Spatial Analysis and Decision Assistance Verification Plan

1. INTRODUCTION

Spatial Analysis and Decision Assistance (SADA) was designed to simplify and streamline the environmental characterization process and enable quick, cost-effective decisions. SADA incorporates visualization, geospatial analysis, statistical analysis, human health risk assessment, cost/benefit analysis, sampling design, and decision analysis tools into a dynamic and interactive software package. Each of these modules can be used independently or collectively to address site-specific concerns in characterization and remedial action design.

1.1 PURPOSE

The purpose of this document is to detail the verification process that is necessary before SADA can be released to the public. Specifically, this document contains a checklist to formally and consecutively test and document each SADA function. Additionally, this document describes the verification process for all modeling results.

1.2 STRATEGY

1.2.1 Reviewer Qualifications

This document will be distributed to at least two internal reviewers for independent review. The reviewers must a) possess an understanding of basic statistics, decision analysis, and human health risk assessment, b) be familiar with the operation and methodologies of SADA, and c) be independent of the software design.

1.2.2 Verification Checklist

Reviewers will be responsible for testing particular sections of the verification plan and will work with the developer to identify or construct data sets that will permit the verification of each of these items. As the verification process proceeds, problems with SADA may be identified that will require this plan to be modified; therefore, amendments will be attached to this plan, as necessary.

The reviewers will indicate "pass" or "fail" for every step of the checklist. As particular check points fail, reviewers will notify the SADA Developer of the failure so that plans for correcting the problem can begin. The SADA Developer will make the appropriate changes to the software and document the resolutions on the SADA Verification Form (see attachment). The reviewer will then re-verify SADA to ensure that all failed criteria have been resolved and sign the Verification Form. The developer will correct as many problems as time permits before the formal release date. Any uncorrected problems will be documented with an estimated date of completion and provided to the user with the first release.

1.2.3 Modeling Verification

In addition to this checklist, all modeling results will be verified according to the following table:

Modeling Component	Verifying Agent
Statistics	Excel 97
Risk Results (RBGs, Risk)	Risk Assessment Information System (June 1998, or latest version)
Data Screens	Excel 97
OK/IK Estimation Map	Geostatistical Software Library and User's Guide (1992)
Variance Map	Geostatistical Software Library and User's Guide (1992)
Inverse Distance/Nearest Neighbor Estimation Map	Excel 97
Risk Maps (point and contoured)	Excel 97
Remedial Design	Excel 97
Probability Map	Excel 97
Cost Assessment	Excel 97
Secondary Sampling Design	Excel 97

As the table portrays, most modeling results will be verified with Excel 97. The inputs and outputs of each modeling component will be imported into an Excel spreadsheet. The modeling process will then be executed in Excel, and the results will be compared to those computed with SADA.

Risk results will be compared to the internal SAS® code used in the Risk Assessment Information System (RAIS). This code has been verified, validated, and cleared for external use on the Internet via the RAIS. The RAIS is continuously reviewed and updated, as necessary.

The geostatistical routines will be compared with the original GSLIB code that was used in their construction. The original code is found in the *Geostatistical Software Library and User's Guide*.

1.2.4   Documentation

All verification checklists will be tracked and maintained as quality assurance records. All electronic records (e.g., test data sets, modeling verification results, SADA output, and error documentation and code corrections) will be maintained by the SADA Developer.

2. VERIFICATION CHECKLIST

2.1   SADA STARTUP/RESET

Verification Step	Pass	Fail
2.1.1 The SADA splash screen opens up properly at initial startup, is correctly displayed, and disappears after setup.		
2.1.2 The Control Panel and Plot windows are opened at first setup.		
2.1.3 The following items are enabled at startup: 　　2.1.3.1　Toolbar "Open" button 　　2.1.3.2　File Menu "New" 　　2.1.3.3　File Menu "Open" 　　2.1.3.4　File Menu "Exit" 　　2.1.3.5　Help Menu		
2.1.4 All other main form, Control Panel, and Plot window items are disabled.		

2.2   ASCII DATA FILE CONVERSION/SADA FILE CREATION

Verification Step	Pass	Fail
2.2.1 When transferring data into a SADA file, the program correctly handles known errors and identifies deviations from expected criteria, such as: 　　2.2.1.1 Presence of illegal characters in column field names (e.g., punctuation marks) 　　2.2.1.2 Presence of nonnumeric values where numerical entries are expected 　　2.2.1.3 Null values in required fields 　　2.2.1.4 Incorrect formats (e.g., unequal number of rows/columns) 　　2.2.1.5 Presence of media qualifiers other than SO, SD, GW, or SW 　　2.2.1.6 Detect values other than 0 or 1		
2.2.2 Columns from the ASCII text file are correctly identified in the Column Definition window.		
2.2.3 The Column Definition window allows selection of columns for specific tasks and correctly reads the changes.		
2.2.4 A unique set of contaminant names is correctly identified.		
2.2.5 In the contaminant selection phase, contaminants marked to ignore are disregarded.		
2.2.6 The user is notified of duplicates and given the choice to a) proceed with SADA choosing the maximal value or b) cease the conversion process.		
2.2.7 Required tables (e.g., Analysis, Chemical Parameters, Data Summary, Titles, GIS Table, Miscellaneous, Pointer, Results, Scenario, Selected, Space Definition, and Variance) are created with correct values and positions.		
2.2.8 "Setup Risk Assessment" should be disabled if no media is selected.		
2.2.9 During a workspace creation failure, all code parameters and enabled properties should be reset.		
2.2.10 Workspace Creation should transition properly to open workspace sequence as if user selected "Open Workspace" from menu.		

2.3   RISK SETUP

Verification Step	Pass	Fail
2.3.1 "Setup Risk Assessment" should not be available if no media is identified in workspace creation.		
2.3.2 If risk has not been set up, only "Setup Risk Assessment" menu items should be enabled in the Risk Menu.		
2.3.3 The user is asked if they would like to save their file before beginning risk setup. The response is correctly handled.		
2.3.4 The user is provided two default parameter files and the option to browse or type in another file name.		

2.3.5 During the matching process, contaminants are correctly identified and classified for the following situations:
    2.3.5.1 No Match – incorrect CAS number <u>and</u> incorrect chemical name
    2.3.5.2 Partial Match – incorrect CAS Number <u>or</u> incorrect chemical name
    2.3.5.3 Match - correct CAS number <u>and</u> correct chemical name		

2.3.6 The contaminant matching form works correctly. Specifically:
    2.3.6.1 Each contaminant is placed into one of the three categories (Matched, Partial Match, or No Match).
    2.3.6.2 When a contaminant match is registered, the correct tox association is made for the "Register" and "All" buttons.
    2.3.6.3 When a contaminant is unregistered, it returns to the matching classification for the original profile match.
    2.3.6.4 Toxicological information is correctly retrieved for registered contaminants and placed correctly in the workspace.
    2.3.6.5 Scenario information is correctly retrieved and placed in the workspace.
    2.3.6.6 The "All" button is disabled for the No Match category and enabled for the others.
    2.3.6.7 The "Register" button is disabled for the No Match category when there is no user-specified name for the chemical.
    2.3.6.8 When a category profile is empty, the "Register" and "All" buttons are disabled.		

2.3.7 When reassociating toxicological links:
    2.3.7.1 There is a warning to save current information first and that SADA will write directly to the re-linking SADA file.
    2.3.7.2 Changes to the SADA file are directly made during the linking process.
    2.3.7.3 If a risk association is already made, a separate prompt appears to update the tox profiles and scenario profiles separately.
    2.3.7.4 The original information is maintained for databases that are not reassociated.
    2.3.7.5 If an error occurs, the user is prompted, conversion is ceased, and completed portions of the failing conversion are removed.
    2.3.7.6 When the risk setup is successful/unsuccessful, the risk related menus and toolbar buttons are enabled/disabled or hidden/visible. The analyte combo box and label combo box are correct.		

2.4   LOADING A WORKSPACE

Verification Step	Pass	Fail

2.4.1 Before a workspace is loaded:
    2.4.1.1 The SADA code is reset.
    2.4.1.2 All objects are returned to a clean and disabled state.		

2.4.2 During workspace load:
    2.4.2.1 The workspace is correctly retrieved from the workspace file.
    2.4.2.2 All GIS maps are translated.
    2.4.2.3 If a .dxf file is nonexistent or invalid, a prompt appears and the
            layer is dropped.		

2.4.3 After workspace load, the first contaminant loads and the Control Panel and graphics display information correctly.		

2.5   SAVING A WORKSPACE

Verification Step	Pass	Fail
2.5.1 The workspace is correctly saved, including all relevant or basic information needed to reconstruct a result.		
2.5.2 The "Save As" function accepts a new file name, checks for its existence, saves if appropriate, and changes the file name to the new file name.		
2.5.3 The workspace is directly updated for "Single Tox Relink" and "Setup Risk Assessment".		

2.6   MISCELLANEOUS

Verification Step	Pass	Fail
2.6.1 The Printer Selection feature correctly displays all available printers.		
2.6.2 Output is sent to the selected printer.		
2.6.3 Scenarios, pathways, and media are enabled/disabled according to the PRG guidance found on the *Risk Assessment Information System* (RAIS) (http://risk.lsd.ornl.gov) with one exception, recreational GW should be the same as residential GW.		
2.6.4 When selecting "Exit" from the File menu or the "X" on the top right corner of the screen, there is a prompt to save the workspace.		
2.6.5 Under the View Menu, "Graphics Box" and "Control Panel" are Correctly checked.		
2.6.6 For "Point Risk", "Estimation", "Grid", "Remedial Zone", and "New Samples", the change in plot circle radius works correctly.		
2.6.7 The Analyte Information Box presents accurate information for contaminants registered for risk.		
2.6.8 The Notebook presents and retains information correctly.		
2.6.9 The Contaminant Manager displays the correct contaminants per media.		
2.6.10 The SADA icon is consistent on all forms.		

2.7 DATA PLOTS, INFORMATION, STATISTICS, AND ANALYTE INFORMATION

Verification Step	Pass	Fail
2.7.1 Everything is disabled until finished drawing a polygon.		
2.7.2 After applying or drawing a polygon, the opposite tool is disabled. For example, if you are drawing on a data plot, model plots will be disabled.		
2.7.3 Everything is disabled when moving a vertex.		
2.7.4 Everything is disabled when moving or deleting a polygon.		
2.7.5 When resizing or zooming, the polygon adjusts itself to the current view.		
2.7.6 For the Space Definition manager, if a polygonal definition is applied to a different layering scheme than the one it was constructed in, the Polygonal Collection Form appears with all available polygons from this definition.		
2.7.7 Under the conditions of 2.7.6, the Polygon Collection Form works properly, scroll bar behaves correctly, drag and drop onto the map form works properly, and the form disappears when the space manager is turned off.		
2.7.8 The polygon tool is disabled for Xz and Yz.		
2.7.9 "Copy" correctly captures the polygon structure and "Paste" places the structure on the existing map.		
2.7.10 "Copy" and "Paste" are disabled for non-map displays.		
2.7.11 Polygons adjust to GIS scalings/normal plot toggles.		
2.7.12 A change in a space definition (named polygon) will instigate a prompt to the user for renaming the new definition.		
2.7.13 Polygonal structure is correctly retained and retrieved.		

2.8   RISK PROCESSES

Verification Step	Pass	Fail
2.8.1 Toxicological information is correctly retrieved from the workspace.		
2.8.2 Risk scenarios are identified through the Screening Scenario Select Form.		
2.8.3 Base risk terms are correctly calculated.		
2.8.4 RBG terms are correctly calculated.		
2.8.5 Risk is correctly calculated.		
2.8.6 The Screening process retrieves the requested screening values.		
2.8.7 The Point Risk process correctly converts data points to risk points.		
2.8.8 Classical data-based risk is correctly reported.		
2.8.9 Geospatially-based risk is correctly reported.		
2.8.10 Summed risks are correct for classical data.		
2.8.11 Summed risks are correct for geospatial modeling.		
2.8.12 Screening Form risk options are correctly enabled or disabled.		
2.8.13 Correct risk results are provided to the cost analysis process.		
2.8.14 Correct risk results are provided to the remedial design process.		
2.8.15 The Scenario database is presented and altered correctly from the Scenario Parameters menu.		
2.8.16 The toxicological database is presented and altered correctly from the Toxicological Parameters menu.		
2.8.17 The risk results are correct under the assumption of lognormality.		

2.9   COST ANALYSIS

2.9.1 A check in the "Pass" box means the following apply for the region specified by the polygon:
- SADA understands when to re-estimate geospatial values.
- For the given interpolator, the correct geospatial results are produced.
- The correct volume of media for the criteria (concentration or risk) is produced.
- The correct cost multiplier is applied to produce the correct result.
- The graphics and export processes correctly report the results.

Interpolator	Site Scale Framework				Block Scale Framework				Works with Polygon On	
	Concentration		Risk		Concentration		Risk			
	Pass	Fail	Pass	Fail	Pass	Fail	Pass	Fail	Pass	Fail
Ordinary (log and normal)										
Indicator										
Inverse Distance										
Nearest Neighbor										

2.10   GEOSPATIAL MAPS

Verification Step					Pass	Fail
2.10.1 The toolbar buttons and menus associated with these maps correctly enable and disable according to the chosen interpolators:						
Interpolator	Estimation	Probability	Variance	Risk	Remedial (Site)	Remedial (Block)
Ordinary	Enabled	Enabled	Enabled	Enabled	Enabled	Enabled
Indicator	Enabled	Enabled	Disabled	Enabled	Enabled	Enabled
Inverse Distance	Enabled	Disabled	Disabled	Enabled	Enabled	Enabled
Nearest Neighbor	Enabled	Disabled	Disabled	Enabled	Enabled	Enabled

2.10.2 A check in the "Pass" box means the following apply for each map/interpolator combination modeling results:
- SADA is determining when it is necessary to re-estimate or draw results from the workspace.
- If it is necessary to re-estimate, the correct parameters are being passed to the correct .dll, and the correct estimates are returned.
- If it is unnecessary to re-estimate, the correct values are returned from the database.
- Any post processing is performed correctly.
- Graphical and Export processes correctly report model results.
- The above conditions hold true when a polygon is present after estimation (On), present before estimation (On), edited after estimation (Edit), removed after estimation (Off), or drawn on an estimation (Draw).

Interpolator	Estimation		Probability		Variance		Risk		Remedial (Site)		Remedial (Block)		Polygons							
													On		Off		Draw		Edit	
	Pass	Fail	Pass	Fail	Pass	Fail	P	F	P	F	P	F	P	F	P	F	P	F	P	F
Ordinary (log and normal)																				
Indicator																				
Inverse Distance																				
Nearest Neighbor																				

2.11   SECONDARY SAMPLING ROUTINES

Verification Step					Pass	Fail
2.11.1 A check in the "Pass" box means that SADA is correctly disabling and enabling secondary sampling options according to the following table:						
Interpolator	Adaptive Fill	Estimate Rank	Variance Rank	Uncertainty Rank	Percentile Rank	
Ordinary	Enabled	Enabled	Enabled	Enabled	Enabled	
Indicator	Enabled	Enabled	Disabled	Enabled	Enabled	
Inverse	Enabled	Enabled	Disabled	Disabled	Disabled	
Neighbor	Enabled	Enabled	Disabled	Disabled	Disabled	

2.11.2 The following tables check model results for two and three-dimensional test cases. A check in the "Pass" box for each sampling strategy means the following:
- Geospatial modeling was correctly performed.
- The correct winning sample location was picked (a tie breaker must be tested as well).
- The correct point estimate is determined and inputted as new data to the geospatial mode.
- The code correctly handles the case of no geospatial estimates.
- The code correctly handles the case when no new sample locations are possible.
- The code correctly handles the case where a true data point falls on a grid point.
- The graphical and export functions are correctly displaying the location of each new sample.

A check in the polygon On/Off box means
- All strategies work with no polygon.
- All strategies work with a polygon present.

A check in the Separation Dist. Box means
- All strategies work without minimum separation constraint.
- All strategies work with minimum separation constraint.

A check in the Poly & Separate Box means
- Secondary Constraint works with a polygon present.

The test case(s) for these strategies should check the following conditions:
- No geospatial estimates are possible.
- Fewer geospatial grid points exist than number of new samples requested.
- A tie between two or more candidate sample locations exists.
- Enough grid points exist, but due to distance constraint, no new samples are possible.

2.11.2.1   Two-dimensional Modeling Results

Interpolator	Adaptive		Estimate Rank		Variance Rank		Uncertainty Rank		Percentile Rank		Polygon On/Off		Separation Dist		Poly & Separate	
	P	F	P	F	P	F	P	F	P	F	P	F	P	F	P	F
Ordinary (l & n)																
Indicator					N/A		N/A		N/A							
Inverse					N/A		N/A		N/A							
Neighbor					N/A		N/A		N/A							

2.11.2.2   Three-dimensional Modeling Results

Interpolator	Adaptive		Estimate Rank		Variance Rank		Uncertainty Rank		Percentile Rank		Polygon On/Off		Separation Dist		Poly & Separate	
	P	**F**	**P**	**F**	**P**	**F**	**P**	**F**	**P**	**F**	**P**	**F**	**P**	**F**	**P**	**F**
Ordinary (l &n)																
Indicator					N/A		N/A		N/A							
Inverse					N/A		N/A		N/A							
Neighbor					N/A		N/A		N/A							

2.12   GIS

Verification Step	Pass	Fail
2.12.1 The .dxf file is properly translated when opened from Layer Control.		
2.12.2 The results are correctly displayed in the Map window.		
2.12.3 The Layer Control module is working properly for layer color, position, and disabling.		
2.12.4 The Show Layers menu item on the main toolbar is disabled when no GIS layers have been translated.		
2.12.5 The layer picture box scrolls properly.		

2.13   EXPORT

2.13.1 A check in the "Pass" box means that the export on the fly function over the visible picture, located on the right mouse click, exported the same information the user currently sees on the screen.

	Normal Assumption		Lognormal Assumption	
	Pass	**Fail**	**Pass**	**Fail**
Histogram				
Sample Locations				
Point Risk				
Estimate				
Variance				
Probability				
Risk				
Remedial Map (Site)				
Remedial Map (Block)				
Cost (Site)				
Cost (Block)				
Sampling Design				
Variography				
Correlation Modeling				

2.14   GRAPHICAL INTERACTIONS

2.14.1 A check in each combination box means that the coexistence of these components within a single picture is correctly functioning, including interactions, limitations, etc.

	Normal		GIS		Zoom In		Zoom Out		Polygon	
	Pass	**Fail**	**Pass**	**Fail**	**Pass**	**Fail**	**Pass**	**Fail**	**Pass**	**Fail**
Normal	N/A	N/A	1*		2*		2*		3*	
GIS	1*		N/A	N/A	2*		2*		3*	
Zoom In	2*		2*		N/A	N/A	N/A	N/A	3*	
Zoom Out	2*		2*		N/A	N/A	N/A	N/A	3*	
Polygon	3*		3*		3*		3*		N/A	N/A
Picture Shift										

1* GIS image is correctly displayed and map images are correctly positioned on the map.
2* All of 1* criteria plus the visible portion of the map is defined by the users zoom with x,y aspect ration preserved.
3* Polygon is correctly positioned on the map.

2.15   CORRELATION MODELING

Verification Step	Pass	Fail
2.15.1 "Angle", "Anisotropy", and "Rotation" are only enabled for 3D data.		
2.15.2 For a given model request, all information must receive valid input, including Nugget effect.		
2.15.3 The previously input correlation model correctly filled in text boxes as well as any IK cutoff parameters.		
2.15.4 For Ordinary Kriging, "OK" is pressed.		
2.15.5 For Indicator Kriging, "IK" is pressed and the first cutoff model (if previously entered) is displayed.		
2.15.6 If variography is performed, it is displayed in model picture as well.		
2.15.7 The model plots correctly.		
2.15.8 The model adapts correctly when there is a change in variography .		
2.15.9 Nested modeling works correctly.		

2.16   EXPERIMENTAL VARIOGRAPHY

Verification Step	Pass	Fail
2.16.1 "Major Anisotropic Axis Select", "Minor Anisotropic Axis Select", and "Clear Axis Select" are disabled when there is no variography.		
2.16.2 Information is checked before each model plot.		
2.16.3 For each cone direction selected, all text boxes to the right must have valid entries.		
2.16.4 The results plot correctly.		
2.16.5 Changing from "OK" to "IK" works accurately and smoothly.		
2.16.6 The selection of major and minor axes works properly.		
2.16.7 Axis selectors recognize the correct line when clicked, and previous axis selections are released.		

2.17 INDICATOR CUTOFF FORM (SUPPORTING VARIOGRAPHY AND CORRELATION MODELS)

Verification Step	Pass	Fail
2.17.1 When "IK" is pressed, the Indicator cutoff form is displayed. It is removed when "OK" is pressed. ("IK" and "OK" are located on the Experimental Variography and Correlation Modeling form)		
2.17.2 The "clear cutoffs" works by clearing all cutoff values in the text boxes.		
2.17.3 The "plot histogram" works correctly by displaying the histogram and all cutoff locations.		

2.18 TOXICOLOGICAL PARAMETERS FORM

Verification Step	Pass	Fail
2.18.1 Toxicological Factors are correctly output to the form, file, and printer.		
2.18.2 Changes to the toxicological factors are checked for validity: no zero or negative values and no character values.		
2.18.3 The user is warned that the toxicological parameters must be saved before leaving this form (as they will be written directly to the file).		

2.19 STATISTICS WINDOW

2.19.1 A check in the "Pass" box means that the corresponding statistic is calculated correctly for the selected data.

Statistic	Pass	Fail
Mean		
Variance		
UCL95		
Range		
Minimum		
Maximum		
Easting Min		
Easting Max		
Northing Min		
Northing Max		
Vertical Min (3D only)		
Vertical Max (3D only)		
Max Detect East		
Max Detect North		
Max Detect Vertical (3D only)		
Max Detect Value		
Actual Mean		
Actual Variance		
Actual UCL95		

2.20   SCENARIO PARAMETERS WINDOW

Verification Step	Pass	Fail
2.20.1 Scenario parameters are correctly output to the screen, file and printer.		
2.20.2 Only media available in the data are enabled.		
2.20.3 Changes to the scenario parameters are checked for validity: no zeros, blanks, characters, or negative numbers.		

SADA Verification Form

Reviewer: (print)_____ **Date**:_____

Problems/Resolution:　　　None　　　As Indicated Below

Failed Criteria	Resolution	Initials and Date Re-verified

Reviewer Signature: _____	Date: _____
SADA Developer Signature: _____	Date: _____