



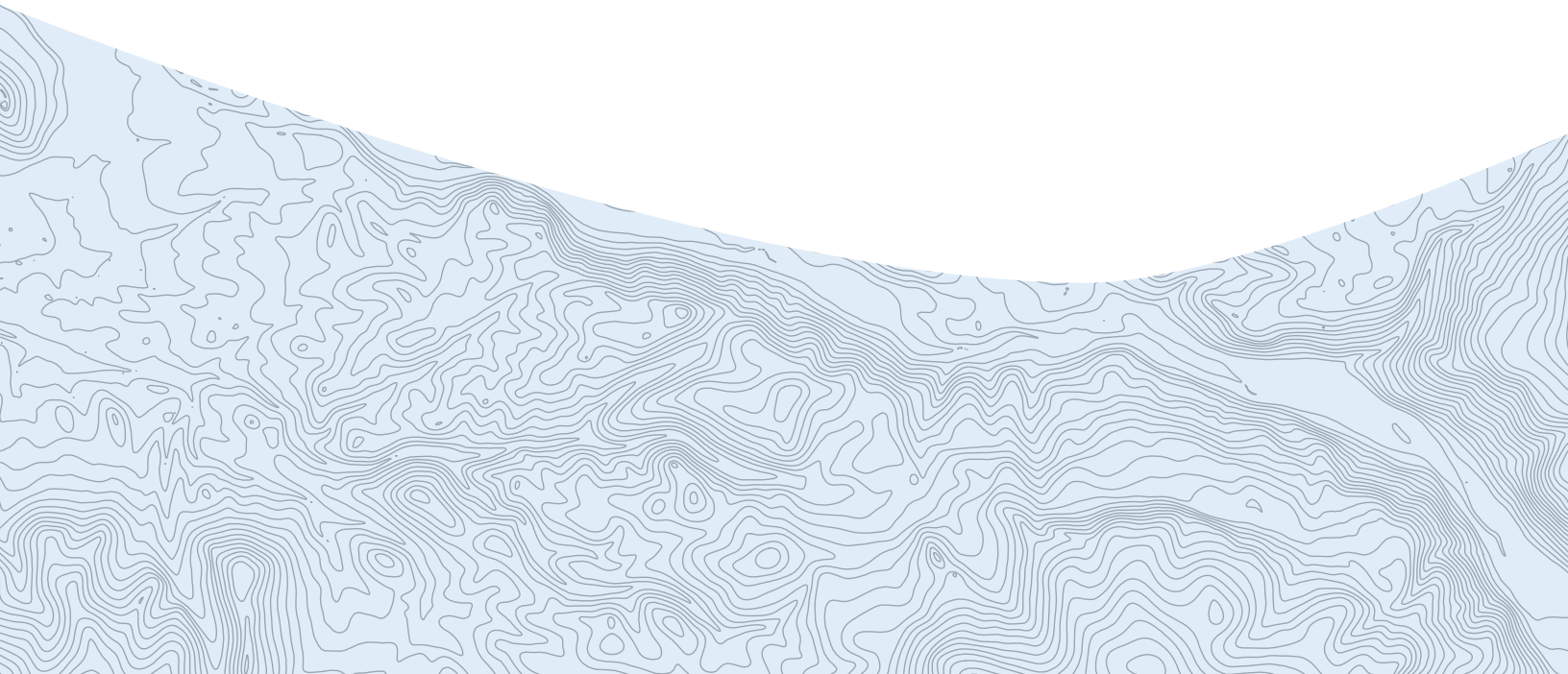
COLORADO
Department of Transportation

GIS

GIS Section Strategic Plan - 2021

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Introduction

Geographic Information Systems (GIS) and geospatial services are a suite of technology systems and services to help practitioners map, investigate, analyze, model, and manage location-based data. Common geospatial technologies include desktop GIS, online and cloud-based GIS platforms, remote sensing and GPS-enabled mobile field data collection applications. CDOT has been using this technology for decades to support its business and operations.

The GIS Section is located within the CDOT Division of Transportation Development (DTD) Information Management Branch and comprises three major units: Applications and Data Services, Data Management, and GIS Support. The Section uses a diverse array of geospatial technology to collect and manage data, develop and publish geospatial datasets and applications and complete business analytics that make it possible to model CDOT roadway assets and other supporting information for operations, planning, analysis, and performance monitoring in a location-intelligent environment. The Section designs static and dynamic cartographic products and leverages innovative technology to add value to CDOT business. The GIS datasets the Section produces and manages are also used for reporting to State and Federal agencies that provide substantial funding to support CDOT projects and roadway maintenance across the state.

This plan defines the strategic direction for the GIS Section by establishing the goals for the next five years. The plan will also serve as a mechanism for communicating Section priorities to the broader CDOT GIS community, other CDOT business units and CDOT leadership.



Mission and Vision

The following statements were developed to encapsulate the ideas and values of the GIS Section. The mission and vision statements are meant to serve as the guiding light for all that we do within the section. They also build upon the CDOT and DTD mission, vision, and core values and are meant to further define how the GIS Section operates within and as an integral part of the larger organization.

MISSION

In collaboration with our customers we collect, manage, integrate and disseminate geospatial data as the foundation for all location-based operations and decision-making. We transform geospatial data into information through innovative visualization and analytics to help CDOT provide the best multi-modal transportation system for Colorado.

VISION


We strive to integrate geospatial intelligence into all aspects of the organization to position CDOT as an innovative leader in location-aware transportation management.

Goals and Objectives

The following goals and objectives were developed to define the major high level tasks that the GIS Section will be working on over the next five years. The goals and objectives were formulated based on several exercises including a customer and partner feedback survey; a Section-wide strengths, weaknesses, opportunities and threats (SWOT) analysis and a collaborative round robin session with the GIS Section unit managers. For more information on this process please see the Appendix. In collaboration with DTD leadership, the Chief Data Office (CDO) and the Office of the Chief Engineer, GIS Section leadership will work to prioritize the goals and objectives annually and identify specific activities to meet them. More information on this process can be found in the Implementation section of this plan. The objectives will be reviewed and potentially revised on an annual basis; the goals will be static for the life of the plan barring any major organizational or technological changes.



2017 GIS User Group Meeting, Region 4, Greeley, CO



GOAL 1: Develop geospatial data governance to ensure CDOT’s geospatial data is accurate, accessible and secure, and viewed and used appropriately.

Objective 1.1: Define and categorize authoritative datasets and institute a data stewardship lifecycle. Develop data standards and metadata for authoritative datasets.

Objective 1.2: Develop data sharing and accessibility protocols to reduce redundancy and duplication, to maintain data security and to attract, engage and enable a broad audience to discover and utilize geospatial data.

Objective 1.3: Work closely with other CDOT business units to advance data quality assurance processes and data workflows that will increase the currency, accuracy and completeness of authoritative geospatial datasets.

Objective 1.4: Institute metrics that inform data users as to the accuracy, timeliness, and completeness of data.

GOAL 2: Formalize governance for online GIS systems and applications and develop a framework for governance in other GIS programmatic areas.

Objective 2.1: Complete Enterprise and ArcGIS Online Governance documentation and integrate and operationalize across CDOT. As part of online governance, develop application governance practices including, but not limited to, ownership, lifecycle management, updates and review processes.

Objective 2.2: Initialize exploratory governance in the following programmatic areas for all of CDOT: GIS program organization and decision-making authority (includes defining regional participation and relationships), technical and project support requests, GIS software and hardware, mobile field data collection devices, and GIS support for emergency operations.

GOAL 3: Invest in our staff as our most valuable asset.

Objective 3.1: Acknowledge GIS Section employee contributions through formal awards and informal recognition. Provide the training and other opportunities our staff need to grow professionally and meet their career goals.

Objective 3.2: Institute recruitment and hiring best practices to ensure we have the best people on board to emulate the mission, vision, values and goals of the GIS Section, DTD, and CDOT.

Objective 3.3: Complete a GIS salary survey to understand local GIS position salary trends and work with human resources to update salary ranges to be competitive.

Objective 3.4: Assess the organization of the GIS Section and determine what changes and/or additional resources would be needed to achieve our goals and support our customers.

GOAL 4: Take effective steps to optimize our architecture and database designs.

Objective 4.1: Build upon previous work with Esri (GDB health check, ArcGIS Monitor, System Architecture Review) to create a sustainable, optimized GIS server and database environment.

Objective 4.2: Work with CDOT system architects, the Office of Information Technology (OIT) and Esri to increase system performance and remedy pervasive challenges with GIS systems support.

GOAL 5: Focus on innovation and advancement in GIS through software diversification, data integration, analytics, and cutting edge technologies.

Objective 5.1: Investigate alternative software solutions for data integration and transformation, analytics, and remote sensing to diversify our software base.

Objective 5.2: Coordinate with the Chief Data Office through initiatives such as the Real-Time Data Hub, Advanced Data Analytics Platform (ADAP) and the DTD Research Branch to augment geospatial research and development via advanced modeling, visualization, and analysis.

Objective 5.3: Explore innovative ways to collect and analyze data such as through LiDAR feature asset extraction, multispectral and hyperspectral remote sensing, unmanned aircraft systems (UAS), 3D and 4D, big data sources, mobile applications and other methods to help solve common business problems, increase efficiency and generate value.

GOAL 6: Develop communication and educational protocols with our customers and partners and integrate effective communication strategies across all aspects of our products and services.

Objective 6.1: Update and expand our exposure, marketing skills and web presence so customers know who to reach out to, what resources are available, how to get support and training, and where to discover geospatial data and applications.

Objective 6.2: Develop protocols to communicate with our customers via newsletters, emails, presentations and other media along regular timelines.

Objective 6.3: Initiate product review processes and invest in staff training to ensure our products and services are audience appropriate and exhibit a high level of cartographic presentation, design principle, and clarity.

GOAL 7: Expand technical support and engage staff across the organization to better integrate GIS into their operations and decision-making workflows.

Objective 7.1: Operationalize technical user support to the larger agency including training, workforce development, and user group outreach to encourage the incorporation of GIS into every aspect of CDOT.

Objective 7.2: Develop regional outreach practices to encourage regional participation in several GIS use categories (i.e. data collection and management, field mobility, sharing and collaboration, informed transportation design, etc.) and regional GIS capacity expansion which may include a designated regional GIS coordinator or GIS data manager.

Connections

The purpose for analyzing connections is to better understand how the GIS Section works with internal and external partners. It is also helpful in illustrating where GIS is well-integrated into a particular CDOT business line and where there are opportunities for improved integration. To analyze these connections we focused on eight common GIS use patterns: mapping and visualization, data collection and management, field mobility, analytics, constituent engagement, sharing and collaboration, training and technical support and research and development. *Figure 1* is a matrix organized to understand relationships and gaps at the CDOT division level and *Figure 2* is a matrix to help illustrate the breadth of all of the business lines that the GIS Section currently works with.

	Mapping & Visualization	Data Collection & Management	Field Mobility	Analytics	Constituent Engagement	Sharing & Collaboration	Training & Technical Support	Research & Development
Division of Maintenance & Operations	✓	✓				✓		✓
Division of Project Support	✓	✓	✓	✓				
Chief Data Office	✓	✓	✓			✓		✓
Division of Transit & Rail	✓	✓		✓				
Office of Transportation Safety	✓							
Division of Transportation Development	✓	✓	✓	✓	✓	✓	✓	✓
Division of Aeronautics								
High Performance Transportation Enterprise								
Office of Innovative Mobility								
Office of Transportation Safety	✓	✓						
Office of Government Relations & Policy	✓			✓	✓			
Division of Human Resources								
Division of Accounting and Finance								
Division of Audit								
Federal Highways Administration		✓						
Office of Information Technology						✓		
Department of Natural Resources	✓	✓		✓		✓	✓	
State Tourism Office	✓				✓	✓		
Local Jurisdictions	✓	✓				✓	✓	
The Public	✓	✓				✓		

Key: Internal Customer External Customer Public

Figure 1: GIS Section analysis of customer use categories by CDOT division and external partners

	Mapping & Visualization	Data Collection & Management	Field Mobility	Analytics	Constituent Engagement	Sharing & Collaboration	Training & Technical Support	Research & Development
SAP Project Systems	✓	✓						
SAP Plant Maintenance	✓	✓						
Permits	✓	✓						
Planning	✓	✓			✓	✓	✓	
eConstruction	✓		✓			✓		
Division of Maintenance & Operations	✓	✓	✓			✓		✓
Civil Rights	✓	✓	✓	✓				
Environmental	✓	✓	✓				✓	
Risk & Resiliency	✓	✓		✓				✓
Government Relations Office	✓			✓	✓			
Civil Integrated Management	✓	✓	✓	✓			✓	
Division of Transit & Rail	✓	✓		✓				
Pavement Management	✓							
Staff Bridge	✓	✓		✓				
Traffic Safety & Engineering	✓							
Division of Transportation Development	✓	✓	✓					
Chief Data Office		✓	✓			✓		✓
Engineering Applications			✓			✓	✓	✓
Traffic Mobility	✓				✓	✓		

Figure 2: GIS Section analysis of customer use categories by CDOT business line

Figure 1 clearly shows that there may be some gaps at the division level that the GIS Section could work to address. In particular there may be opportunities to work with the High Performance Transportation Enterprise (HPTE) group and the Office of Innovative Mobility.

Figure 2 illustrates that the GIS Section works across 19 CDOT business lines and provides varying levels of support to each. There may be opportunities to expand GIS support for several business lines in the following use categories: analytics, constituent engagement (i.e. engagement with the public or partners), sharing and collaboration, training and technical support and research and development so that these customers are realizing the full capabilities that GIS technology can offer them.

GIS Growth

The following infographics (Figure 3) were developed to help understand changes that have occurred in the GIS Section from 2006 to the present. Dates were chosen based on the availability of information and institutional knowledge regarding significant changes within the Section. The graphs illustrate substantial growth in the number of servers, databases, public datasets and linear referencing system miles managed. The graphs also indicate significant growth in the number of both custom and COTS applications developed for GIS Section customers.

Changes in COTS GIS technology over the past several years have made it possible to develop and deploy applications fairly quickly and easily and have enabled this growth to occur. The CDO work with the Esri System of Engagement (currently known as the CDOT GeoHub) contract has also increased the number of servers and applications exponentially. Based on conversations with GIS management some of the growth in contracting dollars (GIS Section projects only) can be attributed to the additional support that has been needed to manage GIS growth. GIS Section staffing has remained mostly static, but numbers have fallen recently to their lowest levels in over a decade.

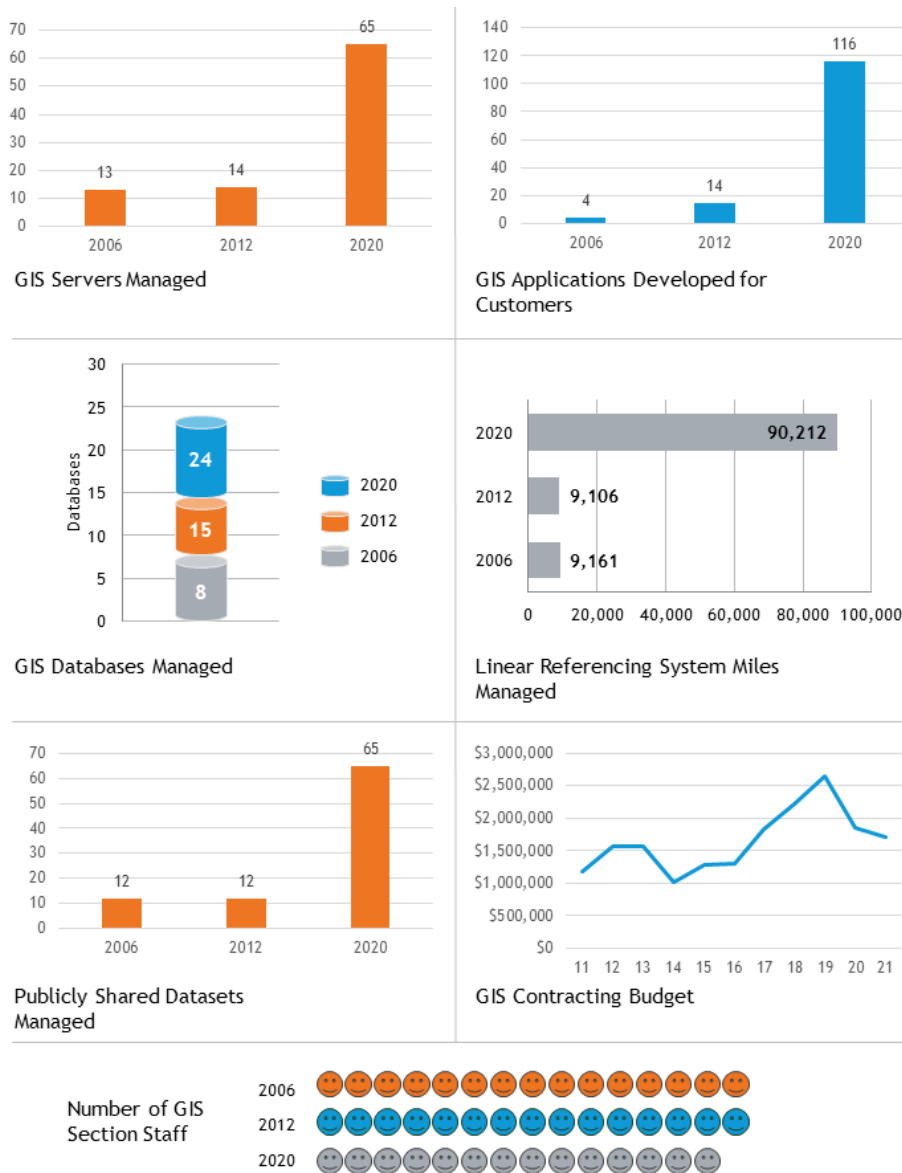


Figure 3: GIS Section metrics infographic

Organization

GIS Section Organization

It's important for the GIS Section to periodically review how we are structured to ensure that the Section is organized and appropriately staffed to meet the GIS needs of CDOT and its partners. The Section is currently organized into three major units (Applications and Data Services, Data Management and GIS Support) and has a total of 14 staff members. Based on our growth analysis geospatial data and applications have been increasingly integrated into CDOT business.

The advent of online GIS services and rapid changes in geospatial technology has changed the paradigm of GIS across the globe and CDOT is no exception. The increase in these types of online platforms are changing the way GIS professionals work and are highlighting the need for expanded GIS governance. In collaboration with DTD, OIT and other CDOT leadership the GIS Section will be working to identify an ideal organization to meet these needs and assessing avenues to more formally support CDOT's robust online GIS systems infrastructure and significantly expanded data requirements from FHWA.

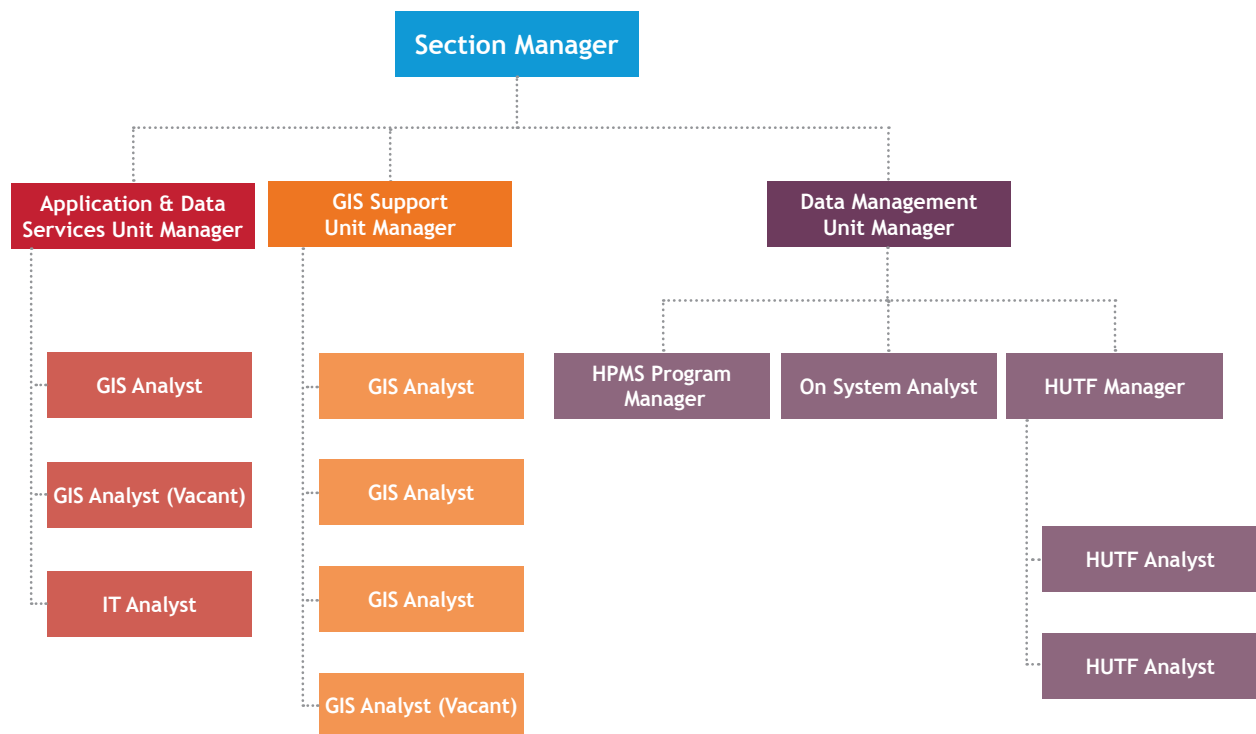


Figure 4: Current GIS Section organization

GIS Community Organization

The GIS User Group serves as an active GIS community of practice within CDOT with voluntary membership from across the agency. The GIS User Group Steering Committee is composed of representatives from each CDOT region as well as several GIS Section staff. The purpose of the steering committee is to plan the quarterly GIS User Group meetings.

During the formulation of this strategic plan it became clear that there is a need to look more specifically at how GIS is supported across the entirety of CDOT and in particular at the regions. There is an increasing need for dedicated GIS support in each regional office and for coordination between regional GIS support, other CDOT division GIS support and the GIS Section. This coordination could be achieved through the advent of a CDOT GIS advisory body. The following table illustrates one possible future scenario for GIS organization and coordination CDOT-wide through an advisory body. More research and analysis is needed before this or other scenarios could be implemented. See the Future section of this document for more information.

Regional GIS Representatives	Division Representatives	GIS Section Representatives
<ul style="list-style-type: none"> ● Region 1 ● Region 2 ● Region 3 ● Region 4 ● Region 5 	<ul style="list-style-type: none"> ● Maintenance & Operations ● Project Support ● Chief Data Office ● Transit & Rail ● Office of Transportation Safety ● Office of Government Relations & Policy ● Division of Transportation Development 	<ul style="list-style-type: none"> ● Section Manager (lead) ● Applications & Data Services Unit Manager ● Data Management Unit Manager ● GIS Support Unit Manager

Table 1: Potential CDOT GIS advisory body membership

Implementation

A strong implementation strategy is crucial to ensure progress is made towards achieving the goals of this plan. The following strategies will be employed to support implementation of the strategic planning goals.

- In collaboration with DTD leadership, the Chief Data Office (CDO) and the Office of the Chief Engineer GIS Section leadership will work to prioritize the goals and objectives annually. The Section will maintain dynamic documentation of each goal and objective and will work to identify specific activities to meet each prioritized goal/objective at the beginning of each calendar year.
- Strategic plan goals will be integrated with staff performance goals. Every GIS Section staff member will identify at least one goal for each performance period that is directly tied to one or more strategic plan goals and objectives.
- The GIS Section manager and the GIS Section unit managers will complete a bi-annual progress review to assess progress towards each goal and objective.
- The GIS Section strategic plan will be integrated with individual unit work plans or strategic plans. To the extent practicable each unit will incorporate the GIS Section goals and objectives into any work or strategic planning that they use for the regular management of their unit.

Future

Two major themes emerged for consideration that would help CDOT with geospatial integration and support across the agency.

- 1. CDOT Geospatial Strategy:** develop a geospatial strategy to define CDOT's direction for GIS integration and support at the organization level. This plan could include guidelines for how GIS is supported and organized across CDOT and lay out plans for regional GIS coordination and support.
- 2. CDOT data governance and integration with the CDO and Enterprise Data Management Advisory Committee (EDMAC):** with the kick off of the EDMAC it is clear that CDOT values the importance of data governance and is working to address systemic issues with data management across the organization. As the majority of data produced and managed at CDOT has some spatial component it is paramount that any work that the GIS Section completes around data governance is informed by the work being completed by the CDO and EDMAC and vice-versa.

Contributors

Core Team

Gary Aucott
Roberto Avila
Nell Conti
Erik Sabina
Phyllis Snider

GIS Section Staff

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Shelley Broadway

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Jennifer McCall
Nick Mesenbrink
Aaron Rhodes
Nate Rodgers
Gerry Shisler
Travis Stieber
George Suresh



A field data collection training day for the CDOT Environmental Branch using ArcGIS Collector and the Geode sub-meter GPS receiver.

Appendix

Process

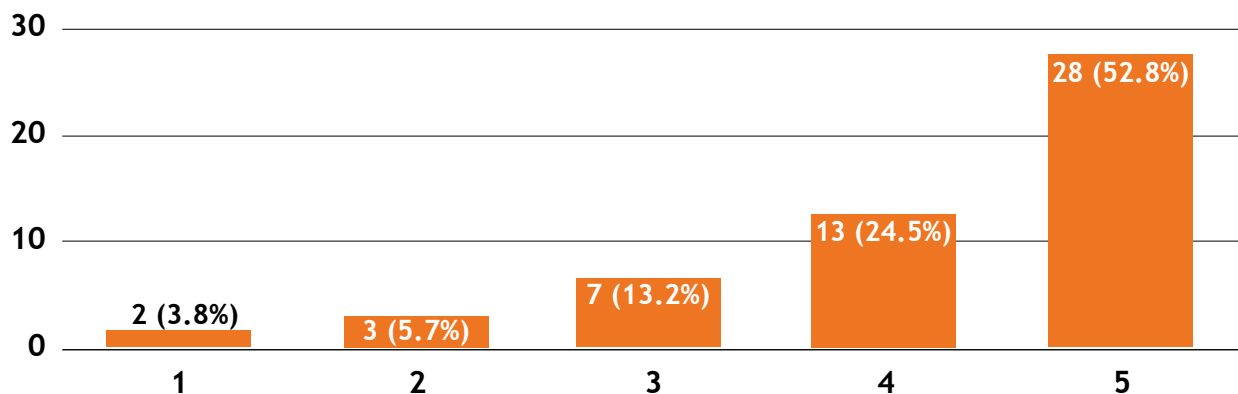
Several preliminary tasks were undertaken to help inform the overall direction and goals of the GIS Section Strategic Plan. The core and extended teams were established by July 2020. A general feedback survey was also sent to over 230 GIS Section customers and partners in July. The feedback survey had a 24% response rate and helped to inform goal formulation by the strategic plan core team. A strengths, weaknesses, opportunities and threats (SWOT) analysis was also completed with all section staff and had a 100% response rate. The SWOT analysis survey results also helped inform the overall goals and objectives for this plan.

The final activity undertaken by the core team to inform the planning process was the development of a connections diagram to map out the internal and external partners and customers that the GIS Section interfaces with. The connections diagram highlights areas where GIS is well integrated within the organization and areas where there may be opportunities for growth. The connections diagram is more fully discussed in the Connections section of this report.

The following graphs illustrate the results of the general feedback survey:

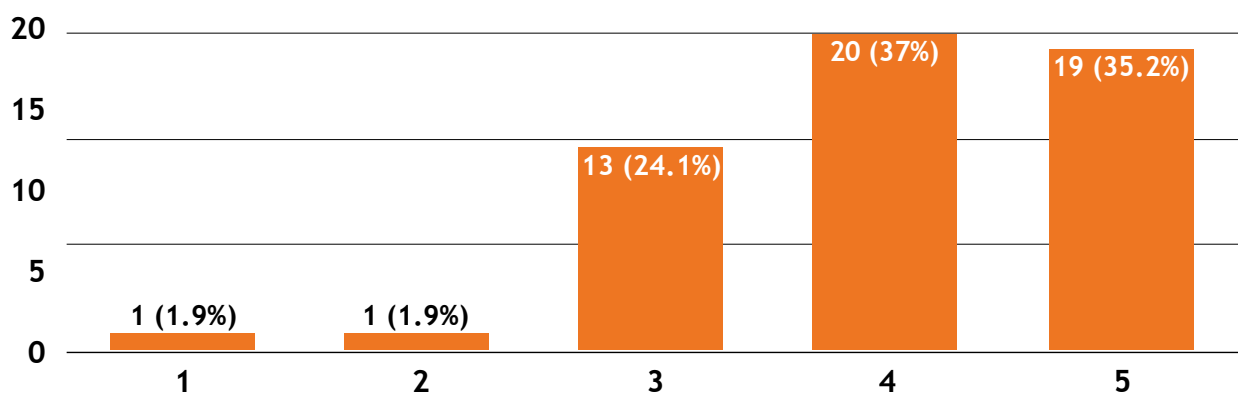
How satisfied are you with the support you've received from the GIS Section?

53 Responses



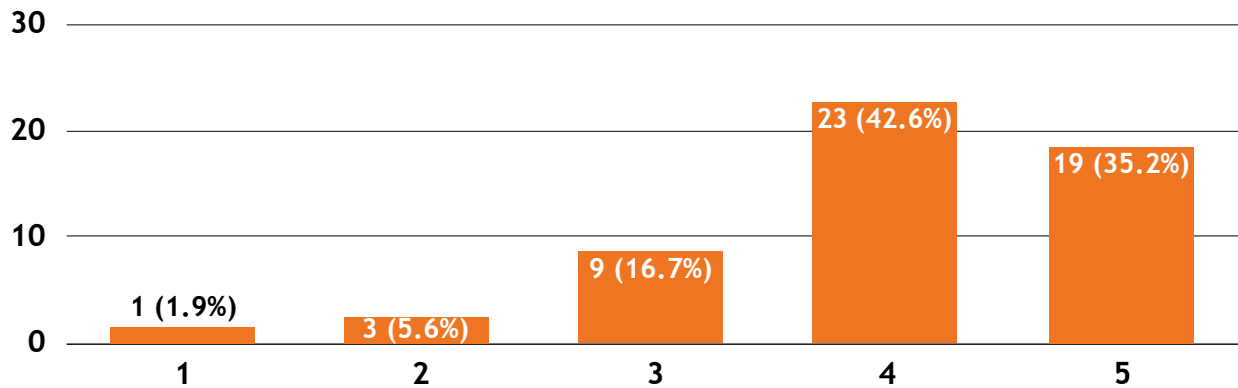
How well do the GIS Section products and services meet your needs?

54 Responses



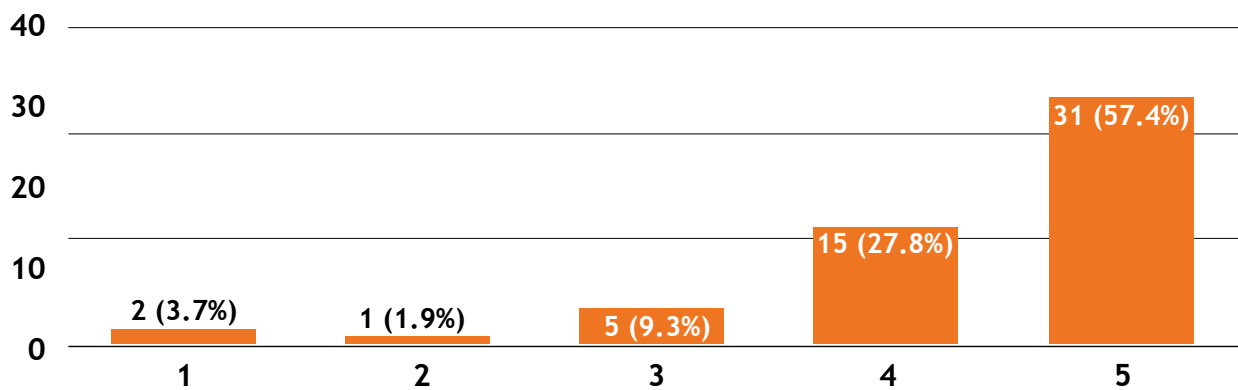
How would you rate the quality of the GIS Section products and services?

54 Responses

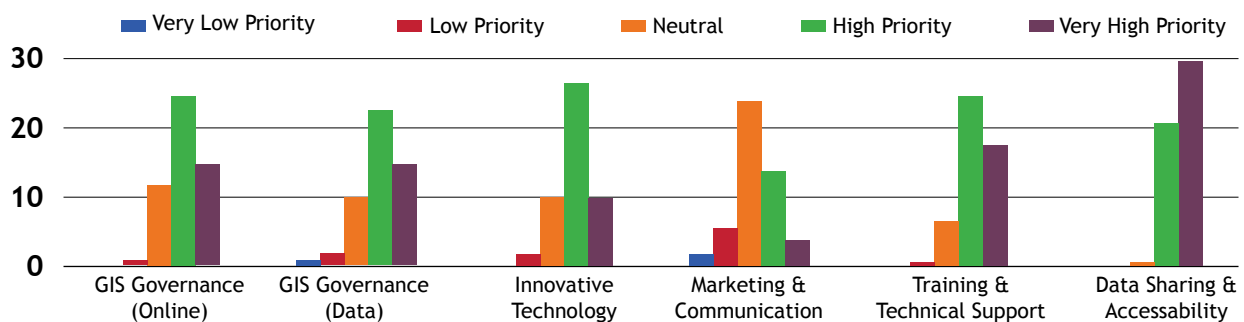


How would you rate the responsiveness of the GIS Section overall?

54 Responses



How would you rank the following items in order of importance for the GIS Section?



The core team convened virtually for two days in August 2020 to review the pre-work and begin formulating the goals and objectives, the mission and vision, and to explore existing and future GIS Section organization. The results of that workshop were collated and went through two review iterations with the core team before being prepared for GIS Section review and finalized.