MONTANA STATE LIBRARY
A GREATER STATE OF KNOWLEDGE

**MEMO**

**To:** Montana Geospatial Information Advisory Council

**From:** Nick Youngstrom, DNRC GIS Manager, Matt Trebesch GIS Analyst, Erin Fashoway, State GIS Coordinator

**Subject:** Geospatial Accessibility Best Practices

**Date:** 11/19/2026

The MGIA Council reviewed the *Geospatial Accessibility Best Practices* guidance documents, developed by the Geospatial Accessibility Working Group of the State of Montana GIS Managers Forum, during its September 17, 2026, meeting.

Best Practice Documents Reviewed included:

- *Steps to Evaluate Accessibility for Interactive GIS Applications*
- *GIS Accessibility Guide for Esri Apps*
- *Alternative Text for Static Maps*

Additional Resource Template*: Map and GIS Web Application Accessibility Inventory Template*

The Montana GIS Managers Forum recommends endorsement of the Geospatial Accessibility Best Practices documents as an official best practice. Consistent with the *Montana Geospatial Data Standard Creation and Promulgation Workflow*, these documents are recommended as best-practice guidance for improving accessibility in geospatial products and services.

Recommended frequency of review and notification: The documents should be reviewed annually, with the next review occurring before April 2028. Review and notification efforts will be coordinated through the Montana GIS Managers Forum and the MGIA Council.

**Primary Authors**

| Name | Role | Agency |
|---|---|---|
| Matt Trebesch | GIS Analyst & Working Group Chair | Montana State Library |
| Nick Youngstrom | GIS Manager & MGIAC State Rep. | Dept. of Natural Resources & Conservation |
| Colton Hash | Geospatial Accessibility Working Group | Dept. of Justice |
| Cambria Ewart | Geospatial Accessibility Working Group Member | Dept. of Justice |
| Ellysse Boughey | Geospatial Accessibility Working Group Member | Dept. of Public Health & Human Services |

Intentionally Left Blank

# Steps to Evaluate Accessibility for Interactive GIS Applications

*These steps can be used to test and evaluate common accessibility issues for GIS web applications. This is not a complete checklist for testing ADA Title II / Section 508 compliance, refer to the WCAG 2.1 AA Success Criteria for the full list of requirements.*

## General Considerations for Evaluating Accessibility

*These points may be helpful to analyze GIS apps, but are not specific pass / fail steps.*

### Consider purpose of GIS Application

- How do users access information?
- What is the intended audience of this application?
- What questions can be asked and answered with the data?
- Do all layers or data attributes need to be included?

### Consider importance of GIS Application

- How many people use this application per month?
- Is this application the only way for users to access critical information?

### Consider structural components of GIS application

- Is there an interactive map element?
    - Most interactive maps have inherent accessibility limitations [1]
- Does the GIS application have separate user interface panels?
    - User interface components should meet all accessibility standards
    - User interface should provide alternative access to map data [2]

- Is the application full screen, scrolling page or embedded in a web page?
    - Scaling requirements may be challenging with full screen applications
    - Some layouts with Esri applications are more responsive for small screens
    - Consider the context of the final web page with embedded applications

- Was the application created with a depreciated platform?
    - Old Esri App builders will have limitations for resolving accessibility issues
    - Esri Dashboards, Experience Builder and Story Maps are modern platforms that can create flexible GIS apps with some options to improve accessibility
- Does the application include a feedback mechanism to report accessibility issues?

## Basic GIS Accessibility for Map Elements

*Test visual clarity of map elements for low vision users. Check map controls and widgets for keyboard-only navigation.*

### **Map Colors:** Check map for color-blind friendly palate

- ❑ Check map color palettes for compatibility with common kinds of color blindness
  - Use ArcGIS color blindness simulator or browser extension for testing
  - Red (protanopia), green (deuteranopia) and blue-yellow (tritanoptia) are the most common forms of color blindness (Henning et. al. 2017)

### **Feature Styling:** Analyze symbology of map features for use of color

- ❑ Confirm that map symbology doesn't rely exclusively on color to convey meaning.
  - Use shapes, line styles and fill patterns to differentiate feature symbology
- ❑ Check if map features have 3:1 color contrast ratio with surrounding elements

### **Basemap Selection:** Check application for high contrast basemap

- ❑ Ensure users have an option to use a high contrast basemap
- ❑ Consider making a high contrast basemap the default setting

### **Map Labels:** Check map labels for clarity and contrast

- ❑ Use simple, commonly used fonts for labels
  - Verdana, Arial, Calibri, Helvetica, Tahoma, Times New Roman, etc
- ❑ Use at least 12px font size, and avoid ALL CAPS for labels
- ❑ Use a Color Contrast Checker to verify labels have a 4.5:1 text color to background contrast ratio
  - Consider using a halo for map labels to ensure 4.5:1 contrast ratio

### **Keyboard Navigation:** Test interactive map controls for keyboard-only use

- ❑ Verify that map element has a visible focus indicator when in focus with tab key
- ❑ When map is focused, test that map navigation shortcut keys can be used
  - Can you pan with arrow keys?
  - Can you zoom with + / - keys?
- ❑ Check if all map controls and map widgets have visible focus indicator
- ❑ Check if map controls and map widgets are operable with keyboard only controls
  - *Tab, tab+shift, enter, space, esc and arrow keys may be used*

## Basic GIS Accessibility for Application User Interface

*Test if user interface controls are accessible for sighted keyboard-only users.*

### **Automated Testing:** Run accessibility browser extension to check for warnings and errors

- ❑ Use automated tools to check for basic accessibility issues with user interface
  - Automated tools cannot detect many issues for GIS Applications [3]
  - Esri user interface components should pass all automated checks
  - Currently only WAVE and Axe DevTools are on SITSD Approved software list
  - WAVE does not work well to test Esri Applications
- ❑ Run test tool on all app pages and screen states separately
- ❑ Run test tool on screens displaying error messages
- ❑ Run test tool in direct source url for embedded applications
  - Test tools will not analyze embedded content within iframes

### **Keyboard Navigation:** Test user interface elements for keyboard-only use

- ❑ Check that all interactive UI elements have a visible focus indicator with tab key
- ❑ Verify that focus indicator does not disappear when tabbing through content
- ❑ Verify that keyboard focus does not get trapped in a loop at any point
- ❑ Check that all UI controls are focusable and usable by keyboard-only controls
  - *Tab, tab+shift, enter, space, esc and arrow keys may be used*
- ❑ If full screen popup windows are used, verify that keyboard users cannot focus or interact with elements behind the popup

### **Alternative Data Access:** Verify that all important information shown by clicking on map features is also accessible for keyboard-only users

- ❑ If map elements can be clicked to show additional information, ensure that can users access this same information easily with keyboard-only controls through an alternative interface [2]

### **Links and Buttons:** Verify that links in application are unique and descriptive

- ❑ Buttons that trigger an action indicate the action they perform
- ❑ Links are unique and describe the content they point to
- ❑ Display text for links do not have raw urls or generic text such as "click here"
  - **Example:** "click here to visit the Montana Government Website" should use more descriptive link text, such as "visit the Montana State Website"

## **Image Alt Text:** Verify that important images have alt text

- ❑ Use testing tool or right click and inspect an image to view alt text
- ❑ Use the Alt Text Decision Tree to determine if alt text is required for an image
    - Images and graphics that convey meaning or have a function should have alt text that describes its purpose in relation to the surrounding context
    - Alt text should include any text that is inside of an image, unless that same text is redundant and present nearby in the application
    - Decorative images, or images that contain redundant information should have empty alt text ( alt="" )

- ❑ Buttons containing only icons have an accessible label that describes the function of the button

- ❑ Logos do not need to be fully described by alt text, but should have alt text for links
    - If a logo image is used as a link, alt text should describe the link
    - **Example**: If the seal for the State of Montana is used as a link to mt.gov, the alt text for the logo could be "Montana State Website"

## **Headings:** Chack if cascading heading levels are used to outline content

- ❑ Use WAVE tool Structure Tab to analyze heading structure of application
- ❑ Heading elements are used to outline sections of user interface

- ❑ Application has unique <h1> tag at the top of each separate page
- ❑ Cascading heading structure is used throughout application:
    - <h1> application / page title
        - <h2> main content section
            - <h3> content subsection

## **Sudden Changes:** Check app for unexpected content changes or jarring animations

- ❑ Application does not have rapid, unexpected changes
    - Users should know what to expect from activating user interface controls
- ❑ Application does not contain content that flashes more than 3 times per second
- ❑ Application does not contain animations over 5 seconds that cannot be paused
    - Avoid very rapid and overly lengthy map panning and zooming animations

## Intermediate GIS Accessibility

*Consider users on mobile devices and users who use magnification tools. Consider accessibility of user interface for blind screen reader users.*

> *These points are more difficult to resolve with existing GIS application builders, but should be checked in evaluating accessibility for GIS apps. Many of these checks can only be resolved by editing HTML or CSS code for applications.*

### **Keyboard Focus:** Check focus and reading order of UI elements for logical sequence

- ❑ Use tab key to check that UI elements are focused in a logical order for keyboard and screen reader users
- ❑ Use a screen reader such as NVDA to traverse reading order for application
    - *Arrow keys and h key may be used with NVDA to step through reading order*
    - Structure of HTML code should reflect tab order and reading order

### **Landmarks:** Check if landmark elements used to outline application content

- ❑ Use automated tool to analyze landmark html elements of application
- ❑ Landmark elements are used to outline sections of user interface
    - <header> <main> <footer> <region> <aside> are examples of structural, semantic elements that provide navigational landmarks for web apps

### **Text Settings:** Test application for ability for users to change text settings

- ❑ Use accessibility bookmarklet to test that users can change text settings to 1.5 line spacing, 2.0 paragraph spacing, 0.12 letter spacing and 0.16 word spacing
    - Activating the 1.4.12 Text Spacing Bookmarklet should change text spacing
    - Users will not be able to change text settings for embedded apps in an iframe

### **Skip Links:** For complex applications, verify that skip links are present to provide quick access to important sections of the user interface

- ❑ When tabbing through the top of your application, do skip links appear that move focus to important sections of the application when activated?
    - **Example:** When using tab through the heading, a “skip to data table” link may appear that moves the keyboard focus to a table element

### **Screen Reader:** Test User Interface with Screen Reader Software

- ❑ Use NVDA for windows, Voice Over with Mac
- ❑ Listen to how content is presented as you use tab key to navigate UI elements
- ❑ All UI form fields have labels that are announced by a screen reader
- ❑ Important images and buttons are announced by a screen reader

### **Screen Reader:** Check if map elements are announced to screen reader users

- ❑ Map element has an aria-label that is announced to screen reader users
    - Aria-labels for simple maps can be similar to alt text for a static map image
    - Aria-labels for complex maps could provide instructions to direct blind users to an alternative interface to access map data

### **Responsive Layout:** Test if app works with different screen sizes and web browsers

- ❑ Application layout shifts to preserve content as the browser window is changed
    - Ensure that content does not overlap or that important elements do not disappear when changing window sizes
- ❑ Confirm that application works with different web browsers
    - Test GIS app with Chrome, Edge, Firefox etc

### **Mobile Devices**: Test application on mobile devices

- ❑ Application is usable on Android and iOS mobile devices with different browsers
- ❑ Application is functional on mobile devices in portrait and landscape modes

### **Screen Magnification:** Test application with browser magnification

- ❑ Application scales without hidden or overlapping content up to 200% full-page magnification on a 1280px wide window
    - All text is visible at with 200% magnification
    - Application UI only scrolls in one direction with magnification

- ❑ Application scales without hidden or overlapping content up to 400% full-page magnification on a 1280px wide window
    - Application UI can scroll in one direction with magnification
    - Full-screen apps can be embedded within an iframe with a min-height property to allow for vertical scrolling with page magnification
    - 400% magnification may not be practical for GIS apps

## Advanced GIS Accessibility

*Consider how blind users may be able to directly access and understand data on an interactive map.*

> *These points may not be feasible to achieve with existing GIS software, but should be considered when evaluating accessibility for GIS apps and working towards full compliance. Unless significant work has been done to implement a fully accessible solution for blind users to navigate an interactive map, it is likely that an interactive map component is completely inaccessible for blind users.* [1]

### **Keyboard Navigation:** Test if map features are selectable by keyboard only controls

- ❑ If map features can be highlighted and selected by a mouse, the same actions be done with keyboard-only controls [2]
    - Can keyboard users "click" on a map in a similar way a mouse user can?
    - Or are all clickable interactions accessible with an alternative interface?

- ❑ Map tools used to select, measure, draw and analyze data are accessible by keyboard only controls

### **Screen Reader:** Test Map Element with Screen Reader Software

- ❑ Interactive map elements are announced by screen reader software
    - Interactive map elements should have descriptive aria-label
- ❑ Check if interactive map elements have an aria-role="application" tag
    - This allows screen reader users to use map shortcut keys when the map is focused

- ❑ Navigating the interactive map is understandable with a screen reader
    - Does alt text dynamically narrate content displayed on the map?
    - Aria-live regions may be used to implement dynamic alt text

- ❑ Blind users can understand important geographic and spatial relationships presented within the interactive map
    - Can blind users engage with map data at different extents to learn about spatial relationships between points, lines and polygons?

# End Notes

## [1] Accessibility Issues for Interactive Maps

Interactive maps have inherent limitations for accessibility. The following WCAG 2.1 AA Success Criteria have been identified as difficult to achieve with existing platforms (Biggs et al., 2025).

- **WCAG SC 1.1.1** Maps are primarily visually oriented. Providing an equal purpose, text alternative for maps is complex, but solutions for interactive alt text exist, such as Audiom.
- **WCAG SC 1.4.11** Non-text contrast ratios of 3:1 between all map features may be difficult to achieve for complex maps, especially with semi-transparent and blended layers.
- **WCAG SC 2.1.1** Keyboard Accessibility for maps requires that all functionality of the map is operable by keyboard only controls. Interactive GIS apps often do not allow keyboard-only users to 'click' on a map to select or highlight a feature.

## [2] Alternative Access to Map Feature Data

Ensuring alternative access to information that can be accessed by clicking on a map is important for keyboard-only and blind users (Biggs et al., 2025).

- Tables, data lists, details / feature info widgets and csv downloads can be configured to provide alternative access to GIS data
- Some components, such as lists or feature info widgets, can serve as a keyboard-only alternative method to select or highlight data on a map
- However, these alternatives may not fully satisfy legal requirements for WCAG SC 1.1.1 or SC 2.1.1.
    - For example, a csv download of GIS data does not serve the **equivalent purpose** of **clicking on an interactive map** with a mouse to open a popup displaying additional information. Manually searching through a table with keyboard-only controls is more cumbersome and less convenient than accessing the same information directly from a map.

## [3] Limitations Using Automated Accessibility Checker Tools

Automated tools such as WAVE and Axe DevTools can only analyze HTML code generated for GIS applications, and will not detect many important issues. Automated tools cannot

analyze contents of interactive maps, images, videos or iframes. Manual testing is required to test keyboard accessibility, focus order, contrast of map elements, responsive layouts and reading order for screen reader software. Accessibility Insights for Web is a helpful tool to guide through both automated and manual checks for generic web applications.

## References:


- 2025, W3C Web Accessibility Initiative, How to Meet WCAG 2.1 Quick Reference
- 2025 Biggs, Brandon et al, Systematically Evaluating Digital Map Tools Based on the WCAG
- 2024, Accessibility Guide for Interactive Web Maps, Minnesota
- 2024, Colorado GIS Mapping Accessibility Guidelines, Colorado
- 2017, Henning, Sabine et al, Accessible Web Maps for Visual Impaired Users: Recommendations and Example Solutions
- Esri Accessibility Resources
- Esri Accessibility Documentation Website

Intentionally Left Blank

# State of Montana GIS Accessibility Guide for Esri Apps

This document can be used as the primary guide to improve and remediate accessibility of Esri Online GIS applications.

## Table of Contents

Table of Contents ..... 1
Overview of Accessibility for Esri Web Apps ..... 3
General notes about Esri App Builders ..... 3
Providing Alternative Access to Data ..... 3
Map Viewer ..... 4
General Tips for Map Viewer ..... 4
Symbology ..... 4
Pop-ups ..... 5
Dashboards ..... 6
General Tips for Dashboards ..... 6
Providing Alternative Access to Data with Dashboards ..... 6
Dashboard Layouts ..... 7
Accessibility for Dashboard Elements ..... 8
Experience Builder ..... 10
General Tips for Experience Builder ..... 10
Providing Alternative Access to Data with Experience Builder ..... 11
Experience Builder Layouts ..... 11
Accessibility for Experience Builder Widgets ..... 12
Story Maps ..... 15
Color ..... 15
Story format, style, and links ..... 15
Plain language (required for U.S. Government organization) ..... 15
Alt text for all media ..... 15
Still media and maps ..... 16

Audio and video ..... 16
Instant Apps ..... 17
Important Accessibility Concepts ..... 18
Text and Typography ..... 18
Headings ..... 20
Links and Buttons ..... 20
Images and Alt Text ..... 20
Basemaps ..... 21
Map Feature Styling Requirements ..... 21
Techniques for Map Feature Styling ..... 22
Magnification Requirements for GIS Applications ..... 23
Ability for Users to Change Text Settings ..... 24
Additional Resources ..... 25

# Overview of Accessibility for Esri Web Apps

## General notes about Esri App Builders

- All web content is legally required to conform to all WCAG 2.1 AA Success Criteria
    - The WCAG criteria do not consider the complexities of interactive GIS apps
- All Esri ArcGIS Online app builders create a webpage composed of HTML elements
    - The resulting HTML code is what assistive technology, such as screen readers, interact with and what automated accessibility testing tools check.
- Although you will have limited control over the resulting HTML code of Esri Online apps, you can control what content is included in applications and how content is presented.
- The Esri application specific sections of this document outline steps that you can take to **do the best you can with the tools that are available**
- The Important Accessibility Concepts Section of this document provides additional information for concepts that affect all GIS applications.

## Providing Alternative Access to Data

- All GIS applications should provide an accessible way for keyboard-only users and blind screen reader users to access important information shown in maps
- Many GIS apps contain important information that is only available by clicking on a map with a mouse. This is not accessible to keyboard users or screen reader users.
- Generally, alternative access to map data can be provided in data tables, downloadable csv files, and feature info elements.
- Specific methods to provide alternative access to map data are outlined in this document for Esri Dashboards and Experience Builder

# Map Viewer

**References for more information**

- Accessibility essentials for GIS and mapping
- Sorry, I Can't Read your Visualization (not GIS specific, but good resource)

## General Tips for Map Viewer

- Accessibility for maps elements must be configured in Map Viewer
- Accessibility for popup content elements must be configured in Map Viewer
    - Popup content can be displayed in Maps, Details or Feature Info Elements
- Try to choose a high contrast basemap as the default setting for maps
    - Users should be able to switch between multiple basemaps
- Ensuring proper contrast for map elements is complex, do the best you can
- Remove unnecessary layers and avoid clutter
    - Use scale dependencies to help differentiate between layers
- In ArcGIS Online Content, always give your map a clear title and short summary

## Symbology

- Does your map use only color to portray important information?
    - Use informative symbols to differentiate point features
    - Use line styles to differentiate line features
        - Different line styes for roads, rivers, railways, etc
    - Use fill Patterns and line styles to differentiate polygon features
        - Be aware that excessive use of fill patterns may be distracting or difficult to decipher. It can be difficult to read a label under a pattern.

- Ensure Map colors are compatible with color deficiencies
    - Use colorblind-friendly color palettes when possible
    - Monochromatic palettes can be used as well
    - Esri's color ramp generator
- Ensure colors don't have extreme ranges
- Ensure Adjacent features have 3:1 color contrast ratio
    - This requirement is difficult to satisfy for complex maps, do the best you can
    - For more information, refer to Map Feature Styling Requirements and Techniques for Map Feature Styling Sections
    - Map Labels
- Map labels should follow the same accessibility standards as typography

- Minimum label size is 12px
- Ensure Labels are not at an extreme angle
- Text and background colors should have a 4.5:1 contrast level for labels
    - Use Halos for labels to ensure 4.5:1 text color to halo color contrast ratio. Halos operate as a consistent background for text.
- Reduce clutter by removing unnecessary labels and using scale-dependent visibility
- Allow space around labels and avoid overlapping labels
- Set labels to appropriate visibility ranges
    - Most important labels should be seen first
    - Street names should not be seen at county level etc.
- Refer to Text and Typography Section for more information
- **Note:** Map Labels are rendered as images for Esri Online Maps. Labels will not be accessible to screen readers, and are not html-based text content

## Pop-ups

- Popup contents should have logical reading order. Only include data that is relevant to the final application
- Pop-up content should follow the same accessibility standards as typography
    - Make links unique and descriptive
    - Format lists as list elements
    - Text is aligned to the left
    - Minimum font size is 12px or .75rem
    - Ideal text font size is 16px or 1.0rem
    - Refer to Text and Typography Section for more information
    - Headings within popups should use proper tags in cascading order
    - Popup Titles use <h2> tags, headings within popups should start with <h3>
    - Headings should be concise, understandable and outline content
- Add Alternative text to images and media elements in popups
- **Custom HTML code can be inserted into popup content**
    - This is a powerful way to customize the presentation of important map data
    - Custom formatting and html code should conform to all WCAG 2.1 AA success criteria
- **Note:** Esri Map pop-up frames may not satisfy magnification requirements and may not be mobile-friendly. Map popups are also difffcult to access by keyboard only controls, and do not have a logical tab order if opened from user interface list elements.

- **Alternatively**, popup content can be displayed in Dashboard details elements or Experience Builder feature info widgets, within an application layout that may work better for small screens and scaling requirements

# Dashboards

**References for more information**

- Improving the Accessibility of Your Dashboard
- ArcGIS Dashboards Accessibility Best Practices
- Colorado Example EEAAP for Dashboards (lists Dashboards accessibility issues)

## General Tips for Dashboards

- Dashboards are designed to be compatible with screen readers, such as VoiceOver and NVDA.
- Default dashboard themes meet minimum color contrast requirements
    - Double check for 4.5:1 contrast ratio for all text in final application
- Provide feedback mechanism for users to report accessibility issues
- If charts or graphs are used, ensure that the same data is provided in an accessible format, such as a table.
    - Consider providing a brief description describing important trends in data visualizations
    - Accessibility may improve for charts and graph elements over time
- **Note:** Dashboards are fairly good for accessibility and are being improved. However, layouts have accessibility limitations, some components are configured improperly.
- Dashboard does not have the skip to function like experience builder
- If anything with text does not have an option to change font size and type it is most likely styled in theme

## Providing Alternative Access to Data with Dashboards

- **Data Download** can be enabled for users to download as a .csv for an accessible alternative
    - Many dashboard elements can be configured for data to be downloaded as a .csv file including filtered views or when map elements are selected.
- **Table Elements** can provide alternative access to important data
- **Details Elements** can provide alternative access to feature data from popups

- **Lists Elements** can provide alternative method to highlight and filter data in maps, tables and charts

## Dashboard Layouts

- Make sure the header panel uses h1 heading tag for app Title
    - Only one h1 tag should be present in application
- Dashboard elements should include a title
    - Element titles will have h2 heading tags
- Use the accessible name property for dashboard elements with a short description to provide an accessible label that can be read by a screen reader
- Make sure all layout panels are visible by default, such as expandable side bars
- Tab order is set by the order of elements in a layout
    - Generally, the focus follows top to bottom and left to right flow
    - Starting at the header, sidebar, all elements and the dashboard reset button if present
    - To traverse the layout users can use “tab” key to highlight panels, then access elements within a panel by pressing the enter key, then tab to traverse interior elements
        - This focus order is unconventional, but is fairly intuitive?
- Create a separate mobile layout for small screens
- Minimize the number of columns in your layout
- **Note:** A Major limitation of dashboards is that layout panels can only use % units of screen height and width. This severely limits the creation of responsive layouts for small screens, font-only and browser page magnification requirements.

## Stacking

- Multiple dashboard elements can be stacked in a panel which creates tabs that users can select from. These tabs are keyboard accessible, but lack ideal focus flow
- Can’t change the orientate of where tabs are on the layout, so it is only seen on the bottom
- Tabs have focus

**Advanced Layout Tips**

- Full screen dashboard apps can be embedded into a webpage with an iframe that has min-height property allowing it to switch to a vertically scrolling application on small screens and browsers with page magnification. However, front-end users cannot change text settings of content within an iframe.

# Accessibility for Dashboard Elements

## Rich Text Elements

- Rich Text Elements allow for custom styling and html code, which must follow all WCAG 2.1 AA website accessibility requirements
- Ensure custom headings fit within cascading heading structure for application
    - Title for Rich Text will be <h2>, start content headings at <h3> level

## Tables

- Test table layout on small screens and on mobile devices
- Filter data to remove unnecessary information
- Increase table size to medium if space allows
- All information on tables should be fully visible
- Simple Tables provide accessible access to data
- Utilize field aliases and avoid the use of acronyms

## Maps

- See **Map Viewer Section** for Improving Map Element accessibility
- For Map Elements, allow users to switch between different basemaps such as light, dark and high contrast.
- Avoid very slow and fast-moving animations, repetitive patterns and overly complex effects.
- When connected to a list when an item is selected, it will zoom into the map and then when deselected it will go back to initial point of view.
- Does not allow custom initial view
- Will only show popups if the feature is physically click not on the list
- Can add instructions for keyboard users
    - Limit the use of zoom and pan animations in the map.
- If popups are used, make sure popups only show necessary data.
    - See **Map Viewer: Pop-ups Section** for editing popup contents

## List Elements

- List elements can provide an accessible way for users to select features and filter other elements
- Can skip the list to get to other elements instead of going through the full list
- Lists can provide keyboard only controls to select features on a map
- Lists can include a search field at the top, allowing quick navigation for long lists

- Provide users with instructions for how the list interacts with the application
    - example “select an item from this list to filter data or highlight map feature”

- **MT Editor Note:** Dashboard Lists are implemented poorly as divs with table aria tags with a single column, rather than as a semantic html list element. Lists are not announced by screen readers as a list by default.
    - You should provide instructions for blind users, identifying the list as a List that can be used to select and filter data.
- When elements are selected in the list, a small selection icon is shown on the left, which may be hard to see

## Serial and Pie chart

- Increase text size for the axes titles and levels
- Avoid using only color to show data
- Choose a theme first and then create the chart
- Use series or slice instead of a legend
- Charts may not be fully accessible, provide alternative way to access data
- When you have too many fields it will hide every other labels
- If you set a minimum view, it will only show that amount

## Embedded Content

- Check that any embedded content meets accessibility standards
- Headings within embedded content should align with heading structure of Dashboard Application
- Embedded content should be evaluated in the source URL if using an automated accessibility checker
- Front-end users can not change text settings of content within an iframe.

# Experience Builder

**References for more information**

- ArcGIS Experience Builder Accessibility
- Colorado Experience Builder Accessibility Resources

## General Tips for Experience Builder

- It is recommended that you use full screen and scrolling pages to build accessible apps
- Navigation focus order follows the order in which widgets were added to the canvas. Rearranging the order of elements in the element outline will change focus order.
- Things to help with reflow order
    - Placing elements in column widgets can force resizing widgets for scaling. It can also create padding for elements
- For size and position for some elements you can use stretch and auto
    - Stretch – Automatically set the size based on the size of the widget's container
    - Auto – Automatically set the size based on the widget's content. Use this mode for widgets that display dynamic content
- The text's for some text items size and positions
    - Width – stretch
        - Sets the size to the length of the container
    - Height – auto
        - Stays the same size as the text rem
        - This means the text will resize automatically when the window size changes since it is rem units and rem units automatically resize as the window changes
- If anything with text does not have an option to change font size and type it is most likely styled in theme
- Alternatively, you can click the A11Y button at the lower right corner of the builder and turn on Auto-calculate element tab orders in fixed layout. It is recommended to click this before you start adding widgets.
    - If widgets are already made you can list them as pending and then re-add them in a logical order for keyboard users.
- Enable accessibility settings for each widget
    - Accessible label – provides label for the widget to get read by screen readers

    - Enable in Skip to – tab order shortcut that allows users to jump directly to focusing on this widget in the keyboard tab order
        - This should only be used for a few important sections of app interface

## Providing Alternative Access to Data with Experience Builder

- **Tables** can provide alternative access to important data
- **Lists** can provide alternative method to highlight and filter data in maps and tables
    - Lists can also be configured to display important feature data
- **Feature Info widgets** can provide alternative access to feature data from popups
- **Nearby widgets** can be used to configure a way for sighted keyboard-only users to query features directly on a map
- **Data Download** can be enabled for users to download a .csv for an accessible alternative

## Experience Builder Layouts

- Layouts should be responsive to different screen sizes and orientations
    - Refine separate layouts for Desktop, Tablet and Phone
- Important user interface panels should be visible by default
    - Side Bars should start out as expanded

**Ersi Recommended templates**

- Billboard, Dart, Foldable, Jewelry box, Launchpad, Plateau, Pocket, Tab

**Default themes with optimized color contrast**

- Default, Dark, Ink, Violet, Vivid, Organization shared

**Advanced Layout Tips**

- User interface panels should dynamically adapt to content
- Avoid using % units to size layout containers and panels
    - If possible, it is best to size layout contents with rem units
    - for now use pixels instead, (in multiplies of 8 work best for screens)
- Use Column and Flow Row Components as dynamic containers
    - Flexbox-based containers expand based on the size of contents
    - Stretch can be used for width and height of elements to fill remaining space in columns and flow rows

    - A vertical scroll bar should appear for columns that can not fit all content
    - Layouts should scale without hidden or overlapping content with browser magnification and font-only zoom

- When possible, use Auto for height of components within column Elements
    - Components should scale with font-only zoom
- Full screen experience builder apps can be embedded into a webpage with an iframe that has min-height property allowing it to switch to a vertically scrolling application on small screens and browsers with page magnification. However, front-end users can not change text settings of content within an iframe.

## Accessibility for Experience Builder Widgets

Listed widgets will have extra accessibility steps

- Maps
    - See **Map Viewer Section** for Improving Map Element accessibility
    - For Map Elements, allow users to switch between different basemaps such as light, dark and high contrast.
    - When connected to a list when an item is selected, it will zoom into the map and then when deselected will go back to initial view
    - Can dock popup but it doesn't have much flexibility
    - Can not select map elements with a keyboard
    - WAVE tool can't see map
- Feature Info
    - See **Map Viewer: Pop-ups Section** for Improving Map Element accessibility
- Chart
    - Scrollable to zoom into different elements of the chart can use a keyboard as well
    - Can download data for alternative access
    - Cannot select items with a keyboard to view details
    - WAVE tool can't see chart
    - If text label is too long you are unable to view it
- Column
    - Add padding to display the focus ring for widgets inside a column
- Coordinates

    - Obtaining the coordinates from the map is not supported by the keyboard
- Directions
    - Reordering stops and adding stops by clicking the map are not supported by the keyboard
- Draw
    - Drawing on the map is not supported by keyboard
- Image
    - You can manually add alt text to images
- List
    - You can use the Esc key to exit a dynamic list
    - Can use rem units which is recommended units for the reflow requirements
    - Can assign heading tags
    - Accessible labels which describe the widget for screen readers
    - Enable in Skip to – table order shortcut that allows users to jump directly to focusing on this widget in the keyboard tab order
    - No option to add a header
        - Workaround: You can place a text element in the layout for instructions
    - Can not have a background color, it will not show the focus order




    - **You have to go through all items on the list to move to the next element**
- Map layers
    - Use left and right arrow keys to expand and collapse group layers
    - You can use the space and enter key to reorder layers with the reorder drop-down menu options
    - After you perform an action, keyboard focus may not return to the options button automatically
- Button
    - Avoid icon-only buttons without labels
    - Shows focus
    - The order the buttons are placed is how the focus order sees them
    - Very difficult to create a logical focus order
- Print

    - Only Classic mode is supported
- Swipe
    - Advance templates are not supported by the keyboard
- Table
    - Selecting table records is not supported by the keyboard
    - Can download data for alternative access
    - Can use keyboard to navigation but it is clunky
    - Will show focus but you have to tab through each element of the table
- Text
    - You can define heading levels in the widget setting under text format
    - Can use rem units which are the recommended units for the reflow requirements
- Timeline
    - Moving the slider is not supported by the keyboard
- View navigation
    - Quick styles slider, arrow 1 and arrow 3 are not supported with screen readers
    - Can use with keyboard but has no focus order

# Story Maps

**References for more information**

- ArcGIS StoryMaps Accessibility Checklist

## Color

- Can create a custom theme in theme builder which allows for color on the spectrum for the background, text and other design elements
- StoryMaps has a built-in contrast checker

## Story format, style, and links

- Consistent layout using short headings and subheadings (create screen reader navigation structure)
- Font styles are easy to read, legibility of serif vs sans serif (subjective)
- Theme is accessible, has sufficient color contrast
- Time awareness, aim to keep reading time under ten minutes
- Links have a short, meaningful descriptions, website is named in hyperlink or within the sentence (do not use “click here” etc.)
- Reading time is under 10 minutes

## Plain language (required for U.S. Government organization)

- Uses simple terms, consult PlainLanguage.gov for the complete Plain language guidelines
- Language is accessible, word choices or idiomatic expressions may affect understanding and translations
- Reading level is accessible for audience, uses short sentences and simple words unless adding definitions
- Meets organizational inclusive language guidelines

## Alt text for all media

- “Object” + “Action” + “Context” structure, may be a short phrase, no punctuation
- Uses 140 characters or fewer for simple media, complex media balances useful context and brevity
- Describes the media in the context it appears, doesn’t repeat caption, running text, or add conclusions

- Limited embedded text, all text embedded in graphics included in alt text regardless of length

## Still media and maps

- Image gallery blocks include contextual alt text describing all content within the gallery
- Charts, graphs and tables including title caption, headers axis labels, no merged, split, or blank cells
- Alt text describes maps purposes if not already covered in running copy
- Simple map alt text uses known reference points example from Penn State University's New England map
- Consistent all text formatting for complex maps ArcGIS Blog example
- Charts and graphs will use high –contrast colors
- Charts and graphs have alt text

## Audio and video

- Has alt text describing ambient sounds or has text transcript for spoken words
- Includes video captions or VTT transcript in accessibility settings
- Closed captions enabled on YouTube videos

# Instant Apps

**Important Note: To further customize instant apps, you need to turn off express mode**

**References for more information**

- Advanced Workflows for Building Accessible Instant Apps
- Calcite Design System Foundations

- Add alt text to images using HTML in rich text editors
- Change keyboard focus indicator color with custom CSS
- Set custom theme colors with a built-in color contrast checker to ensure legible text for users with visual impairments
- Include map descriptions to provide the option to add a text description of your map or scene that will be read by the screen readers
- Enabling the shortcuts menu
    - App adds a tool with a list of keyboard shortcuts available for interacting with the map
- Contrast verification in theme editor
    - Theme editor allows app authors to choose from a set of preset theme colors or create their own
    - Contrast ratio of the text and background color appears next to the theme colors to confirm

# Important Accessibility Concepts

- There are many important accessibility concepts that apply to all web content, whether it is an interactive GIS application, webpage or document.
- As there are few in-depth resources for how accessibility concepts apply to GIS applications, the following sections provide additional information.
- When learning more about GIS Accessibility, it is important to understand how different accessibility concepts relate to the WCAG 2.1 AA Success Criteria, which are the legal standards agencies must meet for ADA / Section 508 Compliance

**Additional Resources for GIS Accessibility Concepts**

- Esri Accessibility Documentation Website
  - This is a good starting point to learning more about accessibility concepts
- Colorado GIS Accessibility Resources
  - Overview of general concepts for GIS Accessibility
- Minnesota Accessibility Guide for Interactive Maps
  - More indepth information for accessibility concepts
- Audiom / XR Navigation Blog
  - In-depth research and analysis of GIS accessibility, practical examples of alternatives

## Text and Typography

- Accessibility concepts for typography apply to all text in map labels, popups, user interface components, web page content and pdf documents
- Editing text properties is an important tool to improve readability of information
  - With Esri App Builders, **you will have limited control to change some text properties** such as line height, character spacing and size with rem units
  - You will have full control of html text properties when editing Rich Text Elements or popup content that can be displayed in maps, Dashboard Details and Experience Builder Feature Info elements

### Text Contrast:

- **WCAG SC 1.4.3 Contrast** requires high contrast for text color and backgrounds
- Small text should meet 4.5:1 foreground to background ratio
  - For map labels, halos can be used as a consistent background color
  - Otherwise, label text would need to be tested for all underlying content in all cases

- Large text can have 3:1 foreground to background ratio
    - Large text is generally defined as 18px bold or larger or 24px or larger
    - The difference between large and small text depends on what font is used

## Text Styling:

- **WCAG SC 1.3.1 Info and Relationships** requires that text is styled appropriately
- Underlining should only be used for hyperlinks
    - If text is not a link, do not make text look like a link
- Bold should only be used to convey important information
    -  tag is narrated to screen readers, <b> tag is not
- Lists of information should be formatted as lists using HTML list tags
    - Use numbered, Ordered Lists <ol> if the order of items is important
    - Use Unordered Lists <ul> if the order of items is not important
    - Nested lists can be used to create a sub list for a particular list itme
        - The tags for the nested list should be contained in the parent <li></li>

## Typography Best Practices

- The following points are not specific WCAG requirements, but are general best practices for accessibility
- Use left justification for blocks of text
- Use simple, commonly used fonts such as Arial, Calibri, Helvetica, Tahoma, Verdana, Times New Roman, Georgia, Book Antiqua and Palatino
- Avoid ALL CAPS
- Aim for 16px (1.0rem) as a base font size
    - Consider 12px (.75rem) as minimum font size for GIS applications

## Advanced Text Requirements

- The following points are defined under WCAG 2.2 AAA Success Criteria
    - AAA is not part of the current ADA Title II or Section 508 requirements
- Reading Level
- Define abbreviations and acronyms, avoid industry specific jargon
- Do not use Full text justification
- Ensure users can apply Font-only text scaling up to 200%
    - This can be tested in Firefox with the Zoom Text Only setting enabled

## Headings

- Headings in web pages and web applications provide a way for screen reader users to quickly understand and navigate content
- The heading levels of the final web page should be in a cascading order, starting with a single <h1> tag at the very top of the web page or application
- If the web application contains multiple pages, a unique <h1> tag should be used as the title of each page
- Proper heading levels will depend on the final context of the web application, and may be different for full screen apps, story maps, and embedded apps

## Links and Buttons

- **Links** in any part of an application should be unique and descriptive, describing the specific resource they point to
    - Links navigate to a new web page, or jump to a location on the web app
- **Buttons** should have text that describes their function in plain text, or an accessible label that is announced to screen reader users
    - Buttons perform an action or a function on the web app
    - Buttons should be styled differently than links

## Images and Alt Text

- Any image, icon or graphic should have a text alternative if it serves a purpose
    - Alt text should be provided for images that describes the purpose of the image in the surrounding context
- Alt text should include any text that is contained within an image
- Decorative images, or images with redundant information, do not need alt text
- Graphs and charts should have alt text that describe important trends
    - If possible, include data for graphs and charts in text or a table
- Use the Alt Text Decision Tree to determine if alt text is needed for an image
- **Static images of maps** should have alt text describing important relationships and information shown in the map
- **Interactive maps** can have alt text that identifies the map as an interactive feature and directs blind users to an alternative interface where they can access map data

## Basemaps

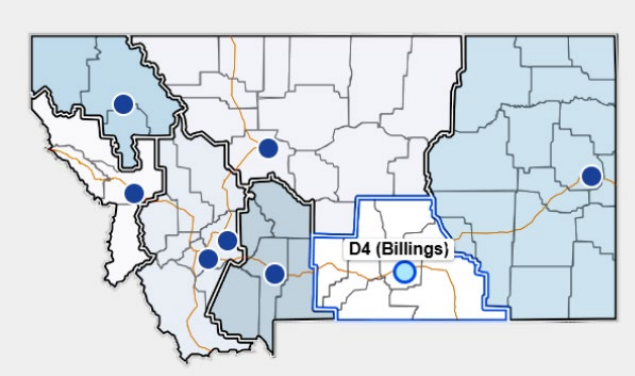
- Applications should allow users to choose between basemaps, including
    - Light enhanced contrast basemap
    - Dark enhanced contrast basemap
    - High contrast basemap
- Make sure Important labels are clearly visible at appropriate scale levels
    - Cities
    - Important landmarks
    - Major roads
    - Emergency Services
- Use the Esri Vector Tile Style Editor to modify basemap colors, label typography, feature visibility and remove unnecessary content
- Consider how features overlayed on top of basemaps will affect contrast and clutter

## Map Feature Styling Requirements

- WCAG **SC 1.4.1 Use of Color** and **SC 1.4.11 Non-text Contrast** apply to how map features are presented to users
    - Color should not be used as the only means of conveying information or distinguishing a visual element
    - Parts of graphics required to understand the content should have a contrast ratio of at least 3:1 against adjacent colors
- It should be assumed that these requirements apply to the final composition of map layers as displayed on a user's screen
    - Overlapping elements and blending modes will affect contrast and coloring of underlying elements
    - Partially transparent or opaque layers within maps may reduce the contrast of basemaps
- Using color-blind friendly palates is not a strict requirement, but is an important consideration
    - As long as color is not the only means to convey information, colors that are not color-blind friendly may be used

## Techniques for Map Feature Styling

- Use a combination of color with different line, point and shape styles
- You can use commonly understood Icons to differentiate point features
- Map Viewer Layer Effects may be used to highlight and increase contrast of features
- Blending modes such as multiply, screen and overlay can be used to preserve contrast, but work differently depending on underlying elements
- Oreo Borders may be used for polygons to differentiate features
    - Overlapping oreo borders should be tested
- Advanced feature styles for webmaps can be imported from ArcGIS Pro




Example of map with Oreo Borders (ensures 3:1 contrast between adjacent polygons)




Example of basemap with multiple line and polygon styles with 3:1 contrast ratio and color-blind friendly pallet

## Magnification Requirements for GIS Applications

- Applications should satisfy both **WCAG SC 1.4.4 Resize Text** and **1.4.10 Reflow**
- Users should be able to use 200% full-page browser magnification to double the size of text and increase the size of layout elements within a 1280px wide window
- The Full WCAG SC 1.4.10 requirements specify that applications should also scale up to 400% with full-page browser magnification within a 1280px wide window
    - This is the equivalent of a 320px wide window, a standard minimum viewport width for mobile devices
    - 200% full page magnification may be a more practical goal for GIS applications
- With page magnification, application pages are allowed to scroll vertically
    - Elements such as large tables can scroll side to side if they are within a separate, scrollable container
- Full page applications, which is the default for some Esri Apps, are likely to severely fail browser magnification requirements
- Full screen applications can be embedded into a webpage with an iframe that has min-height property allowing it to switch to a vertically scrolling application on small screens and browsers with page magnification.
    - However, front-end users can not change text settings of content within an iframe, see the following point for Ability for Users to Change Text Settings.

## Ability for Users to Change Text Settings

- **WCAG SC 1.4.12 Text Spacing** requires that users have the option to change text to the following settings:
    - Line height (line spacing) to at least 1.5 times the font size
    - Spacing following paragraphs to at least 2 times the font size
    - Letter spacing (tracking) to at least 0.12 times the font size
    - Word spacing to at least 0.16 times the font size
- These text settings are not required by default, but rather that users can override styling to apply these settings
    - Avoid changing text spacing properties in html <style> or style="" tags
    - Avoid use of !important for text spacing properties in css
- Plugins such as the 1.4.12 Text Spacing accessibility bookmarklet can be used to test this capability
- Embedded applications may not pass this test, as users generally can not override css settings of content within iframes
- Agencies may need to choose between using iframes to allow for page magnification, or default Esri hosted full screen apps that allow for User defined text spacing.

# Additional Resources

- Compiled Esri App Resources from Accessibility Working Group: Esri Resources
- Esri Accessibility: Accessibility Resources | Accessibility Standards & Guidelines
- Esri Accessibility Documentation Website
- Colorado GIS Accessibility Resources
- Colorado GIS Accessibility Checklist
- Minnesota GIS Accessibility Resources
- Minnesota Accessible Map Training
- Minnesota Accessibility Guide for Interactive Maps
- NSGIC GIS Accessibility Resources
- University of Virginia GIS Accessibility Resources
- Audiom / XR Navigation Blog
- Systemically Evaluating Digital Map Tools Based on the WCAG

Intentionally Left Blank

# Alternative Text for Static Maps

Alternative text is a written description of visual content, including static maps, on web pages. It allows people who use screen readers to understand images and other non-text elements.

The following information was sourced and/or adapted from the Washington's GIS Accessibility Workshop, Colorado Office of Information Technology and Minnesota IT Services.

## Getting Started

Colorado's OIT-GIS suggests that alternative text should provide an overview of the map, with the level of detail adjusted based on the map's complexity and its surrounding elements, such as descriptions and data tables. It's recommended to include a description near the map itself, not just in the alt text, as this makes the information accessible and understandable to all users. This description should explain the map's purpose and what it depicts. For complex maps, include the key findings and outcomes. With a detailed description, the alt text can be brief, such as noting the type of map and then referencing the more detailed descriptions.

Use the W3C's alt Decision Tree to determine how to use the alt attribute of the HTML <img> or pdf <figure> element in various situations.

## Know Your Visual

Before writing alt text, it's important to understand what type of visual you're working with. Washington's GIS Accessibility Workshop categorized visuals into three types, each with different alt text requirements.

- **Decorative:** Elements used only for visual style (e.g., background texture, divider line). Mark these as decorative or with empty alt text (alt=""). If you use a null (empty) text alternative (alt="") to hide decorative images, make sure that there is no space character in between the quotes.
- **Informative:** Visuals that convey information (e.g., logo with agency name, simple chart, locator map). Describe the key meanings in your alt text for these visuals.
- **Functional:** Visuals that act like controls (e.g., search icon, layer toggle). Describe the action the visual performs in the alt text. This is more applicable to **interactive** maps.

## What Not to Include in Alt Text

Colorado's guidelines specify that map elements like north arrows, scale bars, and legends should not have alternative text in static maps. If these elements are essential to understanding the map, incorporate their function into the overall map description instead.

Additionally, avoid these common mistakes:

- Don't start alt text with "Image of…" since screen readers already announce images. In some situations, it may be important to distinguish between paintings, photographs, or illustrations, etc., but it's best to avoid the more generic use of the terms.

- Don’t include an entire dataset or the data summary in the alt text.

## Alt Text Should Not Include Redundant Information

You should consider the context of the image with adjacent information in a document or webpage. If the same information shown in a map is presented nearby in a document or web page, redundant alt text is not required. In this case, you can use an empty alt attribute, or include alt text that directs blind users to where the information is located.

**For example**, the Montana DCI Major Case Section Webpage includes a map with contact information for administrative regions and locations of offices. This same information, including a list of all counties within each region, is provided above the map on the web page as plain text.

The Alt text for the static map is set to: *“Map of Montana divided into Western and Eastern Regions for DCI Major Case Section. All information in map is listed above on this page.”*

## The Alt Text “Recipe”

The alt text of the map should capture the “so what” or the key takeaways users need to understand. Washington recommends this formula:

1. What it is (type + geography)
2. What it shows (variables, time)
3. Key pattern (highest/lowest, clusters, trend)
4. How to get exact values

**Example:** Choropleth map of Washington counties showing 2024 unemployment rate. Highest rates cluster in ABC county. Download the data below.

**Table 1: Examples of alt text improvements**

| Before | After |
|---|---|
| **Map of Washington** | Map of Washington counties showing 2023 wildfire risk index. Highest risk in abc and xyz county. See the table below for county risk index values. |
| **Chart** | Line chart of monthly 911 calls (Jan – Dec 2024). Calls peak in July and decline thereafter. |
| **Img_2496.png** | Washington State Department of Housing logo. |

## Use Plain Language

Remember to use plain language in the alt text and throughout your map. Start with the essential information, make it clear, and design for readability. Also, make sure to use punctuation in the alt text and appropriate space characters; add space characters in the alt text when there’s no space character between the image and adjacent text.

**Table 2: General plain language translations provided by Washington's GIS Accessibility Workshop**

| Before | After |
|---|---|
| **ACS 5 YR DP03** | Income and Employment (American Community Survey 5-year Estimates) |
| **Census Tract Centroid** | Center point of the area |
| **Impervious surface (%)** | Percent of land covered by pavement and buildings |
| **Percentile rank (index)** | How this area compares to others (higher = more burden) |
| **Polygon feature layer** | Mapped area boundaries |
| **Pop-up** | Details panel *(Other options can include detail window or more details)* |
| **SVI (CDC) – Census tract level** | Social Vulnerability by Neighborhood Area |
| **Quantile 5-class** | Darker = higher vulnerability |

## When Alt Text Must Stand Alone

If alt text cannot reference nearby descriptions, Minnesota's guidance notes that it must fully convey the map's message. However, they caution that alt text is hidden from most users and may be overlooked when updates are made to the map.

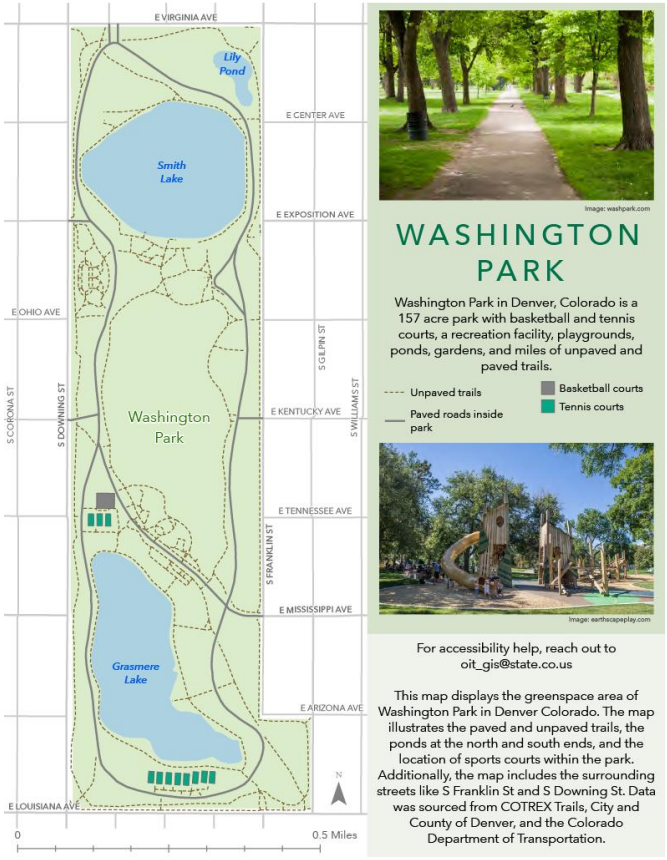
## Including Data Tables

For simple maps with small datasets, Minnesota recommends including a data table following the map. In these cases, the alt text can simply reference the table (for example: "Map 1. See Table 1, page 6"). Ensure the linked text matches the table title. For larger or more complex tables, link to an appendix, website, or spreadsheet/CSV file instead.

## Determining Detail Level

The amount of detail to include in alt text depends on what other information surrounds the map. According to Minnesota's guidelines, if data tables cannot be included, describe what the map conveys in body text or a caption immediately before or after the map. The alt text can then briefly reference the figure number and map type. Always arrange all elements in a logical reading order.

## Additional Examples

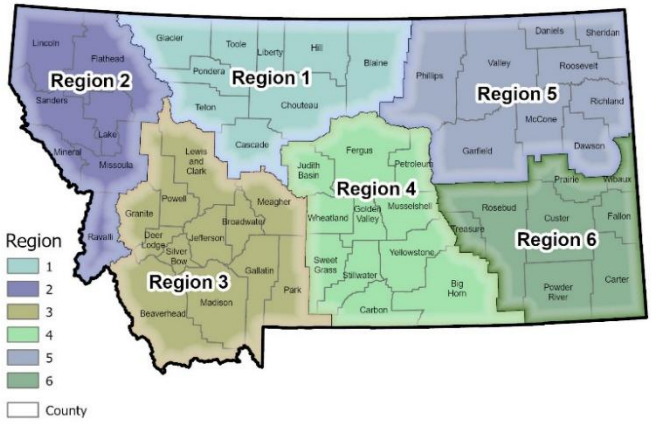



**Example provided by Colorado**

**Alt Text:** Map displaying the extent of Washington Park in Denver, Colorado, and the park's trails, ponds, and sports courts. An unpaved trail and paved road follow the perimeter of the park. At the north end of the park, there are two bodies of water: Lily Pond and Smith Lake. At the south end of the park lies Grasmere Lake and 8 tennis courts. Between Smith Lake and Grasmere Lake is a large grass area, 3 tennis courts, and basketball courts. The park is filled with a network of unpaved trails that follow the perimeter of both lakes, the playgrounds north of Grasmere Lake, and the large grass area in the park's center. The park borders South Downing Street along the western boundary, East Virginia Ave along the northern boundary, South Franklin Street along the eastern boundary, and East Louisiana Ave along the southern boundary.

**Fictional example created by the Geospatial Accessibility Working Group of the GIS Managers Forum**

Alt Text: Map of Montana prevention specialist regions by county. See list on the following page.




List of Prevention Specialists by County

**Region 1**
Blaine, Cascade, Chouteau, Glacier, Hill, Liberty, Ponder, Teton, and Toole.

**Region 2**
Flathead, Lake, Lincoln, Mineral, Missoula, Ravalli, and Sanders.

**Region 3**
Beaverhead, Broadwater, Deer Lodge, Gallatin, Granite, Jefferson, Lewis and Clark, Madison, Meagher, Park, Powell, and Silver Bow.

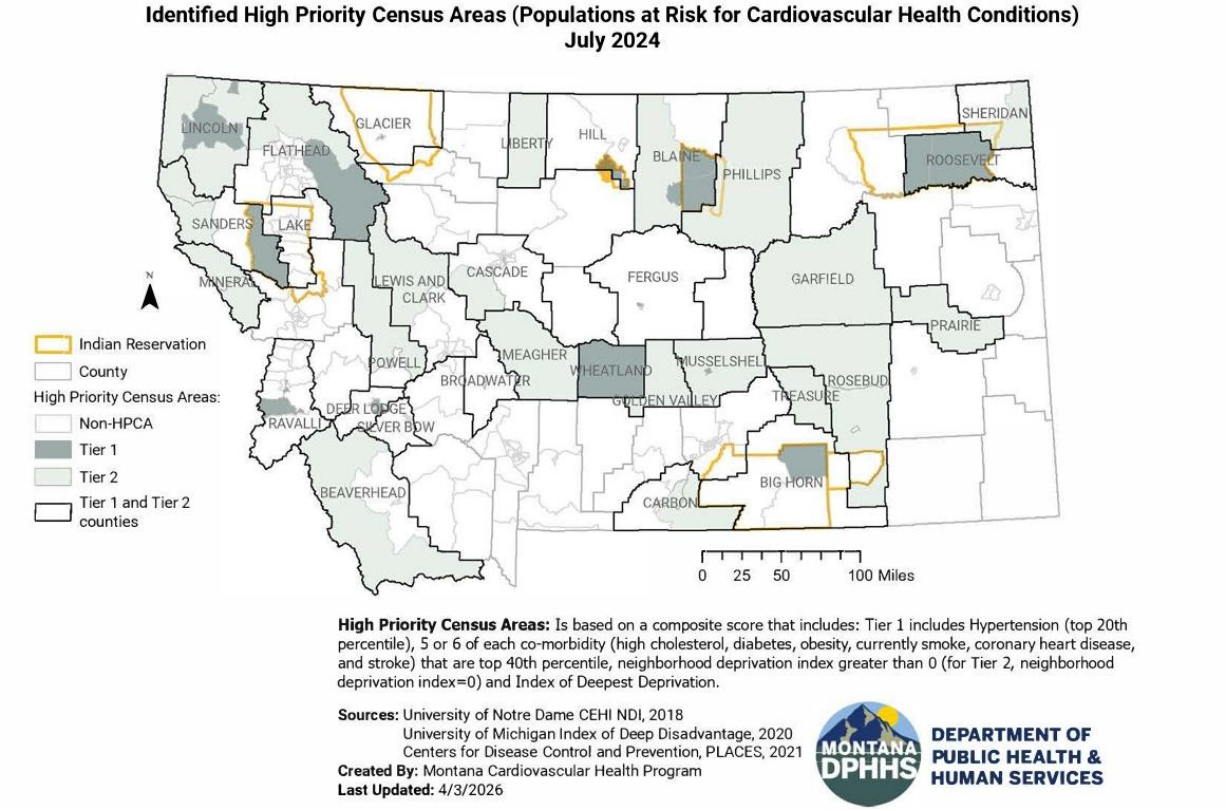
**Region 4**
Big Horn, Carbon, Fergus, Golden Valley, Judith Basin, Musselshell, Petroleum, Stillwater, Sweet Grass, Wheatland, and Yellowstone.

**Region 5**
Daniels, Dawson, Garfield, McCone, Phillips, Richland, Roosevelt, Sheridan, and Valley.

**Region 6**
Carter, Custer, Fallon, Powder River, Prairie, Rosebud, Treasure, and Wibaux.

**Example provided by the Montana DPHHS Cardiovascular Health Program**

**Alt Text:** Choropleth map of Montana census areas showing populations at high risk for cardiovascular health conditions as of July 2024. Tier 1 priority areas, defined by high hypertension rates, multiple co-morbidities, and elevated neighborhood deprivation, tend to overlap with American Indian Reservations. Other Tier 1 concentrations appear in northwestern Montana (Flathead and Lincoln Counties), southwestern Montana (Ravalli and Deer Lodge Counties), and south-central Montana (Wheatland County). Tier 2 priority areas are more broadly distributed across the state, appearing in nearly every region with notable concentrations in the northwest, south-central, and eastern Montana. Contact the Montana Cardiovascular Health Program for underlying data.



## Additional Resources:

Research Paper - Biggs, B., Sloan, D., Oppegaard, B., Giudice, N. A., Coughlan, J. M., & Walker, B. N. (2025). Systematically Evaluating Equivalent Purpose for Digital Maps. *arXiv preprint arXiv:2512.05310*.