



Bicycle Best Practices: Data Management and Storage Protocols

Planning a continuous county bikeway network is similar to environmental planning in the sense that cyclists are creatures with little regard for administrative boundaries. It is easier to implement a multi-jurisdictional bikeway network derived from a common consensus because transitions between different jurisdictions are more likely to be seamless for the user, thereby making the overall system easier to navigate by bicycle. In order to accomplish that vision, however, all member municipalities must agree to common design principles and data storage protocols while collaborating on network implementation.

Data Collection and Consistency

Many of Salt Lake County's jurisdictions have bikeway networks that include existing and proposed facilities. Additional links will be added to these networks over the coming years as new facilities are constructed and existing streets are retrofitted with bikeway facilities. Developing a standardized mapping update process can help minimize the following problems commonly encountered when developing integrated datasets:

- Variations in data format and delivery methods. Some communities only maintain paper maps or digital copies of their bikeway network within a plan document while other jurisdictions maintain a digital repository of bikeway data represented by vector-based features.
- Variations in data attributes that are collected. If digital data are collected, the datasets may track the same type of information (e.g. bikeways) but may not include the same information about these facilities (e.g. the width of bike lanes). It is useful to know the location of bikeways, but the inclusion of similar attributes allows more robust and detailed analysis.
- Variations in the definitions of data attributes that are collected. For example, some municipalities classify shared-use paths as such only if they are paved, while others may not share this requirement. This variation in the definition of the data attributes can create challenges when the data is used for some applications (e.g. a region-wide route planner).

These challenges affect many MPOs and county governments across the country. Interviews with data managers and a survey of Salt Lake County's member jurisdictions show that this is a challenge for Salt Lake County, too. Research with jurisdictional data managers revealed the following commonalities:

- Regional data managers typically maintain both regional bikeway networks and data received from local

municipalities. Several locations did not differentiate between regional and local networks, but expressed interest in identifying a "regional" network to emphasize the importance of inter-jurisdictional connections and to highlight these key corridors as funding priorities.

- Data updates tend to occur irregularly, generally in conjunction with plan updates every three to four years. Three of four agencies indicated the desire to update data more frequently as the data can be used for multiple applications (e.g. multi-modal trip planners and demand modeling).
- Ad hoc updates result in varying levels of detail and accuracy within the region or study area.
- At a minimum, most datasets include name and facility types. Additional facility quality information is desirable but is more challenging to collect for a variety of reasons (e.g. limited staff capacity, the relative level of effort, and access to technology).
- There is an increasing trend of tying data to the roadway or transportation network through a unique identifier and paying increased attention to the spatial data attributes (facility information such as roadway name and bicycle facility type) and topological correctness (line segments used to represent bikeway networks are digitally connected so continuous travel along the "facility" is possible). The addition of a unique identifier allows the data to be used in a multi-modal transportation network. Spatial data attributes and topological correctness are also necessary for the data to be used in routing applications.
- Data managers in most agencies reported a call for updated bikeways facility information typically resulted in marked-up hard copy maps. The resulting staff effort to integrate hard-copy map data into existing digital repositories was time consuming and introduced inaccuracy related to digitizing error.

The following sections provide recommendations based on best practices interviews and survey results.

Countywide Datasets

Currently, the county maintains the following datasets for public use:

- 2002 Annexation
- Cemeteries
- County Libraries
- Golf Courses
- Hospitals
- Parks
- Streams
- Jordan River
- City Council Districts
- Fire Stations
- Lakes
- Major Streets
- Schools
- Zip Codes

Other datasets, such as parcels and FEMA floodplain data are maintained by the county, but unavailable for free download. However, they can be obtained for project-specific work or inquiry. It is recommended that the county also maintain a bikeway layer for public use and download. The county would maintain responsibility for the planning of bikeways and maintenance of the dataset within unincorporated portions of the county, while partner jurisdictions would be responsible for the development and maintenance of the dataset within their administrative boundaries. Based on the selected update method discussed in the next section, county staff may be responsible for harmonizing municipal bikeway datasets with the countywide bikeway network.

Data Update Protocol and Timeframe

Data Update Protocol

A systemic and simple update method is integral to the success of data sharing. Survey results indicate that the ability to update bikeway network data online is highly desirable and while this functionality is currently available, the complexity of editing features while maintaining topological validity can be a significant barrier to implementation. Regardless of the scenario selected, it will be necessary to develop a preliminary base dataset before moving forward. The following steps can be used to develop this bikeway network dataset:

- 1) Determine which dataset will be used as the base for the on-street bikeway network. If the county or MPO maintains a roadway network used for routing emergency vehicles, it is an ideal framework and should be utilized¹. Another potential data source is NAVTEQ². The network should include a unique identifier for each network link that does not change.
- 2) Determine how geometry for shared use paths will be developed and incorporated with the roadway network. Linear features representing trails should be snapped to the roadway network to ensure a topologically correct data set.
- 3) Achieve agreement between member jurisdictions on a schema for maintenance of bikeway data. Additional details are discussed in the *Metadata Standard* section located on page 3.
- 4) Encourage member jurisdictions to develop and attribute the roadway and trail links that fall under their jurisdiction and provide the digital data to the county.

¹ The US Office of Emergency Management typically subsidizes maintenance of network data for this purpose, and building upon this data source may reduce data development and maintenance costs.

² Additional information is available at <http://www.navteq.com/>

- 5) Have the county compile and validate the bikeway network dataset.

Based on this information and an analysis of existing software, the following options are recommended. The County will need to select one of the recommendations.

Scenario 1 – Web Based Update

A web updated based scenario could be implemented using the county's current installation of ESRI's ArcServer, which supports web based editing of existing network features. Interviews with other data managers suggest that while most jurisdictions are interested in development of these systems, the current applications are still cumbersome and best used for editing attributes of existing features (e.g. existing roadway or trail links). In the current systems, adding new linear features while maintaining topological correctness is complicated and can lead to increased editing time and reduced feature accuracy.

Scenario 2 – Unique Feature Based Update

In this scenario, feature information would be updated and joined to a centralized bikeway network based on unique ID's of a roadway network. Each partner jurisdiction would be responsible for submitting a geodatabase containing a unique identifier and agreed-upon relevant feature attributes described in the Metadata Standard section located on page 3. The county would then be responsible for updating and validating the bikeway network dataset. While this system does not allow partner jurisdictions to update their data via the web, it may provide greater data accuracy while allowing the county to monitor advances in web editing functionality.

Responsible Parties

A successful data sharing process is dependent on a partnership between the county and member jurisdictions. Roles and responsibilities are outlined below.

County Bikeway Data Manager

The county should designate a primary contact person (which could be the Bicycle Coordinator described in the Implementation section of this best practice) to coordinate development and ongoing maintenance of the bikeway network dataset. If this person is not housed within Information Services (IS), a process should be developed to ensure a method for clear and consistent communication with IS regarding the development and maintenance of the countywide bikeway network. The duties of this position should include:

- Setting and maintaining a schedule for regular bikeway network updates.
- Maintaining a database of jurisdictional contacts.
- Regular communication with jurisdictional representatives about scheduled updates and modifications to the update process or metadata requirements.
- Communication about new uses of data (e.g. development of new online tools).
- Working with jurisdictional staff to ensure that sufficient resources are dedicated to maintenance of the jurisdictional and county bikeway data infrastructure.
- Including data management goals and objectives in future transportation and comprehensive plan updates.
- Increasing the efficiency of data collection and application development (e.g. distributing bikeway data through UDOT's uPLAN data portal).
- Working with member municipalities to ensure each jurisdiction has the capacity to update data internally or to develop a maintenance agreement with the county or other local jurisdiction.

Partner Jurisdictions

Each jurisdiction should designate a point of contact to manage bikeway network updates. Due to the variety of government structures in Salt Lake County, this representative may be in Community Development (or another planning department), GIS, Public Works, or IS³. Regardless of department, this person should undertake the following responsibilities:

- Ensure that jurisdictional bikeway data are provided to the County Bikeway Data Manager by the deadline requested.
- Develop data or work with staff developing data for both on- and off-street facilities to ensure accuracy of defining attributes and physical location.
- Include data management goals and objectives in future transportation and comprehensive plan updates.
- Inform the County Bikeway Data Manager of changes to the appointed jurisdictional bikeway contact.
- Work with county staff to ensure sufficient resources are dedicated to maintenance of the jurisdictional and county bikeway data infrastructure.

Update Timeframe

The Bikeway Data Manager should request updates from each municipality annually in October, with a submission deadline in November (to correspond with the end of the typical

³ Slight variations exist in departmental naming schemas across jurisdictions in Salt Lake County.

construction season). This would allow for compilation and redistribution of the data to the municipalities the following January. More frequent updates would create an unnecessary burden for staff and would be of limited use. Less frequent updates may result in out-of-date bikeway information and loss of continuity as departments are reorganized or staff turns over. All partner jurisdictions are responsible for providing their data to the County Bikeway Data Manager in the specified digital format on or before the designated deadline. Data provided by jurisdictions that do not adhere to the deadline may not be included in the update.

Existing Versus Planned Facilities

Achieving the goal of getting municipalities located within Salt Lake County to use a common data standard will require effort and follow through. For this reason, the County should initially focus on obtaining data about existing bikeways only. Only after this process is working well should the County attempt to aggregate planned bikeway data.

Data Format

Data should be provided to the county as a geodatabase with Federal Geographic Data Committee (FGDC)-compliant metadata following the approved county standard (discussed in the Metadata Standard section located below).

Data Availability

Bikeway data should be available for public download on the county website. This may require a policy change in jurisdictions where data is not currently available.

Metadata Standard

Metadata, or “data about data”, provide documentation of spatial data, describing content, quality, condition, and other characteristics of a data set. Well-written metadata files benefit the data creators as well as data seekers and users. Proper documentation allows data to be used appropriately and can make it available for others to use as well. A sample standard is included in the Resources section at the end of the Bicycles Best Practice. Well-documented metadata will be compliant with FGDC standards and include the following information⁴:

- Dataset objective or abstract
- Datum, project, and domain
- Data format
- Data standards

⁴ ESRI provides a metadata template that conforms to the FGDC standard that can be accessed through ArcCatalog. Additional information on the FGDC is available at <http://www.fgdc.gov/>.

- Naming conventions
- Field definitions
- Standard attribute fields, their definition, and possible values

Standard Attributes

The recommended list of bikeway network attributes includes features currently tracked by partner jurisdictions in Salt Lake County and new attributes that can make the data useful to a variety of users. These features, at a minimum, should be tracked:

- Roadway or shared-use path name
- Bikeway facility type
- Bikeway width
- Surface (paved/unpaved)
- Year of completion
- Responsible jurisdiction

Other attributes that would be useful, but which would require more effort to populate and maintain include:

- Roadway cross-section information (e.g. number and width of lanes, presence of on-street parking)
- If on-street parking is permitted, designation of the parking type (e.g. parallel, angled, back-in angled) and width

Data Use, Tools, and Applications

Successful multi-jurisdictional datasets should be updated with regularity, but should also meet the needs of known user groups for display and analysis. Failure to meet these needs in the short- and long-term can result in these groups maintaining their own datasets. In order to consolidate the data in one place and meet these user requirements, the county and member jurisdictions should consider desirable data uses and prioritize those that will bring the greatest short- and long-term benefit. These strategies below have been prioritized based on survey feedback and relative ease of implementation.

Near-Term Strategies

On-line Update of Bikeway Assets

Though currently not in widespread use, web based network editing is a highly desirable feature that is rapidly becoming more feasible. This feature can be enabled with Salt Lake County's current ArcServer application, but may be cumbersome and complex when used to add new network data. Other open source development companies such as Dotted Eyes are making this technology part of their open source solutions, but are still limited in terms of adding and

validating new features⁵. This technology could be used to edit information about existing features in the bikeway network and could be used to augment a regular update process.

Multimodal Trip Planner

Many jurisdictions have a bicycle route planner or multimodal route planner. These systems are becoming increasingly easy to implement and can be provided through ESRI, Google, or other open source solutions. Partnering with transit providers such as the Utah Transit Authority can result in a more robust route finder. Noteworthy examples are compared on page 3 of the "Bicycle Best Practices: Mapping" document.

Distribution of Bikeway Data to uPLAN, AGRC, Google Maps, or Open Street Map (OSM)

Wide dissemination of bikeway network data has become increasingly easy in the last several years. Providing bikeway data free of charge to the Google Map and Open Street Map (OSM) communities provides benefits including crowd-sourced applications such as the popular One Bus Away that provides real-time transit information⁶.

The bikeway data should be made available to the public as part of Utah's State Geographic Information Database (SGID), which is hosted and maintained by the Utah Automated Geographic Reference Center (AGRC). This strategy takes advantage of the State's existing distribution framework and data maintenance structure. It also makes it possible in the future for other counties to send the AGRC their bikeway data so that a multi-county or statewide database can be created.

AGRC also hosts UDOT's uPlan mapping platform. Including the bikeway data as part of uPlan would make the data available to the broader public. Salt Lake County could also choose to develop their own web mapping service through AGRC, which contracts basic web mapping and hosting services for minimal cost. Finally, the County and member municipalities may choose to establish a web mapping service using their own internal resources, Google Maps, or OSM. Building and maintaining a new map may incur a greater investment in staff resources than utilizing the existing AGRC infrastructure.

⁵ <http://www.dottedeyes.com>

⁶ Instructions for uploading bikeway data to Open Street Map can be found here: http://wiki.openstreetmap.org/wiki/Main_Page.

Longer-Term Strategies

A variety of other tools can be implemented as longer-term services including:

- Integration of the improved cycling network into regional transportation demand modeling.
 - Example: Portland Metro <http://www.oregonmetro.gov/index.cfm/go/by.web/id/31704/print/true>
- Crowd sourcing maintenance needs
 - Example: Open 311 <http://open311.org/>
- Bike crash (and near miss locations) reporting.
 - Example: San Francisco <http://www.baycitizen.org/data/bike-accidents/report/>
- Tracking facility use via automated and manual counts.
 - Example: Philadelphia <http://geocommons.com/maps/102426>
- Example: National Bicycle and Pedestrian Documentation
 - Project <http://bikepeddocumentation.org>
- Develop traffic hazard index.
 - Example: Bicycle Environmental Quality Index (BEQI) <http://www.sfphes.org/elements/24-elements/tools/102-bicycle-environmental-quality-index>