

**West Davis Corridor
Technical Memorandum 5
STATUS OF ELEVATION DATA AND IMAGERY**
December 17, 2009

Revision Dates: Not Applicable

Purposes of This Technical Memorandum

The purposes of this technical memorandum are (1) to describe the best available elevation and imagery data for the study area for the West Davis Corridor (WDC) Environmental Impact Statement (EIS) and (2) to make a recommendation regarding the need to collect additional elevation and imagery information. The elevation and imagery data would be used during the EIS process to identify the expected environmental and social impacts of the WDC project.

Recommendation Summary

The project team believes that the EIS analysis could be conducted using the available 2-meter *elevation data* with the understanding that more-accurate data would be needed for detailed project design.

The project team believes that the 2009 National Agricultural Imagery Program (NAIP) *aerial imagery* is suitable to use for preparing the EIS. The project team does not believe that additional aerial images need to be collected at this time.

West Davis Corridor Study Area

The WDC EIS study area is located in Davis and Weber Counties, Utah. The study area is bounded by the Great Salt Lake on the west, Interstate 15 (I-15) on the east, about Parrish Lane (Centerville) in Davis County on the south, and about 1200 South (Marriott-Slaterville) in Weber County on the north. The entire study area is about 124 square miles in size.

Best Available Data

Elevation and aerial imagery information about the WDC EIS study area is currently available from the Utah Automated Geographic Reference Center (AGRC). The *best available elevation data* (contour lines) for the study area are 2-meter auto-correlated elevation model (DEM) data that were collected during a 2006 high resolution orthophotography (HRO) flight. The auto-correlation process used for these data is not as rigorous as other methods of elevation modeling such as photogrammetry, light detection and ranging (LiDAR) mapping, or radar mapping, so end users need to be aware that anomalies are expected within the elevation dataset. In comparison to the U.S. Geological Survey (USGS) national elevation dataset (NED), the 2-meter DEM provides higher resolution and horizontal accuracy but also contains the expected anomalies. The 2-meter DEM data are available for download from the AGRC website (gis.utah.gov/elevation-terrain-data/2-meter-auto-correlated-elevation-model-dem).

The *best available aerial imagery* for the study area is 2009 (NAIP) 1-foot color aerial photographs. This imagery, which was collected in the summer of 2009, covers most of the study area, but there are two

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areas (one about 3 square miles and one about 1.25 square miles) along the lake shore that are not captured. For these areas, the 2006 NAIP 1-meter color aerial photographs from AGRC can be used.

Both datasets are available for download from the AGRC website as follows:

- 2009 1-foot data: gis.utah.gov/sgid-image-server/hro-2009-imagery-available-in-image-server
- 2006 1-meter data: gis.utah.gov/naip2006

Both data use the UTM Zone 12 coordinate system and have a *horizontal* datum of NAD 83. The elevation data have a *vertical* datum of NAVD 88. Details about the elevation data and aerial imagery are attached to this memo.

The project team contacted representatives with both Davis and Weber Counties to inquire about the status of more-accurate or recent data. Neither County has more-accurate or recent data available.

Suitability of Available Data

Elevation Data

The terrain in the project area is flat to undulating. Because of this, the 2-meter *elevation data* that are available through the AGRC are not of a resolution that is fine enough to capture subtle elevation differences across the study area. For this reason, these data would not be suitable for detailed project design.

However, the 2-meter elevation data would be suitable to use for preparing the EIS with the understanding that more-detailed project design during the later project stages would require elevation data of a higher resolution (such as 1-foot or even 0.25-foot data). ArcGIS, the program that will be used to interpret and process the elevation data, allows contours to be created at a specified interval from the DEM. There are interval constraints, however, and the level of accuracy could be compromised as the data are manipulated. More-accurate elevation data are particularly important for road profile work and drainage design, but, since the EIS analyses will be based on consider general road profile and drainage information, use of the 2-meter data should not result in any *substantial* miscalculations of impacts that would be related to road profiles and drainage.

Although using more-accurate data when preparing the EIS would allow the project team to better estimate the expected impacts, the EIS could be completed using the 2-meter data, and the results of the impact analyses would suffice for the purpose of the document. If the 2-meter data are used, the project team needs to understand that all impact calculations and mitigation decisions would be based on these data and that impacts would not be recalculated using better resolution data once the Record of Decision (ROD) is signed.

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Because the study area is so large, collecting new elevation data for the EIS would be expensive. UDOT could consider collecting new data if a preferred build alternative is selected. However, if the preferred alternative were to change after the data are collected, UDOT might need to update the data again. This iterative process could affect the schedule and budget.

In summary, the project team believes that the EIS analysis could be conducted using the 2-meter elevation data with the understanding that more-accurate data would be needed for detailed project design.

Aerial Imagery

The project team believes that the 2009 NAIP *aerial imagery* is suitable to use for preparing the EIS. The imagery is recent and covers most of the study area. The two areas that are not covered by the 2009 dataset are included in a 2006 NAIP dataset that could be merged with the 2009 data. Because the two areas that are not included in the 2009 dataset are small and are along the western edge of the study area, the use of the 2006 data should not *substantially* affect the accuracy of work that uses or relies on aerial imagery. The project team does not believe that additional aerial images need to be collected at this time.

Summary

These recommendations apply only to the environmental review phase of the WDC project. If conditions in the study area change dramatically while UDOT is working on the EIS, additional elevation data or aerial images might need to be collected. Additional or updated elevation data and aerial images might also be needed once the project moves into the design phase.

Acronyms Used in this Memorandum

AGRC	Utah Automated Geographic Reference Center	NAVD	North American Vertical Datum
DEM	digital elevation model	NED	national elevation dataset
EIS	Environmental Impact Statement	ROD	Record of Decision
HRO	high-resolution orthophotography	UDOT	Utah Department of Transportation
I-15	Interstate 15	USGS	U.S. Geological Survey
LiDAR	light detection and ranging	UTM	Universal Transverse Mercator
NAD	North American Datum	WDC	West Davis Corridor
NAIP	National Agricultural Imagery Program		

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Attachment: Information about the Best Available Data

Digital Elevation Model using ISTAR (an EDI application) and GPRO (a Horizons application)

The Imagerie Stereo Appliquee au Relief (ISTAR) process is very efficient in the use of existing DEM data as well as the creation of new DEM data from autocorrelation methods. The ISTAR/GPro-Socet Set Automatic Terrain Extraction (ATE) process contains an autocorrelation module that utilizes the stereoscopic imagery derived from various L0/L1 sensor bands to develop DEM mass point data. If a review of the digital orthophotography created from existing DEM indicates that areas fail to meet the required accuracy standard, a digital surface model (DSM) is correlated at a post spacing dependent upon terrain, land cover, and project specifications. The ISTAR/GRPO-Socet Set ATE correlation algorithm computes the X, Y, Z value for each DSM post utilizing every ADS40 Airborne Digital Sensor stereo angle that is available. A mosaic is then created from the separate DSM files where the best vertical value for each posting is selected from all look angles compared against the aerotriangulation adjustment that is incorporated into the mosaic. The autocorrelated surface is filtered using LiDAR processing techniques to remove points falling on above-ground features. The edited mass points are then spliced into and edge-matched with the existing DEM data that is then used for digital orthophoto production.

Data were collected during the summer and fall of 2006.

Accuracy of Products

Product	Horizontal	Vertical
2-meter DEM from 12.5 cm HRO (6 inch)	National Standard for Spatial Data Accuracy (NSSDA), radial root mean square error (RMSE) of 2.2', 95% confidence 3.8'	2.13' RMSE NSSDA 95% 4.2'
2-meter DEM from 25 cm HRO (1 foot)	NSSDA, radial RMSE of 4.4', 95% confidence 7.6'	4.27' RMSE NSSDA 95% 8.4'
5-meter DEM from 1-m NAIP	RMSE 3m, NSSDA 95% of 5.2m	RMSE 4m, NSSDA 95% of 9.8m

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Datum/Coordinate Specification

Horizontal Datum	NAD 83
Vertical Datum	NAVD 88
Coordinate System	UTM Zone 12
Mapping Units	meter
Geoid Model	Geoid03

Imagery Information

The ortho imagery is the result of private and government entities working together under the guidance of AGRC. Image acquisition began on 21 April 2009 and was completed on 13 May 2009. Processing and delivery was completed by Mapcon Mapping Inc. with final delivery October of 2009. This ortho imagery reflects 0.25 M ground sample distance (GSD) rectified to a horizontal accuracy of within a radial RMSE of 0.75 M, at a 95% confidence. The georeferenced tiff format of this product is based on the US National Grid 2,000 M x 2,000 M tiles, and is rectified to UTM zone 12 coordinate system NAD83 (CORS96) meters using auto-correlated DEM or LiDAR DEM (2006-2007) where available.