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NATIONAL CULTURAL RESOURCES INFORMATION MANAGEMENT SYSTEM (NCRIMS) WEB APPLICATION

User Manual

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This document and the technical specifications listed herein comply with all QSI and BLM technical standards and infrastructure.

1 INTRODUCTION

Cultural resources are a fragile, limited, and irreplaceable part of our Nation's heritage. The Bureau of Land Management (BLM) works continually to develop and improve methods to protect these valuable resources against impairment, destruction, and inadvertent loss, while encouraging and accommodating the uses determined appropriate through planning and public participation. One direct outcome of this has been the National Heritage Solution Pilot established to support the implementation of the Cultural Resource Management (CRM) national data standard across State Historic Preservation Offices (SHPO) to meet BLM business and reporting needs. Additionally, this has revealed the need for landscape-level analysis that utilizes weighted suitability modeling with a combination of environmental and social factors.

The National Cultural Resources Information Management System (NCRIMS) is a web-based application hosted by the BLM's National Operations Center (NOC) Enterprise Geographic Information System (EGIS) developed to inform planning, management, and investigation efforts on BLM lands. The NCRIMS application is powered by the CRM national data standard and Cultural Heritage Resource Sensitivity Model (CHRSM), a geoprocessing web tool that enables users to conduct landscape-level analyses for cultural resources on BLM-administered lands.

The BLM Washington Office Cultural Heritage Program, in conjunction with BLM states, determined there is a need to have an enterprise solution to managing cultural heritage data for project and landscape level planning within the organization. An enterprise solution provides cultural heritage data standardization and consistency across the Bureau. Large landscape-scale planning efforts and interstate undertakings have brought to the forefront the need for a comprehensive Bureau wide GIS of cultural resource locations and investigations. The need for a national level cultural resources standard and database has long been recognized to facilitate normalization of common attributes for analytical applications. The CRM national standard is assembled from SHPO and BLM state databases from eleven western states, including AK, AZ, CA, CO, ID, MT, NM, NV, OR, UT, WY. The landscape-level dataset and NCRIMS web application allows the cultural heritage program to engage in evaluations and discussions in front of planning versus at the late stages as has been traditional. Through NCRIMS, cultural heritage values can be evaluated with the “best science,” allowing engagement of constituent participation early to inform outcomes.

The purpose of this document is to provide instruction on usage of the NCRIMS web application, including general information about the controls, navigation, and functionality. Additionally, this document is intended to assist users in understanding the core components of the CHRSM and discovering how to incorporate expert knowledge with statistical analysis to interpret model results.

This manual consists of four main sections:

Section 1: The **Introduction** section briefly describes the history of the NCRIMS application.

Section 2: The **Background** section provides a high-level overview about CHRSM development.

Section 3: The **NCRIMS Web Application Quick Start Guide** section provides instruction to access, load, and interact with the NCRIMS application interface.

Section 4: The **Conduct a Resource Suitability Assessment** section documents the CHRSM tool itself, outlining the steps involved in an assessment as well as a description of the parameterized model inputs, data components, and modeled output.

A glossary of terms is contained in Error! Reference source not found. Error! Reference source not found. and fr equently asked questions can be found in **0 Appendix B: Frequently Asked** Questions (FAQs).

2 BACKGROUND

The National Cultural Resources Information Management System (NCRIMS) web-based application was designed to enable BLM users to conduct landscape-level suitability analyses for planning purposes using the Cultural Heritage Resource Sensitivity Model (CHRSM). The CHRSM utilizes predictive modeling to incorporate expert knowledge and environmental or evidentiary data for identifying areas of cultural resources in order to inform management decisions that support protection.

The CHRSM accepts a series of parameterized user-defined inputs used with BLM-hosted environmental and cultural datasets to provide consistent and reproducible spatially-explicit analyses of landscape characteristics as they relate to cultural heritage resources. The underlying model is an implementation of the Owyhee Land Exchange Cultural Resource Model, version 3 (OLE-3)[1], initially designed by Gnomon, Inc. in 2014, revised in 2017. The OLE-3 generates a sensitivity model that characterizes areas as either high, moderate, or low archaeological sensitivity based on a series of environmental and cultural input data layers. The general methodology derives from documented archaeological data that suggests prehistoric peoples used the landscape in predictable, non-random ways based on their knowledge of the geographic distribution of resources. This exploratory framework was used to investigate associations between various environmental variables with known cultural site locations to enable BLM users to (a) understand how prehistoric peoples used landscape features and resources through time, and (b) focus limited resources on areas that have the highest likelihood to yield significant resources.

The OLE-3 GIS sensitivity analysis on the predicted values and standard errors associated with modeled criteria provides the basis of the CHRSM modeling methodology. In the CHRSM, the default or moderate classification value ranges, or breakpoints, were initially derived from the OLE-3, refined through consultation with BLM experts, and then used to extrapolate low and high breakpoints for the slope and distance to water components. Advanced users that want to customize the CHRSM can reference the Advanced Analytics Component or the OLE-3 report for more technical discussion on adapting the CHRSM methodology, development criteria, decision trees, and observed statistical analytics.

[1] Ingbar, Eric E. and Teresa D. Wriston. 2017. Owyhee Land Exchange Cultural Resource Model Version 3. Submitted to the Bureau of Land Management, Idaho State Office. BLM Report/Contract Number: L15PD00996 Gnomon, Inc. Project Number: 2015-10. 61 pp.

3 NCRIMS WEB APPLICATION QUICK START GUIDE

This section contains instructions for accessing and using the National Cultural Resources Information Management System (NCRIMS) including launching the Cultural Heritage Resource Sensitivity Model (CHRSM) geoprocessing service.

3.1 NCRIMS Web Application Overview

To access the NCRIMS web application, you must be connected to the BLM intranet. In your browser window, navigate to the application web page, located at:

https://webmaps.blm.doi.net/program_apps/BLM_Natl_CRM/

When the application loads, you will see a large map with clickable icons around the perimeter of the map (**Figure 3-1**). These icons are associated with functional components or helper "widgets"[2] that:

(1) assist with map navigation,
(2) provide contextual information about the map contents (e.g., layer symbology, basemap setting), and
(3) perform geoprocessing tasks.

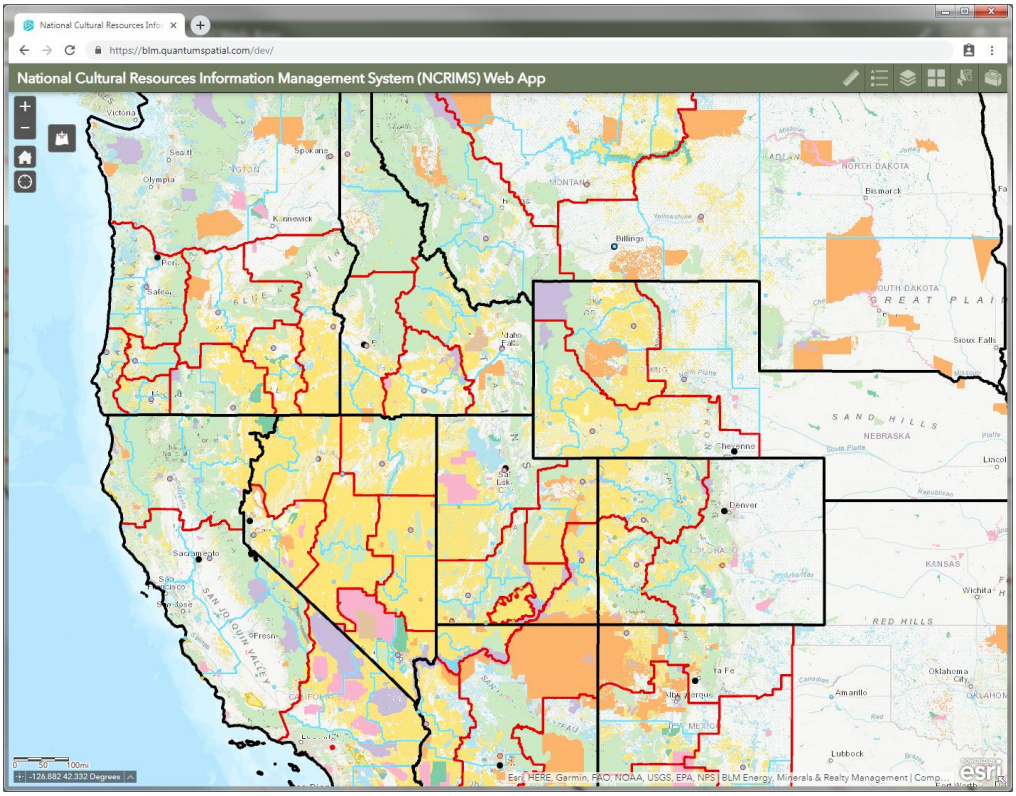


Figure 3-1: *NCRIMS Web Application*

3.2 Map Navigation

Map Navigation components enable users to interact with the map, such as panning & zooming, resetting to home view, or viewing bookmarked extents.

ICON	DESCRIPTION
	The **Zoom Slider** widget provides interactive zoom controls in the map display. Click the zoom slider button to zoom in (+) or out (-) on the map. Alternatively, press and hold the **Shift** key and then use the mouse to draw a box in the map to zoom into the selected area. To zoom out using a box, press and hold the **Shift** + **Ctrl** keys and then draw a box.
	The **Home Button** widget zooms the map to the initial map extent. The **Home Button** widget is automatically enabled when the app starts. Clicking the widget resets the map extent to the map's initial extent.
	The **My Location** widget allows the network to detect your physical location and zoom the map to it. The location can be highlighted if necessary. When the application starts, the **My Location** widget is automatically enabled to access your physical location. Clicking **Find my location** zooms the map to your current location. The widget takes advantage of HTML geolocation. Compared to the native apps, the accuracy of the location in the browser-based app varies based on the type of browser and device. This is a known limitation.
	The **Scalebar** widget displays a scale bar on the map. When the app starts, the **Scalebar** widget is automatically enabled and displayed at the lower left corner of the app. It is updated dynamically when the map's scale changes. The widget respects various coordinate systems and displays units in English or metric values. When working with Web Mercator or geographic coordinate systems, the scale bar accounts for projection distortion and dynamically adjusts.
	The **Coordinate** widget displays x- and y-coordinate values on the map. When the app starts, it displays coordinates in the default coordinate system of the web map. The displayed coordinate values change dynamically when the mouse pointer moves to locations on the map. Click the **Enable clicking the map to get coordinates** button  and then add a point to the map, highlight the coordinates, and make a copy of the coordinates. Click the arrow on the widget to display a list of spatial references specified in the configuration, then choose one from the list. For most spatial references (except WKID 3857 and 4326) click the **Enable clicking the map to get coordinates** button again. 
N/A	The **Overview Map** widget, located in the bottom right corner, displays the current extent of the map within the context of a larger area and updates whenever the map extent changes. The current extent of the map is represented in the overview map as a gray rectangle that can be dragged to modify the extent of the current view. Click the expansion arrow  to expand or fold the widget. When expanded, click the maximize icon  to temporarily maximize or minimize the overview map. 

3.3 Map Information

The following table describes functional components (or "widgets") in the web map that provide contextual or visual information. Once the application loads, click on the associated icon to open a widget. Click the button to collapse the component window or click the in the upper right corner of the window to close it.

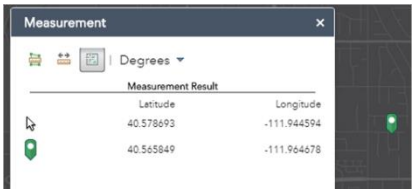
ICON	DESCRIPTION
	The **Legend** widget displays labels and symbols for layers in the map. Click the widget to display the **Legend** window. When no operational layers are rendered in the map, the **Legend** widget is blank.
	The **Layer List** widget provides a list of operational layers and their symbols, and allows you to turn individual layers on and off. Each layer in the list has a check box that allows you to control its visibility. Some layers contain sublayers or subtypes. ***Note:*** *Layers with visible ranges set will be unavailable (grayed out) when zoomed beyond the defined range.* Click the **Layer List** widget in your app to display the layer list or table of contents window. Click on an individual layer to show its symbols. (1) Click on the **Layer menu** button ▪▪▪ to display the layer menu with the following options: ➢ **Zoom To**—Sets the map extent to the extent of the layer. ➢ **Transparency**—Sets the transparency for the layer. ➢ **Enable Pop-up/Disable Pop-up**—Enables or disables the pop-up for the feature layer. If a feature layer does not have a pop-up configured in the map, clicking Enable Pop-up shows all field values for the feature layer. ➢ **Move up**—Moves the layer one level up. ➢ **Move down**—Moves the layer one level down. ➢ **View in Attribute Table**—Opens the attribute table for the feature layer. ➢ **Description/Show Item Details**—Opens the service description or the item details page for the service or the item associated with the layer if available. (2) Click the **Layer Control** button to turn the layers in the list on or off, and expand or collapse the layers. Alternatively, you can use keyboard shortcuts to do the same: ➢ Press Ctrl and check the layer check box to turn the layers on or off in the same level ➢ Press Ctrl and click the arrow to expand or collapse layers in the same level. (3) Click the search button to find layers.
	The **Basemap Gallery** widget enables you to select the visible basemap from a gallery of basemaps available to your organization. Click the **Basemap Gallery** widget to displays all available basemaps and then click a basemap thumbnail to set it as the active basemap.

ICON	DESCRIPTION

The **Measurement** widget allows you to measure the area of a polygon or length of a line, or to find the coordinates of a point. Click the **Measurement** widget icon to open it.

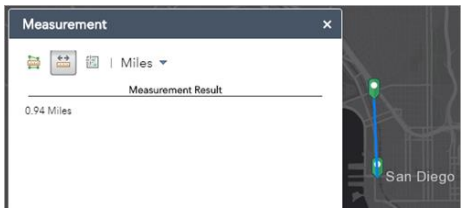
(1) Point Measurements: Click the **Point measurement** button  and click a point on the map.

- The **Measurement** widget displays the coordinates for the point in degrees (decimal). To change the coordinate display format to degrees/minutes/seconds, change the selection in the **Degrees** drop-down menu to DMS.



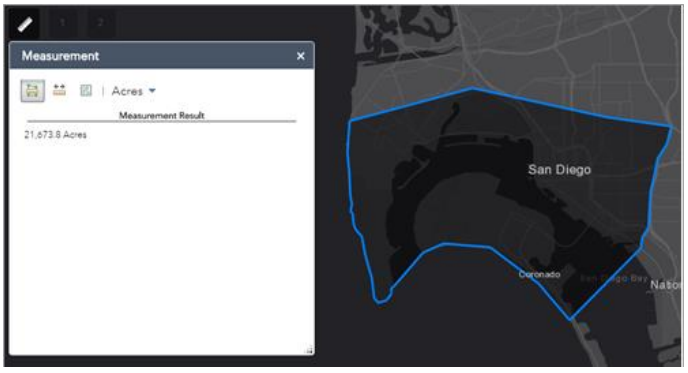
(2) Polyline Measurements

- Click the **Polyline measurement** button  and draw a polyline on the map by clicking two or more points.
- The **Measurement** widget displays the total length of the polyline using the default unit of length. To change the length unit, select the applicable unit of measure from the **Miles** drop-down menu.



(3) Polygon Measurements

- Click the Polygon measurement button  and draw a polygon on the map by clicking three or more points.
- The **Measurement** widget displays the total area of the polygon using the default unit of area. To change the area unit, select the applicable unit of measure from the **Acres** drop-down menu.



The **Add Data** widget enables users to upload shapefile data stored locally and add temporarily as layers in the map (layers added in this way cannot be saved to the map). A shapefile is a vector data storage format for storing the location, shape, and attributes of geographic features. It is stored as a set of related files and contains one feature class. Shapefiles compressed in ZIP format are supported.

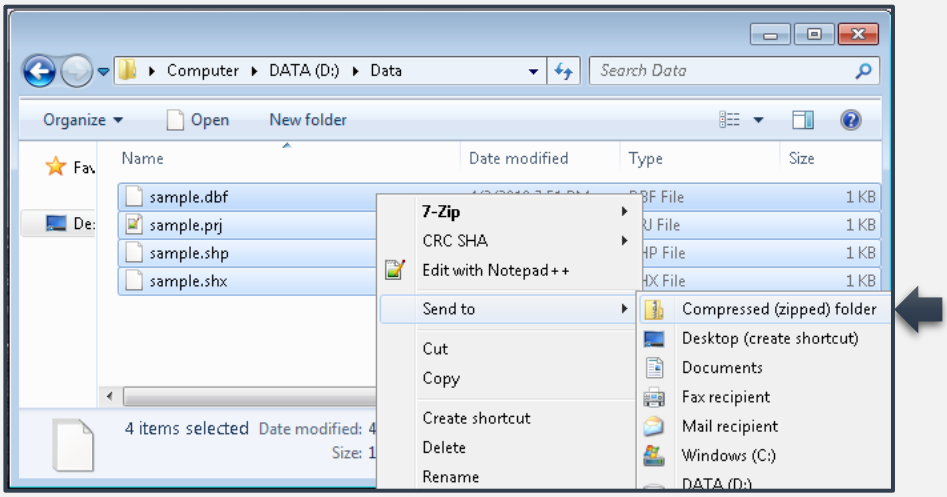
(1) Click to expand the **Add Data** widget. Click **Help** for guidance about adding data.

(2) Before uploading shapefile data:

a. Check that geometries are valid because otherwise they cannot be drawn in the map. Use the Esri Repair Geometry geoprocessing tool to correct invalid geometries.

b. Check the spatial reference. Uploaded shapefiles must use World Geodetic System (WGS 84) as the reference coordinate system.

c. To upload shapefile data, it must be first compressed into a *.zip archive (other compression methods are not supported). On Windows, press and hold **Ctrl** + click to select all associated files, then click **Send to** >> **Compressed (zipped) folder**:



Caution:
*The shapefile must be compressed directly in the root (central) directory of the ZIP archive, not in the nested subdirectories, and must contain at least the *.shp, *.dbf, *.shx, and *.prj components.*

See the related Esri online help topic for more information including considerations and limitations[3].

(3) In the **Add Data** window, drag and drop or browse to the ZIP file and click **Add**. Click **Layers** in the lower right corner to view added layer or click **Back** to return to main pane. The added layer will appear in the **Layer List** as well. Click **Details** to get information about the layer.

(4) To use the added data as input to the CHRSM cultural resource suitability assessment, see section 4.2.1.2.

(5) To remove added layers, click to expand the **Layers** panel in the **Add Data** widget and click the **Remove Layer** button next to the layer to remove it from both the **Layer List** and the map.

The **Select** widget enables users to interactively select CRM Investigation or Resources features on the map and then export the selected features to CSV or JSON format files.

(1) Click the Select widget icon to open it. Choose the layer or layers you want by checking the box. If the layer is not visible:


Layer is turned off in the LayerList: turn layer on in **LayerList** to enable selection.

Layer is out of range: zoom in until within the visible range extent for the layer.

(2) Click the **Layer Control** button  to make all CRM layers selectable or de-selectable, or to toggle whether a layer is able to be selected.

(3) Click **Select** button  to activate selection pointer  and draw on the map to select features:

- Drag the pointer on the map to create a new selection.
- Press Shift while dragging the pointer on the map to add features to the selection.
- Press Ctrl while dragging the pointer on the map to remove features from selection.

The number of selected features is displayed next to the layer name. Click **Clear**  to reset the selection feature set.

(4) Click on a layer name in the main panel to display a list of individual selected features within the overall selected feature set for a layer and then click on an item in the list to view the corresponding summary pop-up. Click the **Back** button  to return to the main panel.

(5) Click the ellipsis (•••) to open the **Selection Actions** drop-down menu. Some actions below may not be available depending on whether user (a) is actively viewing a single feature or a set of features, and (b) has sufficient permissions required to perform action.

- **Zoom or Pan to**—Zooms or pans the map to the selection.
- **Statistics**—Summarizes the total number of items, sum, minimum, maximum, mean, and standard deviation in a chosen field (numeric type only) for selected feature set.
- **Export to CSV file**—Export selection attribute table to a "features.csv" file[4]. CSV files store information in plain text with first row defining the field names.
- **Export to Feature Collection**—Export selection to a "features.json" file. A feature collection is a type of feature layer that retains the subset data with the item and not stored as part of the map.
- **Export to GeoJSON**—Export selection to a "features.geojson" file[5]. GeoJSON is an open standard geospatial data interchange format that represents simple geographic features and their nonspatial attributes.
- **Save to My Content**—Save selected feature(s) as **Feature Collection** items to **My Content** in the contents page in ArcGIS Online or ArcGIS Enterprise. Requires sufficient permissions to create and modify data on the organizational account.
- **Show Pop-up**—View pop-up for a single feature.
- **Add a Marker**—Add a marker for a single feature.
- **Create Layer**—Create a temporary layer from selected feature(s).

> ***Caution:***
> *Do not use the Set as Input of Sensitivity Model to set the Search area of interest parameter in the Geoprocessing widget to the selection.*

3.4 Geoprocessing Component

The geoprocessing component enables users to conduct a CHRSM cultural resource suitability assessment. Click the ^ to collapse the window or click the ⊗ in the upper right corner of the component window to close it.

ICON	DESCRIPTION
	The **Geoprocessing** widget provides a dynamic user interface to execute the CHRSM geoprocessing task. Click the widget icon to open the **Geoprocessing** widget and enter values for all required input parameters (annotated by an asterisk next to the name). The **Input** tab containing **Input** and **Output** parameters with default values set will automatically be selected. Enter a value for each of the input parameters. Some parameters have been pre-configured with default values. If applicable, users can do nothing to accept the default value or select a different option. Once all required input parameters (annotated by an asterisk next to the name) have values, click **Execute** to submit the task. The **Output** tab is selected and displays a progress indicator until execution completes. Upon completion, the geoprocessing results display on the map. Click **Output** to view their attributes. Click **Clear**  on the **Input** tab to clear the location or click the ⊗ on the **Output** tab to clear the geoprocessing results.

[2] https://doc.arcgis.com/en/web-appbuilder/create-apps/widget-overview.htm
[3] https://enterprise.arcgis.com/en/portal/latest/use/shapefiles.htm
[4] https://enterprise.arcgis.com/en/portal/latest/use/csv-gpx.htm
[5] https://enterprise.arcgis.com/en/portal/latest/use/geojson.htm

4 CONDUCT A RESOURCE SUITABILITY ASSESSMENT

4.1 Getting Started

This section contains detailed information about how to conduct a cultural resource suitability assessment using the Cultural Heritage Resource Sensitivity Model (CHRSM). Instruction includes launching the CHRSM, parameter summaries, and information about the geoprocessing service.

4.2 Launching the CHRSM Interface

Click on the toolbox icon in the application toolbar to open the CHRSM interface. The geoprocessing tool interface will open in a new window with the "Input" tab automatically selected (**Figure 4-1**).

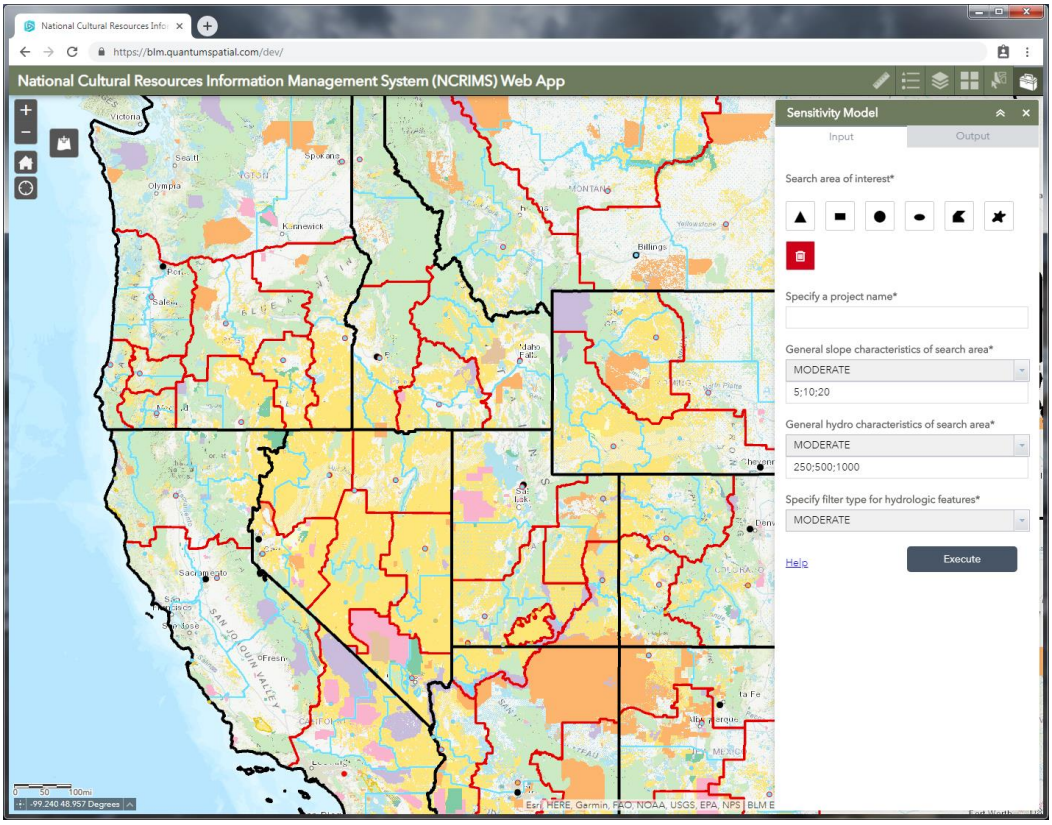
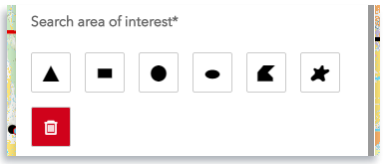


Figure 4-1: *CHRSM User Interface within the NCRIMS Application*

> **Note:**
> *User must Zoom to 1:6 miles to display cultural and hydrologic data.*

4.2.1 Setting Input Parameter Options

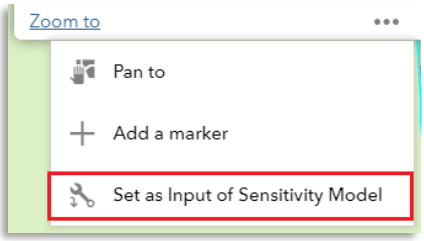
4.2.1.1 Search Area of Interest



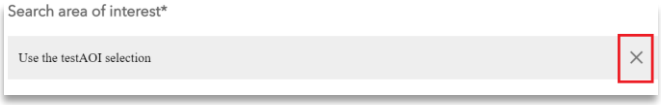
The **Search Area of Interest** (AOI) drawn by the user defines the CHRSM processing extent. Alternatively, the user has the option to use his or her uploaded shapefile as the AOI (section 4.2.1.2). To draw the analysis boundary, click to select a shape for the polygon. To clear a shape once drawn, click the red "clear" button (garbage icon). Users will need to "clear" any existing AOI polygons by clicking the red "clear" button before re-running the CHRSM analysis on a new search area.

> ***Tip:***
> *Large-scale processing capabilities and processing times are contingent on raster storage requirements and therefore constrained by system and network limitations.*
>
> *Currently the AOI area must be between 10 and 500,000 acres due to runtime constraints. App processing time is limited to 20 minutes. Reduce AOI if runtime failure occurs in areas with complex Resources and Investigations.*

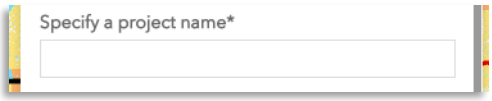
4.2.1.2 Uploaded Area of Interest



The uploaded area of interest (AOI) is the file uploaded by the user via the **Add Data** widget. Information on this widget may be found in section 3.3. To use the uploaded AOI, click the AOI in the map frame. In the AOI's popup, click the ••• icon. Last, select **Set as Input of Sensitivity Model.** To clear the uploaded area of interest from the **Search Area of Interest** parameter, click the "X" located to the right inside the parameter bar.

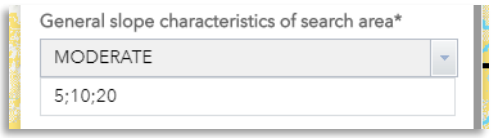


4.2.1.3 Project Name



The **Project Name** is the simple text string used as the report title and to derive names of CHRSM outputs.

4.2.1.4 Slope Characteristics

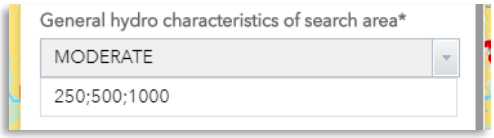


Select the characteristic that most accurately describes the slope, or change in topography, of the project area. Valid inputs include:

- **FLAT** – characterized as flatter landscape with fewer sloped areas
- **MODERATE** – characterized as moderately sloped landscape with average number of sloped areas
- **STEEP** – characterized as steeper landscape with more sloped areas
- **USER-DEFINED** – custom classification thresholds set by user

This parameter determines the influence of the slope component on the model through sensitivity weighting thresholds. If uncertain, select "MODERATE", the default option. See **Figure 4-4** in **Subsection 4.2.3** for information about how thresholds are assigned.

4.2.1.5 Hydro Characterisics

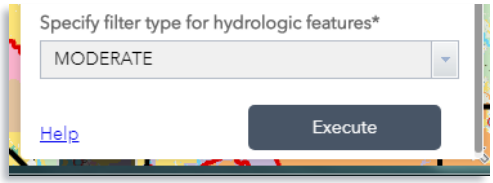


Select the characteristic that most accurately describes the hydrography in the project area. Valid inputs include:

- **WET** – characterized as wetter landscape with more water features
- **MODERATE** – characterized as moderately wet landscape with average number of water features
- **DRY** – characterized as drier landscape with fewer water features
- **USER-DEFINED** – custom classification thresholds set by user

This parameter determines the influence of the distance-to-water component on the model through suitability weighting thresholds. If uncertain, select "MODERATE", the default option. See **Figure 4-6** in **Subsection 4.2.3** for information about how thresholds are assigned.

4.2.1.6 Hydrologic Filtering



Select the degree of selective filtering to be applied to USGS National Hydrography Dataset (NHD) data. Valid inputs include:

- **EXCLUSIVE** – A more conservative set of selection criteria for wetter areas. Generally, this category does not include intermittent or ephemeral data.
- **MODERATE** – A set of selection criteria for an environment that is neither considerably wet nor considerably dry.
- **INCLUSIVE** - A more liberal set of selection criteria for drier areas that includes intermittent and ephemeral data.
- **USER-DEFINED** – custom filtering criteria specified by user

This parameter informs the distance-to-water component of the model by refining the input NHD data used for the distance calculation. If uncertain, select "MODERATE", the default option. See **Table 1** in **Subsection 4.2.3** for information about how filtering criteria is assigned.

4.2.3 Source Data and Suitability Criteria

At its core, the CHRSM analyzes a series of BLM-hosted environmental data layers to predict the cultural resource suitability across a defined analysis area or extent (summarized in **Figure 4-2**). BLM-hosted datasets (#1) are subset by the user-defined analysis area (#2). The Euclidean distance is calculated for individual filtered hydrologic features (#3) and then merged to create a single raster. The Distance to Water (#4) and Slope (#5) submodels are conditionally evaluated, weighted, and finally combined to create the "raw" model (#6). Finally, the model is re-classified to produce a suitability model that predicts the high, moderate, or low cultural site probability (#7).

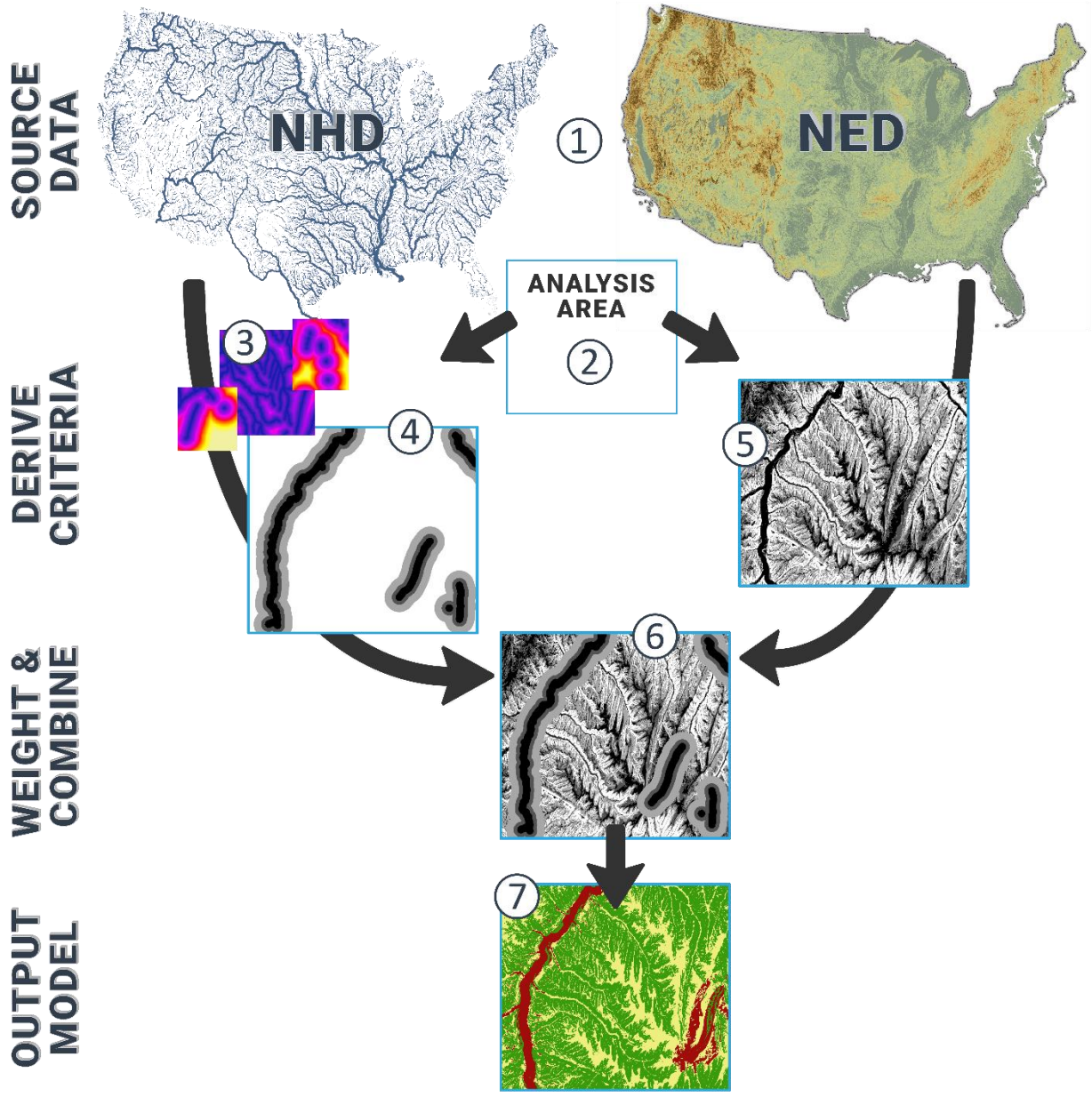


Figure 4-2: *CHRSM Methodology Overview*

4.2.3.1 Slope

The shape and relief of the landscape provide essential environmental context to the model including substrate composition, precipitation patterns, vegetation cover, and whether the landscape is indicative of a depositional (gradual) or erosive (steep) environment. Since people tend to live on gradual slopes rather than steep ones, significant archaeological sites are more likely to be located on gradual slopes[6].

Slope measures the steepness or degree of inclination of the landscape, calculated as the rate of change in elevation over the analysis area. The CHRSM slope layer was derived for internal usage from the BLM's USGS NED2013 Elevation Image Service[7]. Users can select the most appropriate categorical slope characteristic for the project area, and the associated breakpoints (**Figure 4-4**) are used to weight the slope submodel (**Figure 4-3**).

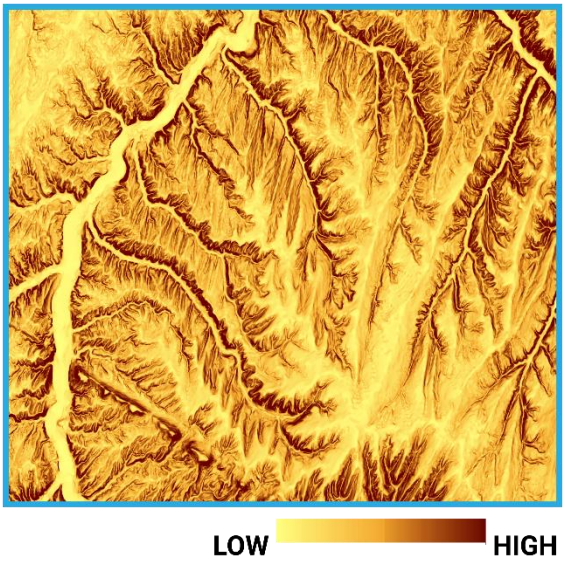


Figure 4-3: *Slope Raster in Sample Analysis Area*

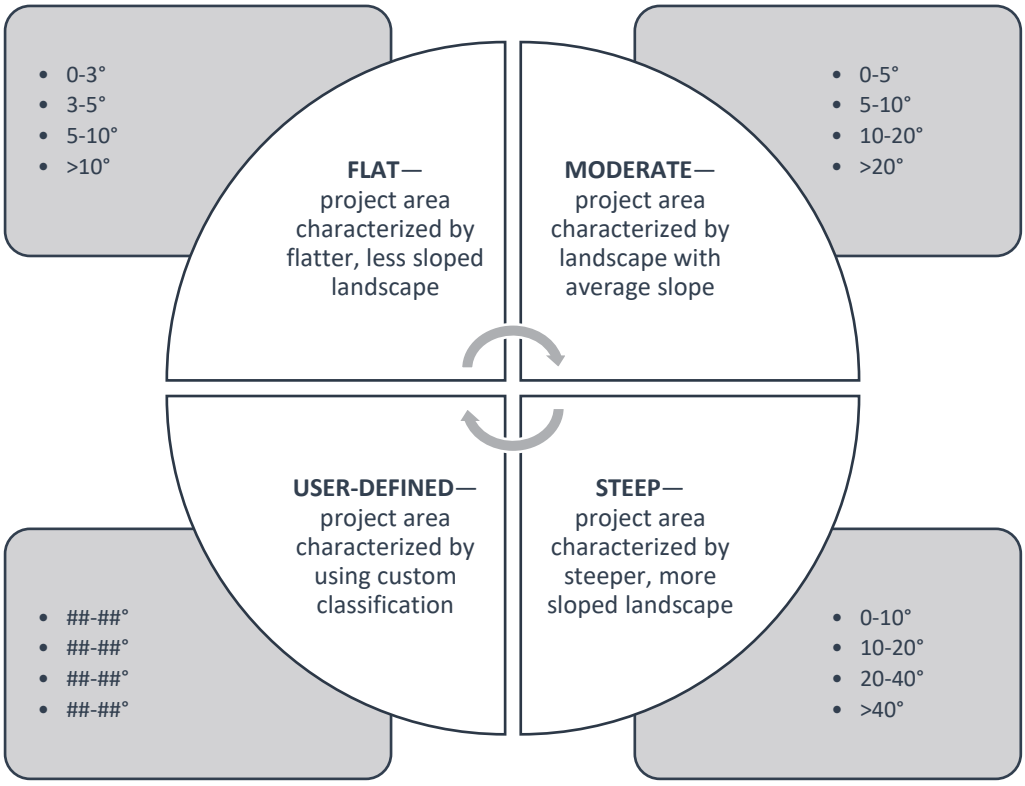


Figure 4-4: *Slope Classification Options*

4.2.3.2 Hydrography & Distance to Water

The hydrology of the landscape also provides key information to the model. People tend to live closer to water but not in poorly drained, wet areas. Hydrographic data used to derive all hydrographic inputs for the model was obtained from the BLM's internally hosted USGS National Hydrography Dataset (NHD).

The CHRSM prioritizes proximity in predicting site locations. Parameterized filtering criteria is used to select the types of features that will be used to generate the distance to water submodel. These features can be generally categorized as (a) perennial, or permanent features that maintain continuous flow throughout the year, (b) intermittent, or seasonal features that maintain periodic flow during times of the year, or (c) ephemeral, or precipitation-dependent features that flow only after rainfall.

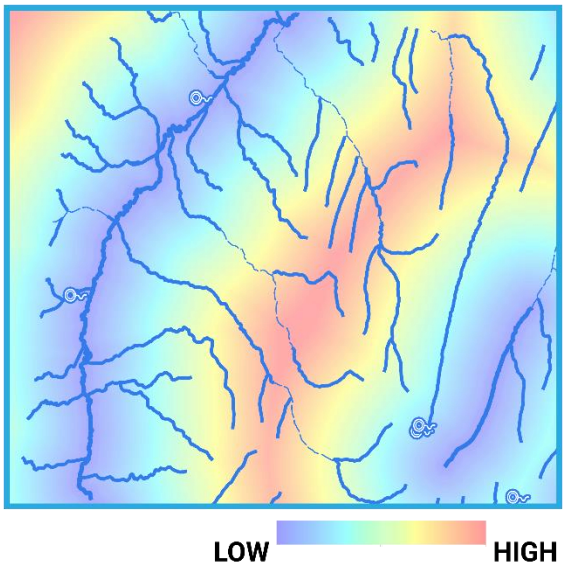


Figure 4-5: *Hydrography Features & Distance to Water Raster in Sample Analysis Area*

Users can choose most appropriate filtering criteria based on the expert knowledge of the project area:

- **EXCLUSIVE**—more conservative set of filtering criteria (for wetter areas) that does not include intermittent or ephemeral data.
- **MODERATE**—filtering criteria for an environment that is neither considerably wet nor considerably dry
- **INCLUSIVE**—more liberal set of filtering criteria (for drier areas) that includes intermittent and ephemeral data.

Alternatively, users can choose **USER-DEFINED** to set filtering criteria to a customized selection of perennial, intermittent, and/or ephemeral feature types. All possible hydrologic feature types are listed by source dataset in **Table 1**. Selectively filtered NHD features are buffered by the maximum distance of the user-defined hydrography characteristic breakpoints (**Figure 4-6**) used to weight the distance to water submodel. The Euclidean distance, or straight-line distance, is calculated from the buffered features using Esri's Spatial Analyst extension, and the resulting distance rasters are mosaicked to create a single distance to water submodel.

Table 1: *Hydrologic Filtering Criteria*

DATASET	FEATURE TYPE	FEATURE CODE
NHDPoint	Spring/Seep	45800†‡§
NHDFlowline	Stream/River	46003†
NHDFlowline	Stream/River: Hydrographic Category = Ephemeral	46000†‡§
NHDFlowline	Stream/River: Hydrographic Category = Intermittent	46007†
NHDFlowline	Stream/River: Hydrographic Category = Perennial	46006†‡§
NHDWaterbody	Estuary	46003†
NHDArea	Inundation Area	40300†‡§
NHDArea	Inundation Area; Inundation Control Status = Not Controlled	46007†
NHDArea	Stream/River: Hydrographic Category = Ephemeral	40307†‡§
NHDArea	Stream/River: Hydrographic Category = Intermittent	46006†‡§
NHDArea	Stream/River: Hydrographic Category = Perennial	46601†
NHDWaterbody	Lake/Pond: Hydrographic Category = Intermittent	46600†‡§
NHDWaterbody	Lake/Pond: Hydrographic Category = Intermittent; Stage = Date of Photography	46602†‡§
NHDWaterbody	Lake/Pond: Hydrographic Category = Intermittent; Stage = High Water Elevation	36100†‡
NHDWaterbody	Lake/Pond: Hydrographic Category = Perennial	49300†‡§
NHDWaterbody	Lake/Pond: Hydrographic Category = Perennial; Stage = Average Water Elevation	39005†
NHDWaterbody	Lake/Pond: Hydrographic Category = Perennial; Stage = Date of Photography	39004†‡§
NHDWaterbody	Lake/Pond: Hydrographic Category = Perennial; Stage = Normal Pool	39006†
NHDWaterbody	Lake/Pond: Hydrographic Category = Perennial; Stage = Spillway	39001†
NHDWaterbody	Playa	39010†‡§
NHDWaterbody	Swamp/Marsh	39011†‡§
NHDWaterbody	Swamp/Marsh: Hydrographic Category: Intermittent	39012†‡§
NHDWaterbody	Swamp/Marsh: Hydrographic Category: Perennial	39009†‡§

† Indicates feature present in INCLUSIVE filtering criteria
‡ Indicates feature present in MODERATE filtering criteria
§ Indicates feature present in EXCLUSIVE filtering criteria

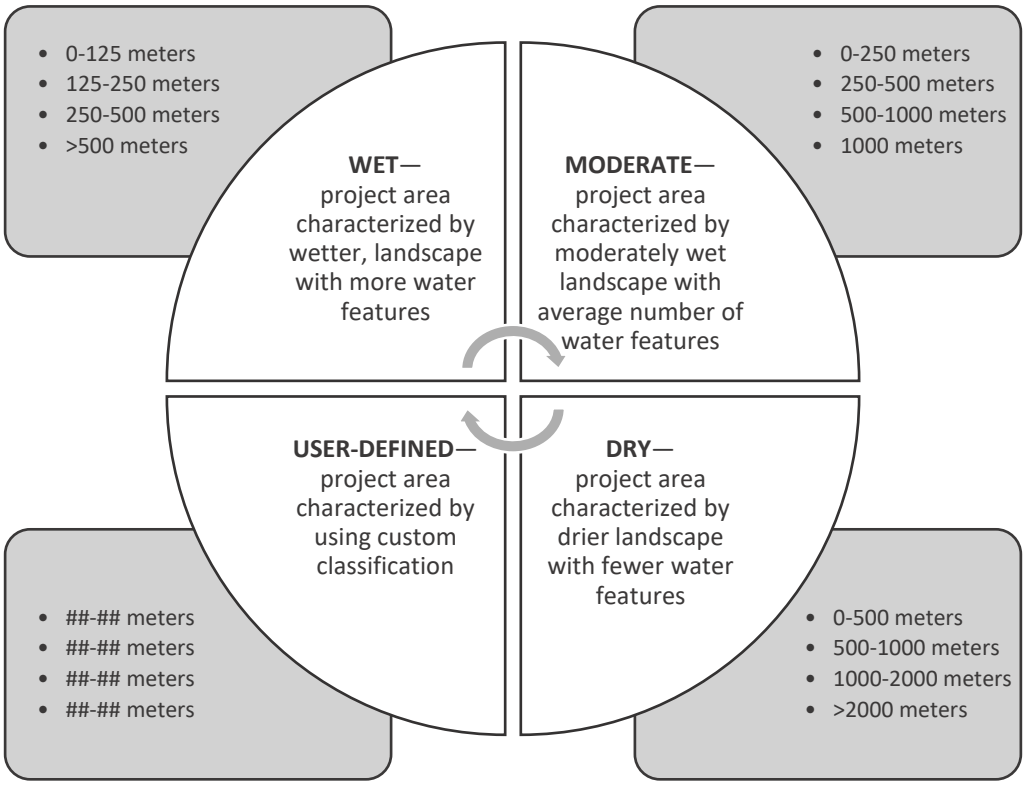
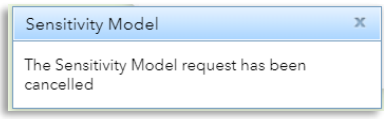


Figure 4-6: *Distance to Water Classification Options*

4.3 Run the CHRSM

Once the parameters have been set, run the tool by clicking the **Execute** button on the geoprocessing pane. When launched, the window will automatically switch to the "Output" tab, runtime messages about progress and results will be visible, and the circular "running application" indicator will show until the tool has completed.

If the CHRSM job needs to be canceled for any reason, click the **Cancel Job** button in the “Input” tab or the “Output” tab. The following message will appear in the map window.



4.3.1 Logging Utility

During execution of the Tool, messages relayed back to the geoprocessor are logged in the interface window and saved in a text file that can be retrieved upon completion. These messages include informative messages such as when the operation started, what parameter values are being used, and general information about the operation's progress, warnings of potential problems during execution, or errors indicating a critical event has prevented execution. The log file records geoprocessing messages generated during the analysis including a parameters section that records the input parameter values set by the user in the interface. The log file can be helpful in diagnosing problems encountered when using the CHRSM.

Any type of text editor or word processing application that supports text formatting—Notepad++, Microsoft Word, WordPad, LibreOffice, OpenOffice, and so on—can be used to view tool-generated log files (*.log). Additionally, some web browsers can also display log files by dragging and dropping the file to open a new tab.

By default, Windows typically uses the built-in "Notepad" program to open a text file. However, on some Windows platforms, Notepad does not correctly display the formatted log file, thereby severely impacting readability. Additionally, the log file may not open if no default program has been specified for opening log files. To remedy this issue, right-click on the file and select the "Open With" command to pick an alternate text editor program to use. If this is not an option, a quick fix is to open the log file in Notepad, select the text, and copy to a different text editor. Then copy the formatted text from the alternate text editor and paste into the original Notepad log file.

4.4 Review Results

When the analysis is complete, the user-drawn analysis boundary polygon layer and output suitability model raster layer will be drawn in the map and downloadable CHRSM products will be visible in the Output tab (**Figure 4-7**).

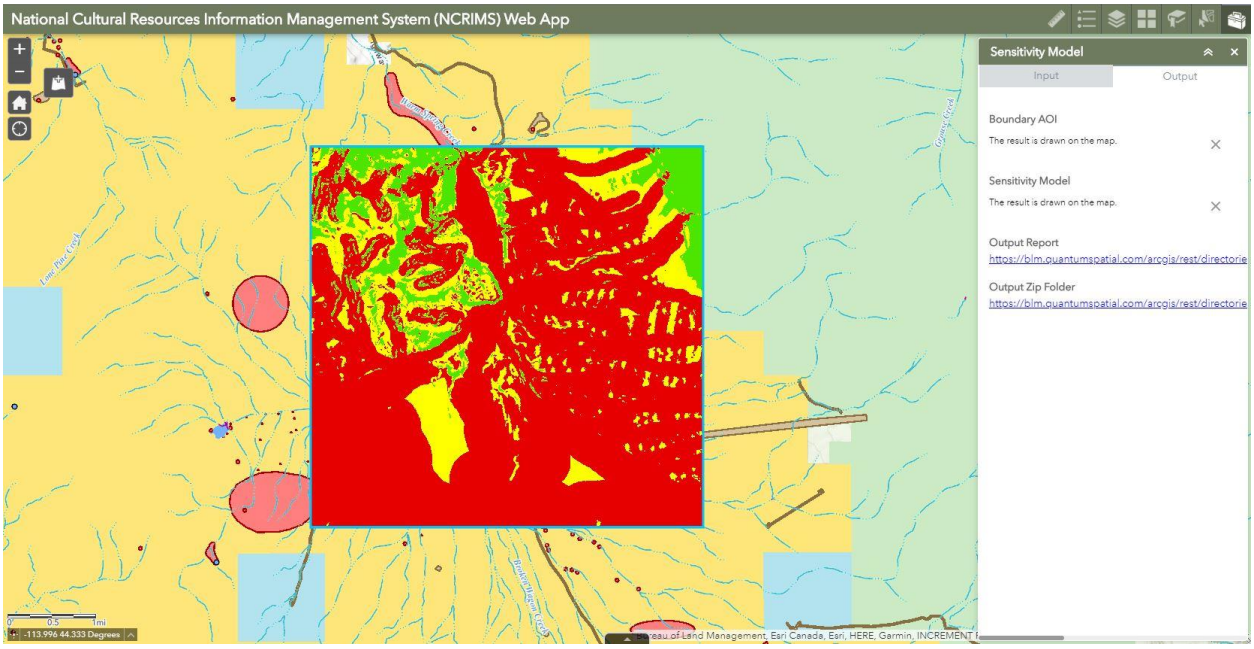
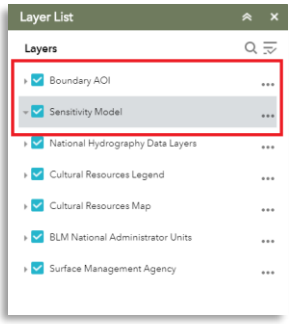


Figure 4-7: *CHRSM Analysis Results in Map*

Outputs include:

(1) analysis boundary polygon map layer
(2) modeled cultural resource suitability raster map layer
(3) summary report file
(4) output zip file archive of intermediate and final data

4.4.1 Map Layers



The area of interest used during analysis and the final raster suitability model are automatically loaded to the application as temporary map layers (**Figure 4-7)**. These temporary result layers are visible at the top of the Layer List. The "collapsed" model classifies the project area into high, moderate, and low probability zones that indicate suitability for presence of cultural resources (symbolized in red, yellow, and green on the map, respectively).

4.4.2 Summary Report

The summary report (*.html) provides information about the project area, including existing surveyed investigations (**Figure 4-8**) or sited cultural resources (**Figure 4-9** and **Figure 4-10**) within the analysis area, suitability modeling criteria and weighting information, and modeled outputs (**Figure 4-11**).

Sample Summary Report

May 24 2019

Area of Interest Summary

Search Area Size (AOI):
12,218.74 acres

Investigation (Survey) Summary for Sample AOI

Note: All surveyed investigation areas have been buffered by 15 meters for acreage and model summaries.

Investigation Class Overall Summary

Investigation Class	Count	Area (acres)	% of Surveyed Area (acres)
Class III Inventory	10	326	3%

Investigation Class by High/Low Sensitivity

Investigation Class	High Sensitivity	Moderate Sensitivity	Low Sensitivity
Class III Inventory	243 acres (75% of surveyed area in AOI)	49 acres (15% of surveyed area in AOI)	33 acres (10% of surveyed area in AOI)

Investigation Date - Years:
N/A

Figure 4-8: *Sample Report - CRM Investigations Summary*

Resource (Site) Summary for Sample AOI

Note: All resource site areas have been buffered by 15 meters for acreage and model summaries.

Resource Temporal Cultural Assignment Overall Summary

Temporal Class	Count	Area (acres)	% of Surveyed Area (acres)
Multicomponent	4	34	<1%
Prehistoric	35	752	6%

Resource Temporal Cultural Assignment by High/Low Sensitivity

Temporal Class	High Sensitivity	Moderate Sensitivity	Low Sensitivity
Multicomponent	33 acres (97% of sited area in AOI)	0 acres (0% of sited area in AOI)	1 acres (3% of sited area in AOI)
Prehistoric	602 acres (80% of sited area in AOI)	88 acres (12% of sited area in AOI)	62 acres (8% of sited area in AOI)

Resource Primary Property Class Overall Summary

Property Class	Count	Area (acres)	% of Surveyed Area (acres)
Site	39	786	6%

Resource Primary Property Class by High/Low Sensitivity

Property Class	High Sensitivity	Moderate Sensitivity	Low Sensitivity
Site	635 acres (81% of sited area in AOI)	87 acres (11% of sited area in AOI)	63 acres (8% of sited area in AOI)

Figure 4-9: *Sample Report - CRM Resources Summary*

Resource Primary Category Name Overall Summary

Category Name	Count	Area (acres)	% of Surveyed Area (acres)
Residential	10	376	3%
Task Specific	22	408	3%
Unknown	7	2	<1%

Resource Primary Category Name by High/Low Sensitivity

Category Name	High Sensitivity	Moderate Sensitivity	Low Sensitivity
Residential	249 acres (66% of sited area in AOI)	77 acres (20% of sited area in AOI)	51 acres (14% of sited area in AOI)
Task Specific	381 acres (93% of sited area in AOI)	14 acres (3% of sited area in AOI)	13 acres (3% of sited area in AOI)
Unknown	1 acres (81% of sited area in AOI)	0 acres (0% of sited area in AOI)	<1 acre (19% of sited area in AOI)

Resource NRHP Eligibility Status Overall Summary

NRHP Eligibility	Count	Area (acres)	% of Surveyed Area (acres)
No	3	<1	<1%
Undetermined	34	785	6%
Yes	2	<1	<1%

Resource NRHP Eligibility Status by High/Low Sensitivity

NRHP Eligibility	High Sensitivity	Moderate Sensitivity	Low Sensitivity
No	<1 acre (100% of sited area in AOI)	0 acres (0% of sited area in AOI)	0 acres (0% of sited area in AOI)
Undetermined	634 acres (81% of sited area in AOI)	88 acres (11% of sited area in AOI)	63 acres (8% of sited area in AOI)
Yes	<1 acre (100% of sited area in AOI)	0 acres (0% of sited area in AOI)	0 acres (0% of sited area in AOI)

Resource Date - Years:

N/A

Figure 4-10: *Sample Report - CRM Resources Summary (continued)*

Model Summary for Sample AOI

Model Parameters

Model Parameter	Thresholds
Moderate Slope Characteristic:	• 0-5 • 5-10 • 10-20 • greater than 20
	Mean Slope in AOI: 8 degrees (Range: 0 - 73 degrees)
Wet Hydro Characteristic:	• 0-125 • 125-250 • 250-500 • greater than 500
	Mean Distance to Water in AOI: 254 meters (Range: 0 - 1,541 meters)
Inclusive Hydrography Filtering Criteria:	
NHDArea	• 40300 - Inundation Area • 40307 - Inundation Area; Inundation Control Status = Not Controlled • 46003 - Stream/River: Hydrographic Category = Intermittent • 46006 - Stream/River: Hydrographic Category = Perennial • 46007 - Stream/River: Hydrographic Category = Ephemeral
NHDFlowline	• 46000 - Stream/River • 46003 - Stream/River: Hydrographic Category = Intermittent • 46006 - Stream/River: Hydrographic Category = Perennial • 46007 - Stream/River: Hydrographic Category = Ephemeral
NHDPoint	• 45800 - Spring/Seep
NHDWaterbody	• 36100 - Playa • 39001 - Lake/Pond: Hydrographic Category = Intermittent • 39004 - Lake/Pond: Hydrographic Category = Perennial • 39005 - Lake/Pond: Hydrographic Category = Intermittent; Stage = High Water Elevation • 39006 - Lake/Pond: Hydrographic Category = Intermittent; Stage = Date of Photography • 39009 - Lake/Pond: Hydrographic Category = Perennial; Stage = Average Water Elevation • 39010 - Lake/Pond: Hydrographic Category = Perennial; Stage = Normal Pool • 39011 - Lake/Pond: Hydrographic Category = Perennial; Stage = Date of Photography • 39012 - Lake/Pond: Hydrographic Category = Perennial; Stage = Spillway • 46600 - Swamp/Marsh • 46601 - Swamp/Marsh: Hydrographic Category: Intermittent • 46602 - Swamp/Marsh: Hydrographic Category: Perennial • 49300 - Estuary

Model Summary

High Sensitivity:	10,327 acres (85% of AOI)
Moderate Sensitivity:	2,233 acres (18% of AOI)
Low Sensitivity:	1,403 acres (11% of AOI)

Figure 4-11: *Sample Report - Model Summary*

4.4.3 Project Output Folder & Files

All CHRSM products that are generated during an analysis are saved in the output zip file. To download associated source data and summary report:

(1) Click the "Output Zip Folder" link in the Output tab of the geoprocessing pane.

(2) In the dialog window, navigate to the local directory where the zipped folder will be saved.

(3) Extract the contents of the downloaded folder to a known location for review.

An example output directory is shown in **Figure 4-12** with the contents discussed below.

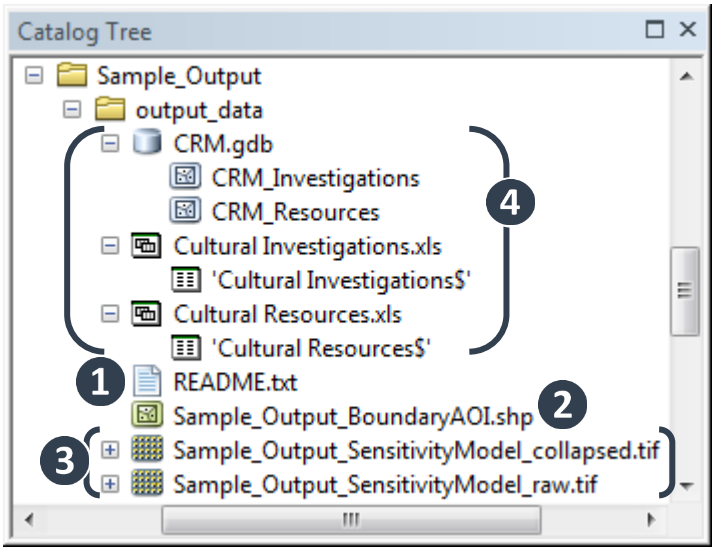


Figure 4-12: *Sample Output Directory*

4.4.3.1 Reference Files

The README text file briefly describes each of the CHRSM outputs. The time- and date-stamped log file (e.g., chrsm_log_YYYYMMDD_HHMMSS.log, not shown) records geoprocessing messages generated during the analysis, including a parameters section that records the input parameter values selected by the user via the NCRIMS interface. The log file can be helpful in diagnosing problems encountered when using the CHRSM.

4.4.3.2 Analysis Boundary

The analysis boundary used during processing is added to the displayed map and saved as a shapefile (Sample_Output_BoundaryAOI.shp).

4.4.3.3 CRM Surveyed Areas in Project Area

CRM investigations & resources in the analysis area are extracted to a file geodatabase (CRM.gdb). These feature classes are only intended to represent a temporary snapshot of the cultural heritage data for the project. Users should practice good data management procedures by deleting the extracted datasets to avoid maintaining redundant data. The feature attribute tables corresponding to the extracted CRM feature classes are also saved as Microsoft Excel 97-2003 compatible files (Cultural Investigations.xls and Cultural Resources.xls).

4.4.3.4 Suitability Model

The raw and final suitability model rasters are both saved as GeoTiff files in the output folder. The raw model (Sample_Output_SensitivityModel_raw.tif) is the weighted and combined slope and distance to water submodels. The raw model is then reclassified to produce the final model raster (Sample_Output_SensitivityModel_collapsed.tif), classifying low, moderate, and high cultural resources suitability across the landscape (**Figure 4-13**).

4.4.4 Interpreting the Suitability Model

Both raw and collapsed models (provided in the downloadable *.zip file at the completion of each model run) are numeric representations of modeled suitability with low numbers representing low suitability and high numbers representing high suitability. The numeric values are ranked and should not be interpreted as relative weights. A value of 3 in the collapsed model should not be interpreted as 3 times as suitable as a value of 1. Likewise, in the raw model, a value of 50 should not be interpreted as 50 times more suitable than a value of 1.

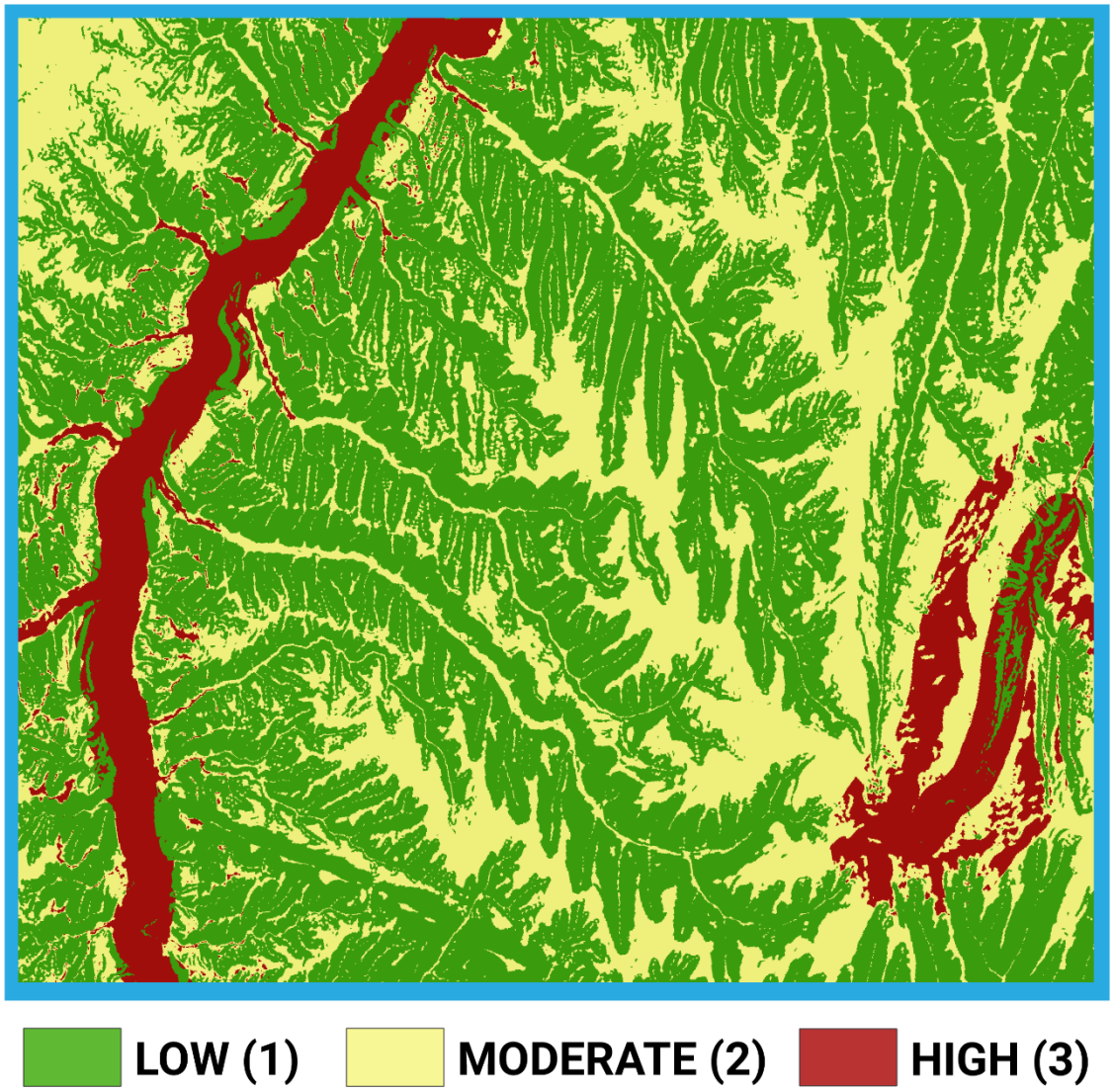


Figure 4-13: *Sample Output Model*

Locations steeper than the top slope threshold set in the model parameters are given a low suitability regardless of the distance to water. Therefore, any areas modeled as highly or moderately suitable that are disconnected from proximate water sources by a low suitability area should be considered carefully since the low suitability area may represent an impeded movement barrier such as a cliff. The advanced user guide provides explanation on how to employ a cost distance analysis (rather than Euclidean distance) to better represent facilitated and impeded movement across a landscape.

To better understand the specific drivers of the model results in a particular location, a user can load the source NHD and NED datasets with the model outputs into an ArcMap document.

4.5 Re-run the Analysis

To re-run the model, first ensure you have saved any desired items from the current run. Then, click to switch back to the "Input" tab.

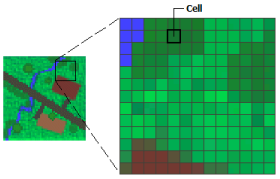
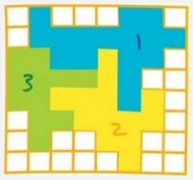
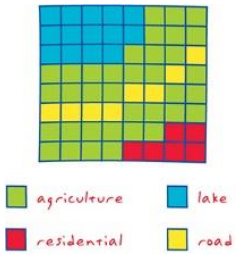
- Same search area — To use the SAME area of interest, make any desired adjustments to the other parameters, and then click "Execute". It is not necessary to "clear" and re-draw the analysis boundary.
- New search area — To use a NEW area of interest, click the "clear" button to remove the existing search area from the map. Next, click to choose a drawing shape and draw the new analysis boundary on the map. Then, make any desired adjustments to the other parameters, and then click "Execute".

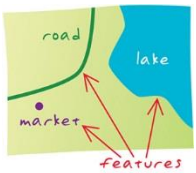
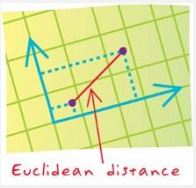
> ***Tip:***
> *For best results, clear any previously run analysis boundary before re-running the tool on a different search area.*

When analysis is complete, close your browser window.

[6] Ingbar, Eric E. and Teresa D. Wriston. 2017. Owyhee Land Exchange Cultural Resource Model Version 3. Submitted to the Bureau of Land Management, Idaho State Office. BLM Report/Contract Number: L15PD00996 Gnomon, Inc. Project Number: 2015-10. 61 pp.
[7] BLM NOC OC-534. USGS NED (Continental USA, 10-meter and 30-meter resolution), GMTED2010 (232-meter resolution), and NOAA eTOPO1 datasets (928-meter resolution).

APPENDIX A: GLOSSARY

TERM[8]	DEFINITION
dataset	Any collection of related data, usually grouped or stored together
raster dataset	A raster consists of a matrix of cells (or pixels) organized into rows and columns (or a grid) where each cell contains a value representing information. Rasters are digital aerial photographs, imagery from satellites, digital pictures, or even scanned maps. 
discrete raster	A raster that typically represents phenomena that have clear boundaries with attributes that are descriptions, classes, or categories. Generally, integers are used for the cell values. In a raster of land cover, for example, the value 1 might represent forestland, the value 2 urban land, and so on. It is assumed that the phenomena that each value represents fill the entire area of the cell. Rasters representing land use, political boundaries or ownership are examples of discrete rasters. 
continuous raster	A raster in which cell values vary continuously to form a surface. In a continuous raster, the phenomena represented have no clear boundaries. Values exist on a scale relative to each other. It is assumed that the value assigned to each cell is what is found at the center of the cell. Rasters representing elevation, precipitation, chemical concentrations, suitability models, or distance from a road are examples of continuous rasters. 
vector	A coordinate-based data model that represents geographic features as points, lines, and polygons. Each point feature is represented as a single coordinate pair, while line and polygon features are represented as ordered lists of vertices. Attributes are associated with each vector feature, as opposed to a raster data model, which associates attributes with grid cells. 

TERM[8]	DEFINITION
feature	A representation of a real-world object on a map. 
shapefile	A vector data storage format for storing the location, shape, and attributes of geographic features. A shapefile is stored in a set of related files and contains one feature class.
geoprocessing tool	A GIS operation that can create or modify spatial data. A typical geoprocessing operation takes an input dataset, performs an operation on that dataset, and returns the result of the operation as an output dataset. Common geoprocessing operations include geographic feature overlay, feature selection and analysis, topology processing, raster processing, and data conversion. Geoprocessing allows for definition, management, and analysis of information used to form decisions.
suitability model	A model that weights locations relative to each other based on given criteria. Suitability models might aid in finding a favorable location for a new facility, road, or habitat for a species of bird.
sensitivity analysis	Analysis designed to test the robustness of model and analytical results to ensure that small changes in model parameters or data structure do not exhibit large changes in the results.
Euclidean distance analysis	In ArcGIS Spatial Analyst, a description of each raster cell's relationship to the closest source. Euclidean distance is measured as the straight-line distance, or distance "as the crow flies", between two points on a plane and is calculated using the Pythagorean theorem. 
CSV file	CSV files contain spreadsheet data stored in plain text as a comma-separated values text file (.csv). The first row in the file defines the names for all subsequent fields. Fields can be separated with a comma, semicolon, or tab. Other separators are not supported.
GeoJSON file	GeoJSON is an open standard geospatial data interchange format that represents simple geographic features and their nonspatial attributes. Based on JavaScript Object Notation (JSON), GeoJSON is a format for encoding a variety of geographic data structures. It uses a geographic coordinate reference system, World Geodetic System 1984, and units of decimal degrees.

TERM[8]	DEFINITION
LYR file	A file with a .lyr extension that stores the path to a source dataset and other layer properties, including symbology.
TXT file	TXT files contain spreadsheet data stored in plain text as a delimited text file (.txt). The first row in the file defines the names for all subsequent fields. Fields can be separated with a comma, semicolon, or tab. Other separators are not supported.
JSON file	A lightweight, human-readable data interchange format (JavaScript Object Notation). An alternative to XML, JSON is language independent but relies on common programming language structures such as objects and arrays.

[8] For a complete listing of GIS terms, refer to the online Esri GIS Dictionary: https://support.esri.com/en/other-resources/gis-dictionary

APPENDIX B: FREQUENTLY ASKED QUESTIONS (FAQS)

A.1 CHRSM Data Inputs and Default Parameter Values

Q: Where do the CHRSM defaults come from (e.g., source data, suitability criteria, weights, and classifications come from?

See the **Background** section for information about the development of the CHRSM. When the CHRSM is run, the classification value ranges default values are read in from a BLM-administered configuration file.

Q: What if there is no source data coverage in my project area?

The CHRSM currently requires slope coverage to process a project area, but will not generate a critical error if there is no hydrographic coverage.

A.2 Model Structure

Q: Does the CHRSM model attraction of cultural resources based on _____?

No. The CHRSM only models the probability that cultural resources will be found throughout the project area.

A.3 Management Implications, Scope, and Applicability

Q: What is the suggested size of a single analysis area? Field Office? District Office? State? Region?

This may vary by agency regulatory requirements and the purpose of the individual analysis. Generally, smaller analysis areas will process through the CHRSM quicker than larger project areas for performance reasons.

Q: What about seasonality of the model (e.g., what to do in a desert setting with considerable variation)?

The CHRSM relies on expert knowledge about the landscape reflected by the parameterized user inputs. Users choose the most representative slope and hydro characteristics for the project area, and then select the degree of hydrologic feature inclusion to be incorporated in the filtering. The recommended workflow is to run the CHRSM once and review the results. Then, if necessary, adjust the parameters and re-run the model.

Q: Could alternative environmental factors be used to inform the output modeled cultural resource suitability?

Yes. Reference the CHRSM Advanced Analytics Component of the User Manual for more information.

Q: Could the model be used to evaluate relative suitability of different potential environmental variables for a landscape?

Yes. Reference the CHRSM Advanced Analytics Component of the User Manual for more information.