Prepared for

Lathrop & Gage LLP
2345 Grand Blvd., Suite 2200
Kansas City, MO 64108-2618

Expert Report

in the Case of
State of Missouri v. Republic Services, Inc. et al.
in the United States District Court
for the Eastern District of Missouri
Eastern Division

Case No. 4:15-cv-01506

Prepared by

Geosyntec consultants

engineers | scientists | innovators

J. Keith Tolson, Ph.D.

13101 Telecom Drive, Suite 120
Temple Terrace, Florida 33637
Project Number FC2004
November 2015

30 October 2015

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ATTACHMENTS

1. INTRODUCTION

1.1 Terms of Reference and Certification

The work described in this Expert Report (Report) was conducted by Geosyntec Consultants ("Geosyntec") for Lathrop & Gage, LLC ("LG") in connection with and related to the West Lake Landfill (WLL) in the State of Missouri. Geosyntec was retained to provide this Report specifically in connection with the case of *State of Missouri v. Republic Services, Inc. et al* (Case No. 4:15cv-01506, in the Eastern District of Missouri, Eastern Division).

The work presented herein was directed, and this report written, by J. Keith Tolson, Ph.D. Principal of Geosyntec's Tampa office (13101 Telecom Drive, Suite 120, Temple Terrace, Florida 33637).

Geosyntec is compensated for my services related to this matter at a rate of $222 per hour for investigation, analysis, report preparation, deposition, and trial preparation, and at a rate of $444 per hour for deposition testimony and court appearances. Compensation for all work related to this matter is in no way tied to the outcome of this litigation.

I have personal knowledge of the facts set forth herein, and if called upon as a witness I would testify competently to them.

> I certify under penalty of perjury that the opinions expressed in this expert report are true and correct to the best of my knowledge and ability as an environmental scientist. My opinions are stated to a reasonable degree of certainty and consistent with prevailing engineering and scientific standards of practice.

_____

J. Keith Tolson, Ph.D. Date

1.1 Professional Background and Qualifications

I am an environmental scientist and emeritus member of American Academy of Environmental Engineers and Scientists, specializing in regulatory affairs and human health risk assessment. I serve as an Adjunct Professor at the Center for Environmental and Human Toxicology at the University of Florida. My *curriculum vitae* is in **Attachment A**.

I received a Bachelor of Science (Honors) in Interdisciplinary Sciences (Chemistry/Statistics) with a Thesis (Pulmonary Medicine), a Master's of Science in Food Science and Human Nutrition (Analytical Chemistry), and a Ph.D. from the College of Medicine, Department of Pharmacology and Therapeutics with Specialization in Toxicology, all from the University of Florida.

I have over 25 years of professional experience in the fields of analytical chemistry, human health risk assessment, fate and transport modeling, and regulatory support for multi-media assessment of exposure to environmental chemicals. During my tenure at the University of Florida I served for six years as lead analytical chemist at the Food and Environmental Toxicology Laboratory, where I worked extensively with measurements of radioactivity in environmental samples (including gamma spectroscopy and liquid scintillation counting). I taught graduate-level analytical chemistry courses and laboratory courses in the proper use of multiple types of analytical instruments. I served as the laboratory quality assurance/quality control (QA/QC) officer on numerous projects and as the laboratory point-of-contact for State and Federal laboratory accreditation. Over the last 12 years, I have been employed at Geosyntec where I serve as a national practice leader in toxicology and risk assessment. I am also active in the field of environmental sciences outside of work, and have served for many years in an advisory capacity to a wide range of governmental and non-profit institutions relating to toxicology, risk assessment, and public health.

I have held both elected and appointed roles with the Society of Toxicology, and published articles on analytical chemistry, toxicology, and risk assessment in peer-reviewed journals, books, and meeting proceedings.

1.2 Scope and Basis of Opinions

I understand that researchers from the Missouri University of Science and Technology (MST) were contacted by the Missouri Attorney General's Office to investigate radiological impacts in the area of the WLL. MST conducted a screening-level assessment of tree cores to assess potential off-site migration of landfill constituents including radionuclides. Tree core samples were collected from areas surrounding the WLL (off-site trees) as well as from trees on the WLL property. Dr. Shoaib Usman of MST led the effort to evaluate the tree core samples for radioactivity.

It is my understanding that the plaintiff in this case contends that radioactivity has migrated from the WLL based on the presumed detections of radioactivity in tree cores samples collected from and in the vicinity of the WLL by the MST and evaluated by Dr. Usman.

I was asked by LG to review documents related to the presence of radioactive compounds in vegetation on and in the vicinity of the WLL. I was asked to review the content of these documents in terms of technical accuracy, completeness, and conclusions relative to the nature and potential source of radioactivity in relation to the WLL.

1.3 Standard to Which My Opinions are Given

My opinions are given to a reasonable degree of scientific certainty. In addition, my opinions are based on my training and education, knowledge, skill, on my review of pertinent documents, standards, and guidelines, and my professional experience. This Report details the conclusions of my evaluation.

1.4 Basis of My Opinions

The information I relied upon in forming my opinions is of a type reasonably relied upon by experts in my field in forming opinions. Specific documents are cited throughout this Report and are presented in the footnotes and the References. The types of information I relied upon for this Report include the following:

- Case-specific documents (*e.g.*, US Environmental Protection Agency (EPA) reports);

- Publicly available guidance, standards, and regulatory documents by organizations and agencies such as EPA, American National Standards Institute (ANSI), Universities, Governmental laboratories, International Organization for Standardization (ISO), and Interstate Technology & Regulatory Council (ITRC);
- General scientific and regulatory literature in the fields of analytical chemistry, QA/QC, health physics, and international standards;
- Peer-reviewed scientific literature; and,
- Discussions with the manufacturer (ORTEC) of the equipment used by Dr. Usman to conduct the radiological analyses.

At the time of this Report, the underlying data files used to manipulate and interpret the data were not provided by Dr. Usman to provide a full review of the methodology employed. In addition, I understand that additional data is being generated by Dr. Usman associated with this project. This report may be supplemented or revised as new information or data become available.

1.5 Limitations of my Opinions

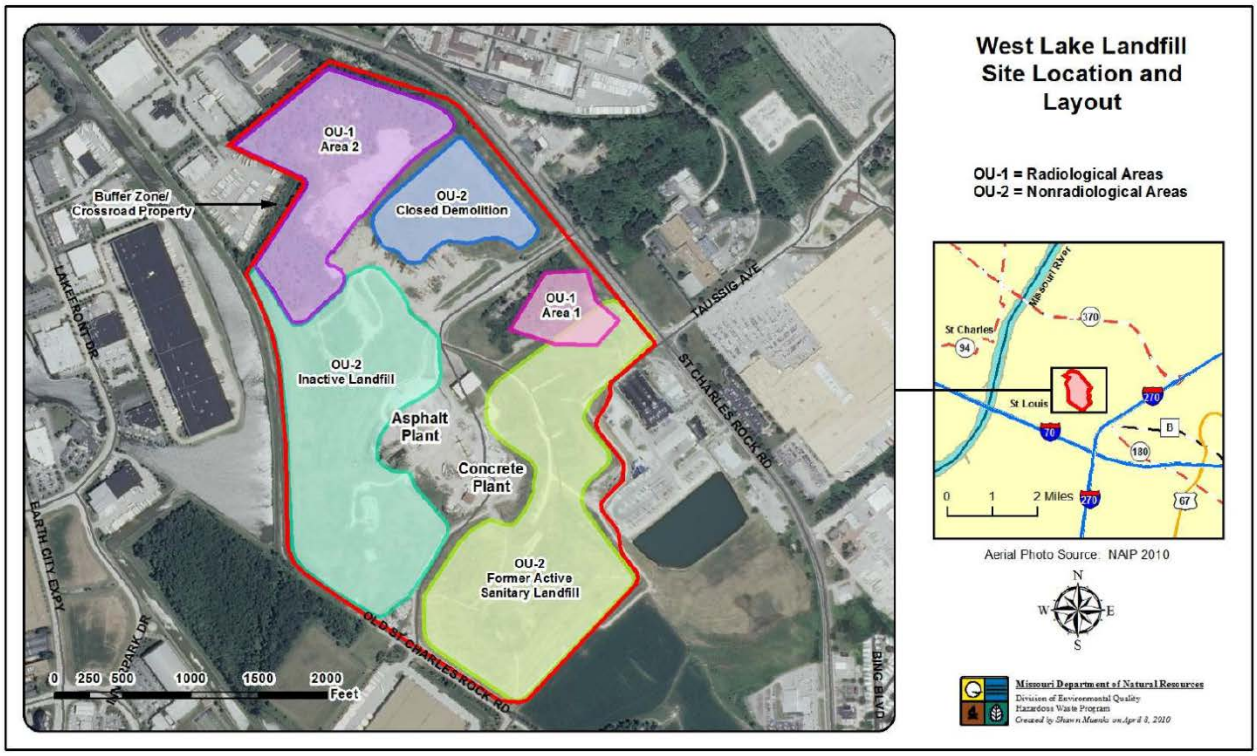
I am not offering opinions regarding the analysis of tree core samples as it relates to non-radiological compounds. These opinions will be provided by Dr. Todd McAlary, also of Geosyntec. I also understand that other experts will address the nature and extent of radiological material in the vicinity of the WLL along with potential fate and transport pathways of radiological and non-radiological compounds.

2 BACKGROUND

The WLL Superfund Site (Site) is located on a 212-acre parcel about one mile north of the Interstate (I)-70/270 interchange within the city limits of Bridgeton, Missouri, and four miles to the west of Lambert-St. Louis International Airport. The Site consists of the Bridgeton Municipal Landfill, which stopped receiving waste in 2005, and several old inactive areas with municipal solid waste and construction and demolition debris. The WLL is divided into two operable units (OUs). OU-1 consists of radiological areas (Area 1 and Area 2) and OU-2 consists of the other

landfill areas, which according to Site records, did not receive radiologically-impacted materials (**Figure 1**).

Figure 1: Location of West Lake Landfill and its Operable Units



Source: Missouri Department of Natural Resources

The WLL originated in 1939 as a limestone quarry. Landfilling at the Site began in the 1950s where portions of the quarry and adjacent areas were used as a landfill for municipal trash and refuse, industrial solid waste, and construction/demolition debris. Mallinckrodt Chemical Works (Mallinckrodt), a contractor to the US Army during World War II, purified uranium from ore as part of the atomic bomb project. Mallinckrodt created waste during this processing. This waste was owned by the US Army. The US Army placed the waste on land next to what is now known as the St. Louis Airport Site, or the SLAPS Site. This land was sold by the US Army to a start-up metals processing company. This company eventually defaulted on their loan and the bank repossessed the material. The material was moved to another piece of property called Latty Avenue and sold to the Cotter Corporation (Cotter). Cotter, who was in the business of mining

uranium, took nearly all of the material from Latty Avenue to Colorado for reprocessing. The only material remaining was leached barium sulfate, which wasn't worth hauling because it was already processed and lacked recoverable materials. In late 1973, in an apparent effort to dispose of the remaining material, 8,700 tons of leached barium sulfate was mixed with 39,000 tons of soil and placed at the WLL.

The Nuclear Regulatory Commission discovered the disposal and investigated the Site, publishing a report in 1977. The WLL Site was designated as a National Priorities List Superfund Site in October 1990. Under the direction of the EPA, in 2006 a Remedial Investigation and Feasibility Study consistent with Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) guidance was completed.

In 2008, Records of Decision (RODs) for OU-1 and OU-2 were signed. Institutional controls were placed on the WLL and long-term monitoring of groundwater, landfill gas generation, and regular inspections of the landfill cap and drainage systems were required by the EPA. The supplemental feasibility study (SFS) for OU-1 was finalized in 2011. In 2012, following consultation with the EPA National Remedy Review Board, the EPA asked the Potentially Responsible Parties (PRPs) to collect additional data. After extensive further investigations by the PRPs, in 2013, the EPA reported that the radioactive waste remained contained within OU-1 and posed no safety risk to outlying areas. However, despite several reports and press releases by the EPA on the containment and public health safety as it relates to the WLL, there has been continued pressure to conduct additional investigations on source and radioactivity in and in the vicinity of the WLL.

Dr. Usman was requested by the Missouri Attorney General's Office to investigate radioactivity levels in tree core samples at and in the vicinity of the WLL and provide an opinion on the potential for off-site migration of radioactivity. Two reports, based on a qualitative evaluation of radioactivity, were generated that detail the findings:

- Report on Westlake Landfill Phytoforensic Assessment Using Gamma Spectroscopy (Usman, 2015); and
- Westlake Landfill Tree Core Analysis Report (Burken, Usman, et al., 2015).

In contrast, a quantitative study was conducted in 2009 to evaluate the levels of radioactivity in vegetation growing in soil at the WLL. The purpose of the 2009 study was to ensure that vegetation being cut and removed as part of site work did not pose a health risk to workers or the general public.

- Vegetative Sampling Results Summary (TA Woodford and Associates, 2009).

This Expert Report focuses on an evaluation of these studies.

3 OPINIONS

3.1 Opinion 1: A Quantitative study in vegetation in and around the WLL indicated levels of radioactivity consistent with expected background conditions.

To the best of my knowledge, the only quantitative study conducted of radiological compounds in vegetation at the WLL was performed in 2009 by TA Woodford and Associates in support of the Health and Safety Plan for clearing vegetation from areas of the WLL. The specific objectives of the study were the following:

1) Evaluate the levels of radioactivity from representative samples of vegetation from areas of the Site where soils were previously identified as having levels of radioactivity greater than twice the background and measure radium-226, isotopic uranium, and isotopic thorium in these samples; and
2) Compare the levels of radioactivity in vegetation samples collected from the Site to background samples collected from areas away from the Site along the Missouri River.

The sampling and analysis was conducted in accordance to a Work Plan[1] that was submitted to EPA and the Missouri Department of Natural Resources (MDNR) for review and approval.

Results from this study showed some spatial variability in reported radioactivity levels between samples (namely with thorium-230, uranium-234, and radium-226 results). It is plausible that the variable radioactivity detected in these plants was a result of differential uptake of radiological compounds from soil and/or groundwater at the WLL. However, the overall radioactivity found

[1] EMSI et al., 2008, Remedial Design Work Plan, West Lake Landfill OU 1, Bridgeton, MO, November 25.

in all samples was either lower than or, in one case, similar to the level of activity found in background[2] Missouri soil. In other words, it was concluded that handling vegetation from the WLL would cause no more exposure to radiation than handling clean soils elsewhere in the State. A comparison of radiological levels in vegetation from the WLL and background vegetation shows detectable levels of radioisotopes in both sample types.

The Agency for Toxic Substances and Disease Registry (ATSDR) recently released a report indicating there is no indication of a release of radionuclides through groundwater or air from the WLL that would create an exposure concern for nearby residents (ATSDR, 2015). The EPA released a press release in response to the claim from the Missouri Attorney General's Office that radiological material has migrated off-site from the WLL. They conclude the following:

> *"The available scientific data indicate that people living near and working outside the boundary of the West Lake Landfill are not currently being exposed to contaminants from West Lake Landfill that are above a level of concern." (EPA, 2015)*

EPA went on to further characterize the 2009 vegetation study as a basis for these conclusions. They state the following:

> *"In 2009, a vegetation sampling study was conducted at the West Lake Landfill to determine if radium, uranium, and thorium were present in vegetative growth in Area 1 and Area 2 of the landfill.*
>
> *A total of seven samples were taken from Area 1 and 13 samples from Area 2. Nineteen of the 20 samples showed radiation levels significantly below background levels. One sample showed a level of 1.38 average picocuries per gram (pCi/g) for radium, which is only slightly higher than the background level of 1.3 pCi/g. All other results were less than 0.33 pCi/g." (EPA, 2015)*

The EPA appears to concur with my analysis of the 2009 vegetation report and characterizes the potential for exposure to radioactivity as below any level of concern.

[2] Background represents control material (in this case soil) that is not believed to be impacted by the Site (i.e. naturally occurring conditions).

3.2 Opinion 2. The study conducted by Usman and colleagues, purportedly showing elevated levels of radioactivity in off-site tree cores, lacks the appropriate methodological rigor or data quality controls to make it reliable and scientifically defensible.

Per the specifications of ANSI/ISO/ASQ Q9001-2008 and EPA QA/G-4, quality systems must be implemented in order to generate data that can defensibly support valid scientific conclusions. To this end, data must be traceable, transparent, and defensible. To be defensible, data must be of an appropriate type and quality. To achieve data quality objectives, as defined in QA/QC documents, data must also be transparent and traceable. Transparency refers to having a data set that encompasses all information used to generate results. Transparency hinges upon systematic documentation of field and analytical processes and procedures. Traceability refers to being able to verify the source of information used in the process. Traceability ensures that each step in the process can be verified, from planning, through sample collection, analysis, and final reporting of results.

I was provided with the field sampling plan, the field logbook, the field sampling standard operating procedure (SOP), the analytical SOP, laboratory notebook, and analytical gamma data associated with the Westlake Tree Core Analysis Report (Burken, Usman et al., 2015). I reviewed this data in the context of established guidance from ANSI/ISO and EPA regarding data quality systems and conclude that the data as presented in the report are not scientifically defensible. Further discussion is provided below.

3.2.1 Type of Data and Potential Sources

Dr. Usman has stated that the experimental design was not intended to be quantitative. Thus, in his own words, the types of data collected in his study are not appropriate for quantitative analysis and are for screening purposes. At best, these results could be used to provide the relative levels of radioisotopes in tree cores. Yet, statistical analysis was performed on the numeric results (i.e., counts) and, subsequently, the probability (e.g., a “99.73% probability”) of samples containing radioactive material was calculated and deemed to be statistically significant. Such statistical

treatment of non-quantitative data is not appropriate and any results or conclusions are not scientifically defensible.

The rationale for sampling for radioisotopes in tree cores was not explicitly stated in the field sampling plan (i.e., data objectives were not clear). However, Dr. Usman concluded in his expert report that the presumed source of radioisotopes is the WLL[3]. Presumably, then, the objective of Dr. Usman's study was to evaluate the potential for migration of radioisotopes from the WLL to off-site vegetation, with the basic premise being: if tree cores are representative of the environment in which the trees grow, then they should reflect the soil and water in that environment.

The sampling design, however, failed to account for the fact that natural daughter products of uranium and thorium are present in background soils[4]. Dr. Usman even states in his deposition that "one would expect radiation everywhere" (Usman Deposition, page 8, line 9-19). Yet, his study conclusions do not distinguish between ambient background radiation and radiation potentially related to the WLL. In fact, a true background sample was not collected during Dr. Usman's investigation.

Further, Dr. Usman's conclusions do not consider the radioisotope "fingerprint" from the tree cores sample results. That is, the specific radioisotopes present in the WLL have been extensively studied and reviewed by EPA (EPA, 2008; EPA, 2011). The WLL radiological-impacted material (RIM) is the product of a chemical process that extracts the uranium and leaves a waste product that is enriched in thorium-230. Thus, enrichment in thorium-230 is the "fingerprint" of the RIM from the WLL (EPA, 2008; EPA, 2011). If the source of radioactivity in the tree cores collected by MST were linked to soils migrating from the WLL, then it is reasonable to assume the same signature would also appear in the tree cores. While it is possible that different radioisotopes are differentially taken up by plants, the relative ratios of thorium-230 to thorium-232 would be an indicator of the WLL RIM signature (i.e., because both are thorium, I would not expect any difference in the uptake of different thorium isotopes). Contrary to this assumption, the data provided in the Westlake Tree Core Analytical Report does not provide a consistent signature. In

3 Usman-0000022. Summary of Findings and Expert Opinion.
[4] Daughter products are breakdown or decay products of elements such as uranium and thorium. This is a natural process of radioactive decay.

some cases thorium-232 levels are double the thorium-230 levels and, in other cases, half[5]. The lack of consistency in the radioisotope ratios suggests no common source for the detected radioactivity.

Finally, the design for tree sampling was not based on a statistical methodology. Thus, it is uncertain whether the data are representative of the population or if the data have sufficient statistical power to make statistically-based conclusions. This, combined with the "batching" of 10 core samples into composite samples prior to gamma spectroscopy analysis "to save time" without any description of how the samples were handled during the compositing, results in data that may not be representative of the sample population and may not support the (unstated, but presumed) data quality objectives. There is no evidence that any guidance for the sampling design was followed.

Samples collected by MST for the purpose of identifying the source of radioactivity were not evaluated in a manner that facilitates this comparison. Moreover, the isotope ratios presented in Dr. Usman's report are not consistent with expectations if the WLL is the source.

3.2.2 Quality of Data

Any scientific investigation should include sufficient QA/QC procedures to ensure that results are accurate, precise, and complete (EPA, 1994). Failure to abide by these QA/QC procedures renders results unreliable. In the following subsections, I discuss some of the short-comings of Dr. Usman's QA/QC procedures. Instances where QA/QC documentation was expected, but was entirely lacking, are discussed in Section 3.2.3.

3.2.2.1 Calibration

A call was placed to the manufacturer (ORTEC) of the instrument presumably used by Dr. Usman. While the exact model for the various instrument components was not provided (i.e., a lack of transparency), I asked in general about the recommendations for QC procedures related to gamma spectroscopy measurements. The manufacturer recommends that QC samples be run on a minimum of a weekly basis and preferably an efficiency check standard be run every day. I was

5 Appendix B of the Westlake Tree Core Analysis Report.

provided the latest guidance manual[6] for a multichannel analyzer that provides some additional information on best practices related to the calibration of the instrument (ORTEC, 2015). The manufacture's guidance recommends developing a control chart and monitoring the instrument routinely for shifts in calibration. The following section is taken from the manual:

> *Energy calibration is accomplished by measuring the spectrum of a source with known full-peak energies… If the Ge detector has adequate long-term stability, these relationships need only be checked each day using a calibration source. (ORTEC, 2015 emphasis added.)*

The guiding standard for how to perform measurements using gamma spectroscopy is found in the American National Standard for Calibration and Use of Germanium Spectrometers for the Measurement of Gamma-Ray Emission Rates of Radionuclides (ANSI N42-14-1999). The discussion on calibration is provided below:

> *The reproducibility of the full-energy peak efficiencies shall be checked periodically (daily to weekly checks are recommended) using a radioactive source with a long half-life emitting at least a low-energy (about 100 keV) and a high-energy (greater than 1300 keV) gamma ray (e.g., NIST mix of 125Sb, 154Eu, and 155Eu, or the equivalent). (ANSI N42-14-1999 emphasis added).*

The recommendations from the manufacturer and national standards are clear – calibration should be evaluated on a regular, preferably daily, basis but no longer than weekly. This is in stark contrast with the system calibration that was performed by MST under the direction of Dr. Usman where months of sample analysis occurred without a single verification of the energy calibration. The effect of instrumental drift can result in misidentification of peaks and shifts in the magnitude of the response associated with gamma energies. The potential for drift in gamma spectroscopy has been identified in the peer-reviewed literature (Dewey and Kearfoot, 2008).

Furthermore, there is some question concerning the single calibration that was performed. Dr. Usman claims that the single energy calibration conducted during the course of the study is represented in a figure in the Westlake Landfill Tree Core Analysis Report (Burken, Usman et al., 2015). The calibration was reported as being performed using three isotope sources (cobalt-60,

[6] The ORTEC GammaVision manual has a generic discussion on calibration. Dr. Usman likely used a different ORTEC software system for collection of tree core data.

cesium-137, and manganese-54). However, it is unclear how Usman's calibration parameters correspond to the raw data files provided. I plotted the raw data from the file labeled calibration.spe (instrument time stamp of 05/06/2015 17:32:16) in **Figure 2**.

Figure 2. Calibration Data Spectra Derived from Raw Data File

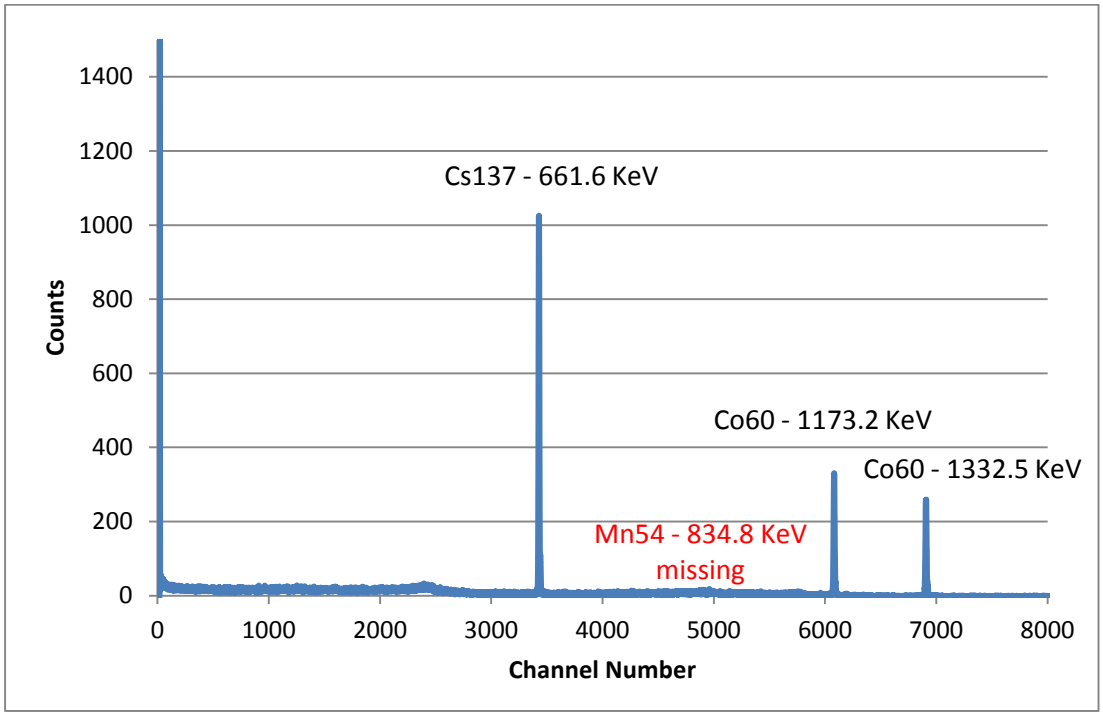


Figure 2 shows the two expected peaks for cobalt-60 and the single cesium-137 peak but is missing the peak expected for manganese-54. In addition, the calibration relationship shown on the Westlake Landfill Tree Core Analysis Report does not match the calibration parameters included in the raw data file.

Finally, it is not evident from the Sampling Plan provided by Dr. Usman that the calibration standards used to calibrate the High Purity Germanium (HPGe) Detector (gamma spectrometer), prior to radiological analysis of the tree core samples were (National Institute of Standards and Technology) NIST traceable as specified. This lack of traceability to a certified standard, results in data that are not defensible.

3.2.2.2 QC Acceptance Criteria

For data to be acceptable by the EPA and the State (i.e., MDNR), and to ensure proper quality control, QC samples must meet specific acceptance criteria (e.g., EPA SW-846 Chapter 1). Examples of field QC samples include, but are not limited to, field duplicate samples, trip blanks, and equipment blanks. Examples of laboratory QC samples include, but are not limited to, background counts, method blanks, laboratory control spikes, instrument calibration, and continuing calibration checks. Each of these QC samples or functions should have listed associated acceptance criteria.

It was not evident that these QC acceptance criteria requirements were met in any of the supporting documentation for the data that used to draw the conclusions in the Westlake Tree Core Sampling Report. No acceptance criteria were listed for either field or laboratory QC samples.

3.2.2.3 Verification and Validation

Dr. Usman stated that others did not review drafts of his report and even he himself had limited time to review the report (Usman Deposition: page 14, lines 16-7 through 16-10). Similarly, there is no documented evidence that the raw data generated during sample collection and analyses were reviewed for precision and accuracy. Sample data must be verified and validated by an independent third party in order for it to be defensible. EPA QA/G-8 (2002) outlines the verification and validation process used for assessing environmental data defensibility and usability. Verification is the process of recalculating results to ensure calculation errors have not occurred. Validation is the process of examining the resulting data to ensure the data were generated per the sampling plan and therefore support the data quality objectives. There is no documentation indicating the data generated for the tree study or the analyses were verified or validated.

3.2.2.4 Training and Competency

Dr. Usman testified that graduate students conducted most of the sampling and analysis. While formal training may or may not be required in a university-led investigation, competency of the personnel involved in the project must be demonstrated to the degree that defensible data are collected and analyzed (ISO/IEC 17025:2005). Documentation that project personnel have read

and understood the project planning documents would indicate completion of basic project training. Competency may be demonstrated through peer and senior review of the documentation that is generated during field collection activities as well as peer and senior review of analytical data produced. There is no documented evidence that the sample collection procedures or analytical procedures were read by the sampling and analysis team.

3.2.3 Transparency

Transparency hinges upon systematic documentation of field and analytical processes and procedures. Procedures should be written in an easily understandable format and contain sufficient detail and clarity to ensure that consistent and defensible results are generated (ISO/IEC 17025:2005, 2010; EPA QA/G-1, 2002; EPA QA/G-4, 2006; EPA QA/G-6, 2007). For the type of investigation conducted by Dr. Usman, planning documentation should include, but is not limited to, a work plan with clearly defined data quality objectives, field SOPs, laboratory SOPs, QA/QC requirements, roles and responsibilities of the staff involved, peer and senior review procedures, and documentation procedures.

The sampling and analysis plan developed for the tree core sampling by MST was found to be incomplete. Additionally the SOPs that were developed to support the project were also found to be incomplete. There was no documentation indicating that the project planning documents developed for sampling and analysis of the tree cores were reviewed or approved for use by anyone with expert knowledge of the methodology or of the protocols required to obtain defensible data. Specific deficiencies are discussed in more detail below.

3.2.3.1 Field Documentation

Documentation is necessary to verify that the samples have been collected per the procedure to ensure that a complete data set has been gathered and that samples have been collected in a consistent manner for the data set to be defensible. Documentation of measurement parameters specified by the field and analytical procedures is required. Examples of specific data that were to be collected during field sampling cited by the sampling and analysis plan are: sampling from the source side of the tree, documentation of the species of the tree sampled, core samples from trees with a minimum diameter of 6 inches, and core samples taken at breast height of the

individual taking the sample. Based on the documentation on the field forms used to track and log tree sample collection, either these specifications were not met or were not recorded. The absence of documentation of these stated requirements indicates the specifications were not met.

Data recorded in field forms and laboratory log books should contain the signatures or the initials and date of the person(s) performing the tasks and recording the information. Unused spaces in forms and log books should be lined through to indicate that they were intentionally left blank. Data should be recorded in indelible ink, not pencil, so that erasures are not possible and error correction is clearly demonstrated. When mistakes occur during data/information recording, each mistake should be crossed out, not erased or obliterated or written over (transformed) or deleted, and the correct value entered alongside. All corrections should be signed and initialed by the person making the correction. In the case of data stored electronically, equivalent tracking and accountability measures should be taken to avoid loss or change of original data (ISO/IEC 17025:2005). The field and laboratory forms and logs that were generated during project data collection and analysis were not completed using correct documentation practices. Data were corrected or changed without initials of the person making the change or with a date indicating when the changes were made. This lack of transparency and traceability results in the inability to determine the validity of the changes. Additionally blank lines and spaces were observed on forms that were not lined through which may indicate that data that should have been recorded were missing. The overall lack of appropriate documentation practices result in a data set that may be incomplete or inaccurate and are not defensible for the purposes of supporting the final project data quality objectives and conclusions.

Dr. Burken admits in his deposition[7] that the field records for tree and vial numbers are not consistent and may be the result of mistakes in recording samples. The problems highlighted by the lack of proper handling procedure extend beyond just a lack of defensibility of the data but draws into question the underlying results of the analysis. The batching procedure used by Dr. Usman creates a situation where a misidentification of a single vial can jeopardize all conclusions.

[7] Burken deposition page 181 line 16.

3.2.3.2 Lab Documentation

Documentation of QA/QC procedures apply to the sample analysis as well. For sample analysis by gamma spectroscopy, analytical samples and calibration standards must be analyzed in a consistent geometry, must be of a similar matrix and must be measured at a consistent distance from the detector in order to provide comparable, representative, and accurate sample results (EPA Method PGH-R-023A). There is no documented evidence that this QA/QC process was followed for the gamma spectroscopy analysis of the tree core samples used to generate data to support the conclusions stated in the Westlake Tree Core Analysis Report. Photographs provided in the Westlake Tree Core Analysis Report show the use of a Styrofoam cut out slipped over the detector body into which vials are placed (**Figure 3**).

Figure 3. Photograph from Westlake Landfill Tree Core Analysis Report Showing Make-Shift Sample Holder

This make-shift sample holder allows for variation of the tree core samples within the vials and the vials within the Styrofoam such that the distance between the tree core samples and the detector may vary between samples and batches. As the distance from the tree cores to the detector is increased, the efficiency is reduced by a complex amount depending on the geometry of the detector and samples. Based on the deposition by Dr. Usman, on at least two occasions, additional samples were simply taped to the Styrofoam holder to allow analysis of extra samples. Dr. Usman has stated that this experimental design was not intended to be quantitative so no efficiency assessment was complete. However, the comparisons between samples ***are*** quantitative and he reports quantitative results in terms of counts, so attention to these types of details is critical for establishing a defensible result. Documentation on how samples were handled and the sampling arrangement in relation to the detector was not recorded as part of the record.

3.2.3.3 Chain of Custody Process

Lastly, based on the documents reviewed it is not apparent that samples were transferred or handled using a chain-of-custody process. A critical activity within any data collection phase involving physical samples is the handling of sample media prior to sampling, handling/transporting sample media to the field, handling samples from the field at the time of collection, storage of samples (at field or other locations), transport of samples from the field site, and the analysis of the samples. Documentation ensuring that proper handling has occurred throughout these activities is part of the custody record, which provides a mechanism for tracking samples through sample collection, processing and analysis. Custody records document the chain-of-custody; the date and person responsible for the various sample handling steps associated with each sample. Custody records also provide a reviewable trail for quality assurance purposes and as evidence in legal proceedings. There is no documentation that indicates that the tree core samples were handled in a manner consistent with a chain-of-custody process.

3.3 Opinion 3. Interpretation of Dr. Usman's results does not provide evidence of migration of RIM material from the landfill – rather the results are more likely a result of instrumental drift and experimental noise mischaracterized by Dr. Usman.

3.3.1 Analysis of Total Activity in Tree Core Batches

Notwithstanding the serious methodological issues identified above, let's assume for a moment that the results (i.e., counts and spectra) provided in Dr. Usman's report are accurate. Even if these results are accurate, **Dr. Usman's interpretation of the results is flawed** as other sources of uncertainty are influencing the results.

For reference, in **Table 1** below, I have summarized batch-specific results as provided in Dr. Usman's raw data files. Dr. Usman did not provide the batch-specific statistics that underlie his conclusions; as such, statistical values in the last two columns of **Table 1** (z-score and probability) are my own calculations developed based on available information from Dr. Usman's report[8,9].

[8] Dr. Usman did not provide sufficient information to evaluate his work. The values indicated on the legend of Figure 1 in Dr. Usman's report may also reflect the net counts. While the net counts for Batch 1 are approximately the same as those calculated from the raw data, the other samples shown have different values. Net counts shown in Appendix B of the Tree Core Analysis Report also show different values.

[9] Dr. Usman's did not report the 3-sigma value. However, based on his determinations that Batch 1 was elevated at 160,000, but Batch 14 was not at 116,000, for my statistical evaluation, I assumed a 3-sigma of 120,000. The simple method of using the square root of the measured activity results in a much smaller 3-sigma and presents even a greater problem in interpreting the results.

Table 1. Gamma Spectroscopy Raw Data Total Spectrum Counts

Batch	Count Time	Normalized 100 hr Counts	Identified as Elevated?[1]	Difference from Background[2]	z-score[3]	Probability
Batch 1	24	25516333	Y	160276	4.0	0.9999692406
Batch 2	70	23722459	N	-1633598	-40.8	<0.0000000001
Batch 2 _Recounted	50	25522496	NA	166439	4.2	0.9999841554
Batch 3	50	25779492	Y	423435	10.6	>0.9999999999
Batch 4	50	25785830	Y	429773	10.7	>0.9999999999
Batch 5	50	25568404	Y	212347	5.3	0.9999999448
Batch 6	50	25882882	Y	526825	13.2	>0.9999999999
Batch 7	50	19600404	N	-5755653	-143.9	<0.0000000001
Batch 8	50	25021766	N	-334291	-8.4	<0.0000000001
Batch 9	50	25292946	N	-63111	-1.6	0.0573086546
Batch 10	50	25050216	N	-305841	-7.6	<0.0000000001
Batch 11	50	25358766	N	2709	0.1	0.5269977261
Batch 12	50	25281856	N	-74201	-1.9	0.0317963283
Batch 13	50	25333378	N	-22679	-0.6	0.2853655834
Batch 14	50	25472612	N	116555	2.9	0.9982151359
Batch15	50	25268928	N	-87129	-2.2	0.0146946449
Batch 16	50	24938196	N	-417861	-10.4	<0.0000000001
Batch 17	50	25006446	N	-349611	-8.7	<0.0000000001
Batch 18	50	25297200	N	-58857	-1.5	0.0705881083
Batch 19	50	25449744	N	93687	2.3	0.9904141384
Batch 20	50	25720346	NA	364289	9.1	>0.9999999999
Batch 21	50	25627632	NA	271575	6.8	>0.9999999999
Batch 22	50	25542942	NA	186885	4.7	0.9999985095
Batch A	50	25547790	NA	191733	4.8	0.9999991798
Batch B	50	25733674	NA	377617	9.4	>0.9999999999
Batch C	50	25658582	NA	302525	7.6	>0.9999999999
BG4 - Background (4 Days)	100	25356057				
BG6- Background (6 Days)	144	25362508				

Notes:

1 Identified in Dr. Usman's Report. Batched listed as NA were not yet evaluated at the time the report was completed.

2 Difference from Background was calculated as the sum of the difference in counts between the batch and the 4 day background sample.

3 z-score (and probabilities) were calculated based on deviation from the standard normal distribution.

For his study, Dr. Usman hypothesized that if a tree core radioactivity spectra is **significantly** greater than the background spectra, radioactivity is "elevated." Dr. Usman reportedly uses a statistical (quantitative) threshold of 3 standard deviations (3-sigma) to determine "significance." Statistical approaches for evaluating the nature and extent of pollutants are not uncommon when evaluating contaminated sites; however, conclusions from such an approach hinge upon having background samples that are, in fact, representative of background conditions. In the case of radioactivity, this is a critical consideration as all living things contain some radioactivity: people, dogs, apples, and tree cores (EPA Radionuclide Basics/Uranium and Thorium).

Despite his apparent understanding of ambient radioactivity (Deposition Page 9), in his study, Dr. Usman defined "background" as radioactivity measured in the study chamber (a lead-lined room) when **NO** material was present. Thus, the finding that radioactivity is higher when tree core samples are present is not surprising; in fact, it is completely expected. A contrary result – where tree core radioactivity was less than background (i.e., empty room) radioactivity – would bring into question Dr. Usman's methodology. Yet, as shown in **Table 1**, this happens in several cases. It is feasible that some tree core batches would have radioactivity that is similar to background or even slightly lower due to measurement uncertainties. However, assuming a 3-sigma level of statistical significance, 40% of "non-elevated" batches have radioactivity levels that are **significantly** lower than background. In making his conclusions, Dr. Usman did not explore these batches that he deemed non-elevated. Since negative radioactivity does not exist, the lower radioactivity level results are not reliable. This lack of reliability for lower radioactivity results necessarily brings into question the reliability of the higher radioactivity results and leaves us only one plausible explanation: the interpretation is flawed and other sources of uncertainty are influencing the system.

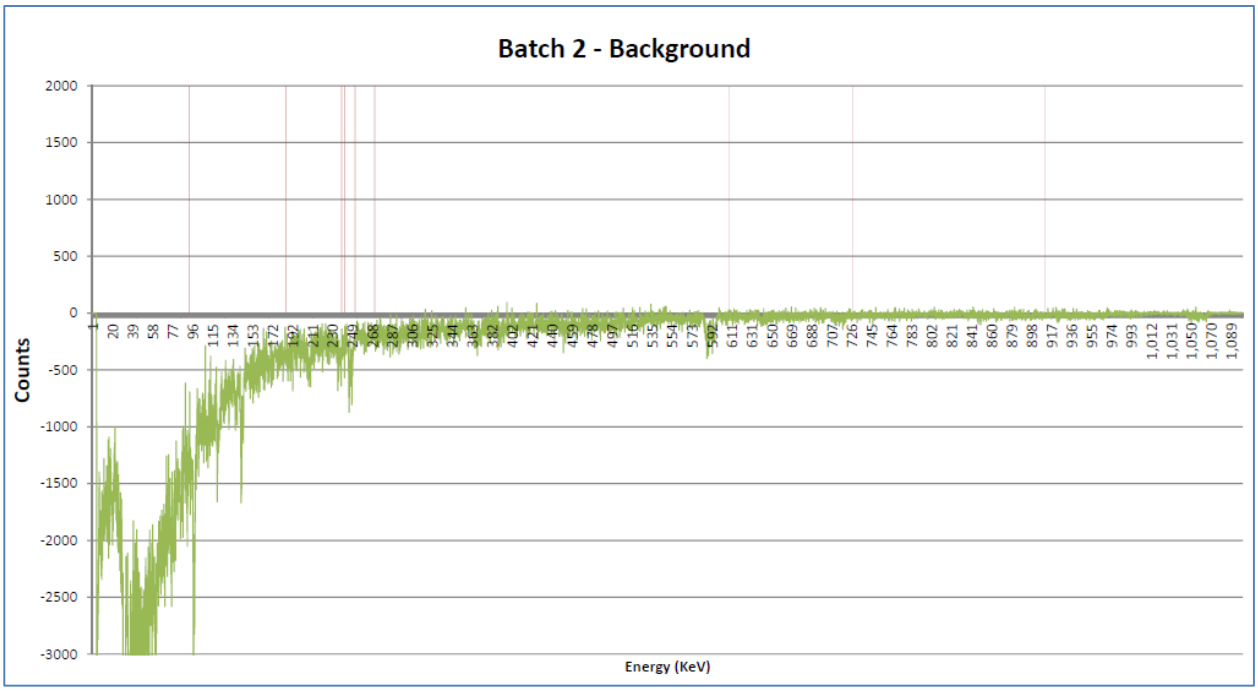
Examples of uncertainty are sensitivity drift and energy calibration drift. These concepts are discussed in the sections that follow.

3.3.1.1 Analysis of Response Drift

Response drift means that an equal level of radioactivity may show a different number of counts on different days. Such a shift in sensitivity could occur through changes in the temperature of the

detector or even a simple repositioning of the power cord that may affect the line voltage. The implications of response drift are best illustrated by reviewing the examples of spectra collected from Dr. Usman's study. I created **Figure 4** below showing a difference spectra comparing the raw counts between Batch 2 and BG4 (background collected over 4 days).

Figure 4. Difference Spectrum Between Batch 2 and Background Showing Response Drift

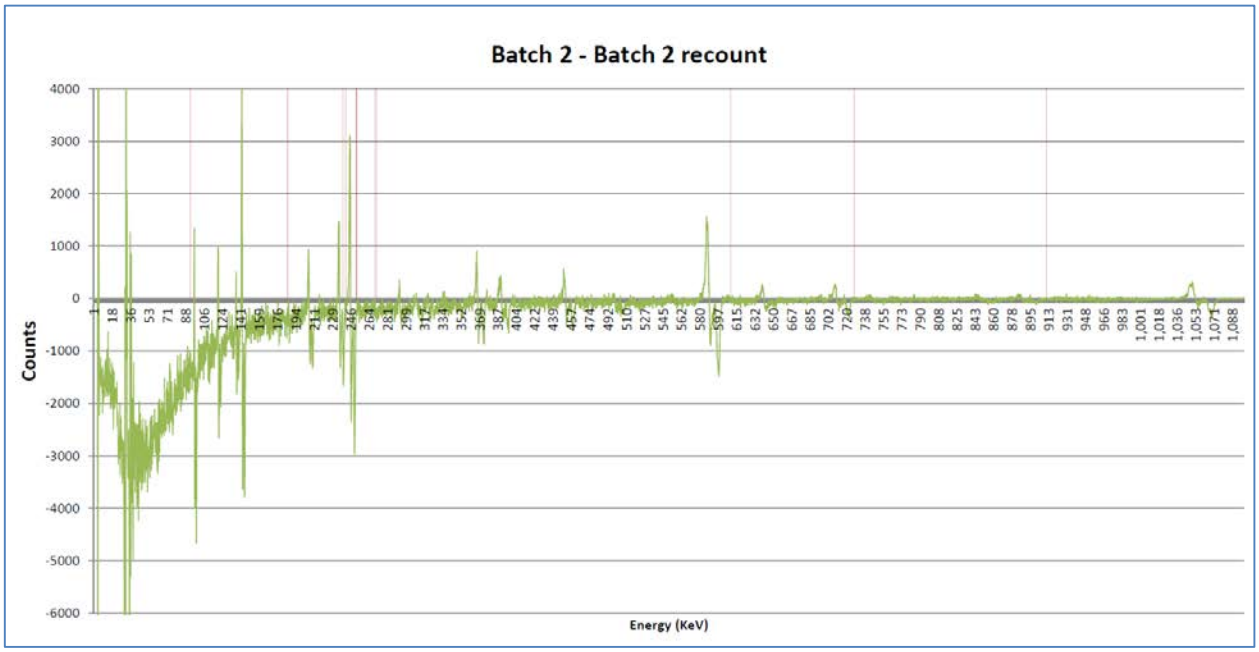


The sum of the differences across the spectra was used by Dr. Usman to determine if a particular batch warranted additional evaluation. This particular sample (Batch 2) was deemed not elevated relative to background (Usman, 2015). The expectation would then be that the background spectra and the Batch 2 spectra would be nearly identical. Therefore, we would expect the difference between the spectra would result in a line nearly coinciding with zero. These comparisons are described as "nearly" as some random measurement uncertainty is expected to be associated with the system. However, a systematic bias is observed where the Batch 2 counts are lower than Background counts across the spectra. The effect is particularly pronounced in the low energy part of the spectra where several of the key isotopes under consideration have signature decay energies.

3.3.1.2 Analysis of Energy Calibration over Time

A more striking example of the problem that can result from improper control of calibration can be found when comparing samples taken even further apart in time than the Background and Batch 2 samples shown above. The raw data provided by Dr. Usman was used to construct **Figure 5**. The gamma spectroscopy log book indicated that Batch 2 data acquisition started on May 29, 2015 while the recount of Batch 2 was done on August 5, 2015. Therefore, 68 days (almost 10 weeks) elapsed between these two measurements. In contrast only one week elapsed between the Background and Batch 2 samples shown earlier. A difference spectrum was developed using the raw data files.

Figure 5. Difference Spectrum Between Repeat Measurements Collected 68 Days Apart Showing Energy Calibration Drift



As shown in **Figure 5**, there is a systematic mismatch of peak energies across the spectra. This is evidenced by the presence of positive and negative mirror image peaks appearing in the spectra. If the peak energies for the Batch 2 recount were shifted then the peaks would overlap and the difference would be close to zero (i.e., no peaks would appear and the result would be

reproducible)[10]. The apparent shift in energy calibration over time is well understood in the scientific literature (Dewey and Kerfott, 2008) and forms the basis for the frequent and systematic calibration protocols recommended by the manufacturer of this equipment (ORTEC 2015). The magnitude of the shift of evaluated by looking at the apparent offset of one of the peaks. For example, peaks in the 1,040 KeV range appear to shift by approximately 20 KeV. According to the established standards for collecting HPGe gamma spectroscopy data, the energy calibration should be within 0.5 KeV (ANSI, 1999).

No efficiency calibration was performed on the initial experimental setup and, contrary to the National Standards for Gamma Spectroscopy Measurements (ANSI, 1999) and the operational guidance provided by the instrument manufacturer (ORTEC, 2015) no efficiency calibration was done over the course of the many months of data collection for this investigation. The fact that other sources of uncertainty play a role in evaluating the results of gamma spectroscopy analysis is a widely accepted theory discussed in both the ANSI and ISO guidance (ANSI, 1999; ISO 2010).

3.3.2 Statistical Improbability of Low Batch Results

As discussed previously, in several batches, tree core radioactivity was less than background (i.e., empty room) radioactivity. Batch 7 provides an example of the absurdity of the low activity samples. If we were to believe the methods used by Dr. Usman govern the probability of obtaining such a low result by chance, the odds are truly staggering. I was not even able to calculate the odds on a personal computer as the numbers were too large for the computer to handle. However, the odds are greater than 1 in 1,000,000,000, 000,000,000[11]. The chance of obtaining

[10] Note that in this case there may still be a shift in the overall spectra due to instrument response drift.
[11] Assumes conservatively the standard deviation of <16,000 and the difference in total counts is 575563 resulting in a z score of >36 and a probability of <1.5E-282.

such a result based on random chance alone is far greater than winning the lottery - repeatedly - every week of the year[12].

The take away from this discussion on the non-elevated batches is that by extension, **the same factors may explain the apparent finding of radioactivity in the batches deemed significantly elevated**. In other words, the differences identified between batches and background appear to be little more than systematic error introduced in the system, some higher and some lower.

4 SUMMARY AND CONCLUSIONS

Based on my review of the available data, radioactivity levels in vegetation at the WLL do not appear to present any environmental concern. The sampling and analysis performed by the responsible parties in 2009 was done under an approved work plan and analyzed under proper QA/QC procedures in a commercial contract laboratory with skilled analysts who routinely conduct analysis of environmental samples. The quantitative results can be viewed in terms of what level of activity and what level of exposure would result from contact with the trees. The supplemental data collected in on-site and off-site trees by MST and analyzed by Dr. Usman adds no quantifiable, reliable, or defensible support for radioactivity in vegetation and provides no evidence supporting the potential for migration of radioactivity.

The deficiencies in the data quality would preclude this information from being accepted by EPA for use as part of the remedial investigation at this Site. EPA has gone further and actually reviewed the reports provided by the Attorney General's office (including the one by Dr. Usman) and reaches the conclusion that they are not persuaded by this new information further concluding that "*people living near and working outside the boundary of the West Lake Landfill are not currently being exposed to contaminants from West Lake Landfill that are above a level of concern*" (USEPA, 2015).

Dr. Usman acknowledges that the methods he used are "novel" and that one of the objectives of the study was to "*develop methodologies for assessing radiation in tree core samples*" (Burken and Usman et al., 2105). Dr. Usman states in his deposition that he has never before conducted an

[12] Assumes the odds of winning the lottery is one in one million.

analysis to determine the level of radioactivity in plants and that he is not aware of any established methods to conduct such an analysis[13]. Furthermore, Dr. Usman acknowledges that his analysis is not quantitative (i.e., he has no way of establishing, as a fact, the level of radioactivity in any sample evaluated) nor does he compare the results to control samples from trees outside the potential influence of the WLL. A detailed review of the work finds numerous inconsistencies, methodological concerns and questionable interpretations of his environmental sampling data. Based on my assessment, the results provided by Dr. Usman offer no insight into the potential for off-site migration of RIM from the WLL.

[13] Usman Deposition page p115 line 5.

5 EXPERT WITNESS SERVICES PROVIDED IN THE LAST FIVE YEARS

Expert Witness, California. Expert Witness in RCRA imminent and substantial endangerment matter (*Exxon-Mobil vs. Nicoletti Oil,* U.S. District Court for Eastern District of California, Fresno, 09-1498).

Expert Witness and Litigation Support, Wisconsin. Principal Investigator and Expert Witness for CERCLA Superfund and National Contingency Plan (National Oil and Hazardous Substances Pollution Contingency Plan) matter (*United States of America and The State of Wisconsin v. NCR Corporation, et al*., U.S. District Court for Eastern District of Wisconsin, Green Bay Division, No 1: 10-C-910).

Expert Witness, Florida. Expert witness in a jury trial associated with an imminent domain matter. (*Lewis Bear v. Emerald Coast Utility Association*).

Expert Witness, Illinois. Lead Risk Assessor and Expert Witness for a Clean Water Act Case associated with recreational use standards in the Chicago River (*United States Environmental Protection Agency (EPA) v. Metropolitan Water Reclamation District of Greater Chicago;* Illinois Pollution Control Board Proceedings).

Expert Witness, Florida. Expert witness in a case involving applicability of certain provisions of the Florida RCRA Rules. (*Rayonier v. Florida Department of Environmental Protection* - Confidential Settlement).

6 REFERENCES

Agency for Toxic Substances and Disease Registry (ATSDR), 2015. An Evaluation of Radiation in Groundwater and Air. West Lake Landfill Operable Unit 1, Bridgeton, St. Louis County, Missouri. CERLIS ID: MOD079900932. U.S. Department of Health and Human Services. Division of Community Health Investigations, Atlanta, Georgia. Health Consultation.

American National Standards Institute (ANSI), 1999. American National Standard for Calibration and Use of Germanium Spectrometers for the Measurement of Gamma-Ray Emission Rates of Radionuclides. Accredited Standards Committee on Radiation Instrumentation, N42-14.

Engineering Management Support, Inc. (EMSI) et al., 2008, Remedial Design Work Plan, West Lake Landfill OU 1, Bridgeton, MO.

International Organization for Standardization (ISO) International Standard 11929, 2010. Determination of the characteristic limits (decision threshold, detection limit and limits of the confidence interval) for measurements of ionizing radiation —Fundamentals and application.

Missouri Department of Natural Resources (MDNR), 2012. West Lake Landfill, Bridgeton, Missouri.

ORTEC® MAESTRO®-32, 2015. MCA Emulator for Microsoft® Windows® 2000 Professional and XP® Professional A65-B32 Software User's Manual

Report of Westlake Landfill Phytoforensic Assessment Using Gamma Spectroscopy, S. Usman Burken et al., 2 September 2015.

S.C. Dewey and K.J. Kearfott, 2008. Calibration Drift in a Laboratory High Purity Germanium Detector Spectrometry System. Health Physics. 94(2) Suppl 1: S27-33.

United States Environmental Protection Agency (EPA). SW-846 Methods. Online, Accessed on October 27, 2015 at http://www3.epa.gov/epawaste/hazard/testmethods/sw846/online/index.htm

United States Environmental Protection Agency (EPA). Radionuclide Basics/Uranium. Online, Accessed on October 26, 2015 at http://www2.epa.gov/radiation/radionuclide-basics-uranium

United States Environmental Protection Agency (EPA). Radionuclide Basics/Thorium. Online, Accessed on October 26, 2015 at http://www2.epa.gov/radiation/radionuclide-basics-thorium

United States Environmental Protection Agency (EPA), 1994. Guidance for the Data Quality Objectives Process, EPA QA/G-4. EPA/600/R-96/055. Office of Research and Development, Washington D.C.

United States Environmental Protection Agency (EPA), 2002. EPA Guidance on Environmental Data Verification and Data Validation, GA/G-8, Office of Environmental Information, Washington D.C., EPA/240/R-004.

United States Environmental Protection Agency (EPA), 2002. EPA Guidance for Developing Quality Systems for Environmental Programs, GA/G-1, Office of Environmental Information, Washington D.C., EPA/240/R-02/008.

United States Environmental Protection Agency (EPA), 2007. EPA Guidance for Preparing Standard Operating Procedures (SOPs), GA/G-6, Office of Environmental Information, Washington D.C., EPA/600/07/001.

United States Environmental Protection Agency (EPA), 2008. Record of Decision, West Lake Landfill Site, Bridgeton, Missouri, Operable Unit 1. CERCLIS ID Number MOD079900932

United States Environmental Protection Agency (EPA), 2011. Supplemental Feasibility Study, Radiological-Impacted Material Excavation Alternatives Analysis, West Lake Landfill Operable Unit 1.

United States Environmental Protection Agency (US EPA), October 7, 2015. History of Off-Site Sampling Near West Lake Landfill.

Westlake Landfill Tree Core Analysis Report, J.G Burken, S. Usman, et al., 2 September 2015

Woodford and Associates, 2009. Vegetative Sampling Results Summary in Support of Health and Safety Plan For Vegetation Clearing and Grubbing West Lake Landfill Operable Unit 1

Attachment 1
Dr. Tolson's Curriculum Vitae

J. Keith Tolson, Ph.D.

Analytical Chemistry
Regulatory Toxicology and Site Assessment
Human and Ecological Risk Assessment
Litigation Support

EDUCATION

University of Florida, College of Medicine, Department of Pharmacology and Therapeutics, Ph.D. with Specialization in Toxicology

University of Florida, Food Science and Human Nutrition, M.S. (Analytical Chemistry and Forensic Toxicology)

University of Florida, Honors Interdisciplinary Science (Chemistry/Statistics) with Thesis in Department of Medicine (Division of Pulmonary Medicine), B.S.

PROFESSIONAL HISTORY

Geosyntec Consultants, Tampa, Florida, Principal Toxicologist, 2004- present.

University of Florida, Department of Physiological Sciences, Research Associate and Adjunct Faculty 2003-present.

University of Florida, Center for Human and Environmental Toxicology, Gainesville, Florida, Staff Toxicologist, 1997-2003.

University of Florida, Institute of Food and Agricultural Sciences, Gainesville, Florida, Senior Scientist – Food and Environmental Toxicology Laboratory, 1991-1997.

BIOSKETCH

Dr. Tolson has over 25 years of professional experience in environmental sciences. His background experience includes the areas of regulatory toxicology, analytical chemistry, environmental fate and transport, and statistical modeling. His practice includes assessing environmental liabilities and preparing risk-based remedial solutions to support regulatory and legal arguments. He is an adjunct professor at the University of Florida where he serves on the faculty at the Center for Environmental and Human Toxicology teaching graduate courses in analytical chemistry, statistics, toxicology and risk assessment. Dr. Tolson was appointed by Florida Governor to serve as toxicologist for the Department of Agriculture and Consumer Services Pesticide Review Council. Prior to joining Geosyntec, Dr. Tolson served for eight years as a consultant to the Florida Department of Environmental Protection, and is co-author of the Department's technical guidance for Soil & Groundwater Cleanup Targets, and Surface Water Rules. He has been active at the state and national level with the development of risk-based remedial strategies for legacy environmental contaminants including: PAHs, dioxins, PCBs, radiological materials, metals, SVOCs, pesticides, and chlorinated solvents.

REPRESENTATIVE EXPERIENCE

Dr. Tolson has extensive expertise under State and Federal regulatory statues. He has led compliance efforts and conducted site assessment to support property transactions and remedial decisions. Several representative projects are described below:

- Confidential Client, Malaysia. Dr. Tolson assisted in the risk-based evaluation of a long-term storage facility for process wastes resulting from rare earth mineral mining from monazite sands. Thorium containing wastes were evaluated using RESRAD for human health scenarios spanning the expected lifetime of the radiological waste cells. A background radiological survey was conducted to evaluate natural levels of radioactivity in the region. The project successfully gained regulatory approval as the largest radiological storage facility in the hemisphere.
- Confidential Client, ID. Dr. Tolson was retained to provide expert services related to litigation associated with an active phosphate mining operation and processing plant. Site related chemicals of concern included nitrates, metals, and radiological materials (NORM and TENORM). Provided exposure assessment and toxicology evaluation for human health concerns and toxic tort litigation raised by neighboring property owner.
- Confidential Client, West Palm Beach, FL. Dr. Tolson was retained to assist in the defense of possible litigation associated with a cancer cluster investigation in a former agricultural area. Groundwater concerns over NORM in groundwater prompted a Florida DOH public health assessment. The Florida coastal region in the vicinity of the site has naturally high radium levels. Dr. Tolson provided a background toxicological report, brain cancer etiology report, and epidemiological review of cases and expected incidence in the population in support of the client. Services included public relation related consulting to restore credibility of the clients property.
- Confidential Client, Plant City, FL. Dr. Tolson was retained to assist in the regulatory strategy and proposed remedy evaluation for a former phosphate mining and processing plant under a CERCLA evaluation. The Site included numerous surface water bodies used as process water ponds. Chemicals of concern included boron and other metals, and radiological materials (TENORM). Work involved evaluation of proposed remedial strategies to find cost-effective alternatives that would meet applicable human health and ecological criteria.
- Confidential Client, AZ. Provided litigation support for potential lawsuits stemming from releases from waste piles and tailing associated with the operations of a zinc mining facilities located near residential properties. Alleged contamination included metals, radiological material (TENORM) and SVOCs in soil and groundwater.
- Confidential Client, Jacksonville, FL. Dr. Tolson was retained to assist a mining interest in site assessment and regulatory evaluation of former mine tailings and process wastes from rare earth enrichment from monazite sands. Work included assessment of background conditions, risk assessment using RESRAD (exposure based) and RAECOM (cover adequacy). Conducted site assessment activities to evaluate nature and extent of radiological impacts in monazite tailing ponds.
- Confidential Client, St. Louis, MO. Dr. Tolson was retained to review Phase I and II environmental assessment reports for a proposed property transaction for a parcel within a Formerly Utilized Sites Remedial Action Program (FUSRAP) area. Uranium processing wastes and ores were managed and

stored on adjacent properties. Concerns at the Site were the adequacy of the methodology used by the USACE and the seller's consultants to evaluate the radiological impacts in soil and groundwater. Dr. Tolson provided an opinion on the results and limitations related to the existing evaluation with respect to residual TENORM identified on the Site.

- Forest Lakes Golf Course, Sarasota, FL. Dr. Tolson led the Geosyntec site investigation and remedial alternatives to evaluate potential risks associated with agrochemical residues on a portion of a former golf course considered for redevelopment. To meet client's requirements to quickly close the Site, Dr. Tolson developed an FDEP approved streamlined site assessment strategy. A novel approach was taken to site closure using a probabilistic risk-based soil clean-up target for arsenic. The remedy avoided any restrictive covenants on the property and reduced the scope of the remedial measures by greater than 90%.
- City of Immokalee, Immokalee, FL. Conducted a Phase I/II assessment in support of a property transaction at a former pesticide storage area and airstrip with impact from chlorinated pesticides and dioxins. Was retained to complete a full site assessment and development of a remedial strategy to address legacy environmental issues. Conducted compound specific weathering analysis and collocated sediment markers to date historical impacts from agricultural use.
- Village Green Golf Course, Bradenton, FL. Dr. Tolson led the site investigation and remediation of a former golf course for residential redevelopment. Site assessment was performed using a mix of fixed-base analytical laboratory data and field technology (XRF) to achieve FDEP approved site assessment in a cost effective manner. The remedy for the site involved application of a novel risk scenario using a 55 and older residential community restriction and allowable soil concentrations of arsenic several times higher than the default values.
- Confidential Client, Belle Glade, FL. Dr. Tolson provided support for client and Counsel in due diligence review, regulatory support and negotiation, ecological risk and strategic planning for the sale of 180,000 acres of agricultural property to the State of Florida as a part of the everglades restoration. Tasks included review of potential ecological risks associated with wetland restoration, and determination of natural and anthropogenic background concentrations of pesticides and metals.
- Confidential Client, ID. Dr. Tolson was retained to provide expert services related to a RCRA site assessment and remedial decisions associated with an active phosphate mining operation and processing plant. A gyp stack containment failure resulted in the discharge of metals and residual radiological compounds in the surrounding property. Work involved assessment activities and evaluation of a cost-effective remedial strategy that would achieve applicable human health and ecological criteria and satisfy reporting and cleanup requirements under RCRA.
- Confidential Client, FL. Provided site assessment support for a former phosphate mine and processing plant that produced deflourinated phosphate which was marketed as a nutritional supplement for animal feed. Concerns at the site included groundwater impacts from metals and radiological materials associated with the processing facility along with multiple former water-filled mine excavations, clay settling ponds, and spoil piles. Provided an alternative cleanup target for boron that was adopted by the FDEP for groundwater that substantially reduced the potential liability.
- Confidential Client, FL. Dr. Tolson was retained to conduct a site assessment on formally mined property that was being considered for residential redevelopment. Concerns were raised by a potential buyer related to low level metals and radiological compounds discovered in soil and groundwater.

Conducted an assessment of arsenic and radiological level in soil and groundwater and provided comparisons to background levels in the Bone Valley formation. Assessment allowed the property transaction to be completed successfully.

- Piney Point, Manatee County, FL. Conducted an evaluation of fill for use in capping and closure of a former phosphate processing facility. Levels of chromium in the potential borrow site soil adjacent to the site was of concern. Conducted a background analysis that demonstrated the levels of chromium were consistent with natural local background concentrations. Demonstrated using geochemical arguments that use of fill with low levels of chromium below the water table would not result in leaching of chromium to groundwater. In addition developed a surface water model to ensure the health of the site-wetlands and offsite contributing flows would not be significantly impacted by use of fill. Permits were granted for use of the adjacent barrow soils, significantly reducing the overall costs of the project.
- Confidential Client. Dr. Tolson was retained to evaluate background sources of fluorides in the environment and potential emission sources from industrial facilities. Tasks included the evaluation of human health concerns related to ingestion of fluoride from incidental ingestion, diet and drinking water. Evaluation of background levels of fluorides in the environment and ecological risks associated with airborne deposition of fluoride in the environment. Specific tasks include a review of cryolite and other natural and manmade fluoride containing substances, evaluation of fate and transport evaluation of hydrogen fluoride and other fluoride salts in the environment, and regulatory review on environmental media and foodstuffs.
- Confidential Client. Dr. Tolson provided strategic consulting to a phosphate production facility on potential control alternatives related to air and surface water discharges. Work involved an evaluation of the State and Federal Rules and a review of potential liability for off-site impacts.
- Sanford MGP Facility, Sanford, FL. Dr. Tolson was retained to assist client and counsel with regulatory and PRP group negotiations at a former manufactured gas plant (MGP) located along an urban stream feeding into a large urban lake. Consulting for the site included developing a strategy for dealing with potential human health claims from affected off-site parties, ecological impacts to the stream and lake, and regulatory requirements for assessment and remediation. Compounds of concern at this site include PAHs, coal tars, wood preservatives, arsenic, and other metals. Successfully negotiated with EPA on behalf of client for exclusion of client as a PRP at the site. Closure was obtained with the remediation of a small portion of one parcel under State cleanup criteria saving the client from participation in the multimillion dollar in-situ stabilization remedy for the broader Site.
- Bradenton MGP Site, FL. Dr. Tolson provided site assessment and regulatory consulting services for a former MGP facility located in an urban setting. Historical activities at the site resulted in comingled wastes from multiple entities. Successfully argued for establishing anthropogenic background delineation limits for arsenic and PAH. Limited extent of assessment by demonstrating off-site contributions based on source fingerprinting. Currently completing the site assessment and development of a remedial action plan for site closure.
- TECO Bayside, Tampa, FL. Dr. Tolson was retained to provide technical oversight on the delineation and remedial strategy for a former coal ash storage area that was adjacent to a marine wetland. Ash residues containing metals (arsenic and chromium) along with PAHs were detected at elevated concentrations relative to standards in soils and groundwater. Successfully negotiated use of alternative

delineation criteria for the former storage area and limited the client to assessment and remediation in accessible portion of the property.

- NASA Kennedy Space Center, FL. Developed KSC-specific cleanup targets for electric workers exposed to PCBs-contaminated soils. Drafted exposure white-paper that accounts for worker exposure parameters toxicity information on PCBs, environmental fate and transport of PCBs in and around transformers, and TSCA considerations for residual PCBs in soils. Supported alternative remediation levels to allow residual PCBs protective of worker health and the environment.
- Miami-Dade Country Environmental Resource Management, Miami, FL. Dr. Tolson conducted a county-wide background study for inorganic compounds to support the County in making risk-based decisions. Data were analyzed statistically to develop county-specific background targets. Results were compared to regional and national levels and are currently used to guide site investigation and cleanup activities for sites in South Florida. Dr. Tolson co-authored the DERM guidance for risk-based corrective action (Chapter 24).
- Rayonier Wood Treatment Facility, Bunnell, FL. Dr. Tolson was retained to develop the risk-based remedial approach to address residual wood treatment contaminants in soil and groundwater. Site contaminates included arsenic, pentachlorophenol, dioxins, PAHs, and chromium. Dr. Tolson performed dioxin fingerprinting analysis by multivariate statistical techniques to differentiate on- and off-site dioxin sources. The dioxin fingerprinting enabled the client to limit assessment activities to site-related releases. Dr. Tolson successfully negotiated a geostatistical approach to estimate contaminant concentration for the development of site-wide exposure concentrations. Those exposure estimates were used in combination with site-specific alternate soil cleanup targets to demonstrate that the proposed remedial actions would achieve Florida's Department of Environmental Protection's risk targets on a facility-wide basis.
- Kennedy Space Center, FL. Dr. Tolson provided technical assistance with the evaluation of dioxins discovered in soils in the vicinity of launch pad 39A. Source assessment was conducted that evaluated the potential for formation of dioxins from PCB containing paints and launch vehicle exhausts. Dioxins were detected in soils where workers may have had exposure during construction. Dr. Tolson assisted NASA with risk communication for workers and appropriate workers screening and safety protocols to allow the project to continue and the issue closed. The dioxin soil area was effectively addressed and construction allowed to proceed.
- Confidential Client, NJ. Conducted site ecological risk assessments for dioxin-like PCBs, dioxins and furans associated with industrial discharge through an on-site creek. Assessment required source identification and fingerprinting to differentiate site-related contamination from general background concentrations found in the Newark Bay and Raritan Bay estuaries. Conducted a regional dioxin source review of potential contributions. Findings from this study were used to provide support for limiting the extent of remedial investigations to the subject property.
- Valley Park, Hagerstown, MD. Dr. Tolson is currently retained by CSXT to provide toxicology and risk assessment support for a 120-acre former Koppers Company wood treatment facility. Processes on the site included both pentachlorophenol and creosote treatment of wood. The major treated wood product produced at the site was railroad ties that were stockpiled over a large area. The site also contains dioxin residues from contaminated pentachlorophenol used on-site. Developed site strategy and remedial action plan for dealing with impacted soils and groundwater including site-specific total equivalent dioxin cleanup criteria protective of site workers.

- Baldwin Station Site, Baldwin, FL. Dr. Tolson was retained as a testifying expert on behalf of Southern Wood Piedmont at a RCRA-permitted facility contaminated with wood preservatives (arsenic, pentachlorophenol) and industrial contaminants (chlorinated solvents, PAHs, dioxins, pesticides, and other metals). Southern Wood is challenging specific technical elements of a risk-based corrective action regulation promulgated by the Florida Department of Environmental Protection. Dr. Tolson was asked to provide expert toxicology opinions concerning Federal and State risk assessment guidance. Particular emphasis was placed on the exposure models and assumptions used to develop risk-based soil and groundwater remediation levels as well as target cancer and non-cancer risk levels used to define acceptable human exposure to contaminated media.
- Confidential Client, Memphis TN. Dr. Tolson was retained to evaluate the human health risks from dioxin and dioxin-like compounds to workers exposed to soils and dusts at a manufacturing facility. Provided recommendations to ensure worker safety and meet regulatory requirements under RCRA, OSHA and State standards.
- Confidential Client, LA. Dr. Tolson was retained as a testifying expert in a litigation matter involving the fate and transport of dioxins and furans from a manufacturing facility to nearby residential properties. Health claims included cancer and non-cancer effects. Dr. Tolson provided exposure analysis and an evaluation of exposure relative to the potential for alleged health effects. In addition, Dr. Tolson provided input on sampling and analysis of dioxins and fingerprinting dioxin profiles to various sources in the areas.
- LCP Chemicals Inc. NPL Site, Linden, NJ. Managed the human health and ecological risk assessments at a former Chlor-alkali facility located on the Arthur Kill, which is part of the Newark Bay estuarine system. Contaminants at the site include arsenic, lead, mercury, PCBs, dioxins and numerous volatile and semi-volatile compounds. Work included completion of the screening level and baseline ecological risk assessments, human health risk assessments, preparation of a mercury-soil physiochemical interaction analysis, interaction with trustees and State agencies on ecological habitat quality and impacts, review of previous assessments prepared by USEPA Region 2 contractors, and providing strategic technical input on site sampling and analysis for the remedial investigation and feasibility studies. Provided guidance to legal team on NRD liabilities and settlement options.
- DOW Chemical, Midland, MI. Dr. Tolson prepared statistical techniques to account for non-detects in sampling data collected along the Tittabawassee flood plain and from fish taken from the river. Historical releases of dioxins and other persistent chemical pollutants have occurred from manufacturing associated in the area. Given the extensive analytical dataset many samples were reported at non-detect and used in the estimation of risk as ½ the detection limit. Often this leads to an overestimation of the true contaminant concentration. Using the fingerprint of the expected congener pattern for site-related and background dioxins, a predicted pattern was established to fit non-detects based on the remaining data rather than simply assigning a surrogate ½ detection limit concentration.
- Development of Chapter 62-780, Florida Administrative Code. Working for the Florida Department of Environmental Protection Division of Waste Management, Dr. Tolson and co-workers at the University of Florida served as expert toxicologists for the State of Florida in developing soil and groundwater cleanup target levels for the Department's Petroleum, Drycleaning, and Brownfields remediation regulations. The task involved detailed cancer and non-cancer toxicological evaluations

of over 400 individual chemicals. Cleanup level adjustments were applied for arsenic to account for recent studies showing that soil bound arsenic is less bioavailable than previously assumed.

- Kennedy Space Center, FL. Dr. Tolson is the technical lead for an ecological risk assessment of the lagoonal water bodies surrounding the Pad 39A and 39B launch complexes at the Kennedy Space Center. Work to date includes development and implementation of a large scale sediment and surface water sampling program across 17 lagoonal ponds, geochronology sampling and analysis, AVS/SEM analysis, food-web modeling of ecological risk, toxicity testing, bioaccumulation studies, and community assessment. Primary constituents of concern are metals. A screening-level risk evaluation and follow-up baseline ecological risk assessment was completed to evaluation of the potential for ecological risk and inform the risk management stage of the project.
- JEA, Jacksonville, FL. Dr. Tolson developed a coal ash delineation technique to expedite field implementation of remedial measures and avoid post-excavation sampling for compounds such as arsenic that would be problematic given the interference with natural background levels. A multi-method demonstration was performed using field loop visualization, field deployed phase contrast microscopy and scanning electron microscopy. Results demonstrated that field methods were capable of accurately identifying ash impacted samples. Regulatory approval of the method was secured allowing the project to be completely successfully.
- Confidential Client – Northwest US. Dr. Tolson is currently providing strategic consulting services to a number of PRPs for a large NRDA in a river system in the Pacific Northwest. This complex site is one of the largest on-going NRDAs in the US and includes: (1) numerous contaminants of concern (COCs) with different fate and transport, toxicological, and bioaccumulative properties; (2) multiple sources of COCs; (3) various impacted media; and (4) two Trustee groups and on-going NRDAs. Geosyntec currently plays a major role on technical subcommittees evaluating and reducing current HEA Service Loss thresholds, identifying critical service-loss drivers, and supporting alternative service loss thresholds. Dr. Tolson developed a GIS-based HEA debit tool to demonstrate the Client's limited liability and continues to negotiate with the Agency and Trustees on behalf of the Client.
- Confidential Client, WI. Provided an environmental liability assessment related to potential NRD liability for an industrial facility with potential impacts from historical activities along a riverine ecosystem. As part due diligence activities for a prospective buyer of a property, conducted a HEA based analysis of potential liability. Also conducted a survey of regional NRD settlements and advised client on the range of settlement for similar sites. Reviewed potential restoration opportunities to mitigate liability in a more cost effective manner through performance of projects with equivalent ecological service.
- Confidential Client, Portland, OR. Dr. Tolson was retained to assist in the CERCLA and NRDA liability evaluation for a gas storage and transfer facility in the industrial corridor within the Portland Harbor Superfund Site. The facility is adjacent to a former chlor-alkali facility and historically received hydrogen from that facility for packaging and distribution. Potential chemicals included mercury entrained in the hydrogen gas lines and sumps along with PCBs in compressor oil and PAHs. Dr. Tolson assisted client in site investigation for upland source control document preparation along with liability evaluation associated with CERCLA.
- LCP Chemicals of Georgia NPL Site, Brunswick, GA. Project manager for CERCLA probabilistic ecological risk assessment at this former chlor-alkali and petrochemical manufacturing facility. The site

occupies more than 500 acres including terrestrial uplands and an estuarine marsh adjacent to the Turtle River. Work included the preparation of a screening level ecological risk assessment for the upland portion of the site to demonstrate post-remedial risk reduction, and the direction of field-sampling activities to support a large-scale ecological risk assessment for the estuary adjacent to the site. More than 50 sampling stations were evaluated for sediment and surface water chemistry, chronic toxicity of surface water, chronic toxicity of sediment, benthic invertebrate community structure, and chemical body burden in a variety of fish, blue crabs, fiddler crabs, marsh grass, and insects. A unique element of the ecological risk assessment included the development of sediment remedial action levels based on site-specific data and probabilistic modeling. Primary chemicals of concern at this site included mercury, lead, PCBs, and PAHs. Uncertainty bounds from the probabilistic assessment were utilized in development of the NRDA for the Site

- Confidential Client, IL. Developed a shadow assessment of NRDA liability for a former smelter facility. Utilized a HEA-based assessment for various reaches of the river. Service loss thresholds were developed from other NRD assessments and data derived as part of the CERCLA assessment. Currently assisting client and counsel in a strategy an regulatory negotiations to reach settlement of NDR liability
- Confidential Client, Green Bay, WI. Reviewed HEA assessment inputs to develop legal strategies for client advocacy along the Fox River. Successfully implemented a revised allocation based on more recent guidance and techniques for NRD assessment. Provided strategic guidance for legal team on NRD liabilities and settlement options.
- Hanlin-Allied-Olin NPL Site, Moundsville, WV. Provided human health and ecological risk assessment support for a former chlor-alkali facility and chemical manufacturing plant as part of a CERCLA RI/FS. Site includes over 100 acres of terrestrial habitat and former manufacturing facilities and several miles of shoreline and sediment impacts along the Ohio River. Assessment involved extensive interaction with USEPA, State and Federal trustees (USF&W). Chemicals of concern at the site included mercury, nitrobenzene, nitrotoluene, aniline dyes, PCBs, dioxins and chlorinated solvents. Initial work completed included screening level risk assessment to an Engineering Evaluation/Cost Analysis under CERCLA. Conducted risk-based GIS mapping to identify areas where potential risks were significant in the selection of remedial strategies. The costs associated with several potential remedial alternatives were evaluated against the anticipated reduction in site risk following the "virtual" implementation of each alternative. This evaluation demonstrated that the most comprehensive remedial approach did not yield significantly more risk reduction than a less costly alternative.
- Confidential Client. Dr. Tolson was retained to assist an industrial client with regulatory issues related to compliance and on-going Rule-making under the NESHAP program for control of priority pollutants at several manufacturing facilities. Assisted client with interpretation of proposed Rules – specifically the risk assessments and implications of emission limits. Emission inventories were evaluated along with potential control technologies to inform client on expected implications of proposed Rules on operations.
- Confidential Project, AZ. Dr. Tolson was retained to assist with a potential litigation matter in a case involving a gaseous release from a manufacturing facility. The affected community included numerous residential properties and an elementary school. Developed a toxicological profile for potential components associated with the release. Provided basic dispersion modeling and dose reconstruction

for potential receptors exposed. Assisted client with strategy to communicate with the public and address potential claims. The case closed without any legal action.

- Portland Harbor Superfund Site, Portland, OR. Dr. Tolson is currently providing CERCLA review and risk assessment support for a PRP group. Legacy sediment contamination includes PAHs, metals, pesticides, and numerous anthropogenic inputs over the 100 year operational history of the port and surrounding industry. The CERCLA remedial investigation has resulted in a complex ecological and human health risk assessment. Tasks include providing comments on risk-based assessment methodology, providing input on implications of assessment on remedial actions required, and developing allocation related assessments.
- Matthiessen & Hegeler Zinc NPL Site, La Salle, IL. Managed the CERCLA human health and ecological risk assessment at a former zinc rolling mill and primary zinc smelter located on the Little Vermillion River. During its operation the facility produced slab zinc, sulfuric acid, and ammonium sulfate fertilizer. Manufacturing processes resulted in the emission of airborne particulate matter containing PAHs, arsenic, cadmium, lead, zinc and other inorganic chemicals. Previously reviewed and commented on the HRS scoring package prepared by Illinois EPA for this site. Commented specifically on the inappropriate use of an inhalation cancer slope factor to characterize the potential toxicity of cadmium via the food chain pathway.
- Confidential Client, Miami, FL. Dr. Tolson was retained to evaluate the toxicological risks associated with research chemicals and low level radioactive waste buried at a former military research facility. Assisted client and counsel with interpretation of risk issues and formulation of legal strategy. Participated as toxicological expert in resolution meeting and subsequent negotiations.
- Confidential Client, US. Dr. Tolson provided technical oversight on site assessment and remediation at several natural gas compressor stations. Legacy contamination (elemental mercury and PCBs) was associated with pipeline operations. Prepared sampling and analysis plans to evaluate elemental mercury in soils and building materials. Prepared risk-based closure strategies to address hot-spots and close environmental concerns associated with the facilities.
- Confidential Client, CA. Dr. Tolson was retained as a testifying expert in Federal court in a RCRA citizen's suit associated with a finding of an eminent and substantial endangerment. The case involved a petrochemical distribution facility where the local regulatory agency had granted a regulatory closure based on a limited assessment of potential site conditions and timing of potential releases from the facility.
- Confidential Client, FL. Dr. Tolson provided expert witness testimony and consultation in workers compensation cases. He was retained in cases involving occupational asthma, chronic solvent exposure, CCA treated wood exposure, worker accidents involving acute solvent exposures, multiple chemical sensitivity claims and pyrolyzed plastic exposure.
- Confidential Client, CA. Dr. Tolson was retained to assist an industrial client with regulatory compliance associated with a potential Significant New Use under TSCA. Provided counsel with supporting information on alternatives to comply with Rules and reviewed EPA requests for ecological testing.
- Confidential PRP Group, CA. Dr. Tolson was retained to assist a PRP group in evaluating the potential for vapor intrusion risk associated with TCE in an industrial area. EPA proposed use of short-term

action levels that may trigger immediate evacuation of occupants for exposures above the action level for time frames as short as one day in duration. Represented clients to EPA scientists and managers to discuss the science behind the risks and disconnect between the regulatory levels set for occupational exposure and the proposed developmental levels proposed (5 orders of magnitude lower). Prepared a white paper detailing the scientific issues associated with the TCE developmental studies and conclusion EPA reached in the OPPT TSCA risk assessment used to support the teratogenic endpoint.

- Confidential Client. Dr. Tolson was retained to assist client with a TSCA compliance issue resulting from manufacture of chemicals designated for use in water treatment. Developed an analytical testing program to quantify unusual molecular species that form in the production of the material. Assisted client with review and comments associated with TSCA rule-making related to industry.
- DuPont de Nemours – Nitro WV. Dr. Tolson was retained by DuPont to conduct a toxicological profile for bis-(2-chloroethyl) ether (BCEE) in support of lowering the EPA-derived toxicity factor for this compound. EPA derived a cancer potency factor for BCEE based on limited studies using older methodology. A reevaluation using more recent cancer guidelines suggests that the EPA-derived potency factor is several orders of magnitude too conservative. Successful regulatory approval of the alternative evaluation will allow the client to safely conclude no remediation of the BCEE plume is required to protect groundwater resources.
- Confidential Client Risk Evaluation, TN. Dr. Tolson was retained to conduct a human health risk evaluation of chlorinated pesticides (heptachlor, chlordane, aldrin/dieldrin, endrin) that were released within an urban stream along a residential corridor over several decades from a pesticide manufacturing plant during the 1950s and 1960s. Contaminated sediments were present within the stream and adjacent properties. Dr. Tolson performed risk evaluations and negotiated with State and EPA Region IV regulators on appropriate remedial action levels on behalf of client. Dr. Tolson assisted client and their legal counsel in strategic planning for regulatory and legal issues as well as communication of complex health risk information to a concerned public.
- Confidential Client, MI. Dr. Tolson was retained to assist in evaluating the potential for exposure and risk associated with a chlorinated solvent groundwater plume that had migrated beneath a residential community. The major contaminant was TCE and concern was raised on the potential for birth defects for residents. Assisted the public relations team to prepare communication materials explaining the problem, company response, and potential for risk. Assisted client and counsel on legal strategy associated with managing the response and remedial effort.
- HoltraChem NPL Site, Riegelwood, NC. Provided technical support for the Screening Level Ecological Risk Assessment (SLERA) at a former chlor-alkali facility located on the Cape Fear River. Developed a phased field sampling plan with the goal of the reducing the number of chemicals of potential concern early in the assessment to limit project costs in later phases of the assessment. This approach was successful at focusing delineation sampling to a few chemicals of concern including mercury, PCBs, hexachlorobenzene, and arsenic.
- City of Portland, Bureau of Environmental Services (BES), Portland, OR. Dr. Tolson assisted the BES and the Oregon Department of Environmental Quality (DEQ) in the investigation of water and sediment quality in the Columbia Slough. Over the last 20 years, extensive remedial investigations, focused investigations, and feasibility studies were conducted in an effort to improve sediment quality by addressing point and non-point discharges. Stormwater and biota monitoring were conducted to assess

the relationship between these parameters and temporal trends compared to previous sampling events. Dr. Tolson planned and conducted the statistical analysis of this data. Fish samples were analyzed for low-level PCBs, dioxins, PAHs, metals, and pesticides.

- Confidential Client, WI. Dr. Tolson was retained to conduct a third party review of site conditions are prepare a CERCLA and NRD liability evaluation for a sediment site in the Great Lakes region. The Site includes multiple parties with contribution of PCBs and other minor contaminants along an urban river. Dr. Tolson reviewed the expert reports related to PCB forensics associated with the Site and provided an opinion on the allocation of liability.
- Development of Cleanup Targets for Chapter 62-777, Florida Administrative Code. Working for the Florida Department of Environmental Protection Division of Waste Management, Dr. Tolson managed the toxicological evaluation and generation of the numerical cleanup criteria for over 200 individual chemicals. This effort involved toxicological evaluation of the cancer and non-cancer effects of each chemical and also a review of chemical and physical properties to estimate fate and transport in the environment. Dr. Tolson also developed the Department's mathematical tools to calculate concentration estimates based on toxic equivalents for PAHs and dioxin/furan/PCB congeners. The Rules were reviewed and adopted though a series of public meetings where Dr. Tolson and co-workers presented the findings and fielded questions on their development and merit.
- Horse Pasture Site, Robins Air Force Base, GA. Provided technical support for the preparation of human health and ecological risk assessments for several SWMUs under evaluation in the RCRA Facility Investigation process. Conducted a vapor intrusion assessment related to potential future commercial and/or residential development of the site. Negotiated a streamlined ecological risk assessment approach with Georgia EPD based on limited habitat quality of certain areas of pasture land. Also successful in negotiating the exclusion of radionuclides from the formal quantitative risk assessments process. Primary chemicals of concern at the site included radionuclides, chlorinated solvents, lead, arsenic, and PAHs.
- Confederate Park Manufactured Gas Plant, Jacksonville, FL. Dr. Tolson provided technical support for the human health and ecological risk-based data screening for the contamination assessment of a former MGP site, currently a city park, located in downtown Jacksonville. Ecological concerns include impacted sediments in a creek that discharges to the St. Johns River. Human health concerns include the consumption of fish from the impacted creek. Currently assisting the city of Jacksonville in negotiations with FDEP regarding the extent of additional assessment required.
- Fresh Kills Landfill, NY. The closed Fresh Kills Landfill on Staten Island is a 2,200-acre site planned for redevelopment as a world-class urban recreation destination, creating the Fresh Kills Lifescape Parkland. Dr. Tolson assisted the City in understanding the environmental and regulatory issues involved in soil contamination used as cover fill. Contaminants of concern included metals, PAHs, and dioxins. Dr. Tolson also was involved in developing remedial targets to define acceptable use areas as a component of the Site Master Plan to support recreational areas, walking paths, cycling paths, water-sports areas, meeting areas, sporting facilities, and nature preserves.
- Confidential Client, CA. Dr. Tolson was retained to investigation of a potential cancer cluster associated with exposure to chemicals and radionuclides in the workplace. Services included medical records review and workplace dose reconstruction along with epidemiological analysis of relative risks between exposed and control groups. Dr. Tolson provided assistance to employee health physicians and company industrial

hygienist to deal with a sensitive workforce, mitigate potential exposures and address employee health concerns. Provided public risk communication consulting to allay worker concerns.

- Confidential Client, FL. Dr. Tolson was retained by a grower association to investigate the uptake of perchlorate into crops. Dr. Tolson prepared an investigation program and evaluated the results of the data in terms of potential human health risks for consumers. He further advised client on remedial strategies to address soil and irrigation water inputs to reduce uptake.
- Confidential Client Risk Evaluation, IL. Dr. Tolson was retained to assist client and legal counsel in a potential toxic tort action involving residential exposure to lead in a neighborhood adjacent to a former smelting site. Services provided include evaluation of air dispersion modeling performed by EPA, statistical analysis of yard lead concentrations relative to age of the houses, secondary sources of lead in the community, evaluation of NHANES data to estimate predicted blood lead distributions for community, and risk evaluation of remedial options that are protective of human health.
- Confidential Client, Orlando, FL. Dr. Tolson was retained to assess potential risks associated with mercury containing flooring installed in a High School gymnasium. Initial work involved an assessment of indoor air and consultation on an action plan to address potential health concerns from parents and staff. Dr. Tolson directed a remedial project to remove and dispose of the flooring under TSCA and restore the building to active use. The assessment and abatement activity were coordinated with the school to minimize disruption and resume the use of the facilities in a timely fashion. Follow-up testing was performed to confirm the building safety.
- LA Unified School District, Los Angeles, CA. Assisted District in interpretation and public dissemination of analytical results associated with lead found in soils during construction of new schools. Provided statistical evaluation on the performance of X-ray fluorescence (XRF) spectroscopy for field analytical measurements for metals. Alternative statistical techniques were applied to assess the ability of XRF to correctly identify a soil sample as above or below acceptable regulatory criteria. A dataset was assembled from multiple sites in southern California with analytical results from both XRF and a fixed-base laboratory. An analysis was conducted to compare the performance of different statistical techniques to evaluate the suitability of XRF results compared to the 'gold standard' fixed-base laboratory results. Results of this analysis showed that alternative methods to those suggested in DTSC guidance may provide a better evaluation of performance. Results were jointly published with DTSC and may provide impetus for revision of these rules and establishment of revised lead standards at school sites in the district.
- Confidential Client, CA. Dr. Tolson was retained to assist in public communication of potential risk from vapor intrusion to indoor air. An adjacent cleanup site was discovered to have a groundwater and vadoze zone plume of chlorinated solvent that were beneath the footprint of a portion of the school. Indoor air sampling showed trace detections of VOCs in indoor air.
- Baseline Risk Analysis for Chapter 62-302, Florida Administrative Code. Working for the Florida Department of Environmental Protection (FDEP) Division of Water Facilities, Dr. Tolson conducted a probabilistic (Monte Carlo) analysis that incorporated fish consumption distributions from the Florida Per Capita Fish and Shellfish Consumption Study conducted by the University of Florida. The analysis used the Florida-specific fish consumption data, combined with standard toxicity and food-chain biotransfer factors developed by the U.S. Environmental Protection Agency to estimate cancer and non-cancer health risks to different segments of the population exposed via their diet to chemicals in surface

water at the State's current standards for non-potable surface water. The risk analysis was used by FDEP to establish new surface water standards for 25 carcinogenic chemicals and 11 non-carcinogenic chemicals.

- Confidential Client, CA. Dr. Tolson assisted in the investigation of a shallow embayment contaminated with PCBs. An area with higher concentrations of PCBs was covered with a sand cap to limit cross media impacts due to bioturbation, currents, and other potential physical disruptions. Subsequent investigations of cap performance revealed recontamination in the area. Dr. Tolson was engaged to provide a statistical evaluation of the PCB contamination relative to potential recontamination sources.
- Kennedy Space Center, Cocoa Beach, FL. Provided technical support for the preparation of human health and ecological risk assessments for multiple SWMUs involving chlorinated solvents, petroleum products, PCBs, and pesticides/herbicides. Successfully adapted and gained regulatory acceptance of a Preliminary Risk Evaluation approach in order to streamline human health risk assessments and the RCRA Facility Investigation process at the Kennedy Space Center. Ecological sites included marine and freshwater sediment areas along with upland terrestrial habitats. Developed facility-specific ecological risk-based screening levels for chlorinated pesticides (DDTs, chlordane, heptachlor, aldrin/dieldrin), metals, PAHs, and PCBs. FDEP plans to integrate the methods used to develop these screening levels into their forthcoming ecological risk assessment guidance.
- Metropolitan Water Reclamation District of Greater Chicago, Chicago, IL. Dr. Tolson conducted a quantitative microbiological risk assessment for recreational use of the Chicago area waterways. The analysis was conducted using probabilistic risk assessment techniques based on site-specific exposure and waterway microbiological sampling. Monte Carlo simulations were performed with different microbiological treatment systems to investigate the human health and ecological effects of various remedial alternatives. Results of the analysis will be used by the District to guide them in deciding what, if any, tertiary treatment will provide a cost-effective reduction in microbiological risks. The ultimate decision will involve hundreds of millions of dollars in infrastructure investments and have regional impacts on water quality.
- Confidential Client, MD. Dr. Tolson was retained to provide site assessment and ecological risk support associated with the potential impacts associated with the release of arsenic, chromium, PAHs, and other constituents from coal combustion product (CCP) storage area in close proximity to a stream and riparian habitat. A CSM was developed to assist in legal strategy and potential streamlined assessment options.
- Confidential Client, WA. Dr. Tolson served as risk assessment lead for facility-wide regulatory compliance audit and corrective action directed by the agency. Provided risk-based remedial strategy for addressing PAH detections in swales and a detention pond adjacent to a consumer product manufacturer parking facility. Utilized alternative cleanup standards along with engineering controls to address pathway risks.
- City of St. Augustine, FL. Dr. Tolson was retained by the city of St. Augustine to assist with regulatory compliance issues associated with movement of waste from an unregulated solid waste disposal area. Dr. Tolson represented the City at a public meeting to brief the public on a proposed plan and discuss the public health implications associated with leaving the wastes in place or moving them through the community. Contaminants of concern included lead, arsenic, PAHs, and PCBs.

- Robbins Air Force Base, GA. Conducted a site-specific risk assessment for soil and groundwater at a former manufacturing/processing facility. Developed Type 4 Risk Reduction Standards (RRS) for all chemicals of concern based on site-specific exposure conditions. RRS were developed under Chapter 391-3-19 of the Georgia Department of Natural Resources, Environmental Protection Division.
- Aerojet, Sacramento, CA. Aerospace research and manufacturing facility with groundwater and soil contamination resulting from 1,4-dioxane stabilized chlorinated solvents use. Dr. Tolson provided vapor intrusion risk assessments to define the extent of remediation needed for protection of human health. Suitable redevelopment land use designations were assessed for each parcel based on risk-based assessment and proposed remedial alternatives. Regulatory oversight on this project was performed by USEPA Region 9 and California EPA.
- CSX Gainesville, GA. Conducted a site-specific risk assessment for Brownfields redevelopment under Georgia Hazardous Site Response Act (HSRA) guidance. Developed Type 4 Risk Reduction Standards (RRS) under Chapter 391-3-19 of the Georgia Department of Natural Resources, Environmental Protection Division for all chemicals of concern based on site-specific exposure conditions. Responsible for developing alternative exposure scenarios for adolescent trail recreators to calculate favorable Risk Reduction Standards (RRSs).
- Confidential Client, FL. Retained to assist a client with TCA contamination to evaluate the presence of 1,4-dioxane in groundwater. Previous assessment and remediation efforts by others had ignored 1,4-dioxane. Testing located the presence of 1,4-dioxane in groundwater near the source area as well as in the remediation system effluent. Efforts involve working with the client to negotiate a path forward with the Florida Department of Environmental Protection regarding 1,4-dioxane to address its presence in groundwater (over 100 feet deep), and methods to remediate 1,4-dioxane at the site.
- Peters Cartridge Factory NPL Site, Kings Mills, OH. Currently managing the baseline human health and ecological risk assessment at this former munitions facility located on the Little Miami River. For more than 50 years, the facility manufactured semi-smokeless cartridge ammunition for shotgun, rifle shells. Chemicals of concern primarily consist of metals such as lead, arsenic mercury, and copper, and volatile organic chemicals associated with degreasing operations. Used IEUBK modeling to develop site-specific lead clean up targets protective of potential future recreational users of the property. This work involved developing regional blood lead distributions as inputs in the modeling. Other aspects of the project include overall site strategy development, human health and ecological risk assessments, and negations with USEPA and Ohio EPA on remedy selection.
- Dow Elanco and Gainesville Pest Control, Gainesville, FL. Dr. Tolson was retained as an expert toxicologist in a toxic tort case. Occupants of apartments were exposed to off-label pesticide application. Dr. Tolson provided written toxicological profiles and exposure assessments to support litigation.
- St. Germain Drum Disposal Sites, Taunton, MA. Managed human health and ecological risk assessments for drum burial sites where waste haulers had illegally disposed of drums containing hazardous waste from multiple facilities in the surrounding area. The sites are related but geographically separated by short distances. High concentrations of VOCs in shallow groundwater plumes triggered concern for the potential vapor intrusion into nearby residential and commercial buildings. Conducted vapor intrusion assessments based on a combination of modeling estimates, soil gas measurements, and indoor air sampling. These multiple assessment techniques were required

because of the complex mix of VOCs in groundwater and the presence of some of the same chemicals in consumer products used inside several of the homes and commercial establishments.

- Fike Chemical NPL Site, Nitro, WV. Provided technical support for the preparation of human health and ecological risk assessments at a former specialty chemical production facility for a multi-company PRP group. Assisted in negotiations with regulators from USEPA Region 3 to establish consensus on risk assessment inputs, particularly the selection of appropriate exposure assumptions for future industrial redevelopment scenarios. Developed site-specific soil cleanup target levels and utilized GIS characterization to demonstrate advantages of targeting remedial actions at isolated areas of elevated dioxin and arsenic concentrations. The primary chemicals of concern at the site were dioxins/furans, arsenic, and chlorinated solvents.
- Confidential Client, MI. Dr. Tolson was retained to provide litigation support for one PRP as part of a multi-party PRP group involved with a CERCLA response at a contaminated sediment site. An opinion was prepared on the potential to challenge EPA selected remedial alternatives to address residual contamination in sediments. Considerations included fate and transport modeling of contaminants in surface water and sediments, appropriateness of EPA selected models for estimating ecological risks, and economic and engineering calculations that supported the remedy decision.
- Crystal Springs Park Landfill, Jacksonville, FL. Dr. Tolson was the project toxicologist for fast-track remedial activities at a city of Jacksonville park located on a former landfill. The work has included assessment of site soils and groundwater for the presence of dioxins, metals, PCBs, pesticides, and semi-volatile and volatile organic compounds; and lake fish tissues for the presence of dioxins. Work also has included design and preparation of plans and specifications for a presumptive remedy involving placement of a soil cap on over three acres of a park ball field/picnic area, preparation of human health risk assessments, and fencing to allow limited park access.
- Doeboy Dump Site, Jacksonville, FL. Dr. Tolson served as project toxicologist for the assessment and remediation of a 27-acre closed landfill site. Work included completion of the site assessment report and assistance with the Community Involvement Plan. In addition, Dr. Tolson provided review and interpretation of environmental data to develop a risk-based strategy to meet human health and ecological criteria for compliance with FDEP requirements for Site closure.

TEACHING

Dr. Tolson is an adjunct faculty member at the University of Florida in the Center for Environmental and Human Toxicology, teaching graduate courses that include:

- Ecological Risk Assessment (VME 6750). A graduate level course in ecological risk assessment principle and practice. Guest Lecturer (2005-2010)
- General Toxicology (VME 6602). A graduate-level course covering the general principles of toxicology and mechanisms by which toxic effects are produced in target organs and tissues. Guest Lecturer. (2000-2010).
- Advanced Toxicology (VME 6603). A graduate-level course providing a survey of the health effects of each of the major classes of toxicants. Guest Lecturer - Pesticides. (1999-2007).
- Human Health Risk Assessment (VME 6934). A graduate-level course dealing with the fundamental concepts, techniques, and issues associated with human health risk assessment. Guest Lecturer. (1999-2009).

AFFILIATIONS

American Academy of Environmental Engineers (Scientist Committee 2011)
Society of Toxicology (Food Safety – Executive Committee Member 1998-2002)
Society for Environmental Toxicology and Chemistry
Society for Risk Analysis
American Chemical Society (Agrochemical, Chemical Toxicology)

AWARDS and COMMENDATIONS

Gamma Sigma Delta, University of Florida Agricultural Honor Society
Sigma Xi, University of Florida Chapter Scientific Honor Society
Phi Theta Kappa, Honor Society
2010 American Academy of Environmental Engineers Project Excellence Award
2008 Society of Toxicology Risk Assessment Best Poster Award
2003 University of Florida, Outstanding Graduate Research Award
2001 Society of Toxicology, Food Safety Best Poster Award
2000 Burdock and Associates Toxicology Travel Award
1999 Society of Toxicology Travel Award
1998 Society of Toxicology, Risk Assessment Section Best Presentation Award

PUBLICATIONS

1. DeHaven PJ, RA Siebenmann and JK Tolson. (2008). Geospatial and Bayesian Statistical Analysis to Enhance Risk-Based Environmental Assessment and Decision-Making. Proceedings Sixth International Conference on Remediation of Chlorinated and Recalcitrant Compounds, Monterey CA.
2. Schuck ME, K Goff, SM Roberts and JK Tolson (2008). Geospatial Considerations in Calculating 95% Upper Confidence Limits on the Mean. Toxicological Sciences 106(1-S):813.
3. Tolson, JK, ME Schuck, M DeFlaun, R Lanyon, TC Granato, G Rijal, C Gerba, and C Petropoulou. (2008). Microbial Risk Assessment for Recreational use of Chicago Area Waterways. Toxicological Sciences, 106 (1-S): 121.
4. Tolson JK, RM Voellmy, and SM Roberts. (2007). Induction of heat stress proteins by adenoviral mediated gene delivery affords protection to HepG2 cells from hepatotoxicants. (Submitted: Toxicol. Applied Pharm.).
5. Tolson JK, CJ Saranko, ME Schuck, and SM Roberts. (2007). Comparison of Tools to Calculate 95% Upper Confidence Limits on the Mean. Toxicological Sciences 96(1-S):1622.
6. Saranko CJ, T Bingman, ME Schuck, and JK Tolson. (2007). Evaluation of Current EPA Cancer Potency Estimates Based on the 2005 Cancer Guidelines. Toxicological Sciences, 90 (1-S):1227.
7. Custance SR, DJ Oudiz, ME Valenzuela, PA Schanen, TL Watson, and JK Tolson. (2007). Comparison of XRF and Fixed Base Laboratory Methods for Analysis of Metals. Toxicological Sciences, 90 (1-S):2008.
8. Schuck ME, EM Tufariello, CJ Saranko, and JK Tolson. (2007). Acceptable Levels of Risk – A Survey of State Regulations. Toxicological Sciences, 90 (1-S):1229.

9. Ettinger R, SC Costello, CL Caulk, JK Tolson. (2007). Quantitative Evaluation of Soil Gas Profile Data for the Assessment of the Vapor Intrusion Pathway. Proceeding of the AEHS. March 19-22.

10. Rijal, G, JT Zmuda, R. Gore, T Granato, C Petropoulou, JK Tolson, C Gerba, RM McCuin, L Kollias, and R Lanyon. (2007). Dry Weather Microbial Risk Assessment of the Chicago Area Waterways (CAWs). American Society for Microbiology 107th General Meeting.

11. JK Tolson, J.K., CP Villaroman, EM Tufariello, SR Custance, R Lanyon, TC Granato, J Zmuta, G Rijal, and C Petropoulou. (2006). Probabilistic model for microbial risk assessment in recreational waters. Toxicological Sciences, 90 (1-S):1631.

12. Saranko CJ, JK Tolson, R Budinsky, B Landenberger, SM Roberts, KM Portier. (2006) Statistical methods for handling censored dioxin/furan congener data. Toxicological Sciences, 90 (1-S):1610.

13. Tolson JK, S Roy, SM Roberts, and KM Portier. (2006) Age-Specific Estimates of Body Weights and Surface Areas for Risk Assessments. (Risk Analysis, Accepted: RA-00037-2006-R1).

14. Tolson JK, DJ Dix, RM Voellmy, and SM Roberts. (2006). Increased Hepatotoxicity of Acetaminophen in Hsp70i Knockout Mice (Toxicol Appl Pharmacol. 210(1-2):157-62).

15. Saranko, C.J., Tufariello, E.M., and Tolson, J.K. (2005). The effect of using multiple contaminant 95% UCLs on cumulative risk estimates. Toxicological Sciences, 84 (1-S):2075.

16. Tolson, J.K., Saranko, C.J., Roberts, S.M., and Portier, K.M. (2005). A Robust Algorithm for Calculating Optimal 95% Upper Confidence Limits (95% UCLs) on the Mean for Environmental Datasets. Toxicological Sciences, 84 (1-S):2074.

17. Tufariello, E.M., Saranko, C.J., Ettinger, R., Roberts, S.M., and Tolson, J.K. (2005). Development of Florida-specific risk-based soil and groundwater cleanup targets for volatilization of chemicals into indoor air. Toxicological Sciences, 84 (1-S):2073.

18. Brellenthin, R.P., Tolson, J.K., Kessler, K., and Saranko, C.J. (2005). Evaluation of the predictivity of a fish uptake model for mercury using empirical data. Toxicological Sciences, 84 (1-S):2076.

19. Tolson JK, and SM Roberts. (2004). Manipulating Heat Shock Protein Expression in Laboratory Animals. Methods. 35(2):149-57.

20. Tolson JK, Stephen M. Roberts, Bernard Jortner, Melinda Pomeroy and David S. Barber (2004). Heat shock proteins and acquired resistance to uranium. Toxicology. 202:172-178.

21. Tolson, J.K, Saranko, C.J., and Portier, K.M. (2004). A Systematic Evaluation of Techniques for Calculating 95% Upper Confidence Limits (95% UCLs) on the Mean. Presented at the Society of Risk Analysis annual meeting, December, 2004.

22. Munson JW, JK Tolson, BS Jortner, SM Roberts, and DS Barber. (2003). Heat shock proteins and uranium nephrotoxicity. Toxicol. Sci. 72(S-1): 1687.

23. Roy S, JK Tolson, KM Portier, and SM Roberts. (2003). Beefing up — Revised body weights and skin surface area estimates. Toxicol. Sci. 72(S-1): 1885.

24. Saranko CJ, CE Mills, JK Tolson, SM Roberts, and KM Portier. (2003). The effect of censored data on the performance of techniques for calculating 95% upper confidence limits (95% UCL) on the mean. Toxicol. Sci. 72(S-1): 1915.

25. Mills CE, CJ Saranko, JK Tolson, SM Roberts, and KM Portier. (2003). Comparison of techniques for calculating 95% upper confidence limits (95% UCLs) on the mean. Toxicol. Sci. 72(S-1): 1916.

26. Tolson JK, DJ Dix, RW Voellmy, and SM Roberts. (2003). Increased hepatotoxicity of acetaminophen in Hsp70i knockout mice. Toxicol. Sci. 72(S-1): 196.

27. Roy S, Ochoa HG, JK Tolson, WG Harris, and SM Roberts. (2002). Volatilization of chemicals from groundwater into indoor air. Toxicol. Sci. 66(1-S):17.

28. Ochoa-Acuna H, JK Tolson, and SM Roberts. (2002). Dermal exposure to contaminants while swimming: An assessment of the risks and hazards associated with USEPA Ambient Water Quality Criteria. Toxicol. Sci. 66(1-S): 102.

29. Tolson JK, RM Voellmy, and SM Roberts. (2001). Cytoprotection afforded by specific upregulation of Hsp27 or Hsp70i in HepG2 cells. Toxicol. Sci. 60:345.

30. Tolson JK, RM Voellmy, and SM Roberts. (2000). Overexpression of heat shock proteins in HepG2 cells using adenoviral gene delivery. The Toxicologist vol. 49:A 201.

31. Ramaiah SK, JW Munson, JK Tolson, and SM Roberts. (2000). Protein adduct formation by norcocaine nitroxide, an N-oxidative metabolite of cocaine. The Toxicologist vol. 49:A 204.

32. Halmes NC, JK Tolson, CJ Portier, and SM Roberts. (2000). Re-evaluating cancer risk estimates for short-term exposure scenarios. Toxicol. Sci. 58:32-42.

33. Tolson JK, KE Jordan, HG Ochoa, and SM Roberts. (2000). Development of Soil Cleanup Target Levels for Chapter 62-777, F.A.C. Division of Waste Management, Florida Department of Environmental Protection. CEHT/TR-00-03.

34. Tolson JK, KE Jordan, HG Ochoa, and SM Roberts. (2000). Development of Site Rehabilitation Action Standards for Chapter 24 of the Miami-Dade County Code. Department of Environmental Resources Management, Miami-Dade County Florida. CEHT/TR-00-02.

35. Tolson JK, HA Moye, SD Walker, and TS Schubert. (2000). Phytotoxic effects of Benlate formulations and N,N'-dibutylurea on ornamental peppers (Capsicum sp.). Pest. Sci.52, 287-291.

36. Tolson JK and SM Roberts. (1999). Cytoprotection from thioacetamide-induced liver injury associated with heat shock protein induction. Toxicol. Sci. 48:196.

37. Halmes NC, JK Tolson, CJ Portier, and SM Roberts. (1999). Re-evaluating cancer risk estimates for short-term exposure scenarios. The Toxicologist vol. 48:81.

38. Halmes NC, CJ Saranko, JK Tolson, SM Roberts and RC James. (1999). Baseline Risk Analysis for Chapter 62-302, F.A.C. (Florida Surface Water Criteria). Division of Water Facilities, Florida Department of Environmental Protection. CEHT/TR-99-3.

39. Saranko CJ, NC Halmes, JK Tolson, and SM Roberts. (1999). Development of Soil Cleanup Target Levels for Chapter 62-777, F.A.C. Division of Waste Management, Florida Department of Environmental Protection. CEHT/TR-99-01.

40. Tolson JK, HA Moye, and JP Toth. (1999). Effect of temperature and humidity on the formation of N,N'-dibutylurea in Benlate fungicides. J. Agric. Food Chem. Vol47, p1217-1222.

41. Tolson JK, JF Gaffney, R Querns, DG Shilling, and HA Moye. (1998). The influence of benomyl formulation on the response of cucumber seedlings (*Cucumis sativus*) to Dibutylurea. Pest. Sci. 52, 287-291.

42. Tolson JK, RM Voellmy, and SM Roberts. (1998). Transgenic mouse model for hepatic expression of the 27kDa human heat shock protein (HSP27). Toxicol. Sci. 42:372.

43. Tolson JK, and SM Roberts. (1996). Improving estimates of risk for workers exposed to contaminated soils at agricultural sites. Fundamental and Applied Toxicology, The Toxicologist vol 30:A 749. (Presented at the annual meeting of the Society of Toxicology, 1996).

44. Tolson JK, T Schubert, S Walker, and HA Moye. (1996). Effect of Benlate formulation type on phytotoxicity to ornamental peppers. Amer. Chem. Soc. 210A344. (Presented at the 210th meeting of the American Chemical Society, Orlando FL, 1996).

45. Tolson JK, and HA Moye. (1996). Effect of heat and humidity on decomposition of benomyl fungicides. Amer. Chem. Soc. 210A126. (Presented at the 210th meeting of the American Chemical Society, Orlando FL, 1996).

46. Tolson JK, HA Moye, and SM Roberts. (1996). Benlate Analytical Data, Formulation Compositions, and Analysis Protocols. FDEP Contract # HW244-12, HW244-13, HW244-14, and HW244-15.

47. Tolson JK, and HA Moye. (1994). Formation of N,N'-dibutylurea from Benlate fungicides. Amer. Chem. Soc. 206A243. (Presented at the 206th annual meeting of the American Chemical Society, Chicago IL, 1994).

48. Shilling DG, HC Aldrich, HA Moye, JF Gaffney, JK Tolson, R Querns, and MA Mossler. (1993). N,N' dibutylurea from n-butyl isocyanate, a degradation product of benomyl: II. Effects on plants. J. Agric. Food Chem. 42:5, pp 1204-1208.

49. Moye, HA, DG Shilling, HC Aldrich, JE Gander, JP Toth, WS Brey, and JK Tolson. (1993). Formation of N,N'-dibutylurea from n-butyl isocyanate, a degradation product of benomyl: I. Formation in Benlate formulations and on plants. J. Agric. Food Chem. 42:5, pp1208-1212.

50. Moye HA, A Anderson, T Ali, and JK Tolson. (1992). Stability of pesticides on Empore extraction cartridges - suitability to remote sampling devices. 3M Grant #FL192.

51. Hart CM, JK Tolson, and ER Block. (1992). Quantitative fatty acid analysis in cultured porcine pulmonary artery endothelial cells: The combined effects of fatty acid supplementation and oxidant exposure. JCP 153:76-87..

52. Tolson, JK, HA Moye, and R Edelstein. (1991). The binding and release of EDB and DBCP from Florida soils. DER Contract WM-263, USGS publications Grant 14-08-0001-g1663.

53. Moye HA, and JK Tolson. (1992). Fluorescence enhancement in ordered media. Amer. Chem. Soc. 204:A35, 1992. (Presented at the 204th annual meeting of the American Chemical Society, Washington D.C., 1992).

54. Bhat BG, JK Tolson, and ER Block. (1991). Hypoxia increases the susceptibility of pulmonary artery endothelial cells to hydrogen peroxide injury. JCP Vol 151, p228-238.

55. Hart CM, JK Tolson, and ER Block. (1991). Supplemental fatty acids alter lipid peroxidation and oxidant injury in endothelial cells. JAP:LCP. Vol 260, pL483-490.

56. Bhat GB, SB Tinsley, JK Tolson, and ER Block. (1991). Mechanism of hypoxia-induced enhanced susceptibility of pulmonary artery endothelial cells to hydrogen peroxide. Am. Rev. Respir. Dis. 141:A733, 1991. (Presented at the annual meeting of the American Thoracic Society, Anaheim, CA, 1991).

57. Bhat GB, JK Tolson, and ER Block. (1991). Serotonin transport in reconstituted endothelial cell plasma membrane proteoliposomes: Effect of hypoxia. Am. Rev. Respir. Dis. 143:A278, 1991. (Presented at the annual meeting of the American Thoracic Society, Anaheim, CA, 1991).

58. Tolson JK, CM Hart, and ER Block. (1991). Fatty acids alter endothelial cell oxidant susceptibility but not total number of double bonds. Am. Rev. Respir. Dis. 143:A734, 1991. (Presented at the annual meeting of the American Thoracic Society, Anaheim, CA, 1991).

59. Hart CM, JK Tolson, and ER Block. (1990). Fatty acid supplementation protects pulmonary artery endothelial cells from oxidant injury. Am. J. Respir. Cell Mol. Biol. Vol 3, p479-483.

60. Hart CM, JK Tolson, ER Block. (1990). Fatty acids alter the susceptibility of cultured endothelial cells to oxidant injury. The FASEB J. 4:A839. (Presented at the 74th Annual Meeting of the Federation of American Societies for Experimental Biology)

61. Tolson JK, ER Block. (1990). Hypoxia increases the susceptibility of pulmonary artery endothelial cells (PAEC) to oxidant stress. Am. Rev. Respir. Dis. 141:A537. (Presented at the Annual meeting of the American Thoracic Society, Boston, MA, 1990).

62. Hart CM, JK Tolson, and ER Block. (1990). Supplemental fatty acids affect oxidant injury and lipid peroxidation in cultured endothelial cells. Am. Rev. Respir. Dis. 141:A820. (Presented at the Annual meeting of the American Thoracic Society, Boston, MA, 1990).