

The OpenTrails Guidebook

A Government's Guide to Preparing & Publishing OpenTrails Data

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Foreword: The Purpose of OpenTrails

[OpenTrails is an open data specification](#) designed to help governments and their partners publish digital trail maps for their visitors.

Specifically, OpenTrails is a web-native format for GIS data maintained by park and public land agencies. This standardized format allows for easier transfer of data describing trail systems and reduces the cost of producing and distributing trail maps via the web.

By producing a regularly-updated OpenTrails “branch” of your GIS data, you will be able to deliver trail information to visitors through a growing variety of web tools, maps, and mobile applications.

Apps using OpenTrails often provide additional features beyond the specification itself, including photo management, alerts, and messaging—exactly the kind of features that make digital maps so powerful in the hands of park rangers and other program staff.

Review: The OpenTrails Data Model

The Value of GeoJSON

OpenTrails is a set of linked GeoJSON and CSV files. [GeoJSON](#) is a format for encoding a variety of geographic data structures. It is a variant of JSON (JavaScript Object Notation), an interchange-format based on JavaScript—the programming language that powers the interactive portions of most websites and apps. **Much of the value of OpenTrails comes simply from getting your GIS data into GeoJSON and making it easily readable and usable by web and app developers.**

If you work with GIS data, you should learn more about GeoJSON! Its also a great way to start learning about web maps and web mapping workflows. [Check out this tutorial](#) from [Maptime](#) organizer Lyzi Diamond to get your feet wet.

Also, [Tom MacWright](#) over at [MapBox](#) has built a browser-based tool for editing GeoJSON files called [geojson.io](#). Using some of the great tools available via [MapBox.js](#), [Leaflet](#), and some [internal GitHub functionality](#), geojson.io allows users to easily edit and create geographic data in the browser. It's a great sandbox for learning about the geodata on the web.

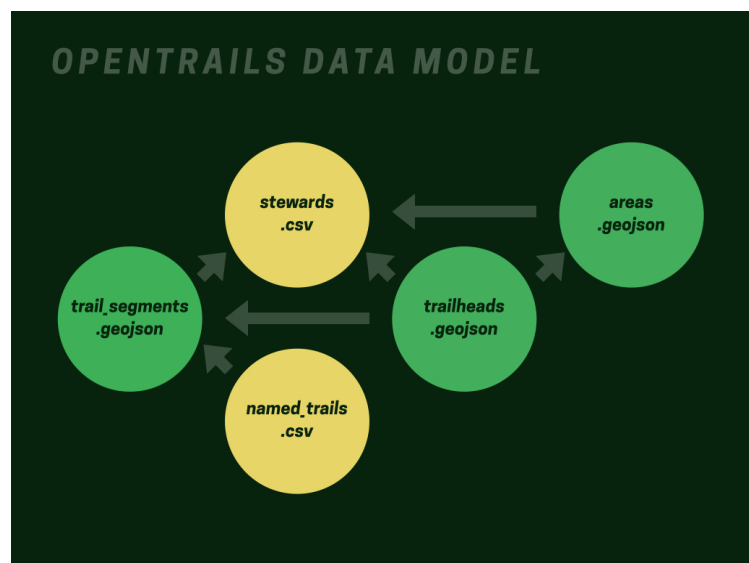
The OpenTrails Object Model

A fully-complete OpenTrails dataset includes **5 linked files**—three files of geodata and two files of description and metadata regarding those geographic features.

[Check out the schema for each file, along with some sample data and map here](#)—a “cheat sheet” produced by Trailhead Labs.

- trail_segments.geojson
- trailheads.geojson
- named_trails.csv
- stewards.csv
- areas.geojson (optional)

Figure 1. Object Diagram of OpenTrails



Key Aspects of the OpenTrails Model

While the data model is relatively straightforward, it is worth describing the importance of certain relationships and the design considerations that led to this model.

1. **“Named Trails”—the trails we advertise to visitors—are groups of segments.**

Trail systems are often complex. One stretch—or segment— of ‘trail’ may actually belong to more than one trail you promote to your visitors. Moreover, any given segment may have different physical attributes and appropriate use from adjacent segments. To capture this reality, the “Named Trails” we publicize are actually defined by groups of segments, and each segment can be a member of many Named Trails.

2. **Trailheads and Trail Segments are linked.**

OpenTrails is designed to help visitors visit and traverse your trail system. As a result, OpenTrails enforces a relationship between trail segments and trailheads. Trailheads are defined as **points of access** to adjacent trail segments. This allows visitors to understand how they can access the trail system and allows other software to perform functions like routing visitors from their current location to a desired trail. Trailheads are associated with one or more segment, which in turn are members of Named Trails.

3. **Areas (boundaries) are stand-alone and thus optional.**

OpenTrails is first and foremost designed to describe trail systems. While most trail systems pass through protected areas, this is not always the case. As a result, geodata describing areas (typically boundaries of parks or protected areas) are not required by OpenTrails, and these features are not linked to trailheads or trail segments directly. All that being said, including areas can make your visitor maps more complete and give visitors important context when orienting themselves or navigating your trail system.

4. **All geographic data is linked to one steward.**

OpenTrails is designed to help governments and other stewards publish trail maps for the visitors for whom they are responsible. As a result, all geographic features—trail segments, trailheads, and areas—are linked to one and only one steward. While many trail system features are maintained by multiple agencies or organizations, it is important not to confuse visitors—the steward represents the best point of contact for additional information or assistance when a visitor is on site.

Step-by-Step: Preparing your data for Conversion to OpenTrails

Step 1: Create Shapefiles

Step 2: Understand: updating shapefile fieldnames is likely required

Step 3: Update fieldnames in your trail segment shapefile

Step 4: Update fieldnames in your trailhead shapefile

Step 5: Associate trailheads with trail segments

Step 1: Create Shapefiles

The OpenTrails Converter (open-trails.codeforamerica.org) is a tool to help organizations start to use and publish OpenTrails data.

The Converter accepts *shapefiles* containing trail segment and trailhead data and publishes a set of OpenTrails-compliant GeoJSON and CSV files as output. If you maintain your trail system data in a [geodatabase](#), you'll need to produce a shapefile version in order to use the converter.

[For more details, take a look at ESRI's ArcGIS Resources article on producing shapefiles from Geodatabase Feature Classes.](#)

Accepted Inputs for the Converter Tool	Output from the Converter Tool
Trail segment shapefile [line or polyline] (.shp, .shx, .dbf, .prj)	trail_segments.geojson named_trails.csv stewards.csv
Trailhead shapefile [point] (.shp, .shx, .dbf, .prj)	trailheads.geojson
Area shapefile [polygon] (.shp, .shx, .dbf, .prj)	areas.geojson

Step 2. Understand: updating shapefile fieldnames is likely required

The OpenTrails Converter *is not* a universal translator. It is a relatively new tool still under active development. That said, it does accept a range of fieldnames based on agency GIS data we have encountered so far. You can take a look at the [Converter's codebase on Github](#) if you are interested in seeing it first hand. You can even [file an issue](#) if you'd like it to accept a wider range of fieldnames.

To use the Converter, follow the steps laid out herein to create a valid “input schema” for your shapefile data.

This is a stepping-stone to OpenTrails—a native GIS schema that the Converter tool can process. There is no single “input schema” but rather a limited set of options that your data must conform to.

Step 3: Update fieldnames in your trail segment shapefile

A. Update “required” fieldnames in your trail segment shapefile

The [OpenTrails specification](#) includes some required fields. Without these fields, the relationships between data that make OpenTrails valuable are impossible to establish.

For your trail segment data, there are two required fields: a unique ID and a trail name. With these two fields, the Converter tool will be able to produce both a **trail_segments.geojson** and **named_trails.csv** file as output. The Converter tool will accept a variety of fieldnames for these required attributes as input.

- **a unique ID field**—which can be used in other datasets to refer to a particular segment.
- **a trail name field**—at least one field which gives a proper name for each trail segment.



trailid	trailname	hike	bike	horse
14	Broad Run Linear - Easement	Yes	Yes	No
15	C. Lacy Compton	Yes	Yes	No
16	Chinn Aquatics and Fitness Center	Yes	Yes	No
17	Cloverdale	Yes	Yes	No
18	Dunbarton	Yes	Yes	No
19	Earl M. Cunard at Ridgfield Village	Yes	Yes	No
20	Foxborough	Yes	Yes	No
21	George Hellwig	Yes	Yes	No
22	Hammill	Yes	Yes	No
23	Harry W. Dawson	Yes	Yes	No
24	Howison Homestead	Yes	Yes	No
25	James Long	Yes	Yes	No
26	John D. Jenkins	Yes	Yes	No
27	Joseph Reading	Yes	Yes	No
28	Lake Ridge	Yes	Yes	No
29	Locust Shade	Yes	Yes	No
30	Marumscro Acre Lake	Yes	Yes	No
31	Mayhew	Yes	Yes	No
32	Nokesville	Yes	Yes	No

What it describes	Is it required?	Acceptable Fieldnames	Type
A unique identifier for each segment of a trail	Yes	'id', 'trailid', 'objectid', 'trail_id', 'object_id'	String
The names of the trails that a segment is a component of	Yes	'name', 'trail', 'trailname', 'trail name', 'trail_name'	String

B. Update “recommended” fieldnames in your trail segment shapefile

The [OpenTrails specification](#) also includes recommended fields for each geographic feature. For trail segments, these attributes largely reflect the appropriate uses of the trail segment.

We recommend you include these attributes to increase the value of OpenTrails data for its intended end-user: the visitor. The Converter tool will accept a variety of fieldnames for these recommended attributes as input. As output, the tool will produce fieldnames that comply with the specification in trail_segments.geojson. The “input schema” that most closely matches OpenTrails output data is a single field for each “use” type, with all values being a boolean—“yes” and “no” being the ideal, but all common-sense variants are acceptable as well.

Table
Recommended "use" attributes
sample_inputs_trailsegments

	FID	Shape	trailname	hike	bike	horse	ski	wheelchair	atv	ailid
▶	0	Polyline M	Coalton	Yes	Yes	Yes	no	No	No	109.01
	1	Polyline M	High Plains	Yes	Yes	Yes	no	No	No	112.01
	2	Polyline M	Sage	Yes	Yes	Yes	no	Yes	No	409.02
	3	Polyline M	Eagle	Yes	Yes	Yes	no	Yes	No	410.01
	4	Polyline M	Eagle	Yes	Yes	Yes	no	No	No	410.03
	5	Polyline M	North Rim	Yes	Yes	Yes	no	No	No	411.01
	6	Polyline M	Old Mill	Yes	No	Yes	no	No	No	413.01
	7	Polyline M	Old Kiln	Yes	No	Yes	no	No	No	404.01
	8	Polyline M	Old Kiln Spur	Yes	No	Yes	no	No	No	405.01
	9	Polyline M	Wonderland Lake	Yes	Yes	Yes	no	Yes	No	407.02
	10	Polyline M	East Boulder - Gunbarrel	Yes	Yes	Yes	no	No	No	502.01
	11	Polyline M	East Boulder - Gunbarrel	Yes	Yes	Yes	no	No	No	502.02
	12	Polyline M	East Boulder - Gunbarrel	Yes	Yes	Yes	no	No	No	502.03
	13	Polyline M	East Boulder - Teller Spur	Yes	Yes	Yes	no	No	No	505.01
	14	Polyline M	Cottontail	Yes	Yes	Yes	no	Yes	No	506.02

What it describes	Is it required ?	Acceptable Fieldnames	Preferred values
Whether hiking is an appropriate use of the trail	No	'hike', 'walk', 'foot'	'yes' or 'no'
Whether bicycling is an appropriate use of the trail	No	'bike', 'roadbike', 'bikes', 'road bike', 'mtnbike'	'yes' or 'no'
Whether horseback riding is an appropriate use of the trail	No	'horse', 'horses', 'equestrian'	'yes' or 'no'
Whether cross-country skiing is an appropriate use of the trail	No	'ski', 'XCntrySki', 'CROSSCSKI'	'yes' or 'no'
Whether a determination has been made that the trail is wheelchair accessible	No	'wheelchair', "accessible", "adaaccess", "accesibil", "ada"	'yes' or 'no'

Whether motor vehicles are appropriate on the trail	No	"MOTORBIKE", "ALLTERVEH", "ATV", "FOURWD", "4WD",	'yes' or 'no'
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C. What to do if you maintain a single “use” column

We have found that some trail stewards maintain indications of appropriate trail use—hiking, biking, equestrian use, etc.—in a single field. Often, this field is named “use” or “trailuse” and contains a list for each activity, as shown in the table below.

id	use	trailname
2	bike, hike, ski, ada	RED_Paul Douglas
3	bike, hike, ski, ada	RED_Paul Douglas
4	bike, hike, ski, ada	RED_Paul Douglas
5	hike, bike, ski, horse	YELLOW_Des Plaines
6	hike, bike, ski, horse	BLACK_Des Plaines
7	hike, bike, ski, horse	OLIVE_Des Plaines
8	hike, bike, ski, horse	BLACK_Spring Lake
9	hike, bike, ski, horse	BLACK_Spring Lake
11	bike, hike, ski, ada	BLACK_Paul Douglas
12	bike, hike, ski, ada	BLACK_Deer Grove
13	bike, hike, ski, ada	RED_Thorn Creek
15	bike, hike, ski, ada	RED_Thorn Creek
21	bike, hike, ski, ada	PURPLE_Burnham Greenway

The OpenTrails Converter will accept and successfully transform this schema. Just make sure that each value is delimited via spaces, commas, or semi-colons.

D. Decide whether to keep other fieldnames

For the time being, the Converter tool does not maintain any extra attributes your data may contain. Or to state it another way—the converter will discard all fields beyond the required and recommended ones.

To be clear, data is OpenTrails-compliant if it has all of the required fields, even if it has other fields as well. The specification is extensible, like the GeoJSON specification is built atop of. But for now, the OpenTrails Converter tool will strip away those extra fields during conversion, so keep that in mind.

As a result, you can either prepare your data for use by removing all other fields, or simply leave those fields be. Either way, the zipfile of OpenTrails data you receive as output from the Converter will only include required and recommended fields.

Step 4: Update fieldnames in your trailhead shapefile

A. Update “required” fieldnames in your trailhead shapefile

The [OpenTrails specification](#) includes some required fields for trailheads as well. These fields enable us to establish the relationships between data that make OpenTrails valuable.

There are two required fields for trailhead data. The Converter tool will accept a variety of fieldnames for these required attributes as input.

- **a unique ID field**—can be used in other datasets to refer to a particular segment.
- **a trailhead name field**—at least one field which gives a proper name for a trailhead

FID	Shape *	segmentids	thname	address	parking	water	restroom	info
77	Point ZM	101.01	Doudy Draw	4100 Eldorado Springs Dr.	Yes	No	No	Yes
62	Point ZM	108.01	CR S. 67 - Fowler	3000 County Rd 67	No	No	No	Yes
0	Point ZM	109.01	Coatton and Hwy 128	18200 Highway 128, 0.35mi E. on hwy 128 NWTC	No	No	No	Yes
73	Point ZM	110.01;111.01	South 66th	None	No	No	No	Yes
72	Point ZM	113.01;114.01;106.1	Marshall Mesa	5258 E. Eldorado Springs Dr	Yes	No	Yes	Yes
71	Point ZM	114.03	Old Marshall Mesa	None	No	No	No	Yes
88	Point ZM	115.01;112.01;103.1	Greenbelt Plateau	5101 Highway 128	Yes	No	No	Yes
74	Point ZM	116.01	Flatirons Vista	3663 State Hwy. 93	Yes	No	Yes	Yes
33	Point ZM	201.01	South Mesa	4111 Eldorado Springs Dr.	Yes	No	Yes	Yes
16	Point ZM	210.01	South Boulder Creek West	1405 South Foothills Hwy.	Yes	No	Yes	Yes
18	Point ZM	218.01	Shanahan Ridge at Hardscrabble	2094 Hardscrabble Rd.	No	No	No	Yes
17	Point ZM	219.01	Shanahan Ridge at Galena Way	Lehigh St. & Galena Way	No	No	No	Yes
96	Point ZM	220.01	North Fork Shanahan at Lehigh	1915 Lehigh St.	No	No	No	Yes
19	Point ZM	221.01	Cragmoor	2355 Cragmoor Dr.	No	No	No	Yes
20	Point ZM	228.01	Green Mt. West Ridge	5093 Bison Dr.	No	No	No	Yes
22	Point ZM	230.01	Wildwood Road	None	No	No	No	Yes
21	Point ZM	231.01	Bear Mountain Drive at Wildwood Ln	1245 Wildwood Rd	No	No	No	Yes
23	Point ZM	233.01	Table Mesa Trail at North Vassar	None	No	No	No	Yes
24	Point ZM	233.01	Table Mesa Trail at South Vassar	None	No	No	No	Yes
57	Point ZM	235.01	NCAR	1850 Table Mesa Dr	Yes	No	No	Yes
63	Point ZM	237.01	Table Mesa Water Tank	1850 Table Mesa Dr	No	No	No	Yes

What it describes	Is it required?	Acceptable Fieldnames	Preferred values
A unique identifier	Yes	'id', 'objectid', 'object id'	string
The name of the trailhead itself	Yes	'name', 'thname'	string

B. Integrate trail segment IDs into trailheads shapefile

While the OpenTrails specification **does not require** that your trailhead features be associated with segments of trail, it is strongly encouraged. In fact, this relationship enables a good bit functionality, and a number of OpenTrails-driven web apps and maps are designed with this relationship in mind.

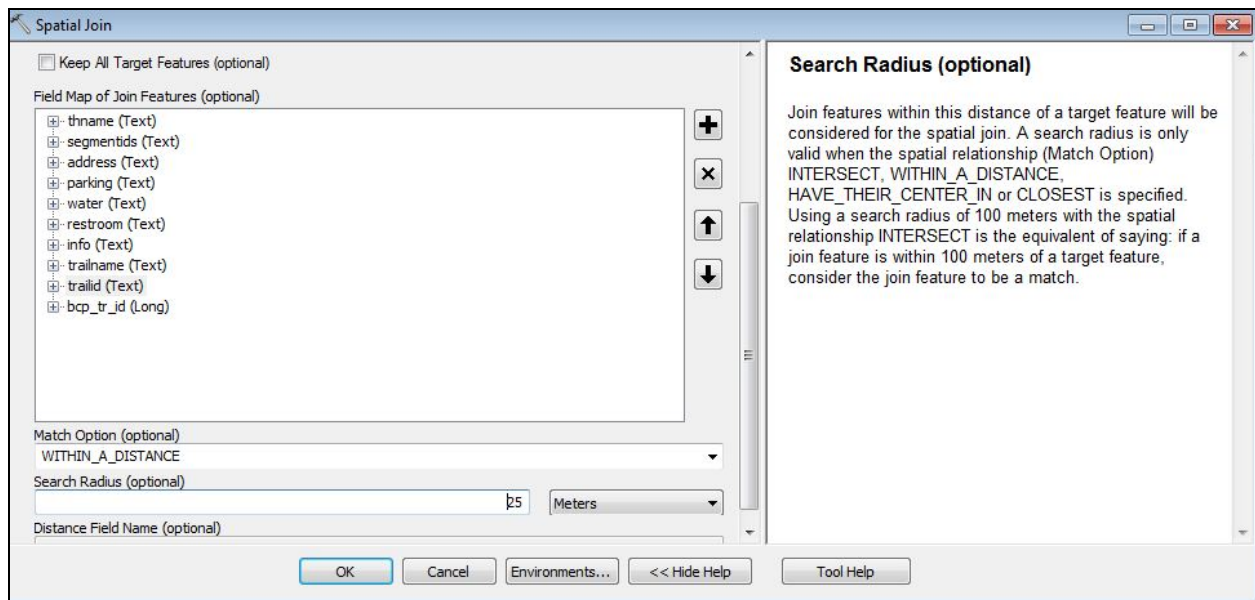
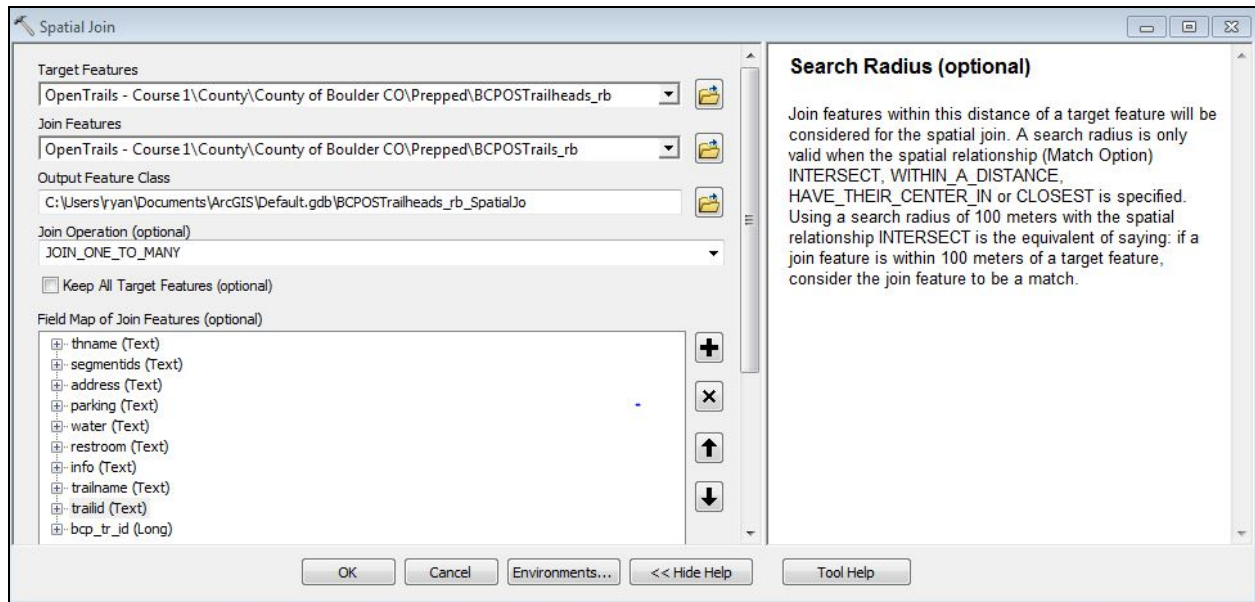
We expect most agencies publishing OpenTrails for the first time will need to create this relationship from scratch.

The OpenTrails specification is not actually concerned with how these associations are created. It's up to you!

What follows is a well-tested way to create this link between trailhead features and segment features. Specifically, this method will transfer the IDs of trail segments into a new field inside your trailhead features. It takes two shapefiles, joins them spatially in a new Feature Class, and then allows the renewed export of updated shapefiles.

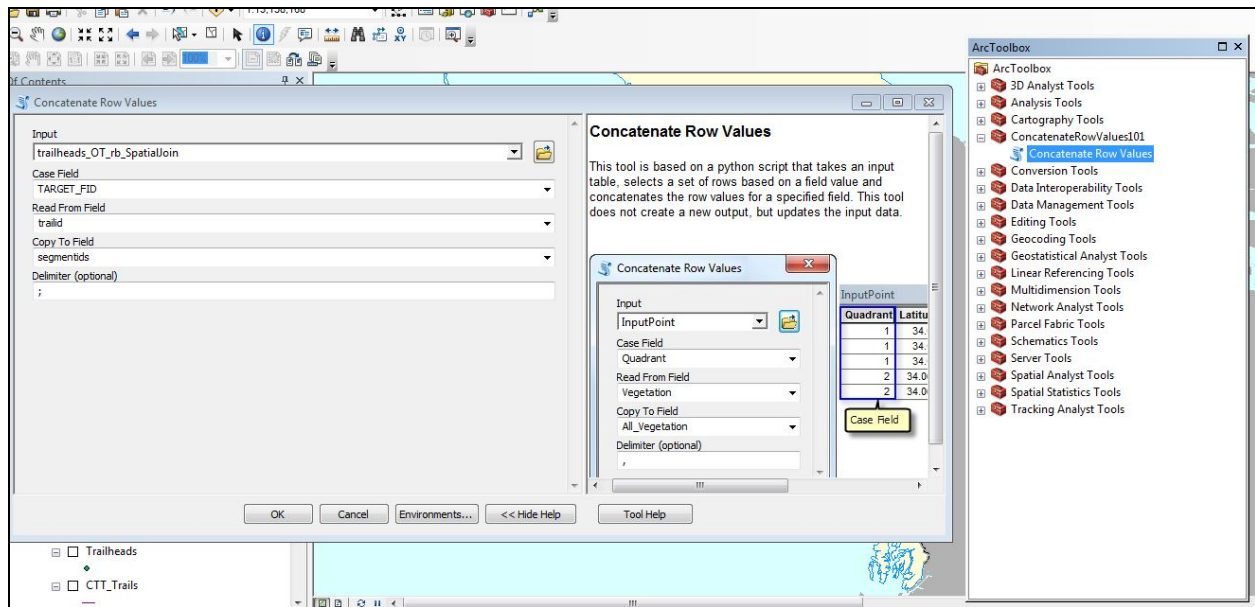
What it describes	Is it required?	Acceptable Fieldnames	Values
The unique ids of the trail segments the trailhead provides access to	No	'trail', 'trail_name', 'trail1', 'trail_seg_ids', 'segmentids'	string-encoded array of values

1. Step 1
 - a. Create a new map (MXD) that includes both your segment shapefile and your trailhead shapefile.
 - b. Open the Spatial Join tool in ArcToolbox
 - i. Target Features: choose the trailheads shapefile
 - ii. Join Features: choose the trail segments shapefile
 - iii. Output Feature Class: keep default (**you will export to a new shapefile later in the process**)
 - iv. Join Operation: one to many
 - v. Keep all of the trailhead layer fields, but only keep the trailid field from the trailsegments (can keep other trailsegment fields and delete later if desired)
 - vi. Match Option: WITHIN_A_DISTANCE
 - vii. Search Radius: 25 meters (**based on some testing, may require some manual cleaning, please choose according to your specific trail segments and trailheads**)
 - viii. Click OK to run the join



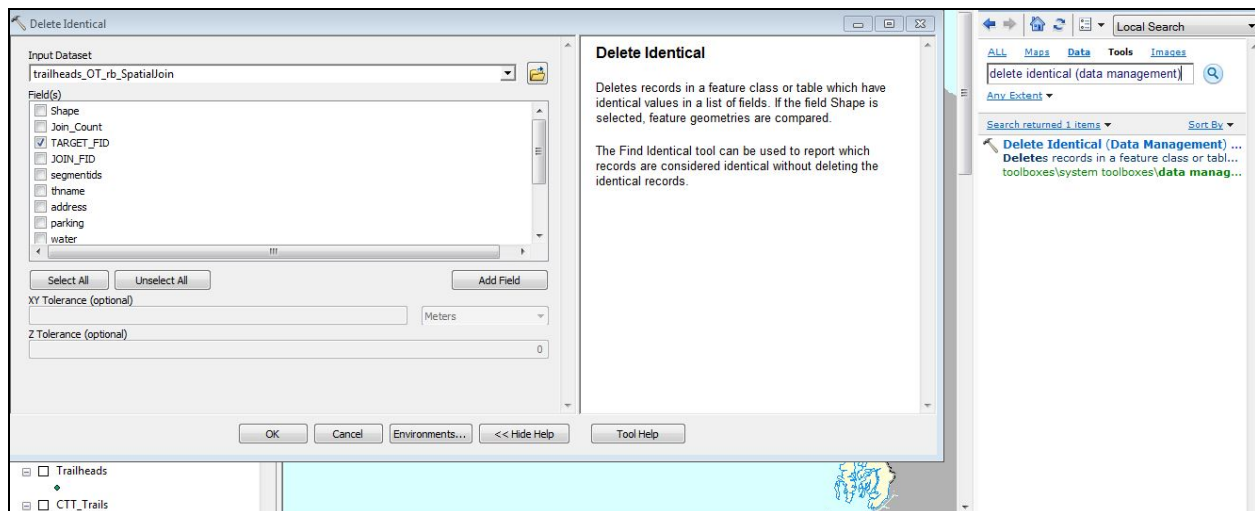
2. Step 2

- If there are any "null" values (trailheads not within 25m of trail), then make sure to select all of the non-null values before running the Concatenate Row Values Tool
- Download the Concatenate Row Values Tool and import into your ArcToolbox (link here): <http://www.arcgis.com/home/item.html?id=52dfcef46fdb4c76bfbcb08dc01570f3c>
 - Input: the output file from Step 1
 - Case_Field: TARGET_FID
 - Read From Field: "trailid" (the trail segment id from the spatial join in Step 1)
 - Copy To Field: "segmentids" (empty field to be populated with list of trail segments; make sure that field is string and 255 characters)
 - Delimiter: ; (semicolon)
- Click 'Ok' to run.



3. Step 3

- Open the Delete Identical tool in ArcToolbox
 - Input: The output from Step 2
 - Field: TARGET_FID
 - Leave the rest of the default settings
 - Select OK
 - Confirm that the number of records is equal to your source trailhead file
- Export out as your new trailhead shapefile
- Remove unnecessary fields: Object_ID, Join_Count, Join_FID, Target_FID, Trailid (used to populate 'segmentids')
- Success!



C. Update “recommended” fieldnames in your trailhead shapefile

The [OpenTrails specification](#) also includes “recommended” fields for each geographic feature. For trailheads these attributes largely reflect the available “amenities” at the given location.

We recommend you include these attributes to increase the value of OpenTrails data for its intended end-user: the visitor. The Converter tool will accept a variety of fieldnames for these recommended attributes as input. As output, the tool will produce fieldnames that comply with the specification in trail_segments.geojson. The “input schema” that most closely matches OpenTrails output data is a single field for each “use” type, with all values being a boolean—“yes” and “no” being the ideal, but all common-sense variants are acceptable as well.

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73	Point ZM	110.01;111.01	South 66th	None	No	No	No	Yes
72	Point ZM	113.01;114.01;106.1	Marshall Mesa	5258 E. Eldorado Springs Dr	Yes	No	Yes	Yes
71	Point ZM	114.03	Old Marshall Mesa	None	No	No	No	Yes
88	Point ZM	115.01;112.01;103.1	Greenbelt Plateau	5101 Highway 128	Yes	No	No	Yes
74	Point ZM	116.01	Flatrons Vista	3663 State Hwy. 93	Yes	No	Yes	Yes
33	Point ZM	201.01	South Mesa	4111 Eldorado Springs Dr.	Yes	No	Yes	Yes
16	Point ZM	210.01	South Boulder Creek West	1405 South Foothills Hwy.	Yes	No	Yes	Yes
18	Point ZM	218.01	Shanahan Ridge at Hardscrabble	2094 Hardscrabble Rd.	No	No	No	Yes
17	Point ZM	219.01	Shanahan Ridge at Galena Way	Lehigh St. & Galena Way	No	No	No	Yes
96	Point ZM	220.01	North Fork Shanahan at Lehigh	1915 Lehigh St.	No	No	No	Yes
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20	Point ZM	228.01	Green Mt. West Ridge	5093 Bison Dr.	No	No	No	Yes
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23	Point ZM	233.01	Table Mesa Trail at North Vassar	None	No	No	No	Yes
24	Point ZM	233.01	Table Mesa Trail at South Vassar	None	No	No	No	Yes
57	Point ZM	235.01	NCAR	1850 Table Mesa Dr	Yes	No	No	Yes
63	Point ZM	237.01	Table Mesa Water Tank	1850 Table Mesa Dr	No	No	No	Yes

What it describes	Is it required?	Acceptable Fieldnames	Preferred values
The street address of the trailhead, if one exists.	No	'add', 'addr', 'address', 'street', 'siteaddr'	string
Whether there is parking for visitors at the trailhead.	No	'park', 'parking', 'parking lot', 'roadside'	'yes' or 'no'
Whether there is drinking water for visitors available on site.	No	'water', 'drinkingwa', 'drinkwater'	'yes' or 'no'
Whether there are restrooms for visitors at the trailhead.	No	'restrooms', 'bathroom', 'toilet'	'yes' or 'no'
Whether there is information for visitors at the trailhead.	No	'info', ' ', 'kiosk'	'yes' or 'no'

Step 5: Prepare your Areas Shapefile (Not yet supported)

The [OpenTrails specification](#) also includes an “areas” file—a set of polygons meant to describe the bounds of the protected areas that trails often traverse. This file *is not required*. Because the file is optional, OpenTrails has no dependencies on this file. However, providing users with these boundary shapes can help anchor them as they orient themselves and traverse your trail system.

The OpenTrails Converter does not yet support the conversion of shapefiles describing areas. This functionality is coming soon.

What it describes	Is it required?	Acceptable Fieldnames	Preferred values
A unique identifier	No (the converter will create one, if it is absent)	'id', 'objectid', 'object id'	string
The names of the park or protected area	Yes	'name', 'parkname'	string

Updating OpenTrails Data

Every agency has a different way of updating their data. For the purposes of OpenTrails, the important thing to remember is that this visitor-centric version of your data is a “branch” off of your “master database”. For the time-being, OpenTrails is best considered a “one-way” conversion—existing tooling does not support the conversion of OpenTrails data back into Shapefiles, and the workflows for incorporating changes into your master database would be considerably more nuanced for each agency.

Recommended Metadata

When you publish OpenTrails, consumers of the data will expect the data to retain freshness over time. As you get feedback about the accuracy or completeness of your data, you should make changes in your master database, resulting in an updated OpenTrails dataset “downstream”.

To give consumers a sense of your data’s freshness and the model that it conforms to, it is extremely useful to provide metadata. While metadata is currently outside the bounds of the OpenTrails specification itself, we have crafted the simple table below to serve as a v1.0 of recommended metadata properties.

Specification Link	opentrailsdata.org/specification
Specification Version	V 1.1
Date Published	September 1, 2014
Update Schedule	Quarterly
Point of Contact Name	Your name
Point of Contact Email	Your email
Point of Contact Phone	Your phone
Description of Changes	Narrative description of updates, authored for each edition.