority
2. USGS – U.S. Geological Survey

BMI Complex
Henderson, Nevada

FIGURE A-1
USGS and SNWA
Sampling Stations in the
Las Vegas Wash
Henderson, NV

Basic Remediation Company

Prepared by: DBS&A CRS
Date 05-24-2010
S:/PROJECTS/BRC/ES10.0042_BRC_TRANSPORT_MODEL_RUNS/GIS/MXDS/FIGUREA-1_USGS_AND_SNWA_SAMPLING_STATIONS.MXD 014250

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Table A-1. Estimate of Selenium Loading to the Las Vegas Wash

SNWA Sample Location	SNWA Station	Average Selenium Concentration [a] (µg/L)	Nearest USGS Stream Gauge with Data	USGS Station Location	Discharge [b]			Selenium Discharge		Change in Selenium Discharge (Loading) (lb/d)
					ft^3/s	ft^3/d	L/d	µg/d	lb/d	
Estimate Using USGS Long-Term Mean Flow										
Upstream City of Las Vegas	LW10.75	13.4	9419679	Las Vegas Wasteway Nr E Las Vegas, NV	183	1.58×10^{7}	4.48×10^{8}	6.00×10^{9}	13.2	—
Upstream Pabco Weir	LW8.85	2.6	9419679	Las Vegas Wasteway Nr E Las Vegas, NV	183	1.58×10^{7}	4.48×10^{8}	1.16×10^{9}	2.6	–10.7
Downstream Pabco Weir	LW6.85	4.3	9419700	Las Vegas Wash at Pabco Rd Nr Henderson, NV	106	9.16×10^{6}	2.59×10^{8}	1.12×10^{9}	2.5	–0.1
Upstream Historical Lateral Weir	LW5.9	3.0	9419700	Las Vegas Wash at Pabco Rd Nr Henderson, NV	106	9.16×10^{6}	2.59×10^{8}	7.78×10^{8}	1.7	–0.7
Downstream Historical Lateral Weir	LW5.5	3.3	9419700	Las Vegas Wash at Pabco Rd Nr Henderson, NV	106	9.16×10^{6}	2.59×10^{8}	8.56×10^{8}	1.9	0.2
Upstream Demonstration Weir	LW4.95	3.2	9419700	Las Vegas Wash at Pabco Rd Nr Henderson, NV	106	9.16×10^{6}	2.59×10^{8}	8.30×10^{8}	1.8	–0.1
Downstream Demonstration Weir	LW3.1	3.1	9419753	Las Vegas Wash abv Three Kids Wash blw Henderson, NV	244	2.11×10^{7}	5.97×10^{8}	1.85×10^{9}	4.1	2.3
Downstream Lake Las Vegas	LW0.8	3.0	9419800	Las Vegas Wash blw Lake Las Vegas Nr Boulder City, NV	144	1.24×10^{7}	3.52×10^{8}	1.06×10^{9}	2.3	–1.7
Estimate Using January 19, 2009 Flow Data										
Upstream City of Las Vegas	LW10.75	13.4	9419679	Las Vegas Wasteway Nr E Las Vegas, NV	343	2.96×10^{7}	8.39×10^{8}	1.12×10^{10}	24.8	—
Upstream Pabco Weir	LW8.85	2.6	9419679	Las Vegas Wasteway Nr E Las Vegas, NV	343	2.96×10^{7}	8.39×10^{8}	2.18×10^{9}	4.8	–20.0
Downstream Pabco Weir	LW6.85	4.3	9419700	Las Vegas Wash at Pabco Rd Nr Henderson, NV	315	2.72×10^{7}	7.71×10^{8}	3.31×10^{9}	7.3	2.5
Upstream Historical Lateral Weir	LW5.9	3.0	9419700	Las Vegas Wash at Pabco Rd Nr Henderson, NV	315	2.72×10^{7}	7.71×10^{8}	2.31×10^{9}	5.1	–2.2
Downstream Historical Lateral Weir	LW5.5	3.3	9419700	Las Vegas Wash at Pabco Rd Nr Henderson, NV	315	2.72×10^{7}	7.71×10^{8}	2.54×10^{9}	5.6	0.5
Upstream Demonstration Weir	LW4.95	3.2	9419700	Las Vegas Wash at Pabco Rd Nr Henderson, NV	315	2.72×10^{7}	7.71×10^{8}	2.47×10^{9}	5.4	–0.2
Downstream Demonstration Weir	LW3.1	3.1	9419753	Las Vegas Wash abv Three Kids Wash blw Henderson, NV	404	3.49×10^{7}	9.88×10^{8}	3.06×10^{9}	6.8	1.3
Downstream Lake Las Vegas	LW0.8	3.0	9419800	Las Vegas Wash blw Lake Las Vegas Nr Boulder City, NV	337	2.91×10^{7}	8.24×10^{8}	2.47×10^{9}	5.5	–1.3

[a] Data from the Southern Nevada Water Authority (SNWA) monitoring program for the Las Vegas Wash; provided by Basic Remediation Company (BRC).
[b] First set of estimates uses U.S. Geological Survey (USGS) long-term mean flow data (period not defined) as of January 19, 2009. Second set of estimates uses USGS flow data collected January 19, 2009. All flow data provided by BRC.

µg/L = Micrograms per liter
ft^3/s = Cubic feet per second
ft^3/d = Cubic feet per day
L/d = Liters per day
µg/d = Micrograms per day
lb/d = Pounds per day