Geosyntec consultants

Certification for Selected Statistical Methods

CCR Unit: Peg's Hill Landfill, Maysville, Kentucky

Certification:

I, **Scott Graves**, a qualified professional engineer registered in the Commonwealth of Kentucky, have reviewed the available information on the Peg's Hill Landfill groundwater monitoring system and baseline groundwater monitoring data and, based on my review, and in my professional opinion, certify that the selected statistical methods presented in the narrative description that accompanies this certification are appropriate for evaluating groundwater monitoring data for this CCR unit as described in 40 CFR §257.93(f) and (g). This certification and the underlying evaluation to select appropriate statistical procedures were conducted under my direction or supervision according to a system designed to assure that qualified personnel selected the statistical procedure pursuant to 40 CFR Part 257.93. This certification is, to the best of my knowledge, accurate and complete.

Printed Name: Scott Graves

PE License Number: 21274 State: Kentucky

Seal and Signature

10/17/2019

Date

NARRATIVE DESCRIPTION OF STATISTICAL METHODS

Introduction

The Peg's Hill Landfill will be a new coal ash residuals (CCR) landfill. The landfill's groundwater monitoring system has been designed and constructed to meet the requirements of 40 CFR Part 257.91. The baseline groundwater quality data collected, and the available statistical methods listed in 257.93(f) and (g), were evaluated to select and certify the appropriate statistical method to be used for the Detection Monitoring program. This narrative summarizes the certified statistical methods that were selected, and that will be used, to derive background concentrations for each Appendix III constituent at each downgradient compliance well.

Upper Tolerance Intervals (Upper Tolerance Limits, UTL)

Upper tolerance limits (UTLs) are statistical ranges calculated using the background dataset. They are developed to specify a threshold background concentration that contains a certain percentile of the range of background values at a certain probability level. For example, a 95/95 UPL will contain 95 percent of the background concentration range at a 95 percent confidence level. By definition, a small percent of the background population will exceed the UTL. Future compliance well sample results that exceed the UTL are considered to be a statistically significant increase (SSI) above background. UTLs account for the variation in background concentrations, the size of the background dataset, and the frequency of non-detect results. Parametric UTLs are used when the background data follow a normal distribution or can be transformed to a normal distribution. Nonparametric UTLs are used when the background data do not follow a known statistical distribution model. If the background data are all non-detect values, the laboratory reporting limit (RL) may serve as the UTL, or the Double Quantification Rule (DQR) can be used wherein two successive detections in a downgradient compliance wells constitute an SSI above background.

Control Charts

Control Charts use a control limit (CL) that is calculated from the background data. If a compliance measurement exceeds the CL, it is considered to be an SSI over background concentrations. CLs can only be calculated for data that fit a parametric distribution (i.e. normal distribution or can be transformed to a normal distribution such as lognormal distributions). They are sometimes more useful than UTLs because they can display a long-term record of the actual compliance point data over time along with the background CL in graphic form making it easier to identify trends in the data, whereas UTLs only show a point in time comparison between the most recent data and background limits. CLs can be used for both inter-well testing and intra-well testing programs.

Selected Statistical Methods

The following statistical methods were selected and certified as appropriate to calculate the background concentration and to be used during the Detection Monitoring program. As required by 40 CFR Part 257.93(g)(4), the confidence level and the percentage of the population that will be contained by the selected statistical method at least as effective as the other statistical methods listed in 40 CFR Part 257.93(f) and (g). The selected statistical methods will be used to calculate background concentrations for comparison to downgradient compliance well sample concentrations for Appendix III constituents during the Detection Monitoring program.

Appendix III Analyte	Statistical Approach	Monitoring Well	Selected Test**
Boron	intra-well	PH-MW-03	CL
	inter-well	PH-MW-04	UTL
	inter-well	PH-MW-05	UTL
Calcium	inter-well	all three*	UTL
Chloride	inter-well	all three*	UTL
Fluoride	inter-well	all three*	UTL
pH	inter-well	all three*	CL
Sulfate	intra-well	PH-MW-03	CL
	intra-well	PH-MW-04	CL
	inter-well	PH-MW-05	UTL
TDS	inter-well	all three*	CL

* All three compliance wells including PH-MW-03, PH-MW-04, and PH-MW-05

** All selected statistical tests are parametric methods except sulfate at PH-MW-05.