Solute Transport Modeling

Work Plan

BMI Upper and Lower Ponds Area

Submitted to:

October 2, 2009

Prepared for:

Daniel B. Stephens & Associates, Inc.

6020 Academy NE, Suite 100 • Albuquerque, New Mexico 87109

Responsible CEM for this Project

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.

Stephen J. Cullen, Ph.D., C.E.M. (No. 1839, Exp. 11/12/09)
Daniel B. Stephens & Associates, Inc.

Individuals Who Provided Technical Input to this Document

T. Neil Blandford, P.G.
Daniel B. Stephens & Associates, Inc.

John J. Dodge, P.G.
Daniel B. Stephens & Associates, Inc.

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1. Introduction

This document is a proposed work plan for solute transport modeling at the Basic Remediation Company (BRC) Eastside property (the Site) delineated in Figure 1. The modeling is to be completed by Daniel B. Stephens & Associates, Inc. (DBS&A) on behalf of BRC for submittal to the Nevada Division of Environmental Protection (NDEP). The model developed under this work plan will be referred to as the BRC Eastside Site solute transport model. The Site solute transport model will be based on the groundwater flow model documented in DBS&A (2009) and approved by NDEP on July 24, 2009, with some modifications to recharge as discussed in Section 5 below. This work plan is consistent with the previous modeling work plan submitted by BRC (DBS&A, 2006), with appropriate updates or revisions based on the simulation results of the BRC Eastside Site groundwater flow model.

A draft transport model work plan was prepared and submitted to NDEP on September 8, 2009. NDEP comments (dated September 14, 2009) to the draft work plan were discussed in a teleconference with NDEP on September 24, 2009. BRC's responses to NDEP comments are incorporated into this revised work plan as Appendix A.

The term "Site" as used in this document refers specifically to the BRC Eastside property, which includes the Upper and Lower Ponds area (Figure 1). Some areas that are not owned by BRC, but are adjacent to the BRC property, are included in the model domain in order to develop a physically reasonable groundwater flow and solute transport model. Where a distinction in terms is important, the terms "Site" and "model domain" will be used to convey the relevant distinction.

The remainder of this work plan consists of the following sections:

- Section 2. Statement of Model Purpose
- Section 3. ASTM Standard Guides
- Section 4. Computer Code Selection
- Section 5. Numerical Model Development
- Section 6. Predictive Simulations

- Section 7. Sensitivity Analysis
- Section 8. Documentation

It is BRC's intent to coordinate with NDEP during model development. BRC will be responsible for coordinating and scheduling all meetings and conference calls as appropriate.

2. Statement of Model Purpose

The intended purpose of the solute transport modeling is stated in DBS&A (2006) as follows:

> Evaluate the current and future transport and discharge of dissolved contaminants in groundwater from the Site to the Las Vegas Wash, either directly or indirectly. This also includes evaluation of the potential effects that a rising water table may have on future contaminant transport, including remobilization of contaminants that potentially exist in the vadose zone beneath source areas. In addition, this includes evaluation of contaminant mass flux to the upper unconfined water-bearing zone through leaching of contaminants in the vadose zone due to recharge.

The predictive solute transport simulations will be based on the predictive groundwater flow simulations, where expected changes at the land surface across the Site are accounted for. As a screening level evaluation of model results, predicted solute concentrations will be compared to U.S. Environmental Protection Agency (EPA) maximum contaminant levels (MCLs) and State of Nevada Las Vegas Wash receiving water standards.

The predictive simulations documented in DBS&A (2009) indicate that water levels within the uppermost water-bearing unit, the Quaternary alluvium (Qal), are expected to decline in the future, rather than rise above current or recent levels. This result is true even for the case where greater than expected recharge is applied across the Site. This result is due primarily to the elimination or reduction of significant sources of recharge on or adjacent to the Site, such as the City of Henderson (CoH) Southern and Northern Rapid Infiltration Basins (RIBs). Consequently, BRC believes that the potential remobilization of contaminants in the vadose zone due to a rising water table is no longer a significant potential process of concern. However, predicted movement of the water table will be monitored during the simulations to confirm this expectation, particularly in the vicinity of potential source areas.

In addition, the proposed approach to conducting estimates of contaminant mass flux to the water table through leaching of contaminants in the vadose zone due to recharge is not presented in this work plan. This component of the modeling is being conducted by another BRC consultant (ERM), and the approach and results of these computations are or will be documented separately. The results of these analyses will be incorporated into the Site solute transport model as described in Section 6.

3. ASTM Standard Guides

The American Society for Testing and Materials (ASTM) has developed a series of Standard Guides for certain aspects of groundwater flow and solute transport modeling. At the request of NDEP, these Standard Guides were consulted and used as appropriate during development and application of the BRC Site groundwater flow model. ASTM Standard Guide D-5880-95, Subsurface Flow and Transport Modeling, will be followed during application of the BRC Site solute transport model.

It should be noted that the above documents were specifically developed as Standard Guides, rather than standards, in recognition of the state of the art of groundwater model development and with appreciation for the site-specific nature of modeling applications. Due to site-specific conditions and complexities, available data, computer code limitations, and a variety of other factors, the ASTM development committees recognized that it is not possible or appropriate to prescribe every step or detail in the modeling process in a set of formal standards. As such, BRC will use the ASTM Standard Guide D-5880-95 as a guidance document, consistent with its intended use.

4. Computer Code Selection

In accordance with the Groundwater Modeling Work Plan (DBS&A, 2006) and the completed BRC Site groundwater model (DBS&A, 2009), the MODFLOW-SURFACT code developed by HydroGeoLogic, Inc. of Herndon, Virginia will be used to simulate saturated zone solute transport. MODFLOW-SURFACT is an upgraded, proprietary version of the U.S. Geological Survey (USGS) MODFLOW code that can be commercially purchased. The code includes all of the functionality of the standard MODFLOW-98 software developed by the USGS, but also includes a number of added simulation capabilities and advanced simulation algorithms that will be useful for simulating groundwater flow and solute transport beneath the Site. MODFLOW-SURFACT has been employed by numerous governmental and private entities since 1996, and contains the following primary simulation capabilities and advantages:

- Saturated or variably saturated three-dimensional groundwater flow for water of uniform density and temperature for steady-state or transient conditions. The saturated groundwater flow module will be used for the Site.

- Advanced solution algorithm for rigorous simulation of model cell drying (simulated water level below the base elevation of the cell) and rewetting that conserves mass balance. This capability is very useful for simulating groundwater flow in hydrogeologic units of limited saturated thickness, such as occurs within the alluvium at the Site.

- Full three-dimensional transport simulation capability for saturated or variably saturated groundwater flow that accounts for advection, dispersion, linear and non-linear retardation, and constituent decay.

A full description of the MODFLOW-SURFACT code is available online at www.hgl.com. Once at the home page, the user can browse to “modeling”, then “software”, then “MODFLOW SURFACT”.

5. Numerical Model Development

This task involves development of the solute transport model so it can be used for predictive simulations. The groundwater flow model is documented in DBS&A (2009) and associated NDEP comments and BRC responses to comments related to that report. As agreed to in BRC's response to comments dated June 16, 2009, the recharge applied to developed and undeveloped areas for the current condition groundwater flow model need to be updated prior to use of the model for new predictive simulations, including solute transport simulations. The overall proposed approach to the solute transport model development is outlined below. Note that the solute transport model is based to a very large extent on the existing groundwater flow model. Details of the groundwater flow model are provided in DBS&A (2009) and are not reproduced or explained further in this work plan.

5.1 Groundwater Flow Model Update

The current version of the groundwater flow model will be updated to adjust the prescribed recharge beneath developed and undeveloped areas as agreed to in BRC's response to comments dated June 16, 2009. Specifically, prescribed recharge beneath undeveloped areas will be adjusted downward to 2 percent of average annual precipitation, which is about 4 inches per year or less, and prescribed recharge beneath developed areas will be increased in order to maintain model calibration. Once the current period model is recalibrated to the adjusted recharge values, the base case predictive simulation will be rerun based on the updated recharge values. Previous parameter estimation runs conducted using the inverse parameter estimation code PEST (Watermark Numerical Computing, 2004) indicate that this adjustment will not cause a significant change in the current period simulation results. To the extent possible, available literature references and BRC's prior estimates for recharge will be cited to support the recharge value determined using the model.

Once this task is completed, a brief letter report that summarizes the updated groundwater model calibration for the current simulation period (2007) will be provided to NDEP. The letter report will describe the adjusted recharge values used and will provide several plots to illustrate that the updated model has remained reasonably calibrated to observed Qal and Upper Muddy

Creek Formation (UMCf) water levels. The letter report will also document predicted movement of the water table under build-out conditions. BRC intends to obtain NDEP's concurrence on the updated groundwater flow model simulations prior to conducting the solute transport simulations.

5.2 Solute Transport Boundary Conditions

In order to conduct solute transport simulations, all model boundary conditions need to be assessed with regard to solute concentration. This section summarizes the boundary conditions that will be applicable to the predictive simulation model and the proposed approach to assigning solute concentration. Prescribed solute concentration is only required for boundary types that allow for the inflow of groundwater. Where groundwater exits the model domain, the concentration of the exiting water is simulated by the model. Examples of boundary conditions used in the Site groundwater model that allow for the efflux of water include general head, prescribed head, prescribed flux (including wells), and drains.

Boundary conditions applied in the Site groundwater model that allow for the inflow of groundwater include general head (model layers 1 and 2), prescribed head (model layer 2), and prescribed flux, including wells (model layers 1 and 2). For each of these boundary types, the prescribed concentration will be determined based on observed conditions and monitoring data. For example, constituent concentrations assigned to prescribed influx boundaries will be based on contour maps developed from monitor well data (note that prescribed solute concentration can be zero). Prescribed solute concentration for recharge will be zero, with the exception of known or potential source areas as described in Section 6. Solute concentration assigned to the CoH RIBs, the Birding Preserve, and the AMPAC injection wells will also be based on reported data; they are expected to be very low.

Inflow from the south within the main paleochannel that crosses beneath the Western Hook Area will be a significant source of solute mass flux into the Western Hook Area. Additional mass flux is expected to occur from the off-site Plants Area as well. The Tronox Athens Road Well Field extracts a portion of this impacted water, and recharge from the CoH Water Treatment Facility and the Birding Preserve will dilute solute concentrations in this area. Solute concentrations assigned to the groundwater inflow will be based on current observed concentrations, but will be reduced in the future based on observed concentration trends at monitor wells closest to the boundary. If the monitor wells do not indicate a discernable reduction in concentration, then assigned values will be held constant. Additional information regarding remedial measures that are being or will be conducted by other parties will also be considered to the extent information is available. For example, if groundwater capture systems are planned that should reduce constituent concentrations at the model boundary, assumed reductions in prescribed solute concentrations can be applied in the predictive simulations. All assumptions regarding boundary flux assigned constituent concentrations will be documented in the transport modeling report.

In the predictive simulations provided in DBS&A (2009), evapotranspiration is set to zero. The same approach is proposed for the solute transport model; therefore, there will be no evapotranspiration flux. In the MODFLOW-SURFACT code, evapotranspiration will not remove solutes from the groundwater system, but may have the effect of increasing concentrations through removal of water. This approach is conservative for some constituents from the aspect that it may simulate greater solute concentrations in regions of evapotranspiration than would actually occur. For example, perchlorate can be removed from groundwater through evapotranspiration and be retained in plant tissue. However, this process is not expected to be of significant concern based on the groundwater flow model simulation results.

5.3 Solute Transport Hydraulic Properties

Hydraulic inputs required for solute transport modeling include effective porosity and longitudinal, lateral, and vertical dispersion coefficients. These parameters will be estimated based on published literature values and relevant site information. For example, the effective porosity will be less than total porosity as measured from core samples. Effective porosity will be calculated for layer-specific soils from measurements of total porosity and field capacity water content made on the soil cores acquired in the field; it will also be estimated based on material type, literature values, and possibly analytical calculations of solute transport.

The lateral and vertical dispersivities will be 10 and 100 times less than the longitudinal value, respectively (Gelhar et al., 1992). The longitudinal dispersivity will be based on analyses presented in Xu and Eckstein (1995), which build on the work of Gelhar et al. (1992) and Neuman (1990). Neuman (1990) and Gelhar et al. (1992) present analyses of the effects of spatial scale on the magnitude of dispersivity; their analyses are based on a large dataset of applied dispersivity values determined through field investigation and model calibration. The weighted regression equation (14b) in Xu and Eckstein (1995) provides a basis for estimating the longitudinal dispersivity for a given field scale of contaminant transport for the case where observed dispersivities from field data are more highly weighted than those determined through modeling studies. BRC believes that this is the most appropriate approach because dispersivity values determined from previous modeling studies encompass the limitations and errors inherent in those studies. Equation 14b from Xu and Eckstein (1995) is as follows:

$$\alpha_L = 0.83\ (\log_{10} L)^{2.414}$$

where α_L = the longitudinal dispersivity (meters)

L = the field scale over which the dispersivity applies (meters)

Assuming a field scale (L) of about 3,000 meters (the approximate distance from the southern edge of the Upper Ponds area to Las Vegas Wash), the resultant longitudinal dispersivity is about 17 meters, or 55 feet. BRC proposes to use this value for initial transport simulations, with possible subsequent adjustments based on transport simulation results and input from NDEP. Xu and Eckstein (1995, p. 908) also note that for L greater than about 1,000 meters, the increase in longitudinal dispersivity ". . . is so small that it can practically be ignored without causing significant error." Therefore, at the length scale of contaminant transport that has occurred at the Site, it is expected that the longitudinal dispersivity has essentially attained its maximum expected value.

Simulation of the transport of relatively conservative constituents, such as perchlorate (IT&RC, 2005 and Tipton et al., 2003), does not require consideration of the retardation coefficient (R). For conservative constituents, solute transport is assumed to occur at the same rate as the pore velocity of the groundwater. For constituents that exhibit transport velocities less than that of groundwater, such as various forms of arsenic, the simulation approach requires consideration of R. R is constituent dependent, and will be calculated using the retardation equation (Dragun, 1988) incorporating distribution coefficients (K_d) calculated from the product of Site-specific values (e.g., fraction organic content [f_{oc}]) and published scientific literature values (e.g., organic carbon partition coefficient [K_{oc}]) for modeled organic constituents. K_d values for inorganic constituents will be determined using published scientific literature values for the appropriate redox (eH-pH) range for the Site.

Site data as reported in the Closure Plan (BRC et al., 2006) indicate that volatile organic constituents are of relatively minor concern at the Site and within the model domain. Therefore, Site vapor transport in the vadose zone will not be simulated.

The relative effects of alternative values of hydraulic transport parameters will be evaluated in a sensitivity analysis (Section 7).

6. Predictive Simulations

Predictive groundwater flow simulations will be conducted using the simulated groundwater flow field from the current conditions simulation (as updated for recharge as described in Section 5) as the starting point for the predictive simulation. BRC anticipates that predictive simulations will be conducted for a period of 50 years, although longer time frames will be simulated if needed. The hydrologic effects of anticipated changes in land use will be incorporated into the model through anticipated changes in groundwater recharge, as was done in DBS&A (2009).

Predictive solute transport simulations will be conducted based on the results of the groundwater flow predictive simulations. Initial constituent concentrations (representative of current conditions) within each model layer will be entered into the model based on observed data and interpreted contaminant plume maps. This approach requires that an estimated solute concentration be provided for every active model cell (note that the estimated concentration can be zero). In addition, solute concentration associated with boundary inflow terms, such as prescribed flux, recharge, or general head boundaries also need to be prescribed. Estimation of boundary term solute concentrations will also be based on observed data.

As discussed with NDEP, BRC will follow a phased approached to transport model development. For initial model development, BRC plans to simulate transport of a relatively conservative solute (perchlorate) and a relatively non-conservative solute (arsenic) to bracket an expected range of minimum and maximum transport distance. The results of these first two model runs will be submitted to NDEP for review and comment on overall model setup before a larger set of simulations is completed with other analytes of interest.

BRC will review the Site groundwater monitoring data (all rounds) to develop a proposed list of analytes that will be simulated in the transport model. As discussed with NDEP, the list of analytes will consist of those parameters that exceed U.S. EPA MCLs. For those parameters that do not have an assigned MCL, basic cleanup levels (BCLs) will be used as the screening criteria to develop a proposed list of analytes that will be simulated in the transport model. It is anticipated that analytes without a BCL will not be modeled (with NDEP approval). In addition, the initial model runs and the draft list of proposed analytes to be simulated will be reviewed to determine whether certain solutes or classes may be ruled out as a remaining risk to be investigated.

BRC intends to conduct two sets of predictive solute transport simulations for each selected constituent, as described below:

- *Base Case Simulation*: The base case simulation will consider the future migration of each selected constituent that already exists in groundwater. This approach will assume that inputs of additional contaminants due to recharge from the surface are zero, although mass input may occur at various model boundaries, depending on observed data.

- *Added Source Simulation*: The added source simulation will consist of the base case simulation with potential sources of contaminant due to recharge added through time, as indicated by the results of the vadose zone leaching models that have been, or will be, completed for the multiple source investigation sub-areas. The first sub-area (Mohawk) has already been completed using the approach where the leaching model is based on a maximum soil concentration column, which is the combination of the results from multiple soil cores. The area over which each source term is applied will need to be estimated. Although the first set of transport model simulations will be completed prior to completion of the full set of vadose zone models, selected example source term inputs will be used for non-completed source term inputs pending completion of final source term characterization.

Conducting the solute transport simulations in this manner will allow for the comparison of the two sets of simulation results, thereby allowing evaluation of the potential effects of continuing near-surface sources on solute concentrations in groundwater.

7. Sensitivity Analysis

Sensitivity analysis will be conducted for all key model input parameters, and the results will be reported in the model documentation. Expected solute transport model input parameters that will be considered in the sensitivity analyses include effective porosity, dispersion coefficients, retardation coefficients, and solute source term strength. The sensitivity analysis will be conducted in accordance with ASTM Standard Guide D-5611.

8. Documentation

All of the modeling tasks presented above will be thoroughly documented in a completion report. The report and electronic model input and output files will be provided to NDEP in draft form for review and comment prior to completion of the final report and submission of the final modeling electronic files.

References

Basic Remediation Company (BRC), Environmental Resources Management (ERM), Montgomery Watson Harza (MWH), and Daniel B. Stephens & Associates, Inc. (DBS&A). 2006. *BRC closure plan, BMI Common Areas, Clark County, Nevada.* August 2006.

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Neuman, S.P. 1990. Universal scaling of hydraulic conductivities and dispersivities in geologic media. *Water Resources Research* 26(8):1749-1758.

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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.

Figure

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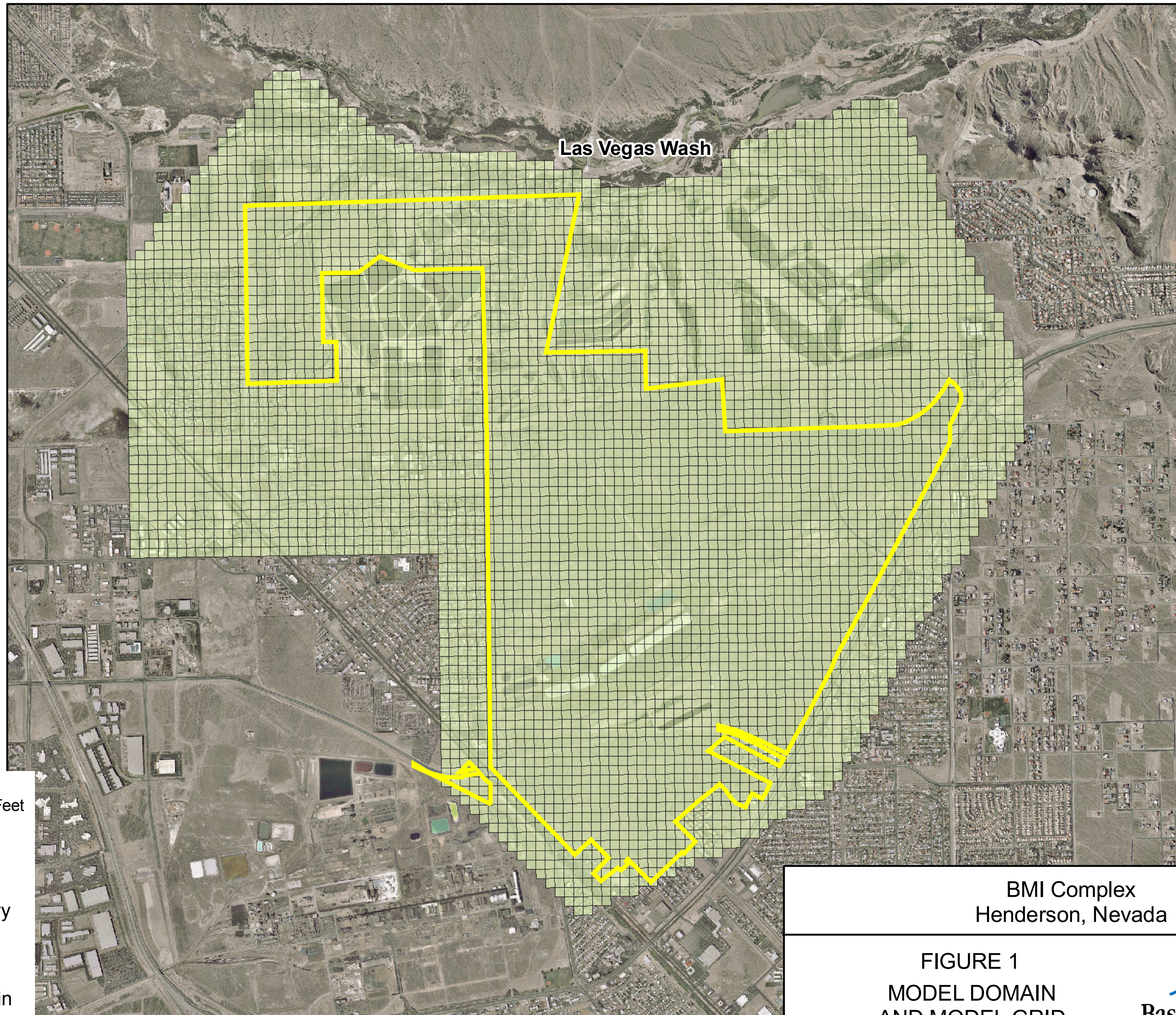

N

0 1,750 3,500 Feet

Explanation

- Site boundary
- Model grid
- Model domain

Source: Aerial photograph, April 2004

BMI Complex
Henderson, Nevada

FIGURE 1
MODEL DOMAIN
AND MODEL GRID

Basic Remediation
COMPANY

Prepared by:		Date	
DBS&A	GJ	9/8/09	S:/PROJECTS/BRC/ES09.0057_MODEL_UPDATE/GIS/MXDS/WORK_PLAN_FIGURES_9-09/FIG01_MODEL_DOMAIN_AND_MODEL_GRID.MXD 908090

Daniel B. Stephens & Associates, Inc.
JN ES09.0057

Figure 1

Appendix A

Response to NDEP Comments

Response to Nevada Division of Environmental Protection (NDEP) Comments dated September 14, 2009 regarding
Solute Transport Modeling Work Plan, BMI Upper and Lower Ponds Area,
dated September 8, 2009
NDEP Facility ID# H-000688

1. General comment, although the subject work plan covers the appropriate procedures, it is lacking in detail as discussed in this review.

Response: BRC provides responses below and has provided an updated version of the work plan that reflects our response to comments where appropriate.

2. Section 2, Statement of Model Purpose, Page 2, the NDEP has the following comments:
   a. Despite BRC's belief that "a rising water table is no longer a significant potential process of concern", NDEP expects that the modeling effort will continue to evaluate such effects and their regards to contaminant transport, especially pending the proposed changes to recharge distributions.

Response: BRC will continue to assess the magnitude of water level change under predictive (site development) conditions, and will report these observations in the memorandum that will provide the groundwater model simulation results for the updated recharge distribution.

   b. Please include in this Section a discussion of how the simulated solute concentrations will be used, *e.g.*, comparison to USEPA MCLs and/or Las Vegas Wash (receiving water) standards. Such a comparison is in effect a risk-based evaluation.

Response: BRC anticipates that the simulated solute concentrations will be compared to each of these sets of standards as a screening-level comparison. Where a solute is predicted to fail to meet the screening level(s), there may be additional investigation and analysis as appropriate.

3. Section 5, Numerical Model Development, NDEP suggests distributing draft figures for the letter report for informal comment, prior to submitting the letter report. Since NDEP anticipates that changes to the most recent groundwater flow model output will be nominal, this may speed NDEP concurrence for the letter report.

Response: BRC appreciates this suggestion and will follow this approach.

4. Section 5.1, Groundwater Flow Model Update, as recharge applied to developed areas is increased to preserve calibration upon decreasing recharge to undeveloped areas, please also reference previous BRC calculations and/or other references regarding recharge resulting from inefficient water utility delivery systems.

Response: BRC will reference these items as requested. Prior BRC estimates and literature references will be cited to the extent possible in addition to values obtained through groundwater flow model calibration. The intent is to support values derived through model calibration through published literature to the extent possible.

5. Section 5.2, Solute Transport Boundary Conditions, Pages 6 and 7, the NDEP has the following comments:
    a. Although this Section may or may not be the appropriate place, BRC should discuss the solutes planned for the modeling process. This discussion needs to include a discussion of the site-related chemicals (SRC) list. A table presenting the SRC list including whether each solute will be modeled or not, and rationale would be useful.

Response: The solutes planned for the modeling process are discussed in Section 6 (third paragraph). As discussed with NDEP, BRC will follow a phased approached to model development. For initial model development, BRC plans to simulate transport of a relatively conservative solute (perchlorate) and a relatively non-conservative solute (arsenic) to bracket an expected range of minimum and maximum transport distance and solute transport model behavior. The results of these first two model runs will be submitted to NDEP for review and comment on overall model setup and approach before a larger set of simulations is completed for other analytes of interest.

As noted in BRC's Eastside groundwater monitoring reports, BRC developed and used the SRC list to initially identify potential analytes for subsequent soil and groundwater investigations and monitoring. After five rounds of groundwater sampling and analysis, a subset of analytes from the original SRC list has been identified as the primary constituents in site groundwater.

BRC will review this subset with the new 2009 groundwater dataset to develop a proposed list of analytes that will be simulated in the transport model. As discussed with NDEP, the list of analytes will consist of those parameters that exceed U.S. Environmental Protection Agency maximum contaminant levels (MCLs). For those parameters that do not have assigned MCLs, basic cleanup levels (BCLs) will be used as the screening criteria to develop a proposed list of analytes that will be simulated in the transport model. It is anticipated that analytes without BCLs will not be modeled (with NDEP approval).

In addition, the initial model runs and the draft list of proposed analytes to be simulated will be reviewed to determine whether certain solutes or classes may be ruled out as a remaining risk to be investigated. After this review, specific solutes would be modeled as required.

    b. Second paragraph, the main paleochannel that occurs across the Western Hook area may present some issues as there is contaminant load from the upgradient BMI Complex. This Section should include a discussion of this issue.

Response: The referenced section has been revised to address this issue.

    c. Second paragraph, next to last sentence, because at this time the NDEP does not know what solutes will be modeled, it is difficult to indicate whether zero solute concentrations will be appropriate for the City of Henderson facilities. Please note that the City of Henderson RIBs and Birding Preserve receive waters containing greater than zero concentration perchlorate.

Response: BRC will use available information to prescribe non-zero solute concentrations for each of these recharge sources as appropriate, as discussed in the updated work plan.

d. Third paragraph, NDEP notes that the current groundwater flow model includes evapotranspiration terms set to zero. BRC should note that evapotranspiration is a main water budget item for the current AMPAC model for areas to the west of the Site and this issue requires additional consideration.

Response: As discussed with NDEP, evapotranspiration need not be considered solely based on current AMPAC modeling preliminary results; the BRC modeling is proceeding independent of other investigations.

6. Section 5.3, Solute Transport Hydraulic Properties, Page 7, the NDEP has the following comments:
   a. BRC provides examples of how porosity; lateral and vertical dispersion coefficients will be determined. Pleases provide an example of the method proposed for determining longitudinal dispersion coefficients.

Response: The method proposed by BRC is provided in the updated work plan.

   b. Third paragraph, the assumption that perchlorate is a "conservative" constituent does not appear to be entirely supported as the USEPA reports a range of values from 0.76 to 1.25 L/kg (Susarla et al, 1999). Please provide justification for this assumption.

Response: BRC will review and provide references regarding perchlorate transport and retardation to support our proposed approach.

7. Section 6, Predictive Simulations, the NDEP has the following comments:
   a. BRC states that predictive simulations will be conducted for a period of 50 years. Noting that one of the goals for the model would be to generate solute concentrations at the Las Vegas Wash for comparison with MCLs and/or receiving water standards, NDEP may require that simulations be conducted for whatever period length results in quasi-static conditions, pending the results of initial transport modeling.
   b. NDEP notes that only two solute classes are proposed to be simulated: conservative and non-conservative. BRC should understand that additional specific solute cases may be required to provide input to risk assessments conducted within the model domain.

Response: BRC will conduct predictive simulations for a longer period of time if necessary. Regarding transport simulations for additional constituents, please see the response to Comment No. 5a above.