GIS WEB APPLICATIONS STANDARDS

DRAFTED BY THE GIS WEB APPLICATIONS TASK TEAM UNDER THE PERVIEW OF THE ARCHITECTURE AND APPLICATIONS SUBCOMMITTEE OF THE ENTERPRISE GIS COMMITTEE, UPDATED BY THE ARCGIS SERVER CADRE

TABLE OF CONTENTS

OVERVIEW

PURPOSE

The purpose of this document is to provide guidance to the development of GIS web applications. This is a living document that will change as industry and technology standards change. To keep web applications up to date, they should change to reflect current standards.

SCOPE

The standards defined within this document apply to all GIS Applications within the Department.

AUDIENCE

Anyone developing or overseeing the development of a GIS web application for use within the Department.

OVERVIEW

GENERAL GOALS

HIGH QUALITY USER EXPERIENCE

Simple and Usable – In an effort to anticipate user needs there is a tendency to build a multitude of functions into an application. Overcomplicating the user interface reduces the usability of the application. Actual usage needs should drive application functions.

INTUITIVE

a. Controls are obvious or labeled/indicated where necessary.
b. Purpose of application is clearly yet unobtrusively communicated.
c. User knowledge of popular applications is leveraged.

WORKFLOW

Refer to Software Development Life Cycle (SDLC) documentation

GENERAL GOALS

BACKGROUND DATA (LAYERS/ATTRIBUTES)

Background data should strive for adherence to Spatial Data Standards (including metadata, datums, and projections).

TYPES OF APPLICATIONS

A “GIS web application” does not have a single definition. Standards set forth in this document attempt to acknowledge and account for differences that exist between different types of web applications based on audience and accessibility. See **Application User Interface Standards** for descriptions of different application types.

WEB PRESENCES

DWR PORTAL VISIBILITY

All publically accessible DWR web pages and applications must be available through the DWR Portal. The content manager must provide the DWR Webmaster with a navigation link to be placed into the DWR Portal directing visitors to the application or State Program managing the application. The navigation link must direct public visitors to either, 1) the State Program/Activity which will then contain a link to the web application, or 2) directly to the web application. If a navigation link from the DWR Portal directs visitors to the State Program, then a navigation link directly to the web application must be placed within the State Program's web pages.

LINK TO PORTAL

All applications should provide a prominent link back to the Portal or to the State Program/Activity site that provides it the most context. This will help to orient the user as to the authority of the application and the source of its data and development efforts.

LAUNCH PAGE

A launch page is a web page that precedes a map or logon page and provides context to the information provided in the application.

a. While popular for GIS applications and formerly recommended, it is **not** considered a best practice to include a launch page. For heavy application users, the launch page is a distraction from the main content and even first-time users will often dismiss the launch page without reading it, meaning communicating information in a launch page is usually not the best option.

LOGON PAGE

When an application requires a user to login the function should be provided on the logon page. The result of a successful login should open the application. In-application popup logins may be used when some information is restricted and some is not. Successful authorization would allow access to the restricted data.

a. For specifications on security see Section 6 "Security".

LOOK AND FEEL

Refer to Application User Interface Standards for Look and Feel

BRANDING / OWNERSHIP

Users need to know they are operating a DWR application. DWR should be mentioned specifically as well as the section/division that the application is associated with. The DWR logo can be included to further illustrate this connection, although it is not specifically required. A contact for application and data-related questions must be included and kept up to date.

GRAPHICAL USER INTERFACE (GUI) FRAMEWORK

The GUI Framework refers to the functionality of the map interface, functions, navigation, layout, and widgets. While no specific UI is mandated, following these standards will in most cases create a better application. For map content standards refer to Section 7 Map Data.

GIS APPLICATION NAME

Logically represents the intended use of the application or data represented.

LOOK AND FEEL

LAYOUT

a. Should be functional in all reasonable screen sizes and contexts.
b. Should be optimized for expected users (e.g. if the app is intended to be used from mobile devices, it should be explicitly designed with that in mind from the start).

CASCADING STYLE SHEETS

California public web pages are designed with a default style configuration which is applied through Cascading Style Sheets (CSS). CSS are a set of statements that specify the presentation, including fonts and colors, of the document in a centralized manner that requires minimal configuration.

However, web applications are quite different from web pages in layout, function, purpose, and interaction. As such, the central style sheets used by public web pages should **NOT** be included in the application.

a. Should a standard application CSS file be developed by either the ArcGIS Server Cadre / Applications and Architecture GIS subcommittee or DTS, it should be included in all applications. Such style sheets would include helpful style frameworks as well as any as yet to be determined stylistic requirements.
b. Use of starter CSS files provided in templates by the ArcGIS Server Cadre is encouraged

COLOR SCHEMES

Refer **to DWR's Web Application User Interface Standards** (3)

TOOL/NAVIGATION INTERACTION

TOOLS

No specific tools are mandated. Rather, tools should be included based on the purpose of the application. For example, while it is often useful to turn layers on and off if many are included in an application, if an app's purpose is to showcase just one layer, a tool that managers layers doesn't make sense and clutters the UI. Use tools judiciously to drive the central point of the application and no more.

NAVIGATION

The ability of the user to easily navigate an application plays a large part in the overall acceptance of an application. In the case of a GIS application this is extended to the ability to navigate around the map.

a. In map-based applications, the mouse should have panning capabilities by default.

b. In map-based applications, the scrollbar and double-clicking should zoom the map by default.

FORMS

See Web Applications Standards

FUNCTIONALITY

Not all of these functions are required; when present these suggestions should be followed.

DATA EXTRACTION/DOWNLOAD

Offering a data extraction or download function is optional. However, if the function is present, choosing among the following data types is recommended:

Raster –ESRI GRID, Tagged Image File Format (TIFF), Portable Network Graphics (PNG), ASCII

Point / Vector – Shapefile (SHP), Keyhole Markup Language (KML), Feature class (GDB), AutoCAD Drawing File (DWG), Geography Markup Language (GML), ASCII, Layer file package (LPK), ASCII

MAP VIEWER FRAMEWORK

Currently, the ArcGIS Server Cadre recommends use of the ArcGIS API for JavaScript for one's map viewer framework. While the Flex Viewer may be used to develop basic applications quickly, the JavaScript API will provide more flexibility and availability on more platforms without requiring a plugin. Descriptions of the two APIs follow:

FLEX

The ArcGIS Viewer for Flex is a ready-to-deploy viewer application. It is configurable, so you can easily add tools and data content without programming. You can also extend its functionality with custom widgets created with the ArcGIS API for Flex.

JAVASCRIPT

The ArcGIS API for JavaScript (JavaScript API) is a browser based API for developing high performance, easy to use mapping applications. The API allows you to easily embed maps in your Web page

MAP DATA

DISCLAIMERS AND USAGE

Any disclaimer concerning the data displayed in the application needs to be available in the application (or near the application if it is embedded in a webpage). The disclaimer should neither be hidden away, nor repeatedly forced upon the user.

DATUM

A datum is a set of parameters and control points used to define the shape of the earth. Datums provide a frame of reference for measuring locations, and may be determined for local, regional, or worldwide extents. There are both horizontal and verticals datums.

a. **Horizontal Datum** – See Spatial Data Standards – Section 7.2.
b. **Vertical Datum** – See Spatial Data Standards – Section 7.3.

PROJECTION

A map projection transforms the three-dimensional shape of the earth onto a two-dimensional surface that can be printed on paper or viewed on a computer screen. There are many different kinds of map projections, each trying to preserve one or more real world properties such as area, shape, distance, and direction. No single projection preserves all these properties - some are focused on preserving particular properties while others may partially preserve multiple properties as a compromise projection. Because no one projection is perfect for all needs DWR supports the use of seven projections. Project requirements should dictate which projection to use for a specific application.

a. **Web Mercator** – Web Mercator has been adopted as the standard projection for web GIS applications throughout the internet. Because of its wide-spread use it is the preferred standard to be used for GIS web applications. Additionally, Web Mercator is recommended for ArcGIS tiled map services that overlay content from ArcGIS Online, Google Maps and Bing Maps. This projection is not intended for critical data analysis.
b. **Latitude and Longitude (unprojected)**
c. **UTM**
    a. **10**
    b. **11**
    c. **10.5 “California UTM”**
d. **Teale Albers**
e. **State Plane**

LABELS

SCALE DEPENDENCY

Adding scale dependencies to a layer is one of the easiest ways to improve performance of the application. Labels should be displayed only when they are meaningful within the context of the application. The ultimate goal is to minimize the amount of data at any given scale. The less data there is to process, the faster the response can be generated.

ANNOTATIONS

The annotation feature type is for the storage of text in the geodatabase. Storing text in the geodatabase provides the ability to edit the text and more efficient drawing speeds than dynamic labeling since the positions of text are fixed. If you do not need to dynamically label your data, annotations are often a good idea.

BASEMAPS

THIRD PARTY BASEMAP

Several basemap services are available free of charge via the internet from ESRI and others. These have come to be recognized as the standard way to deliver a basemap to users and will in most cases provide better performance than an in-house basemap. If using a non-ESRI basemap, ensure that you are aware of the terms of use and possible cost associated with it.

CACHED MAP LAYERS (TILES)

When there are high volumes of traffic or the layer doesn't change often determine which layers may degrade loading speeds and see if they can be cached.

a. **Basemaps** - see section 6.5 Basemaps
b. **Operational Layers** - when there are high volumes of traffic or the layer doesn't change often

DYNAMIC MAP LAYERS

Server receives request for data from the client, constructs image based on the request and sends the result to the client. Dynamic map layers are slower than cached map layers but can be fast if optimized. Use for real-time data, applications that provide custom or changing symbology, frequently-changing data where caching is prohibitive, or maps used by a small numbers of users

FEATURE LAYER (CLIENT-SIDE GRAPHICS)

Feature layers differ from tiled and dynamic map service layers because they bring geometry information across to the client computer to be drawn by the client. Feature layers potentially cut down on round trips to the server. A client can request features it needs and, perform selections and queries on those features without having to request additional information from

the server. Feature layers decrease the processing burden on the server by moving the processing to the client's browser. Feature services are appropriate when the layer responds to user interaction, such as a mouse click or hover and for:

a. **Interactive operational layers for mashups**
b. **Layers that need to be symbolized on the fly**
c. **Query or geoprocessing results**

USE SCALE DEPENDENCIES

To reduce clutter and improve map performance set layers to display at relevant scales.

ELIMINATE UNNECESSARY LAYERS

It is important to maintain the scope and purpose of the application. Only include layers that contain data pertinent to the purpose of the application.

LIMIT NUMBER OF LAYERS FOR PERFORMANCE

Use best practices when showing operational map layers. By limiting the number of layers operational at a given time, the performance level of the application will be better maintained and will provide a better user experience.

SYMBOLOGY

Each program and industry has their own symbology standards that are valid for their needs. Pending further direction on symbology, GIS web applications should use symbology that matches the corresponding program or industry's standard symbology to encourage better cohesiveness between project and program materials. In the future, if DWR defines a GIS web application symbology standard, web applications should be updated to conform to the tenets of said standard.

LEGEND

Explain symbology in a legend. Without a legend, the meaning of a map is unclear. A legend or another mechanism which describes symbology is required on all applications.

COLOR-BLIND ACCESSIBLE

Symbols should be chosen and/or designed as to not rely on color alone to distinguish between symbols. Symbols can vary in color, contrast, size, shape, pattern, and label.

SECURITY

LOGIN/LOGOUT

PROPER LOGIN PROCEDURE

AUTHENTICATION/AUTHORIZATION

When an application requires that access be limited the authentication information will be gathered on the launch page.

AUTHENTICATION/AUTHORIZATION MECHANISM

An authentication and authorization mechanism is available that conforms to DWR's SOA infrastructure. This is the only approved method of authentication /authorization for web applications.

USER RECOGNITION

Each page within the application should identify the logged in user.

USER NAME

Display "First name" and "Last name" (John Smith) in the upper right-hand corner of the application window using the same font style as applied to bolded page content.

LOGOUT PROCEDURE

The application should provide a logout button to the right of the user name. The logout button should destroy the any session data and close the window and direct the user to the launch page. Best practice suggests a warning be prompted before continuing logout procedure.

SESSION TIMEOUT

Session timeouts are recommended to limit duration of an idle open session. Session timeouts should be set no longer than 24 hours.

MINIMUM SPECIFICATIONS

MINIMUM PC SUPPORT

- CPU - Core 2-1.67Ghz
- RAM - 1GB
- Connection - 1.5Mbps

PERFORMANCE

Applications should perform well on a variety of application platforms. Following these standards should help bring a smooth experience to most users. However, it is recommended to test your application on many different platforms to ensure adequate performance is different scenarios (variation in network, CPU, resolution, etc.).

BROWSER

- Internet Explorer 9 is the department standard supported browser and so must be supported by your application. However, the public often uses various other browsers and so an effort should be made to allow your application to work on many different browsers. If a desired feature of your application requires advanced features of modern browsers (canvas, webGL, localStorage, etc.), your application must otherwise still function on older supported browsers (IE9). The user should be notified that a feature is unavailable due to the deficiency of their browser.

WORKS CITED

1. **Department of Water Resources - Division of Technology Services**. Software Development Life Cycle (SDLC). s.l. : Internal Report, 2011.

2. **Department of Water Resources - Enterprise GIS Committee**. Spatial Data Standards. Enterprise GIS Committee Portal. [Online] June 21, 2010. [Cited: April 11, 2011.] https://dwrgis.water.ca.gov/documents/269784/aa1329f5-696b-43b0-8478-f46ddb84238c.

3. **Department of Water Resources - Division of Technology Services**. DWR Web Application User Interface Standards. s.l. : Internal Report, 2010.

4. **California Technology Agency - Information Organization, Usability, Currency, and Accessibility Working Group**. How to Implement an Accessible Website. State of California WebTools. [Online] 2011. [Cited: October 7, 2011.] http://www.webtools.ca.gov/Accessibility/How_to_Implement.asp.

5. **Bartley, Jeremy and Hutchins, Kelly**. An Overview of the ArcGIS APIs for JavaScript, Presentation Slides. ESRI Proceedings. [Online] March 22-25, 2010. [Cited: March 17, 2011.] http://proceedings.esri.com/library/userconf/devsummit10/tech/tech_10.html.

6**. Chong, Brian and Fan, Justin**. Best Practices for Creating Web Maps, Presentation Slides. ESRI Training. [Online] February 3-4, 2010. [Cited: March 17, 2011.] http://downloads2.esri.com/campus/uploads/library/pdfs/120559.pdf. http://downloads2.esri.com/campus/uploads/library/pdfs/120559.pdf.

7**. ESRI**. Web Application Performance. ESRI ArcGIS Resource Center. [Online] [Cited: March 17, 2011.] http://resources.arcgis.com/content/enterprisegis/10.0/web_performance.

8**. Quinn, Sterling and Brenneman, Tom**. Best Practices for Designing Effective Map Services, Presentation Slides. ESRI Proceedings. [Online] March 7-10, 2011. [Cited: March 17, 2011.] http://proceedings.esri.com/library/userconf/devsummit11/papers/tech/best_practices_for_designing_effective_map_services_2011.pdf.

9. **California Technology Agency - Information Organization, Usability, Currency adn Accessibility Working Group**. Recommendation on Accessibility Standards for California State Web Pages. State of California WebTools. [Online] June 2006. [Cited: October 7, 2011.] http://www.cio.ca.gov/stateIT/pdf/IOUCA_Accessibility_Recommendation_Adopted_071406.pdf.

10. **Department of Water Resources - Division of Technology Services**. DWR's SOA Infrastructure. s.l. : Internal Report.

11**. OWASP Foundation**. OWASP Project. The Open Web Application Security Project. [Online] March 17, 2011. [Cited: March 17, 2011.] https://www.owasp.org/index.php/Category:OWASP_Project.

12. **OWASP Secure Coding Practices - Quick Reference Guide**. The Open Web Application Security Project. [Online] March 17, 2011. [Cited: March 17, 2011.] https://www.owasp.org/index.php/OWASP_Secure_Coding_Practices_-_Quick_Reference_Guide.

13. **OWASP Top Ten Project. The Open Web Application Security Project**. [Online] March 17, 2011. [Cited: March 17, 2011.] https://www.owasp.org/index.php/Category:OWASP_Top_Ten_Project.

For Documents from DWR's DTS Contact:
DTS – Business Applications Services
Brian Niski
bniski@water.ca.gov
(916) 653-7316