NOAA Habitat Equivalency Analysis Tools

Background and Documentation

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CHAPTER 1 | Background on Habitat Equivalency Analysis (HEA) and the HEA Tool

Habitat equivalency analysis (HEA) has become an industry-standard analytical approach in natural resource damage assessment to quantify ecological injuries and scale compensatory restoration actions. The fundamentals of HEA were established in 1994[1] and have subsequently been validated through numerous court cases and academic papers. Over time, the method has been increasingly applied to more complex sites, including sites with multiple habitat types, sites subject to wide array of contaminants at varying concentrations, and sites subject to different types of primary remediation at various points in time.

Performing HEA calculations that take into account all these factors, particularly when combined with the desire for a higher degree of spatial resolution and the ability to evaluate a variety of scenarios, requires a great deal of computational power. Such analyses also require more flexibility than can be accommodated by the spreadsheet tools most commonly used to perform HEA calculations.

The habitat equivalency analysis (HEA) tool is designed to streamline the evaluation of complex sites, based on contaminant concentrations in sediments or soils. The tool also records analyst parameter selections and the data sources used to provide for easier record-keeping and project sharing.

To perform HEA calculations, trustees must determine how long the injury will persist, the relative service level of the injured and replacement resources, and the lifetime of the replacement project. NOAA's HEA Tool performs an equivalency analysis designed to meet these needs. The NOAA HEA Tool guides users through these steps using both ESRI (R) ®ArcGIS geographic information system (GIS) and Microsoft (R) ®Access software to:

- access spatial datasets (e.g., datasets from Query Manager or DIVER),
- interpolate contaminant concentrations,
- define important site parameters,
- input HEA parameters,
- conduct HEA analyses, and
- view and export a wide range of HEA results.

It allows users to enter multiple different HEA inputs as distinct "scenarios" for purposes of conducting sensitivity analyses. It also permits users to input characteristics of compensatory restoration projects and estimates the scale of these projects needed to compensate for site injuries.

The HEA Tool allows users to conduct geospatially explicit calculations in an automated fashion, using a user-friendly interface. The key feature behind this approach is a custom application that allows the user to access HEA functionality from a single navigation system. The system coordinates the collection

[1] Unsworth, Robert and Richard Bishop, "Assessing Natural Resource Damages using Environmental Annuities," Ecological Economics, 11: 35-41, 1994.

and processing of data, spatial analysis, and HEA calculations. The user works from within the navigation system to manage the process.

1.1 Calculation Approach

HEA calculations are performed on grid or rectangular cells, where grid cells are of a user-defined size. Each grid cell has associated with it a specific set of attributes that influence the HEA calculations. These attributes include habitat type, habitat condition, remediation action (including no action), a relative habitat value, contaminant concentrations for each contaminant included in the GIS dataset, a subsite identifier, and a footprint identifier.[2] Once HEA calculations are performed on each grid cell, results can easily be summarized across habitat types, subsites, or footprints, as desired.

Injury calculations are driven by the contaminant concentrations present in individual grid cells and the projected changes of these concentrations over time.

Initially, contaminant concentrations associated with individual grid cells are estimated by interpolation in ArcGIS. In the Microsoft® Access interface, the user associates these concentrations to a specific year (e.g., 2005), termed the "assigned data year" in the HEA Tool. Based on these data and other user inputs, the tool projects grid cell-specific contaminant concentrations backwards in time to the user-selected start of the analysis (often 1981 by convention, though this is left to the user), and also projects the concentrations forward until the user-selected end year of the analysis.

For each contaminant, the user can enter a rearwards annual rate of change in concentration (as a percentage) and a forward annual rate of change in concentration (as a percentage). In estimating contaminant concentrations prior to the assigned data year, the HEA Tool *increases* contaminant concentrations using the user-entered rearward annual rate. If this rate is zero, the HEA Tool assumes that concentrations prior to the assigned data year are equal to those in the assigned data year. For years subsequent to the assigned data year, the HEA Tool *decreases* concentrations annually using the user-entered forward projection rate. The graph below illustrates how these inputs are used to project estimated contaminant concentrations over time (see red lines), depending on whether or not the grid cell is subject to remediation.

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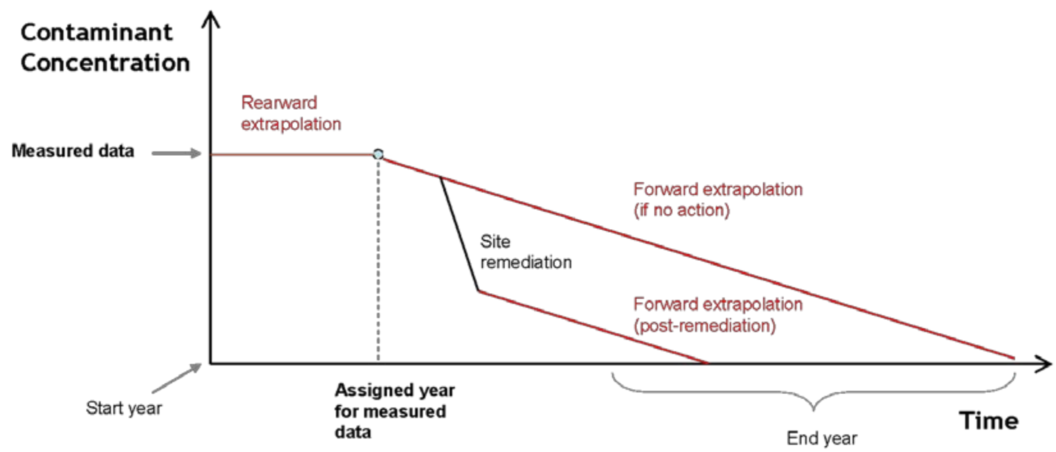
[2] Footprints are contiguous areas of contamination that are sometimes associated with a specific source. A grid cell may be part of more than one footprint (e.g., a mercury footprint and a PCBs footprint). Some grid cells may not be associated with any footprints. Consequently, injuries should not generally be summarized across footprints as this may result in either overestimating injury (in the case of geographically overlapping footprints) or underestimating injury (in the case of areas with injury but not associated with a footprint).

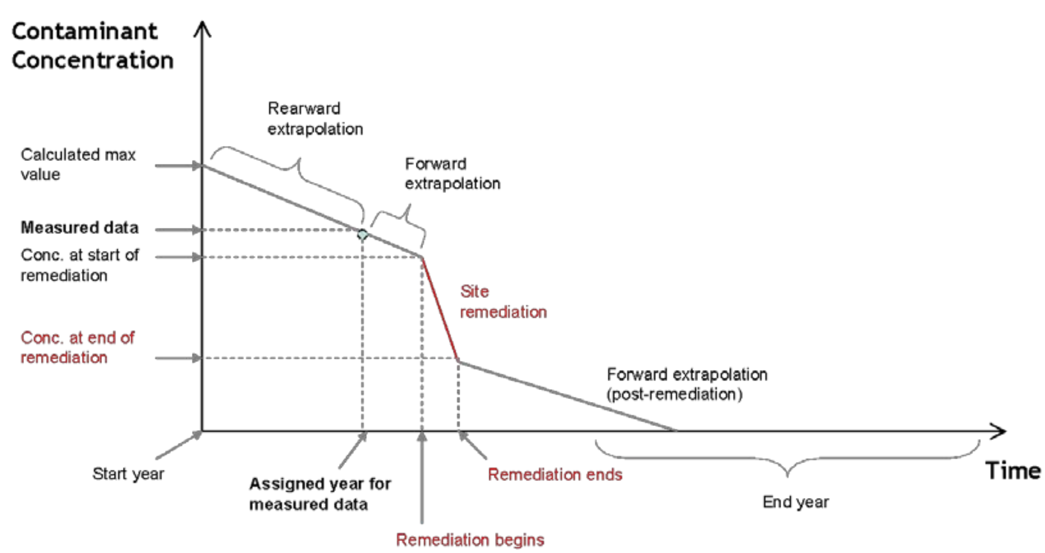
PROJECTION OF CONTAMINANT CONCENTRATIONS AROUND THE ASSIGNED DATA YEAR



As indicated, some cells may be subject to remediation activities that result in a different trajectory of concentrations over time than would otherwise be the case.

For all remediation projects anticipated at any part of the site, the user is required to enter information that describes the project. Information that the user must enter includes, for each project, its starting and ending years, and the effect of the project on each contaminant included in the analysis. The effect of the project on a contaminant can either be expressed as a total percentage reduction achieved by the project (e.g., 80%) or as the concentration achieved at the time the project is completed.

PROJECTING CONTAMINANT CONCENTRATIONS OVER TIME WITH ACTIVE REMEDIATION



Once contaminant concentrations are projected across all years of the analysis for each grid cell and contaminant, the HEA Tool estimates the injury experienced by each grid cell for each year of the analysis. Injuries are based on the projected contaminant concentrations within the cell. In particular, for each grid cell and year, each contaminant present in the cell is (separately) assigned an injury percentage between zero and 100%.

After calculating the percent injury for each grid cell at the site, the HEA Tool estimates injuries by grid cell in discounted service acre years (DSAYs) using a user-entered discount rate (3% is often used as a default rate; see HEA literature for additional details). In general,[3] injuries are calculated for each year of the analysis from the user-entered start date to the user-entered end date. Discounting is conducted relative to the user-entered base year for the scenario.

A site may contain more than one habitat type, and different habitat types may vary in the value of the ecological services provided. Furthermore, even within a given habitat type, areas may be degraded for reasons unrelated to contamination and may, therefore, provide a lower ecological value than similarly contaminated areas. To account for these differences, the HEA Tool requires the user to enter in relative habitat values (RHVs).

An RHV between zero and one must be entered for every habitat type included in the analysis and must be entered for each of three conditions: fully functional, baseline adjusted (i.e., partly degraded), and degraded. Because in some cases, the state of degradation of a specific grid cell may not be known, the user is also required to enter a default RHV to apply to such areas.

RHVs are used to modify cell-specific DSAY calculations. In particular, after estimating injuries, in DSAYs, for each grid cell, the values are multiplied by the relevant RHV for that grid cell.

Injury across the site can then be calculated by summing the total injury, in DSAYs, across all grid cells. Injuries may also be broken out by habitat type, subsite, or footprint, at sites where this information is available. Results can be viewed in tabular form and can also be exported.

1.2 Hardware/Software Requirements

To apply the Access-based NOAA HEA tools, users must be operating a Windows-based computer with Microsoft Access and ESRI ArcGIS. Current versions of Windows supported include Windows XP and 7. The Access-based tools have been tested in MS Access 2010 and 2013. The GIS components of the tools are compatible with ArcGIS 10.0, 10.1 and 10.2 and require a valid license for the Spatial Analyst extension. Initial trials indicate the tools should also be compatible with ArcGIS 10.3, but extensive compatibility testing has not been performed. The database and GIS tools are configured for running with either a 32 or 64-bit processor.

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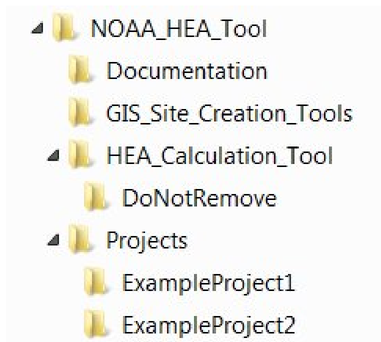
[3] As described later, to reduce computational time and generate preliminary estimates, a time-step function may be selected to generate an estimate of injuries on a periodic basis (e.g., every 10 years) instead of conducting a separate calculation for each year of the analysis.

CHAPTER 2 | Tool Installation and Workflow

2.1 Installing the HEA Tools

The HEA Tools are distributed as a zip archive. This archive (NOAA_HEA_Tool_VX.X.zip) when unzipped establishes a folder structure at the installation location and unpacks all ArcGIS and MS Access tools to the correct locations within that folder structure. The “X.X” in the file name will vary by tool version. The zip archive will create a new master software folder called “/NOAA_HEA_Tool/” and a series of subfolders within, as depicted below:



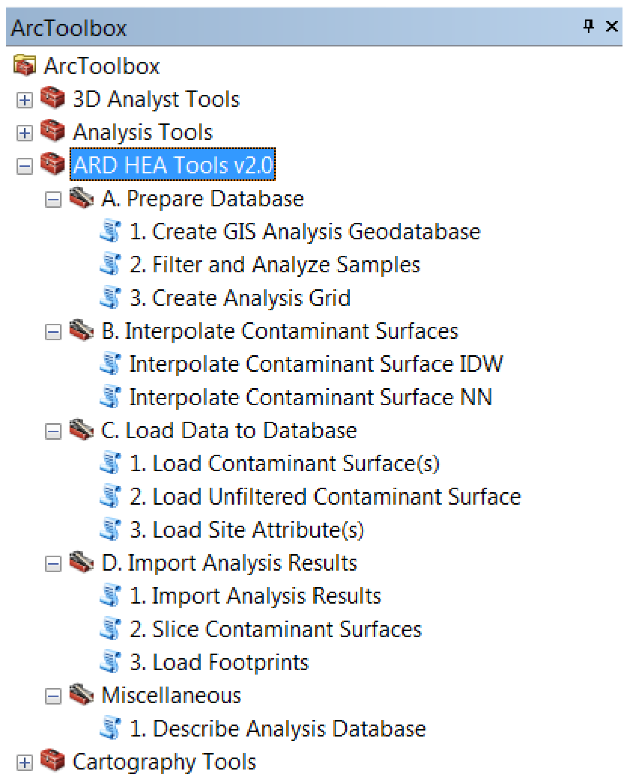
The “Documentation” subfolder contains the project documentation. The “GIS_Site_Creation_Tools” subfolder contains the tool components intended for use with ArcGIS including python scripts (.py and .pyc), an ArcGIS toolbox file (.tbx), metadata templates (.xml), an ArcGIS layer file (.lyr), and ArcGIS project file (.mxd). The “Projects” subfolder is empty but is intended to contain individual folders for each project generated using the ArcGIS tools. The “HEA_Calculation_Tool” subfolder contains the NOAA Access HEA Tool file (HEA Tool.mdb) and all the files required for the Access Tools to operate in the “DoNotRemove” subfolder. Users should not move or alter any files in the “DoNotRemove” or “GIS_Site_Creation_Tools” subfolders.

It is important to ensure that all tools are located in the folder structure as depicted above. Failure to do so will cause errors for some processing steps. Note that the initial ArcGIS Tools that setup analysis geodatabases for a new project will automatically create a new project folder. It is good practice to not include spaces or special characters in the name of these project folder or any other files. Though not required, it is recommended to install the “/NOAA_HEA_Tool/” folder at the root drive level (e.g. “C:/”). If a user is installing a newer version of these tools alongside an older version, the folder name can be changed if a previous version of “/NOAA_HEA_Tool/“folder is already present.

To install the ArcGIS Tools, take the following steps:

1.) Open ArcMap
2.) Right-click on the background of the ArcToolbox window.
3.) Select "Add Toolbox".
4.) Navigate to the directory where these files were unzipped and select the "ARD HEA Tools.tbx" file.

The HEA Tools toolbox will then be available in the ArcToolbox window in either ArcMap or ArcCatalog:



The MS Access Tools do not require any additional installation steps.

2.2 Workflow

The toolset has two main components: the ArcGIS Tools and the Access Tools. These are intended to be used in a specific order, or workflow. This intended workflow begins with spatial data preparation and analysis using the ArcGIS Tools. Analysts should begin by using the ArcGIS tools in the “A. Prepare Database” toolset to create a personal geodatabase to store all analyses, establish an analysis grid, and filter and import point referenced contaminant data into the personal geodatabase. Analysts may then use the ArcGIS tools in the “B. Interpolate Contaminant Surfaces” toolset to perform spatial interpolations, and load all interpolated contaminant concentrations into the geodatabase. Finally, analysts may load these Interpolated surfaces, surfaces interpolated outside of the ArcGIS Tools from other sources, and other sites attributes into the analysis geodatabase using the ArcGIS tools in the “C. Load Data to Database” toolset. Each of these toolsets and individual tools are described in detail in Chapter 3 below.

After all data in loaded into the GIS analysis geodatabase, then analysts move to the MS Access Tools to conduct the actual HEA analysis. The Access-based program will guide users through identification of the project, development of scenarios, running the analyses, and then viewing the results. Chapter 4 below provide details on each of these steps. Finally, after HEA analysis has been completed via the Access Tools, analysts can use the ArcGIS tools in the “D. Import Analysis Results” toolset to import and view HEA calculation results, or conduct further spatial analyses.

CHAPTER 3 | ArcGIS Tools

3.1 Introduction

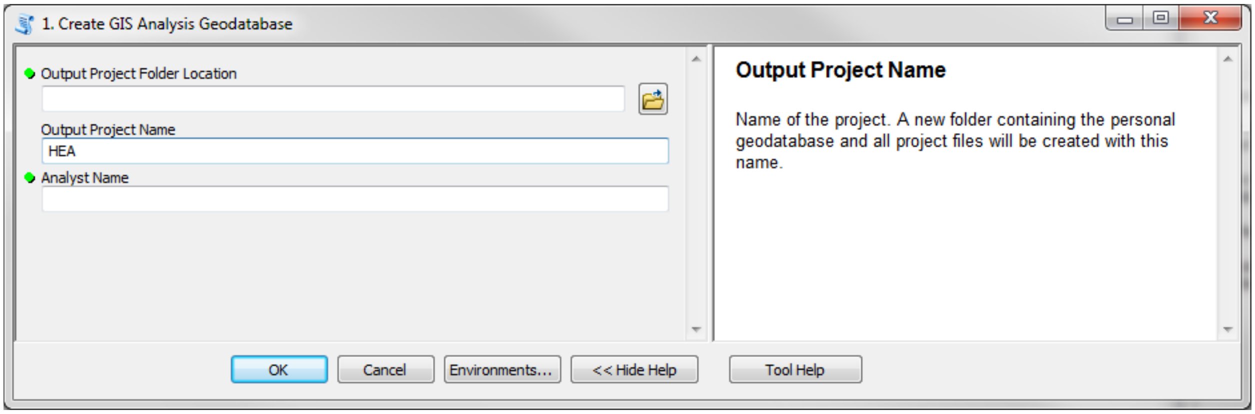
This chapter deals with the portion of the HEA Tools set of software tools for use in ArcGIS. These tools allow simple creation and population of an ESRI personal geodatabase intended for use in subsequent analyses via an interface in Microsoft Access (described in Chapter 4 below). The tools provide for simple import and visualization of the analyses conducted in Microsoft Access via ArcGIS cartographic functionality. Any point referenced data set in a projected coordinate system containing contaminant sediment chemistry sampling data that is useable in ArcGIS is suitable for use with the HEA tools. Make sure that all shapefiles are in the same projected coordinate system when running through the steps in the HEA tool.

3.2 Tool Descriptions

Each sequential tool is described separately below.

Tool Description: A1. Create GIS Analysis Geodatabase

This tool allows the analyst to create a blank personal geodatabase (.mdb) from a template, if starting a new HEA project. All subsequent spatial analysis results carried out by the tools in the GIS toolbox are stored in this personal geodatabase. At the end of the initial spatial analysis phase, the contents of this personal geodatabase are used by the Access database tools to make the HEA calculations with additional user input. This tool automatically creates empty tables with the appropriate data structure to hold contaminant data and ancillary area descriptors (footprints, habitats, depth, sub-sites, etc.).



Inputs:

Output Geodatabase Location: Required. The folder where the HEA GIS analysis personal geodatabase will be created.

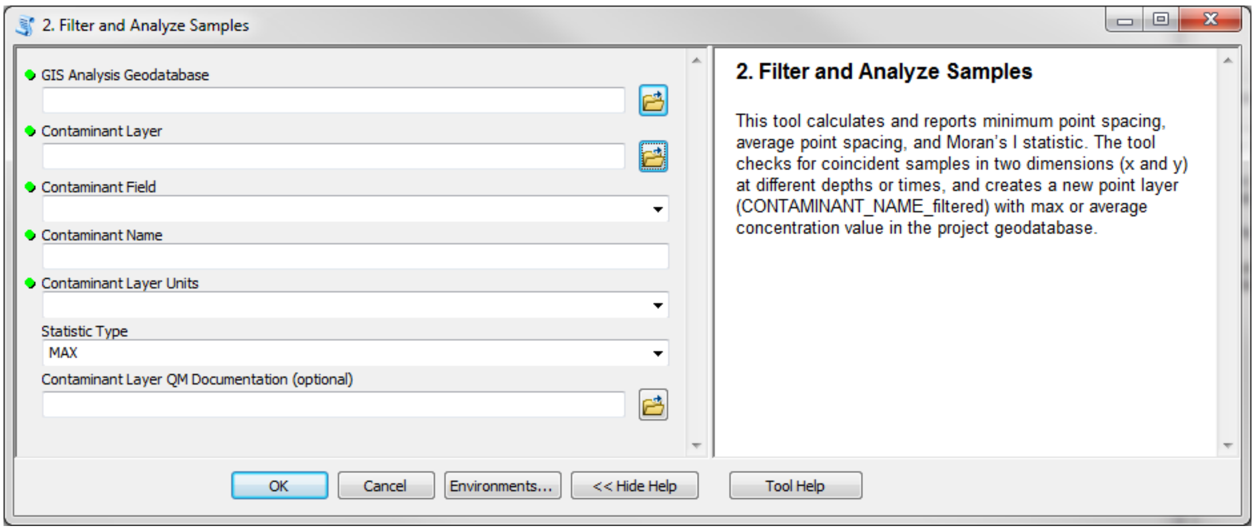
Output GIS Analysis Geodatabase: Required. The name of the output HEA GIS analysis personal geodatabase. Note that the "_GIS" will be appended to the end of the file name by default, if not included.

Analyst Name: Required. The name of the analyst creating the analysis geodatabase.

Tool Description: A2. Filter and Analyze Samples

This tool calculates and reports minimum point spacing, average point spacing, and Moran's I statistic. The tool checks for coincident samples in two dimensions (x and y) at different depths or times, and creates a new layer with max or average concentration value in the project geodatabase. This layer is stored within the GIS analysis geodatabase.

The tool executes various spatial statistical calculations as implemented by the ArcGIS geoprocessor, including the algorithms and required inputs. See the ESRI Average Nearest Neighbor and Spatial Autocorrelation (Morans I) tools in the ArcGIS help documents for help for additional description of methods and statistics.



Inputs:

GIS Analysis Geodatabase: Required. The name of HEA GIS analysis personal geodatabase to load data to.

Contaminant Layer: Required. The point data layer containing contaminant sampling data.

Contaminant Field: Required. The field containing concentration values for the specified contaminant. Note that this field must be numeric.

Contaminant Name: Required. The name of the contaminant sampled. The default is the contaminant field name, but this may be changed. This must be unique within the GIS analysis geodatabase.

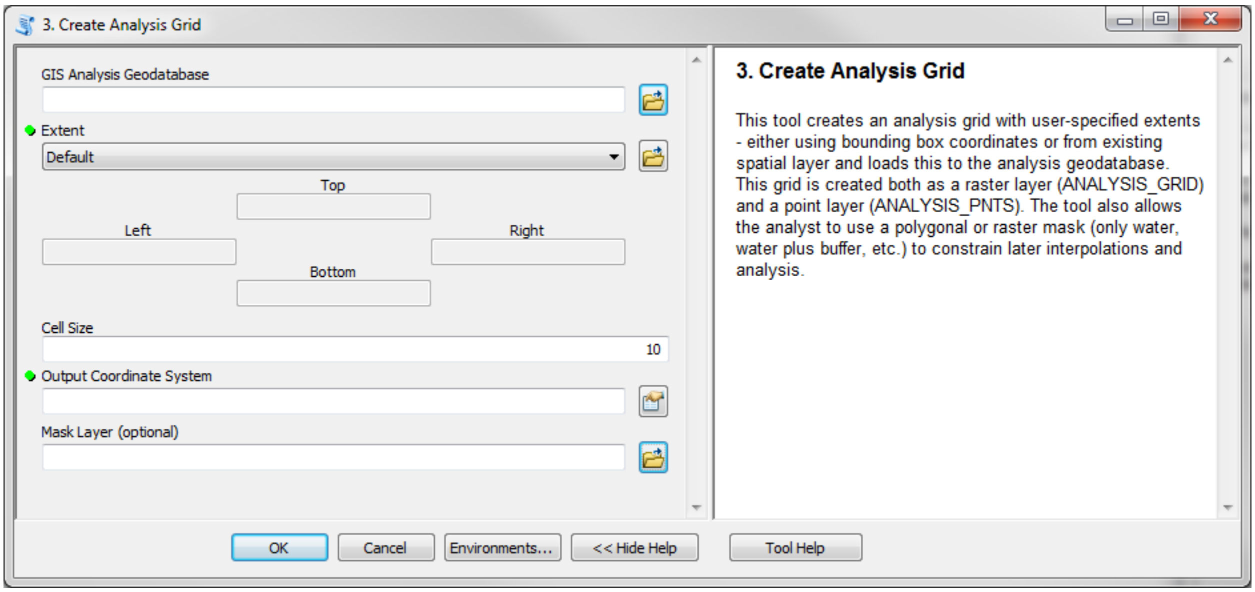
Contaminant Layer Units: Required. The units of the contaminant concentrations for the specified contaminant: parts per million (PPM) or parts per billion (PPB).

Statistic Type: Required. The method for handling contaminant concentration values at coincident 2-D locations, either due to samples occurring at different depths, or at different times. MAX takes the maximum concentration value at a given location. MEAN takes the mean concentration value at a given location.

Contaminant Layer QM Documentation: Optional. The autodoc text file generated by Query Manager containing documentation for each query output. Note that the tool will attempt to locate this file automatically. Text files other than Query Manager autodoc files may also be specified.

Tool Description: A3. Create Analysis Grid

This tool creates an analysis grid with user-specified extents - either using bounding box coordinates or from existing spatial layer and loads this to the analysis geodatabase. The tool also allows the analyst to create an optional mask (only water, water plus buffer, etc.) to constrain later interpolations and analysis. The selection of an appropriate cell size for analysis grid is of particular importance. Generally, analysis grid cells should be small enough to resolve important spatial features and gradients in concentrations of contaminant of concern, but no smaller. Very small grid cell sizes yield large numbers of grid cells which can dramatically slow performance of HEA calculations in the Access database. While every case is unique, analysts should consider cell sizes generally between 5 and 50 meters as a starting point.



Inputs:

GIS Analysis Geodatabase: Required. The name of HEA GIS analysis personal geodatabase within which to create an analysis grid. Note that creating a new grid in a geodatabase already containing an analysis grid will overwrite the previous grid. Only one analysis grid may be created for any given geodatabase.

Extent: Required. The layer with which the spatial extent of the analysis grid will be defined, in the coordinate system specified below.

Cell Size: Required. The cell size of the analysis grid, in linear units of the coordinate system specified below.

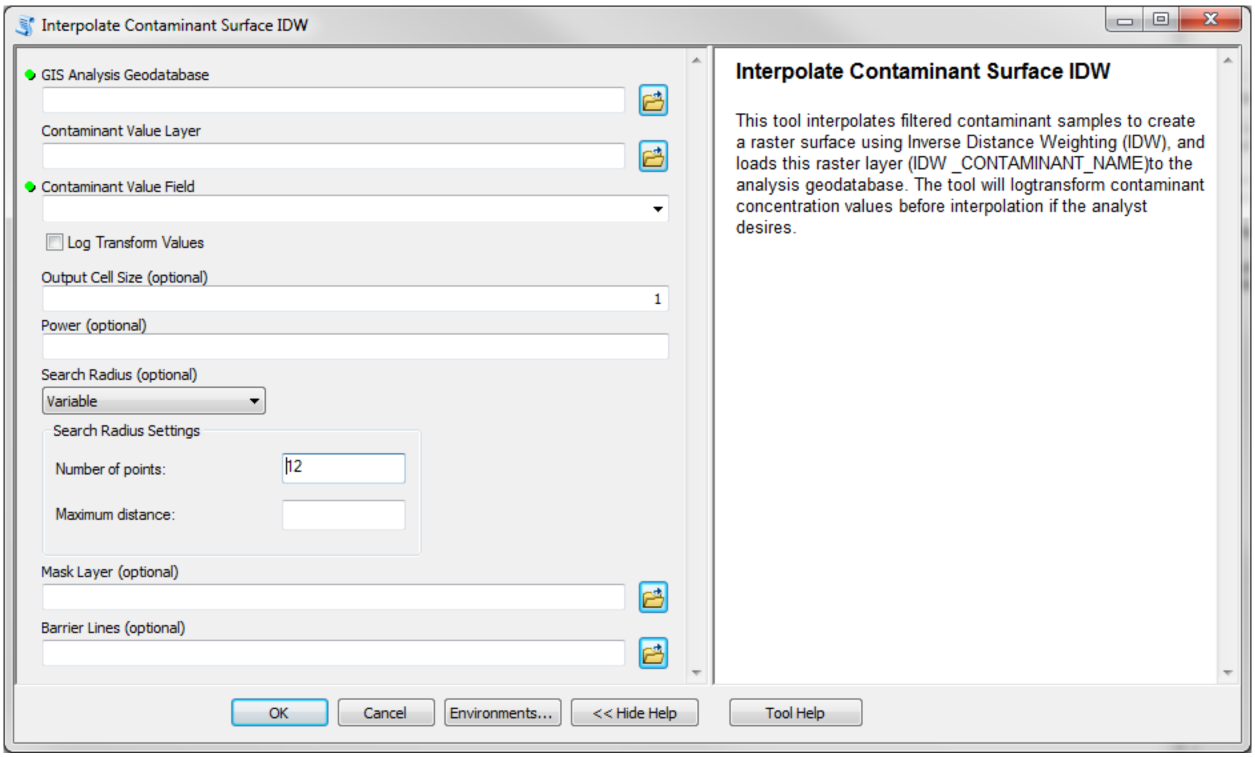
Output Coordinate System: The coordinate system of the analysis grid. Note that the specified coordinate system must be projected. Geographic coordinate systems are not permitted.

Mask Layer: Optional. The mask layer to constrain the extent of the analysis grid.

Tool Description: B1. Interpolate Surface IDW

This tool interpolates filtered contaminant samples to create a raster surface using Inverse Distance Weighting (IDW), and loads this raster to the analysis geodatabase. Users should use either this interpolation method, the Natural Neighbors interpolation method, or another interpolation method that is not included in the HEA Tools. The tool will optionally log transform contaminant concentration values before interpolation. If the log transform option is selected, the output interpolated raster is back-transformed to units of concentration for ongoing analysis.

The tool executes IDW as implemented by the ArcGIS geoprocessor including the algorithm and required inputs. See the ESRI Inverse Distance Weighting tool help for additional description of tool inputs and methods.



Inputs:

GIS Analysis Geodatabase: Required. The name of HEA GIS analysis personal geodatabase to create the interpolated raster surface.

Contaminant Value Layer: Required. The filtered contaminant layer containing concentration values to interpolate.

Contaminant Value Field: Required. The field containing the filtered concentration values.

Log Transform Values: Required. Toggles the log-transformation of values prior to interpolation. Note that if log-transformation is selected, the tool back transforms the resulting interpolated surface to units of the original concentrations for further downstream analysis. Use of log transformation should be evaluated on a case-by-case basis. The default is no transformation.

Output Cell Size: Required. The cell size of the output interpolated raster contaminant concentration surface. The default is the cell size of the analysis grid within the HEA GIS analysis personal geodatabase. Note that specifying a cell size other than this default value is should be performed with caution.

Power: Optional. The exponent of distance. Controls the significance of surrounding points on the interpolated value. A higher power results in less influence from distant points. It can be any real number greater than zero, but the most reasonable results will be obtained using values from 0.5 to 3. The default is 2.

Search Radius: Optional. Defines which surrounding points will be used to control the raster. There are two options: VARIABLE and FIXED. Variable is the default.

> VARIABLE {number_of_points} {maximum_distance}
>
> Number of Points — An integer value specifying the number of nearest input sample points to be used to perform interpolation. The default is 12 points.
>
> Maximum Distance — Specifies the distance, in map units, by which to limit the search for the nearest input sample points. If the number of points for the VARIABLE option cannot be satisfied within that maximum distance, a smaller number of points will be used.
>
> FIXED {distance} {minimum_number_of_points}
>
> Distance — The distance, in map units, specifying that all input sample points within the specified radius will be used to perform interpolation. The default radius is five times the cell size of the output raster.
>
> Minimum Number of Points — An integer defining the minimum number of points to be used for interpolation. If the required number of points is not found within the specified radius, the search radius will be increased until the specified minimum number of points is found. The default is zero (0).

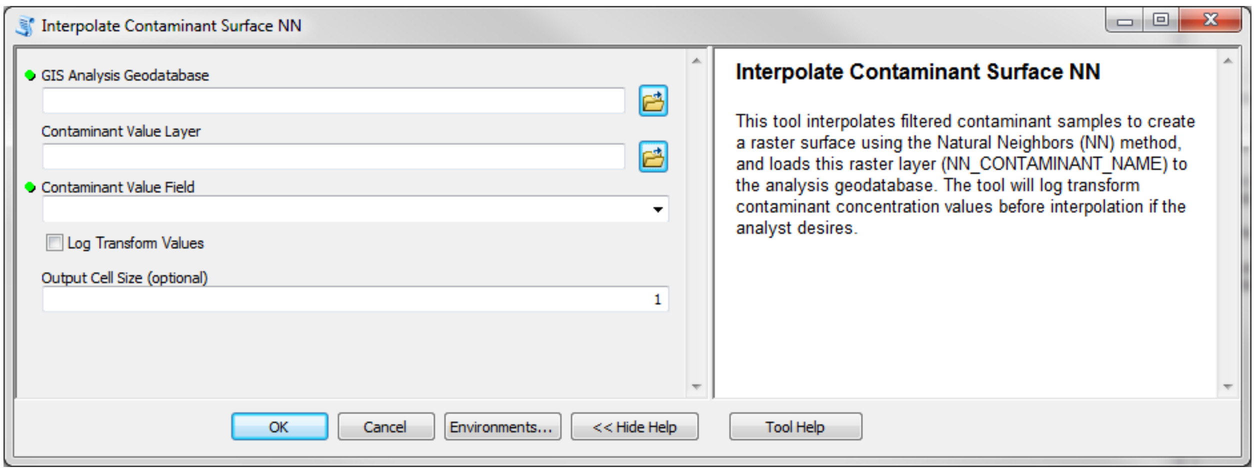
Mask Layer: Optional. The mask layer to constrain the extent of the interpolated grid.

Barrier Lines: Optional. Polyline features to be used as a break or limit in searching for the input sample points.

Tool Description: B2. Interpolate Surface NN

This tool interpolates filtered contaminant samples to create a raster surface using Natural Neighbors (NN) method, and loads this raster to the analysis geodatabase. The tool will optionally log transform contaminant concentration values before interpolation. If the log transform option is selected, the output interpolated raster is back-transformed to units of concentration for ongoing analysis. Note that this interpolator does not generate values outside the convex hull of the input points. If the analysis grid extends beyond this convex hull, then the cells outside it will contain null values. Analysts may need to manually replace or assign values to these cells for further HEA anlaysis.

The tool executes NN as implemented by the ArcGIS geoprocessor including the algorithm and required inputs. See the ESRI Natural Neighbors Interpolation tool help for additional description of tool inputs and methods.



Inputs:

GIS Analysis Geodatabase: Required. The name of HEA GIS analysis personal geodatabase to create the interpolated raster surface.

Contaminant Value Layer: Required. The filtered contaminant layer containing concentration values to interpolate.

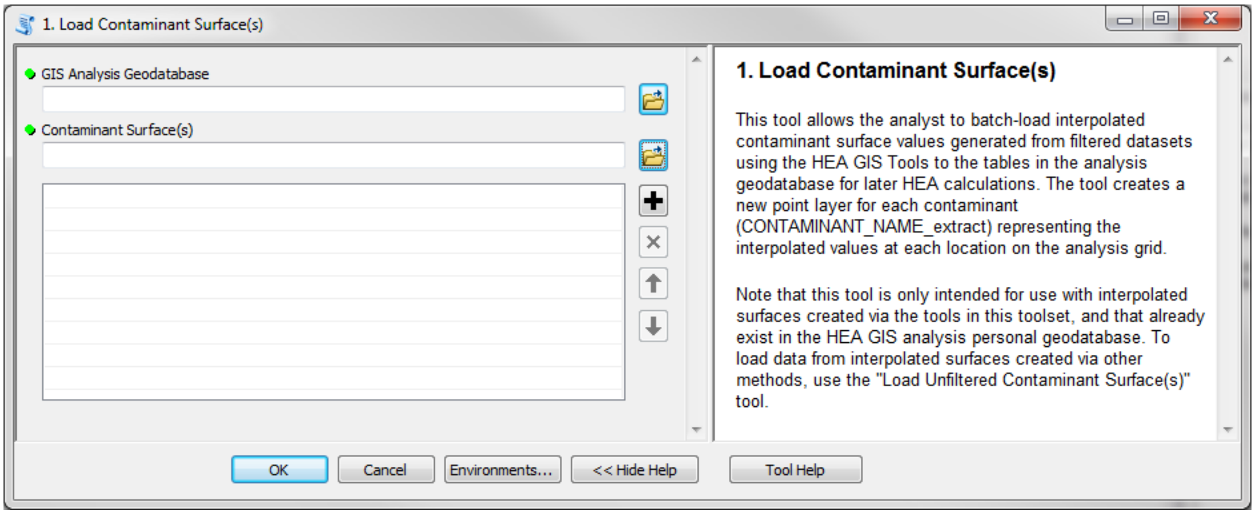
Contaminant Value Field: Required. The field containing the filtered concentration values.

Log Transform Values: Required. Toggles the log-transformation of values prior to interpolation. Note that if log-transformation is selected, the tool back transforms the resulting interpolated surface to units of the original concentrations for further downstream analysis. The default is no transformation.

Output Cell Size: Required. The cell size of the output interpolated raster contaminant concentration surface. The default is the cell size of the analysis grid within the HEA GIS analysis personal geodatabase

Tool Description: C1. Load Contaminant Surface(s)

This tool allows the analyst to batch-load interpolated contaminant surface values generated from filtered datasets using the HEA GIS Tools to the tables in the analysis geodatabase for later HEA calculations. Note that this tool is only intended for use with interpolated surfaces created via the tools in this toolset, and that already exist in the HEA GIS analysis personal geodatabase. To load data from interpolated surfaces created via other methods, use the "Load Unfiltered Contaminant Surface(s)" tool.



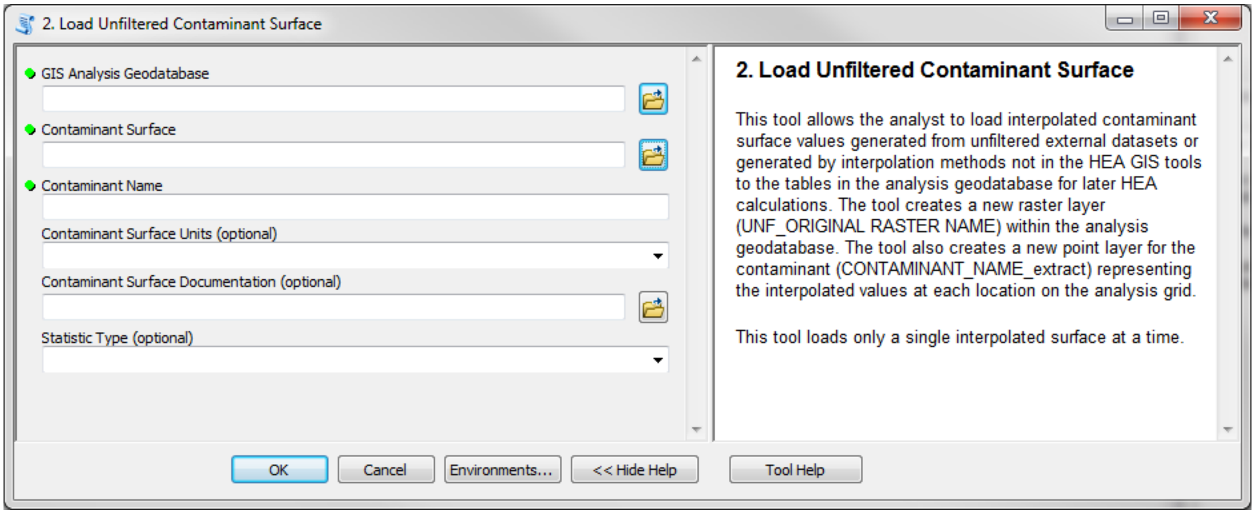
Inputs:

GIS Analysis Geodatabase: Required. The name of HEA GIS analysis personal geodatabase to load the interpolated contaminant values into.

Contaminant Surface(s):   Required. The interpolated contaminant raster surface(s) to load into the HEA GIS analysis personal geodatabase.

Tool Description: C2. Load Unfiltered Contaminant Surface

This tool allows the analyst to load interpolated contaminant surface values generated from unfiltered external datasets or generated by interpolation methods not in the HEA GIS tools to the tables in the analysis geodatabase for later HEA calculations in the Access database. This tool loads only a single interpolated surface at a time.



Inputs:

GIS Analysis Geodatabase: Required. The name of HEA GIS analysis personal geodatabase to load data to.

Contaminant Surface: Required. The interpolated contaminant raster surface to load into the HEA GIS analysis personal geodatabase.

Contaminant Name: Required. The name of the contaminant of concern.

Contaminant Surface Units: Optional. The units of the contaminant concentrations for the specified contaminant: parts per million (PPM) or parts per billion (PPB).

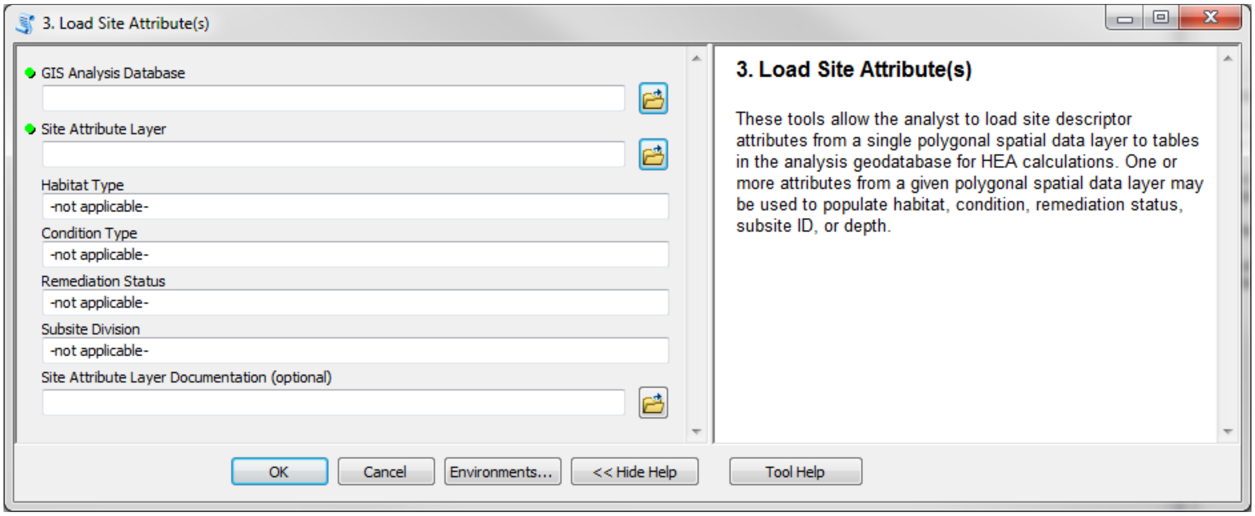
Contaminant Surface Documentation: Optional. A text file containing metadata describing the interpolated surface. This may either be autodoc text file generated by Query Manager containing documentation for a query output, or another text file.

Statistic Type: Optional. The method used for handling contaminant concentration values at coincident 2-D locations, either due to samples occurring at different depths, or at different times. MAX indicates that the maximum concentration value at a given location was used. MEAN indicates that the mean concentration value at a given location was used. OTHER indicates that another method was used to handle coincident sample vales.

Tool Description: C3. Load Site Attribute(s)

This tool allows the analyst to load site descriptor attributes from a single polygonal spatial data layer to tables in the analysis geodatabase for HEA calculations. One or more attributes from a given polygonal spatial data layer may be used to populate habitat, condition, remediation status, subsite ID, or depth.

In some cases, a single polygonal data layer will contain attributes describing only one of these factors. In this event, this tool would be run with only one attribute set to the field that contains the information to be used.



Inputs:

GIS Analysis Geodatabase: Required. The name of HEA GIS analysis personal geodatabase to load data to.

Site Attribute Layer: Required. The polygon data layer containing site attribute data.

Habitat Type: Optional. The field containing habitat codes or values for the area of interest. Note that this field may contain any text or numeric values, but that all whitespaces and special characters except minus signs (-), underscores (_), and periods (.) will be stripped. If this value is left as "-not applicable-" then no values for habitat type will be loaded from the specified data layer.

Condition Type: Optional. The field containing condition codes for the area of interest. Note that this field may contain ONLY the following text values: "FF", "BA", "D", "NA" These codes indicate, respectively: Fully Functional, Baseline Adjusted, Degraded, and Not Applicable. If this value is left as "-not applicable-" then no values for condition will be loaded from the specified data layer.

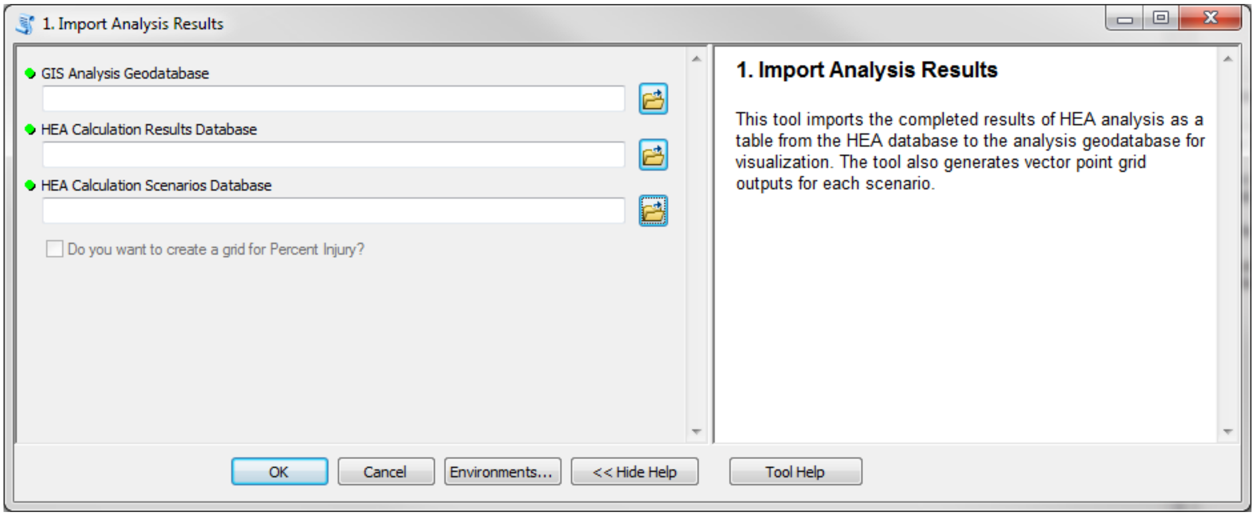
Remediation Status: Optional. The field containing remediation status codes or values for the area of interest. Note that this field may contain any text or numeric values, but that all whitespaces and special characters except minus signs (-), underscores (_), and periods (.) will be stripped. If this value is left as "-not applicable-" then no values for remediation status will be loaded from the specified data layer.

Subsite Division: Optional. The field containing subsite codes or values for the area of interest. Note that this field may contain any text or numeric values, but that all whitespaces and special characters except minus signs (-), underscores (_), and periods (.) will be stripped. If this value is left as "-not applicable-" then no values for subsite divisions will be loaded from the specified data layer.

Site Attribute Layer Documentation: Optional. The autodoc text file generated by Query Manager containing documentation for each query output. Note that the tool will attempt to locate this file automatically. Text files other than Query Manager autodoc files may also be specified. This file is loaded into the analysis database for whichever of the above values are set to

Tool Description: D1. Import Analysis Results

This tool imports the completed results of HEA analysis as a table from the HEA Access database to the analysis geodatabase for visualization. Note that this tool is intended to be run after the HEA calculations take place by the Access Tools (See Chapter 4 below). The tool generates vector point grid outputs for each scenario.



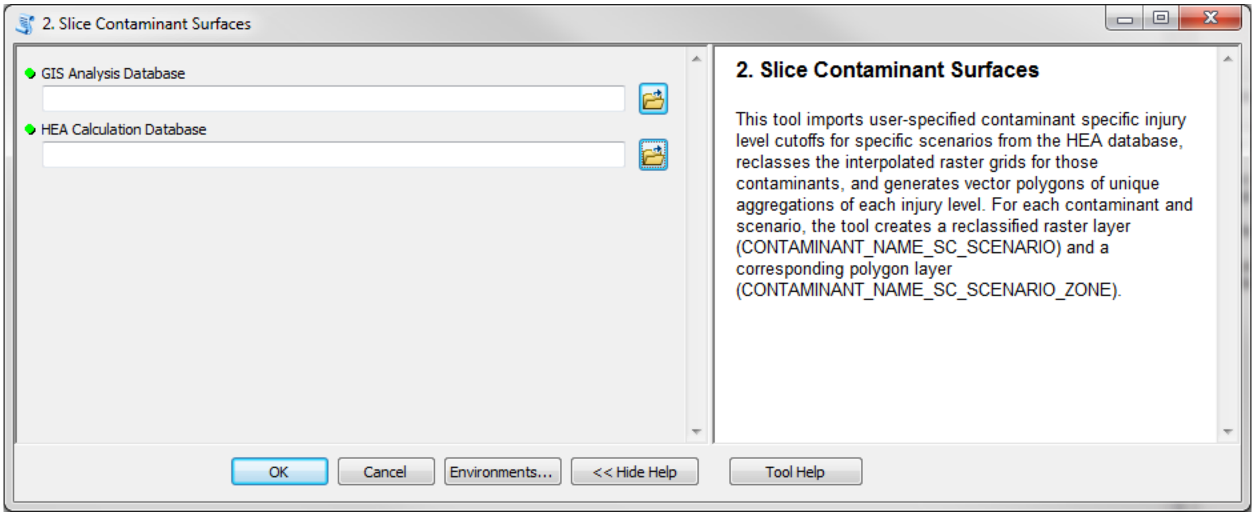
Inputs:

GIS Analysis Geodatabase: Required. The name of HEA GIS analysis personal geodatabase to load data to.

HEA Calculation Database: Required. The name of HEA calculation Access database to extract HEA analysis results from.

Tool Description: D2. Slice Contaminant Surface

This tool imports user-specified, contaminant specific injury level cutoffs from the HEA Access database, reclasses the interpolated raster grids for those contaminants, and generates vector polygons of unique aggregations of each injury level.



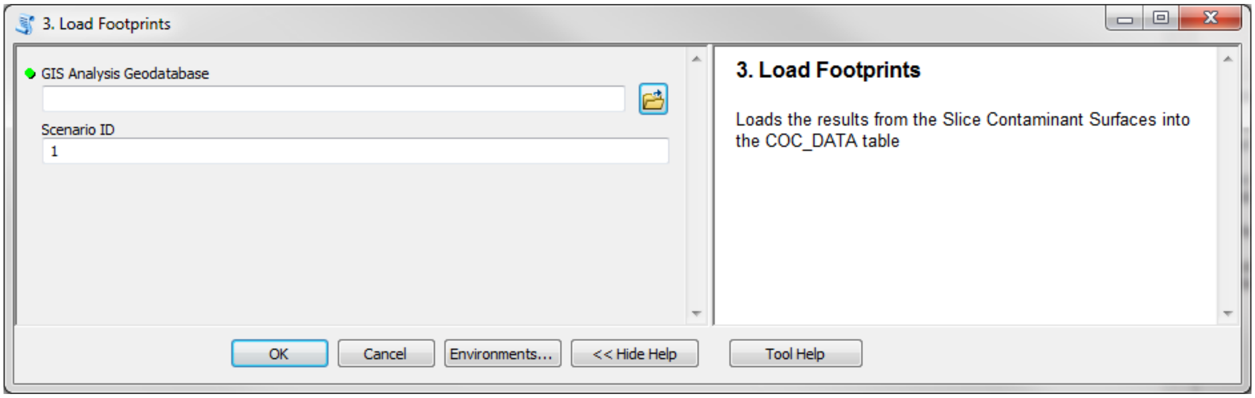
Inputs:

GIS Analysis Geodatabase: Required. The name of HEA GIS analysis personal geodatabase to load data to.

HEA Calculation Database: Required. The name of HEA calculation Access database to extract injury cutoff levels from.

Tool Description: D3. Load Footprints

This tool loads results from the Slice Contaminant Surfaces in the COC_DATA table for later use.



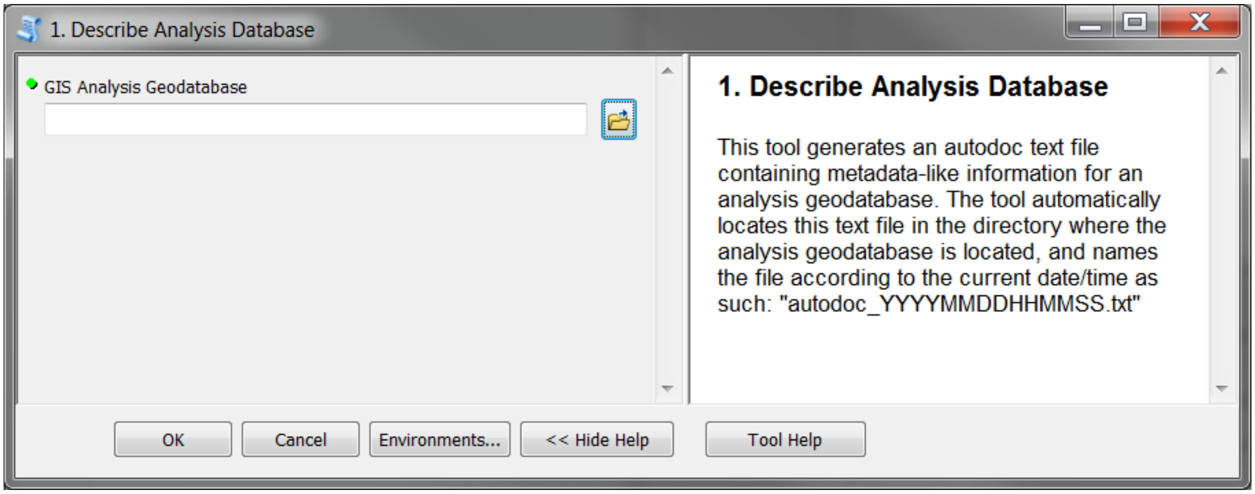
Inputs:

GIS Analysis Geodatabase: Required. The name of HEA GIS analysis personal geodatabase to load data to.

Scenario ID: Required. The name of the scenario for which footprints are required.

Tool Description: Miscellaneous. Describe Database

This tool may be run at any stage in the workflow after the creation of a GIS analysis geodatabase to provide information about the current status and contents of that database. This tool generates an autodoc text file containing metadata-like information and automatically locates this text file in the directory where the analysis geodatabase is located. This text file is named according to the current date/time as such: "autodoc_YYYYMMDDHHMMSS.txt". The tool also outputs this information to the tool window for inspection.



Inputs:

GIS Analysis Geodatabase: Required. The name of HEA GIS analysis personal geodatabase to describe.

3.3 GIS Analysis Geodatabase Data Structure

The following tables describe each non-spatial data table created in the analysis geodatabase and the contents of their fields. Note that the analysis geodatabase is an ESRI personal geodatabase, so there are multiple tables within that contain spatial or other information. These are not described here. See ArcGIS documentation for a description of the default personal geodatabase table structure.

The PROJECT_ATTRIBUTES and COC_INVENTORY tables are created when the GIS analysis personal geodatabase is first created by the "**Create GIS Analysis Geodatabase"** tool, and store project related details on contaminants, metadata, and other information. These tables will generally only contain a limited number of records.

PROJECT_ATTRIBUTES		
Field	**Type**	**Contents**
CELL_SIZE	Integer	Analysis grid cell size
TOTAL_CELLS	Integer	Analysis grid total cell count
UNITS	Text (10)	Analysis grid cell size units
ANALYST	Text (50)	Name of analyst creating database
SITE_HABITAT_DOC	Text (25000)	Text from site habitat attribute metadata file
SITE_CONDITION_DOC	Text (25000)	Text from site condition attribute metadata file
SITE_REMEDIATION_DOC	Text (25000)	Text from site remediation attribute metadata file
SITE_SUBSITE_DOC	Text (25000)	Text from subsite attribute metadata file
SITE_DEPTH_DOC	Text (25000)	Text from site depth attribute metadata file

COC_INVENTORY		
Field	**Type**	**Contents**
COC_NAME	Text (20)	Unique name of contaminant of concern
COC_UNITS	Text (20)	Concentration units of contaminant
COC_QMDOC	Text (25000)	Text from Query Manager or other metadata file
COC_XML	Text (600)	XML describing process history
COC_NOTES	Text (20)	Notes describing contaminant
INPUT_LAYER_NAME	Text (50)	Input contaminant point concentration file name
FILTER_LAYER_NAME	Text (50)	Filtered contaminant point concentration file name
STAT_TYPE	Text (20)	Filter statistic for coincident samples
LOG_TRANSFORM	Text (5)	Log transform indicator (true/false)
MIN_DIST	Float	Minimum nearest neighbor statistic
AVG_DIST	Float	Average nearest neighbor statistic
MAX_DIST	Float	Maximum nearest neighbor statistic
NNRATIO	Float	Nearest neighbor ratio
NNZSCORE	Float	Nearest neighbor z-score
NNPVALUE	Float	Nearest neighbor p-value
SAINDEX	Float	Spatial autocorrelation index
SAZSCORE	Float	Spatial autocorrelation z-score
SAPVALUE	Float	Spatial autocorrelation p-value
INTERP_LAYER_NAME	Text (50)	Interpolated contaminant concentration raster file name
INTERP_TYPE	Text (5)	Interpolation method code (IDW or NN)

The SITE_ATTRIBUTE and COC_DATA tables are also created when the GIS analysis personal geodatabase is first created, and store cell-by-cell values for site attributes and contaminant concentration data. These tables may contain very large numbers of records, depending upon analysis grid size, resolution, and the number of contaminants.

SITE_ATTRIBUTE		
Field	**Type**	**Contents**
GRID_ID	Integer	Analysis grid cell unique ID
HABITAT_ID	Text (20)	Site habitat attribute code
CONDITION_ID	Text (20)	Site condition attribute code
REMEDIATION_ID	Text (20)	Site remediation status attribute code
SUBSITE_ID	Text (20)	Subsite attribute code
DEPTH	Text (20)	Site depth/elevation attribute code

COC_DATA		
Field	**Type**	**Contents**
GRID_ID	Integer	Analysis grid cell unique ID
COC_NAME	Text (20)	Unique name of contaminant of concern
COC_VALUE	Float	Value of contaminant at that grid cell
FOOTPRINT_ID	Text (20)	Unique footprint ID for contaminant at that grid cell

The ANALYSIS_RESULT S and ANALYSIS_SCENARIOS tables are created when HEA analysis results are imported into the GIS analysis geodatabase by the “**Import Analysis Results”** tool. These tables contain cell-by-cell analysis outputs and scenario specific parameters, respectively. Note that the ANALYSIS_SCENARIOS table is imported directly from the HEA calculation database without modification.

ANALYSIS_RESULTS		
Field	**Type**	**Contents**
Scenario_ID	Integer	HEA Scenario unique ID
GRID_ID	Integer	Analysis grid cell unique ID
ExpYear	Integer	Year of analysis output at that grid cell
Condition_Value	Float	Condition value of analysis output at that grid cell
SAY_Injury	Float	Service-Acre Year of analysis output at that grid cell
DSAY_Injury	Float	Discounted Service-Acre Year of analysis output at that grid cell

ANALYSIS_SCENARIOS		
Field	**Type**	**Contents**
Scenario_ID	Integer	HEA Scenario unique ID
Scenario_Name	Text(30)	TBD
Scenario_Notes	Text(10000)	TBD
Analyst_Name	Text(255)	TBD
Assigned_Data_Year	Integer	TBD
Discount_Rate	Float	TBD
PV_Year	Integer	TBD
Injury_Start_Yr	Integer	TBD
Injury_End_Yr	Integer	TBD
Injury_Aggregation_Method	Text(11)	TBD
Time_Step	Integer	TBD
InputsComplete	Integer	TBD
CalcNow	Integer	TBD
CalcStatus	Text(20)	TBD
CalcsComplete	Integer	TBD
Calc_Units	Integer	TBD
Calc_Warning	Text(100)	TBD
Analyst_Date	Date/time	TBD

Finally, the USER_THRESHOLDS table is created when HEA analysis result cutoff values are imported into the GIS analysis geodatabase by the "**Slice Contaminant Surface"** tool. This table contains scenario and contaminant specific injury level thresholds. Note that the USER_THRESHOLDS table is imported directly from the HEA calculation database without modification.

USER_THRESHOLDS		
Field	**Type**	**Contents**
Scenario_ID	Integer	HEA Scenario unique ID
COC_NAME	Text (20)	Unique name of contaminant of concern
Thres_A_High	Float	Upper concentration value threshold for injury category A
Thres_B_High	Float	Upper concentration value threshold for injury category B
Thres_C_High	Float	Upper concentration value threshold for injury category C
Thres_D_High	Float	Upper concentration value threshold for injury category D
Thres_E_High	Float	Upper concentration value threshold for injury category E
Thres_A_Perc	Float	Percentage injury value for injury category A
Thres_B_Perc	Float	Percentage injury value for injury category B
Thres_C_Perc	Float	Percentage injury value for injury category C
Thres_D_Perc	Float	Percentage injury value for injury category D
Thres_E_Perc	Float	Percentage injury value for injury category E
Thres_F_Perc	Float	Percentage injury value for injury category F

3.4 Batching or Scripting Tool Runs

All tools may be run in batch mode. This allows the user to run multiple instances of the tool at the same time to automate repetitive tasks. For example, users may wish to import multiple contaminant shapefiles into a GIS analysis geodatabase at once using the "Filter and Analyze Samples" tool.

To run tools in batch mode, right click on any tool in the ArcGIS Toolbox window. Select "Batch…" from the context menu. This launches the batch mode of that tool. In this mode, each input of a tool is presented as a column in a table. Rows may be added to this table, with each row containing the values of the tool inputs for a single run of the tool. Double click a blank row and enter the appropriate values for each tool input.

The tools may also be called from user-created python scripts to facilitate automation of common tasks via scripting.

Chapter 4 | MS Access-based Tools

This chapter provides information on installing and using the MS Access-based portion of the HEA Tools. This portion of the tools requires the inputs created using the ArcGIS components described in Chapter 3. For software and hardware requirements and installation and structure, please see Chapters 1 and 2.

4.1 Creating and Selecting Projects

After running through the initial components of the ArcGIS elements of the tool (Toolsets A, B, and C; see Chapter 3), users should next launch the Access-based scenario modeling tool. In the C:/NOAA_HEA_Tool/ HEA_Calculation_Tool/ folder, double click the HEA Tool.MDB file. The Access-based program will guide users through identification of the project, development of scenarios, running the analyses, and then viewing the results. The sections below provide details on each of these steps.

4.1.1 Adding a New Project

When you first open the tool, you will see the project selection/creation screen.

Follow these steps to add a new project to your Access tool:

1) Select “Create new project” radio button

2) Enter a project name. The project name can be no longer than 50 characters and can be comprised of numbers and letters. We recommend avoiding the use of symbols.

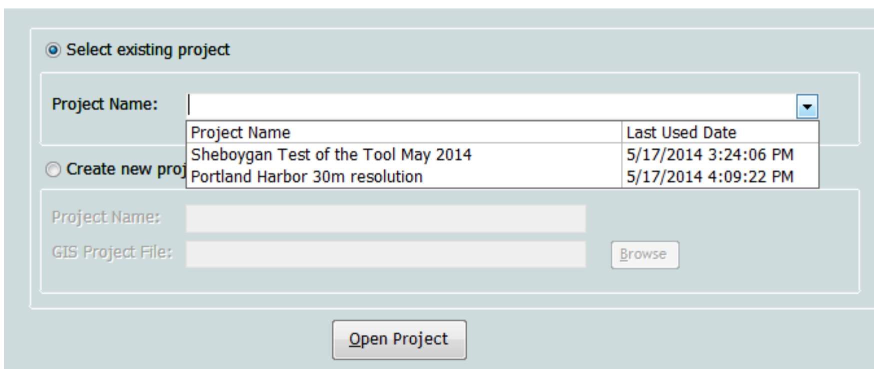
3) Browse to the GIS Project database file created by HEA GIS Tool.
   IMPORTANT: For the tools to function correctly, before initiating a new project, users must run through the ArcGIS-based tools and store the corresponding GIS database file within the Projects folder (C:/NOAA_HEA_Tool/Projects).

4) Click “Initiate Project” button.

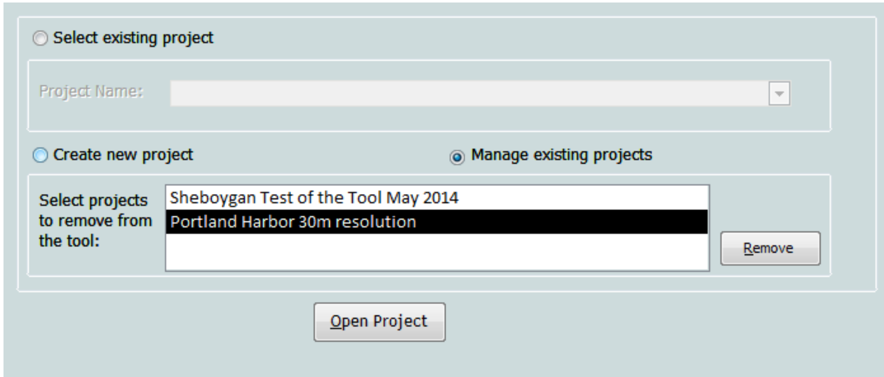
Due to security requirements within MS Access, you will be notified and then need to approve four separate popup screens to complete the project initiation process. Confirm the first notification pop-up and then press the Open key four times. This process creates the analysis databases specific to the project based on the templates contained in the DoNotRemove folder. After adding the new project, the tool will automatically open to the Project Management screen.

4.1.2 Opening and Managing Previously Added Project

If you have previously added a project, to open the project file, check the “Select existing project” radio button, and choose the project Name from the dropdown list. Then, click “Open Project”.



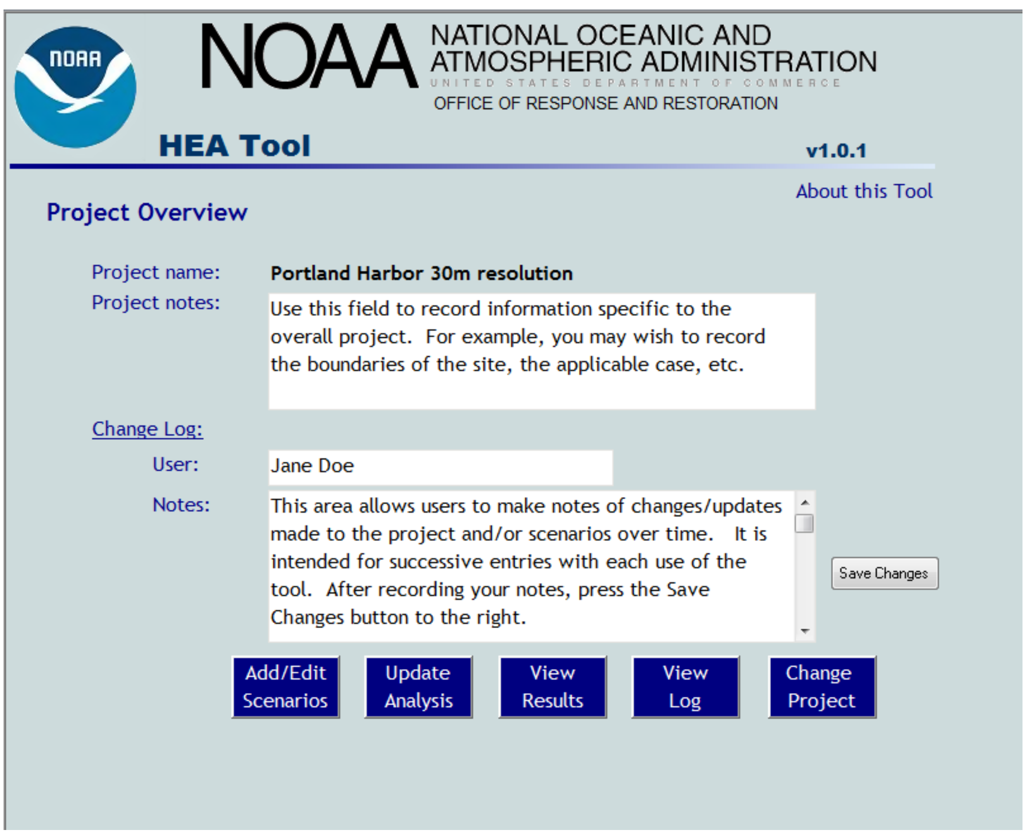
From this screen, you may also remove previously added projects from the database. Select “Manage existing projects”, highlight the project to be removed, and then select the “Remove” button on the right. This removes the project from the HEA Tool database; however, it does not remove the underlying GIS project files. Those will remain in your file directory within the Projects folder.



4.2 Project Overview

After adding a project or selecting from a previously added project, you will be taken to the Project Overview page. This page also serves as the main menu for navigating within the tool. For additional information on the navigation options, see the text box below.

On the Project Overview page, you may enter summary information about the project as well as log successive change notes that can then be printed via the View Log button.



Overview of the main menu options:

Add/Edit Scenarios

Opens the scenario definition and management screens. See the remainder of this chapter for additional details on scenario development.

Update Analysis

Takes users to the summary page showing the status of scenario entry and analysis. From this page, users can run analyses for completed scenarios.

View Results

If the project has completed analyses, this link takes the user to the basic overview of the results. From that menu, users can then choose to access the standard reporting screen or a custom query tool.

View Log

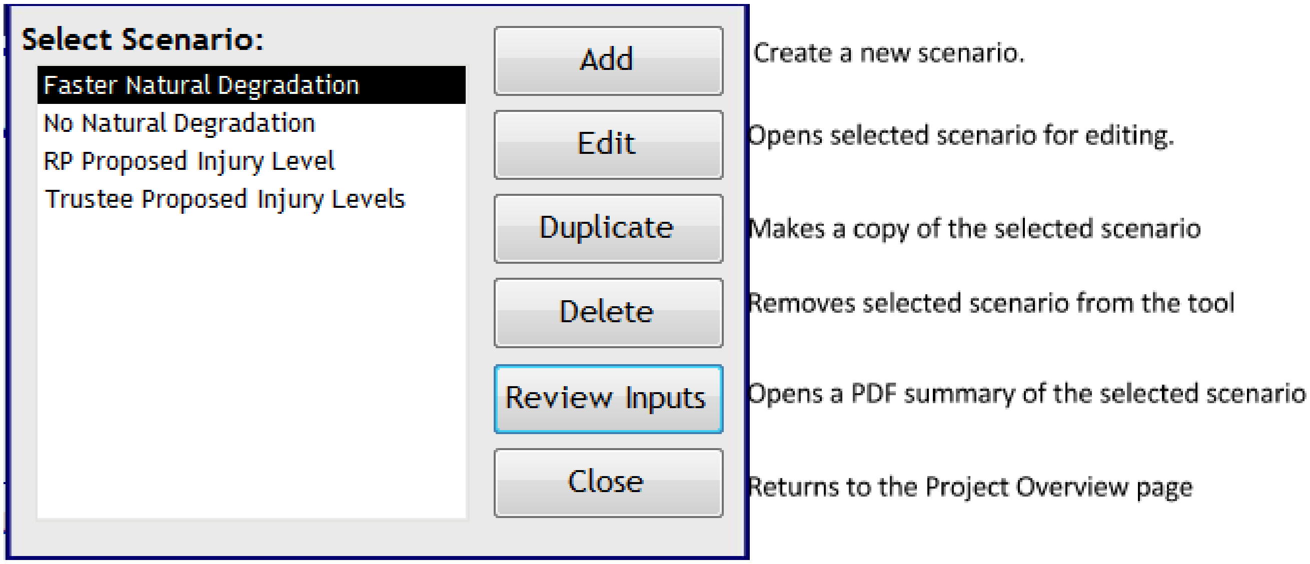
Provides a PDF format page containing any added Change Notes logged for this project.

Change Project

Takes the user back to the project selection page in order to switch to another project.

4.2.1 Add/Edit Scenarios

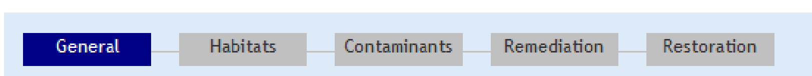
On the Project Overview page, click "Add/Edit Scenarios" to open the Select Scenario popup box. Within this screen users can add, edit, copy, delete, and review the inputs of individual scenarios. See the screenshot below for information on each of the navigation options.



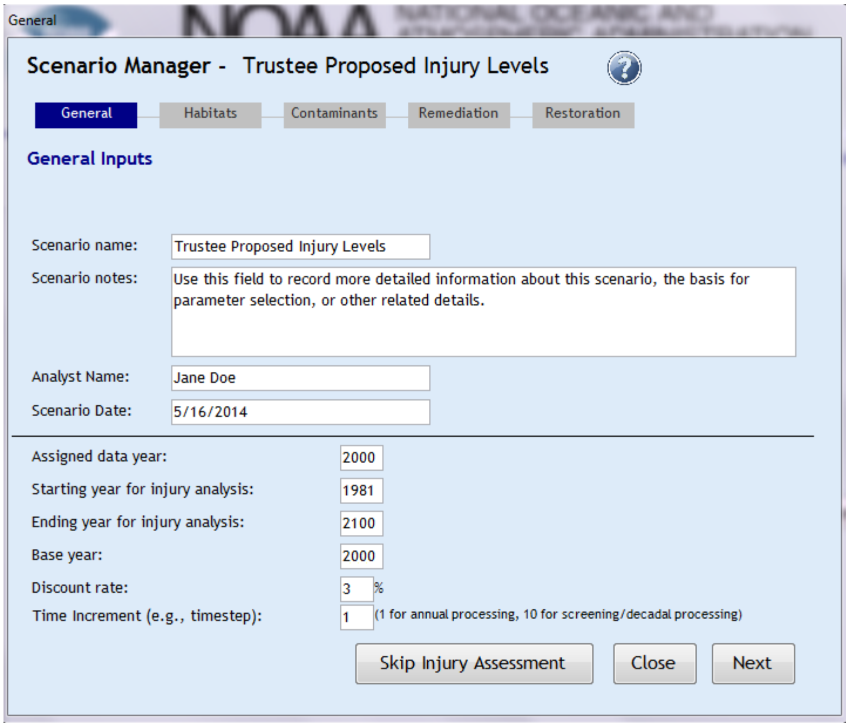
When adding a new scenario, please note that the scenario name can be no longer than 30 characters. Once you have named a new scenario, or when you select Edit for an existing scenario, you will be taken to the scenario input screens described below.

4.2.2 Scenario Manager General Inputs

The scenario manager guides users through the definition of scenario parameters required to conduct the HEA. The graphic located at the top of the screen illustrates your progress through the five separate steps – general parameters, relative habitat values, contaminant injury rates, remediation project effects, and (optionally) restoration offsets. Due to the interconnected nature of the parameters, you must proceed linearly through the parameter setting. Back and Next buttons on the screen will guide you through the steps.



The general input screen serves to record overarching details about the scenario as well as the vintage of the data and timeline for your analysis. The individual parameters as described in the table below.



Parameter	**Description**
Scenario notes	Enter any descriptive information of use to future users.
Assigned data year	The HEA Tool requires that all measured contaminant data are associated with a specific year (i.e., the date most representative of the contaminant concentration data or the "assigned data year"). Contaminant concentrations are then extrapolated in time backwards from the assigned data year to the start year of the analysis, and from the assigned data year forwards to the ending year. If the contaminant data are all based on different analysis years, then the analyst will need to determine the most representative year to use. For example, you may wish to use a weighted average based on the number of sample analyzed each year or the earliest year samples were collected. (Note: This is a required field)
Starting and ending years for injury analysis	The HEA Tool estimates injuries beginning at the starting year and continuing through the ending year. The start year should reflect the estimated date of contamination (in the case of superfund sites the earliest date used is generally

	1981 given the passing of the CERCLA statues in December 1980). Note: This is a required field)
Discount rate	This rate is used to discount past and future estimated injuries into their present-value equivalents. A 3% rate is standard and is recommended by NOAA (see Habitat Equivalency Analysis: An Overview (NOAA DARP, 2006). (Note: This is a required field)
Base year	This is the year into which service acre-years (SAY) equivalents are converted for expressing results in equivalent units. It is typically the current year. (Note: This is a required field)
Time Increment	This Increment can be changed to expedite processing of the model for screening purposes. The default is 1 (e.g., processing each year of the analysis period) and represents a detailed analysis. For screening analyses, users can choose a different interval. For example, users can select 2 to skip every other year or 10 to process on a decadal basis. Increasing the increment improves the speed of the analysis by calculating contaminant concentrations over time for only a subset of the analysis years and then applying the same injury values between the analyzed years. (Note: This is a required field)

After entering each of the required elements, press "Next" to continue.

4.2.3. Setting Relative Habitat Values (RHVs)

Habitats used in this tool reflect categorizations imported from GIS. The "NA" habitat name value and Unknown Habitat Type values reflect areas where no habitat designations were specified via the GIS tools. If a habitat type (e.g., fully functional) does not exist in this study area, the name of the habitat type is in grey. Although the depth of individual grid cells can be defined within the GIS, this parameter is not currently used in the Access-based HEA Tool. If you wish to delineate results based on depth categories, we recommend integrating additional habitats or sub-sites within the GIS tool.

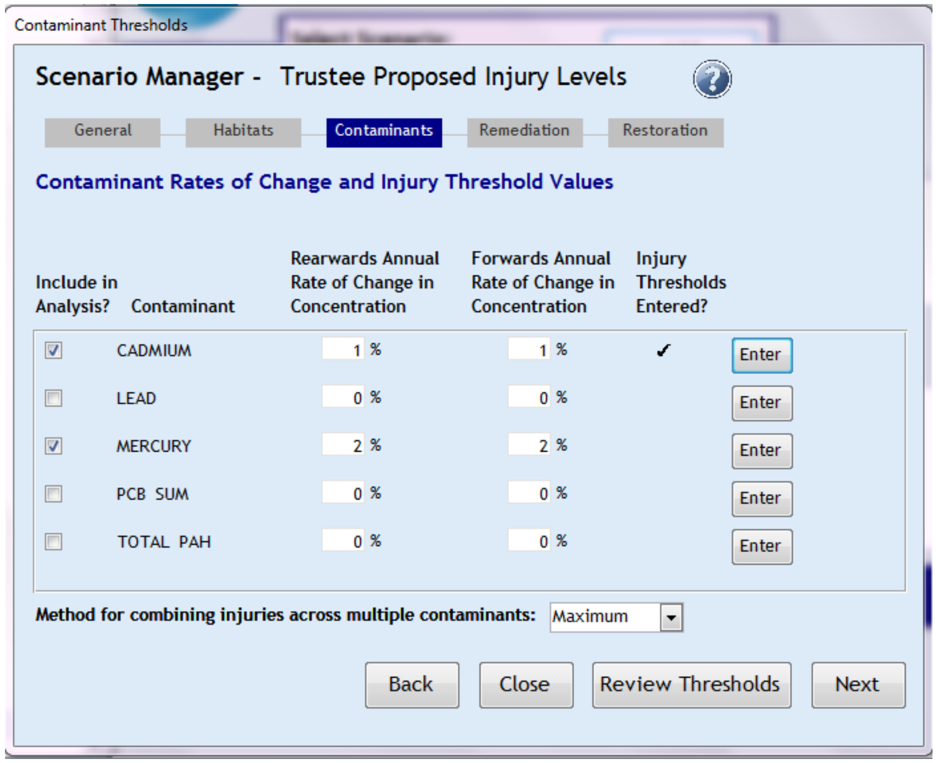
RHVs reflect the relative value of the ecological services provided by each habitat type. RHVs range from zero to one, with their value depending not only on habitat type but also on its condition.

Habitat Type	Description
Fully functional	This condition represents a habitat in a pristine state, unaffected by anthropogenic activities.
Baseline adjusted	This condition represents habitat that has been moderately degraded by anthropogenic activities other than exposure to hazardous substances. For instance, habitats may have been affected by physical disturbances such as dredging or infill, subject to agricultural use or deforestation, and so forth.
Degraded	This condition represents habitat that has been severely degraded by anthropogenic activities other than exposure to hazardous substances.

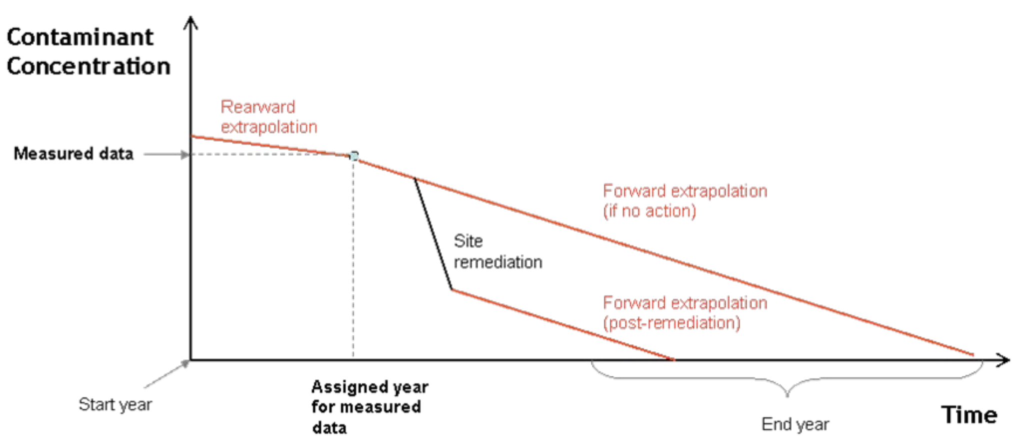
After defining the RHVs, press next to continue to the next screen.

4.2.4 Setting Contaminant Rate of Change and Injury Thresholds

The Access database next guides users through contaminant-specific parameters for each contaminant processed in the GIS tool. For a given scenario, you may select one or all of the available contaminants for inclusion in the analysis.



Forwards and rearwards extrapolation rates, and injury thresholds, are required for every included contaminant. Forward and rearwards extrapolation rates are used to estimate contaminant concentrations forwards and backwards in time relative to the assigned data year for the GIS data used. Contaminant concentrations are extrapolated from the start year until the end year. The graph below illustrates how these inputs are used to project estimated contaminant concentrations over time (see red lines).



For each contaminant to be included in the analysis, check the corresponding “Include in Analysis” box, enter the degradation rates (forwards and backwards), and then click the “Enter” box on that row to access the contaminant threshold screen. Details for this screen are described in the next section.

In cases where there is more than one contaminant present in a given cell and included in the analysis of injury, the user can choose how to combine the injury determination.   If only one contaminant is included, then disregard this input parameter.

The specifics of the project would dictate which combination approach to use:

- In the "*Maximum*" method, the largest percentage injury across all measured contaminants for a given grid cell and year, is selected as the injury value for that grid cell and year.   For example, if one contaminant results in a 90% injury and the other 10%, the tool uses 90% for that cell and year. This method is the fastest to calculate and good for very large sites with lots of grid cells and/or cases where multiple contaminants are present but the footprints are distinct from one another.

- In the "*Average*" method, the percentage injuries across all measured contaminants are averaged for each grid cell and year. NOTE: This approach is not recommended. In the above example of 90% and 10%, it leads to an assumption of 50% injury.

- In the "*Incremental*" approach, the percent injury equals:

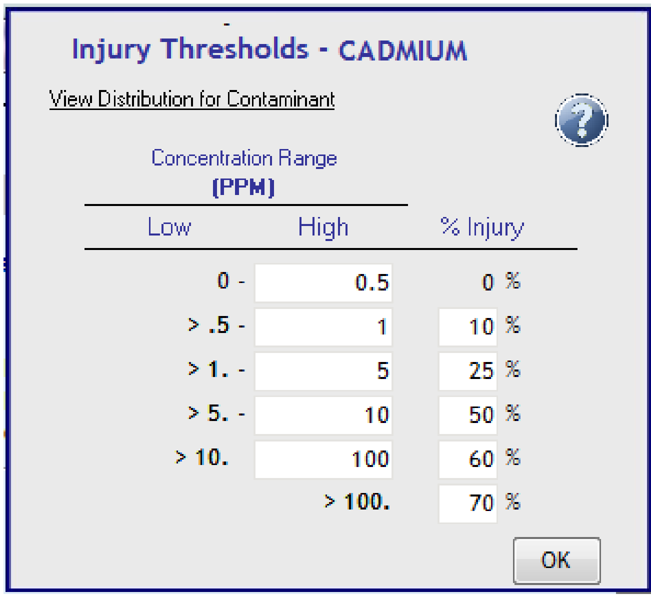
$$100\% - \prod_{x}^{y}(100\% - \%Inj_x)$$

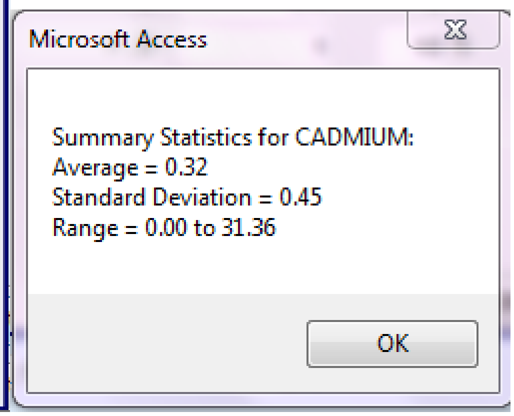
  where x represents an individual contaminant, and y is the number of contaminants included in the analysis.   Incremental is a more intensive approach that looks to integrate the injury together. It considers all injury as additive. For example, in the example above, the total percent injury would be assumed to equal 91% (100% - 90 % = 10% residual services. That 10% residual services then impacted by 10% injury leads to 9 % residual services or 91% injury). This is a good approach to use if the contaminant impacts are considered additive.

If the contaminants are seen to be overlapping and acting through similar mechanisms, users may also wish to consider using an offline approach such as PEC-Q (a probable effects quotient) that combines the effects of the various contaminants prior to doing the HEA.   If done this way, then you would have one synthesis "contaminant" in the HEA tool.

4.2.5 Setting Contaminant Injury Thresholds

For each contaminant included in the analysis, injury thresholds must be specified. As noted above, the "Enter" button on the Contaminant details page opens a pop-up box to define the injury thresholds. The box that appears identifies the selected contaminant (in the header) and the units defined in the GIS data (below the Concentration Range header). You may also select the "View Distribution for Contaminant" to access a basic overview of the average, standard deviation, minimum, and maximum values for this contaminant across the project area.

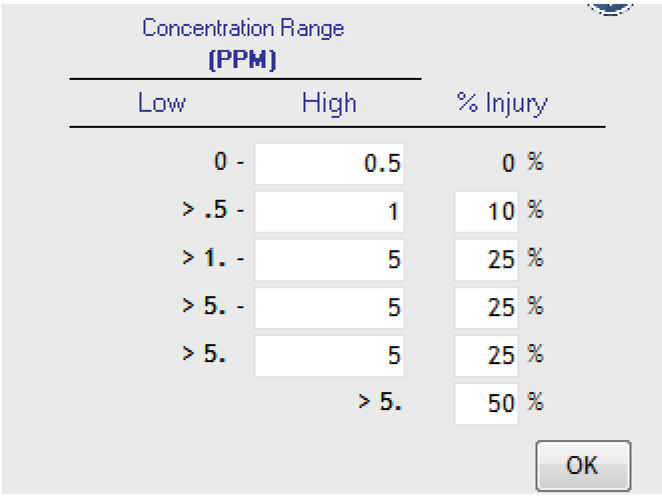




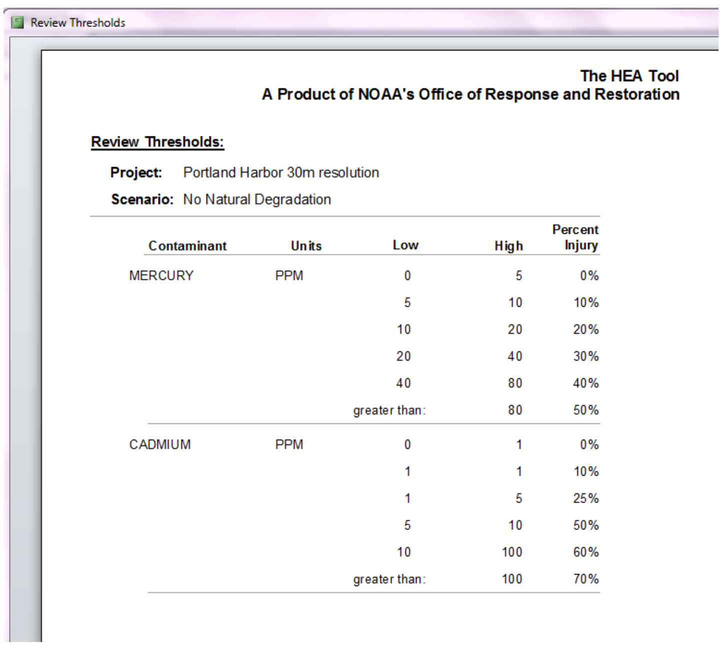
There is space for six concentration ranges for each contaminant, where the first range is from 0 to a specified concentration and represents 0% injury. The sixth range encompasses all values greater than the concentration threshold specified in the fifth range. Note that the low end concentration for the first range is fixed at 0 and all other low end concentrations are locked and will equal the high end concentration of the preceding threshold. In addition, the percent injury of the first threshold is locked at 0%.

In the text boxes, enter injury threshold concentrations and the associated percent injury for each range. Concentrations should be tailored to this particular contaminant and entered in the units specified. Percent values must be between 0 and 100. Concentration values and percentages must increase or stay the same from the first range through the sixth.

IMPORTANT: All fields must be filled out, to specify fewer than six thresholds, set the high end concentration and percent injury equal to the preceding values. For example, if you only need to set four threshold bins, you will need to repeat the high concentration and % injury in rows four and five as shown below.



Once users have completed entry of the contaminant thresholds, press “OK” to return to the Contaminant details page. From here, users can continue to define the contaminant handling parameters as well as access a basic report-out of the thresholds chosen across all contaminants. To access the report, select the “Review Thresholds” button at the bottom of the screen.


Review Thresholds

The HEA Tool
A Product of NOAA's Office of Response and Restoration

Review Thresholds:

Project: Portland Harbor 30m resolution

Scenario: No Natural Degradation

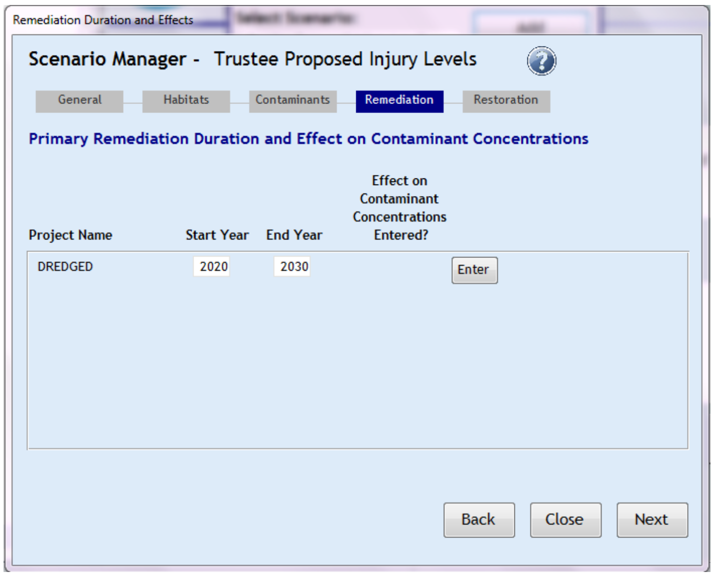
Contaminant	Units	Low	High	Percent Injury
MERCURY	PPM	0	5	0%
		5	10	10%
		10	20	20%
		20	40	30%
		40	80	40%
		greater than:	80	50%
CADMIUM	PPM	0	1	0%
		1	1	10%
		1	5	25%
		5	10	50%
		10	100	60%
		greater than:	100	70%

Once all contaminant details are entered, select “Next” to continue to the Remediation page.

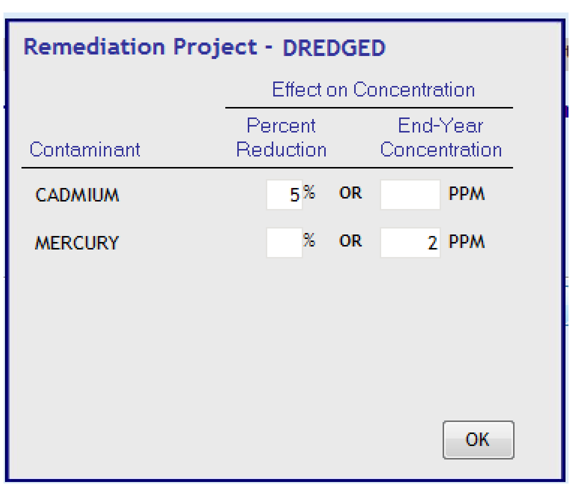
4.2.6 Setting Primary Remediation Inputs

The locations of primary remediation projects are imported from the GIS data. If no remediation project was specified, you may select the Next button to continue.

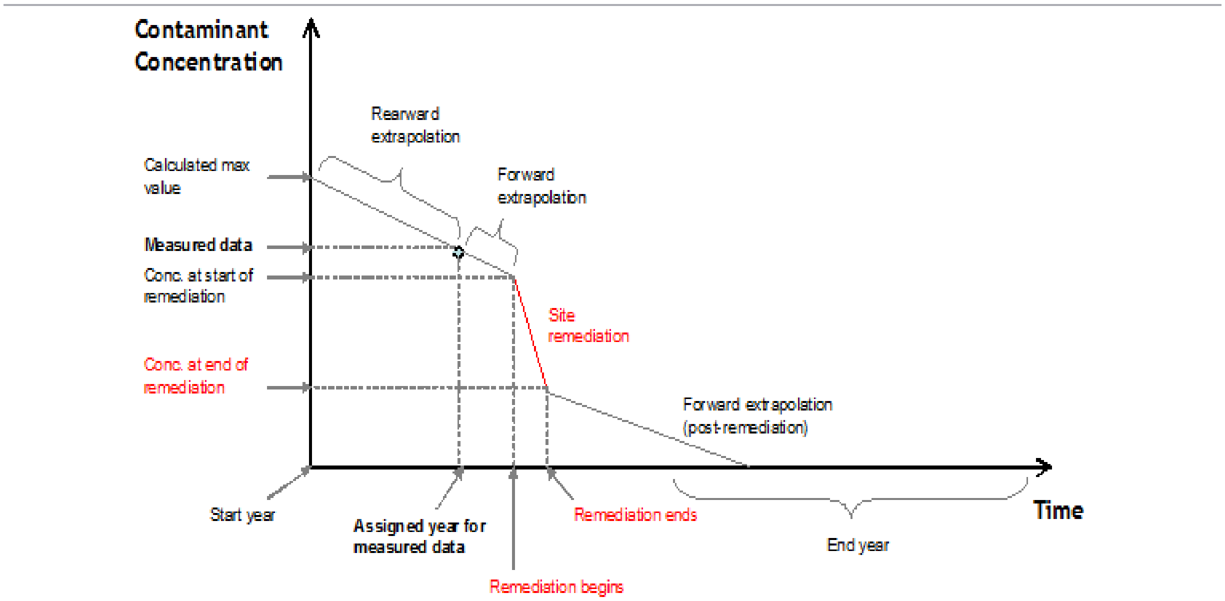
For each remediation project defined within the GIS tool, the user must enter the start and end year. The start year must be greater than, or equal to, the assigned data year (the assumed vintage of the GIS data). The end year must be greater than, or equal to, the remediation project start year.



The user must also enter the effect of each primary remediation project on every contaminant included in the injury analysis. Select the Enter button for each project to access this screen. The effect of each project may be expressed either as a resulting absolute concentration in the contaminant level, or as a reduction in percentage terms, from the level of the contaminant at the time of remediation commencement.



The graph below illustrates how these inputs are used to project estimated contaminant concentrations over time (see red lines)

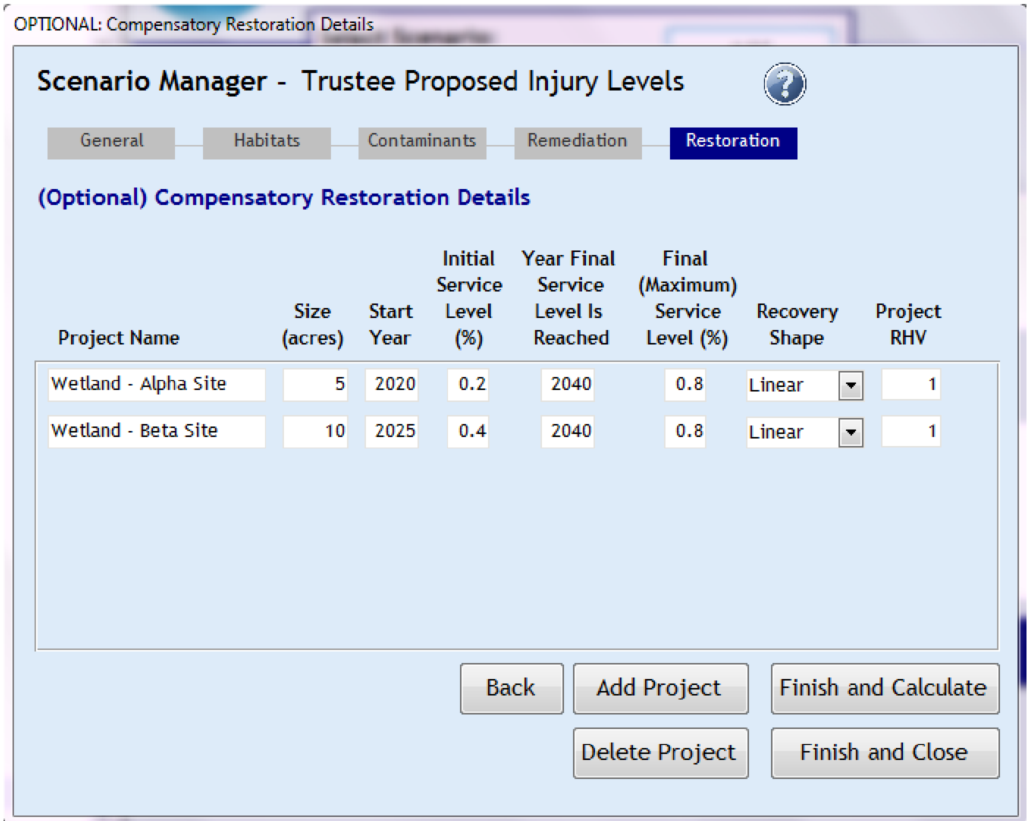


Once complete, select "Next" to open the final scenario definition screen.

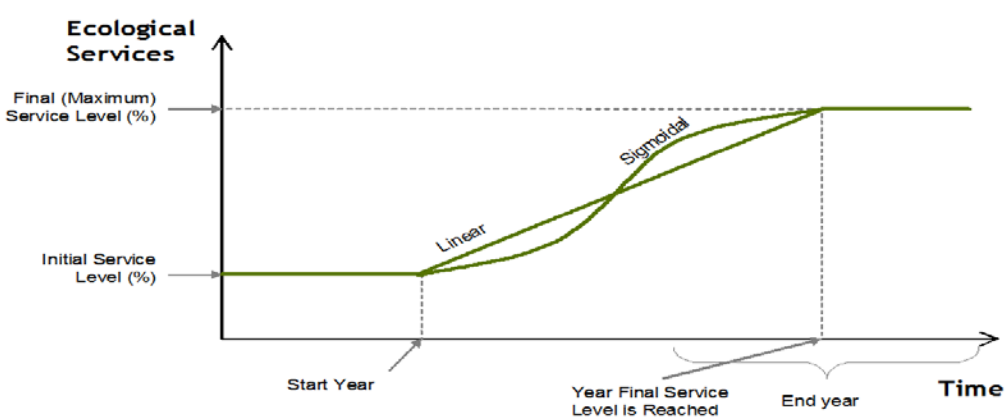
4.2.7 Setting Compensatory Restoration Inputs

Compensatory restoration projects are offsite efforts designed to increase the level of ecological services provided within a specific area to be restored. The improvements in services achieved through compensatory restoration are intended to offset estimated injuries within the assessment area.

Because different habitats may have different relative values, each compensatory restoration project is assigned to one (and only one) habitat. If a project (e.g., dredging) occurs over more than one habitat type (e.g., nearshore and deepwater areas), the project should be split into two separate 'projects,' and the project parameters must be entered twice: once for each habitat type. Entering information for compensatory restoration projects is optional, but if selected, all the following inputs are required for each project.



The graph below illustrates how these inputs are used to project estimated services over time (see green lines).



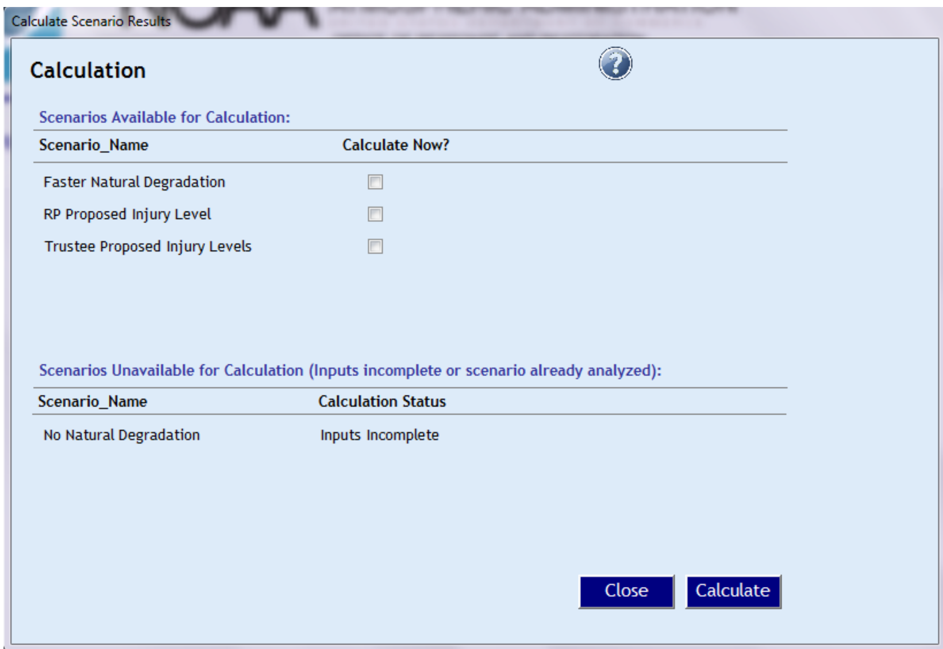
Parameter	**Description**
Project Name	A descriptive name
Size (acres)	The size of the restoration project within the given habitat type, in acres.
Start Year	The year that restoration project implementation is expected to commence.
Initial Service Level (%)	The level of ecological services provided by the habitat in the restoration project area, prior to project implementation.
Year Final Service Level is Reached	Project completion (potentially followed by natural recovery) are expected to result in an increase in ecological services. At some point, a final maximum service level is assumed to be achieved (see below). This entry represents the first year that the final maximum level is achieved.
Final (Maximum) Service Level	This is the terminal maximum service level reached as a consequence of project implementation plus subsequent natural recovery (if any). This value may be reached either immediately upon project completion, or some time thereafter, reflecting ongoing natural recovery. The value of the final service level must be equal to or less than 100%.
Recovery Shape	Recovery between the "Start Year" and the "Year Final (Maximum) Service Level is Reached" is defined as linear only at this time. In future versions of the model, the sigmoidal (S-shaped) recovery option may be included.
RHV	The Relative Habitat Value (RHV) reflects the value of the ecological services provided by the habitat type within the compensatory restoration project area, relative to the other habitat types included in the analysis. The RHV must be between zero and one.

Select “Add Project” to continue adding projects. You may also remove a project by selecting “Delete Project” and then identifying the project name to be deleted. The two right-most buttons take the user to either the scenario analysis screen (Finish and Calculate) or to the main menu (Finish and Close).

4.3 Performing Calculations

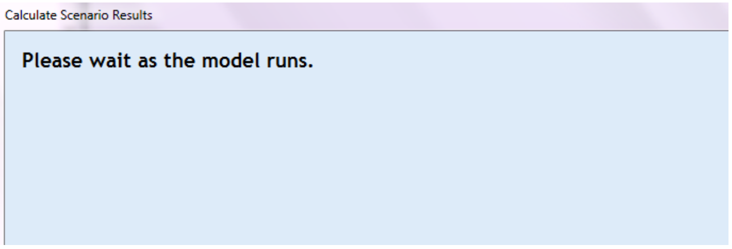
To access the Calculation page, you can either: 1) select “Update Analysis” from the main menu, or 2) select “Finish and Calculate” from the last screen of the Scenario definition pages (Compensatory Restoration).

Once on the Calculation page, performing the analysis is allowed only for those scenarios for which a complete set of HEA parameters has been entered. These scenarios are listed under "Scenarios Available for Calculation." Scenarios lacking one or more inputs are listed under "Scenarios Unavailable for Calculation."



Most scenarios will be complete within one or two minutes. In some situations, however, you may be presented with a message immediately to the left of the Scenario Selection. For example, you may see “Alert - Calculations May Be Lengthy.” Depending on the number of grid cells included in the project area, number and extent of contaminants, and years included in a scenario, HEA calculations for an individual scenario may require significant time to complete. While the model runs you will see a “Please wait as the model runs.” popup. During the model run, you can allow the tool to run in the background while accessing other programs.

> IMPORTANT: Although you may access other programs, it is important that you do not open the ArcGIS data as this may interfere with the analysis.

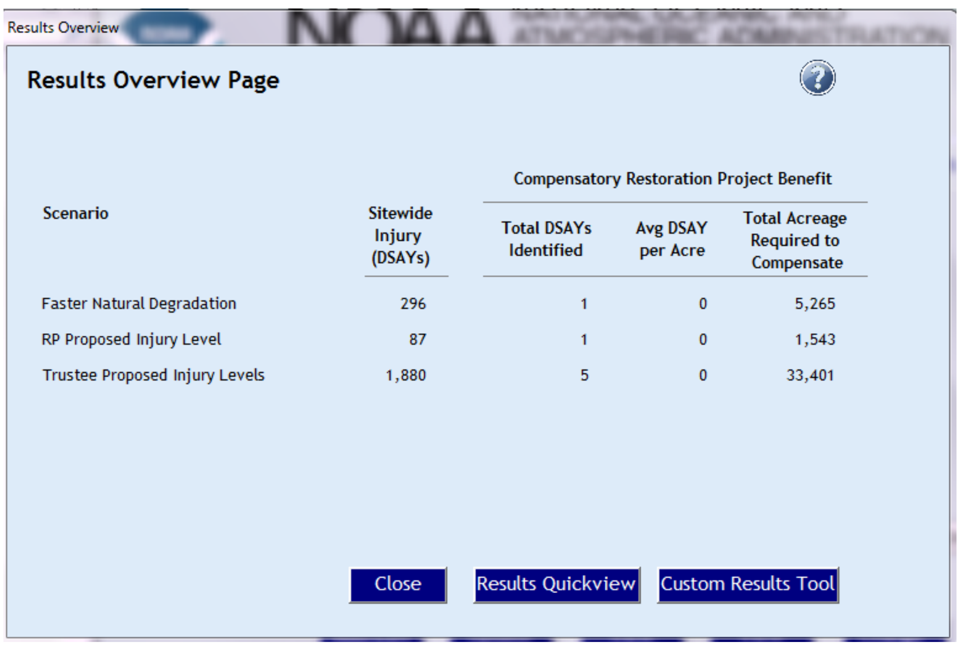


4.4 Viewing Results

After a scenario analysis is complete, the tool will bring users to the results screens. Alternatively, users can jump to the results page via the “View Results” button on the main Project page.

4.4.1 HEA Results Landing Page

The first results page provides a basis overview of each scenario. The table shows, by scenario, both the Discounted Service Acre Years (DSAYs) of sitewide injury and, separately, DSAYs of compensatory restoration project benefits. Results are presented only for scenarios with completed calculations.



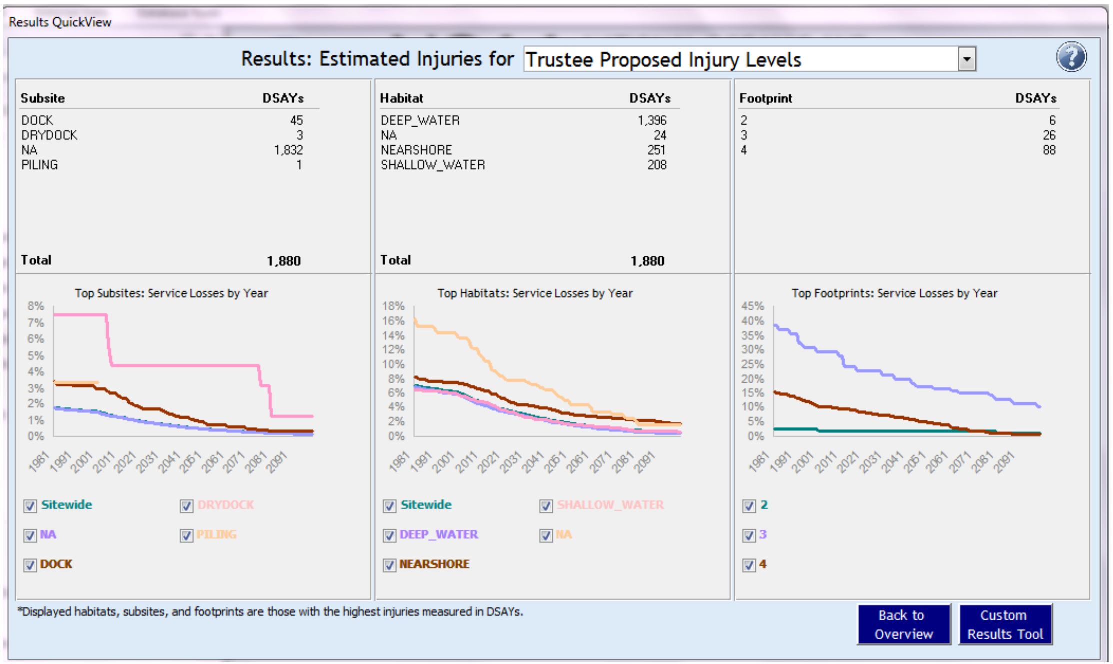
From this landing page, users can access to separate result detail pages. These include:

Results Quickview: Clicking on this button will open a dashboard of key information about a specific scenario, including tabular injury results by subsite, habitat, and footprint, and charts showing changes in service losses over time.

Custom Results Tool: Clicking on this button will open a custom results generation tool, through which a series of charts and tables can be viewed and exported.

4.4.2 HEA Results Quickview Help

The results quickview provides a snapshot of key information about a particular scenario. To choose which scenario results to view, click on the dropdown at the top of the screen and choose the desired scenario from the list. This list includes only scenarios for which calculations are complete.



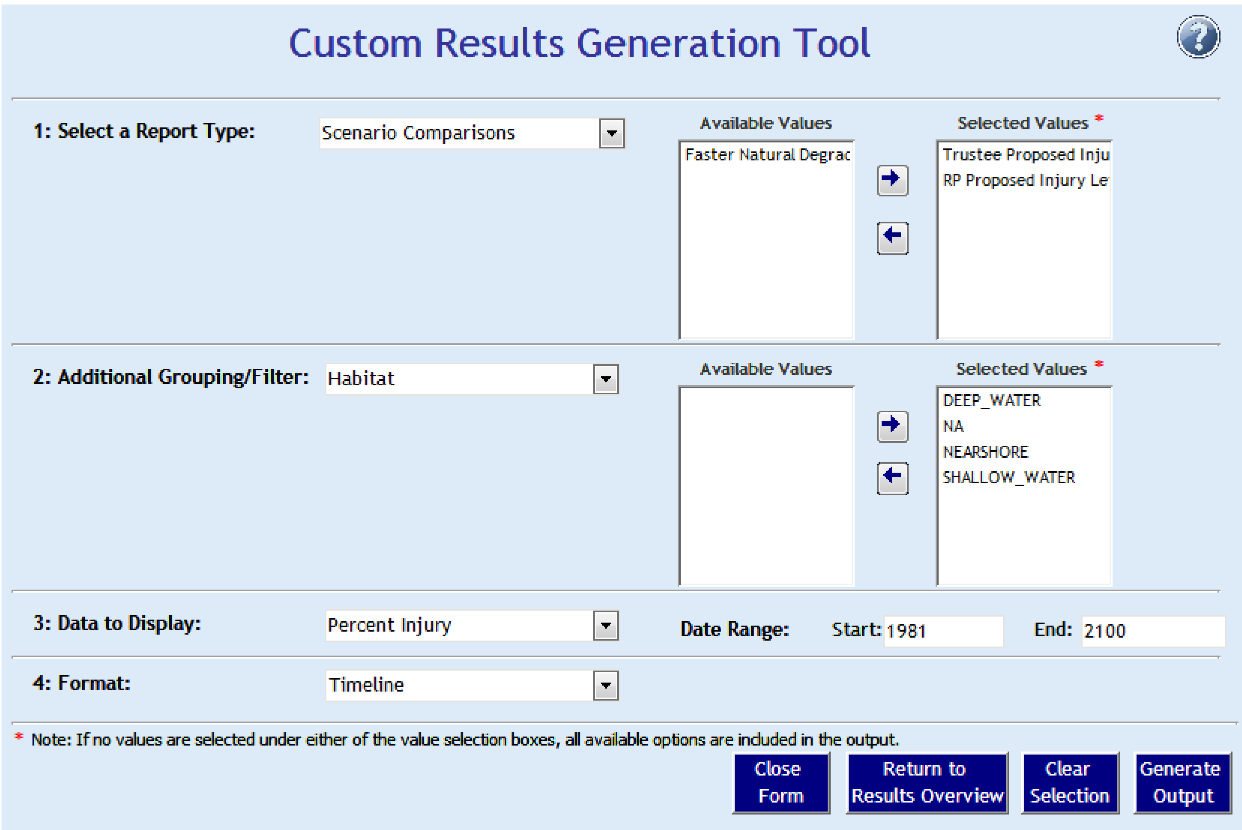
The three panels present scenario results broken down by subsite, habitat, and footprint. Each panel contains a table of DSAYs by category and a graph of percent service loss by year. The scale of the graphs will adjust automatically as you turn an individual data series on or off. Click the box next to a series name to show or hide its trendline.

Displayed habitats, subsites, and footprints are those with the highest injuries measured in DSAYs. For more complete information, or to export results, click the 'Custom Results Tool' box at the bottom of the screen.

NOTE: Footprints are an optional project delineation tool available from inside of the GIS tool. For example, analysts may wish to sub-divide a project according to difference in RP allocations. If your project does not include footprints, the last panel will be blank. To add footprints, close the Access database, open the GIS-based HEA tools, and follow the corresponding instructions for footprint designation.

4.4.3 HEA Custom Results Generation Tool

The custom results generation tool (accessible from either the results landing page or Quickview screens) allows users to generate targeted outputs of the scenario results. Users can produce a table, graph/chart, or export specific results to a separate file. To use this feature, select the details of interest for each of the four rows. Parameters include: (1) the report type, (2) an additional grouping or filter, (3) type of data to display, (4) format of the results.



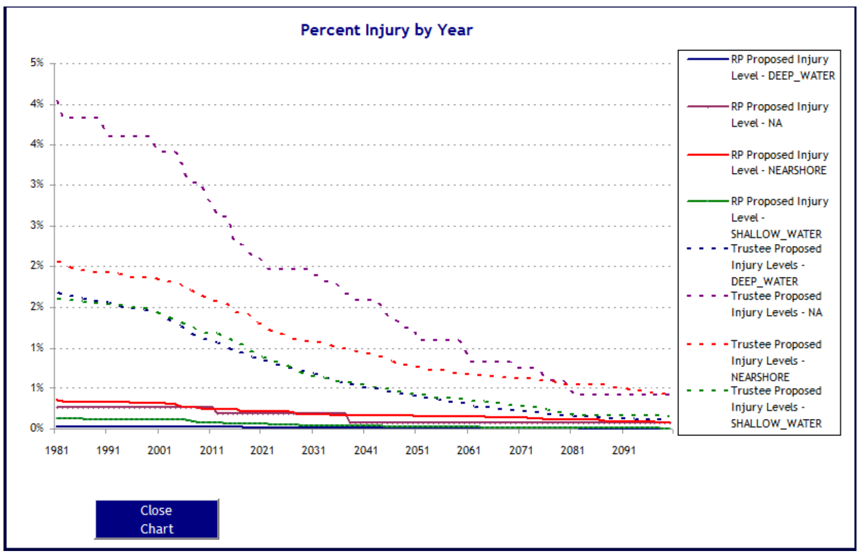
The first two parameters include selection boxes. Report Type allows for the generation of reports targeted around comparison of the contaminant details or the relative scenario results. The Additional Grouping/Filter allows for generation of the data at the site-wide level, or to disaggregate the results according to the habitat, footprint, or subsite designations. After selecting an option from these first two parameter dropdown lists, associated possible values will appear in the 'Available Values' box. To limit the output to a subset of the available values, select the values of interest and click the right arrow to move them to the 'Selected Values' box. To remove an item from the 'Selected Values' list, click on the item and click the left arrow.

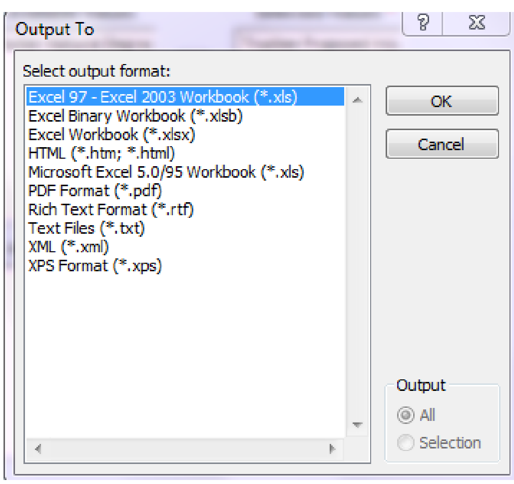
For example, if 'Contaminant Statistics' is chosen as the report type, all contaminants appear in the 'Available Values' box. To limit the output to only 'Cadmium', click on 'Cadmium' and click the right arrow to move it to 'Selected Values'. To show all contaminants in the output, you can select all contaminants or leave the selection empty.

The Data to Display parameter will update according to the earlier parameters selected. For Contaminant-based report, the only option is Summary Results. For Scenario-based comparisons, you may choose between obtaining DSAY or Percent Injury information.

Finally, the Format parameter allows users, where applicable, to generate a Table of the results, a time-series chart (for percent injury results), or to export the data to a separate program file for offline analysis/use.

COC_NAME	COC_UNITS	HABITAT_ID	Min_Value	Max_Value	Avg_Value	StdDeviatior
CADMIUM	PPM	DEEP_WATER	0.01	5.59	0.31	0.25
CADMIUM	PPM	SHALLOW_WATER	0.00	5.00	0.32	0.29
MERCURY	PPM	DEEP_WATER	0.00	7.08	0.09	0.24
MERCURY	PPM	SHALLOW_WATER	0.01	69.96	0.18	2.04





Chapter 5 | Frequently Asked Questions

1. **How do I update my computer if a more recent version of the models is now available?**

   As new versions of the HEA tool are released, NOAA will provide guidance on the extent to which prior analyses can be moved into the new tool. As such, additional information will be made available as applicable.

2. **What if, after working through the full GIS and Access tools for a project, I need to go back and refine the spatial attributes for the project area?**

   The GIS and Access-based tools provide the capability to work through each of the steps and then move back and forth between each as needed to refine the analyses. Be sure to only have one tool open at a time for a given project to prevent file conflicts. After completing any GIS revisions, you can return to the previously generated Access project. Your original scenarios will be present; however, depending upon the revisions made, you may need to edit the scenario details before re-running the analysis.

3. **What spatial data do I need to begin an analysis?**

   Typical datasets that are either required or suggested to have before you conduct a HEA are:

   - Sediment or soil analytical chemistry data in shapefile or similar format – (required)
   - Site attributes shapefile(s) that include, habitat type, condition type, remediation status (See page 18) (optional)
   - Site boundaries (optional)

4. **What should I do if a schema lock occurs while running the GIS tools?**

   If s schema lock error is reported, it is recommended shut down ArcGIS and re-start.

5. **What if, there already is a /NOAA_HEA_Tool/ folder containing data from previous projects and the user does not want to combine different projects into the same Access database, can the folder name be changed?**

   The folder name can be changed, but the subfolders must remain in the same location in order for the Access tool to work. The user can change /NOAA_HEA_Tool/ to /NOAA_HEA_Tool_Test/ and still be able to use the tools properly.

6. **When should an extent mask be used during the various GIS tool steps, such as A.3 Create Analysis Grid or during the interpolations?**

   An extent mask should be used any time the user wants to constrain the analysis to within the extent of a project boundary polygon rather than the rectangular bounding box of all the input data. The extent mask allows the analyst to use a polygonal or raster mask (only water, water plus buffer, etc.) to spatially constrain following interpolations and analyses.

Appendix A. Filtered Sample Data Metadata Template

```
Identification_Information:
  Citation:
    Citation_Information:
      Originator: National Oceanic and Atmospheric Administration (NOAA)
National Ocean Service (NOS) Office of Response and Restoration (ORR)
      Publication_Date: Unknown
      Publication_Time: Unknown
      Title: XXXX
      Geospatial_Data_Presentation_Form: vector digital data
      Online_Linkage:
  Description:
    Abstract: These data represent the locations and filtered concentration
values for a single Contaminant of Concern (COC).  These data were created
via the use of a suite of automated tools as intermediate data layers for
conducting Habitat Equivalency Analyses (HEA).  These tools were created by
the National Oceanic and Atmospheric Administration (NOAA) National Ocean
Service (NOS) Office of Response and Restoration (ORR) and are referred to
below as HEA GIS Tools.  Typically, these data have been exported from NOAA
ORRs Query Manager database, and imported into ArcGIS via the use of
standardized import tools, and further processed by the automated HEA GIS
tools.  See the HEA GIS Tools documentation, data set lineage, and
accompanying Query Manager documentation for additional details.
    Purpose: Habitat Equivalency Analysis (HEA) is an industry standard
analytical approach for scaling ecological restoration.  The HEA GIS Tools
that generated these data have been developed to standardize and document
spatial and analytical methods used to conduct these analyses.  Specifically,
these data describe filtered and processed contaminant sampling data intended
to be used as part of HEA calculations.
  Time_Period_of_Content:
    Time_Period_Information:
      Single_Date/Time:
        Calendar_Date: unknown
        Time_of_Day: unknown
    Currentness_Reference: ground condition
  Status:
    Progress: In work
    Maintenance_and_Update_Frequency: As needed
  Spatial_Domain:
    Bounding_Coordinates:
      West_Bounding_Coordinate: -122.816670
      East_Bounding_Coordinate: -122.605125
      North_Bounding_Coordinate: 45.748929
      South_Bounding_Coordinate: 45.291970
  Keywords:
    Theme:
      Theme_Keyword_Thesaurus: None
      Theme_Keyword: HEA
      Theme_Keyword: Habitat Equivalency Analysis
    Theme:
      Theme_Keyword: Contaminant
      Theme_Keyword: Sampling
  Access_Constraints: These data may be subject to restricted distribution
requirements.  See dataset originator for additional information.
```

Use_Constraints: These data may be subject to use restrictions. See dataset originator for additional information.
  Point_of_Contact:
    Contact_Information:
      Contact_Organization_Primary:
        Contact_Organization: National Oceanic and Atmospheric Administration (NOAA) National Ocean Service (NOS) Office of Response and Restoration (ORR)
      Contact_Address:
        Address_Type: mailing and physical address
        Address: 1305 East-West Highway
        City: Silver Spring
        State_or_Province: Maryland
        Postal_Code: 20910
      Contact_Voice_Telephone: 301.713.4248
      Contact_Facsimile_Telephone: 301.713.4389
  Native_Data_Set_Environment: Microsoft Windows XP Version 5.1 (Build 2600) Service Pack 3; ESRI ArcCatalog 9.3.1.3000
Data_Quality_Information:
  Attribute_Accuracy:
    Attribute_Accuracy_Report: These data have been derived from data collected as part of one or many efforts, aggregated into a single data set according to a set of standard practices, and further filtered according to user choices. Attribute accuracy is dependent upon these sources, processes and choices, but is standardized. These data have not been formally evaluated for attribute accuracy as part of the HEA GIS Tool processing. See the HEA GIS Tools documentation, data set lineage, and accompanying Query Manager documentation for additional details.
  Logical_Consistency_Report: These data have been derived from data collected as part of one or many efforts, aggregated into a single data set according to a set of standard practices, and further filtered according to user choices. Logical consistency is dependent upon these sources, processes and choices, but is standardized.   These data have not been formally evaluated for logical consistency as part of the HEA GIS Tool processing. See the HEA GIS Tools documentation, data set lineage, and accompanying Query Manager documentation for additional details.
  Completeness_Report: These data have been derived from data collected as part of one or many efforts, aggregated into a single data set according to a set of standard practices, and further filtered according to user choices. The data are therefore as complete as these sources, processes and choices dictate.   These data have not been formally evaluated for completeness as part of the HEA GIS Tool processing. See the HEA GIS Tools documentation, data set lineage, and accompanying Query Manager documentation for additional details.
  Positional_Accuracy:
    Horizontal_Positional_Accuracy:
      Horizontal_Positional_Accuracy_Report: These data have been derived from data collected as part of one or many efforts, aggregated into a single data set according to a set of standard practices, and further filtered according to user choices. Horizontal spatial accuracy is dependent upon these sources, processes and choices, but is standardized. These data have not been formally evaluated for horizontal accuracy as part of the HEA GIS Tool processing. See the data set lineage and accompanying Query Manager documentation for additional details.
    Vertical_Positional_Accuracy:

Vertical_Positional_Accuracy_Report: These data have been derived from data collected as part of one or many efforts, aggregated into a single data set according to a set of standard practices, and further filtered according to user choices. Vertical spatial accuracy is dependent upon these sources, processes and choices, but is standardized. These data have not been formally evaluated for vertical accuracy as part of the HEA GIS Tool processing. See the data set lineage and accompanying Query Manager documentation for additional details.

Lineage:
Source_Information:
Source_Citation:
Citation_Information:
Originator: National Oceanic and Atmospheric Administration (NOAA) National Ocean Service (NOS) Office of Response and Restoration (ORR)
Publication_Date: Unknown
Publication_Time: Unknown
Title: NOAA ORR Query Manager
Source_Scale_Denominator: Varies
Type_of_Source_Media: computer program
Source_Time_Period_of_Content:
Time_Period_Information:
Single_Date/Time:
Calendar_Date: unknown
Time_of_Day: unknown
Source_Currentness_Reference: ground condition
Source_Citation_Abbreviation: NOAA ORR Query Manager
Source_Contribution: Typically, these data have been exported from NOAA ORRs Query Manager database, imported into ArcGIS via the use of standardized import tools, and further processed by the automated HEA GIS Tools.

Spatial_Data_Organization_Information:
Direct_Spatial_Reference_Method: Vector
Point_and_Vector_Object_Information:
SDTS_Terms_Description:
SDTS_Point_and_Vector_Object_Type: Entity point
Point_and_Vector_Object_Count: XXXX

Spatial_Reference_Information:
Horizontal_Coordinate_System_Definition:
Planar:
Grid_Coordinate_System:
Grid_Coordinate_System_Name: Universal Transverse Mercator
Universal_Transverse_Mercator:
UTM_Zone_Number: 10
Transverse_Mercator:
Scale_Factor_at_Central_Meridian: 0.999600
Longitude_of_Central_Meridian: -123.000000
Latitude_of_Projection_Origin: 0.000000
False_Easting: 500000.000000
False_Northing: 0.000000
Planar_Coordinate_Information:
Planar_Coordinate_Encoding_Method: coordinate pair
Coordinate_Representation:
Abscissa_Resolution: 0.000000
Ordinate_Resolution: 0.000000
Planar_Distance_Units: meters
Geodetic_Model:

```
      Horizontal_Datum_Name: D_WGS_1984
      Ellipsoid_Name: WGS_1984
      Semi-major_Axis: 6378137.000000
      Denominator_of_Flattening_Ratio: 298.257224
Entity_and_Attribute_Information:
  Overview_Description:
    Entity_and_Attribute_Overview: These data describe the locations and
filtered concentration values for a Contaminant of Concern (COC) extracted
from NOAA ORRs Query Manager database and filtered via the HEA GIS Tools.
The data have been filtered to yield a single COC value at each 2-D point
location based upon user choices.
    Entity_and_Attribute_Detail_Citation: See the HEA GIS Tools
documentation, data set lineage, and accompanying Query Manager documentation
for additional details.
Distribution_Information:
  Resource_Description: These data may be subject to distribution
restrictions.  See the dataset originator for additional details.
  Standard_Order_Process:
    Digital_Form:
      Digital_Transfer_Information:
        Transfer_Size: 0.059
Metadata_Reference_Information:
  Metadata_Date: 20101130
  Metadata_Contact:
    Contact_Information:
      Contact_Organization_Primary:
        Contact_Organization: National Oceanic and Atmospheric Administration
(NOAA) National Ocean Service (NOS) Office of Response and Restoration (ORR)
      Contact_Address:
        Address_Type: mailing and physical address
        Address: 1305 East-West Highway
        City: Silver Spring
        State_or_Province: Maryland
        Postal_Code: 20910
      Contact_Voice_Telephone: 301.713.4248
      Contact_Facsimile_Telephone: 301.713.4389
  Metadata_Standard_Name: FGDC Content Standards for Digital Geospatial
Metadata
  Metadata_Standard_Version: FGDC-STD-001-1998
  Metadata_Time_Convention: local time
  Metadata_Extensions:
    Online_Linkage: http://www.esri.com/metadata/esriprof80.html
    Profile_Name: ESRI Metadata Profile
```

Appendix B. Interpolated Contaminant Surface Metadata Template

```
Identification_Information:
  Citation:
    Citation_Information:
      Originator: National Oceanic and Atmospheric Administration (NOAA)
National Ocean Service (NOS) Office of Response and Restoration (ORR)
      Publication_Date: Unknown
      Publication_Time: Unknown
      Title: XXXX
      Geospatial_Data_Presentation_Form: raster digital data
      Online_Linkage:
  Description:
    Abstract: These data represent interpolated concentration values for a
single Contaminant of Concern (COC).  These data were created via the use of
a suite of automated tools as intermediate data layers for conducting Habitat
Equivalency Analyses (HEA).  These tools were created by the National Oceanic
and Atmospheric Administration (NOAA) National Ocean Service (NOS) Office of
Response and Restoration (ORR) and are referred to below as HEA GIS Tools.
Typically, these data have been exported from NOAA ORRs Query Manager
database, and imported into ArcGIS via the use of standardized import tools,
and further processed by the automated HEA GIS tools.  See the HEA GIS Tools
documentation, data set lineage, and accompanying Query Manager documentation
for additional details.
    Purpose: Habitat Equivalency Analysis (HEA) is an industry standard
analytical approach for scaling ecological restoration.  The HEA GIS Tools
that generated these data have been developed to standardize and document
spatial and analytical methods used to conduct these analyses.  Specifically,
these data describe interpolated contaminant sampling data intended to be
used as part of HEA calculations.
  Time_Period_of_Content:
    Time_Period_Information:
      Single_Date/Time:
        Calendar_Date: unknown
        Time_of_Day: unknown
    Currentness_Reference: ground condition
  Status:
    Progress: In work
    Maintenance_and_Update_Frequency: As needed
  Spatial_Domain:
    Bounding_Coordinates:
      West_Bounding_Coordinate: -122.817554
      East_Bounding_Coordinate: -122.680476
      North_Bounding_Coordinate: 45.655799
      South_Bounding_Coordinate: 45.536688
  Keywords:
    Theme:
      Theme_Keyword_Thesaurus: None
      Theme_Keyword: HEA
      Theme_Keyword: Habitat Equivalency Analysis
    Theme:
      Theme_Keyword: Contaminant
      Theme_Keyword: Sampling
```

Access_Constraints: These data may be subject to restricted distribution requirements. See dataset originator for additional information.
Use_Constraints: These data may be subject to use restrictions. See dataset originator for additional information.
Point_of_Contact:
Contact_Information:
Contact_Organization_Primary:
Contact_Organization: National Oceanic and Atmospheric Administration (NOAA) National Ocean Service (NOS) Office of Response and Restoration (ORR)
Contact_Address:
Address_Type: mailing and physical address
Address: 1305 East-West Highway
City: Silver Spring
State_or_Province: Maryland
Postal_Code: 20910
Contact_Voice_Telephone: 301.713.4248
Contact_Facsimile_Telephone: 301.713.4389
Native_Data_Set_Environment: Microsoft Windows XP Version 5.1 (Build 2600) Service Pack 3; ESRI ArcCatalog 9.3.1.3000
Data_Quality_Information:
Attribute_Accuracy:
Attribute_Accuracy_Report: These data have been interpolated from data collected as part of one or many efforts, aggregated into a single data set according to a set of standard practices, and further filtered according to user choices. Attribute accuracy is dependent upon these sources, processes and choices, but is standardized. These data have not been formally evaluated for attribute accuracy as part of the HEA GIS Tool processing. See the HEA GIS Tools documentation, data set lineage, and accompanying Query Manager documentation for additional details.
Logical_Consistency_Report: These data have been interpolated from data collected as part of one or many efforts, aggregated into a single data set according to a set of standard practices, and further filtered according to user choices. Logical consistency is dependent upon these sources, processes and choices, but is standardized. These data have not been formally evaluated for logical consistency as part of the HEA GIS Tool processing. See the HEA GIS Tools documentation, data set lineage, and accompanying Query Manager documentation for additional details.
Completeness_Report: These data have been interpolated from data collected as part of one or many efforts, aggregated into a single data set according to a set of standard practices, and further filtered according to user choices. The data are therefore as complete as these sources, processes and choices dictate. These data have not been formally evaluated for completeness as part of the HEA GIS Tool processing. See the HEA GIS Tools documentation, data set lineage, and accompanying Query Manager documentation for additional details.
Positional_Accuracy:
Horizontal_Positional_Accuracy:
Horizontal_Positional_Accuracy_Report: These data have been derived from data collected as part of one or many efforts, aggregated into a single data set according to a set of standard practices, and further filtered according to user choices. Horizontal spatial accuracy is dependent upon these sources, processes and choices, but is standardized. These data have not been formally evaluated for horizontal accuracy as part of the HEA GIS Tool processing. See the data set lineage and accompanying Query Manager documentation for additional details.

```
    Vertical_Positional_Accuracy:
      Vertical_Positional_Accuracy_Report: These data have been derived from
data collected as part of one or many efforts, aggregated into a single data
set according to a set of standard practices, and further filtered according
to user choices.  Vertical spatial accuracy is dependent upon these sources,
processes and choices, but is standardized.  These data have not been
formally evaluated for vertical accuracy as part of the HEA GIS Tool
processing.  See the data set lineage and accompanying Query Manager
documentation for additional details.
  Lineage:
    Source_Information:
      Source_Citation:
        Citation_Information:
          Originator: National Oceanic and Atmospheric Administration (NOAA)
National Ocean Service (NOS) Office of Response and Restoration (ORR)
          Publication_Date: Unknown
          Publication_Time: Unknown
          Title: NOAA ORR Query Manager
      Source_Scale_Denominator: Varies
      Type_of_Source_Media: computer program
      Source_Time_Period_of_Content:
        Time_Period_Information:
          Single_Date/Time:
            Calendar_Date: unknown
            Time_of_Day: unknown
        Source_Currentness_Reference: ground condition
      Source_Citation_Abbreviation: NOAA ORR Query Manager
      Source_Contribution: Typically, these data have been exported from NOAA
ORRs Query Manager database, imported into ArcGIS via the use of standardized
import tools, further processed and interpolated by the automated HEA GIS
Tools.
Spatial_Data_Organization_Information:
  Direct_Spatial_Reference_Method: Raster
  Raster_Object_Information:
    Raster_Object_Type: Pixel
    Row_Count: XXXX
    Column_Count: XXXX
    Vertical_Count: 1
Spatial_Reference_Information:
  Horizontal_Coordinate_System_Definition:
    Planar:
      Grid_Coordinate_System:
        Grid_Coordinate_System_Name: Universal Transverse Mercator
        Universal_Transverse_Mercator:
          UTM_Zone_Number: 10
          Transverse_Mercator:
            Scale_Factor_at_Central_Meridian: 0.999600
            Longitude_of_Central_Meridian: -123.000000
            Latitude_of_Projection_Origin: 0.000000
            False_Easting: 500000.000000
            False_Northing: 0.000000
      Planar_Coordinate_Information:
        Planar_Coordinate_Encoding_Method: row and column
        Coordinate_Representation:
          Abscissa_Resolution: 30.000000
```

```
          Ordinate_Resolution: 30.000000
        Planar_Distance_Units: meters
    Geodetic_Model:
      Horizontal_Datum_Name: D_WGS_1984
      Ellipsoid_Name: WGS_1984
      Semi-major_Axis: 6378137.000000
      Denominator_of_Flattening_Ratio: 298.257224
Entity_and_Attribute_Information:
  Overview_Description:
    Entity_and_Attribute_Overview: These data describe interpolated filtered
concentration values for a Contaminant of Concern (COC) extracted from NOAA
ORRs Query Manager database and filtered via the HEA GIS Tools.  The data
have been filtered to yield a single COC value at each 2-D point location
based upon user choices, and interpolated using methods documented in the
data set lineage.
    Entity_and_Attribute_Detail_Citation: See the HEA GIS Tools
documentation, data set lineage, and accompanying Query Manager documentation
for additional details.
Distribution_Information:
  Resource_Description: These data may be subject to distribution
restrictions.  See the dataset originator for additional details.
  Standard_Order_Process:
    Digital_Form:
      Digital_Transfer_Information:
        Transfer_Size: 0.000
Metadata_Reference_Information:
  Metadata_Date: 20101130
  Metadata_Contact:
    Contact_Information:
      Contact_Organization_Primary:
        Contact_Organization: National Oceanic and Atmospheric Administration
(NOAA) National Ocean Service (NOS) Office of Response and Restoration (ORR)
      Contact_Address:
        Address_Type: mailing and physical address
        Address: 1305 East-West Highway
        City: Silver Spring
        State_or_Province: Maryland
        Postal_Code: 20910
      Contact_Voice_Telephone: 301.713.4248
      Contact_Facsimile_Telephone: 301.713.4389
  Metadata_Standard_Name: FGDC Content Standards for Digital Geospatial
Metadata
  Metadata_Standard_Version: FGDC-STD-001-1998
  Metadata_Time_Convention: local time
  Metadata_Extensions:
    Online_Linkage: http://www.esri.com/metadata/esriprof80.html
    Profile_Name: ESRI Metadata Profile
```

Appendix C. HEA Results Metadata Template

```
Identification_Information:
  Citation:
    Citation_Information:
      Originator: National Oceanic and Atmospheric Administration (NOAA)
National Ocean Service (NOS) Office of Response and Restoration (ORR)
      Publication_Date: Unknown
      Publication_Time: Unknown
      Title: XXXX
      Geospatial_Data_Presentation_Form: remote-sensing image
      Online_Linkage:
  Description:
    Abstract: These data describe scaled injury in units of Discounted
Service Acre Years (DSAY) for a particular scenario within a Habitat
Equivalency Analysis (HEA).  See the HEA Tool documentation, HEA GIS Tools
documentation, and accompanying Query Manager documentation for additional
details.
    Purpose: Habitat Equivalency Analysis (HEA) is an industry standard
analytical approach for scaling ecological restoration.  The HEA Tool that
generated these data was developed to standardize and document spatial and
analytical methods used to conduct these analyses.  Specifically, these data
describe scaled injury per raster grid cell in units of DSAYs for a
particular scenario within a given set HEA calculations.
  Time_Period_of_Content:
    Time_Period_Information:
      Single_Date/Time:
        Calendar_Date: unknown
        Time_of_Day: unknown
    Currentness_Reference: ground condition
  Status:
    Progress: In work
    Maintenance_and_Update_Frequency: As needed
  Spatial_Domain:
    Bounding_Coordinates:
      West_Bounding_Coordinate: -122.817554
      East_Bounding_Coordinate: -122.680861
      North_Bounding_Coordinate: 45.655799
      South_Bounding_Coordinate: 45.536689
  Keywords:
    Theme:
      Theme_Keyword_Thesaurus: None
      Theme_Keyword: HEA
      Theme_Keyword: Habitat Equivalency Analysis
    Theme:
      Theme_Keyword: Contaminant
      Theme_Keyword: Sampling
  Access_Constraints: These data may be subject to restricted distribution
requirements.  See dataset originator for additional information.
  Use_Constraints: These data may be subject to use restrictions.  See
dataset originator for additional information.
  Point_of_Contact:
    Contact_Information:
      Contact_Organization_Primary:
```

Contact_Organization: National Oceanic and Atmospheric Administration (NOAA) National Ocean Service (NOS) Office of Response and Restoration (ORR)
Contact_Address:
Address_Type: mailing and physical address
Address: 1305 East-West Highway
City: Silver Spring
State_or_Province: Maryland
Postal_Code: 20910
Contact_Voice_Telephone: 301.713.4248
Contact_Facsimile_Telephone: 301.713.4389
Native_Data_Set_Environment: Microsoft Windows XP Version 5.1 (Build 2600) Service Pack 3; ESRI ArcCatalog 9.3.1.3000
Data_Quality_Information:
Attribute_Accuracy:
Attribute_Accuracy_Report: These data have been generated from one or more aggregated raw data sets, interpolated and processed by a suite of HEA GIS Tools, and passed to a database tool designed to conduct HEA according to user specified parameters. Attribute accuracy is dependent upon these sources, processes and choices, but is standardized. These data have not been formally evaluated for attribute accuracy as part of the HEA GIS Tool processing. See the HEA Tool documentation, HEA GIS Tools documentation, and accompanying Query Manager documentation for additional details.
Logical_Consistency_Report: These data have been generated from one or more aggregated raw data sets, interpolated and processed by a suite of HEA GIS Tools, and passed to a database tool designed to conduct HEA according to user specified parameters. Logical consistency is dependent upon these sources, processes and choices, but is standardized. These data have not been formally evaluated for logical consistency as part of the HEA GIS Tool processing. See the HEA Tool documentation, HEA GIS Tools documentation, and accompanying Query Manager documentation for additional details.
Completeness_Report: These data have been generated from one or more aggregated raw data sets, interpolated and processed by a suite of HEA GIS Tools, and passed to a database tool designed to conduct HEA according to user specified parameters. The data are therefore as complete as these sources, processes and choices dictate. These data have not been formally evaluated for completeness as part of the HEA GIS Tool processing. See the HEA Tool documentation, HEA GIS Tools documentation, and accompanying Query Manager documentation for additional details.
Positional_Accuracy:
Horizontal_Positional_Accuracy:
Horizontal_Positional_Accuracy_Report: These data have been generated from one or more aggregated raw data sets, interpolated and processed by a suite of HEA GIS Tools, and passed to a database tool designed to conduct HEA according to user specified parameters. Horizontal spatial accuracy is dependent upon these sources, processes and choices, but is standardized. These data have not been formally evaluated for horizontal spatial accuracy as part of the HEA GIS Tool processing. See the HEA Tool documentation, HEA GIS Tools documentation, and accompanying Query Manager documentation for additional details.
Vertical_Positional_Accuracy:
Vertical_Positional_Accuracy_Report: These data have been generated from one or more aggregated raw data sets, interpolated and processed by a suite of HEA GIS Tools, and passed to a database tool designed to conduct HEA according to user specified parameters. Vertical spatial accuracy is dependent upon these sources, processes and choices, but is standardized.

```
These data have not been formally evaluated for vertical spatial accuracy as
part of the HEA GIS Tool processing.  See the HEA Tool documentation, HEA GIS
Tools documentation, and accompanying Query Manager documentation for
additional details.
  Lineage:
    Source_Information:
      Source_Citation:
        Citation_Information:
          Originator: National Oceanic and Atmospheric Administration (NOAA)
National Ocean Service (NOS) Office of Response and Restoration (ORR)
          Publication_Date: Unknown
          Publication_Time: Unknown
          Title: NOAA ORR Query Manager
      Source_Scale_Denominator: Varies
      Type_of_Source_Media: computer program
      Source_Time_Period_of_Content:
        Time_Period_Information:
          Single_Date/Time:
            Calendar_Date: unknown
            Time_of_Day: unknown
        Source_Currentness_Reference: ground condition
      Source_Citation_Abbreviation: NOAA ORR Query Manager
      Source_Contribution: Typically, these data have been exported from NOAA
ORRs Query Manager database, imported into ArcGIS via the use of standardized
import tools, further processed and interpolated by the automated HEA GIS
Tools.
    Source_Information:
      Source_Citation:
        Citation_Information:
          Originator: National Oceanic and Atmospheric Administration (NOAA)
National Ocean Service (NOS) Office of Response and Restoration (ORR)
          Publication_Date: Unknown
          Publication_Time: Unknown
          Title: NOAA HEA Tool
      Source_Scale_Denominator: Varies
      Type_of_Source_Media: computer program
      Source_Time_Period_of_Content:
        Time_Period_Information:
          Single_Date/Time:
            Calendar_Date: unknown
            Time_of_Day: unknown
        Source_Currentness_Reference: ground condition
      Source_Citation_Abbreviation: NOAA HEA Tool
      Source_Contribution: These data have been processed by a database tool
designed to conducte HEA according to user specified parameters.
Spatial_Data_Organization_Information:
  Direct_Spatial_Reference_Method: Raster
  Raster_Object_Information:
    Raster_Object_Type: Pixel
    Row_Count: 440
    Column_Count: 354
    Vertical_Count: 1
Spatial_Reference_Information:
  Horizontal_Coordinate_System_Definition:
    Planar:
```

```
      Grid_Coordinate_System:
        Grid_Coordinate_System_Name: Universal Transverse Mercator
        Universal_Transverse_Mercator:
          UTM_Zone_Number: 10
          Transverse_Mercator:
            Scale_Factor_at_Central_Meridian: 0.999600
            Longitude_of_Central_Meridian: -123.000000
            Latitude_of_Projection_Origin: 0.000000
            False_Easting: 500000.000000
            False_Northing: 0.000000
      Planar_Coordinate_Information:
        Planar_Coordinate_Encoding_Method: row and column
        Coordinate_Representation:
          Abscissa_Resolution: 30.000000
          Ordinate_Resolution: 30.000000
        Planar_Distance_Units: meters
    Geodetic_Model:
      Horizontal_Datum_Name: D_WGS_1984
      Ellipsoid_Name: WGS_1984
      Semi-major_Axis: 6378137.000000
      Denominator_of_Flattening_Ratio: 298.257224
Entity_and_Attribute_Information:
  Overview_Description:
    Entity_and_Attribute_Overview: These data describe scaled injury per
raster grid cell in units of DSAYs for a particular scenario within a given
set HEA calculations.
    Entity_and_Attribute_Detail_Citation: See the HEA GIS Tools
documentation, data set lineage, and  accompanying Query Manager
documentation for additional details.
Distribution_Information:
  Resource_Description: These data may be subject to distribution
restrictions.  See the dataset originator for additional details.
  Standard_Order_Process:
    Digital_Form:
      Digital_Transfer_Information:
        Transfer_Size: 0.000
Metadata_Reference_Information:
  Metadata_Date: 20101130
  Metadata_Contact:
    Contact_Information:
      Contact_Organization_Primary:
        Contact_Organization: National Oceanic and Atmospheric Administration
(NOAA) National Ocean Service (NOS) Office of Response and Restoration (ORR)
      Contact_Address:
        Address_Type: mailing and physical address
        Address: 1305 East-West Highway
        City: Silver Spring
        State_or_Province: Maryland
        Postal_Code: 20910
      Contact_Voice_Telephone: 301.713.4248
      Contact_Facsimile_Telephone: 301.713.4389
  Metadata_Standard_Name: FGDC Content Standards for Digital Geospatial
Metadata
  Metadata_Standard_Version: FGDC-STD-001-1998
  Metadata_Time_Convention: local time
```

```
Metadata_Extensions:
  Online_Linkage: http://www.esri.com/metadata/esriprof80.html
  Profile_Name: ESRI Metadata Profile
```