

## Technical Memorandum

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**TO:** David Blaha (ERM)  
**FROM:** Interrallogic, Inc.  
**DATE:** Tuesday, May 8, 2012  
**SUBJECT:** Plant Site GoldSim Model (Base v01) Task 1 QA Evaluation

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Interrallogic, Inc. has completed a Task 1 QA evaluation of the Plant Site GoldSim model. In this evaluation, we compared the contents of Table 1-1 and supporting tables contained in the file “Water Modeling Work Plan - Plant Site v5 APR2012.pdf” to model-generated tables of input values. When necessary, Work Plan inputs were checked within the GoldSim model itself for stochastic elements and some lookup tables. Although data evaluation packages for two versions of the model were provided (“Existing” and “Base”), only the Base version of the model was subjected to this evaluation. It is our understanding that the “Existing” version is a subset of the “Base” model; therefore the “Existing” version was not subjected to a separate Task 1 QA evaluation. Overall, we did not identify any major issues that would cast doubt on the validity of the model with regard to inputs. We did however identify a number of secondary issues, which are discussed below. A table detailing specific issues found as part of this evaluation is attached.

### **General Comment 1: Significant Figures**

Many variables reported by the model have a large number of significant digits. However, in the Work Plan many of the matching values are reported with very few significant digits and appear to have been arbitrarily rounded for aesthetic purposes. Because of this difference, comparison of values between the Work Plan and model-output values was limited to the number of digits shown in the Work Plan tables (i.e., we were not able to evaluate additional digits output from the model). Some values have been flagged as discrepancies in the attached summary table because the Work Plan values were rounded to the point that they showed values of zero when in fact the values used in the model were not zero. We recommend that the number of significant digits shown in the Work Plan match the number of significant figures used in the model and that the model report input values with the same number of significant figures.

**General Comment 2: Reporting of statistical summaries rather than actual values**

Model-produced output files for some variables were displayed as statistical summaries instead of the actual input values. Corrections were made to the model output elements and new output files were created; however this issue should be corrected in the master version of the model so that this issue does not recur during future QA evaluations.

**General Comment 3: Inconsistency and ambiguity between Work Plan data descriptions and variable names used in model**

There is occasional inconsistency or lack of specificity between variable names and titles of columns in numbered supporting tables. For example, compare column titles for Table 1-31 to variable names reported from the model – “Forested Area to Cell 2E” is called “Contr\_Watershed” and “Saturated Tailings Volume” is called “Pond\_Sat\_Vol”. Examples of ambiguity are shown in Table 1-32: “Cell 2W Area to Cell 2E” and “Cell 2W to Cell 1E” are both reported as “Contr\_Embank\_Area” in the model output. Similarly, “Forested Area to Cell 2E” and “Forested Area to Cell 1E” are both reported as “Contr\_Watershed” in the model output.

**General Comment 4: Suggestion for improving the way vector-based inputs to “uncertain” elements are documented in Table 1-1.**

In the instances where vectors are used as inputs to the uncertain variables listed in Table 1-1, we recommend showing the specific names of the vector inputs used to define the distribution rather than simply referencing a supporting table. Having a specific name for each vector input to uncertain variables provides for a more streamlined QA process and helps reduce any potential ambiguity as to which table column serves as the input to a distribution statistic. See for example GW\_Alpha\_Rand (Table 1-1, page 3) and supporting Table 1-5. Without opening the model, it is not absolutely clear which table column is used for uncertain distribution mean and standard deviation. Additional ambiguity is caused due to the display of the first two data columns in Table 1-5 (“Mean” and “Standard Deviation”) which do not appear to be used directly in the model but are instead reverse-transformed from the adjoining columns. Showing actual model variable names or a close facsimile in the supporting tables is also suggested in order to more precisely indicate which table values are used within the model and to make them easier to find within the model.

**General Comment 5: Suggestion to streamline future Task 1 QA iterations**

Future Task 1 QA checks of input values could be conducted more quickly if tables output to Excel mirrored existing input tables in the Work Plan in order to reduce the need to search across multiple output files or worksheets for particular values. We suggest the numbering of pages in Work Plan Table 1-1. Model-produced input QA files could then be formatted so that each page contains only the variables referenced on a given Table 1-1 page. In a similar manner, model output documenting the inputs found on supporting Work Plan tables should be formatted so that each worksheet contains only the values from each corresponding Work Plan table.

Task I QA Evaluation of Plant Site GoldSim Model							
Model Name: NorthMet_PlantSite_Base_v01							
Workplan File: Water Modeling Workplan - Plant Site v5 APR2012.pdf							
Evaluation Performed by Interrallogic, Inc.							
May 2012							
Description	Workplan Tables		GoldSim Model Elements		GoldSim Output Tables		Comments
	Value	Units	Value	Units	Value	Units	
<b>Table 1-1, Page 1:</b>							
Surface_Constant_Standards(Hardness)	500				(missing)		Listed as 500 mg/L in Table 1-2, blank in model output table
Ground_Primary_Standards(Hardness)	999999				(missing)		Listed as 999999 in Table 1-4, blank in model output table
Ground_Secondary_Standards(Hardness)	999999				(missing)		Listed as 999999 in Table 1-4, blank in model output table
<b>Table 1-1, Page 2:</b>							
<i>(no issues found)</i>							
<b>Table 1-1, Page 3:</b>							
Table 1-5							Ambiguity as to which values are actually used in the model. See general comments for more info.
Table 1-6							Recommend column headings more similar to variable names
Table 1-6							Example of over-rounding of values shown in supporting tables - this is an issue impacting most supporting tables. Comparison of exact input values between supporting tables and model output was not possible due to truncation of significant figures.
Table 1-7							Example of consequences of too much rounding: Values for TI at MLC-3 and MLC-4 shown as 0 in Table 1-7 but are actually 0.000001 in model output
Mine_Site_Flow_Rate							Min and max input values for truncated normal distribution not shown on Table 1-8
Mine_Site_Conc							Min and max input values for truncated normal distribution not shown on Table 1-9 or 1-10
Mine_Site_Conc							Table 1-1 is missing a reference to Table 1-10 to show the standard deviation values used in the distribution. See general comments regarding the suggestion to incorporate more detailed documentation of the exact input vectors used to define uncertain variable distributions as a way to avoid this problem.
<b>Table 1-1, Page 4:</b>							
<i>(no issues found)</i>							

Description	Workplan Tables		GoldSim Model Elements		GoldSim Output Tables		Comments
	Value	Units	Value	Units	Value	Units	
<b>Table 1-1, Page 5:</b>							
NM_Files_Release							Variable name as shown not found in model - suggest showing specific variable names used for each constituent on supporting tables to eliminate any ambiguity as to which model elements the table numbers are used.
NM_Course_Release							Variable name as shown not found in model - suggest showing specific variable names used for each constituent on supporting tables to eliminate any ambiguity as to which model elements the table numbers are used.
NM_Content		mg/kg					Units on Table 1-16 expressed as "ppm". Although functionally equivalent, units should be expressed consistently throughout the project. The use of "ppm" is often discouraged.
LTVSMC_Content: Alkalinity	1.00E+20				1.00E+12		Assumed high values shown on Table 1-22 do not match values reported by model
LTVSMC_Content: Cl	1.00E+20				1.00E+12		Assumed high values shown on Table 1-22 do not match values reported by model
LTVSMC_Content: F	1.00E+20				1.00E+12		Assumed high values shown on Table 1-22 do not match values reported by model
<b>Table 1-1, Page 6:</b>							
Size_factor(Maximum)	N/A		1e10				Table 1-1 does not show a max value for a truncated normal distribution
<b>Table 1-1, Page 7:</b>							
Dam_WT_Depth		m				ft	Table 1-1 should show units as ft (as in Table 1-29 and model output)
Beach_WT_Depth		m				ft	Table 1-1 should show units as ft (as in Table 1-29 and model output)
<b>Table 1-1, Page 8:</b>							
Pond_Bottom_Area (and other variables)							Time series output expressed as statistical summaries instead of values
Table 1-31							Model variable names not clearly related to Table 1-31 column headings
Table 1-32							Model reports identical names for variables shown in Table 1-32
<b>Table 1-1, Page 9:</b>							
Cell_Areas		acre					Units inconsistent between Table 1-1 and Table 1-33 (uses sq. meters)

Description	Workplan Tables		GoldSim Model Elements		GoldSim Output Tables		Comments
	Value	Units	Value	Units	Value	Units	
Table 1-35							Numerous additional examples of over-rounding of values in supporting tables resulting in incorrect presentation of input values and inability to check all significant figures.
Table 1-37							Not clear where 4th group of columns in Table 1-37 (Pond) is output by model for QA purposes - values not confirmed
Table 1-39							Numerous additional examples of over-rounding of values in supporting tables resulting in incorrect presentation of input values and inability to check all significant figures.
Table 1-39	"Dams"				"Other"		Values for Seepage_Direction(Dams) in Table 1-39 shown in model output file as Seepage_Direction(Other). Should be greater similarity between inputs tables and names of model variables
Initial_Pond_Concs_2E (Table 1-44): Ba	0.25				0.032		
Initial_Pond_Concs_2E (Table 1-44): K	12				11.6		
Initial_Pond_Concs_2E (Table 1-44): Pb	0.0016				0.0025		
Initial_Pond_Concs_2E (Table 1-44): Tl	0.00017				0.0002		
Initial_Pond_Concs_2E (Table 1-44): Zn	0.013				0.015		
Initial_Pond_Concs_1E (Table 1-44): Ba	0.25				0.032		
Initial_Pond_Concs_1E (Table 1-44): Mg	47				46		
Initial_Pond_Concs_1E (Table 1-44): Pb	0.0016				0.0003		
Initial_Pond_Concs_1E (Table 1-44): Tl	0.00017				0.0002		
Initial_Pond_Concs_1E (Table 1-44): Zn	0.013				0.015		
<b>Table 1-1, Page 10:</b>							
<i>(no issues found)</i>							
<b>Table 1-1, Page 11:</b>							
Babbitt_Effluent_Conc							Although listed as a model variable, a unique element with this name is not found in the model. As mentioned in the Description, Babbitt_WWTP uses SW_RO_Concentration as an input. Perhaps should not be listed as a separate uncertain variable, but instead shown as deterministic values linked to SW_RO_Concentration so it does not give the appearance of additional uncertainty.
Babbitt_Effluent_Conc		mg/L		ug/L			Units shown in table 1-1 not consistent with Table 1-6 and units in model
PRB_Efficiency		%		%/day			Units shown in Table 1-1 not consistent with Table 1-45 and units in model

Description	Workplan Tables		GoldSim Model Elements		GoldSim Output Tables		Comments
	Value	Units	Value	Units	Value	Units	
<b>Table 1-1, Page 12:</b>							
Table 1-46, Variable Name: L							Variable name shown on Table 1-46 (L) doesn't match variable name in Table 1-1 (La) and model output (La)
Table 1-46, Variable Name: Init_Grad	(positive values)				(negative values)		
Table 1-47, Constituent: Sb					(not reported - "uncertain" variable)		Suggest that all uncertain variables and distribution characteristics be listed on Table 1-1 and not just on supporting tables
Table 1-49	"--"				"0"		Table 1-49 shows some areas as "--", model output reports as "0". Might consider alternate means of representing non-existent values (i.e. -999999 for example) here and elsewhere.
<b>Table 1-1, Page 13:</b>							
Watershed_Yield							Although it might function as an uncertain variable when combined with additional model elements, the model element referenced by this name is a deterministic lookup table not an uncertain element.
Expected_Toe_Conc		mg/L		ug/L		ug/L	Units shown in table 1-1 not consistent with Table 1-54 and units in model
<b>Table 1-1, Miscellaneous</b>							
Perc_Ntoe_MLC3							Variable name not found in Table 1-1