Accessible Map Recommendations

With thanks to our generous colleagues at Perkins School for the Blind, as well as Geoff Freed and the Publishing Accessibility Action Group (PAAG; https://www.paag.uk/): Roger Firman, Simon Holt, Nick Bromley, Simon Mellins, and Stacy Scott.

General Considerations (static and interactive maps) (For designers and developers)

Simplicity

In order to help users focus on the intent of the map, whether static or interactive, strive to keep the map as simple as possible within the context of the subject matter. Some points to consider include:

- **Position a brief text summary of the map in the reading order before the map itself.** This will help all users, especially those who rely on assistive technology such as screen readers, to determine if they want to invest time in studying the map or bypass it in favor of other material.
- **Consider whether the information conveyed in the map can also be delivered in an alternative, accessible format**, such as a data table or an ordered/unordered list. While these formats can be easier for assistive technology users to read and interpret, many users can benefit from having a choice of how to display the data.
- **Follow conventional cartographic design conventions** for symbols, structures and color (e.g., blue for water; green for vegetation).
- **Mute the basemap** so the main point or intent of the map can be brought forward and is as easy to visually discern as possible.
    - Consider using color on the target area of the map, leaving the basemap as grayscale. This can help users focus on the most relevant material while minimizing distractions.
    - Reduce or eliminate unnecessary details.

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- **When providing print maps, include a URL for an online version** if one is available. Use a shortened URL in order to make it easier for users to manually enter the address into a browser.

Text Styles
(For designers)

Text Color and Contrast

- Aim for a minimum 4.5:1 foreground/background contrast ratio for all text, even if the text size qualifies for the reduced 3:1 contrast ratio specified in the Web Content Accessibility Guidelines (see WCAG 1.4.3/Contrast (Minimum)).
    - For enhanced visibility, consider using a 7:1 foreground/background contrast ratio for text (WCAG 1.4.6/Contrast (Enhanced)).
    - In the map below (Figure 1), the text identifying each country in South America has insufficient contrast with the background colors. The foreground/background contrast ratios range from approximately 1:1 (Brazil) to 1.4:1 (Argentina).

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Figure 1 

Fonts

- For readability, sans serif fonts are generally preferred over serif fonts. While there is no single font that is designated as accessible, the following are generally considered to be optimally readable:
    - Arial (sans-serif)
    - Book Antiqua (serif)
    - Georgia (serif)
    - Helvetica (sans-serif)
    - Palatino (serif)
    - Tahoma (sans-serif)
    - Verdana (sans-serif)
- Use the largest font size possible:
    - There is no standard minimum font size specified for accessibility.

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    - As a general rule, choose the largest font size that will work within the constraints of the map itself. When possible, use a minimum 12pt font size.
        - In cartography, a 6pt font is often considered the lower limit for readability, but this may be difficult for many users to read easily, especially those with low vision.
        - Online, 12pt is often considered the baseline font size for accessibility and readability.
- In interactive or online maps, use relative font sizes (ems or percentages) rather than fixed sizes (pixels or points). This will ensure that users can take advantage of browser tools to increase and decrease font sizes.
- Avoid the use of fancy or highly-decorative fonts.
- Use italics sparingly: a few words or a brief sentence at most.
- Bold text for emphasis is acceptable, but do not underline text for emphasis: underlined text can easily be confused with linked text.

Labels

- See advice above regarding font sizes and types.
- Ensure labels have sufficient contrast with all backgrounds.
    - See advice above regarding text contrast.
- Many maps have backgrounds composed of graduated colors. In these cases, consider using effects (e.g., a translucent mask; text outline, halo or blur) to give the text an even-colored background.
    - In the example below (Figure 2), the labels for both North and South Korea have sufficient contrast with their

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backgrounds. Additionally, note that the black borders have sufficient contrast with both the red and white regions, and that the line pointing to South Korea has sufficient contrast with the blue and the red backgrounds.

- However, black/red (as seen with the ‘South Korea’ label) can be a particularly bad combination for users with protanopia colour-vision deficiency. It’s not that problematic in this example but something to bear in mind. A dual colour leader line - one white, one black - can be helpful against a variable background because at least one of the lines should provide sufficient contrast.

Figure 2

- Avoid overlapping labels.
- Ensure text spacing is even and sufficient.
    - For interactive maps, users must be able to adjust text and line spacing without any loss of content. See [WCAG 1.4.12/Text Spacing] for adjustability parameters and details.

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- Display text in horizontal orientations whenever possible. While vertical labels are acceptable, avoid displaying upside-down labels.

Non-Text Objects

(For designers)

Non-Text Color and Contrast

- Provide a minimum 3:1 foreground/background contrast ratio for all non-text objects, including borders (WCAG 1.4.11/Non-text Contrast).
    - In the example below (Figure 3), the light-gray border has a contrast ratio of 1.2:1 with the pink states (such as the border between North and South Dakota), and 1.3:1 between the blue states (such as the border between North and South Carolina).

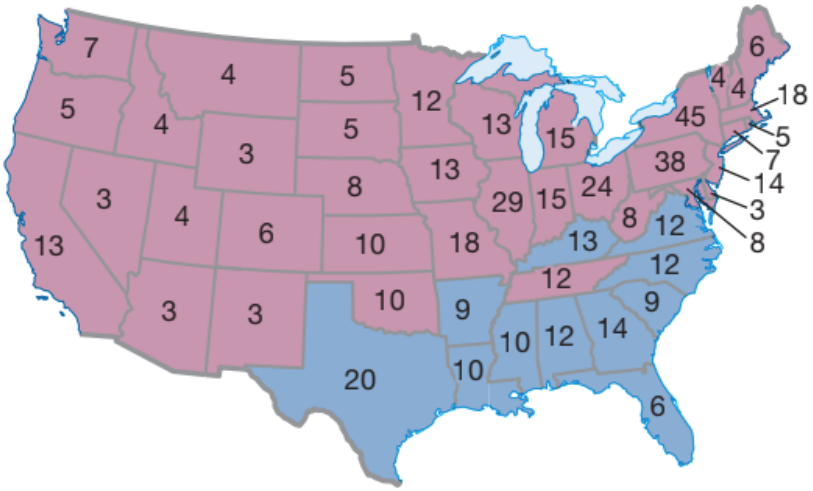

Figure 3

- Where sections or regions of different colors meet, ensure there is at least a 3:1 contrast ratio at the point of contact.

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- In the example below (Figure 4), the light region in the middle of South America has a contrast ratio of 1.5:1-2.3:1 with the yellow and blue regions to the left and right, respectively.

Figure 4

- Consider using borders to ensure sufficient contrast between adjacent colors. Ensure the borders have sufficient contrast with all abutting colors.
- Do not use color alone to distinguish features, sections or regions
  - Include labels in addition to colors, ensuring sufficient contrast between background colors and text.
  - Labels can be positioned over regions, or offset with connecting lines.

Patterns
(For designers)

- Patterns can be a useful tool to offset sections or regions from one another, but too many patterns can be distracting or

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confusing. In some cases, excessive patterns may cause users to feel off-balance.

- While accessibility guidelines do not limit the number of patterns in a map, the general guidance is to avoid using more than two.
    - Apply patterns over transparent backgrounds.
    - Avoid using dashed or broken lines over opaque backgrounds.
- As an alternative to patterns, consider using fills instead.
    - Ensure fills have sufficient contrast with adjacent colors or borders.
- Pattern glare is a visual disturbance resulting from viewing repetitive striped patterns. It can lead to eye strain and migraine. Avoid large areas of regular stripes, especially with high contrast, to prevent pattern glare.

Lines

(For designers)

- Use different line styles to distinguish different meanings.
    - While there is no standard limit on the number of line styles that may be used in a single map, the general recommendation is to avoid more than six.
- Ensure sufficient contrast between lines and backgrounds.
- Consider using stroke widths that are no narrower than 1 point.
- Avoid using broken lines (such as dotted or dashed lines) over patterned backgrounds.
    - These may be very difficult for low-vision users to distinguish clearly.

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    - Combined patterns (that is, lines over background patterns) may also cause confusion for some users with cognitive disabilities.
- In the example below (Figure 5), all black lines have contrast ratios greater than 3:1 against both the yellow and green regions.

Figure 5 

Images

(For designers and developers)

- All informative images must be marked with alt text that identifies the image or its purpose (WCAG 1.1.1/Non-text Content).
    - There is no technical limit to alt-text length, and best practice recommendations vary. 250 characters or 2-3 brief sentences is a good guideline to follow although not a hard and fast rule.

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    - The context in which the image is used will govern whether the alt text identifies what the image looks like, or its purpose.
    - Alt text should ideally convey the intent of the map or map detail, and avoid excessive details that are outside the main focus.
- If providing photo captions adjacent to images, use the <figure> and <figcaption> elements to create a programmatic group of the image with the caption. See a brief tutorial on grouping images for more information.
- If brief alt text cannot provide a sufficient description, include a long image description.
    - Briefly summarize the image in the alt text, then add instructions on where to find the longer description. For example:
        - alt="Map of Italy before unification. Read forward for a long description."
        - alt="Map of Italy before unification. See the text on this page for a complete discussion."
- Long descriptions must be conveyed visibly on the page or linked to on a separate HTML page.
    - Visible descriptions are required, so all users can take advantage of them.
    - When linked to on a separate HTML page, the page must have a link returning the user to the main text and the image being described.
    - When displayed on the same page, long descriptions must be permanently displayed as a <details> HTML element to

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allow for the user to reveal and hide the description when desired.
    - Where useful, incorporate lists, data tables, and other rich HTML elements into long descriptions.

Interactive Maps

General

(For designers and developers)

Interactive maps must conform to the relevant criteria found in the Web Content Accessibility Guidelines version 2.2, A/AA. As a general rule, this will include:

- Keyboard-accessible controls
- A visible focus indicator around all active elements
- Controls that are labeled for identification by assistive technologies
- Sufficient contrast for text and non-text objects
- Text alternatives for images
- Avoiding the use of color alone to convey information

Although maps themselves are exempt from 1.4.10 Reflow requirements because they may require two-dimensional scrolling in order to be understood, ancillary content (instructions, legend, UI controls) are not exempt. For these and similar elements, be sure to consider possible reflow requirements, such as reading/focus order, visible text and controls, etc.

Additionally, the page or document that contains the map must also conform to WCAG 2.2 A/AA criteria. A full Web-accessibility tutorial is

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not within the scope of this document; however, you can find more information about Web accessibility on Confluence.

Map Instructions and Help

Depending on the subject matter, complex interactive maps can be difficult to use for many students, but especially so for those who are navigating with assistive technology or from the keyboard alone. For these reasons, providing instructions about how the map operates is strongly encouraged. The content and length of these instructions will vary depending on the type of map, but generally speaking they should include the following information:

- A summary and description of the map and its purpose.
    - This can include information about layout and orientation, including the location of controls, which will be especially valuable for screen-reader users.
- Information about keyboard controls, including a list of shortcuts.
- An explanation of how controls are labeled.
- Contact information for further assistance or questions.

These instructions can be made available in an accessible panel or modal dialog (or other accessible formats) but, regardless of how they are presented, they should be available from any screen– for example, via a permanently visible button labeled “Help”.

Keyboard accessibility (For developers)

- All controls– buttons, links, targets or other interactive elements– must be focusable and operable using the keyboard

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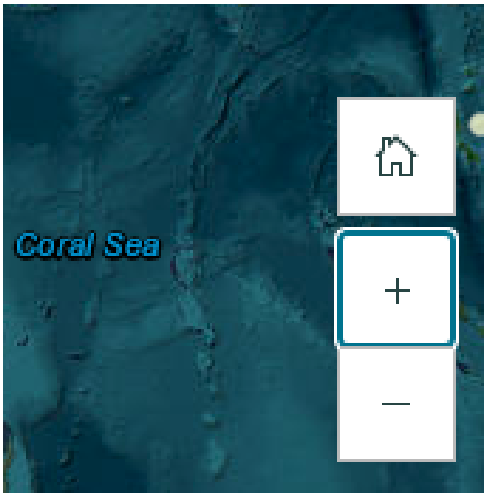
alone (WCAG 2.1.1/Keyboard). In the example below (Figure 6), the zoom controls as well as the Home button (to return the map to the default view) can all be focused and operated from the keyboard (note the focus indicator on the “+” button).

Figure 6 

- Controls must also receive a visible focus indicator (WCAG 2.4.7/Focus Visible).
    - The focus indicator must have at least a 3:1 contrast ratio with all backgrounds (WCAG 1.4.11/Non-text Contrast).
- Additionally, the focus order must follow a logical pattern that preserves the meaning and operability of the active elements on the page (WCAG 2.4.3/Focus Order).
    - For example, the focus order typically moves linearly through a page or a map from left to right and top to bottom. However, a non-linear focus order is permissible if it is important for understanding the function of the page or map.
- The keyboard focus must not become trapped inside a map (WCAG 2.1.2/No Keyboard Trap) or elsewhere on the page. Users must be able to move the focus into and out of the map freely.

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- If zooming and panning are supported, provide keyboard-accessible buttons to control these features.
    - Consider including a button that returns the map to its default state as well.
- If a full-screen option is available, ensure that users can press the Esc key to return the map to the original (non full-screen) view.
    - Also ensure that the focus indicator returns to the button or control that launched the full-screen view.
- As noted earlier, while maps themselves are exempt from 1.4.10 Reflow requirements, ancillary content (instructions, legend, UI controls) will still need to be visible and usable without two-dimensional scrolling.

Target size
(For developers)

- Targets– that is, links, buttons or other interactive controls– must be of sufficient size, or have sufficient spacing around them, so users can accurately select them (WCAG 2.5.8/Target Size (Minimum)).
    - The default size of each target must be at least 24 x 24 CSS pixels (either in size or spacing).
        - Overlapping or undersized targets are not permitted unless displaying targets in this manner is essential to the purpose of the map.
            - Even if it is essential, authors are nonetheless strongly encouraged to give users a way to separate or enlarge the targets (e.g., via a zoom control).

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    - In non-essential contexts, if targets overlap or have insufficient spacing, authors must give users a method to separate or enlarge the targets to at least 24 x 24 CSS pixels (e.g., via a zoom control).
- Targets must meet the same contrast requirements as other non-text objects.
- Targets must also be keyboard accessible.
- As an alternative to selecting targets on the map, consider providing a list of links that serve an equivalent purpose– that is, to expose objects on the map, or to move the map to a specific position. In the example below (Figure 7), a list of links is provided in a side panel ("Map Index") adjacent to the interactive map.

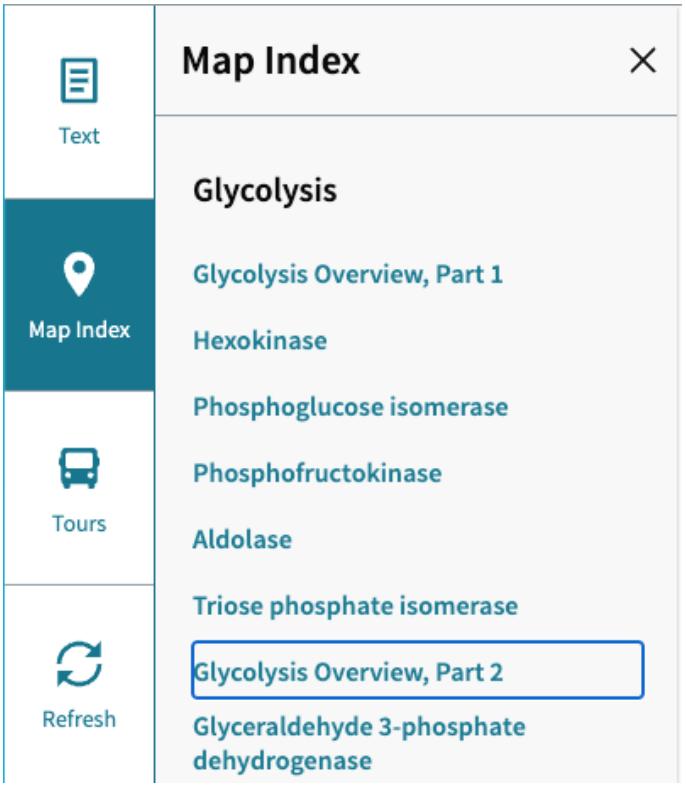

Figure 7

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Hovers and Pop-Ups
(For developers)

- Any content that appears on hover (such as a tooltip or a box containing additional information about a target) must be accessible from the keyboard as well as a pointer (WCAG 1.4.13/Content on Hover or Focus).
    - Users must be able to pass a pointer over the content once exposed without that content disappearing.
    - Users must be able to press the Esc key to close the hover or pop-up, regardless of how it was originally exposed.
        - Be sure to return the focus indicator to the control that launched the content in the first place.
    - The content must persist until the user chooses to dismiss it.
- If the hoverable content is important for everyone to read, consider not hiding it and instead incorporating permanently it into the visible map or page. This will eliminate users having to take extra steps in order to access the content.
- As an alternative to hovers or pop-ups, consider displaying the additional content in a side panel or separate region. Ensure that this content is contained within its own landmark region, such as `<aside>`, to make it easier to find with assistive technology, and that it is preceded with a heading. In the example below (Figure 8), selecting a marker on the map launches content in a side panel.

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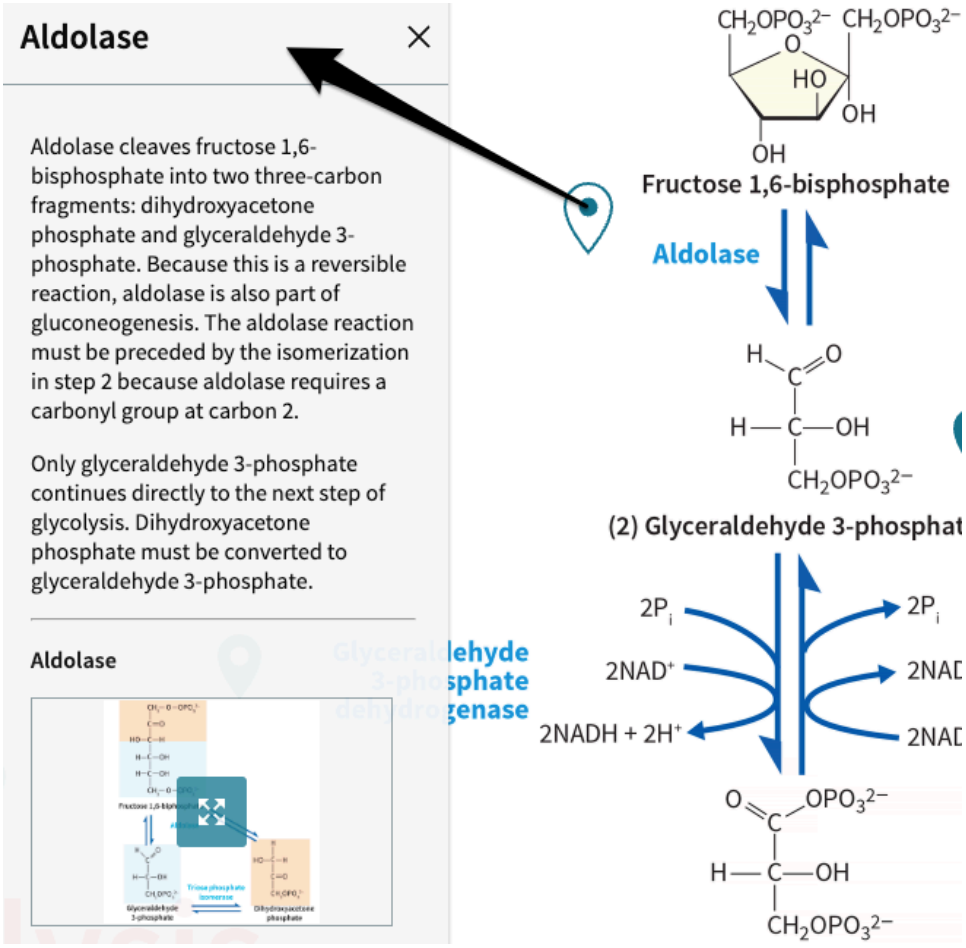

Figure 8

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Keyboard Shortcuts
(For developers)

Keyboard shortcuts can make maps easier to control for all users, especially those who rely on keyboard navigation or who have disabilities involving fine motor control.

- Avoid using shortcuts that involve a single letter, punctuation or symbol character unless those shortcuts can be deactivated or remapped by users, or unless they are active only when the component (such as the interactive map itself) has focus (WCAG 2.1.4/Character Key Shortcuts).
    - Note that arrow-key shortcuts **are** permitted.
- Provide a complete list of keyboard shortcuts, as well as information on how to deactivate/activate them, in the same place where users can find map instructions or help.
- If implementing shortcuts that involve modifier keys, such as Ctrl or Cmd, ensure these shortcuts do not interfere with assistive technologies.

Legends
(For developers)

- In general, legends should follow accessibility best practices for text, contrast, non-text contrast and images.
- Images within legends should be marked with alt text that describes not only what the image represents, but its appearance as well. In the example below (Figure 9), the alt text for the first color, green, would be `alt="Green: Full voting with effective date."`

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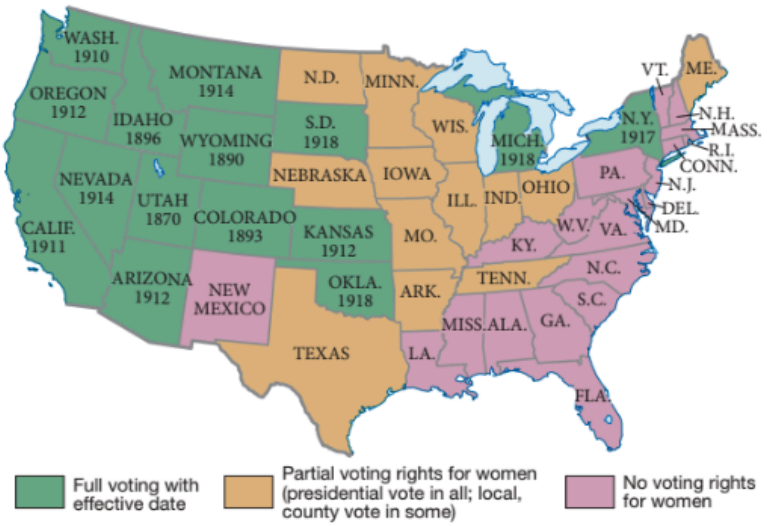

Figure 9

- If the legend contains visual headings, ensure these are structured as headings as well. In the example below (Figure 10), "Historic Structures" and "Tour Routes" are marked with `<h3>`.

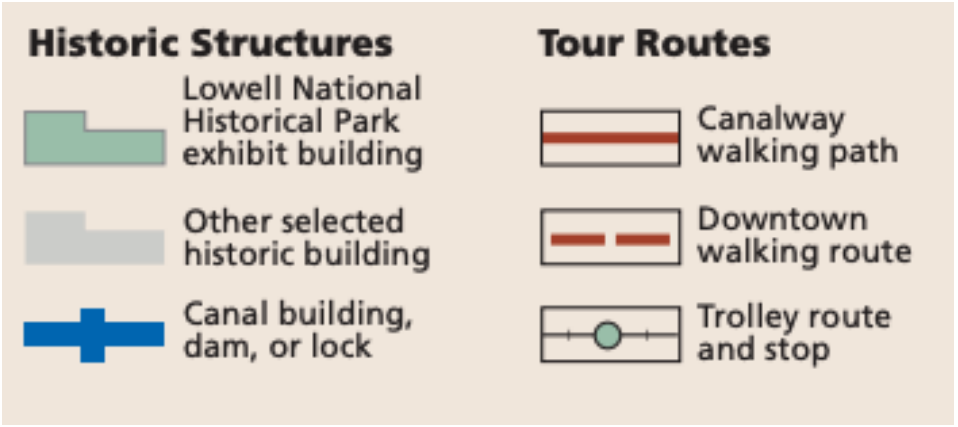

Figure 10

- Context and consistency are important when considering how to label legends.
    - `<nav>` regions are best suited to interactive legends, for example, a legend that contains links to other locations. Mark the region with aria-label so it can be easily identified by screen-reader users: e.g., `<nav aria-label="Legend">`.

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    - An `<aside>` or a `<section>` may be suitable to label a legend, but regions should be used sparingly as too many on a page can reduce their effectiveness.
    - Including the heading text 'Legend' and using this as a region's name via `<aria-labelledby>` offers a few advantages over `<aria-label>`. Consider grouping legend items in some way such as a list or a subheading. If they are interactive, a `<fieldset>`/`<legend>` would work as well.
- Implementing a hidden legend is acceptable as long as the controls to show/hide the legend are accessible and clearly labeled.
    - An accessible accordion widget (or the `<details>` HTML element) is one approach to consider for implementing hidden legends.
- If the map legend is provided as an image, all information contained within the legend must be conveyed via alt text or a long description. This includes text as well as symbols.

Resources

General Map Accessibility

- From the State of Minnesota:
    - Map Accessibility
    - Static Map Accessibility
    - Interactive Map Accessibility
- Esri: Accessibility Essentials for GIS and Mapping
- ArcGIS Maps/Story Maps and Accessibility

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- Map Design Considerations for Accessibility (Word document)
- Maps for HTML Community Group (W3C)
    - W3C/OGC Joint Workshop Series on Maps for the Web
- Web Map Tools Evaluation (WCAG 2.1)

Creating Image Descriptions

- Web Accessibility Initiative (WAI) Images Tutorial
- Cooper Hewitt Guidelines for Image Descriptions
- DIAGRAM Center Image Description Guidelines

Web Accessibility

- WCAG 2.2 Quick Reference Guide
- ARIA Authoring Practices Guide (ARIA APG)
- Web Content Accessibility Guidelines 2.2 (WCAG 2.2)
    - WCAG Overview

Assistive Technology

- Overview of Assistive Technology (Paths to Literacy)
- What is assistive technology? (ATIA)
- Screen readers:
    - JAWS (Freedom Scientific)
    - NVDA (NV Access)
    - VoiceOver (Apple Accessibility)
    - TalkBack (Android)
- Screen-reader demonstration (University of California-San Francisco)
- ZoomText screen magnifier (Freedom Scientific)
- Screen-magnifier demonstration (Sight and Sound Technology)

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