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VADA DIVISION OF ENVIRONMENTAL PROTECTION
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STATE OF NEVADA
Department of Conservation & Natural Resources
DIVISION OF ENVIRONMENTAL PROTECTION

Kenny C. Guinn, Governor
Allen Biaggi, Director
Leo M. Drozdoff, P.E., Administrator

August 26, 2006

Mr. Mark Paris
Basic Remediation Company (BRC)
875 West Warm Springs
Henderson, NV 89015

Re.: Nevada Division of Environmental Protection Response to:
BRC's *Statistical Methodology Report*
dated August 8, 2006
NDEP Facility ID# H-000688

Dear Mr. Paris:

The NDEP has received and reviewed BRC's correspondence identified above and provides suggested changes to the text via a red-line mark up of the document. This mark up is provided as Attachment A to this letter. If BRC concurs with the proposed changes please develop a finalized report and resubmit. If BRC does not concur, it is suggested that these issues be discussed in a conference call before BRC resubmits the report.

Should you have any questions or concerns, please do not hesitate to contact me at (702) 486-2850x247.

Sincerely,

Brian A. Rakvica, P.E.
Supervisor, Special Projects Branch
Bureau of Corrective Actions

cc: Jim Najima, NDEP, BCA, Carson City
Bill Frey, NDOJ, Carson City
Barry Conaty, Akin, Gump, Strauss, Hauer & Feld, L.L.P., 1333 New Hampshire Avenue, N.W., Washington, D.C. 20036
Brenda Pohlmann, City of Henderson, PO Box 95050, Henderson, NV 89009
Mitch Kaplan, U.S. Environmental Protection Agency, Region 9, mail code: WST-5, 75 Hawthorne Street, San Francisco, CA 94105-3901
Rob Mrowka, Clark County Comprehensive Planning, PO Box 551741, Las Vegas, NV, 89155-1741
Ranajit Sahu, BRC, 311 North Story Place, Alhambra, CA 91801
Rick Kellogg, BRC, 875 West Warm Springs, Henderson, NV 89015
Craig Wilkinson, TIMET, PO Box 2128, Henderson, Nevada, 89009-7003
Kirk Stowers, Broadbent & Associates, 8 West Pacific Avenue, Henderson, Nevada 89015
George Crouse, Syngenta Crop Protection, Inc., 410 Swing Road, Greensboro, NC 27409
Susan Crowley, Tronox, PO Box 55, Henderson, Nevada 89009
Keith Bailey, Tronox, Inc, PO Box 268859, Oklahoma City, Oklahoma 73126-8859
Sally Bilodeau, ENSR, 1220 Avenida Acaso, Camarillo, CA 93012-8727
Lee Erickson, Stauffer Management Company, 400 Ridge Rd, Golden, CO 80403
Chris Sylvia, Pioneer Americas LLC, PO Box 86, Henderson, Nevada 89009
Paul Sundberg, Montrose Chemical Corporation, 3846 Estate Drive, Stockton, California 95209
Joe Kelly, Montrose Chemical Corporation of CA, 600 Ericksen Avenue NE, Suite 380, Bainbridge Island, WA 98110
Jon Erskine, Northgate Environmental Management, Inc., 300 Frank H. Ogawa Plaza, Suite 510, Oakland, CA 94612
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John Yturri, Centex Homes, 3606 North Rancho Drive, Suite 102, Las Vegas, NV 89130
Michael Ford, Bryan Cave, One Renaissance Square, Two North Central Avenue, Suite 2200, Phoenix, AZ 85004
Vincent Aiello, Beazer Homes, 4670 South Fort Apache, Suite 200, Las Vegas, NV
Paul Black, Neptune and Company, Inc., 8550 West 14th Street, Suite 100, Lakewood, CO 80215
Teri Copeland, 5737 Kanan Rd., #182, Agoura Hills, CA 91301
Paul Hackenberry, Hackenberry Associates, 550 West Plumb Lane, B425, Reno, NV, 89509
Dave Gratson, Neptune and Company, 1505 15th Street, Suite B, Los Alamos, NM 87544

Attachment A

NEWFIELDS

STATISTICAL METHODOLOGY REPORT
BMI COMMON AREAS (EASTSIDE)
HENDERSON, NEVADA

Prepared by

Shahrokh Rouhani, Ph.D., P.E.

NewFields Companies, LLC

For

Basic Remediation Company

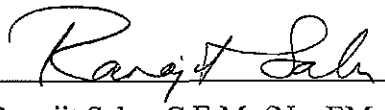
875 West Warm Springs Road, Henderson, Nevada, 89015

Revised/Final

August 16, 2006

NEWFIELDS COMPANIES, LLC
1349 West Peachtree Street, Suite 2000, Atlanta, GA 30305
Tel: (404)347-9050; Fax: (404)347-9080

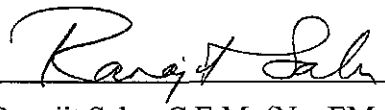
I hereby certify that I am responsible for the services described in this document and for the preparation of this document. The services described in this document have been provided in a manner consistent with the current standards of the profession and to the best of my knowledge comply with all applicable federal, state and local statutes, regulations and ordinances. I hereby certify that all laboratory analytical data was generated by a laboratory certified by the NDEP for each constituent and media presented herein.



August 16, 2006

Dr. Ranajit Sahu, C.E.M. (No. EM-1699, Exp. 10/07/2007) Date
BRC Project Manager

I hereby certify that I am responsible for ensuring that this document has been subject to quality control review.



August 16, 2006

Dr. Ranajit Sahu, C.E.M. (No. EM-1699, Exp. 10/07/2007) Date
BRC Project Manager

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STATISTICAL METHODOLOGY REPORT

BMI COMMON AREAS (EASTSIDE)

HENDERSON, NEVADA

1. INTRODUCTION

This document describes the statistical methods that will be used to confirm the final soils closure at each of the Eastside Sub-areas of the BMI Common Areas (Figure 1). The Eastside Sub-Areas of the BMI Common Areas generally includes areas to the east of Boulder Highway and north of Lake Mead Parkway.

This revision of the report incorporates Nevada Division of Environmental Protection (NDEP) comments, dated July 20 and August 10, 2006, on the June 16 and August 8, 2006 versions of this report, respectively. NDEP comments and response to comments are provided in Appendix A. The definitions of the Sub-areas and the location of the Site are described in the Closure Plan (in review by NDEP) and are not repeated here.

This report contains as much detail as can reasonably be provided at this time while focusing on methodology issues. The individual Sub-area reports will contain complete data analyses, which will address Sub-area-specific issues such as exploratory data analysis methods, dealing with non-detects, and background comparisons issues such as differences in geology or sampling and analysis protocols for the site and background data. The No-Build Sub-area report will also address ecological risk end-points, which are relevant only for that Sub-area. This area will be addressed using similar statistical methods as presented in this report, as applicable.

The analytical data will be reviewed for applicability and usability following procedures in USEPA's (1992) *Guidance for Data Usability in Risk Assessment (Part A)* and USEPA's (1989) *Risk Assessment Guidance for Superfund (RAGS)*. Based on USEPA (1989) guidance, non-detects for COPCs will be assigned a value of one-half the detection limit. Other methods for addressing non-detects may be considered. For radionuclide data, the actual reported value will be used, including when the actual value is reported as below the minimum detectable activity (MDA, which will be reported as well). The comparison of site-related soil concentrations to background levels will be conducted using the project-specific background datasets presented in BRC/TIMET

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(2006). This report discusses background data as a function of geology and depth of sampling. The BRC/TIMET background data report is pending approval by the NDEP.

The analyses discussed below will be performed within each Sub-area of the site subsequent to a sequence of initial and intermediate cleanup and sampling activities, as follows:

- **Initial Cleanup:** The cleanup of each Sub-area will be initiated by the removal of impacted soils based on the Conceptual Site Model (the "CSM")[1]; review and analysis of the existing soil and sediment physical and chemical data, including the extent of discolored soil and sediment; and detailed inspection of aerial photographs. These initial removals are intended to address all the known impacted parts of the Sub-area, primarily relying on visual evidence and site knowledge, as guided by historical data. Further details of the initial removal as well as the iterative nature of the removal/sampling along with certain "stopping" rules are discussed in the Corrective Action Plan (the "CAP").[2]

- **Confirmation Sampling:** Upon completion of the initial cleanup, a series of multi-depth confirmatory samples will be collected based on a combination of stratified random and biased (judgmental) sampling. The main elements of this confirmation sampling are discussed in Section 2 of this document. Collected samples will be assigned to specific soil layers according to well-defined if/then rules.

Intermediate Sampling and Cleanups: The confirmation data are then subjected to a series of statistical tests to identify "exceeding" samples, if any, as described in Section 3 of this document. In case of a confirmed exceeding sample, its vicinity will be targeted for additional delineation sampling and/or removal. This removal will be followed by additional confirmation sampling at these erstwhile exceeding locations. Sample results from the removed part of the Sub-area will be marked as excluded in the dataset, while non-exceeding delineation and confirmatory samples will be included in the dataset. This iterative process continues until the Sub-area is devoid of any exceeding samples or until all of the stopping rules discussed in the CAP are satisfied.

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[1] BRC acknowledges that the CSM has not been finalized at this time.

[2] The stopping rules and the general iterative methodology are shown in Figure J of the CAP. BRC acknowledges that the CAP is under review by NDEP at this time.

- **Final Confirmation Dataset:** At this stage, the final confirmation dataset, consisting of the original non-exceeding confirmation data, and non-exceeding data generated during intermediate cleanups, will be subjected to a series of statistical analyses to provide the necessary information concerning representative exposure concentrations, as discussed in Section 4 of this document.

- **Data Adequacy and Sample Size Evaluation:** Finally, as described in Section 5 of this document, the adequacy of the final confirmation dataset in each Sub-area will be evaluated in accordance with probabilistic procedures developed by Neptune and Company, Inc. for the TRECO site (Appendix C, Attachment C-2, MWH, 2006).

The statistical computations and tests described herein will be performed using GiSdT® (www.gisdt.org, Neptune and Company, Inc., 2006) or SPSS Version 11.5.0 (www.spss.com) software.

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2. CONFIRMATION SAMPLING

Upon completion of the initial cleanup in a given sub-area, confirmation sampling will be conducted. This sampling will be conducted on the basis of combined random and biased (judgmental) sampling, as follows:

- **Stratified Random Locations:** For this purpose, the Sub-area will be covered by a 3-acre cell grid network. Within each 3-acre cell, a sampling location will be randomly selected. The main objective of this stratified random sampling is to provide uniform coverage of the Sub-area.

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- **Biased Locations:** Additional sampling locations will be selected within or near small-scale contamination points of interests, including but not limited to previous debris locations, berm walls near excavated ponds, and conveyance ditches. For this purpose, the randomly selected location within a corresponding 3-acre cell may also be adjusted in order to cover a nearby point of interest. Further details concerning location of biased samples in specific Sub-areas, including maps showing each proposed sampling location and sample depth will be provided in the corresponding Sampling and Analysis Plan (the "SAP") for each Sub-area.

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At each selected location, multi-depth soil samples will be collected and analyzed for the list of site-related chemicals. The analytical sample results will then be divided into

surface (0-2' depth), subsurface (2'-10' depth), and deep (>10' depth) layers, according to the following rules:

- **Rule 1: IF** the sample is collected in a relatively flat part of the Sub-area (i.e., an area not targeted for substantial grading), **THEN** the depth of the collected soil sample will be used to designate its soil layer grouping.

- **Rule 2: IF** the sample is collected in a part of the Sub-area targeted for substantial grading, **AND** the sampled soil is located in an area expected to be covered by fill material (e.g. exposed excavated surfaces of ponds), **THEN** the soil layer grouping of the sampled soil will be determined based on the difference between its elevation and the final (post-graded) surface elevation in that part of the Sub-area.

- **Rule 3: IF** the sample is collected in a part of the Sub-area targeted for substantial grading, **AND** the sampled soil is expected to be used as surface or subsurface fill (e.g. soil within a berm), **THEN** the sampled soil will be assigned to the surface layer.

- **Rule 4: IF** the sample is collected in a part of the Sub-area targeted for substantial grading, **AND** the sampled soil is expected to be used as subsurface fill (e.g. soil within a berm), **THEN** the sampled soil will be assigned to the appropriate subsurface layer.

All soil samples will be tagged in the database with numeric designations of their corresponding assigned soil layer grouping based on these three rules.

3. INTERMEDIATE SAMPLING AND CLEANUP

Upon layer-designation of confirmation soil samples, a series of tests will be conducted to determine whether sampled locations within a given layer include "exceeding" samples. An exceeding sample is one that warrants further investigation, which may include additional localized soil removal. Exceeding samples will be defined consistent with the following rules:

- **Chemicals without background concentrations:** For chemicals without corresponding background distributions, the distribution of its reported concentrations in each layer will be constructed. The 95% upper confidence limit of the mean (the "UCL") of these distributions will also be computed. **IF** the constructed distribution

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indicates the presence of anomalous concentrations (e.g. high values at the end of an elongated tail of a uni-modal distribution, or values forming an elevated sub-population of a multi-modal distribution), **AND** the inclusion of these anomalous values causes the computed UCL to exceed 1/10 of the risk-based screening level of the chemical,[3] **THEN** samples associated with anomalous values will be considered as potential exceeding samples.

- **Chemicals with background concentrations:** For chemicals with corresponding background distributions, the distribution of its reported concentrations in each layer will be constructed. These concentration distributions will then be statistically compared to the background concentration distributions. Appropriate two-sample tests, including parametric Levene's Test for equality of variances, t-Test for equality of mean (assuming equal variances), and t-Test for equality of mean (assuming unequal variances), and non-parametric Slippage Test, Quantile Test, and Wilcoxon Rank Sum Test with Gehan modification (e.g., DON, 2004) will be used to identify exceeding samples through comparison of site and background distributions. In addition, the 95% upper tolerance limit (the "UTL") of the reported concentrations of such chemicals in each layer will be computed using the background data. **IF** inclusion of elevated measured values in a given layer causes the rejection of the appropriate two-sample test [QUESTION TO BMI – is the UTL going to be used here? If not, please explain why it is included herein?] **THEN** samples associated with such elevated values will be considered as potential exceeding samples.

Areas with potential exceeding samples may be subjected to re-sampling prior to the confirmation of the location as an exceeding sample. After any such re-sampling, the above process will be repeated to confirm the exceeding status of the targeted sample location.

Upon confirmation of an exceeding sample, additional neighboring delineation sampling will be conducted based on a "step-out" approach. Step sizes and directions will be dependent on the location of the exceeding sample and perhaps the magnitude of the exceedance. Additional step-out or step-in sampling may be conducted to further refine the extent of the required removal. Each removal will be followed by confirmatory

[3] The multiplier 1/10 is proposed as a reasonably conservative criterion for allowing for cumulative risks from multiple chemicals.

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sampling. General aspects of intermediate delineation and confirmatory sampling procedures will be discussed in the SAP for the Sub-area.

After the above intermediate removals, results associated with removed exceeding samples will be marked as excluded from the dataset, while non-exceeding delineation and confirmation data will be included in the dataset. The revised dataset will then be subjected to the above exceeding sample determination process, which will be repeated until all exceeding samples are adequately addressed.

4. FINAL CONFIRMATION DATASET

At this stage, the final confirmation dataset for the Sub-area, consisting of the original non-exceeding confirmation data for the Sub-area, along with the non-exceeding data generated after intermediate sampling and cleanup, will be subjected to a series of statistical analyses in order to determine representative exposure concentrations for that Sub-area, as described below.

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Correlation Analysis: Confirmation measurements of each chemical in a given soil layer will be used to compute variograms. Variograms are quantitative measures of spatial correlation exhibited by spatial datasets. Englund and Sparks (1988) define the variogram as a plot of the variance (one-half the mean squared difference) of paired sample measurements as a function of the distances (and optionally of the direction) between samples. Spatially correlated data will yield variograms that are clearly distinguishable from those produced by uncorrelated data. Upon a thorough inspection of computed omni-directional and directional variograms, the status of spatial correlation of a chemical in a given soil layer will be determined. **Representative Exposure Concentrations:** Depending on the chemical-specific findings of variogram analyses above, the following computations will be conducted.

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- **Uncorrelated Data:** If the confirmation dataset of a given chemical in a given soil layer exhibits no discernable spatial correlation (i.e. the variogram is statistically indistinguishable from a horizontal line), then each measurement is assumed to be equally representative for that chemical at any point in the Sub-area. Under this condition, the available dataset for the entire Sub-area, sub-setted by layer if necessary, as well as the descriptive summary statistics, including means and standard errors will be used to compute the appropriate UCLs for deterministic risk assessment purposes for that chemical.

If the probabilistic risk assessment option[4] is invoked for a specific chemical, the computed mean concentration and standard error will be considered as parameters of the distribution of representative exposure concentrations for that chemical within the given soil layer of the Sub-area.

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For cumulative risk evaluation, the computed mean concentration and standard error will be considered as parameters of the distribution of representative exposure concentrations for that chemical within the given soil layer of the Sub-area. The intent of the cumulative risk calculation is to compute the combined risks posed by chemicals of interest. These calculations will be performed within a probabilistic framework for each category of chemicals of interest, e.g. carcinogens (chemicals and radionuclides), and non-carcinogens. For this purpose, concentrations of each chemical of interest within the targeted category in a specific layer will be represented by a distribution consistent with the mean concentration and standard error of the observed data of that chemical within the given layer. Having these concentration distributions, multiple sets of concentrations of chemicals of interest within a given a soil layer will be generated through Monte Carlo simulation. For each set, which contains one simulated concentration for each chemical of interest in the targeted category, risks associated with individual chemicals will be calculated, and then summed. This summed risk represents the cumulative risk of the given set of simulated concentrations. This process is repeated for all simulated sets, which yields a large number of simulated cumulative risks. The simulated cumulative risks will then be ranked in order to determine the 95 percentile cumulative risk. This 95 percentile risk will be considered as the representative cumulative risk of the targeted category of chemicals in the given soil layer for the Sub-area in question.

- **Correlated Data:** If the confirmation data set for a given chemical within a given soil layer exhibits spatial correlation (i.e. the variogram is statistically different from a horizontal line), geostatistical block estimation analysis (known as block kriging) will be performed. Block kriging is a minimum-variance linear estimation process in which point measurements in and around a given block (referred to herein as a cell) are used in order to compute the estimated value of the investigated variable (i.e., chemical concentration) over the targeted cell. Block kriging also computes the standard error of the estimated cell value. This computational process is mainly

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[4] Probabilistic risk assessment option will not be applied to lead or asbestos.

driven by the spatial correlation of the investigated variable. For more information, see Matheron (1971), Journel and Huijbregts (1978), Isaaks and Srivastava (1989), and ASCE (1990a, b).

For this purpose, the Sub-area will be covered by grids consisting of cells equal to the size of desired exposure units, i.e. 1/8-acre (for residential receptors) and 1/2-acre (for worker and recreational receptors) cell grids. At this stage, the expected, layer-specific, chemical concentration over each cell and the corresponding estimated standard deviation will be computed, which in turn will be used to calculate the UCL for each cell.

Final confirmations based on deterministic risk assessment will be performed using the maximum UCL across all cells , or block kriging will be applied to the entire Sub-area to estimate an overall mean, standard error, and UCL for the Sub-area. A similar approach will be taken for cumulative risk evaluation and probabilistic risk assessment. These analyses will use estimated distributions from either an individual cell (e.g. the cell with the maximum UCL) or the entire Sub-area. The specific choice between using block kriging estimates in individual cells or the entire Sub-area will be explained in the individual Sub-area report, if applicable.

5. DATA ADEQUACY AND SAMPLE SIZE EVALUATION

The final confirmation dataset will consist of stratified random samples, additional samples biased toward known small-scale contamination areas, as well as biased not-exceeding delineation and confirmation samples associated with intermediate cleanups in the Sub-area. The dataset is clearly aimed at providing coverage of the Sub-area in its entirety, as well as at all points of interest. The *a posteriori* nature of this dataset poses a number of difficulties when considered within the traditional framework of *a priori* statistical approaches, commonly used in data quality assessments ("DQAs") for confirmation of data quality objectives ("DQOs"). In response to these theoretical issues, NDEP proposed an alternative procedure, developed by Neptune and Company, Inc. at the TRECO site (Appendix C, Attachment C-2, MWH, 2006), for data adequacy and DQA. Consistent with this proposed approach, the following procedures will be used to assess the adequacy of confirmation data within a given soil layer of the sub-area.

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- **Chemicals without background concentrations:** For such chemicals, the NDEP proposed procedure will be used, which is a simple probabilistic approach to data adequacy. This procedure is initiated by the construction of a distributional model (estimated distribution) for the mean concentration of each chemical of interest. Distributional models are selected from among an appropriate class of distributions (e.g. normal or gamma), whose parameters will be estimated using bootstrapping, or maximum likelihood estimation procedures. The estimated distributions of mean concentrations are then used to evaluate the probability of the mean concentration exceeding the risk-based screening level for the chemical of interest. The above-cited TRECO site document provides further details about merits of the proposed and alternative procedures.

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- **Chemicals with background concentrations:** For such chemicals, consistent with the spirit of the above-proposed probabilistic approach, and per discussion and agreement with NDEP and its consultants per the meeting held on May 31, 2006, a probabilistic two-sample test is proposed. For this purpose, multiple pairs of sub-area (layer-specific) measurements and background measurements will be selected randomly. For each pair, the difference between their reported concentrations will be calculated. The distribution of simulated differences will then be evaluated to demonstrate the likelihood of a zero-mean difference.

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6. REFERENCES

American Society of Civil Engineers (ASCE) Task Committee on Geostatistical Techniques in Geohydrology (S. Rouhani, Chairman and Principal Author), Review of Geostatistics in Geohydrology, I. Basic concepts, *ASCE Journal of Hydraulic Engineering*, 116(5), 612-632, May 1990a.

American Society of Civil Engineers (ASCE) Task Committee on Geostatistical Techniques in Geohydrology (S. Rouhani, Chairman and Principal Author), Review of Geostatistics in Geohydrology, II. Applications, *ASCE Journal of Hydraulic Engineering*, 116(5), 633-658, May 1990b.

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Englund, E., and A. Sparks, GEO-EAS (Geostatistical Environmental Assessment Software) User's Guide, EPA600/4-88/033, ENMSL, Environmental Protection Agency, Las Vegas, 1988.

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USEPA. 1992. Guidance for Data Usability in Risk Assessment. Office of Emergency and Remedial Response, Washington D.C. Publication 9285.7-09A. PB92-963356. April.

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VADA DIVISION OF IRONMENTAL PROTECTION
protecting the future for generations

STATE OF NEVADA
Department of Conservation & Natural Resources
DIVISION OF ENVIRONMENTAL PROTECTION

Kenny C. Guinn, Governor
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August 29, 2006

Mr. Mark Paris
Basic Remediation Company
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Henderson, NV 89009

Re. **BMI Plant Sites and Common Areas Projects, Henderson, Nevada**
Derivation of Toxicological Surrogate

Dear Sirs and Madam:

Attachment A contains the Nevada Division of Environmental Protection's (NDEP's) derivation of toxicological surrogates for dimethyl phosphorodithioic acid (DMPT) and diethyl phosphorodithioic acid (DEPT). The Companies must use these toxicological surrogates for DMPT and DEPT unless a suitable technical justification can be made to substantiate the use of a different surrogate.

If you have any questions, do not hesitate to contact me.

Sincerely,

Brian A. Rakvica, P.E.
Supervisor, Special Projects Branch
Bureau of Corrective Actions

BAR:s

Attachment A

Chemical Requiring Surrogate	Toxicological Surrogate	Oral Reference Dose (mg/kg-day)
DMPT (dimethyl phosphorodithioate)	dimethoate	0.0002
DEPT (diethyl phosphorodithioate)	phosalone	0.002

II. Mechanism of Action of Organophosphate Pesticides

Inhibition of the cholinesterase enzyme (ChE) is a biochemical mechanism common to all organophosphate (OP) pesticides (Amdur et al., 1991). Transmission of nerve impulses in the body requires the ChE enzyme. OP pesticides disable ChE, which can result in symptoms of neurotoxicity, including tremors, nausea, and muscular weakness at low doses and paralysis and death at higher doses. OPs have a similar mechanism of action in both insects and mammals, including humans, however the more toxic forms of OPs (i.e., the oxygen analog metabolites formed via oxidative desulfuration in both insects and mammals) are rapidly detoxified in mammals, but not in insects due to a lack of the detoxifying enzymes in insects. This mechanism is the basis for the species selectivity of OP pesticides.

At very low doses, OPs may cause some inhibition of ChE in mammals, including humans, without associated neurotoxicity. This phenomenon is supported by the fact that effect levels for ChE inhibition are generally lower than effect levels for neurotoxicity in mammalian species (Amdur et al., 1991; USEPA, 1998, FAO/WHO, 1997). The three primary tissues in which mammalian ChE data are monitored, for purposes of toxicological studies, are red blood cells, plasma, and brain. USEPA acknowledges that ChE inhibition is more accurately categorized as an exposure biomarker rather than a toxicological endpoint for *red blood cells and plasma*:

> "In the absence of clinical signs in humans or animals or the absence of morphological data in animals, the quantitative nature of the inhibition of red blood cells (RBC) and/or plasma cholinesterase inhibition is considered unreliable for assessing significant biological adverse changes, but can be used as a biomarker of exposure." (USEPA, 1998).

However, USEPA recommends that a noted decline in *brain* ChE should be evaluated by risk assessors in terms of possible effects that are biologically significant, and uses such data in setting or supporting reference doses (USEPA, 1998).

III. Selection of Toxicological Surrogate for DMPT

Identification of Toxicological Surrogate

Dimethoate (CASRN 60-51-5) was selected as the toxicological surrogate for purposes of characterizing potential noncancer risks (i.e., hazard quotients) for DMPT. This selection is supported by the following:

- Like DMPT, dimethoate is a dimethyl phosphorodithioate. Dimethyl phosphodithioates have two sulfur atoms bonded to the central phosphorus, one of which is a double bond, and two oxygens bonded to the central phosphorus, each also bonded to a methyl group (see Figure 1).

- DMPT is a chief metabolite of dimethoate in mammals (FAO/WHO, 1997) (Figure 1) and, similar to other OP pesticides, inhibits ChE (FAO/WHO, 1997; USEPA, 2006).

mg/kg-day (equivalent to approximately 1 ppm in the diet for two years) and an uncertainty factor (UF) of 300. The UF of 300 is based on the application of (1) a UF factor of 100 to account for interspecies (extrapolation from rat to human) and intraspecies (human variability) differences and (2) an additional UF of 3 to account for the lack of a chronic dog feeding study and rabbit teratology study. When the NOEL is divided by the comprehensive UF of 300, the resulting oral RfD is 2 E-4 mg/kg-day (0.0002 mg/kg-day). Because dimethoate is identified as a toxicological surrogate for DMPT, this RfD is identified as applicable to DMPT for purposes of assessment of potential chronic health risks to residential and occupational receptors using the USEPA CERCLA risk assessment framework (USEPA, 1989 and relevant supplements)[4].

IV. Selection of Toxicological Surrogate for DEPT

Identification of Toxicological Surrogate

Phosalone (CASRN 2310-17-0) was selected as the toxicological surrogate for purposes of characterizing potential noncancer risks (i.e., hazard quotients) for DEPT. This selection is supported by the following:

- Like DEPT, phosalone is a diethyl phosphorodithioate. Diethyl phosphodithioates have two sulfur atoms bonded to the central phosphorus, one of which is a double bond, and two oxygens bonded to the central phosphorus, each also bonded to an ethyl group (see Figure 2).

- DEPT is a chief metabolite of phosalone in humans (Vasilic et al., 1993) and, similar to other OP pesticides, inhibits ChE (Vasilic et al., 1993).

- Because phosalone is rapidly hydrolyzed in the body, its diethylphosphorus metabolites, including DEPT, are considered a more sensitive indicator of exposure in humans, as compared with the parent chemical (Vasilic et al., 1993).

- In addition to DEPT, there are two other chief metabolites of phosalone: diethyl phosphorothioate (DETP) and diethyl phosphate (DEP). DETP and DEP are direct metabolites of phosalone and are also metabolites of DEPT (i.e., DEPT is metabolized to DETP which is further metabolized to DEP) (Vasilic et al., 1993) (Figure 2).

- Based on the above, it is likely that the ChE inhibition reported following oral administration of phosalone is associated with DEPT and DEPT metabolites, which are the rapidly formed human metabolites of phosalone.

[4] USEPA has not assigned a dermal or inhalation RfD for dimethoate. Accordingly, extrapolation of the oral RfD to dermal and inhalation exposure pathways is an option that may be used for purposes of risk assessment of dimethoate and DMPT (USEPA, 2004). Uncertainties should be discussed when health risks are based on route extrapolation (USEPA, 1989).

VI. References Cited

Agency for Toxic Substances and Disease Registry (ATSDR), 2005). Minimal Risk Levels (MTLs) for Hazardous Substances, December. www.atsdr.cdc.gov/mrls.html

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USEPA, 1998. The Use of Data on Cholinesterase Inhibition for Risk Assessments of Organophosphate and Carbamate Pesticides. Office of Pesticide Programs, October 27. www.epa.gov/fedrgstr/EPA-PEST/1998/November/Day-05/6022.pdf#search=%22ChE%20inhibition%20is%20a%20biomarker%22

USEPA, 1999. Revised Review of the Human Health Assessment for Dimethoate, 1999. Reregistration Branch II, Health Effects Division, December. www.epa.gov/pesticides/op/dimethoate/hedrra.pdf

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USEPA, 2004. Preliminary Remediation Goals (PRGs), Region 9 , October. www.epa.gov/region09/waste/sfund/prg/index.html

USEPA 2006. Integrated Risk Information System (IRIS). Online database of USEPA toxicity criteria. Website: www.epa.gov/iris/

Vasilic, Z., Drevenkar, V., Stengl, B., Frobe, Z., and Rumenjak, V., 1993. Diethylphosphorus metabolites in serum and urine of persons poisoned by phosalone. Chem. Biol. Interact. 87(1-3):305-313.

Based on our initial review of the Technical Memorandum that you provided to us regarding "Identification of Toxicological Surrogates for DMPT and DEPT", dated August 28, 2006, we do not believe that appropriate surrogates and toxicity values have been selected for the subject compounds. The selected surrogate compounds (dimethoate for DMPT and phosalone for DETP) are both parent organophosphate pesticide compounds. As is the case for the organophosphate pesticides in general, the selected surrogates are toxic due to their activity as cholinesterase inhibitors, as noted in the technical memorandum. The information that we have reviewed demonstrates that while some metabolites of these parent compounds may exhibit cholinesterase inhibition, the two compounds in question (DMTP and DETP) do not. This conclusion is based on information reported by the US Center for Disease Control (CDC) in its extensive investigation of human exposure to environmental chemicals, including pesticides (CDC, 2005).

The nomenclature for the compounds in question can be somewhat confusing: The sources we reviewed generally used the term DMDTP (O,O'-dimethyl dithiophosphate) for the compound with CAS No. 756-80-9, referred to as dimethyl phosphorodithioate (DMPT) in the Technical Memorandum, one of the other chemical synonyms for this compound. Similarly, our sources generally used the term DEDTP (O,O'-diethyl dithiophosphate) for the compound with CAS No. 298-06-6, referred to as diethyl phosphorodithioate (DEPT) in the Technical Memorandum.

The CDC report specifically addresses the six dialkyl phosphate metabolites of organophosphate pesticides (CDC, 2005, p. 357):

- Dimethylphosphate (DMP)
- Dimethylthiophosphate (DMTP)
- Dimethyldithiophosphate (DMDTP)
- Diethylphosphate (DEP)
- Diethylthiophosphate (DETP)
- Diethyldithiophosphate (DEDTP)

The CDC (2005, p. 357) states that the dialkyl phosphate metabolites of organophosphate pesticides, such as DMDTP and DEDTP are not considered toxic. They are monitored as markers of potential pesticide exposure.

"Exposure to organophosphates may occur by ingestion, inhalation, or dermal contact. Farm workers, pesticide applicators, and manufacturers of these pesticides may have higher levels of exposure. The acute effects of the organophosphates from intentional and unintentional overdoses or from high-dose exposure are well known and include neurologic dysfunction that results from inhibition of acetylcholine breakdown in the central and peripheral nervous systems. This dysfunction results from the inhibitory effect of organophosphates on the enzyme acetylcholinesterase. Symptoms may include nausea, vomiting, cholinergic effects, weakness, paralysis, and seizures.

About 75% of registered organophosphate pesticides will be metabolized to measurable dialkyl phosphate metabolites. In contrast to the organophosphates, the dialkyl phosphate

metabolites do not inhibit acetylcholinesterase enzymes. Dialkyl phosphates themselves are not considered toxic, but they are markers of exposure to organophosphates. Dialkyl phosphate metabolites can be present in urine after low-level organophosphate exposures that do not cause clinical symptoms (Davies and Peterson, 1997; Franklin et al., 1981). Measurement of these metabolites reflects recent exposure that has occurred predominantly in the last few days."

It is therefore clear that while some organophosphate pesticide metabolites may exhibit cholinesterase inhibition, the use of surrogate compounds that exhibit cholinesterase inhibition is not appropriate for DMPT (DMDTP) and DEPT (DEDTP), that do not exhibit this behavior, and are considered to be non-toxic by the CDC. An electronic copy of the CDC report will be forwarded to you for your convenience.

Some additional information regarding the chemistry and the limited available toxicity data for these compounds is available in a Test Plan submittal for DEDTP under the USEPA High Production Volume (HPV) program, and in the Registry of Toxic Effects of Chemical Substances (RTECS) database. References for this information are also attached.

We look forward to discussing development of appropriate toxicity-based action levels for these compounds. We are prepared if necessary to have a qualified toxicologist review the available information and make appropriate recommendations, subject to review by your staff. Please let us know if we can provide any additional information.

References

Bayer CropScience LP. 2003. O,O-Diethyl Dithiophosphate, CAS No. 298-06-6, Test Plan, and supporting data. November 26, 2003

Centers for Disease Control and Prevention (CDC). 2005. Third National Report on Human Exposure to Environmental Chemicals. July 2005.

RTECS. 2004. On-line search. RTECS Number TD7350000 (CAS No. 298-06-6).

RTECS. 2004. On-line search. RTECS Number TE0525000 (CAS No. 756-80-9).

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NEVADA DIVISION OF ENVIRONMENTAL PROTECTION
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STATE OF NEVADA
Department of Conservation & Natural Resources
DIVISION OF ENVIRONMENTAL PROTECTION

Kenny C. Guinn, Governor
Allen Biaggi, Director
Leo M. Drozdoff, P.E., Administrator

September 1, 2006

Mr. Mark Paris
Basic Remediation Company (BRC)
875 West Warm Springs
Henderson, NV 89015

Re.: Nevada Division of Environmental Protection Response to:
BRC's *Statistical Methodology Report*
dated August 28, 2006
NDEP Facility ID# H-000688

Dear Mr. Paris:

The NDEP has received and reviewed BRC's correspondence identified above and provides conditional approval. The conditions of the approval have been discussed with BRC via telephone and it is the understanding of the NDEP that BRC accepts the conditions. NDEP will manually make the changes discussed below. A response to this letter is therefore not required. The conditions of the approval are as follows:

Page 4, rule three, second line the phrase "surface or subsurface" should be changed to "surface".

Page 9, third line, the word "among" should be deleted.

Should you have any questions or concerns, please do not hesitate to contact me at (702) 486-2850x247.

Sincerely,

Brian A. Rakvica, P.E.
Supervisor, Special Projects Branch
Bureau of Corrective Actions

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