New Mexico DCA NMCRIS Upgrades Deliverable 4: Design Report

This document presents design recommendations for a future version of the NMCRIS application. It is based on interactions with stakeholders that defined the basis of the existing environment and the functional requirements to upgrade the existing NMCRIS application for the New Mexico Department of Cultural Affairs.

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Executive Summary

This Design Report offers recommendations for a future-state NMCRIS system. It comprehensively covers the following: network, hardware, data forms, disconnected editing, map service, reporting, database export, roles, user interface, and data storage. These recommendations were made based on stakeholder-stated needs, architecture standards, and newest Esri functionality.

Along the course of this assessment, DCA staff and external stakeholders were asked the following questions with the intent of generating decisions that would advance DCA’s own thinking about the application:

1. What parts of the database are unknown or confusing?
2. Which known issues should be prioritized?
3. What steps in the project status should be tracked?
4. What types of communications should be sent and when?
5. Should a test server be setup?
6. Are the suggested workflows complete?
7. What information should be extractable in a report?

The answers provided by all stakeholders helped clarify the overall objectives and user expectations for the upgrade. In terms of design consideration, areas that will make the most impact on user adoption and efficiency are:

1. Creating a leaner and well-documented database
2. Allowing users to land on a worklog page of their relevant items
3. Allowing users to more easily upload information through completely editable forms
4. Locating the most relevant database items in the List Views
5. Providing a Report View as a window to user-desired fields according to different roles
6. Creating a simpler user interface with a unified view of tabular and spatial data
7. Adding Google Imagery as a more current and high resolution background
8. Creating a more powerful keyword records search

This report provides design recommendations intended to meet the design objectives. The details of each recommendation are described within the document. To help DCA prioritize among the many suggested improvements, the report also provides, where possible, estimates of the level-of-effort that will likely be required to implement the various recommendations. However, this report does not project the actual costs or development time as those will naturally vary with the details of the proposed solution.

As the project moves forward, the next steps could be a series of phases toward a full implementation of a new version of NMCRIS:

Phase 1
1. Wireframe layout  
2. Database design  
3. User Interface design  

**Phase 2**  
1. Priority 1 functional design  
2. Software and hardware configurations  
3. Support: training, documentation, customer service  
4. Implementation to production  

**Phase 3**  
1. Priority 2 functional design  

The multitude of functions in this system will require many test cases. The amount of testing should not be underestimated and could be 25% of the effort in development. Any client that is about to undergo a development project should work to limit their Phase I functionality to those functions that meet the minimum viable product. The project risk grows with each added function making it difficult to meet time and cost expectations. An Agile Development may help reduce the risk in software development but it requires a highly responsive team that is usually faster than the normal government pace of execution. It also requires a very disciplined approach to creating and managing backlogs, to having developers handle product development in truly short sprints, and requires a budget that can fully cover the MVP (minimum viable product). The last is often hard to know in advance. The consequence of slow development is an architecture that is outpaced by advancing technology during the project and potential for stakeholder and user disengagement.

**Recommended Software Configuration**

**User connection environment**

There are 4 groups of users that access the NMCRIS web application or have direct access to its data through a database connection into ArcMap. As a blanket recommendation, all user groups shall be required to use the latest version of Mozilla, Internet Explorer, or Chrome. There are other browsers but for a non-commercial application, the support of these takes additional development and testing time. Web browser versions are automatically updated during updates. This will reduce testing and liability for older browser versions. However maintenance will need to be in place to continually react to new browser updates that may cause issues to some of the functionality.

**Customers**
Customers must access the web application only as they are outside of the network in different locations in the State. Having web-connected users serves the original intent to offer scalable access to the data in digital format. No alternatives are practical.

Lead Agencies

Lead Agencies must access the web application only as they are outside of the network in different locations in the State. Having web-connected users serves the original intent to offer scalable access to the data in digital format. No alternatives are practical.

HPD

HPD currently has access to the web application. Since they are on the network, they have the option to use the network access to NMCRIS data. HPD has described only limited data access and editing needs. The limited editing can be handled by a web application with the suggested enhancements that have been listed in this assessment. Therefore, there is no need to provide expanded access to NMCRIS data other than the standard database connection offered to all HPD users.

ARMS

ARMS users access the web application to emulate some of the same workflows as the other three groups and to perform customer service. But there are some internal editing and data export practices that require network data connections. They should continue to have network access to a common drive where the core data repositories exist. Users have reported performance issues with data access and this is likely due to the internet service into ARMS network or the hardware accessing the internet. These were described in the environment report. Once there is improved bandwidth into ARMS, then lost database connections will diminish. And the table connection can be configured with custom queries and table relationships for more efficient data access. These two types of network access are necessary:

1. **ArcMap Database connection** - this allows users to view and edit all NMCRIS geospatial data and their tabular attributes. Licensing must be maintained through Esri for this connection. An SOP to manage the DB connection credentials is maintained here: [https://drive.google.com/drive/folders/1EJFbrLw8LIQWIIId9zC_G7u-1d8UidfHu](https://drive.google.com/drive/folders/1EJFbrLw8LIQWIIId9zC_G7u-1d8UidfHu)

2. **SQL Server Database logic** - allows a user to have direct access to the entire tabular structure for performing data editing and data export. For users to interact with the SQL RDBMS, SQL Server Management Studio (SSMS) will need to be installed on client machines. SSMS allows multiple users to connect to and edit the NMCRIS database. Additionally, SSMS can also manage the security components restricting access and editing capabilities. SSMS allows for stored procedures and views necessary to create custom and standard exports. This will be a replacement for prior procedures of using MS Access for tabular data manipulation. Standard SQL server training is recommended as well as establishing a replacement for the legacy Wiki to hold Standard Operating Procedures.
Modification of online forms

DCA identified a number of areas where online forms could benefit from redevelopment. The primary online forms users file out, like LA, NIAF, and HCPI, all have new field requests. In some instances, the development workload is merely adding a column to a table. In other instances, development would require a new field and also a web component (i.e., input text box).

Table 1.0 UI components for LA, NIAF, and HCPI forms

<table>
<thead>
<tr>
<th>Online Form</th>
<th>New UI Components</th>
<th>New UI Component Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>LA</td>
<td>For recording information in new site visit</td>
<td>Table Field(text)</td>
</tr>
<tr>
<td></td>
<td>1. Input for “Recorder(s)”</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Location source graphics</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1. Option for “Other Topo Maps”</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Location source graphics</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1. Option for “qtr sections” in PLSS</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Physical Descriptions for all visits, Basis for Site</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Boundaries section</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1. <em>Distribution of Archaeological Features &amp; Artifacts</em></td>
<td></td>
</tr>
<tr>
<td></td>
<td>2. <em>Modern Features or Ground Disturbance</em></td>
<td></td>
</tr>
<tr>
<td></td>
<td>3. Property Lines</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4. Topographic Features</td>
<td></td>
</tr>
<tr>
<td></td>
<td>5. Other:</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Physical Description, Local Vegetation:</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1. Overstory</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2. Understory</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Physical Description,</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1. Observations of Site Settings</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Assemblage Data, Assemblage size,</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1. Counts section in table (if &lt;100) for all artifact classes</td>
<td>Table Field - Four fields to match the four classes</td>
</tr>
<tr>
<td></td>
<td>2. Assemblage Remarks</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3. Components, Basis for Cultural/Temporal Affiliation</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>References:</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1. Written Sources of Information</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2. Additional Sources of Information</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Site Record Attachments:</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1. Site Location Map (USGS 7.5' topo; required)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2. Sketch Map or Site Plan (required)</td>
<td></td>
</tr>
<tr>
<td>NIAF</td>
<td>1. Option for “Other Agency(ies)”</td>
<td>Table Field(text)</td>
</tr>
<tr>
<td></td>
<td>2. Applicable Cultural Resource Permit No(s)</td>
<td>Table Field(text)</td>
</tr>
</tbody>
</table>

**Client Customer(Project Proponent) Contact information:**
- 1. Contact
- 2. Address
- 3. Phone

**Land Owner/Manager**
- 1. Grand Total

**Records Search:**
- 1. Dates of HPD/ARMS Field Review
- 2. Dates of Other Agency File Review

**Survey Data:**
- 1. NAD 27
- 2. NAD 83
- 3. Other Topo Map

**Projected Legal Description:**
- 1. Yes
- 2. No
- 3. Unplatted
- 4. Nearest City or Town
- 5. Other Description
- 6. Survey Field Methods, Additional Narrative
- 7. Environmental Setting
- 8. Percent Ground Visibility
- 9. Condition of Survey Area

**Cultural Resource Findings**
- 1. Yes
- 2. No

**Attachments**
- 1. USGS 7.5 Topographic Map with sites, isolates, and survey area clearly drawn (required)
- 2. Copy of NMCRIIS Map Check (required)
- 3. LA Site Forms - new sites (with sketch map & topographic map) if applicable
- 4. LA Site Forms (update) - previously recorded & un-relocated sites (first 2 pages minimum)
- 5. List and Description of Isolates, if applicable
6. **List and Description of Collections, if applicable**

**Other Attachments**
1. Photographs and Log
2. Other Attachments
3. (describe):

**Certification of Information:**
1. Printed Name
2. Signature
3. Date
4. Title

**Reviewing Agency:**
1. Reviewer’s Name
2. Date
3. Accepted
4. Rejected

**SHPO:**
1. Reviewer’s Name
2. Date
3. HPD Log #
4. Date Sent to ARMS

**Cultural Resource Findings:**
1. Management Summary

<table>
<thead>
<tr>
<th>HCPI</th>
<th>Determination of Eligibility</th>
<th>Table</th>
</tr>
</thead>
</table>

**File Attachments**

While gathering requirements for NMCRIS improvements, two issues were identified with file attachments:

1. Users were restricted on file upload size, causing laborious efforts to upload multiple files
2. Upload latency partially due to complex filing system and shared resources on the application server.

In the design process, both issues have been addressed. The front end UI addresses how the user can make multiple attachments with a higher upload cap and a visual of their current upload status. The backend redesign will reduce the complexity of the current file storage system and also dedicate resources to storage and retrieval.

In the NMCRIS redesign, to add attachments to a site or activity, the user shall click on the “Attach” web component. The user is presented with 2 options:

1. To navigate to file(s) for upload, or
2. Drag and drop files
A user can attach an unlimited number of files but could reach the maximum upload file size, as either a single file or batch of files. The UI should include notification to the user their current upload volume exceeds the maximum session cap. The UI should also show an itemized list of files with current upload status.

Additionally, metadata associated with the files will be captured in the upload process. The metadata contributes to the naming convention of each file. The user selects options from the associated dropdown lists to identify file type and form type. The user can also provide a brief description of the item, such as ‘site documents’, ‘site image’, etc. Another method for assigning metadata is to allow users to ‘tag’ the item with identifying words (ie ‘jpeg’, ‘site’, ‘NIAF’, ‘report’ ‘2019’). Tagging is a popular method for assigning metadata using brief descriptions. Tagging can have picklists to limit the options a user can select while still providing enough metadata to name, store, and query items.

**Figure 2.0 File attachment upload wireframe**

Once upload is complete, the attachments are stored on a file server in a simplified folder tree for future retrieval. The files can then be accessed via a query or as part of an export. File uploads can be restricted by file type or file size. However, a restriction should be implemented cautiously. File size upload restrictions should provide an alternative to the user (i.e., FTP Server). File type restrictions should minimize the upload of unnecessary, unsafe, or proprietary-based software file extensions. A protocol should be established to scan and quarantine files that don’t pass a security scan for viruses.
Offline Form Entry

In the future, disconnected data entry through mobile clients could be a NMCRIS add-on workflow. There are a couple Off-the-Shelf options for this without having to build a custom application.

**Esri Collector and Esri Collector Classic**

a. Hardware Requirements

Esri has two mobile apps: Collector for ArcGIS and its predecessor now called “Collector Classic”. Collector for ArcGIS is specifically designed for iOS mobile devices. Android and windows are not yet supported; however, both will be supported in subsequent releases. Collector Classic supports iOS, Android, and Windows devices. However, it is no longer being supported with upgrades or enhancement releases.

b. Software Requirements

To use Collector, an organization must have an ArcGIS organizational account via ArcGIS Online or ArcGIS Enterprise. All users must have a Level 2 user account. Collector requires an ArcGIS version of at least 10.2.2 for non-versioned data and 10.3 for versioned data; however, for functionality in an enterprise architecture, ArcGIS 10.3 is required. For mobile devices to access Collector, the app must be downloaded from the App Store.

c. Data Requirements

Collector requires data and services to be configured for offline use. Maps and assets must be downloaded onto a mobile device before entering the field. The maps and services must be part of an AGOL account or ArcGIS Enterprise solution. In order for offline data edits to be supported in a disconnected state, the data must be published as services and those services must be configured for edit, query, and sync. Only enterprise geodatabases are supported. Data must also have Global IDs as part of the schema. However, both versioned and unversioned enterprise geodatabases are supported. If a data layer is part of a geometric network, then the relationship is ignored while edits are applied. Data limitations include: z-values without default attributes, m-values of created features will be null, and data cannot be a shapefile or file geodatabase.

**Boundless Anywhere - Part of BoundlessGeo Open Source**

Their mobile mapping application for Android and iOS is used to extend data collection in the field. The Boundless Anywhere works in conjunction with Boundless Exchange to sync data collection in a disconnected to semi-disconnected state.

d. Hardware Requirements

Limited information is provided online as to the hardware requirements for supporting the Boundless packages. However, mobile devices are a known requirement based on the purpose of offline support. No additional hardware specs were provided.

e. Software Requirements
Handheld devices require iOS 8.X or higher and Android 5.0 or higher. Anywhere works in conjunction with Boundless Exchange, which requires an annual subscription for licensing. No additional software install requirements were provided.

f. Data Requirements

None listed on website

Survey123 for ArcGIS

Integrates easily with ESRI ArcGIS Enterprise components, can function in a disconnected state, is form-centric, allows custom form development, and formats easily with handheld devices.

g. Hardware Requirements

Android and Apple are supported devices. Devices must have the following:

- CPU: 2.2 GHz Minimum or higher
- Processor: Intel Pentium 4, Intel Core Duo, or Xeon Processors
- RAM: 2 GB or Higher
- Display: 24-bit color depth
- Resolution: 96 dpi

h. Software Requirements

To use Survey123, an organization must have an ArcGIS organizational account via ArcGIS Online or ArcGIS Enterprise. In ArcGIS Enterprise, the software requires the configuration of ArcGIS Portal 10.4 or greater. The application can be downloaded from the Apple Store, Google Play,

i. Data Requirements

You cannot publish surveys to ArcGIS Enterprise that use certain reserved keywords as field names, such as end (field names containing these keywords are acceptable, such as endSurvey, as long as they are not exactly the keyword). A full list of these keywords is available in each worksheet type of the Survey123 XLSForm template.

All field names must be in lowercase when publishing to ArcGIS Enterprise.

A feature service published to a portal has a limit of 500 columns, including system fields, meaning that your survey can have no more than 496 questions. The workaround for this is to include a repeat, and set `repeat_count` to 1 to extend the survey over multiple tables. This limitation is imposed by the enterprise geodatabase, not the portal.
The name of a question in the survey worksheet must be fewer than 32 characters in length. Additionally, when using Portal for ArcGIS 10.4.1 or earlier, the maximum name length for questions inside of a repeat is 19 characters.

When ArcGIS Enterprise is deployed in a disconnected environment, survey templates, samples, and submission URLs to ArcGIS Online feature services do not work.

**Usability and Productivity**

NMCRIS shall have improved productivity by reducing clicks, improving user interface guidance along workflows, and producing information in complete and usable forms.

**Unified View of Data**

The current application is divided into a Tabular and a Spatial application. GIS by its nature is an integration of these two items with simple connections and transitions between views of the two types of data. The next design of the software should adopt a unified view of tabular and spatial data. For example:

1. When viewing a site record, the user can scroll through the site form to see a map of the feature rather than changing to a spatial view.
2. When doing an activity search on the map view, the user can see tabular results of all records with actionable controls rather than changing to a tabular view.
3. When filling in site record info or editing info in the forms, the user can also access the map frame as part of the view.

**Efficient Workflows and Development Requirements**

Each of the workflows has been documented in individual worksheets. For this Design report two columns were added: Development Requirements and Future Workflow. In all cases, the design has reduced the number of clicks and looks to generate practical outputs that users need out of the system. NMCRIS shall preconfigure views and reports that meet the end user needs without additional database manipulation.

Prior work in deliverable 3 was extended with further recommendations listed in these documents. In the Functional Specification document, two new fields were added to the Known User Issues sheet:

https://drive.google.com/open?id=1u-cBQbRyP3hnc0VjDkdn3t7j41YZFfNZXm6CLQKHy7Y

The first field is Level of Effort (LOE) where there is an indication of how much effort each issue might take from the developer standpoint: low, med, and high. The second field is Action, which was decided upon by DCA to determine priorities in functional development: Phase I, Phase II, or Phase III.
The Functional Specification document also refers to workflow sheets. Two new fields were added for this Design Report: Functional Requirements and Future Workflow. See these individual worksheets to see these values filled in to support design recommendations.

**Activity Search**
https://drive.google.com/open?id=1C9oXHoIIbod6yKwA0nO3E7HzKYn5dxGyv9KcaKrLsxE

**Activity Registration and Online NIAF**
https://drive.google.com/open?id=1VlkHaUiSLqm0576bxsmsgn7x-MZ5cLFs-5-CBlC8e9Vg

**Activity Spatial Data Entry**
https://drive.google.com/open?id=122cxT4RATleFMptFStwQwSPVJRLRJE4NTYDfs_7ky4

**Resource Tabular Data Entry - LA**
https://drive.google.com/open?id=1qkiF8TTfclneu9i5ZH8R6LmpIaNI984GqqFmzlro

**Resource Tabular Data Entry - HCPI**
https://drive.google.com/open?id=1aipIgk1S2goB8aKDffHldu8NN6WoBayMTHC-bpkC6hk

**Resource Spatial Data Entry**
https://drive.google.com/open?id=1dNq6-Qj9R6YQT7pSJ-QbDegqQztRfsLDI_t6ffN3-g4

**Activity and Resource Report Submission and Validation**
https://drive.google.com/open?id=1-ELeT9RbRwE1EdeF5h8RhRFVjGoesxwHf9efYF_jY

**Login and Logout**
https://drive.google.com/open?id=1FGVM12UcU4Q7PacgOHGCsewMCRwc8xyzRmQpG7FJsS4

**Project Compliance Review**
https://drive.google.com/open?id=1bptuCSxgtTWKIMGko5d_ozc9Ill1HdN_pcUHouojN-I
Records Check In
https://drive.google.com/open?id=1ZNAeExy6MjCeUyMvfCb5HDUh9JTQinpP946slqGE3Eg

Tabular and Spatial Data Validation
https://drive.google.com/open?id=1F9nI5LR0xyO8lMQNICIQGsv72s3QWSQgHmtge78Urko

Customer Service
https://drive.google.com/open?id=1HrLmadT55cHLOQ9SkqS5iqcKae5mGMVj9ar3DjasVHW

Administrative Reporting - End of Year Report
https://drive.google.com/open?id=1YV1YfwVgbFQAliexkemO8jnVoxRP8Pj2QoU6f82CcV8

Administrative Reporting - HPF Report
https://drive.google.com/open?id=1kKNOJS6Qyhr3f7gGWlhfVLH45TzlqHsxgeQgfP1xY

Administrative Reporting - Reviewer Report
https://drive.google.com/open?id=1vUG_M5d7TF5fBTX5UfpGxl61Ns60okSlz8VWb5h4kA

HPD Data Import and Export
https://drive.google.com/open?id=1ELVybB4_Ln1NhfE1658qaG7NUpW8C1wEMRtdRmM

Billing
https://drive.google.com/open?id=11vfhtyc33ek1_7RQ_fwMUZjMN8pTxp7nwOoLFUmagKg

User Interface (UI) Improvements
Standards in web interface design shall be used to improve the user experience. Table 3.0 provides general standards that should be employed in the next version to improve upon existing interface issues.

**Table 3.0 UI Requirements**

<table>
<thead>
<tr>
<th>Item</th>
<th>UI Requirement</th>
<th>Sample Issue</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>UI style should be the same throughout in colors, fonts, controls</td>
<td>CTA and CSA have different header style, menu colors, and fonts</td>
</tr>
<tr>
<td>2</td>
<td>Tabbing through forms</td>
<td>Current form skips certain fields in tabbing</td>
</tr>
<tr>
<td>3</td>
<td>Logical order of picklists: alphabetized or by frequency</td>
<td>User Profile page, Agency picklist is not alphabetized</td>
</tr>
<tr>
<td>4</td>
<td>Ordering of search filters is organized so that higher frequency items are on top and types of filters are sectioned together</td>
<td>Register Property List search functions are unorganized</td>
</tr>
<tr>
<td>5</td>
<td>Hyperlinkable text are in standard blue font</td>
<td>Throughout NMCRIS, hyperlinks are a tan color</td>
</tr>
<tr>
<td>6</td>
<td>Icon controls come from the same style family</td>
<td>Activity list page has different icon style for Edit Activity, NIAF report, NIAF Summary</td>
</tr>
<tr>
<td>7</td>
<td>Table Headers should be readable with larger font, different background and functional to control sort order</td>
<td>Activity list doesn’t have a distinct header</td>
</tr>
<tr>
<td>8</td>
<td>Text entry fields have consistent logical placeholders</td>
<td>New Activity Registration/Lead Agency has useless placeholder text ‘Begin typing here...’</td>
</tr>
<tr>
<td>9</td>
<td>Reduce text on all pages and utilize hover tips</td>
<td>New activity registration has 9 different instruction statements seen on the form that could be created as hover tips</td>
</tr>
<tr>
<td>10</td>
<td>Utilize controls consistently within order of operations</td>
<td>Reports page presents picklist of Report Types, then Submit down below</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Queries presents different query buttons. These should be the same. On Activity List page filters, there are 3 Go buttons when only one is needed at the bottom of the search section.</td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>11</td>
<td>Use consistent and readable fonts with high contrast</td>
<td>Header has white text ‘Hello Name’ that is unreadable on light blue background</td>
</tr>
<tr>
<td>12</td>
<td>Header should have standard control conventions organized tightly in upper right: Name, Settings, Signout</td>
<td>Header has a link to Training, while Signout is a menu button. Should be reversed</td>
</tr>
<tr>
<td>13</td>
<td>Menu selections should be indicated in different color</td>
<td>On CTA menu, if you click any menu, it stays same color</td>
</tr>
<tr>
<td>14</td>
<td>Tables should be in standard convention with controls and values separated</td>
<td>On Activity List, the link to GIS is embedded in a field. Might consider placing with the other icon controls</td>
</tr>
<tr>
<td>15</td>
<td>Controls should be centralized in their own Toolbar and be applied to selected record</td>
<td>On the Activity list, the Edit, NIAF Report, and Activity Summary controls are repeated through each</td>
</tr>
<tr>
<td>16</td>
<td>Consistent error message styles</td>
<td>On Activity list, if user searches for a NMCRIS number that can’t be found, they are redirected to another page with error message rather than a popup message on same page.</td>
</tr>
<tr>
<td>17</td>
<td>Utilize error prevention</td>
<td>Do not allow alphanumeric characters in number fields, or numbers in text searches as can be seen in Activity List Search Filters</td>
</tr>
<tr>
<td>18</td>
<td>Adhere to State of NM, HPD web style</td>
<td>Headers, logos, fonts, and border colors should be identical to other State of NM webpages.</td>
</tr>
</tbody>
</table>

In addition to the UI suggestions above, the application should document how it addresses Section 508 compliance to support the American Disability Act. Examples of this are to have text versions of any oral narratives that might be used in training videos. Include hover tips for every user control that could
be read by a screen reader and converted to audio output. The application is not capable to be completely compliant but documentation as to the efforts put forth is necessary.

The NMCRIS UI currently acts like a large “forms over data” application. Currently, users must have a sound general knowledge of the ARMS database information structure in order to perform many common tasks effectively. NMCRIS can be made far more efficient by providing workflows for common business needs. For example, right at the start of the application, the user can be provided a landing page leading directly to common workflows.

The application can lead to the 6 views that launch the different workflows. In some cases, billing or reporting workflows land in the same place to see a Report View of information that can be readily downloaded. Each view should be designed to have the most relevant functions and information visible with no additional clicks. The table below describes the 6 Landing Page launch points and maps to the 11 workflows.

Table 4.0 Landing page views

<table>
<thead>
<tr>
<th>Item</th>
<th>Views</th>
<th>Description</th>
<th>Workflows</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>View worklog</td>
<td>User sees records they are connected with such as project owner, or pending your review</td>
<td>All workflows</td>
</tr>
<tr>
<td>2</td>
<td>Register an activity</td>
<td>User sees activity registration form</td>
<td>Activity Registration</td>
</tr>
<tr>
<td>3</td>
<td>Search and edit records</td>
<td>User sees integrated map and tabular searches and results lists</td>
<td>All workflows</td>
</tr>
<tr>
<td>4</td>
<td>Generate a report</td>
<td>User selects type of tabular query and sees data in tabular array which they may export to a local CSV file. Some reports restricted by roles such as ‘Billing’.</td>
<td>Project Compliance Review</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Administrative Reporting</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>HPD Data Import and Export</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Billing</td>
</tr>
<tr>
<td>5</td>
<td>Get help or training</td>
<td>User can submit a help ticket or view help documentation or videos</td>
<td>All workflows</td>
</tr>
<tr>
<td>6</td>
<td>Perform administration</td>
<td>Restricted to admin roles to add nmcris users, set roles, edit selected domains, perform LILO</td>
<td>LILO</td>
</tr>
</tbody>
</table>
See this link to a wireframe of the Landing page.
https://drive.google.com/open?id=1YyzLwYwkYU2OcRCj2M8lQ9RvGrsGfjwH

**Figure 5.0 Landing page wireframe**

Clicking the ‘Search and edit records’ button will lead the user to the integrated spatial/tabular view of all records that are searchable with edit controls for those records they have privileges. See this link to a wireframe of Resource List page.

https://drive.google.com/open?id=1sQUrUM05_QyfqslEDaLvjRbAGlcVbWwr
Further inspection into details, downloads, geography then represent next steps in the workflows. Subsequent to this assessment, a wireframe and UI development task should ensue for the entire application.
Improved Map Service

The map service shall be integrated into the records search for prefield query. It will exist as part of any new form as an entry point to digitize new resources. The overall aesthetic will be to simplify the interface by making a single text query apply to many items like resource number, activity number, place, and address. This will eliminate many of the UI buttons for specific queries. Also, the tools to be utilized will be restricted to essential enduser tools rather than default map viewer tools provided in the Esri template. ARMS will review what tools are essential. The address locator is supported by the ESRI Streetmap service. It will provide a geocoded street layer that allows an entered address to be parsed out into its individual components and compared to several address fields in the database. The result is a query and zoom-in according to address. This will make it much simpler to locate historic properties known by address.

See this link to a wireframe of this page.

https://drive.google.com/open?id=1Ybkyel1Hy85xY3Nhln8-bXFpIllWoXRa
Some search result scenarios would be:

1. Enter city  
   Map displays zoomed in view of city
2. Enter Site no  
   Map zooms in to location of selected site  
   Results table shows key attributes of selected site
3. Enter Activity no  
   Map zooms in to location of selected activity  
   Results table shows key attributes of selected activity and key attributes of resources connected to activity

Map service programming language

The ArcGIS Web Application Developer Framework for .NET is still available within the current ArcGIS Library. However, the VB.NET used in the current NMCRIS for 9.3.1 is no longer supported and should
be abandoned in future development. If a .NET framework is preferred, ESRI supports the ArcObjects SDK for 10.6x. However, a web-friendlier alternative exists in the ArcGIS Javascript API.

The ArcGIS Javascript API recommends accessing the API using a Content Delivery Network (hosted version). This is the application API only and not the application nor the data which would reside at DCA.

Benefits include:

- Javascript is a highly recognized language for the World Wide Web and implements smoothly with HTML
- CDN's are a collection of geographically distributed web servers that deliver content efficiently.
- The servers are load balanced and monitored 24/7
- No need to download and re-install the API when new versions are released. Developer just needs to modify the script tag in your application to point to the new version.

Javascript is highly conformable and flexible. The map service component can be written separately and embedded within any application. Additionally, javascript in conjunction with HTML/CSS provides a highly recognizable and functional application across all browsers.

Limitations with using Javascript API with Web Browsers:

- WebGL implementation of Internet Explorer is not optimized for memory-intensive applications, and it might not work reliably when opening certain scenes or when rendering large datasets.

An additional map service program option is Leaflet. An example of Leaflet implementation was demonstrated to DCA via the Oregon Cultural Resource Information System (OCRIS) application. ESRI Leaflet is a lightweight set of tools for adding ESRI services and basic functions to a mapping application. Leaflet uses a combination of HTML/CSS and Javascript to display basemaps, consume services, display data, and provide simple spatial analysis. Leaflet can be used as a standalone mapping application or embedded in applications or websites written in different programming languages.

Clip and Ship

NMCRIS shall produce a results table for Area of Interest (AOI) selections. The user shall define the AOI through: drawing an AOI selection box, uploading a shapefile boundary, or uploading a KMZ file. This will allow the user to gain valuable information for multiple activities and resources. Exporting all records to a CSV meets the need to copy and paste the resource numbers into site reports. Exporting feature layers from list of results meets the need for users who want to display the information in their local versions of ArcMap.

The layers to be clipped will be restricted by privileges. The amount of data to be clipped will be restricted by file size. First method will be to clip the viewable space at 1:100,000 scale. Second will be to clip an onscreen digitized AOI. And third will be to upload a project boundary shapefile with an option for a buffer. Any data requests beyond this shall be submitted to ARMS.
See this link to a wireframe of this page.
https://drive.google.com/open?id=1geko1Bc9xhVL4lwowfKvCHxnwKURwLnB

Figure 8.0 Clip and Ship results wireframe

Import/export to KML/KMZ
Users without Esri software have requested support for a data feature exchange between NMCRIS and Google Earth. The Map Service shall be created so that visible features shall be exportable as a zipped Google Earth layer file (KMZ). This can be displayed on a Google Earth view. The function would be enabled through the Clip and Ship tool as an added data format choice: Shapefile or KMZ.

When users digitize features in Google Earth, their files are in KML. Currently users can upload a shapefile representing their surveys. At this same dialog, the user would have a choice to upload a KML file. The ArcGIS javascript API can be employed to convert the KML to Esri’s native shapefile format and then the process would proceed as currently exists.

**Enhanced Identify tool**

In prefield query, the map service is used to query features in the area of interest. The map Identify function should return meaningful results for the one-to-one database values that then lead the user with a hyperlink to view the Activity or Resource report. For archaeological sites show: Master DOE, record status, site type, property type (part of future conversion from properties to sites), occupation type, and link to scanned LA form(s). For HCPIs show: Master DOE, record status, street address, and link to scanned HCPI form(s). And for activities show: author, report title, record status, report date, performing agency, and report number. For register properties show: number, property name, street address, national register listing (Yes/No), national historic landmark listing (Yes/No), associated district, and category. The application shall also provide a link from the Identify dialog to display the NIAF, LA, or HCPI report. Master DOE is not currently a field but it will be calculated as a new field in the database based on logic provided by DCA. It is likely to reflect the lastest DOE entered into the system, so the Master DOE value will be dynamically reading from other fields to represent a real time value.

See this link to a wireframe of this page.

[https://drive.google.com/open?id=1oZYrl_af3fy8Q0hT130OfM9s2H-GB19n](https://drive.google.com/open?id=1oZYrl_af3fy8Q0hT130OfM9s2H-GB19n)
New background layers

The background layers listed in Deliverable 3 includes these new layers: Street map, Google imagery, and USGS National Map. These shall be supported through these services:

1. Streetmap - Esri map service supporting address geocoding with no extra cost
2. Google Imagery - Google map service with no extra cost
3. USGS National Map Topo - An adaptive scale web service at no extra cost

Public Access

This development requirement is to create a public access view of a subset of NMCRIS information. In this view, no login or permission restrictions would be necessary. And the intent is to allow users to view Historic Properties, query attributes, and view on top of the standard background layers. A model view can be seen for the Wisaard (Washington) application and was validated as useful by interview with John Miller, Taos Planner.

https://fortress.wa.gov/dahp/wisaardp3/
Table 10.0 Public Access

<table>
<thead>
<tr>
<th>Item</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Developer shall expose a public access URL that does not require login</td>
</tr>
<tr>
<td>2</td>
<td>Developer shall create a map service view that includes existing and new base layers</td>
</tr>
<tr>
<td>3</td>
<td>Developer shall add to the map service two built environment categories of layers: Architectural Resources, Properties and Districts.</td>
</tr>
<tr>
<td>4</td>
<td>Developer shall make symbology different between layers and categorized architectural resources: Determined eligible, Determined not eligible, No determination</td>
</tr>
<tr>
<td>5</td>
<td>Developer shall show these identified attributes as a list upon graphic query: DOE, name, property type, street address, and link to scanned HCPI</td>
</tr>
<tr>
<td>6</td>
<td>Developer shall create a hyperlink from Attributes window to: Image, Resource Summary, Report</td>
</tr>
</tbody>
</table>

Reporting Tools

DCA identified standard reports required from the NMCRIS database that could either summarize data, provide a standard extract of specific fields between multiple tables, or a combination of both. Based on these requests, the database and web components required to meet these requests have been provided.

A central Report View will be accessible by all users. Some of the reports will be accessible based on roles. The types of reports available will be the standard Activity Reports and Resource Reports. But additionally, the needs from ARMS and HPD are characterized below with the types of information that shall be presented in a cell array that meets their needs for view and download to CSV.

Table 11.0 UI Components for standard reporting

<table>
<thead>
<tr>
<th>Report</th>
<th>Requested Fields or Values</th>
<th>New UI Component</th>
</tr>
</thead>
</table>
| Historic Preservation Fund End of Year Report (EOYR) | **State Nominations:** Districts sent by State to NR (Count)  
Buildings sent by State to NR (Count)  
Sites sent by State to NR | **Database:**  
Database View presented in a digital form export  
- Filters applicable fields from core tables  
- Summarize data by counts  
**NMCRIS Application:** |
<p>| Federal Cumulative Products Report (Fed into HPF report above) | <strong>Review and Compliance:</strong> Properties meeting NR criteria Properties NOT meeting NR criteria Findings of ‘No Properties’ or ‘No Effect’ Other findings of ‘Effect’ | <strong>Database:</strong> Database View presented in a digital form export - Filters applicable fields from core tables - Summarize data <strong>NMCRIS Application:</strong> 1. Button for Standard Export 2. Apply Digital Signature |</p>
<table>
<thead>
<tr>
<th>State Cumulative Products Report (Fed into HPF report above)</th>
<th>MOA signed Programmatic agreements signed</th>
<th>3. Table to CSV export process (back-end)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Log Number</td>
<td>NMCRIS Number</td>
<td>Location String</td>
</tr>
<tr>
<td>Date In</td>
<td>Date Due</td>
<td>Date Out</td>
</tr>
<tr>
<td>Revision 1 Initials</td>
<td>Revision 2 Initials</td>
<td>Subject Sender</td>
</tr>
<tr>
<td>Lead Agency</td>
<td>Sect 106</td>
<td>MOA Final</td>
</tr>
<tr>
<td>PA Final</td>
<td>Pre Consultation</td>
<td>No Property, No Effect</td>
</tr>
<tr>
<td>Property, No Effect</td>
<td>No Adverse Effect (NAE)</td>
<td>Conditional NAE</td>
</tr>
<tr>
<td>Adverse Effect</td>
<td>Post Consultation</td>
<td>DOE Eligible</td>
</tr>
<tr>
<td>Not Eligible</td>
<td>Undet</td>
<td>File Location</td>
</tr>
<tr>
<td>Response Type</td>
<td>Comment</td>
<td>Status</td>
</tr>
</tbody>
</table>

**Database:**
- Database View presented in a digital form export
- Filters applicable fields from core tables
- Summarize data
- Filter for annual request (date range)

**NMCRIS Application:**
1. Button for Standard Export
2. Table to CSV export process (back-end)

<table>
<thead>
<tr>
<th>Performance Report</th>
<th>Activity Registrations Surveys</th>
<th>Survey acres</th>
<th>Historic properties</th>
<th>Archaeological sites</th>
<th>ARMS Activities entered</th>
<th>ARMS Surveys entered</th>
<th>ARMS Survey acreage</th>
<th>ARMS Sites entered</th>
<th>ARMS Historic Properties</th>
</tr>
</thead>
</table>

**Database:**
- Database View presented in a digital form export
- Filters applicable fields from core tables
- Summarize data

**NMCRIS Application:**
1. Button for Standard Export
2. Table to csv or PDF export process (back-end)
<table>
<thead>
<tr>
<th>Item</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Allow the viewing and download of a NIAF form in PDF.</td>
</tr>
</tbody>
</table>
NMCRIS requires a Report View module that will use queries to access tables, link tables, and select fields to be seen in an array of relevant information that is used for summary reports. The list of reports is seen in Deliverable 3.

### Table 13.0 Summary Report functions

<table>
<thead>
<tr>
<th>Item</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Roles determine which reports are accessible</td>
</tr>
<tr>
<td>2</td>
<td>A picklist of report choices</td>
</tr>
<tr>
<td>3</td>
<td>Enter dates From and To as a filter of records</td>
</tr>
<tr>
<td>4</td>
<td>Scrollable records in view</td>
</tr>
<tr>
<td>5</td>
<td>For client data export, a browse to file containing Site Numbers that filter info</td>
</tr>
<tr>
<td>6</td>
<td>Export to CSV format</td>
</tr>
</tbody>
</table>

See this link to a wireframe of this page.

Paperless Project Review

The project review process has inadequate communications to stakeholders during the review process and has caused confusion and excessive customer support calls to determine where projects are being held up. Resources are processed within the activity they are associated with so no other steps or status changes are set aside for them. See these requirements to provide more accountability and transparency.

Table 15.0 Paperless project review requirements

<table>
<thead>
<tr>
<th>Item</th>
<th>Step</th>
<th>Status</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Activity Registration</td>
<td>Data Entry in Progress</td>
<td>1. Change status to Data Entry in Progress</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2. Upon opening record, show status on header with NMCRIS number</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>3. Display status on Activity List</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>4. Display status on Activity Summary</td>
</tr>
</tbody>
</table>
|   | Resource Data Entry | 1. Upon opening record, show status on header with NMCRIS number  
|   |                   | 2. Display status on Activity List  
|   |                   | 3. Display status on Activity Summary  
| 3 | Validate and submit | 1. Change status to Sent to Lead Agency  
|   | Sent to Lead Agency | 2. Upon opening record, show status on header with NMCRIS number  
|   | (After validate and submit. Has permission to roll back to Data entry in progress if not approved) | 3. Display status on Activity List  
|   |                   | 4. Display status on Activity Summary  
| 4 | Lead agency approval | 1. Change status to Sent to SHPO  
|   | Sent to SHPO | 2. Email to consultant  
|   |                   | 3. Upon opening record, show status on header with NMCRIS number  
|   |                   | 4. Display status on Activity List  
|   |                   | 5. Display status on Activity Summary  
| 5 | Activity Login | 1. Change status to Sent to SHPO  
|   | Sent to SHPO (overcomes deficiency in Lead Agency status change) | 2. Email to consultant  
|   |                   | 3. Upon opening record, show status on header with NMCRIS number  
|   |                   | 4. Display status on Activity List  
|   |                   | 5. Display status on Activity Summary  
| 6 | Project Compliance Review | 1. Change status to SHPO review complete  
|   | SHPO review complete | 2. Email to consultant  
|   |                   | 3. Upon opening record, show status on header with NMCRIS number  
|   |                   | 4. Display status on Activity List  
|   |                   | 5. Display status on Activity Summary  
| 7 | Received at ARMS | 1. Change status to Waiting ARMS validation  
|   | Waiting ARMS validation | 2. ARMS begin validation  
|   |                   | 3.  
| 8 | Tabular and Spatial Data Validation | 1. Change status to Filed  
|   | Filed at ARMS | 2. Email to project owner  
|   |                   | 3. Upon opening record, show status on header with NMCRIS number  

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To facilitate record review and approval, a Work Log page will be established for each user. These will be sectioned into Activities and Resources. Each will display the status of the item with the less mature status items displayed on top. The work log records that will be seen will be based on the role of the user and will establish a queue of items they are tracking or need to address in some way. These are some of the needed User Worklog lists.

1. Contractor sees records that they own but have not yet submitted
2. Lead agency sees records they need to review
3. SHPO sees records they need approve
4. ARMS sees records they need to validate

Each record will list the Number, Status, Owner, Days in current status. A click into any record is a hyperlink to the form with either view only or edit privileges as determined by the combination of Role/Status. At this point, the user has the unified view to work with spatial and tabular data.

See this link to a wireframe of this page.

https://drive.google.com/open?id=13CVixUdInTr-6ygzsdIGF4dcveL-IFBq
Data Import and Export

Customer service supports various data exports with tedious customization processes requiring MS Access. The following UI demonstrates efficiency improvements by providing user input optimization, data export, and interactive mapping components.
Normalize existing tables

In an effort to improve data comprehension and remove additional data cleansing processes, the associated tables will consist of concise and informative field names, applicable aliases, and extended metadata. Additionally, the tables will have architectural relationships for simple joins, exports, and filtering. The upgrade to the tabular structure in the database was defined in the Environment Report.
An action fields is located in this worksheet that makes a suggestion for each table and field.

**Increase data compatibility**

Tables will consist of field types capable of conforming to ancillary relational database management systems and geospatial software. For instance, the BigINT field type used as a primary key in several NMCRIS tables is not compatible with either MS Access or Esri products. All occurrences the BigINT field type should be converted to the Integer field type. Data compatibility will ensure exported tables remain useful for distribution without additional field manipulation.

**Automate common data exports**

Capitalizing on ARMS common data export requests, the UI will provide users the self service options of common data exports through the Clip and Ship method below. For custom data exports, the users may rely on the Reports View or call customer service to perform the export through a SQL Server or ArcMap query.

**Clip and Ship self service exports**

The Clip and Ship function should be designed to allow users to download geospatial and tabular data for features that fall within a digitized boundary, a selected project area, or an uploaded project AOI. Data to be downloaded will be sites, surveys, and properties and relevant attributes. The attributes, layers, and role access will be dictated by ARMS. The output given to the user should be a compressed file geodatabase.

**Table 18.0 Clip and Ship export content**

<table>
<thead>
<tr>
<th>Role</th>
<th>Layer</th>
<th>Attributes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Archaeologist</td>
<td>Activity</td>
<td>NMCRIS No.; Performing Agency; Performing Agency no.; Lead Agency; Lead Agency No.; Sponsor; Activity Start Date; Survey Acreage; Resource Count; Isolates Count; Report Date; Author; Report Title; Record Status; Comments</td>
</tr>
<tr>
<td></td>
<td>Archaeological Site</td>
<td>LA No.; Property Type; Site Type; Occupation Type; Master DOE; Site Area (sqm); Lithic Artifact Count; Ceramic Artifact Count; Historic Artifact Count; Assemblage Remarks</td>
</tr>
<tr>
<td></td>
<td>Architectural Resource (Building)</td>
<td>HCPI (or HBI) No.; Street Address; Master DOE</td>
</tr>
<tr>
<td>Architect</td>
<td>Activity</td>
<td>Architectural Resource (Building)</td>
</tr>
<tr>
<td>-----------</td>
<td>----------</td>
<td>----------------------------------</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

For file downloads greater than 50 MB (or accepted cap), the user shall be informed that the shipping file size is too large and they would need to contact customer service for an FTP post of their desired data. Customer service would then perform the data extract through a direct connection to the NMCRIS database and would post the data to an FTP server.

**Report Standard Exports**

A predefined set of standard custom queries from the tabular data will be accessible from the Reports picklist and would be visible based on roles (ARMS sees more reports than endusers). The ‘Standard Export’ options could meet the needs of the main NMCRIS stakeholders who have repeated requests for tabular data such as BLM or DOT seen in wireframe below. Or a standard query could be named as another type of report such as Visits History. Without defining them, ARMS did state that there are several common reports that make up 75% of the requests, so these could be constructed as SQL queries to populate the report view here. Customer service shall generate the tabular download as they have always done.

ARMS shall determine what reports are seen by internal roles. But other reports such as NIAF or Site Report shall be a standard report that is seen by all endusers from this view. These standard reports shall be downloaded as a PDF.
Roles and Privileges

The NMCRIS Admin View will allow the Admin role to manage user accounts, expiration dates, emails, login credentials, and roles. The roles to be assigned by Admin are defined in this table, along with their data access privileges.

https://drive.google.com/open?id=1JOWEBoEwEeAqIDNM5dMFot_30lC8OvKooguLxXfbTug

Table 20.0 Role Change Summary

<table>
<thead>
<tr>
<th>Item</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Allow the owner of the record to have greater edit privileges</td>
</tr>
<tr>
<td>2</td>
<td>Allow permission for agencies and HPD to do DOE review</td>
</tr>
<tr>
<td>3</td>
<td>Allow ARMS staff the ability to edit GIS production data directly through ArcGIS</td>
</tr>
<tr>
<td>4</td>
<td>Allow S.R. Editor to edit Register Properties features in map service</td>
</tr>
<tr>
<td>5</td>
<td>Allow HPD Assistant, Archaeologist, and Architect to perform LILO</td>
</tr>
<tr>
<td>6</td>
<td>Allow a public role to view historic properties</td>
</tr>
<tr>
<td>---</td>
<td>---------------------------------------------</td>
</tr>
<tr>
<td>7</td>
<td>Rename Role 25 to ‘Billing’ with all privileges of Admin plus billing</td>
</tr>
<tr>
<td></td>
<td>Rename HPD Admin and Support to ‘HPD Administration Assistant’</td>
</tr>
<tr>
<td>8</td>
<td>Add a ‘Tribal’ role with ability to see records on Tribal land. A new field will be added to DB to flag records within tribal land. A new data entry checkbox to be added to allow user to determine that record is flagged as Tribal.</td>
</tr>
<tr>
<td>9</td>
<td>Geography needs to be added to Lead Agency so that ‘BLM field office A’ cannot review ‘BLM field office B’</td>
</tr>
<tr>
<td>10</td>
<td>Condense 2 admin roles into one</td>
</tr>
<tr>
<td>11</td>
<td>Renumber roles according to increased privileges</td>
</tr>
</tbody>
</table>

**Customer Service**

Currently customer service is handled with emails and phone calls that are then manually tracked as an entry into a shared spreadsheet. There is enough volume of calls for this statewide system to consider a modest workorder tracking system. After users receive a request, a record is created in the system to define, assign, solve, and communicate back to the client. The value in this would be retrievable information on prior issues, complete closure that issues have been addressed, and evidence of future development needs. DCA should investigate 3rd party systems that would have local access within DCA.

**Meeting System Reliability**

**Optimal Architecture in DCA Virtual Machines**

**Improve performance in Current Infrastructure**

a. **Software Upgrades**

An ArcGIS Enterprise and SQL Server software upgrade will provide a reliable geospatial enterprise environment necessary to meet the needs of the current NMCRIS application components. As software becomes increasingly outdated, it is also easily compromised, corruptible, misaligned, or simply incompatible. When an application is the core component granting users access to data, browsers can become increasingly incompatible with outdated application software. Therefore, it is essential to keep upgrading an enterprise environment.
An ArcGIS upgrade from 9.3.1 to 10.6x will provide the necessary software improvements to support requested functionality and reduce the manual effort of restarting software services on the hosting server. ArcGIS 10.6x will also provide improved technology for hosting services, an increase in options for serving out data to users, and improvements for use in mobile applications.

ArcGIS Enterprise upgrade from 9.3.1 to 10.6.1 will require an upgrade to two environments:

(1) Client

Client install will be required for every client machine needing access to ArcGIS software. All client’s must have version 10.5.1 uninstalled and then, 10.6.1 installed. All client machines requiring direct access, or direct connect, to the NMCRIS database, will also need the additional software installed:

- Microsoft ODBC Driver 17 and 13
- SQL Server Native Client (depends on SQL Server version)

Additionally, as a side note, for each user, any file geodatabases that exist on the machine should be upgraded. ArcGIS Pro is optional.

(2) Server

The server environment will require a license manager server upgrade to manage new license versions. The production and test server will require an upgrade to a .NET environment of at least 4.5. IIS will also need to be upgraded to an appropriate version, 7 or 8, depending on Windows environment and currency. The servers will also require an uninstall of 9.3.1 and install of 10.6.1 ArcGIS Server Enterprise.

A SQL Server upgrade will be required to meet the ArcGIS install. ArcGIS 10.6.1 requires a minimum of SQL Server 2012 SP4 for compatibility. However, DCA should consider SQL Server 2014 or 2016 to stay ahead of ESRI software releases and also to see a true performance increase.

Software upgrades to the client and servers can be conducted by DCA IT, with the support of a consultant. Although consultant support might be required in certain instances, the labor and cost should be minimal. The majority of labor is easily accomplished by IT, given staff availability. The majority of labor falls to the migration of databases from the current version to the upgraded version. Minimal hours should be dedicated to a consultant for upgrading software.

**Meeting Data Storage Requirements**

There is a need to increase storage capacity where electronic documents will be stored. The current storage drive on the application server supports 349 GB, of which only 62 GB of free space remains. This is not a physical limitation of the server as this virtual machine can have additional allocation of
storage space. And this can be done as the new application dictates. Storage increase should be estimated based on the findings in deliverable 3.

Table 21.0 Projected storage growth

<table>
<thead>
<tr>
<th>Year</th>
<th>NMCRIS New Registrations</th>
<th>NMCRIS Backlog Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>2017</td>
<td>**30.25 GB + (30.25 * 11%) = 33.6 GB</td>
<td>***9,735 GB / 10% Annually = 97.35 GB/YR</td>
</tr>
<tr>
<td>2018</td>
<td>33.6 GB + (33.6 * 11%) = 37.29 GB</td>
<td>9,735 GB / 10% Annually = 97.35 GB/YR</td>
</tr>
<tr>
<td>2019</td>
<td>37.29 GB + (37.29 * 11%) = 41.39 GB</td>
<td>9,735 GB / 10% Annually = 97.35 GB/YR</td>
</tr>
<tr>
<td>2020</td>
<td>41.39 GB + (41.39 * 11%) = 45.94 GB</td>
<td>9,735 GB / 10% Annually = 97.35 GB/YR</td>
</tr>
<tr>
<td>2021</td>
<td>45.94 GB + (45.94 * 11%) = 50.99 GB</td>
<td>9,735 GB / 10% Annually = 97.35 GB/YR</td>
</tr>
<tr>
<td>2022</td>
<td>50.99 GB + (50.99 * 11%) = 56.59 GB</td>
<td>9,735 GB / 10% Annually = 97.35 GB/YR</td>
</tr>
</tbody>
</table>

b. File Storage Reorganization

Ideally, the storage of digital documents should not live on the same server as the NMCRIS application. A file server should host the documentation for the application to upload and retrieve. Additionally, the file structure should be simplified. The current file tree structure places documents in the fourth branch “C:\NMCRISHCPIDocs\To_45999\45001\Approved\*.PDF”. In Windows, a folder stores the index information (links to child files & child folder) in an index file. This file will get very large when you have a lot of children. It doesn’t distinguish between a child that is a folder and a child that is a file. The only difference in the content of a child is either the child's folder index or the child's file data. Over time, as more folders and files are created, the index file will get fragmented. When it gets too fragmented, you will be unable to add files to that folder due to an exhaustion of index fragment limitations. To keep the index from fragmenting, plan to subdivide storage with a max file and folder count of 100,000. If documents were stored based on naming convention within a tertiary branch, the files would have a shorter retrieval path and would not reach the index fragment limit. DCA has indicated that the current fourth-branch structure of “Proposed” and “Approved” folders is not operationally necessary and could/should be removed. Additionally, the current convention creates folders unnecessarily. Hundreds of empty folders exist on the current application server. If the execution of storing documents is scaled back to a tertiary branch in the filing system and did not consist of excessive unused folders, then the files could be easily stored and retrieved by the NMCRIS application.

c. Bandwidth

Bandwidth is a known culprit for latency. When tested, a few DCA locations notably had bandwidth issues. Performing diagnostics and resolving these issues will improve the user experience. For the purpose of documentation and consideration, the following information has been extracted from online sources:
File size / Upload speed = upload time

i. At 1 Mbps up, it will take 1 hour, or ½ of the time of the .512 Mbps.
   \[(3,600,000,000 \text{ MB} / 1,000,000 \text{ bps} = 3,600 \text{ seconds} / 60 = 60 \text{ Minutes})\]

ii. At 3 Mbps up, it will take 20 Minutes to upload, or 1/6 of the .512 Mbps.
   \[(3,600,000,000 \text{ MB} / 3,000,000 \text{ bps} = 1,200 \text{ seconds} / 60 = 20 \text{ Minutes})\]

iii. At 5 Mbps up, it will take 12 Minutes to upload, or 1/9 of the .512 Mbps.
   \[(3,600,000,000 \text{ MB} / 5,000,000 \text{ bps} = 720 \text{ seconds} / 60 = 12 \text{ Minutes})\]

In circumstances where large files are uploaded, then the upload speed tends to matter more than the
download speed. Streaming is an example of requiring greater download than upload. When an
application allows attachments, then upload speeds are dependent on the users upload availability.

On-Network

Users experiencing latency on-network can be resolved by increasing upload speeds. In order to
increase upload for users, DCA should consider applying additional funds toward internet infrastructure
at site locations where speed tests and diagnostics prove poor connectivity or speed results. As a
standard, upload speeds should meet the same speed required for streaming, roughly 5-7MB. However,
a more precise indicator could be determined based on the average upload file size identified in the
functional requirements section and the aforementioned upload times bulleted above.

Off-Network

DCA can do little to diminish latency issues for off-network users with poor upload speed; however, the
information could help inform when sessions timeout. Additionally, NMCRIS could offer guidance via a
helpful UI to inform users current upload status, as demonstrated above with the file attachment UI. If
DCA considers:

\[
\text{average file size 3 MB / upload cap of 50 MB} = \text{max number of files user can upload in current session}
\]

then

\[
\text{session timeout} = \text{max files} \times \text{number of minutes each file takes to upload}
\]

Thus, the timeout is designed to ensure a session is not ended prematurely. However, DCA should
strongly consider the value, if any, a session timeout provides.

d. Index Core Tables

An index is a copy of information from a table that speeds up retrieval of rows from the table or view.
Indexes are paramount to achieving good database and application performance. Poorly designed
indexes and a lack of indexes are primary sources of poor RDBMS performance. One value of an index is
they are smaller than a table. This allows SQL Server to search the index more quickly, so when a query
hits a particular column in a table and if that column has an index on it, the SQL Server can choose to
search the index rather than searching the entire table. If an index is created for primary key columns,
foreign key columns, and columns related to primary searches, then the database can provide results
more quickly. Indexes are also presorted. So, in an alpha or numeric search, SQL Server can discern which direction to begin the search.

e. **DCA User Machines**

Where applicable, DCA users should also have their machines upgraded to ArcGIS 10.6x. Without an upgrade, they will be unable to view the data or services. Additionally, if any users intend to connect to the database directly, then additional software would need to be installed:

i. SQL Server Native Client 2012 (if using SQL Server 2012)

ii. SQL Server ODBC Driver 17 (if using SQL Server 2014 or newer)

f. **Disaster Recovery & Backups**

DCA already conducts regular backups. But if the network for NM suffers a temporary outage or catastrophic failure, the NMCRIS application will cease to be available. A cloud alternative should be considered.

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**Meeting System Adaptability**

Current technology for scalability and resiliency are being realized by many agencies in cloud-based services like Amazon Web Services, Microsoft Azure, or Google Cloud Platform. But DCA has stated that it intends to keep architecture “on premises”. This decision should be reviewed prior to development. But in the case that on premise architecture remains, the solutions for adaptability are summarized below.

**Improve Availability in Current Infrastructure**

The advantage of virtual machines is that they are scalable and easy to built. In the current infrastructure, only three machines currently handle the load of the NMCRIS application. Only two of the machines host the production environment.

a. **File Server**

The current environment stores all NMCRIS HCPI, LA, and related documents on the application server. In a future state, the files should be stored on a file server. A file server is used specifically for hosting files for storage and retrieval. A file server provides several benefits:

i. Separates storage for valuable files from the application server hosting the NMCRIS application. If the application server becomes corrupted, the NMCRIS files are not affected.
ii. Traffic for uploading and downloading files does not affect the NMCRIS application server; as in, the application server resources are not dedicated to the upload and download of documents.

iii. Easily scalable as a virtual machine to meet storage requirements without affecting the application server or database server activity.

iv. It does not perform computational tasks and does not run programs; thus, all resources are dedicated to storage and retrieval.

b. Database Server

The current database server lacks redundancy. Although backups are stored at the State Library and shadow copies are imaged every four hours, neither allow the database server to be highly available. Ideally, a redundant database server should exist for the application to redirect to when the current production database server becomes unavailable. Potentially, DCA could leverage the current test database for a failover. In this case, a process should be implemented to continuously update the test database with production database on an acceptable cadence.

c. Application Server

The current application server lacks redundancy. If the server were to become corrupted or unavailable, nothing exists to ensure the application and components persist. A redundant measure should be implemented to ensure a highly available scenario, for instance, a failover application server. In a VM environment, a failover is a simple instance to create. However, the DCA network could be the single point of failure if the internet goes down. This is where a cloud environment provides additional support. Thus, if the network goes down for DCA, external clients are not affected. Additionally, as the failover would be hosted in a separate region, if the cloud suffers an outage in one region, the failover remains unaffected.

Expanding into Mobile Apps

Current technology is capitalizing on the use of mobile and handheld devices. Programming languages have focused efforts on creating libraries specifically designed to make web applications compatible with a variety of device sizes. For example, Bootstrap is a library designed by Twitter to be highly responsive to varying screen size and screen rotation. Additionally, Esri and Bootstrap have teamed up to create a pilot library where both mapping and web application components can respond to immediate resizing without losing framework integrity. This pilot is called Calcite Maps. Both Esri and Bootstrap rely heavily on HTML/CSS and Javascript to keep the components highly responsive and the reorganization of the web components incredibly intuitive. Neither require additional supporting software installs or special configuration. Additional libraries exist for seamless integration between PC and Mobile when developing web applications. Future iterations of NMCRIS should adopt a library capable of conforming to an increase in mobile users.
Figure 22.0 Architecture future state
Deliverable Documents

Sub 1 – Draft Report  (Andres)
12/27/18  NMCRIS_Design_Report_v1.docx

Sub 2 – Revisions to Draft  (Andres)
2/9/19 NMCRIS_Design_Report_v2

Sub 3 – Submit Final Report  (Andres)
2/22/19 NMCRIS_Design_Report_v3