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Missouri River Basin Explorer Web Application Technical Documentation

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October 2012

Pacific Northwest NATIONAL LABORATORY

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1.0 Introduction

Designed by the U.S. Army Corps of Engineers (USACE) for the Missouri River Recovery Program (MRRP), the Missouri River Basin Explorer is a web-based interactive tool that describes Missouri River processes and natural resources. Since November 2011 when the initial decision was made to develop the Explorer tool, it has gone through numerous iterations prior to being launched to the public in October 2012. Several storyboards were developed into a prototype that was reviewed by basin stakeholders between July 10 and August 8, 2012. Based on reviewer input, the final prototype was revised before being hosted on the Missouri River Recovery Program website.

This documentation provides brief context for the Missouri River Basin Explorer tool, including its purpose and audience, objectives and specifications, its design/layout, and its underlying architecture. The content of this web-based application is driven by the objectives outlined in the USACE Guidance in Section 3.0 and subsequent additions made after consideration of user feedback.

2.0 Purpose and Audience

The purpose of the Missouri River Basin Explorer web tool is to improve communication about and understanding of the Missouri River's natural resources and their ecological integrity by illustrating the relationships between the Missouri River system, the MRRP, and threatened and endangered species' life history requirements, and eventually the human values associated with the river.

The design and presentation of the information provided in the Explorer tool was aimed to meet the broad and basic needs of the public. Although the primary target audience is the general public, the tool will be useful for a variety of users, including resource managers, scientists, and educators.

3.0 Specifications and Assumptions

In March 2012, the USACE provided the following objectives or specifications to help achieve the purpose stated above.

1. The web application should clearly communicate Missouri River ecological processes, stresses, current MRRP management actions, uncertainties, and the relationships between them and with the federally protected species found within the river basin: least tern, piping plover, and pallid sturgeon.

   Specifically, the website should include graphics and information about the following:

   a. Natural Missouri River ecosystem components and processes (river flows, sediment, river habitat, floodplain habitat, plants and animals)

   b. Interior least tern, piping plover and pallid sturgeon life history and habitat needs

   c. MRRP management actions in light of riverine processes (A) and listed species (i.e., physical and biological responses) (B)

   d. Stressors that act on the Missouri River (dams, operations, navigation, channelization, agriculture, urbanization), as they relate to A and B.

   e. Geographic variability in habitats, stresses, and ecological processes throughout the Missouri River basin.

   In addition, to clearly communicate and deliver information to users, the application should encompass the following:

   - easy navigation
   - graphics that are simple, clear, and easy to understand
   - graphics and text that work together to describe all elements mentioned above
   - technical information that is refined for the target audience and provides answers within 3 to 4 clicks of the mouse (if feasible)
   - individual pages that are printable
   - pop-up definitions and beneficial search capability
   - theme, color schemes, and language that are attractive and consistent throughout all pages.

2. The application needs to be compatible with the existing MRRP website functionality.

   - The existing MRRP website is built off of an Oracle Database, and each page is dynamically generated by accessing separate data and representing them on the web page.
   - It was assumed that the audience will access and use this tool on a desktop computer rather than on a mobile device.

3. The application will use conceptual models that articulate pathways from management actions to species-critical needs.

4. The application should be revisable and expandable. As understanding of the river system improves through adaptive management, increasingly complex information will need to be added. The complex information will be built off of the original site design and information, not as an independently separate replacement. To effectively add and refine the information the end product should be adjustable and expandable to include new graphics, revised text, and links or ties to predictive or analytical models.

4.0 Website Design/Layout

To meet product design and communication objectives, a portable Flash-based application was developed. It comprised four main "levels," a term used to describe the hierarchy of the site, or how one navigates through the site to get to specific information:

Level	Description
1	Welcome/Topic Selection
2	Region Selection
3	Interactive Overview
4	Detailed Report

The *Welcome*/*Topic Selection* screen orients users to the purpose of the module and how they can use and access information. It provides the option of selecting from one of five topical categories: Natural Environment, Missouri River Endangered Species, Challenges, Solutions, and Human Values (the last is to be created at a later date). Once a category is selected, a *Region Selection* screen prompts the user to select one of five regions of interest. Selecting a region takes users to the *Interactive Overview*. The *Interactive Overview* provides specific information about the natural environment, Missouri River Endangered Species, challenges (stressors), and solutions (management actions) specific to the region, and it shows links and connections between the elements. *The Detailed Report* provides in-depth information about subtopics in narrative form. Figure 1 depicts the hierarchy of information within and between the levels.

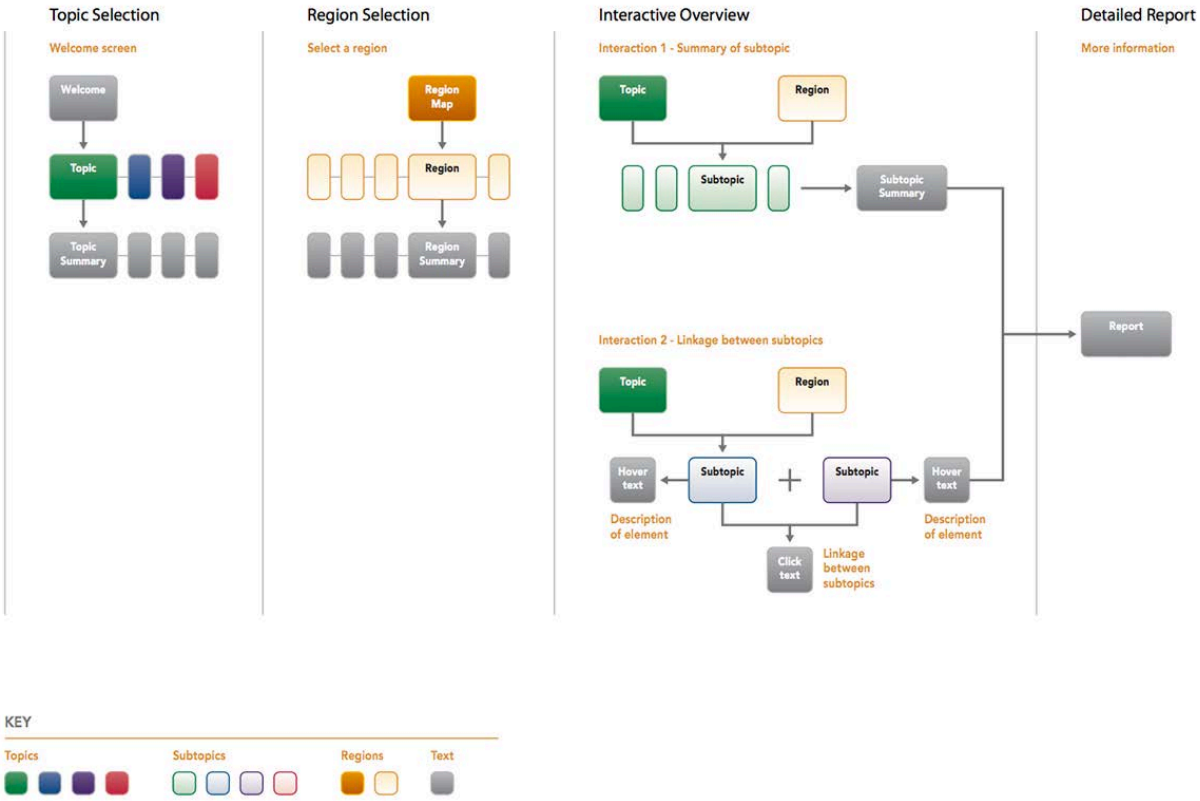


Figure 1. Site Diagram Flow. The elements shaded in gray represent elements for which text is written. Colored boxes show subcategories.

4.1 Welcome/Topic Selection

The *Welcome/Topic Selection* is the entry point to the Explorer tool. It provides a brief visual and narrative overview of the purpose of the tool and elements of the Missouri River Basin Explorer. A welcome paragraph explains what the tool is and its purpose. Buttons for Natural Environment, Missouri River Endangered Species, Challenges, Solutions, and Human Values (to be populated at a later date) provide basic information about what each topical category means and how to navigate to that topic area (Figure 2).

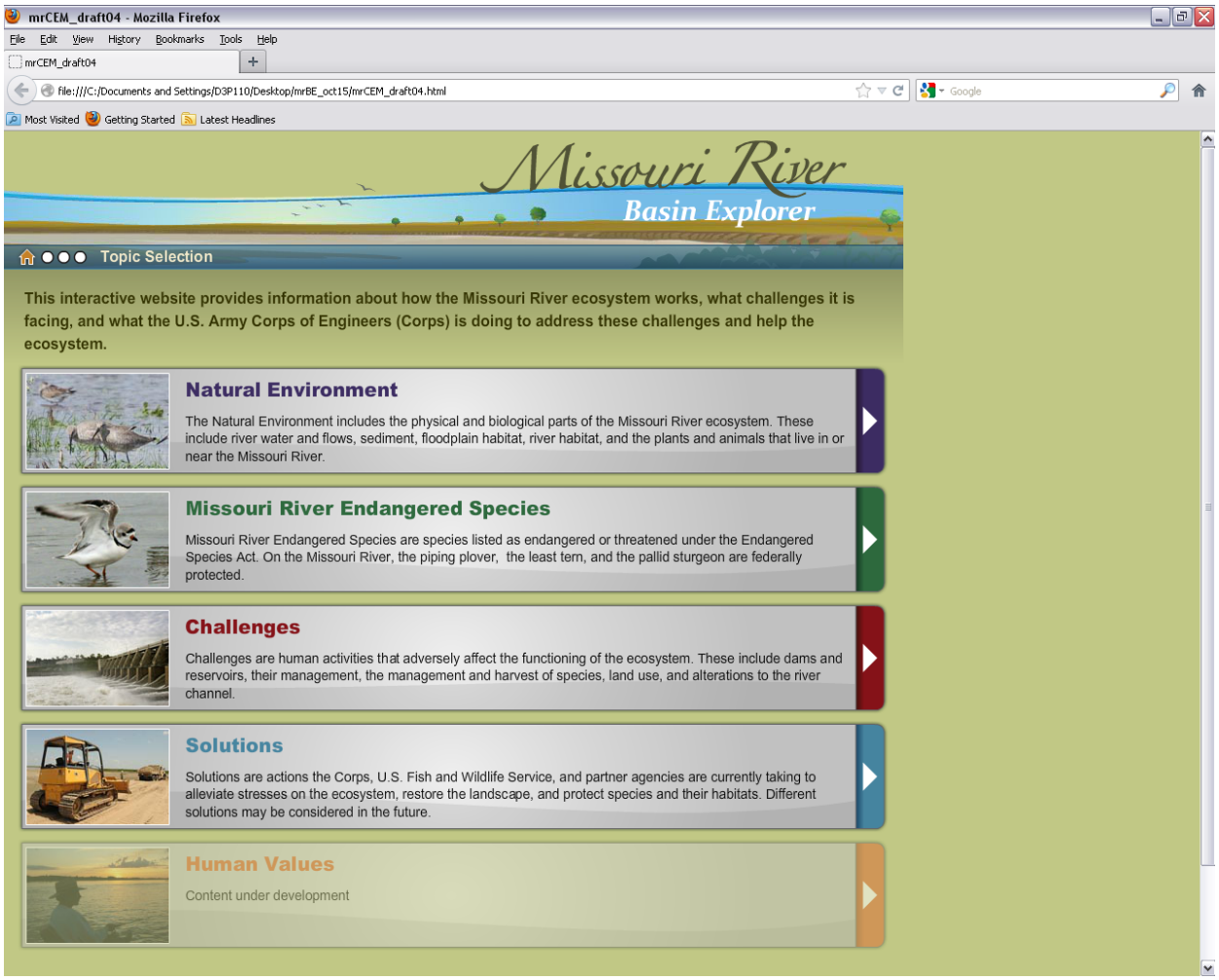


Figure 2. Welcome/Topic Selection

4.2 Region Selection

After users select a topic, a map appears asking them to select one of the five regions of the river (Figure 3). The map provides geographic reference points to aid in region selection. A text box below the map gives a basic description of each selected region.

Figure 3. Region Selection

4.3 Interactive Overview

The *Interactive Overview* provides the general conceptual model—an overview of how the system works in general and specific to each region. This level addresses the criteria described previously in Section 3.0; i.e., Missouri River ecological processes, stressors, current MRRP management actions, uncertainties, and the relationships between them as they relate to the federally protected species: least tern, piping plover, and pallid sturgeon. The application also displays relationships that articulate pathways from management actions to species-critical needs. Also, at the top of the screen there is an instructions tab which provides a brief overview of how to navigate through the interactive portion of the application.

The *Interactive Overview* has two main components: a background image for the selected region and a bottom box. The bottom box includes menus that provide access to Natural Environment, Missouri River Endangered Species, Challenges, and Solutions categories. When one of these elements is selected in the bottom box, color-coded dots for the focal elements and key connected elements in the ecosystem appear on the background image. Hovering the cursor over an icon pops up a short definition of that

element (Figure 4 river habitat popup box). At the same time, a summary of additional information about the element appears in the bottom box, followed by region-specific information about the element.

From the *Interactive Overview*, users can navigate between elements using the menu buttons or by selecting the icons of other components shown on the screen. They can use the region buttons to navigate between regions. Selecting a "more information" link takes users to the *Detailed Report*.

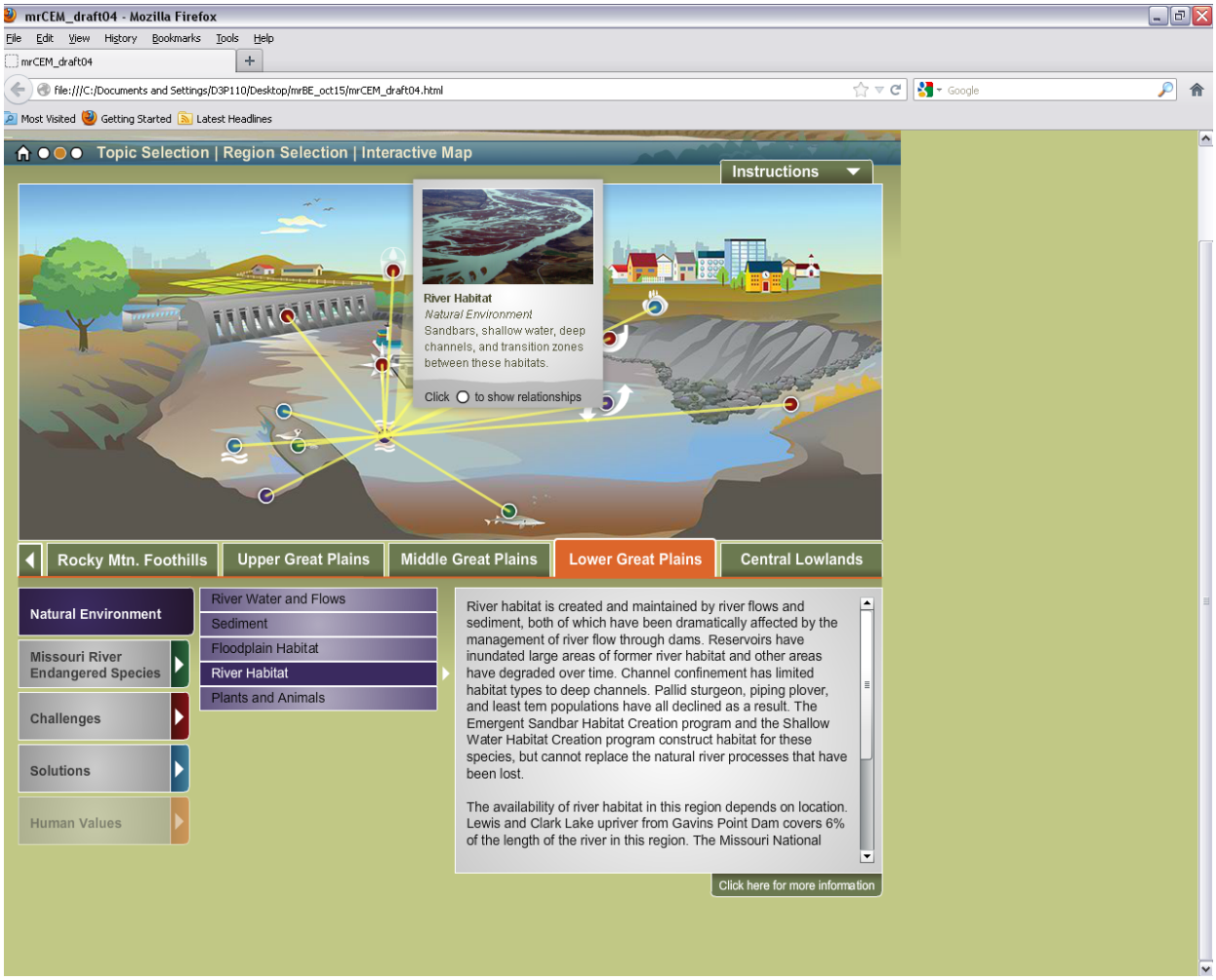


Figure 4. Example of the Interactive Overview Screen, River Habitat in the Lower Great Plains Region Selected

4.4 Detailed Report

The *Detailed Report* contains the full text for each component (Figure 5). The format consists of the full "story" for each component: the definitions and explanation of how the component works and how it fits in the natural environment/species−challenges−solutions action framework of the conceptual model. Text components from the *Interactive Overview* are drawn from this full report. The region-specific descriptions for all regions are also included in this report. The text on this page is available in PDF form. Color-coded links within the *Detailed Report* provide access to full text for other topics.

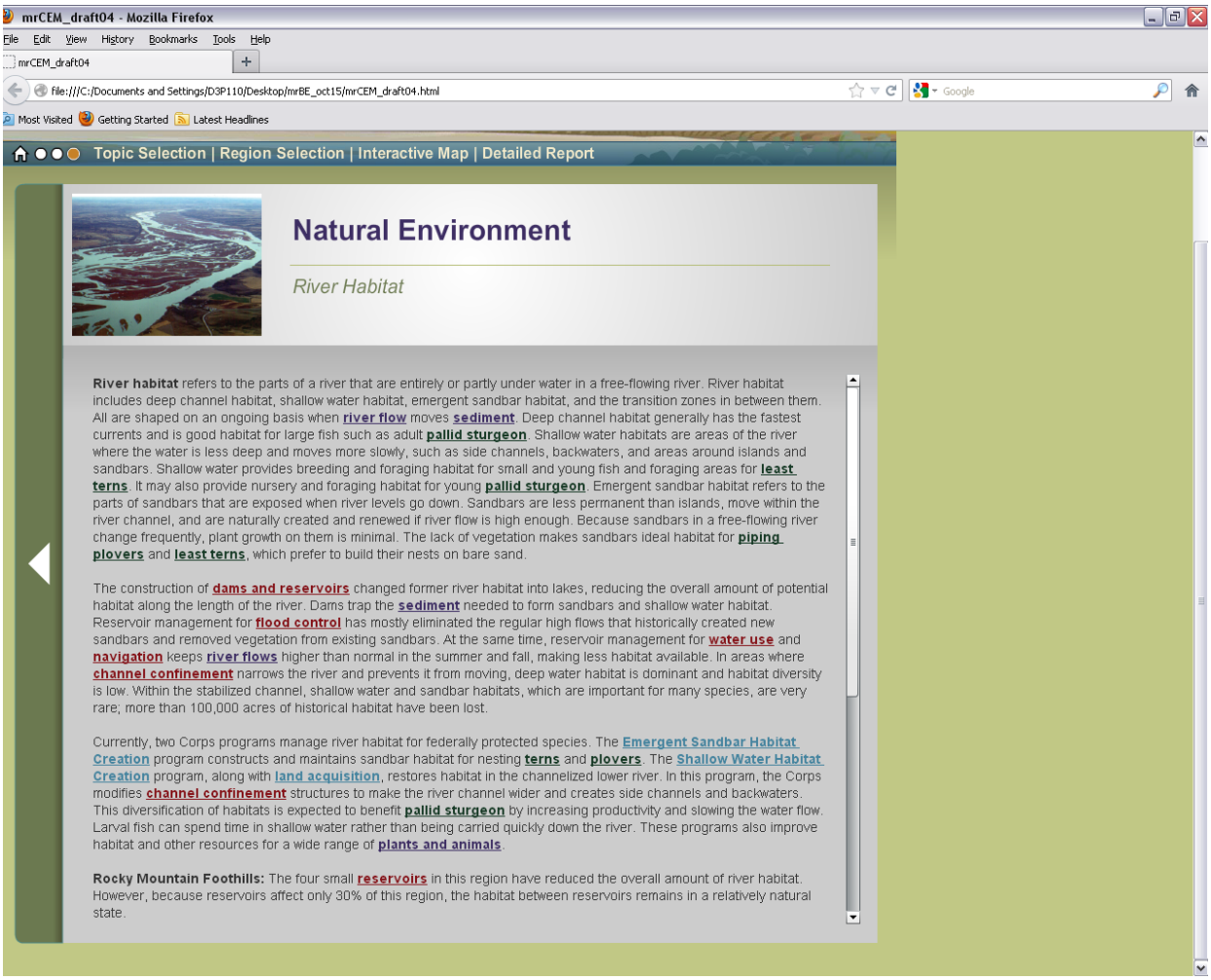


Figure 5. Detailed Report for River Habitat

5.0 Software Program Architecture

The conceptual ecological model for the Missouri River Basin Explorer was developed using Adobe Flash[1] to deliver web content that enables visual interaction with the site. The native flash file is housed on the existing Missouri River Recovery Program website, http://www.moriverrecovery.org. The exported flash content is embedded in a frame on the web page.

5.1 Flash and Its Components

Figure 6 shows a view of the folder structure of files that make up the exported flash content. The application is developed in Adobe Flash using the .fla file. The layout and programming (actions) are defined in this file, which contains the user interface design, including buttons and background images.

[1] Adobe Flash is a software application used to create rich web content. The editable flash file is an .fla file. From this document, an .swf file is exported to use in an html webpage.

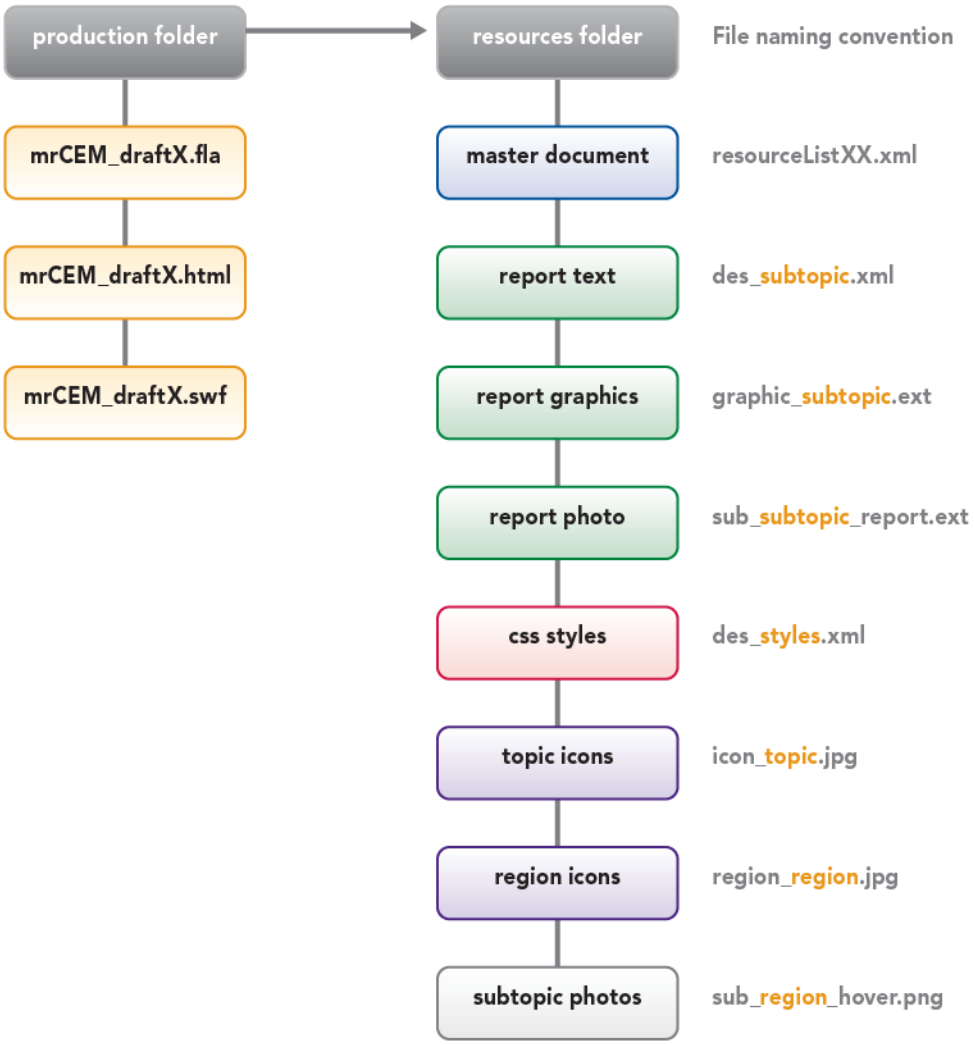


Figure 6. Folder Structure of MRBE Files

The .fla file may contain embedded graphics and text. Under the resources folder, there are some pictures and an .xml file that contains the text. The flash file contains links that reference these assets and bring them into the movie. When the project is complete, a movie is compiled into a (.swf) file. A website like the MRRP's can then bring in the .swf file to be played on its website. This .swf file still references the resource links for text and graphics. If one were to open the .xml file and change the text, one would see the new text in the movie.

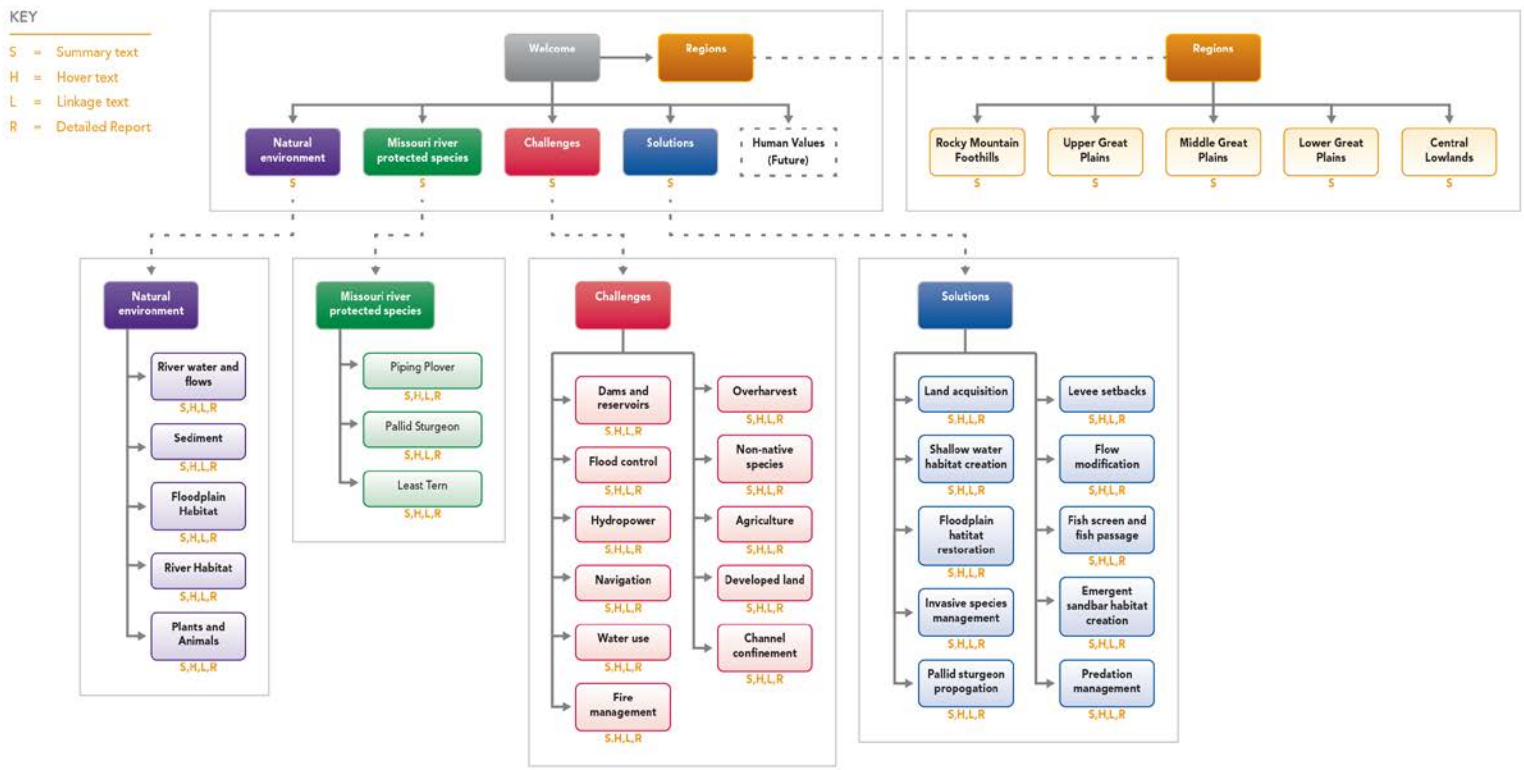
5.2 Missouri River Basin Explorer Web Application Delivery

Project files delivered will look much like the contents of the sample directory (Figure 6) and will provide the ability to directly access most text and graphics. Delivery will include the following:

- a single .swf file
- the original .fla file
- a folder for images/resources. This will help Explorer tool to load faster because many of the assets are stored separately and brought in as needed. The assets can be edited outside of the flash document, so that most edits to text and images can be accomplished without any knowledge of Flash programming. These files include, a main resources .xml file (store text, links, and image file names), .xml files for each detailed report, and image files.
- two .doc files that contain the original text that goes into the XML files. This enables easier review and revision of text which can then be copied and pasted into the XML files. One of the documents contains the detailed reports including HTML code that links to other detailed reports.

Appendix A - Site Map

The following site map depicts the hierarchy of levels within the Explorer tool and the specific elements found within each level. It also describes what type of text is displayed for each element.

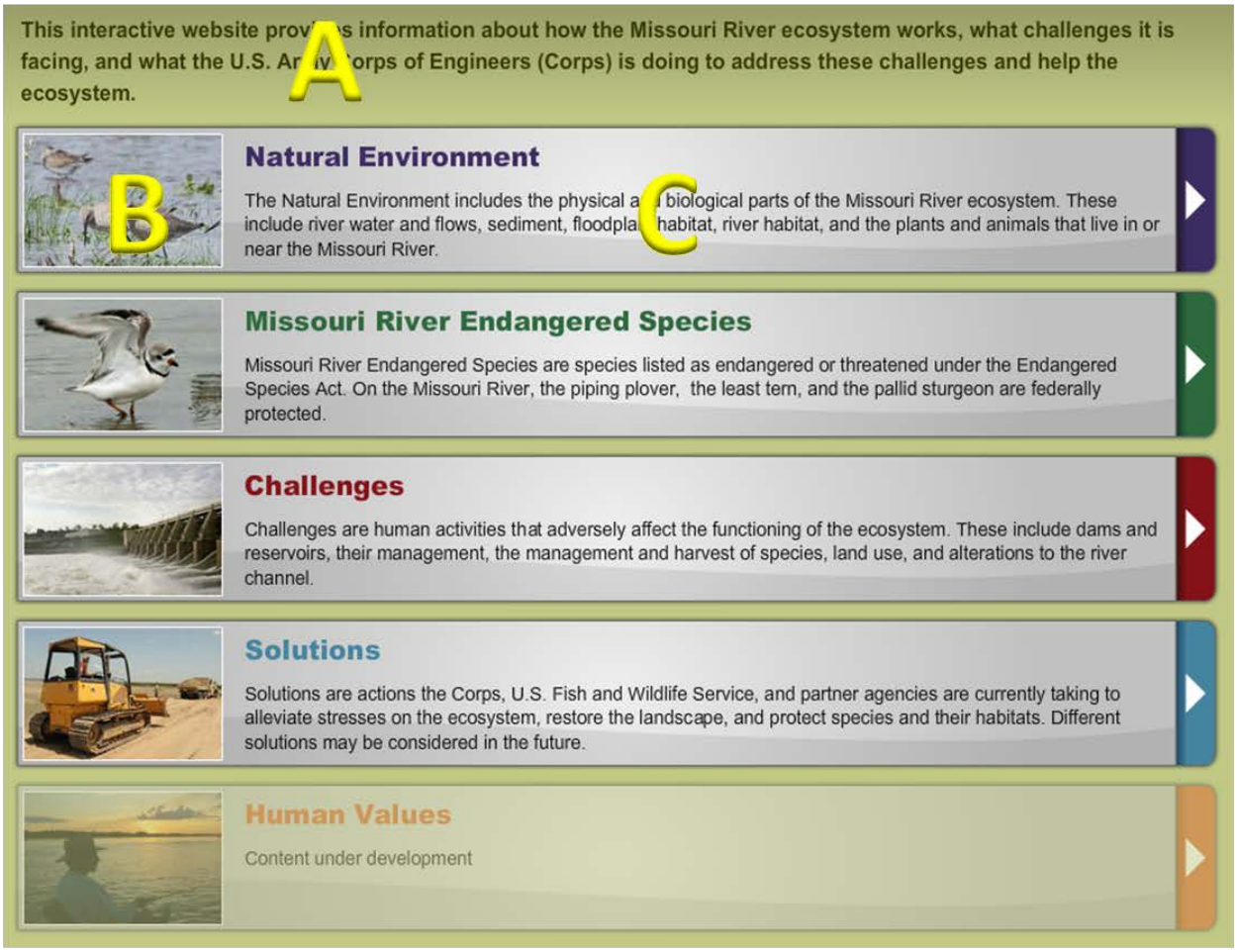


Appendix B - File Structure for Text and Graphics

The following images show where text and graphic elements on screen shots are specified in the html documents. The components for level 1−3 of the module are contained in resourceList03.xml. The components for the full report pages are contained in individual files under the naming convention des_*.xml, e.g. des_riverFlow.xml.

Text can be changed within the XML documents, taking care not to alter the XML tags themselves. Text may also be edited using the associated Word documents and then pasted into the XML file. This is recommended so that an offline copy of the text is maintained for future reference, and so that spellchecking and other resources are available during text changes.

Images can be changed by replacing graphics saved in the resources folder with a new graphic by the same name. The file names are indicated within the clips of XML documents shown below, but those lines of XML should not be altered.



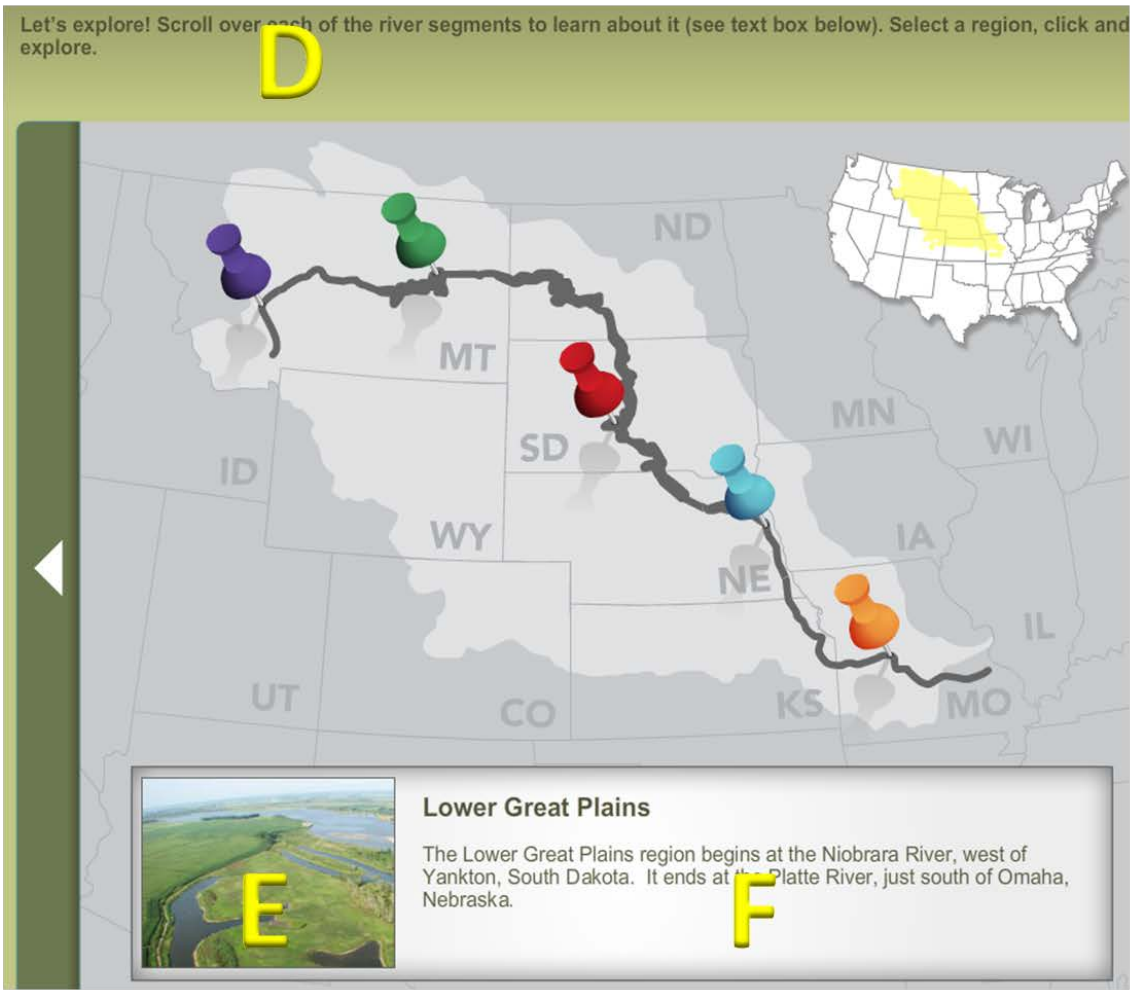
resourceList03.xml

```
<dataList>
  <!-- level 01 Welcome  -->
  <pageLevel pageName="Topic Selection">
     <pageLink><a href='event:Topic Selection'>Topic Selection</a></pageLink>
    <!-- Page text  -->
     <pageHeading>Welcome to the Missouri River Basin Explorer</pageHeading>
     <pageIntro>This interactive website provides information about how the Missouri River
        ecosystem works, what challenges it is facing, and what the U.S. Army Corps of
        Engineers (Corps) is doing to address these challenges and help the
        ecosystem.</pageIntro>
     <pageInstructions>No instructions for this page</pageInstructions>
    <!--  Topic name  -->
    <topicChoice>
       <topicName>Natural Environment</topicName>
       <topicPhoto>icon_ecologicalComponents.jpg</topicPhoto>
       <description>The Natural Environment includes the physical and biological parts of the
          Missouri River ecosystem. These include river water and flows, sediment, floodplain
          habitat, river habitat, and the plants and animals that live in or near the Missouri
          River.</description>
     </topicChoice>
```

A

B

C



resourceList03.xml

```
<pageInstructions>Let's explore! Scroll over each of the river segments to learn about it
   (see text box below). Select a region, click and explore.</pageInstructions>
```

D

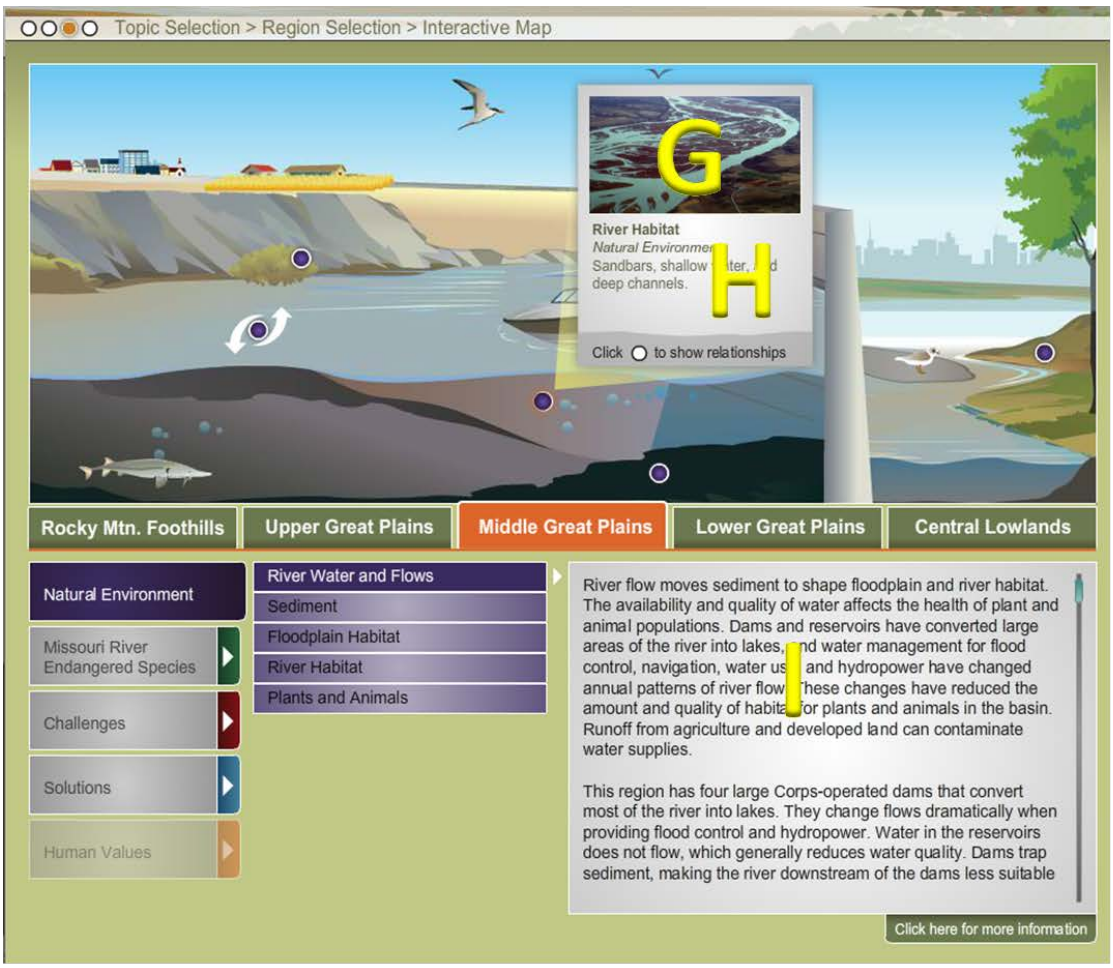
```
<!-- level 02 Region Select  -->
<pageLevel pageName="Region Selection">
   <pageHeading>Select a region</pageHeading>
   <pageIntro>Move your mouse over a river segment for a description of each region.
      Click anywhere on the segment to continue.</pageIntro>
```

⋮

F

```
<region>
   <regionName>Lower Great Plains</regionName>
   <regionText>The Lower Great Plains region begins at the Niobrara River, west of
      Yankton, South Dakota. It ends at the Platte River, just south of Omaha,
      Nebraska.</regionText>
   <regionPhoto>region_lowerGreatPlains.jpg</regionPhoto>
 </region>
```

E



resourceList03.xml

```
<regionsFound regionName="Middle Great Plains">true</regionsFound>
<regionSubtopicText>River flow moves sediment to shape floodplain and river habitat.
  The availability and quality of water affects the health of plant and animal
  populations. Dams and reservoirs have converted large areas of the river into
  lakes, and water management for flood control, navigation, water use, and
  hydropower have changed annual patterns of river flow. These changes have
  reduced the amount and quality of habitat for plants and animals in the basin.
  Runoff from agriculture and developed land can contaminate water supplies. This
  region has four large Corps-operated dams that convert most of the river into
  lakes. They change flows dramatically when providing flood control and
  hydropower. Water in the reservoirs does not flow, which generally reduces water
  quality. Dams trap sediment, making the river downstream of the dams less
  suitable for species that have adapted to muddy water.</regionSubtopicText>
```

I

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H

```
<subtopicHover>Sandbars, shallow water, and deep channels.</subtopicHover>
<hoverPhoto>sub_RiverHabitat_Hover.png</hoverPhoto>
```

G

Natural Environment

River Flows

The **flow of water** determines the character of a river ecosystem. The amount and changes in river flow determine how **sediment** moves, the amounts and types of **river habitat** and **floodplain habitat**, and the types of **plants and animals** that live in and around the river. Water temperature and the levels of oxygen, nutrients, and contaminants in the water also affect how species fare in the ecosystem.

Historically, snowmelt and spring rain caused high water in the Missouri River during the spring and early summer. Water levels usually decreased in the summer to low levels through the fall and winter. Every few years, high levels of snowmelt or rainfall flooded land along the river, changing the shape and location of the river channel in the process. In other years, droughts caused low water levels. Large differences in river flow during a year and between years created an ecosystem adapted to an ever-changing river of diverse habitats including floodplains, sandbars, shallow water, and deep channels. Species native to the Missouri River rely on seasonal and yearly changes in the river flow and temperature to help them grow, migrate, forage, and breed.

Dams have inundated large stretches of the original river channel and floodplain in **reservoirs**, which have little to no flow. The lack of flow changes water temperature and quality. The Corps manages the release of water from the reservoirs for **flood control**, **navigation**, **hydropower**, **water use** and other purposes authorized by Congress before the dams were constructed. Water management has changed the how much water moves down the river and when, changing the amount of water available during different seasons and reducing the number of years in which water is very high or very low. Dam operations for **hydropower** cause frequent and sudden changes in flow when power is generated. By slowing and altering river flow in reservoirs, dams greatly reduce the amount of **sediment** carried downstream. The lack of **sediment**, along with reduced flow, greatly limits natural habitat creation in the river. The **use of water**, especially by **agriculture**, also changes the amount of water available. Runoff from **agriculture** and **developed land** can contaminate river water with nutrients, metals, and toxic chemicals.

Certain **flow modifications** have been considered as a means of restoring some natural processes and timing of river flows.

Rocky Mountain Foothills: In this region, river water is naturally colder and clearer than the water lower in the river. While reservoirs above a series of small dams cover about one-third of the river above Great Falls, the dams have had only a minor effect on water flow and temperature in the river. Because the area is largely rural, there are fewer sources of contamination to affect water quality.

des_riverFlow.xml

```
<report>
  <reportTopic>Natural Environment</reportTopic>
  <reportSubtopic>River Flows</reportSubtopic>
  <reportImage>sub_RiverWater_Report.png</reportImage>
  <reportText> The <b>flow of water</b> determines the character of a river ecosystem. The
    amount and changes in river flow determine how <a href='event:Sediment'><font
    color="#3C2C62">sediment</font></a> moves, the amounts and types of <a
    href='event:River Habitat'><font color="#3C2C62">river habitat</font></a> and <a
    href='event:Floodplain Habitat'><font color="#3C2C62">floodplain habitat</font></a>,
    and the types of <a href='event:Plants and Animals'><font color="#3C2C62">plants and
    animals</font></a> that live in and around the river. Water temperature and the levels of
    oxygen, nutrients, and contaminants in the water also affect how species fare in the
    ecosystem. Historically, snowmelt and spring rain caused high water in the Missouri River
    during the spring and early summer. Water levels usually decreased in the summer to low
    levels through the fall and winter. Every few years, high levels of snowmelt or rainfall
    flooded land along the river, changing the shape and location of the river channel in the
    process. In other years, droughts caused low water levels. Large differences in river flow
```

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