



Washington State Department of Transportation

Monument Mapping Engine, v5.8.1

February 4, 2022

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Recommended Citation:

Daniels, R.C. and K. Williamson. 2022. *Washington State Department of Transportation Monument Mapping Engine, v5.8.1*. White Paper, Information Technology Division, Washington State Department of Transportation, Olympia, WA.

The Monument Mapping Engine was initially released in 1999 and supports WSDOT's ongoing geodetic survey activities. It was upgraded in 2001, 2003, 2008, and 2010. In 2015 the application was rewritten to support ArcGIS 10.2/10.3, to use multiple map services, and to support the newly released ArcGIS JavaScript API. In 2016, 2017, and 2021 the servers supporting the application were upgraded to ArcGIS Server 10.3.1, 10.5.1, and 10.6.1, respectively. Version 5.7.1 runs under ArcGIS Server 10.7.1. After each software upgrade the map documents used by the application for the map services was upgraded. The current version number of the application is 5.8.1 and its interface was modified to match the 'new' WSDOT external website look. This version runs under ArcGIS Server 10.8.1.

The Mapping Engine uses scale dependent rendering with five different map services to display a variety of services as one zooms into a specific survey station on the map. The map services provided are WSDOT Survey monuments, National Geodetic Survey (NGS) stations, Washington State Route mileposts, Washington County Boundaries, and a Topographic base map. When first started the application provides a statewide view with the location of WSDOT's geodetic survey monuments and National Geodetic Survey's HARN and CORS stations shown on top of ESRI's™ topographic base map. Washington county boundaries and State Route mileposts are available as well. The user may select a WSDOT or NGS monument by clicking on the map. If a monument is found near the position clicked a pop-up window opens that shows basic information about the station and the user can then request the complete data sheet for the station from the pop-up window. In the twelve-month period March 2019 to February 2020 the application received 3,842 unique sessions and in January 2020 had 296 unique users. Based on the cost of installing a monument, the time required to fulfill an in-person information request, the number of visits to this site, and discussions with members of the professional Land Surveyors' Association of Washington; WSDOT estimates that the State has achieved over \$1.7 million in cost avoidance since the application was initially fielded in 1999.

(<https://www.wsdot.wa.gov/monument>)

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This document is preliminary, has not undergone formal review or editing and is provided for informational purposes only.

Washington State Department of Transportation (WSDOT) Monument Mapping Engine, version 5.8.1

Background

The Monument Mapping Engine was first fielded in 1999 as an out of the box ArcView IMS™ application to support WSDOT's survey activities. At the request of the Geodetic Survey Section, Geographic Services Office (now known as the GeoMetrix Office), the Information Technology Division redeveloped the application using ESRI's ArcIMS technology; to include support for Digital Raster Graphics (i.e., USGS 7.5' Topographic maps) and query functions. Development began March 20, 2001 and was completed on April 12, 2002. The application was ported with minimal changes in September 2008 to ArcIMS 9.2 and a new server, updated in 2010, and rewritten in 2014.

At the release of ArcGIS 10 by ESRI™ in 2010 the original image map service technology used by the Monument Mapping Engine application was removed from ArcIMS. This necessitated the fourth major upgrade of the application. In March 2011 the new Monument Mapping Engine, known as version 4.0, was released. This was the first version of this application to run as a native ArcGIS Server application.

In 2014 ArcGIS 10.2 and 10.3 was released. This release changed the way that maps services are published on the server (i.e., as a tiled service vs. an image service) and introduced a new ArcGIS JavaScript application programming interface (API). The recommended way that the application handled map services changed as well. In the past a single map service usually contained all the map layers needed for an application. At 10.2 it is recommended that each layer be its own map service, this allows the map services to be reusable and distributed across several servers.

At version 5.0 of the Monument Mapping Engine multiple ArcGIS Map Services are used, these are located on several ArcGIS Servers. The application now utilizes up to five feature services at a time and two supporting utility services (e.g., print and query). The application had major version changes in 2016, 2017, 9/2021, 2/2022 (this release) when the supporting ArcGIS and Web servers were upgraded.

Getting Around the Application

When started the application initially provides a statewide view that displays WSDOT's geodetic survey monuments, National Geodetic Survey's HARN and CORS stations, County boundaries and State Routes mileposts on top of a ESRI™ topographic base map (Figure 1a and 1b). Within the application red triangles indicate the location of survey monuments or stations maintained by the Washington State Department of Transportation. Blank symbols (e.g., circles, triangles, gold stars) show the location of National Geodetic Survey survey stations.

Figure 1a. Initial screen seen when visiting the Monument Mapping Engine prior to version 5.7.2.

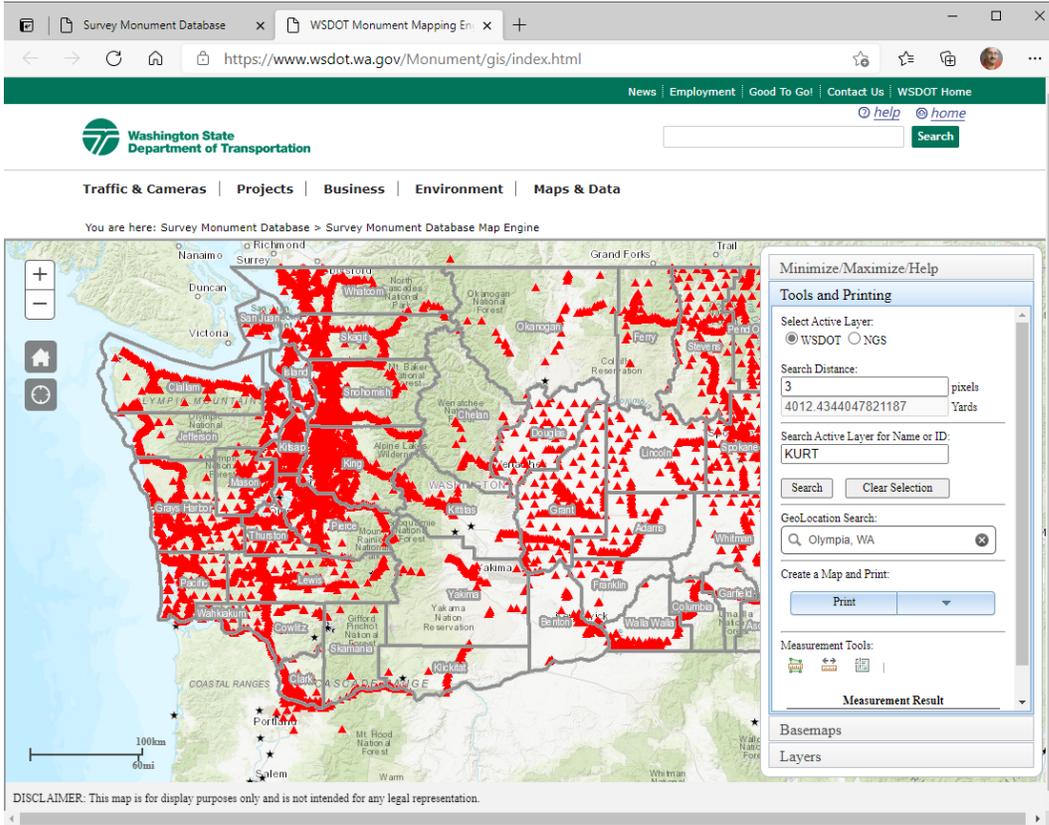
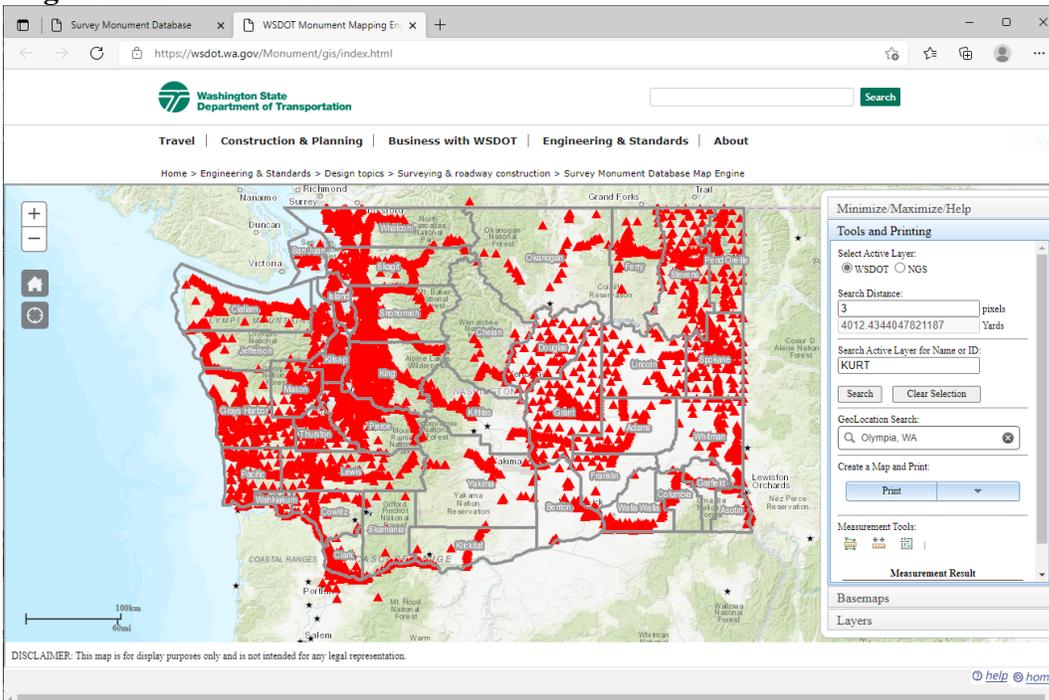
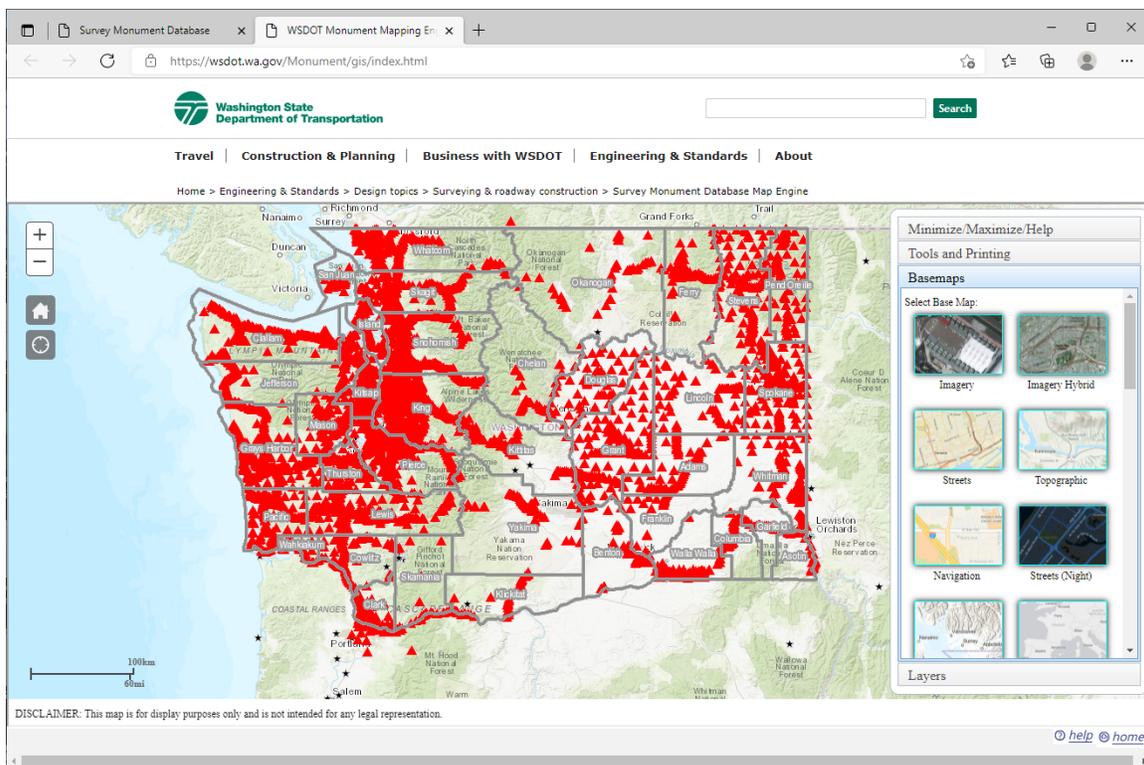


Figure 1b. Initial screen Initial screen seen when visiting the Monument Mapping Engine after version 5.7.2.



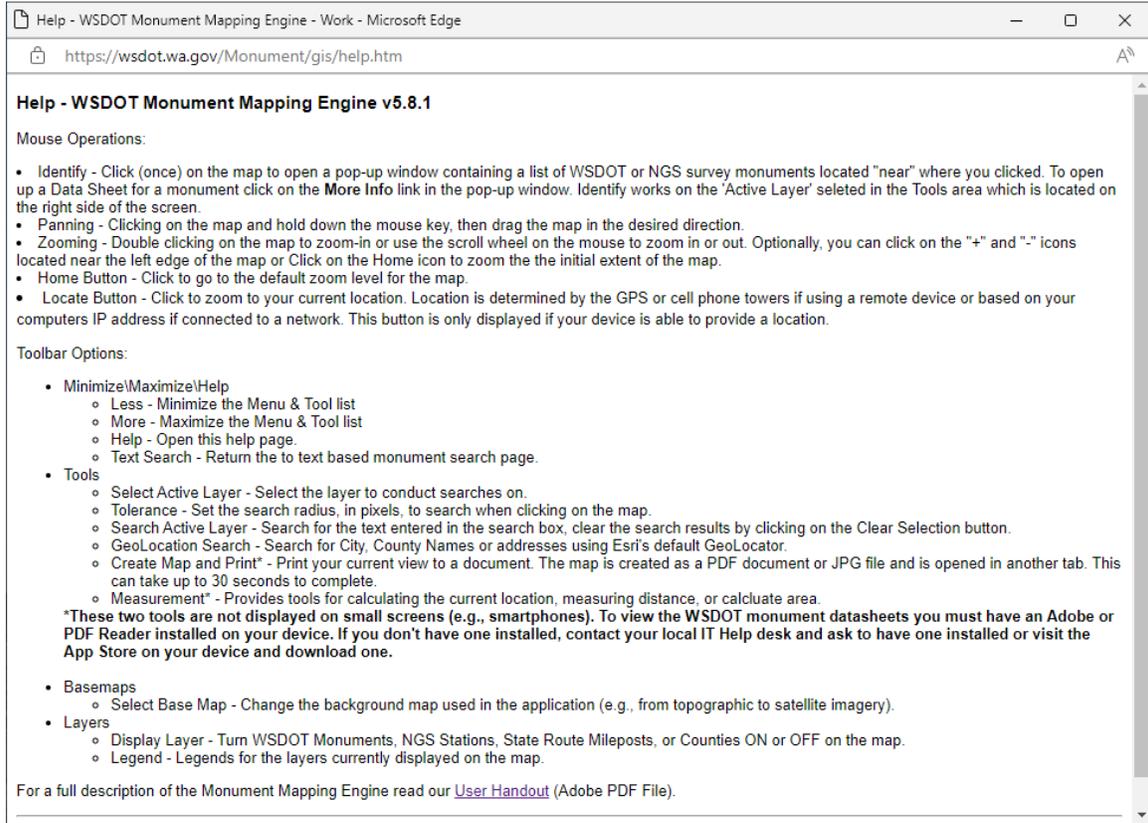
In the past as one zoomed into the map past a scale of 1:250,000 the shaded relief map was replaced with a color 1:250,000 scale USGS topographic map. If you continued to zoom in past 1:50,000, the 1:24,000 scale USGS maps (a.k.a., 7.5 minute topographic quadrangles) turned on. At 1:12,000 and larger scales the topographic maps was replaced with air photography from the Washington State Orthophoto Partnership. At this release scale dependency is still used but the underlying base map does not change. Instead, the user is provided 13 different base maps to choose from, which include imagery. To change from the default ESRI™ topographic map click on the applications “Basemaps” tab. This tab provides access to the basemap gallery which has 29 possible background maps, to include a standard WSDOT Basemap (Figure 2).

Figure 2. The base map used as the backdrop for the application can be changed by the user in the “Basemaps” tab.



Using the tools available (see Table 1) within the application the user can zoom into their area of interest and then interactively select a monument, print a map (Figure 3), measure area, distance, and determine the coordinates of any point on the map and retrieve a site description/data sheet for a selected WSDOT geodetic monument or NGS survey station (Figure 4).

Table 1. Tools available within the Monument Mapping Engine.



When selecting a station to retrieve a data sheet, be aware that within the application two data layers are selectable but only one is active at any given time. The selectable layers are the WSDOT Survey Monuments and NGS Survey Stations. The Identify and Select tools work on these layers. By default, the WSDOT Geodetic Survey Monuments is the initial "active" layer. You may use the radio buttons found in the "Tools and Printing" tab to select or change the currently active layer.

Figure 3. Example of a printable “to reach” map for survey monument IS3418, highlighted in blue. Maps may be printed to PDF or JPG.

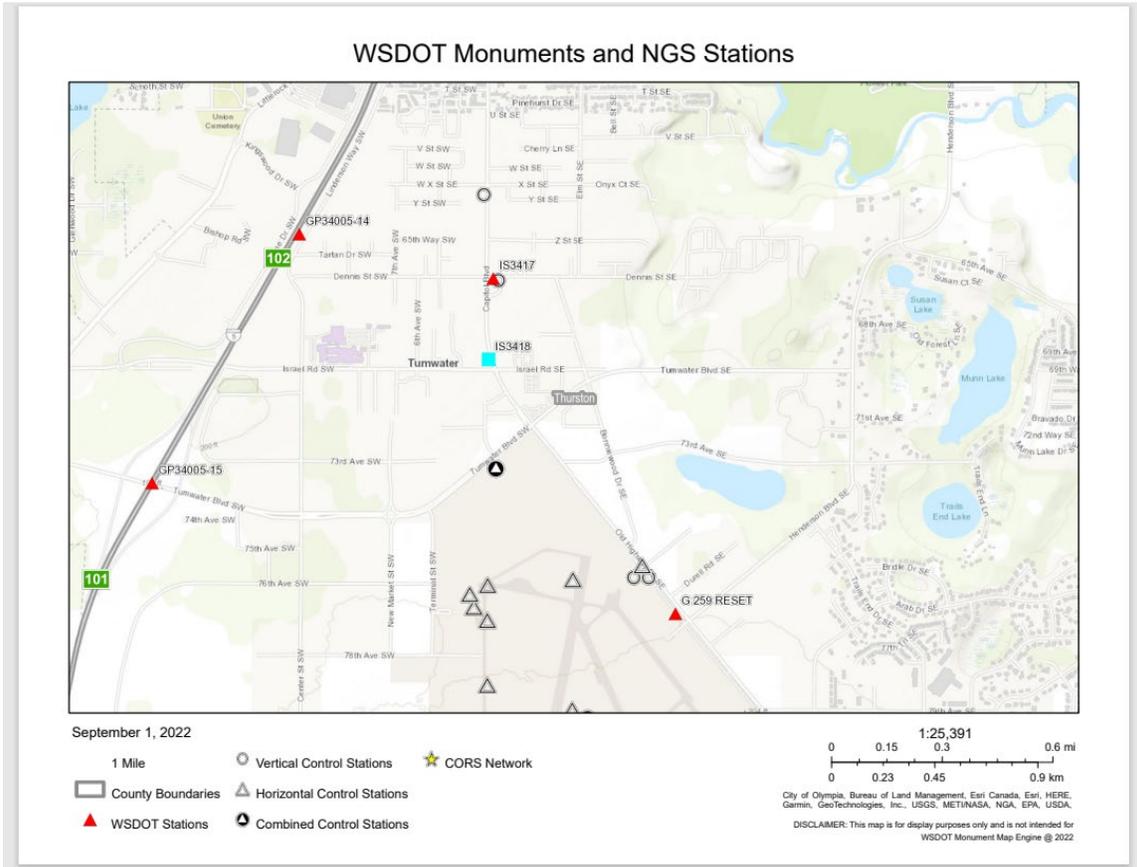


Figure 4. Example of a monument data sheet obtained using the application for survey monument G 259 RESET.

Washington State Department of Transportation
Geographic Services
SURVEY INFORMATION SYSTEM Report of Survey Mark

Designation: G 259 RESET	T.R.S.: 17N, 2W, 11	ACCOUNTS INFORMATION		
Monument ID: 654	Corner Code:	BOOK	PROJECT	INVOICE
NGS Pid: SC2867	State Route:	55	PL4013	23-93028
State: WASHINGTON	Mile Post:	28	OL1905	23-93043
County: THURSTON	Station:	115	PL8013	23-97050
Region: OL	Offset:	94	MS3747	23-99045
Nearest Town: TUMWATER	Owner: GS	167	PN0013	23-00044
USGS Quad: MAYTOWN	Bearing: M	207-209	MS4357	23-01032
		233	MS5400	23-05032
		NA	MT0319	23-11026

TO REACH THE STATION FROM THE INTERSECTION OF SR 005 AND AIR INDUSTRIAL WAY IN TUMWATER, GO EASTERLY 1.13 MILES ALONG AIR INDUSTRIAL WAY TO THE INTERSECTION WITH CAPITAL BLVD (OLD HWY 099) TURN RIGHT AND GO SOUTHEASTERLY 0.62 MILES ALONG CAPITAL BLVD TO THE OLYMPIA AIRPORT - PORT OF OLYMPIA ADMINISTRATION BUILDING AND MARK ON RIGHT. IT IS LOCATED IN A GRASSY AREA BETWEEN THE FRONTAGE RD AND PARKING LOT FOR THE PORT OF OLYMPIA ADMINISTRATION OFFICES, 31.2 METERS @ 220 DEGREES FROM THE APPROXIMATE CENTERLINE OF OLD HWY 99, 61.2 METERS @ 310 DEGREES FROM THE APPROXIMATE CENTERLINE OF THE ENTRANCE TO OLYMPIA REGIONAL AIRPORT #7643, 1.0 METER @ 130 DEGREES FROM A WITNESS POST AND 37.6 METERS @ 165 DEGREES FROM TELEPHONE RISER # F75W1. THE MARK IS A NGS BRASS DISK SET INTO THE TOP OF A ROUND CONCRETE MONUMENT WHICH IS SET LEVEL WITH THE GROUND SURFACE.

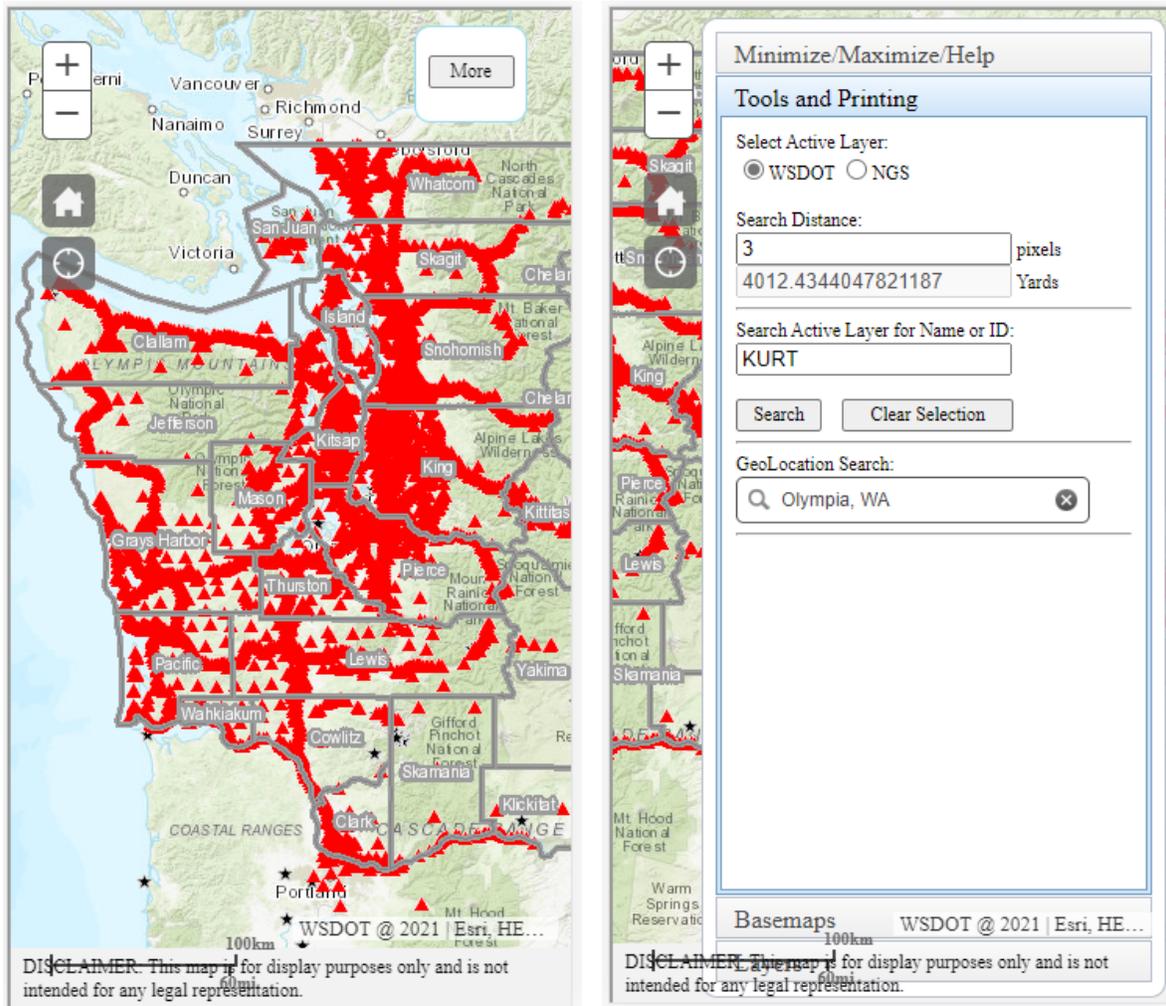
Survey Control					
Datum: NAD 83/11		Date: 08/22/2013			
Lat: 46 58 32.986245 N		Long: 122 53 48.528527 W		Ellips: 37.624 (M) 123.438 (USFt)	
Geoid: -21.291 (M)					
Washington State Plane Zone: South					
Northing	Easting	Scale	Comb Factor	Conv Angle	
185336.784 (M) 608059.099 (USFt)	317665.167 (M) 1042206.469 (USFt)	0.99993783	0.99993193	-1.44 27.7	
Ortho:	Date: 08/01/1992	Survey Info	Accuracy	Network	Method
Datum: NAVD 88		Horizontal	2 CM	PRIMARY	GPS
Elevation: 58.915 (M) 193.290 (USFt)		Ellips	5 CM		GPS
		Ortho	1 CM	PRIMARY	DIFF LEVELS

Several search tools are available Tools tab. The GeoLocation tool may be used to search the map by location key words -for best results use common place names like Tumwater, WA or Thurston County, WA. The Search Active Layer for Name tool allows you to search by Station Name, and if found, will automatically zoom the map to that location. The Measurement tool can be used to measure areas, distances, and determine the coordinates of any point on the map.

To support field use and small screen devices such as smartphones the tab bar may be minimized and there is now a “zoom to my location” button on the left side of the screen (Figure 5). When this button is clicked the application zooms into your current location. Location is obtained from your devices GPS (if enabled), your wireless or cell network, or an estimated location is made based on your computers IP Address. *This tool

supports HTTPS so the location you send to the server and the returned results are encrypted.

Figure 5. Monument Mapping Engine application as seen on a small screen device with the tab bar minimized and maximized.



Note - on small screen devices the WSDOT banner bar is not displayed, and the GeoLocation and Measurement tools will be unavailable.

Several benefits have been realized from making the survey information publicly available. Firstly, before the site was implemented WSDOT manually filled monument information¹ requests. Secondly, it has encouraged federal, state, city, and local surveyors to integrate our survey network into their projects. This assists WSDOT in maintaining the network, as local construction or maintenance activities are less likely to destroy a station.

¹ After the September 11th terrorist attack, the Monument Mapping Engine was taken off-line for security review. While it was off-line, WSDOT personnel spent ½ to 1 FTE per day responding to phone requests for information.

Since the Monument Mapping Engine's release in 1999 it has received 1000 to 1500 unique pageviews per month. Based on the cost of installing a monument², the number of site visits, and discussions with members of the professional Land Surveyors' Association of Washington, WSDOT estimates that the State has achieved over \$1.8 million in cost avoidance since 1999.

Current Environment

The current ArcGIS production server is a virtual machine with two 2 Cores using Intel(R) Xeon(R) CPU E5-2667 v2 @3.30GHz and 8 GB RAM with 120 GB SSD. The application now uses three internal ArcGIS map services for the main map and two external services. The maps generated by the services are delivered to the client as 24-bit PNG color images. The applications HTML and JavaScript pages were developed from code templates obtained from ESRITM and then extensively customized by WSDOT.

History Summary

The modification made in the current February 2022, v5.8.1, release of the application is:

- Upgrade ArcGIS JavaScript API support from 3.27 to 3.39 and
- Upgrade to ArcGIS Server 10.8.1.

The primary modification made in the November 2021, v5.7.2, release of the application was:

- Update interface to match the new look and feel of the WSDOT Intranet web pages.

The primary modifications made in the September 2021, v5.7.1, release of the application were:

- Upgrade ArcGIS JavaScript API support from 3.26 to 3.37 and
- Upgrade to ArcGIS Server 10.7.1.

The primary modifications made in the March 2021, v5.6.2, release of the application were:

- Upgrade ArcGIS JavaScript API support from 3.21 to 3.36.
- Move application to new server and update to support ArcGIS Server 10.6.1.
- Make County Boundaries on by default on initial load of the application.
- Add HTTPS support.

² It costs between \$5000 and \$7000 to install and survey a monument into the geodetic network –depending on the accuracy requirements for the new station.

The primary modifications made in the June 2017, v5.0.3, release of the application were:

- Upgrade to ArcGIS Server Standard 10.4.1 and
- update map documents to support new ArcGIS version.

The primary modifications made in the January 2016, v5.0.1, release of the application were:

- Upgrade to ArcGIS Server Standard 10.3.1 and
- Add Location button to interface (zoom to my GPS location).