



Survey Section Discovery Review Findings Summary

November 11, 2021

Prepared by:



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Montana Department of Transportation
Survey Section
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Thank you for taking the time to complete the U.S. CAD Discovery Review Process. During this journey your team has helped us gain a deeper understanding about the Survey Section. By reviewing the Autodesk's Discovery Documentation and the information you provided during our Discovery Review Session, we've compiled the information and summarized the findings within this document.

Our goal through this process is to help the Survey Section achieve more. We understand the challenges that exist within the industry and your significant investments to make your Department of Transportation great. Through this process we trust that you will have also gained more insight into your organization.

Herein you will find our findings and recommendations. We trust that you will find this information useful in your pursuit to achieve more as an organization.

We look forward to strengthening our partnership with MDT and the Survey Section.

Best Regards,

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EXECUTIVE SUMMARY

Montana Department of Transportation (MDT) enlisted U.S. CAD to gather information about your section and provide recommendations based on our experience and knowledge. Prior to U.S. CAD's Discovery Review Session, the Survey Section participated in a thorough discovery process performed by Autodesk. Through our Discovery Process U.S. CAD was able to uncover insights about how the Survey Section performs business, technologies currently used, required deliverables, existing pain points, section objectives, and goals. The information gathered from the completed Discovery Workbook(s) and Discovery Workshop was used to help us better understand these areas of your organization and to prepare this document.

During our review of your Autodesk Discovery Documents, and while performing the Discovery Review Session we identified/noted the following items:

- Develop a process to replace Survey Pro for legacy projects.
- Move Construction away from Survey Pro.
- Working with large image files is problematic.
- Current survey feature codes utilize multiple attributes.

This report highlights our understanding of the items listed above and our proposed recommendations as a part of the MDT CADD Implementation process.

U.S. CAD did observe several immediate opportunities that would allow the Survey Section to utilize the AEC Collection. Note, in the future, once other bureaus have completed their migration to the Autodesk AEC Collections, there could be potential opportunities for increased cross collaboration.

This report is broken out into the following sections:

Department Profile	The organizational structure of the division and interactions with internal and external teams.
Recommendations	In this section we provide our specific recommendations on process and solutions based on our findings during the Discovery Process.
Training Program	This section identifies the potential training opportunities based on the team's wish list items, pain points, goals, and objectives.
Next Steps	In this section we provide our specific recommendations on process and solutions utilizing a Production Project where additional "Fit Gaps" may be exposed requiring additional training.

DEPARTMENT PROFILE

The Department Profile section provides our understanding of the organizational structure, key staff within the organization, departmental relationships, and how the Survey Section interacts with other internal MDT bureau's/departments.

During the Discovery process, U.S. CAD was introduced to several staff members who are integral components of the MDT Survey Section. These employees have immense knowledge and skills working within the Survey ecosystem and related sections. Their knowledge of the inner workings of MDT's Survey Section, and outside entities, provided us with the needed details for a thorough understanding of day-to-day operations.

The key staff members along, with the additional Survey Section staff create, consume, edit, and share survey related data with MDT's functional design areas.

During the Discovery process, the Survey Section personnel assisted U.S. CAD in identifying five key sections comprising the Survey Section. The sections identified are as follows:

- **Cadastral Survey**
- **Engineering Survey**
- **Control Survey**
- **LiDAR/UAV Survey**
- **Photogrammetry Survey** (*please refer to the 10/14/2021 approved Photogrammetry Findings & Recommendations report*)

These five survey sections have similar workflows and deliverables, but there are enough differences between them for each to be detailed separately in this section.

The Cadastral Survey Section's main objective is to establish and re-establish property boundaries and generate the supporting drawings and documentation as Certificate of Survey and Certified Corner Recordation. Once a survey request form is received a control survey and the topography and field work survey is completed for the project, using Trimble Access, the survey data is post-processed in Trimble Business Center (TBC) software. The TBC data is exported as a Microsoft Excel (.csv) file containing coordinate points, descriptions, and attributes. The .csv file is then imported into two separate software applications; in GEOPAK to create a .gpk file for the project and the base for the roadway design project, and in MicroStation to generate the Certificate of Survey and Certified Corner Recordation drawings.

The Cadastral Sections deliverables include a GEOPAK (.gpk) file, a MicroStation (.dgn) file of the Certificate of Survey, and an Adobe (.pdf) of the Certificate of Survey and Certified Corner Recordation's for the functional design areas. All the data is placed on DMS for consumption. Project support files are also placed on DMS including an ASCII (.txt) file of the points shown on the Certificate of Survey (point, northing, easting, elevation, feature, and description), a ZIP (.zip) file of all the cadastral data, and a text (.txt) file describing how the survey data was created (datums and adjustments, geoid, and what marks were held). Additional data that is included are field books, GPS logs, and pictures of monuments and evidence.

Some of the tools used by the Cadastral Survey Section:

Activity	Solution(s)	Additional Solution(s)
Data Collection - Field Work	Trimble Access	
Field Data Post-Processing	Trimble Business Center (TBC)	
Mapping Software	MicroStation, Geopak	
Deliverables	MicroStation (.dgn), GEOPAK (.gpk)	Adobe (.pdf), Compressed File (.zip), ASCII (.txt)
Project Collaboration	DMS	

As-Built plans are also leveraged for data.

The Engineering Survey Section captures and processes a projects existing field conditions and data and delivers to the functional design areas. The start of their workflow is similar to Cadastral in that it begins with the survey request form and control survey data. A .job or .jxl file of the control survey is created and uploaded to Trimble Access to begin the topography and field survey. After the field data is captured, the data is post-processes in Trimble Business Center (TBC) software and exported. The TBC data is exported as a Microsoft Excel (.csv) file containing coordinate points, descriptions, and attributes. The .csv file is then imported into two separate software applications; in GEOPAK to create the base for the roadway design project data, and in MicroStation for the projects DTM (.tin) file.

A GEOPAK (.gpk) file and MicroStation (.dgn) file, along with ASCII (.txt) files containing culvert information, hydraulics information and explanation of submitted and a ZIP (.zip) file of all data is placed on DMS to be consumed by the design functional areas.

Some of the tools used by the Engineering Survey Section:

Activity	Solution(s)	Additional Solution(s)
Data Collection - Field Work	Trimble Access	
Field Data Post-Processing	Trimble Business Center (TBC)	
Mapping Software	MicroStation, GEOPAK	
Deliverables	MicroStation (.dgn), GEOPAK (.gpk)	Compressed File (.zip), ASCII (.txt), TIN (.tin)
Project Collaboration	DMS	

The Control Survey Section's primary focus is establishing and providing a horizontal and vertical control network for the other Survey sections. Once a Survey Request Form has been received, the Control Survey section will conduct their field survey activity. The control data is the post-processed using Trimble Business Center (TBC). NOAA's Online Positioning User Service (OPUS) is also used. All the Control Survey data is then delivered to the other Sections via DMS. The deliverables include a compressed file (.zip) of an ASCII coordinate file(.itf), a text file explaining the submitted data (.txt), a MicroStation (.dgn), an ASCII file with descriptions of points within the projects vicinity (.des), an ASCII file with descriptions of the points used for the project and an ASCII file containing the geodetic information, ellipsoid height, metric state plane, elevation, scale factor and marks used for project (.pts). A compressed file (.zip) of the data collector files.

Some of the tools used by the Control Survey Section:

Activity	Solution(s)	Additional Solution(s)
Data Collection - Field Work	Trimble Access	
Control Data Post-Processing	Trimble Business Center (TBC)	OPUS
Mapping Software	MicroStation	
Deliverables	MicroStation (.dgn)	Compressed File (.zip), ASCII (.txt, .ift, .des, .pts)
Project Collaboration	DMS	

*NOAA Online Positioning User Service (OPUS)

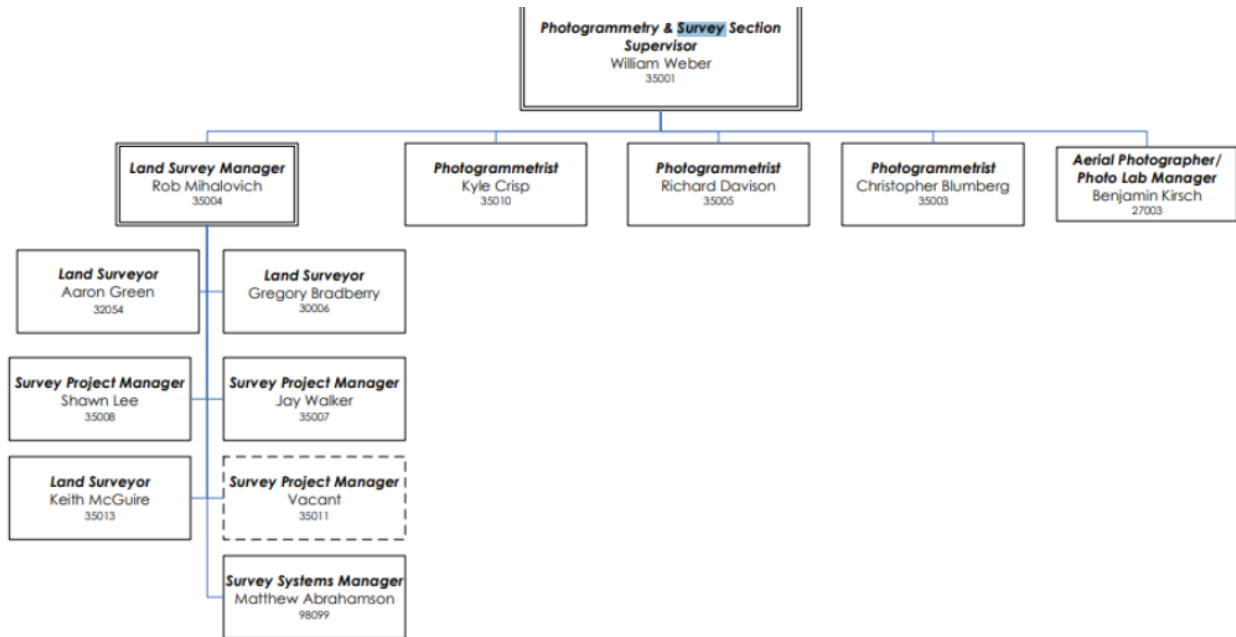
The **LiDAR/UAV/Point Cloud** Survey Section provides supplemental point cloud data to the Engineering Survey section. If it is determined that additional point cloud data may benefit the project the LiDAR/UAV section will be notified of the supplemental request. It will then be determined, depending on the project, which point cloud gather method would be more efficient, LiDAR or UAV.

If LiDAR is used, the data is post-processed using Trimble Business Center (TBC) and exported as a point cloud file (.las). When a UAV is used for capturing the data, Pix4D software is leveraged for creating the point cloud (.las) and an orthorectified image (.tif). The point cloud (.las) file from either process and the orthorectified image (.tif), from the UAV process, are packaged and delivered along with the Engineering Survey data. All of the survey data is placed on DMS for consumption by the requestor.

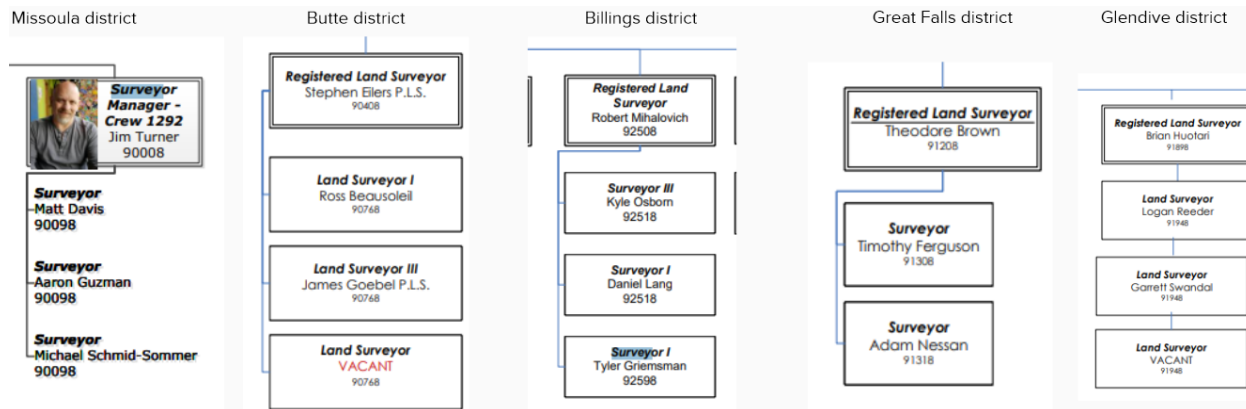
Some of the tools used by the LiDAR/UAV/Point Cloud Survey Section:

Activity	Solution(s)	Additional Solution(s)
LiDAR Post-Processing	Trimble Business Center (TBC)	
UAV Post-Processing	Pix4D	
Deliverables	Point Cloud (.las), Orthophoto(.tif)	
Project Collaboration	DMS	

Below is the Organizational Chart of the MDT Survey Section supplied by MDT.



Below is the Organizational Chart of the MDT Survey Section by district as supplied by MDT.



RECOMMENDATIONS

Based on the information shared by the Survey Section through the Autodesk's Discovery process and U.S. CAD's Discovery Workshop, we have prepared a summary of our recommendations for the Survey Section as discussed below. This information is prepared for you to consider as you make investments in moving forward toward your goals and objectives. We look forward to the discussions around these recommendations and next steps.

Survey Section

U.S. CAD believes that by integrating the use of the products included in the Autodesk AEC Collection in all relevant bureaus and having one localized set of standards for all MDT project data would provide easy access to all MDT sections and external entities if shared. The true intent of standardization would be to provide accurate and consistent data/plans for users to access and reduce the possibility of errors and omissions. The capabilities of the AEC Collection would improve collaboration by providing access to maps, specific project site data, current/past projects, as-built plans, etc. Incorporating this information into the existing projects and utilizing automated processes in the AEC Collection's products would reduce rework and provide for faster project turnaround, inherently improving the workflow for the Survey Section.

By utilizing the Autodesk AEC collection, the Survey Section will be able to collaborate not only with the other Survey sections more efficiently, but the MDT functional design areas as well. Civil 3D's ability to share data through its survey database and data shortcut tools will allow the Survey Section to consume, create and deliver survey data more efficiently. A few topics that were discussed during the discovery process were the ability to have a central location for control data, export format to .xml for consumption of construction, control survey to be part of the as-built process and to have a software platform that can manage and edit large surfaces. These topics can be achieved by incorporating Civil 3D and the Autodesk AEC Collection in to the Survey Section's workflows.

Civil 3D

Civil 3D takes the process of designing in a 2D environment and instantly turns elements into intelligent 3D model components that are dynamic in nature. As a result of this dynamic capability, designers can make a change in one area of the project, and several other connected areas will be updated as a result. Civil 3D's dynamic capability will assist in the use of tables which currently are static and have to be updated when the design changes. This can save a tremendous amount of time by reducing the editing process as well as eliminating potential errors. Civil 3D also automates the process of reporting as a result of utilizing intelligent Civil objects that not only are inter-connected but also possess a rich collection of data. Having knowledge of the available tools and how they are being leveraged within other MDT bureaus will help bridge the data gap and improve efficiencies between functional areas.

ReCap

ReCap is a 3D scanning software used to transform scanned data into a digital model that can be imported as a point cloud into the Civil 3D workflow. Reality capture (ReCap) data can help stake holders better understand and verify existing conditions to visualize the project site and make better design decisions.

BIM 360

The Autodesk cloud collaboration tool, BIM 360, will be a crucial piece to the Survey Section future workflow. Being able to share, review, and manage data in one centralized location will be a huge benefit. Autodesk's BIM 360 provides access to data anywhere and anytime as well as design collaboration, project management and document management tools.

The following tables outline the Survey Section current activities and recommended Autodesk (and other) solutions to be implemented. These solutions are the basis for the proposed Training Program outlined below.

Cadastral Survey

Activity	Solution(s)	Additional Solution(s)
Data Collection - Field Work	Trimble Access	
Field Data Post-Processing	Trimble Business Center (TBC)	
Mapping Software	Civil 3D	
Deliverables	Civil 3D (.dwg)	Adobe (.pdf), Compressed File (.zip), ASCII (.txt)
Project Collaboration	BIM 360	PCMS

Engineering Survey

Activity	Solution(s)	Additional Solution(s)
Data Collection - Field Work	Trimble Access	
Field Data Post-Processing	Trimble Business Center (TBC)	
Mapping Software	Civil 3D	
Deliverables	Civil 3D (.dwg) Surface (.xml)	Compressed File (.zip), ASCII (.txt)
Project Collaboration	BIM 360	PCMS

Control Survey

Activity	Solution(s)	Additional Solution(s)
Data Collection - Field Work	Trimble Access	
Control Data Post-Processing	Trimble Business Center (TBC)	OPUS
Mapping Software	Civil 3D	
Deliverables	Civil 3D (.dwg)	Compressed File (.zip), ASCII (.txt, .ift, .des, .pts)
Project Collaboration	BIM 360	PCMS

LiDAR/UAV

Activity	Solution(s)	Additional Solution(s)
LiDAR Post-Processing	Trimble Business Center (TBC)	Autodesk ReCap
UAV Post-Processing	Pix4D, Trimble Business Center (TBC)	Autodesk ReCap
Deliverables	ReCap (.rcp), Ortho Image (.tif)	
Project Collaboration	BIM 360	PCMS

TRAINING PROGRAM

U.S. CAD recommends performing a high-level demonstration of the tools within the Autodesk products to the Survey Section to give them further insight on what file types can be imported and exported. With this knowledge U.S. CAD feels the Survey Section will have a better understanding of what the design departments' capabilities are. Topics may include consuming, leveraging, and delivering parcel data. Topics may also include what types of data will be published to BIM 360 for the Survey Section's use.

By exposing the civil tools included in the Autodesk products, to all MDT bureaus, staff will have the knowledge needed for making informed decisions on what data is available and how to access it. Providing the Survey Section with tools to import survey, GIS, as-built, and other related data and utilize this data in their current workflows is key to removing existing inefficiencies and frustrations within the Section. It is equally important for the Section to export data capable of being consumed by the other MDT Bureaus.

U.S. CAD recommends the following training courses for the Survey Section staff.

- **101 AutoCAD Fundamentals for Bentley Users** - This course, intended to assist those who have utilized Bentley products and have limited or no Autodesk AutoCAD experience, is focused on basic interface and functions within the AutoCAD product.
- **201 Civil 3D Fundamentals I** – This course will introduce the Civil 3D user interface and terminology and provide an understanding of Parcels, Surfaces and Survey.
- **202 Civil 3D Fundamentals II** – This course continues creating the knowledge of Civil 3D features and their functions.
- **203 Civil 3D Fundamentals III** – This course delivers insight into Sections, Section Views, Templates, Styles, Data Shortcuts, Printing, Sheet Setup, Sheet Set Manager and Quantities.
- **301 BIM360 Collaborate Pro for Infrastructure I** - This course provides an overview of what the web- based collaboration tool has to offer and how it can be leveraged to collaborate with internal divisions, field personnel and consultants. The course will also deliver the tools necessary to manage the account, set up new projects, activate various modules, where to set up workflows, and manage project members and settings.
- **701 Recap I** - This course will introduce the benefits of using ReCap for dimensioning, annotation, and visualization of point clouds including the associated Civil 3D workflow.

By exposing the Survey Section to the Autodesk software tools included in the list above, staff will have the knowledge needed for making informed decisions on what data is available and how to access it. Providing the Survey Section with tools to import, utilize and share data in their current workflows is key to removing existing inefficiencies and frustrations within the Section. It is equally important for the Survey Section to export data capable of being consumed by other MDT Bureaus.

NEXT STEPS

A Production Project will be identified by the MDT CAD Implementation Executive Team. A Production Project provides opportunity for MDT to refine proposed future MDT workflows, identify gaps, and give insight into configuration needs. This process has already led to the creation (and implementation) of the MDT State Kit. The State Kit was utilized on prior Pilot Projects giving deeper insight into how best to update and configure the solution. The Production Project will also provide insight into the requirements for additional content that needs to be included in MDT's State Kit as well as other key configuration elements that will help with production efficiencies.

The MDT CAD Implementation Executive Team have identified early adopters within each functional design area. U.S. CAD will work closely with the early adopters to develop workflow processes and procedures, as mentioned in our recommendations, to ensure their portion of the project can be completed utilizing Autodesk's AEC Collection. U.S. CAD will provide support and mentoring throughout the production project.

- During this phase additional "Fit Gaps" may be uncovered. If there are, additional training may be recommended.
- U.S. CAD and Autodesk will remain engaged with MDT to ensure successful implementation and Production Project completion.
- U.S. CAD and Autodesk will arrange regular meetings with MDT staff to assist them in attaining their goals and objectives.
- Upon completion of the Production Project, MDT to meet with U.S. CAD and Autodesk to explore expanded implementation options and identify the most effective path forward and to meet MDT's larger BIM goals.

In addition to the Production Project, Workflow Road Maps will be developed and presented to MDT. With several MDT Pilot Projects already completed, (or currently being executed) the process of refining the workflows based on MDT feedback can begin. The goal is to confirm workflows that will be included in the initial stages of the broader implementation and training at MDT. The Workflow Road Maps are important to gain clarity of the scope and schedule of the Training and Implementation requirements, as well as the configuration needs for MDT's state-wide rollout of the AEC Collection solution