GIS DATA MANAGEMENT AND NEEDS ASSESSMENT

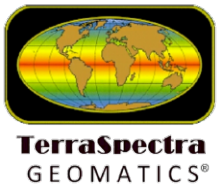
Clark County, Nevada

Final Project Report - Deliverable D03
Project Number 2011-TSG-901

Prepared for:

4701 W Russell Road, Suite 200
Las Vegas, NV 89118

Prepared By:



2700 East Sunset Road, STE A-10
Las Vegas, NV 89120

Final Version
February 22, 2016

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Acknowledgements

The author of this report (Larry Tinney) would like to thank Kimberley Jenkins, Lee Bice, John Brekke, Scott Cambrin, Stefanie Ferrazzano, Heather Green, Trudy Lindstrom, and Larry Mata of the Desert Conservation Program for their participation in the User Needs Assessment and Interviews. Kimberly, Lee, and Larry also provided useful review comments prior to finalization of the report.

This work was supported by the Clark County Desert Conservation Program and funded by the Southern Nevada Public Land Management Act as Project #2011-TSG-901C.

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ACRONYMS AND ABBREVIATIONS

AMP	Adaptive Management Plan
BCCE	Boulder City Conservation Easement
BLM	Unites States Bureau of Land Management
DCP	Desert Conservation Program
DEM	Digital Elevation Model
DOD	Department of Defense
GIS	Geographic Information System
GISMO	Geographic Information System Management Office
GPS	Global Positioning System
IT	Information Technology
MOA	Memorandum of Agreement
MOU	Memorandum of Understanding
NPS	Unites States National Park Service
MSHCP	Multiple Species Habitat Conservation Plan
TSG	TerraSpectra Geomatics
US	United States
USFS	United States Forest Service
USFWS	United States Fish and Wildlife Service

EXECUTIVE SUMMARY

The purpose of this project was to conduct a basic program level assessment of the geospatial data sets and geographic information system (GIS) software used by the Clark County Desert Conservation Program (DCP). The DCP serves as the Administrator of the Clark County Multiple Species Habitat Conservation Plan (MSHCP) on behalf of six local and one state organization. Most of the project activities supporting the MSHCP involve the collection or analysis of geospatial data. Common examples include the recording of map coordinates for observation or environmental sample locations, mapping of vegetation types or conditions, and developing spatial models of species habitats. Of special significance is the inherently long-term nature of many MSHCP activities, such as species trend analyses. This requires careful attention to a long-term lifecycle approach to geospatial data management.

The current MSHCP is based on a 30-year permit from the US Fish and Wildlife Service. The permit identifies an initial set of over 600 conservation actions that may be implemented. The goal is no net unmitigated loss or fragmentation of habitat and to maintain stable or increasing populations of 78 covered species. MSHCP activities involve geospatial data from several local, state, and federal organizations. The potential volume of data that needs to be accessed to support MSHCP activities is rapidly growing. The information products that are required for planning, research, and permit-related activities determines the data resources that should to be available for effective program operations. How these data resources are developed, organized, and maintained is important to the program's long-term success. DCP initiated this project to further their development of geospatial data and software.

A standard GIS planning review approach was used for this assessment. As developed and outlined by Tomlinson[1], a full approach for GIS implementation is a 9-step process. The scope of this project was for initial steps which begin to address the requirements definition-related phases. Specific deliverables for this project included: 1) a geospatial data needs assessment, covered in this report, and; 2) recommended geospatial data management guidelines. Some general observations collected during the user needs assessment are discussed in the summary section of this report. Also included in the summary are recommendations for how DCP might systematically proceed with the remaining steps for implementing additional GIS applications. Primary recommendations from the project assessment include the following:

- Clark County DCP should develop a MSHCP geospatial data management plan.
- Further expansion and integration of DCP geospatial databases appears warranted.
- DCP geospatial data accessibility should be simplified for both internal and public users.
- Additional GIS Training would improve the use of geospatial data by DCP personnel.
- Further development of a pilot web map applications is recommended.

The review determined that nearly all MSHCP activities are inherently geospatial in nature. Further integration and development of the DCP geospatial database and applications could improve programmatic performance for both short-term and long-term requirements. If undertaken, the full costs of development and maintenance of an expanded system need to be recognized and planned.

[1] Thinking About GIS: Geographic Information System Planning for Managers, Fifth edition. Roger Tomlinson, 2013.

1.0 INTRODUCTION

A basic program level assessment of the geospatial data sets and geographic information system (GIS) software used by the Clark County Desert Conservation Program (DCP) has been completed. Both geospatial data requirements and more general user needs for geospatial data that support DCP activities were reviewed for the assessment. This Introduction section provides a brief summary of DCP activities as background, followed by specific goals and objectives for the project. Subsequent sections address the: Approach used for the assessment, Results and Discussion of the results, and a Summary that includes recommendations for the path forward.

1.1 Background

The DCP serves as the Administrator of the Multiple Species Habitat Conservation Plan (MSHCP) on behalf of six local and one state organization, collectively the Clark County MSHCP Permittees:

City of Las Vegas
City of North Las Vegas
City of Henderson
City of Mesquite
City of Boulder City
Clark County
Nevada Department of Transportation (NDOT)

Clark County serves as the implementing agent for the MSHCP and the DCP serves as the Plan Administrator. The MSHCP is a long-term and evolving plan supporting a 30-year permit (2001 TO 2031) from the US Fish and Wildlife Service under the Endangered Species Act of 1973[2] . The 1989 emergency listing of the Desert Tortoise as a threatened species eventually led to the development of the current Clark County MSHCP, which was finalized in September 2000. The history and collection of guiding documents are well described and available on the DCP website[3]. The implementing agreement[4] for the current permit covers data collection for 78 species, requires Permittees to collect a $550 per acre disturbance fee, and involves geospatial data transfers among the following federal and state organizations:

US Fish and Wildlife Service (USFWS)
US Bureau of Land Management (BLM)
US Forest Service (USFS)
US National Park Service (NPS)
Nevada Division of Wildlife
Nevada Division of Forestry
Nevada Division of State Parks

The implementing agreement also specifies significant public outreach for education and public advisory input for development and operation of the program, as well as periodic status reporting to USFWS.

[2] In accordance with Section 10(a)(1)(B) Habitat Conservation Plans and Incidental Take Permits. Such plans are prepared by nonfederal parties wishing to obtain permits for incidental take of threatened and endangered species. The plans must describe the anticipated effects of proposed take and how these effects will be minimized and mitigated.
[3] http://www.clarkcountynv.gov/airquality/dcp/Pages/about.aspx
[4] Clark County Multiple Species Habitat Conservation Implementing Agreement, November 2000.

Most of the science-related project activities supporting the MSHCP involve the collection or analysis of geospatial data. Common examples include the recording of map coordinates for observation or sample locations, mapping of vegetation types or conditions, and developing species habitat models. The long-term nature of many MSHCP activities requires special attention to a long-term lifecycle approach to geospatial data management. Geospatial data is recognized as a critical resource supporting DCP project activities and decision-making. The initial development and implementation agreements for the MSHCP recognized the significant role of geospatial data for plan success. Example statements include:

> "A critical element of the [MSHCP] AMP [Adaptive Management Plan] is the database upon which management decisions are made. This database would provide the basis for evaluating species, ecosystem, and/or landscape status and trends, and would be used to evaluate management actions directed at conservation of biological resources… Specifically, the AMP would (a) provide an analysis of all land-use trends in Clark County to ensure that take and habitat disturbance is balanced with solid conservation, (b) monitor population trends and ecosystem health, (c) evaluate effectiveness of management actions at meeting MSHCP goals of conservation and recovery, and (d) track habitat loss by ecosystem…. The AMP would gauge the effectiveness of existing conservation measures and propose additional or alternative conservation measures, as the need arises, and deal with changed or unforeseen circumstances."[5]
>
> "In addition, adaptive management activities funded in the first biennium include development of the spatial analysis/database/geographic information system (GIS)…"[6]
>
> "MSHCP Develop Project includes … interagency GIS capacity coordination and enhancement…"[7]

A similar example about data sharing and the need for compatible standard formats was noted:

> "All data collected shall be made available for evaluation and analysis as part of the AMP process and shall be collected and maintained in a manner and form compatible with the AMP database and GIS format which shall be established and maintained … in collaboration with the County and the Federal Land Management Agencies."

The MSHCP identifies over 600 conservation measures, most of which have specific geospatial data components. Based on the above background, the MSHCP can be broadly described as involving:

- Many themes or types of geospatial data – 78 individual species and their habitats
- Many organizations – 6 local, 4 State, and 4 Federal, plus academic and public involvement
- Many type of activities – over 600 potential conservation measures
- Long Timeframe – 30 year permit (2001 to 2031) and an additional 50 years under discussion

These characteristics present obvious and major challenges for development and use of geospatial data for the DCP. Potential issues are readily apparent in functional areas such as data discovery, data quality standards, documentation about the data (metadata), data sharing and access options, and long-term data storage and recall. The long-term challenges of monitoring trends and coordination among organizations, since nearly 90% of Clark County falls under federal land management, were also noted.

[5] MSHCP Biological Opinion, by USFWS, November 2000, pg. 2.11
[6] Ibid, pg. 2.16
[7] Adaptive Management Implementation MOA Final Signed, pg. 10

1.2 Goals and Objectives

The overall goal of this project was to conduct a basic program level assessment of the geospatial datasets and geographic information system (GIS) software used by the Clark County Desert Conservation Program (DCP). Specific objectives for the project were to develop the following deliverables:

1. *Develop and deliver a set of **Geospatial Data Management Guidelines** applicable to DCP staff activities that involve geospatial data. DCP has an existing DCP Data Management Guidelines document (dated November 2012) that is provided to contractors supporting MSHCP projects. The objective of this task was to update and expand the guidelines to include internal DCP project activities.*

2. *Develop and deliver a **Geospatial Data Requirements and User Needs Assessment** report for the DCP. This assessment material is included in this final report. The final report was also defined to summarize any general observations developed during the assessment and provide some specific path forward recommendations.*

The next section provides a brief description of the approach used to develop these deliverables.

2.0 APPROACH

The initiation of this project involved a "Kick-off" meeting on 19 August 2015 with the DCP Project Manager, Kimberley Jenkins, and Senior GIS Analyst, Lee Bice. TerraSpectra Geomatics (TSG) was represented by Elaine Ezra, TSG Program Manager, and Larry Tinney, Task Lead. Kimberley Jenkins is supervisor of the DCP technical groups and a lead advocate for development of a DCP programmatic GIS database and web-based applications for public outreach. Lee Bice has been involved with most of the DCP GIS database development projects and expressed interest in several improvement topics. The kick-off meeting addressed basic expectations for the project deliverables. TSG provided an overview of the planned approach to develop the deliverables. The following steps were discussed:

- A technical review meeting with Lee Bice to discuss the existing GIS environment and functions.
- Review of key guiding documents and various reports available on the DCP web site.
- Development and conduct of a web-based user survey of DCP staff.
- Follow-up individual interviews with all of the technical staff survey respondents.
- A meeting with representatives of Clark County GIS Management Office.
- Preparation of the DCP geospatial data management guidelines document.
- Preparation of a final report (this document) summarizing the geospatial needs assessment with recommendations for the path forward.

The initial project effort involved a review and expansion of the existing DCP Data Management Guidelines document (November 2012). The existing document is oriented towards DCP contractors providing data, whereas the expanded Geospatial Data Management Guidelines document (February 2016) was developed with an orientation towards DCP staff project activities. A primary emphasis was the use of a full data life cycle approach to geospatial data management.

The approach used by TerraSpectra Geomatics for the needs assessment portion of the project followed a systematic methodology that has been validated by decades of successful GIS implementations. Adapted from Tomlinson (2013), the full approach would be a 9-step process, as shown below. The scope of work for this project included only the initial needs assessment involved in steps 1 through 4:

1. **Consider the Strategic Purpose**
2. **Build the Foundation**
3. **Review Requirements and Needs**[8]
4. **Describe the Information Products**
5. **Consider the Data Design**
6. **Choose a Logical Database Model**
7. **Determine the System Requirements**
8. **Consider the Benefit-Cost, Migration, and Risk Analysis**
9. **Plan the Implementation**

[8] Tomlinson's methodology recommends a technology seminar at this stage for most organizations to promote a broader understanding of key GIS concepts and the process for implementing GIS databases and applications.

3.0 RESULTS AND DISCUSSION

The existing DCP Data Management Guidelines document (November 2012) was reviewed and used as the basis for an expanded Geospatial Data Management Guidelines document (February 2016). The expanded guidelines document was developed with an orientation towards DCP staff project activities. The primary restructuring was based on use of a full data life cycle approach to geospatial data management. The draft document was reviewed by DCP and the final version is attached as Appendix A – Geospatial Data Management Guidelines.

The following sub-sections summarize the results of the needs assessment survey. They are organized by the initial four GIS planning steps noted earlier.

3.1 Strategic Purpose

The project kick-off meeting identified the primary organizational mission of DCP as being driven by the Clark County Multiple Species Habitat Conservation Plan (MSHCP) and related agreements. The DCP web site includes copies of guiding documents that provide detailed descriptions of these program requirements[9]. These include:

- *MSHCP and Environmental Impact Statement – June 2000*
- *MSCHP Biological Opinion – November 2000*
- *MSHCP Implementing Agreement – November 2000*
- *MSHCP Permit – January 2001*
- *Adaptive Management Program MOU – December 2002*
- *Guiding Principles and Recommendations from the Committee for the Amendment of the Clark County MSHCP – October 2010*

These guiding documents were reviewed to identify examples of geospatial data requirements and needs for the DCP. Superseded DCP guiding documents are also available on the web site, which provides a useful history of the program's development. As recorded in the history section, the development of the program was initiated in response to the August 1989 emergency listing of the desert tortoise (*Gopherus agassizii*) by the U.S. Fish and Wildlife Service (USFWS) as an endangered species[10].

[9] http://www.clarkcountynv.gov/airquality/dcp/pages/guidingdocuments.aspx
[10] http://www.clarkcountynv.gov/airquality/dcp/Pages/about.aspx

DCP identifies their program activities into categories shown below:

Non-Discretionary Items

Boulder City Conservation Easement	Public Information and Education
Riparian Property Management	Wild Tortoise Assistance Line
Tortoise Fencing	General Administration

Discretionary Items

Research	Protective Measures
Inventory	Restoration and Enhancement
Monitoring	Land Use Policies and Actions

The USFWS Permit for the MSHCP, the Implementing Agreement (2000), and the Adaptive Management Plan, each identify the need for substantial amounts of interagency coordination and sharing of science quality geospatial data related to ecosystem habitats.

Almost all of the DCP activities reviewed were considered to have existing and well-defined geospatial data components that could benefit from further GIS database integration. The integration and use of geospatial data from multiple organizations is one of the major challenges for DCP. It was noted in this review that DCP has both coordination and compliance responsibilities, as well as specific project activities supporting the MSHCP. As Plan Administrator, Clark County acts on behalf of itself and fellow permittees[11]. Also of special note was that nearly 90% of Clark County falls under Federal and State stewardship. The primary Federal land stewards in Clark County are: the US Bureau of Land Management (BLM), US National Park Service (NPS), US Fish and Wildlife Service (USFWS), Department of Defense (DOD), and US Forest Service (USFS). Each of these organizations has a substantial geospatial data program. Aligning the DCP geospatial data activities with these programs to minimize redundancy and ensuring use of best available data is critical and recognized by DCP. Considered most pertinent to the MSHCP Administrator role of DCP are the GIS programs and activities of BLM and USFWS.

MSHCP Projects

Recent individual project reports available on the DCP web site were reviewed for the period 2010 through 2015 (45 reports). Of these, 35 reports included GIS-based maps showing sample locations, habitat models, or project area locations, indicative of the significance of geospatial data to MSHCP projects. Of those not including map products, the themes were generally administrative or oriented towards equipment or data management issues (including one GIS and data management project).

The document reviews verified that geospatial data is recognized as a standard if not a critical and key component of MSHCP project activities. Delivery of GIS-formatted products is a standard deliverable for most DCP contractor projects. Guidelines regarding format and metadata have been developed and appear to be routinely checked during QA/QC reviews of project data submittals.

[11] Cities of Las Vegas, Henderson, North Las Vegas, Boulder City, Mesquite and the Nevada Department of Transportation

3.2 Build the Foundation

Management and technical staff commitment is recognized as important to the success of any program. The Kick-off meeting participants included two key principals involved in developing and potentially expanding the DCP GIS program – Kimberly Jenkins, the overall supervisor of the DCP technical group, and Lee Bice, the senior GIS analyst responsible for the DCP GIS database. All of the staff interviewed indicated an interest and support for development of an expanded DCP GIS database. The current organizational structure of the DCP is included as Appendix B.

Demonstrations of DCP's existing GIS database and related elements of the Clark County Information Technology (IT) infrastructure were provided by Lee Bice on August 27 and September 30, 2015. These sessions included a review of existing datasets and general discussions of geospatial work flows and procedures currently used by DCP.

A presentation was provided by representatives (Robert Vega and Brian Bulduc) of the Clark County Geographic Information Systems Management Office (GISMO) on 5 October 2015. Clark County operates GISMO to: 1) Facilitate coordination of GIS capabilities in the local community; 2) Develop and maintain GIS resources for County Departments; and 3) Maintain the emergency response 911 dispatch base file (Street Centerline Database). GISMO has developed and maintains an Enterprise GIS application for Clark County and has recently provided support for a BCCE web-based GIS viewer using their OpenDoor application as well as ArcGIS Online.

3.3 Requirements and Needs

A web-based survey was developed and reviewed with the DCP Project Manager and GIS Manager. The survey was then conducted between 28 September 2015 and 6 October 2015. Participants and position titles for those who provided survey inputs were:

- *Kimberley Jenkins* *Principal Environmental Specialist*
- *Trudy Lindstrom* *Administrative Specialist*
- *Heather Green* *Management Analyst*
- *Scott Cambrin* *Senior Biologist*
- *Stefanie Ferrazzano* *Biologist*
- *Lee Bice* *Senior GIS Analyst*
- *Larry Mata* *Environmental Specialist*
- *John Brekke* *Project Coordinator*

Results were provided by 100% of the survey participants. The web-based user survey allowed for an efficient summarization and graphical presentation of the survey results. Individual one-on-one interviews were then conducted by Larry Tinney with participants during October 2015. These interviews averaged one hour in length. This allowed for any necessary clarifications or expansions of the answers provided, as well as the exploration of some additional topics.

3.4 Survey Results

The DCP Geospatial Data Management Survey was conducted between September 28 and October 6, 2015, with participation by all 8 members surveyed. Full tabulations and graphic presentation of the results are provided in Appendix C – Survey Results. A summary review of the individual questions and results are provided below[12].

Q2: DCP or Similar Environmental Program/Project Experience

Over half of the survey group has over 5 years of DCP or related experience. Less than half of the group has over 10 years of DCP experience. Overall the organization is considered to have a full range of experience levels with the program or similar environmental programs.

Q3: Organizational Role(s)

Two members cited Program Management roles; all 8 survey members cited Project Management roles; 5 cited Environmental Specialist roles, and; 4 cited Geospatial Analyst roles. The 100% response for Project Management roles was considered noteworthy, indicating a substantial proportion of the group's activities involve oversight and administrative matters.

Q4: What geospatial software have you used? Which do you prefer?

Both Google Maps and Google Earth were used by all members of the survey group, with Google Maps the most frequently used package (7 of 8 respondents), followed in order by ArcGIS Desktop (5), Google Earth (4), and Clark County "Open Door" (4). Top preferences were equally split between Google Earth (2), ArcGIS Desktop (2), and Clark County "Open Door" (2). The results are indicative of the spit between simple and user friendly viewing packages (Google Map and Google Earth) and the more technical packages (ArcGIS Desktop and Clark County "Open Door") required for many DCP projects.

Q5: What geospatial data-related manipulation or presentation software do you use?

The most frequently used (4 of 8) and overall most used (7) geospatial data manipulation software was identified as spreadsheets. Presentation software was also widely used (7), as was Graphing/Charting, but less frequently than spreadsheets. Database software was used less frequently (6). Modeling software was used by a majority of the group (5), but not used at all by (3).

Q6: Involvement with Geospatial Data Handling

Responses for Geospatial Data Development, Analysis, and Product Generation were generally similar: 6 of 8 responding positively as involved in these activities. Frequency of use favored Geospatial Data Development (4 responded with Frequently) over Data Analysis and Product Generation (both with 2 responses for Frequently).

[12] Question 1 (Q1) was related to survey respondent contact information and is not presented.

Q7: Characterize the importance of your current or anticipated use of geospatial data and scale.
This question provided a list of 32 types of typical geospatial data themes that were categorized in terms of importance for the respondent's DCP activities. These were identified by the respondents as either Critical, Important, Useful, Rarely Use, Never or Unsure. For each theme, the most common scale of use was also identified as Countywide, Regional, or Site Specific.

Three basic themes were identified by all respondents as always having some level of usage for their tasks. These themes were DCP Project Locations, Administrative Boundaries, and Threatened and Endangered (T&E) Species. The lists below identify different rankings and groups of the top rankings, with data types that might be considered most uniquely and directly tied to the MSHCP noted in bold **blue.**

CRITICAL THEMES

5 Responses (63%)
DCP Project Locations
Field Sample Locations
Roads and Trails
Base Maps
Elevation

4 Responses (50%)
Fauna Habitat Models
T&E Species
Land Ownership
Current/Recent Orthos
Utilities

3 Responses (38%)
Land Use/Land Cover
Flora Habitat Models
Wetland/Riparian

CRITICAL OR IMPORTANT

6 Responses (75%)
Roads and Trails
Land Use/Land Cover
Fauna Habitat Models
Flora Habitat Models
Invasive/Exotic Plants
T&E Species
Base Maps
Utilities
Land Ownership
Elevation
Current/Recent Orthos

5 Responses (63%)
DCP Project Locations
Field Sample Locations
Wetland/Riparian
Soils

4 Responses (50%)
Geology

CRITICAL, IMPORTANT, OR USEFUL

7 Responses (88%)
DCP Project Locations
T&E Species
Administrative Boundaries
Land Ownership
Current/Recent Orthos

6 Responses (75%)
Field Sample Locations
Roads and Trails
Land Use/Land Cover
Fauna Habitat Models
Invasive/Exotic Animals
Flora Habitat Models
Invasive/Exotic Plant
Base Maps
Utilities
Elevation
Precipitation
Hydrography
Geology
Soils

All of the themes listed in the survey received responses indicating some level of existing or expected use. A detailed review of the full set of responses and these rankings can be used to assist the prioritization of ongoing maintenance and refinement of existing themes. It would also assist the prioritization for potential development of additional themes to meet anticipated needs for future applications (examples are noted later in responses to Q9). Several of these themes, such as Wetland/Riparian, Land Use/Land Cover, Roads and Trails, and T&E Species, have major involvement if not lead responsibility assigned to other organizations. DCP already cooperates with some of these other organizations for joint development, data transfers and/or web-based map services. Further development of these cooperative arrangements as part of a DCP Geospatial Data Management Plan is recommended.

The responses for the most applicable scale for each of the data themes showed little significant pattern. All of the data types were considered appropriate for DCP applications at both County-wide and Regional scale use, with all but three themes (Temperature, Precipitation, and Groundwater) also considered applicable to site specific use.

Q8: Most important or most common geospatial information products that you currently use.
Responses to this question were diverse and appeared focused upon each individual's project related activities; no distinct patterns were readily apparent. Three of the respondents mentioned their general resource data collection activities and two of these specified data analyses for inventory or identification of patterns in the geospatial data.

Q9: Describe geospatial information products that you would like to have available.
This question also resulted in a wide range of responses, some of which were specific to individual project management responsibilities. These included:

- An application or tools to assist tracking of grading permits, as an example of products that would help streamline and/or automate the mitigation fee process and calculation of impacts.
- Web-based mapping application that would allow ready identification of species potentially impacted by development or conservation projects.
- Maps of Reserve project features such as signs, roads and their status, barriers, desert tortoise guards, informational kiosks, et cetera.
- More broadly, additional geospatial database development for the MSHCP program was desirable, along with better data access and distribution methods for both maps and data.
- Providing more public access to maps and data was also noted at both a general level and the application specific examples noted above.

It is recommended for the development of any geospatial information product noted above that required inputs, processing steps, and overall work flows be defined. Definition of "use cases" can help ensure that the final product meets expectations and provides the benefits that the requestors anticipate.

Q10: Workflow or process issues you consider to be most significant impediments.

The following provides a rank ordering by importance of the seven potential workflow impediment issues included in the survey:

- **Training on Use of GIS Analysis Tools** was considered the most critical issue for the organization (3 of 8 responses as critical, 2 additional as important).
- **Identifying Suitable DCP Data Sets** was also very highly ranked (3 critical, 1 important).
- **Simplified Access to GIS Data and Analysis Tools** ranked third (1 critical, 4 important, 1 minor).
- **Availability of Good Metadata** ranked next (1 critical, 4 important).
- **Identifying Outside Organization Data** was a somewhat lower concern (1 critical, 3 important).
- **Availability of More Advanced Analytical Tools** was fairly similar (5 important).
- **Identifying Other County Data** was lowest ranked (1 critical, 1 important, 2 minor concern).

3.5 Information Products

DCP activities involve a wide range of geospatial information products. The process for systematic development of geospatial information products is often best addressed by beginning with descriptions of the end products. For example, is it a specific map, chart, list, et cetera? How frequently is it needed? What accuracy levels are required or desired? Then, what types of input data are needed? What are the work flows and processing steps necessary to generate the final products? Standardizing this process to some degree can improve operational efficiencies. This would involve the use of information product description forms that fully describe each product and address the types of questions noted above. The effort required to develop a comprehensive set of these descriptions can be substantial and was beyond the scope of this review.

For each of the DCP activities, an inventory of information products should be developed. This inventory should include both the existing products that have been routinely or periodically prepared, as well as proposed products that will enhance or provide a new capability for the DCP. This initial inventory of information products should be a list of descriptive titles, organized by DCP activity. It may be useful to consider developing categories of products into functional groups, such as: map, web-site map, web-map, schematic, tabular data, report, report map, report table, chart, imagery, 3-D visualization, data, map-service or web-application. The status of the information product is useful during the initial prioritization. Table 1 below provides an example format for compiling the initial inventory.

Table 1. Example of Potential Information Product Inventory List.

DCP Activity(s)	Information Product Number and Title / (Requestor)	Category	Status
Admin	#1 – MSHCP Projects Map (Henson)	Interactive Web Map	Existing
Tortoise Fencing	#2 – Clark County roads with Tortoise Fencing (Brekke)	Static Web-Site Map	Existing
BCCE	#3 – BCCE Management Plan - BCCE Detail Map (Henson)	Report Map	Existing
BCCE	#4 – BCCE Management Plan - BCCE Land Ownership (Bice)	Report Map	Existing
AMP	#5 – Annual Adaptive Management Report – Acres/ Type of Habitat loss within Clark County (Cambrin)	Report Table	Existing
Public Info	#6 – Map display of species potentially impacted by a development or conservation project (Jenkins)	Interactive Web Map	Proposed

Following the development of a full list, the list should be prioritized for further review and expansion of details for those items considered most suitable for additional development. The example below shows a brief follow-up description for a potential product.

Table 2. Example of Potential Information Product Description.

DCP Activity(s)	Information Product Number and Title / (Requestor)	Category	Status
Public Info	#6 – Map display of species potentially impacted by a development or conservation project (Jenkins)	Interactive Web Map	Proposed
General Description: Interactive web map allowing user to define a development or project location (point or polygon) using current aerial imagery or topographic map base. Query results provide a list of species whose habitat is potentially affected and recommended mitigation actions.			
Data Needed: Base imagery and topographic map. Habitat models for MSHCP covered species and possibly others of potential concern.			
Processing Steps: Development of custom GIS map service viewer with basic drawing and measurement tools. Development of geoprocessing tool to overlay defined area over habitat models (possibly collapsed to a single composite layer) and display list of intersecting species; also specifically recommended mitigation actions.			
Frequency: Estimated usage by public is difficult to estimate; anticipated usage is less than current parcel specific Open Web application, which could be used to develop upper limit on estimate.			
Costs: Labor - Existing data collection and preparation: 1 week; Map service development, testing, and documentation: 6 to 8 weeks. Computer Services – additional costs to be determined upon further review.			
Benefits: Ready access to potentially impacted species could provide greater transparency to MSHCP activities and identify possible mitigation actions in early planning stages where alternatives can be more readily incorporated. It may also encourage development in areas of less significance for habitat disturbances.			

Further development of these topics would be appropriate for any products prioritized for potential development. Additional details in all of the above areas would be appropriate for a final cost and benefit analysis.

3.6 Additional Observations and Path Forward

Several general observations regarding options for implementing specific database themes and standard operating procedures were developed during this project. Some of these topics should be further addressed in detail during subsequent planning steps (Tomlinson steps 5 through 9). An internal review of this initial needs assessment by DCP staff is also recommended. Any follow-on implementation activities would require detailed information product specifications. This would require a substantial amount of time and effort by DCP staff and management. Two related DCP database activities directly related to the MSHCP were noted during this assessment:

- *MSHCP Implementation Database*
- *Species Status Database*

Given the significance of their content to the MSHCP, both of these appear to warrant further review from a geospatial perspective. A primary objective of this review would be to assess their potential for either full integration, or minimally linkages to a more comprehensive GIS database.

Following an internal review of this assessment, the following summarizes the additional planning activities that DCP should consider for further development of the DCP geospatial data program. The detailed nature of these activities would necessitate major involvement of DCP staff.

Inventory: Conduct a more detailed inventory with brief descriptions of existing and proposed geospatial information products, including maps, tables, lists, and other derived products.

Prioritize: Develop an initial set of priorities that meet near-term project and long-term programmatic needs that support the MSHCP.

Descriptions: Provide more detailed descriptions for selected items, including data inputs, functional processes, outputs, accuracy, frequency, and similar criteria discussed earlier.

Database Design: Review database design requirements and options; select an appropriate data model that can be used to generate the selected information products.

System Requirements: Confirm that requirements can be met by existing or proposed system configuration.

Review Options: Review basic benefits and costs of development of system options.

Implementation: Prepare an implementation plan and initiate data and application development.

As an alternative to this this basic “waterfall” sequence of development, the selection of one or two priority projects could be used for a more rapid development cycle. This can provide some useful process experience for the organization, but may require some rework for future modifications.

4.0 SUMMARY

An assessment of existing and some proposed geospatial data needs has been conducted for the DCP. As part of this assessment, geospatial software and data sets used by DCP were examined and a survey of user needs was undertaken. A document providing project recommendations for geospatial data management guidelines applicable to DCP activities was also developed.

Five groups of recommendations were developed around the following topical themes:

1. Clark County MSHCP Geospatial Data Management Plan
2. DCP Geospatial Database Development
3. DCP Geospatial Database Accessibility
4. Web Map Applications
5. GIS Training

The following recommendations are considered the primary areas where DCP may most effectively move forward with their geospatial data program:

- **Clark County MSHCP Geospatial Data Management Plan**
  DCP should consider developing a programmatic MSHCP plan based on a full life cycle approach to geospatial data management. The large number of organizations involved with MSHCP data makes this a difficult task, but it also increases the need for one. The plan should systematically address the key types of geospatial data used by participants and identify in detail the standard informational products that are required by DCP. Standard information products for both programmatic and project specific needs should be defined in enough detail for prioritization, development, and implementation, which should include web-based access options. Aligning geospatial database development with MSHCP needs for science quality data to support research, inventory, monitoring, and especially long-term trend analyses is recommended.

- **DCP Geospatial Database Development**
  Survey respondents noted that additional GIS database development would benefit several DCP activities. Priorities for additional development and periodic updates of specific data themes should be identified, preferably in a plan, as discussed above. DCP should review the potential benefits of integrating or minimally linking the existing MSHCP Implementation Database and the Species Status Database into a more comprehensive database design addressing MSHCP needs. Opportunities for further sharing of geospatial resources with other organizations should also be routinely pursued, including the sharing of web-based map services.

- **DCP Geospatial Database Accessibility**
  The implementation of simple data discovery tools for both internal and selected public views of DCP geospatial data is recommended. The use and documentation of standardized directory structures and file naming conventions can facilitate this, if made readily available, as can more advanced tools that can search geospatial metadata clearinghouses. Resources including the existing DCP web site, GISMO map server, and cloud based web map applications, can also

provide simplified data access and viewing options that should be considered for both data sources and product development.

- **Web Map Applications**
  Custom web-based map applications can provide advanced functionality for both internal and public facing views of MSHCP data. Providing more public access to maps and geospatial data was identified as a major programmatic need for DCP. The BCCE application developed using the GISMO map server and ArcGIS Online provide simple examples. Development of more advanced applications should undergo a standard requirements review and system design to ensure that appropriate datasets and functionality are available. A pilot project involving a range of functional requirements (e.g., data entry, geoprocessing, reporting, etc.) is recommended. This would allow the DCP organization to gain experience with the technical issues involved and develop a standardized set of procedures for additional applications.

- **GIS Training**
  Additional training on GIS analysis software was top-ranked as a priority need by a majority of the DCP personnel surveyed. Geospatial data and analyses have a significant role in DCP programmatic and project activities. Opportunities for training should be pursued and actively promoted. Noteworthy are expanding options for online training. Periodic attendance at the GIS Community and User Conferences by key GIS staff is also recommended. Additional training is needed for building capacity for a more data driven culture. This requires embedding a stronger geospatial skill set throughout the organization.

Some potential next steps for the path forward were noted in the previous section. As a final note, obtaining programmatic support from higher levels of the County's DCP management structure is considered important to long-term programmatic success. Major progress will require a substantial amount of DCP personnel time and effort to define in detail the content and processing steps required to develop the specific information products needed to support their activities. It is important that everyone involved understands both the commitment required, as well as the potential benefits of a stronger geospatial program.

5.0 REFERENCES

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APPENDIX A – GEOSPATIAL DATA MANAGEMENT GUIDELINES

Desert Conservation Program
Recommended Geospatial Data Management Guidelines

Introduction

The purpose of this document is to provide general guidelines for geospatial data management activities conducted by DCP staff. Geospatial data is a critical resource supporting DCP project activities and decision-making. The information products that are required for planning, research, and permit-related activities determine the data resources that should be available for effective program operations. The volume of data that may need to be sorted through is growing exponentially, so how these data resources are developed, organized, and maintained is important to the program's long-term success. Most of the science-related project activities supporting the Clark County Multiple Species Habitat Conservation Plan (MSHCP) involve the collection or analysis of geospatial data. Common examples include the recording of map coordinates for sample locations, mapping of vegetation types or conditions, and developing species habitat models. The long-term nature of many MSHCP activities requires special attention to a long-term lifecycle approach to geospatial data management.

Figure 1 provides a conceptual lifecycle for DCP geospatial data development and use. Also shown are cross-cutting elements (i.e., data description, data quality, and data backup and securing) that should be performed across all stages of the lifecycle to ensure that the data are discoverable, well described, and preserved for both short-term and long-term access and use.

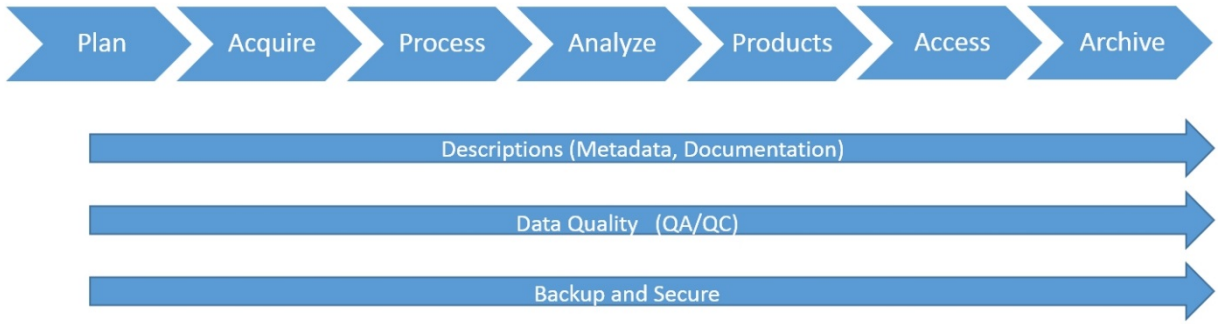


Figure 1. A Conceptual Lifecycle Model for DCP Geospatial Data[1].

MSHCP projects that provide conservation benefits (*implementation projects*) should be demonstrated to be effective, and be documented well enough to support assessment. Projects that provide information to determine the effectiveness of implementation projects or to provide information on species or ecosystem status (*information gathering projects*) must be documented well enough so that the procedures used can be repeated and the information produced can be used or combined with other datasets to perform the analyses that assess progress toward MSHCP objectives.

DCP has implemented a basic set of Data Management Guidelines applicable to MSHCP project data. As specified in the Guidelines, a Data Management Plan should be initiated in the overall project planning phase. It should also be updated, as appropriate, throughout the data management lifecycle. Plans

[1] Modified from USGS Open-File Report 2013-1265 (Figure 1) USGS Science Data Lifecycle Model to better match a typical Desert Conservation Program project sequence.

should be developed for all data production projects, however, the level of detail may vary depending upon the, scope complexity and importance of the project.

The existing Data Management Guidelines are oriented towards supporting contractors. They are also applicable to activities undertaken by DCP staff. This document builds upon the existing Guidelines with the inclusion of additional elements that are specific to DCP staff activities and responsibilities. The development of a tiered or graded approach for data management plans is recommended. The appropriate tier or grade level should be dependent upon the scope, complexity, and importance of the geospatial data involved.

Project Phase Elements

The following sections review specific data management elements using the conceptual lifecycle model presented in Figure 1. For a typical data work flow, the output of each element provides input to the next phase element. There are also cross-cutting elements applicable to all phases of the data lifecycle; these are described after the sequential project phase elements are reviewed.

Plan

Projects undertaken under contract to DCP are required to follow the Data Management Guidelines (Version 2.0, dated November 2012). Development and use of a checklist to review compliance with the guidelines is recommended. Appendix A provides an example review checklist of data management planning considerations.

Projects undertaken by DCP staff should include Data Management Plans that describe the project and the methods that will be used to manage any MSHCP project data. An overall description of the project should be developed that briefly describes the project in executive summary style. This should include the MSHCP project number, any contract title(s) and number(s), and all funding sources. Also include the following:

Project Location: Describe the project location using UTM[2] (Zone 11), NAD83[3] meter coordinates representing the outline of your project area. These coordinates need not be exact, but they should represent the project area(s) and not outlines of the county, state, or Mojave Desert. This will facilitate automated geospatial data discovery.

Goals and or Objectives: Describe the project's purpose and include any goal or objective statements related to the geospatial data that have been proposed for the project.

Roles and Responsibilities: Document the names of all data collection staff, data processing staff, and data management staff. Describe the role and responsibilities of each staff person regarding data collection, quality control, quality assurance, processing, analysis, and management.

DCP Data Management Plans should detail how the geospatial data will be stored during each phase of the data lifecycle. The appropriate DCP policies should be considered, especially in terms of any interim

[2] UTM: Universal Transverse Mercator coordinate system.
[3] NAD83: North American Datum 1983.

or time limited storage. In general, final DCP project data is expected to be maintained for at least the lifetime of the MSHCP, if not indefinitely.

A draft plan should be subject to either external review or another DCP staff member prior to finalizing.

Acquire

Data acquisition can involve either existing or new data collection activities. Proper data descriptions (see Descriptions in the Cross-Cutting Elements section later) are critical to the appropriate use of both existing and any new data acquisitions.

Existing Data

Internet-based data discovery tools have significantly improved for identifying potential geospatial datasets that can be reused for multiple purposes. Noteworthy are the foundational datasets developed by federal geospatial data programs (FGDC National Geospatial Data Asset Management Plan, March 2014) and numerous geo-community provided datasets that can be accessed as web services via vendor applications, such as ArcGIS Online. A Data Management Plan should list existing data that will be used in the project, including appropriate citations and metadata files that specify the source details, especially the data source dates. For example, existing data may include spatial data representing stream reaches from the U.S. Geological Survey (USGS) National Hydrography Dataset (NHD) or soils data from the Natural Resources Conservation Service (NRCS) Soil Survey Geographic (SSURGO) database.

New Data

The data collection methods planned for any new geospatial data acquisitions should be described in the Data Management Plan.

Methods: Within the body of the project report, provide a review of the final methods used for collecting geospatial data[4]. Cite literature references for standard data collection methods where appropriate, noting any deviations from those standard methods. This report should document any changes in data collection and software tools made throughout the project term. Note also the storage location and fate of any samples collected and where voucher specimens have been deposited. A description of the methods used is a required component of the final data deliverable and should be referenced in the metadata.

Spatial Data: Spatial data should be collected with Global Positioning System (GPS[5]) receivers whenever possible. Resource or mapping grade GPS units are recommended, although recreational grade units can be used for data with lower accuracy requirements, such as wildlife siting locations or generalized habitat maps.

The make and model of each GPS unit used for the project, and record the error for each location or feature collected should be documented. Error should be recorded as Probability Dilution of Precision (PDOP) on mapping grade units and Estimated Positional Error (EPE) on recreational grade units. If your

[4] Provide in either Microsoft Word (.docx) or Adobe Acrobat Portable Document Format (.pdf).

[5] GPS is the original United States System designation; as other systems have since been developed (e.g., GLONASS, BeiDou, and Galileo) a broader name for this type of system has been developed. This broader designation is Global Navigation Satellite System or GNSS.

GPS data is corrected using any type of satellite-based or ground-based augmentation system, a record the type of correction used (e.g. WAAS[6], post-processing, or beacon) should be documented.

Point locations or features should be recorded by averaging positions to increase accuracy. For example, when collecting locations for high accuracy features, such as section corners, a minimum of 180 positions should be averaged at 1 position per second. A minimum of 30 positions should be averaged for all other features. Positions for lines and polygons should typically be collected at a rate of 1 position per second or at a minimum of 10-foot intervals.

When using mapping grade GPS units, a data dictionary should be used on the unit to provide consistency in data collection and reduce data collection errors (see Data Dictionary below). Available GPS metadata should be collected, inspected, and rejected if data do not meet specified requirements.

Aspatial Data: Data that are not spatially linked are also gathered by MSHCP projects. These are often tabular, but may also include voucher specimens, photographs or samples of soil, etc. Examples of aspatial tabular data include data collected in laboratories for research projects, data regarding individual observer's error rates to calibrate monitoring project results, data regarding the results of an educational outreach effort, and data regarding seed fates are all examples of data that may not include spatial location attributes. The associated collection of point or linear locational coordinates with otherwise aspatial data can greatly enhance the multiple uses of the data and is recommended.

Data Dictionary: A data dictionary defines the fields and domains in a database, spatial data file, or GPS data collection file. Data dictionaries may already be prescribed and provided by DCP, or project participants may be required to create their own. Information from the data dictionary will be entered into the Entity Attribute section of the metadata for each dataset. Data dictionaries are generally only available for mapping grade GPS units, so this may be a selection criterion depending on the type of system to be used. See Appendix A for an example of a data dictionary.

Source List: Use of a unique data source identifier (source key) is recommended to document the original source and dates of all data acquisitions. This can be especially important for external data acquisitions, which may periodically update a dataset being used. A simple text list or spreadsheet can be used to maintain pertinent source data details.

Process

The preparation of existing or new geospatial data for analysis, often termed either pre-processing or processing, may entail: definition of data elements; integration of disparate datasets; Extraction, Transformation, and Load operations (ETL); and application of calibrations to prepare the data for subsequent analyses. Appropriate work flow processing descriptions should be planned and developed. The outputs of processing become the inputs that are suitable for subsequent analyses.

Recent advances have been made in software tools supporting the creation and management of complex scientific workflows[7]. Work flow models and identification of associated datasets can help to ensure the ability to replicate data processing and analyses. The repeatability of data processing and analyses is a recognized goal of the MSHCP program. The formats of the work flow processing descriptions vary with

[6] WAAS: The Wide Area Augmentation System, operated by the United States Federal Aviation Administration.
[7] DataONE Best Practices Primer, page 7, from www.dataone.org, accessed November, 2015.

the specific disciplines and methods of data acquisitions involved. These range from good field notes to detailed processing logs and geospatial data models.

Analyze

Analyses involve the activities associated with the exploration and interpretation of processed data. At this stage of the data lifecycle, hypotheses are tested, patterns are revealed, and conclusions may be made. Typical geospatial outputs from this stage are map layers with associated geospatial statistics. These are often documented in subsequent project reports and other document products. As noted above, detailed documentation of the analysis steps involved should be developed to allow the workflow to be replicated by others.

Products

Geospatial data may be developed in various formats, including some intermediate products that may warrant delivery with other final products. Developmental guidelines for different formats include the following:

Paper Datasheets: If paper data forms are used during the project, provide digital copies. Digital copies may be provided in Adobe Acrobat (.pdf) format digitally scanned at 300 dpi or greater resolution. Document all scanning settings in the Data Management Plan.

Photos, Sound, and Video Recordings: Describe basic settings used on the camera or other recording device and the file format(s) used for short term and archival storage.

Spatial Data: Spatial data should be stored electronically in a spatial data file format (e.g., Esri shapefile or geodatabase) or as coordinates in a relational database. The accuracy of the collected data will be reported in the metadata. A graded approach for metadata requirements can be used, based on the scope, complexity, and importance of the data being described. If spatial datasets include related tables (e.g., Access .mdb with associated .tbl tables), document all table relationships between tables and spatial data. For all attribute data associated with spatial coordinates, see the Tabular Data section below.

Tabular Data: Tabular data should be stored in electronic format in a relational database or spreadsheet. Use of a database is preferred and allows for data validation as data is entered into the database and for exploratory data analysis (see Data Accuracy and Quality section below).

If multiple related tabular datasets are delivered, provide key fields and describe all linkages of fields in relational tables in the data dictionary and metadata files. Pay particular attention to the use of zero (0) versus <null> values in tabular datasets; zeroes can be interpreted as either no data or zero value. In the data dictionary and metadata sections provide your definition of the use of zero (0) and <null> values in the tabular data. Do not deliver tabular datasets with embedded password protection.

Review Procedures: DCP staff review of geospatial data submitted by contractors could benefit by the development of standard checklists of review criteria. Software tools, such as Esri's Data Reviewer[8] may also facilitate the review process.

[8] Data Reviewer consists of a series of tools that support both automated and visual analysis of data. It can be used to automatically scan and identify common geospatial data problems such as topological errors and duplicate records.

Product Identifiers: For products developed by DCP staff, a unique product identifier would be useful, as would maintenance of an online product log and workspace area where copies could be made available.

Product Templates: The development and maintenance of a set of map templates is considered a best practice to standardize the content, sourcing, and DCP brand appearance of map products.

Access

Data Sharing: Any project geospatial data that has potential general use should be considered for sharing. Both internal and external data sharing criteria should be defined. Internal sharing can involve a central GIS database location or a project specific directory area that has been identified to potential users. Both internal and external sharing can potentially involve the use of web services for making the geospatial data available. Appropriate tags and standard metadata are generally required for sharing.

Responding to public records request forms comprise a special category of data sharing.

Data Restrictions: Document any portion of the data that are "confidential" or copyrighted as defined by law, regulation, or policy. All other data will be subject to disclosure upon request as per Nevada Public Records Law.

Archive

Data Storage: Describe long term data storage requirements and any repositories or archives where data will be deposited for permanent storage.

Cross-Cutting Elements

Each of the primary data lifecycle elements discussed earlier address discrete inputs, activities, and outputs that are unique to that stage. As shown in Figure 1, however, there are also critical cross-cutting activities that must be performed across all stages of the lifecycle to support effective geospatial data management. The three cross-cutting elements noted are described below.

Descriptions (Metadata, Documentation)

Metadata: All datasets must include or have associated metadata documentation. The metadata for all project data will describe in detail the data that will be collected and the methods that will be used for collection, field crew training or certification, and equipment calibration. Spatial data and databases must be documented with Federal Geographic Data Committee (FGDC) Content Standard for Digital Geospatial Metadata (CSDGM), version 2.0, FGCC-001-1998 compliant metadata[9].

[9] Since ISO 19115 and the associated standards have been endorsed by the FGDC, federal agencies have been encouraged to transition to ISO metadata. It is recognized that the transition to ISO metadata may require several years of transition.

Metadata contains information such as: who created the data, data accuracy, what the data are useful for, and how to read the data. Computer programs such as ArcCatalog or other applicable software programs[10] can create Esri-compatible metadata for spatial data sets.

Tabular data should include much of the same metadata information required for spatial data. Metadata for voucher specimens, photos, or other samples should include descriptions such as the rules for selection of the sample, camera settings, care during transportation, and the ultimate fate of samples, such as deposit in a repository or a herbarium. Whichever program is used to document metadata, all metadata should be exported in .xml or .txt format for submission with final data deliverables.

Metadata should also include information about access or copyright restrictions (e.g., any proprietary, confidential, private, or copyright limits for redistribution).

Version Control and File Names: Describe a standard digital file naming protocol and a version numbering system for datasets to assist in identifying the various data files during the project and at completion.

Data Quality (QA/QC)

This section of the Data Management Plan describes the processes to be used in ensuring the accuracy and quality of the project data, commonly referred to as Quality Assurance and Quality Control (QA/QC). Detail the specific QA/QC procedures to be used for the project. The EPA's Quality System website (http://www.epa.gov/quality/index.html) can be useful for example guidance on developing quality standards for projects.

At a minimum, QA/QC procedures for your project must address:

- Methods to ensure that field data forms and tables are complete. Standardization of data collection procedures may include development and use of data dictionaries, including those for databases and mapping-grade GPS units that require data be entered in all fields before the form can be closed.

- Standardization of data management including development and use of a spatial data files and electronic databases with data validation procedures.

- Methods for post-collection data verification using display of spatial data to detect location errors, detection of outliers or biologically-nonsensical values for tabular data, statistical reports and graphs, or other procedures.

Backup and Secure

Data Storage: Describe short term storage and backup cycles. The County will maintain a copy of the data deliverables according to County Records Management Policies, which may be time limited.

[10] The EPA Metadata Editor (EME) is a simple geospatial metadata editor that allows users to create and edit records that meet the Federal Geographic Data Committee (FGDC) Content Standard for Digital Geospatial Metadata (CSDGM) requirements. EME is installed as an extension to Esri's ArcCatalog.

Appendix A. Data Management Planning Considerations - Review Checklist

Plan	Life Cycle Elements
	Does a formal Data Management Plan need to be developed for this project?
	Who is responsible for managing the data and the data management plan?
	Who will review the data management plan?
	What is the project type (e.g., Information Gathering or Implementation Project)?
	What is the project location? (boundary using UTM Zone 11 NAD83 meters coordinates)
	What are the project's goals and/or objectives related to geospatial data?
	What data are you collecting?
	What are the data accuracy requirements?
	Does the data already exist?
	Have you checked for other possible sources for your data needs?
	Where will the data and data management plan be stored?
	What are the roles and responsibilities of DCP staff related to data collection, data QA/QC, processing, and analysis?
	Who is responsible for creating/updating the metadata?
	What is the schedule and budget for data collection?
Acquire	
	For new spatial data:
	How will data be collected? (Electronically or on paper? In-house or by contractor?)
	For data collected using GPS, will the make and model of each GPS unit used for the project be documented with the data?
	For GPS data, has the error been recorded with the data (e.g., PDOP or EPE)?
	For GPS data, will any type of correction be used and recorded (e.g., WAAS, post-processing, or beacon)?
	For GPS data, has the number of logged positions at a point feature been recorded with the data?
	Will a data dictionary be used to ensure data collection consistency and to reduce data collection errors?
	Are there any data standards for this data type? Have they been used on this project?
	How have the final methods used for collecting the project's geospatial data been documented?
	For existing spatial data:
	If you are obtaining data from an outside source, will you be able to store a local copy of the data?
	If you are accessing someone else's data, did you document the steps you used in order to obtain the data?
	If the outside source data is being updated, will you be notified or will you have to manually check?
	What will you do if the outside data source is no longer available in the future?
	Have all sources of data, both spatial and aspatial, been assigned a source ID and stored with the project?
Process	
	What naming conventions are being used for files? What about table columns and rows?
	Have the software applications used for processing the data been identified (e.g., software application, version, functions)?
	How have the methods used for processing the project's geospatial data been documented?
	Have any data problems been identified during the processing that may limit the use of the data for this project?
	Have these limitations been documented in the metatadata or a report?
Analyze	
	Have software applications used for analyzing the data been identified (e.g., software application, version, functions)?
	Have any data problems been identified during the analyses? Are these documented in metadata or a report?
	Are the processing and analysis steps adequately documented to allow for potential replication of the work involved?
Products	
	What kinds of outputs will be needed? (e.g., Electronic or paper? Alphanumeric or spatial?)
	Who will use the data and what are all the most likely uses for the data? Will it be available to the public?
	If applicable, have all paper data forms been scanned at 300 dpi or greater and stored with the project data records?
	Have all photos, Audio and Video Recordings been stored with the project data records?
	Have all spatial data been stored in a spatial data file format (e.g., Esri geodatabase or shapefile)?
	Have all tabular data been stored in a relational database or spreadsheet?
	Has a data dictionary been developed to describe the fields and linkages of data fields?
	Have product identifiers been assigned to each developed product? Was the product independently reviewed?

Data Management Planning Considerations - Review Checklist

Access	
	Are there any specific requirements for sharing or storing the data?
	How do these requirements impact the needs to store, access, and protect the data?
	Are there any security or sensitivity issues that might limit access or preclude you from sharing the data?
	Are there any restrictions on sharing data that you have acquired from other sources?
	When publishing a report, will the data be published as well? If so, which data will be included?
	Is there a deadline or schedule for sharing your data?
	Does your project have a specific repository for your data?
	Are there any policies or plans regarding where you should post your data?
Archive	
	How will non-digital data be preserved, such as field notebooks and maps?
	Is someone responsible for migrating data sets that are in old/outdated formats?
	If files are being migrated or converted, is someone performing a check on both files (original and converted files)?

Cross-Cutting Elements

Descriptions (Metadata, Documentation)	
	What format will be used to collect the data?
	Are there any data standards for this data type?
	What specific file types will be used to store the data?
	Will you be using a standard file naming format and version control?
	What formats will the data and metadata be in?
	What metadata standard will be used?
	How will the metadata be reviewed to ensure that it is adequate and correct?
	Have you captured the workflow (data inputs, transformations, and analytical steps to achieve the final data output)?
	Will a different format be used to share or publish the data?
Data Quality (QA/QC)	
	How will the data be checked and certified? In-house or by contractor?
	Will in-house review be done by an individual other than the person collecting the data?
	Is QA/QC occurring throughout the data lifecycle?
	Are the QA/QC steps being documented?
	Is data that is transcribed or copied checked for errors against the original data set?
	Have you reviewed the data, such as selecting a random sample, looking for outliers, graphing and plotting the data?
Backup and Secure	
	How is the data being stored and backed up?
	Who is handling the backups?
	If your data is being stored elsewhere, do they have a backup policy in place?
	Are the data and backups being stored in multiple places to protect against a single-point failure?
	Is someone checking to ensure that backups are being done properly and data can be retrieved?
	Does more than one person know where the data are being stored and how to access them?
	How long will backups be kept?

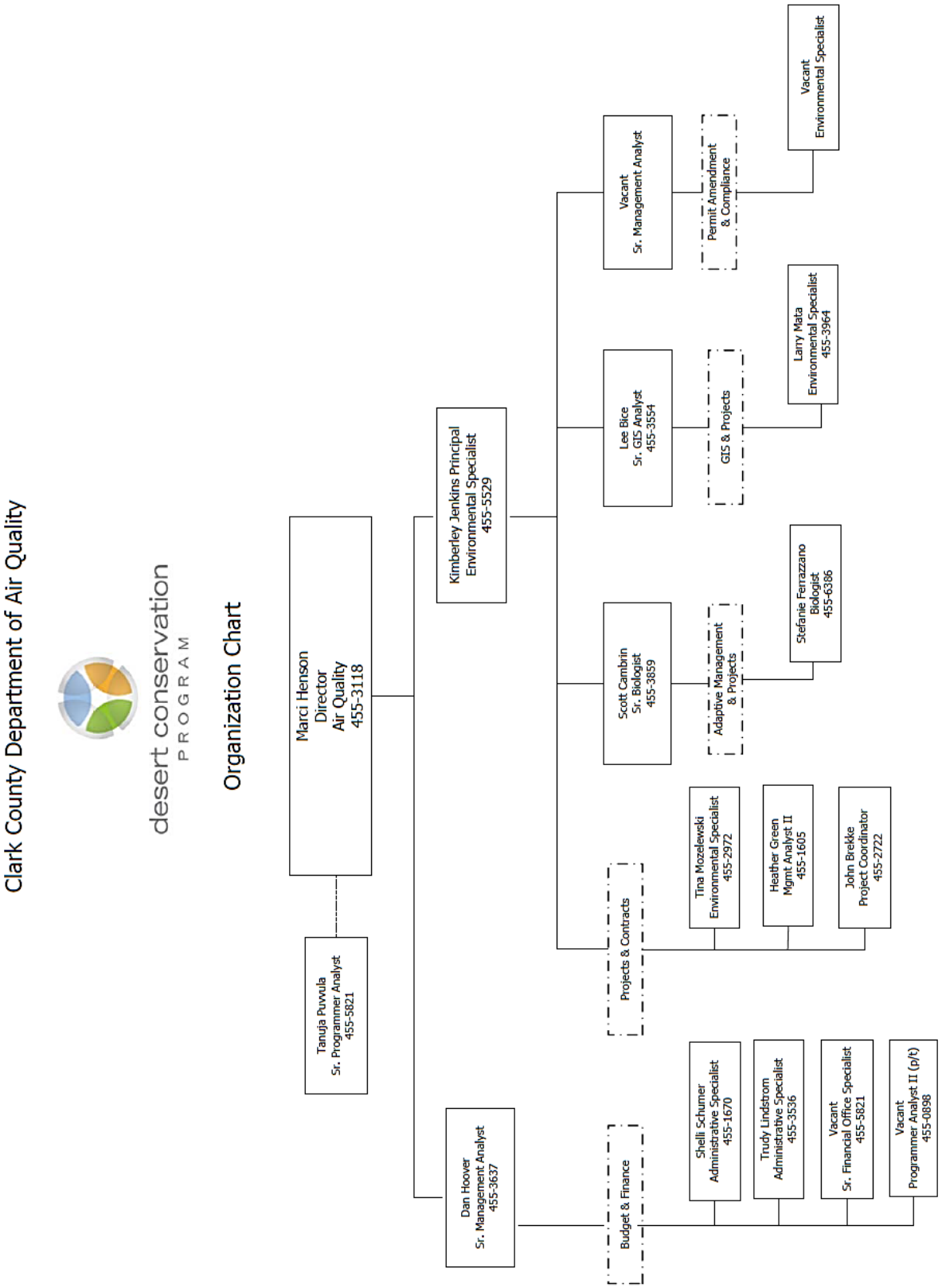
Modified for DCP use from: http://www.usgs.gov/datamanagement/plan/dmplans.php (December 2015)

Appendix B Data Dictionary

The following is a basic example of a data dictionary used for inventorying roads:

Field	Domain	Field Description	Field Type
Name	255 characters of text	Official name of road	Text
Number	0..n	Official road number	Number/Integer
Maintenance Responsibility	County NPS BLM USFS USFWS Private Other	Agency or individual responsible for maintaining the road	Text
Maintenance Frequency	Annually Semi-annually Monthly As needed Not maintained	Frequency with which road is maintained	Text
Width	0.00..N.nn	Width of road in meters	Number/Float
Length	0.00..N.nn	Length of road in meters	Number/Float
Surface Type	Paved Gravel Dirt 4x4 Other	Surface condition of road	Text
Class of Use	Motorized Equestrian Hiking Other	Class of road use	Text

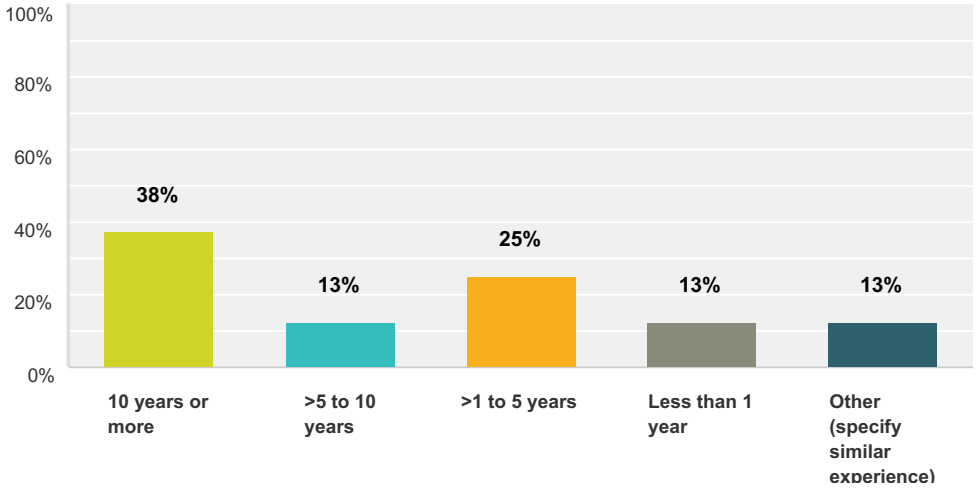
APPENDIX B – DESERT CONSERVATION PROGRAM ORGANIZATION CHART


Clark County Department of Air Quality
desert conservation
PROGRAM
Organization Chart
Marci Henson
Director
Air Quality
455-3118
Tanuja Puvvula
Sr. Programmer Analyst
455-5821
Kimberley Jenkins Principal
Environmental Specialist
455-5529
Dan Hoover
Sr. Management Analyst
455-3637
Budget & Finance
Shelli Schumer
Administrative Specialist
455-1670
Trudy Lindstrom
Administrative Specialist
455-3536
Vacant
Sr. Financial Office Specialist
455-5821
Vacant
Programmer Analyst II (p/t)
455-0898
Projects & Contracts
Tina Mozelewski
Environmental Specialist
455-2972
Heather Green
Mgmt Analyst II
455-1605
John Brekke
Project Coordinator
455-2722
Scott Cambrin
Sr. Biologist
455-3859
Adaptive Management
& Projects
Stefanie Ferrazzano
Biologist
455-6386
Lee Bice
Sr. GIS Analyst
455-3554
GIS & Projects
Larry Mata
Environmental Specialist
455-3964
Vacant
Sr. Management Analyst
Permit Amendment
& Compliance
Vacant
Environmental Specialist

APPENDIX C - SURVEY RESULTS

Q2 DCP or Similar Environmental Program/Project Experience

Answered: 8 Skipped: 0

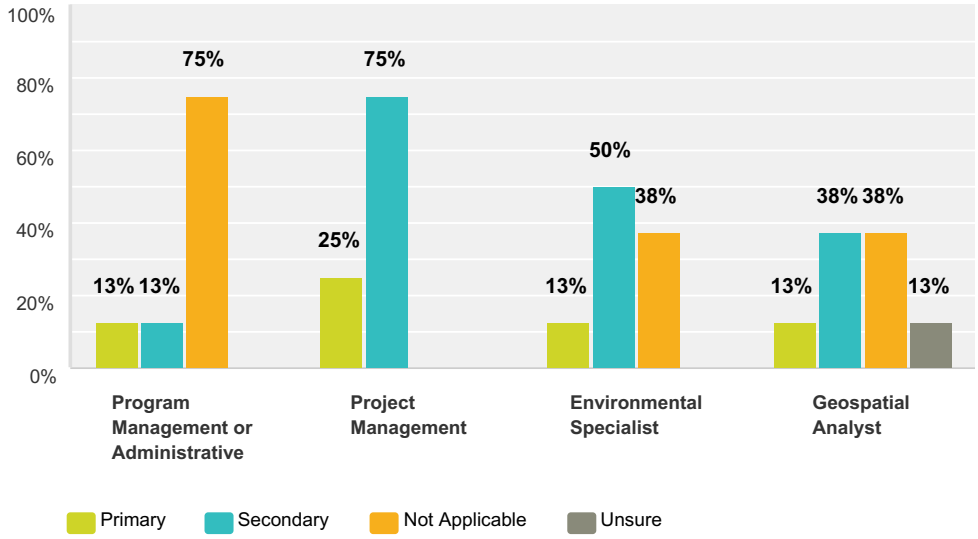


Answer Choices	Responses	
10 years or more	38%	3
>5 to 10 years	13%	1
>1 to 5 years	25%	2
Less than 1 year	13%	1
Other (specify similar experience)	13%	1
Total		8

#	Other (please specify nature of Similar Environmental Program/Project Experience)	Date
1	~ 5 years experience: endangered species surveys; vegetation monitoring; habitat assessments	10/1/2015 4:01 PM

Q3 Organizational Role(s) - Multiple secondary roles are possible. Provide at least one response for each type of roles listed (rows).

Answered: 8 Skipped: 0

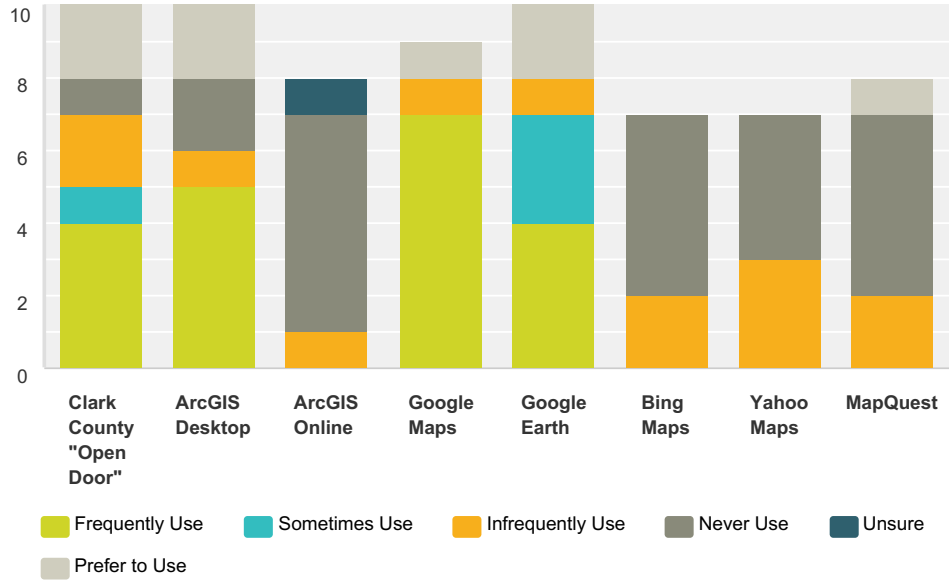


	Primary	Secondary	Not Applicable	Unsure	Total	Weighted Average
Program Management or Administrative	13% 1	13% 1	75% 6	0% 0	8	2.63
Project Management	25% 2	75% 6	0% 0	0% 0	8	1.75
Environmental Specialist	13% 1	50% 4	38% 3	0% 0	8	2.25
Geospatial Analyst	13% 1	38% 3	38% 3	13% 1	8	2.50

#	Other (please specify and characterize as Primary or Secondary)	Date
1	Contract Management - Primary	10/6/2015 12:16 PM
2	I am in charge of the Adaptive Management Process as my primary resposnibility	9/28/2015 12:37 PM

Q4 What geospatial software have you used? Also, of any you are familiar with, which do you prefer?

Answered: 8 Skipped: 0

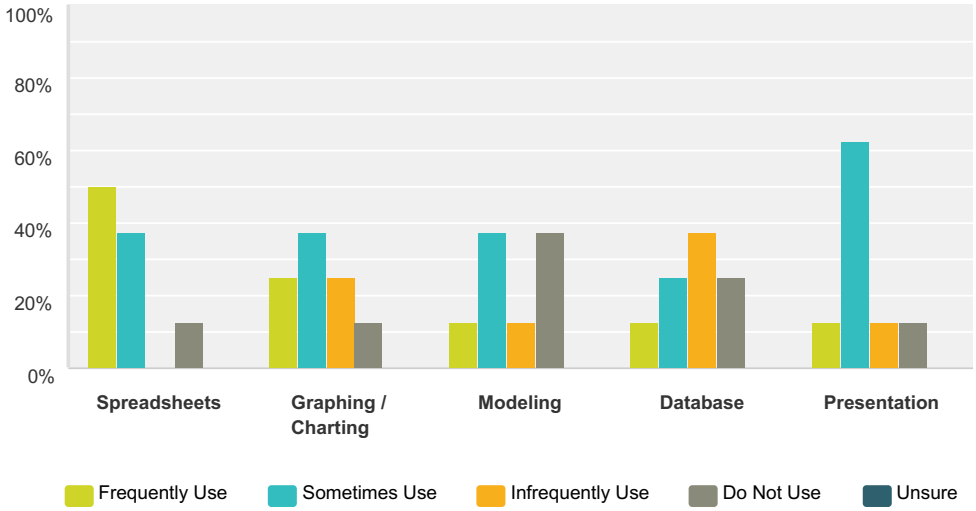


	Frequently Use	Sometimes Use	Infrequently Use	Never Use	Unsure	Prefer to Use	Total Respondents
Clark County "Open Door"	**50%** 4	**13%** 1	**25%** 2	**13%** 1	**0%** 0	**25%** 2	8
ArcGIS Desktop	**63%** 5	**0%** 0	**13%** 1	**25%** 2	**0%** 0	**25%** 2	8
ArcGIS Online	**0%** 0	**0%** 0	**13%** 1	**75%** 6	**13%** 1	**0%** 0	8
Google Maps	**88%** 7	**0%** 0	**13%** 1	**0%** 0	**0%** 0	**13%** 1	8
Google Earth	**50%** 4	**38%** 3	**13%** 1	**0%** 0	**0%** 0	**25%** 2	8
Bing Maps	**0%** 0	**0%** 0	**29%** 2	**71%** 5	**0%** 0	**0%** 0	7
Yahoo Maps	**0%** 0	**0%** 0	**43%** 3	**57%** 4	**0%** 0	**0%** 0	7
MapQuest	**0%** 0	**0%** 0	**29%** 2	**71%** 5	**0%** 0	**14%** 1	7

#	Other (please specify and indicate any preference)	Date
1	I have infrequently used Fragstats. I used ERDAS 10 years ago.	9/29/2015 10:39 AM

Q5 What geospatial data-related manipulation or presentation software do you use?

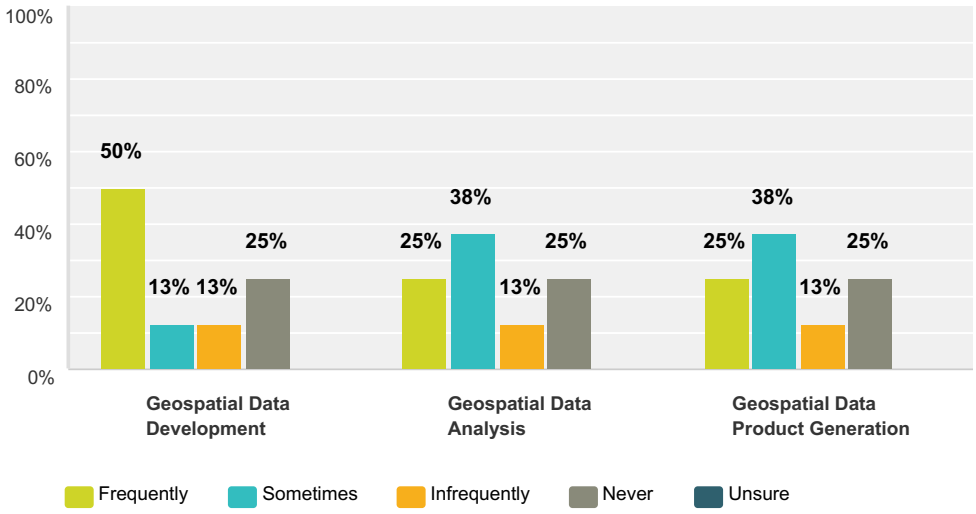
Answered: 8 Skipped: 0



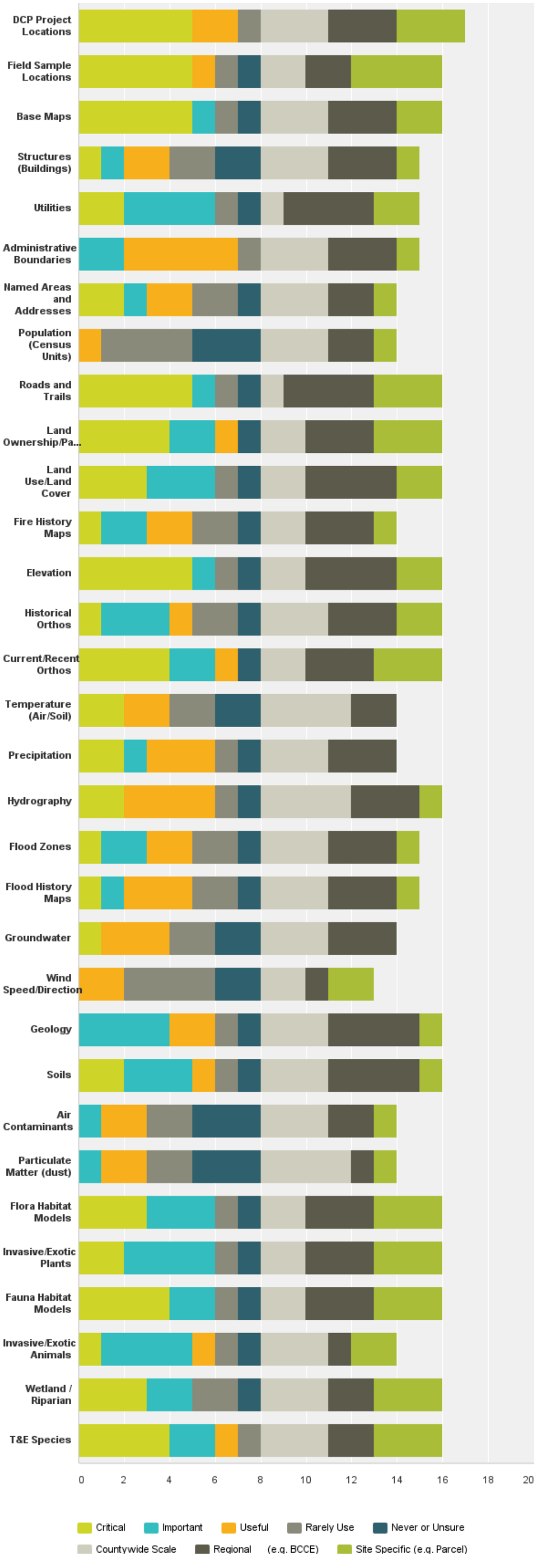
	Frequently Use	Sometimes Use	Infrequently Use	Do Not Use	Unsure	Total	Weighted Average
Spreadsheets	**50%** 4	**38%** 3	**0%** 0	**13%** 1	**0%** 0	8	1.75
Graphing / Charting	**25%** 2	**38%** 3	**25%** 2	**13%** 1	**0%** 0	8	2.25
Modeling	**13%** 1	**38%** 3	**13%** 1	**38%** 3	**0%** 0	8	2.75
Database	**13%** 1	**25%** 2	**38%** 3	**25%** 2	**0%** 0	8	2.75
Presentation	**13%** 1	**63%** 5	**13%** 1	**13%** 1	**0%** 0	8	2.25

Q6 Involvement with Geospatial Data Handling

Answered: 8 Skipped: 0



	Frequently	Sometimes	Infrequently	Never	Unsure	Total
Geospatial Data Development	**50%** 4	**13%** 1	**13%** 1	**25%** 2	**0%** 0	8
Geospatial Data Analysis	**25%** 2	**38%** 3	**13%** 1	**25%** 2	**0%** 0	8
Geospatial Data Product Generation	**25%** 2	**38%** 3	**13%** 1	**25%** 2	**0%** 0	8



Q7 Characterize the importance of your current or anticipated use of these types of geospatial data. Also, indicate the most common scale you expect to use.

	Critical	Important	Useful	Rarely Use	Never or Unsure	Countywide Scale	Regional (e.g. BCCE)	Site Specific (e.g. Parcel)	Total Respondents
DCP Project Locations	63% 5	0% 0	25% 2	13% 1	0% 0	38% 3	38% 3	38% 3	8
Field Sample Locations	63% 5	0% 0	13% 1	13% 1	13% 1	25% 2	25% 2	50% 4	8
Base Maps	63% 5	13% 1	0% 0	13% 1	13% 1	38% 3	38% 3	25% 2	8
Structures (Buildings)	13% 1	13% 1	25% 2	25% 2	25% 2	38% 3	38% 3	13% 1	8
Utilities	25% 2	50% 4	0% 0	13% 1	13% 1	13% 1	50% 4	25% 2	8
Administrative Boundaries	0% 0	25% 2	63% 5	13% 1	0% 0	38% 3	38% 3	13% 1	8
Named Areas and Addresses	25% 2	13% 1	25% 2	25% 2	13% 1	38% 3	25% 2	13% 1	8
Population (Census Units)	0% 0	0% 0	13% 1	50% 4	38% 3	38% 3	25% 2	13% 1	8
Roads and Trails	63% 5	13% 1	0% 0	13% 1	13% 1	13% 1	50% 4	38% 3	8
Land Ownership/Parcels	50% 4	25% 2	13% 1	0% 0	13% 1	25% 2	38% 3	38% 3	8
Land Use/Land Cover	38% 3	38% 3	0% 0	13% 1	13% 1	25% 2	50% 4	25% 2	8
Fire History Maps	13% 1	25% 2	25% 2	25% 2	13% 1	25% 2	38% 3	13% 1	8
Elevation	63% 5	13% 1	0% 0	13% 1	13% 1	25% 2	50% 4	25% 2	8
Historical Orthos	13% 1	38% 3	13% 1	25% 2	13% 1	38% 3	38% 3	25% 2	8
Current/Recent Orthos	50% 4	25% 2	13% 1	0% 0	13% 1	25% 2	38% 3	38% 3	8
Temperature (Air/Soil)	25% 2	0% 0	25% 2	25% 2	25% 2	50% 4	25% 2	0% 0	8
Precipitation	25% 2	13% 1	38% 3	13% 1	13% 1	38% 3	38% 3	0% 0	8
Hydrography	25% 2	0% 0	50% 4	13% 1	13% 1	50% 4	38% 3	13% 1	8
Flood Zones	13% 1	25% 2	25% 2	25% 2	13% 1	38% 3	38% 3	13% 1	8
Flood History Maps	13% 1	13% 1	38% 3	25% 2	13% 1	38% 3	38% 3	13% 1	8
Groundwater	13% 1	0% 0	38% 3	25% 2	25% 2	38% 3	38% 3	0% 0	8
Wind Speed/Direction	0% 0	0% 0	25% 2	50% 4	25% 2	25% 2	13% 1	25% 2	8
Geology	0% 0	50% 4	25% 2	13% 1	13% 1	38% 3	50% 4	13% 1	8
Soils	25% 2	38% 3	13% 1	13% 1	13% 1	38% 3	50% 4	13% 1	8
Air Contaminants	0% 0	13% 1	25% 2	25% 2	38% 3	38% 3	25% 2	13% 1	8
Particulate Matter (dust)	0% 0	13% 1	25% 2	25% 2	38% 3	50% 4	13% 1	13% 1	8
Flora Habitat Models	38% 3	38% 3	0% 0	13% 1	13% 1	25% 2	38% 3	38% 3	8
Invasive/Exotic Plants	25% 2	50% 4	0% 0	13% 1	13% 1	25% 2	38% 3	38% 3	8
Fauna Habitat Models	50% 4	25% 2	0% 0	13% 1	13% 1	25% 2	38% 3	38% 3	8
Invasive/Exotic Animals	13% 1	50% 4	13% 1	13% 1	13% 1	38% 3	13% 1	25% 2	8
Wetland / Riparian	38% 3	25% 2	0% 0	25% 2	13% 1	38% 3	25% 2	38% 3	8
T&E Species	50% 4	25% 2	13% 1	13% 1	0% 0	38% 3	25% 2	38% 3	8

#	Other (please specify type, importance, and scale of use)	Date
1	Access to data provided by BLM would be useful. For example, mining claims, pending land use authorizations, herd management areas, visual resource management classes. These aren't critical, but would be useful. Also, critical habitat designations are important to have access to as well (available from USFWS).	10/5/2015 8:57 AM

Q8 Given the above examples, please list and describe below the most important or most common geospatial information products that you currently use to perform your work.

Answered: 8 Skipped: 0

#	Responses	Date
1	I do not use any of the above.	10/6/2015 12:22 PM
2	Open Door, this program assists me with knowing where the parcel is located, what year construction began and whether the parcel has been disturbed	10/6/2015 7:45 AM
3	Most common GIS products currently used: Maps that depict the location of various resources in relation to proposed project sites - looking at/calculating acres of impacts to species habitats and/or ecosystems. Summary of impacts to modeled species habitats Calculating the area of proposed reserve units (or similar management areas) broken down by resource features and/or land management unit (i.e., How many ares of Mojave desert scrub are managed by BLM or in private ownership across the County? How many acres of the Stump Springs unit contains modeled habitat for species x, or consists of Joshua tree habitat?)	10/5/2015 8:57 AM
4	Currently, the most imprtant product for me is probably accurate road layers for navigational purposes.	10/1/2015 4:21 PM
5	Imagery, georeferenced and historical	9/30/2015 9:31 AM
6	All county geospatial data Occurrence (species data) Project data Habitat models Data from BLM, USFWS, NNHP, NDOW, NPS Data downloaded from others; state, private and academia	9/29/2015 10:53 AM
7	The most common things I do is check data comming in from contractors to make sure it is in the correct locations and to look for discrepencies. I will also look for patterns in the data that may be useful in analyzing the data at a later time. I make maps to deciminate the data that has already been collected or a plan for new data collection to contractors so they will no what is expected of them. The majority of this is done i ArcGIS desktop with creation of new shapefiles in ArcCatolog or Arc Tool Box.	9/28/2015 1:03 PM
8	Maps, showing signage and other points with desert tortoise guards, cable barriers, closed roads, open roads and other information pertaining to on-the ground projects.	9/28/2015 12:43 PM

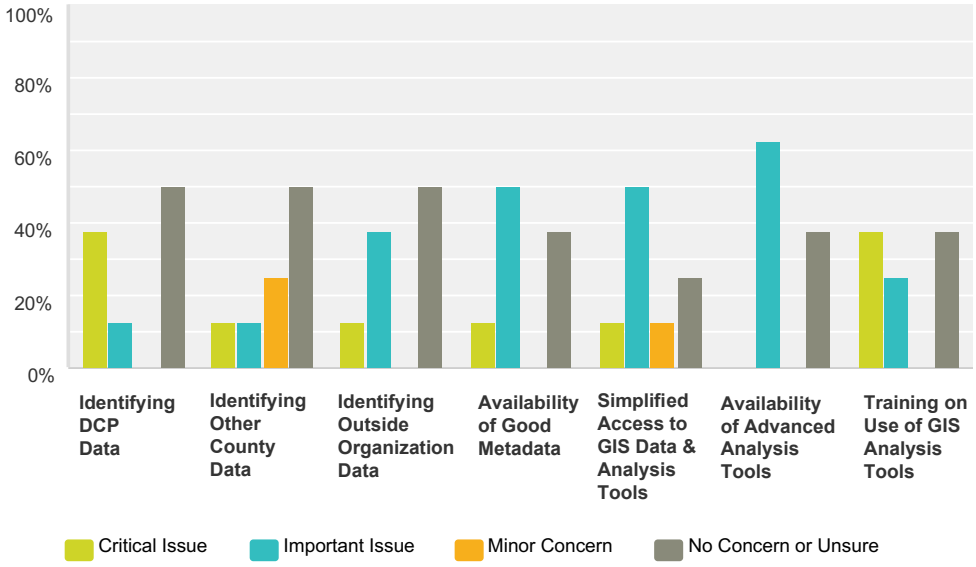
Q9 Consider the types of questions you would like to answer using geospatial data in the future and list and describe geospatial information products that you would like to have available to perform your work.

Answered: 8 Skipped: 0

#	Responses	Date
1	N/A	10/6/2015 12:22 PM
2	Monitoring the grading permits as they are submitted to the county for running annual reports.	10/6/2015 7:45 AM
3	I am interested in a product that would help streamline and/or automate our mitigation fee process and calculation of impacts. For example, when a grading permit of pulled, affected parcel numbers are identified on the map, which automatically gets tallied as impacts. Impacts can be identified/sorted by ecosystem, administrative units (city jurisdiction), or modeled species habitats. From this, one could pull out monthly/yearly/biennial summary of the number of acres developed, number of acres of each ecosystem impacted, and number of acres of modeled species impacted. Ideally, this type of system could be carried forward under permit amendment to aid in rapid identification of mitigation requirements at the time that a grading permit is pulled. Another thing that I would like to see is some sort of web-based mapping tool that lets you identify species potentially impacted. This would consist of a few base map options (aerial imagery, topo map), key features that could be turned on/off (city jurisdictions, federal land management units, highways and major roads, reserve unit boundaries), and a project area drawing tool (polygon or box drawing tools to identify project boundaries). The tool could summarize species and ecosystems impacted. For example, draw a box to identify a proposed project site, and the tool can summarize the number of acres of each type of ecosystem that falls within the project site as well as a list of the species habitat impacts (maybe it identifies acres of modeled habitat using species distribution models, or maybe it just identifies presence or potential presence of species using a combination of species distribution models and species occurrence records).	10/5/2015 8:57 AM
4	Unsure.	10/1/2015 4:21 PM
5	Projects with varying scale. Commonality is need for best imagery available.	9/30/2015 9:31 AM
6	A better way for DCP to access data and create maps. A better way for DCP to distribute maps and spatial data. A better way to store DCP data. A better way for the public to access DCP maps and data.	9/29/2015 10:53 AM
7	A range of Biotic (veg cover, habitat models) may be useful along with a host of Abiotic data from climate, soils, elevation, slope, wash layer, disturbance, and topography would be useful along with roads and boundary layers.	9/28/2015 1:03 PM
8	1. Number of signs, types of signs and locations of signs. 2. Locations of closed roads and status; restored, barrier or no work. 3. Number and locations of DT guards and locations for future DT guards. 4. Locations and types of current and future Gabion Kiosks.	9/28/2015 12:43 PM

Q10 Please identify those workflow or process issues you consider to be the most significant impediments to your more effective use of geospatial data for your DCP work.

Answered: 8 Skipped: 0



	Critical Issue	Important Issue	Minor Concern	No Concern or Unsure	Total	Weighted Average
Identifying suitable DCP data sets for your use	**38%** 3	**13%** 1	**0%** 0	**50%** 4	8	2.63
Identifying suitable data sets from other County organizations	**13%** 1	**13%** 1	**25%** 2	**50%** 4	8	3.13
Identifying suitable data sets from outside organizations	**13%** 1	**38%** 3	**0%** 0	**50%** 4	8	2.88
Availability of good metadata describing data quality (from any source)	**13%** 1	**50%** 4	**0%** 0	**38%** 3	8	2.63
Simplified access to basic geospatial data and analysis tools (i.e., "user friendly" tools)	**13%** 1	**50%** 4	**13%** 1	**25%** 2	8	2.50
Availability of more advanced analytical tools to process geospatial data	**0%** 0	**63%** 5	**0%** 0	**38%** 3	8	2.75
Training on use of geospatial analytical tools	**38%** 3	**25%** 2	**0%** 0	**38%** 3	8	2.38

#	Other (please specify)	Date
1	Availability of data to the public	10/5/2015 8:27 AM