

Asset Inventory for On-System Bridges and Culverts over Water

Prepared by David R. Maidment, 12/31/2022

Input: TxDOT Roadway Inventory lines and NBI Bridge point data

Output: Line and point feature classes for On-System bridges and culverts in the Austin District

The analysis data and results are at: <https://utexas.box.com/s/aer07ucj5pzb3gd9g6rbxxng6hjuio9j>

Results only at: <https://utexas.box.com/s/0h21qjh4fgsb7udi2vpct5bskdqsbixm>

(1) Get the Data

TxDOT District Boundaries are at: <https://gis-txdot.opendata.arcgis.com/> under txdot districts

TxDOT Maintenance Section Boundaries are at: <https://gis-txdot.opendata.arcgis.com/> under txdot maintenance section boundaries

TxDOT Roadway Inventory OnSystem is at: <https://gis-txdot.opendata.arcgis.com/> under txdot roadway inventory on system

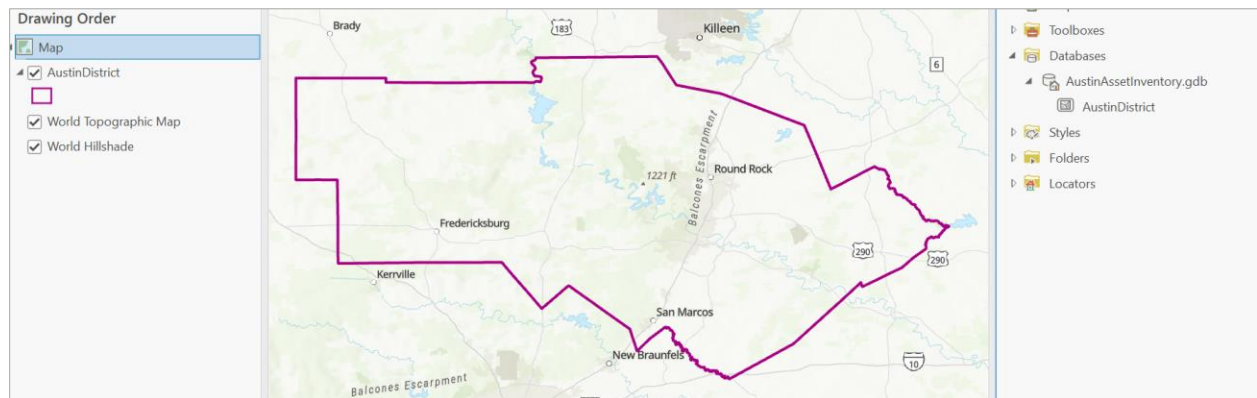
TxDOT Bridges is at: <https://gis-txdot.opendata.arcgis.com/> under txdot bridges

Ellis Bridges is at: <https://www.cae.utexas.edu/prof/maidment/StreamflowII/Data/EllisBridge.zip> This is a dataset derived from AssetWise by Trenton Ellis of TxDOT H&H that includes an attribute for bridge thickness.

(2) Define the Analysis Domain

Open a new folder in Windows Explorer, **AssetInventory** and established a new ArcGIS Pro project in that location called **AustinAssetInventory**

Add the District boundaries to the map and select the Austin District as for **DIST_NM = Austin** and export the resulting selected features to a new feature class **AustinDistrict**

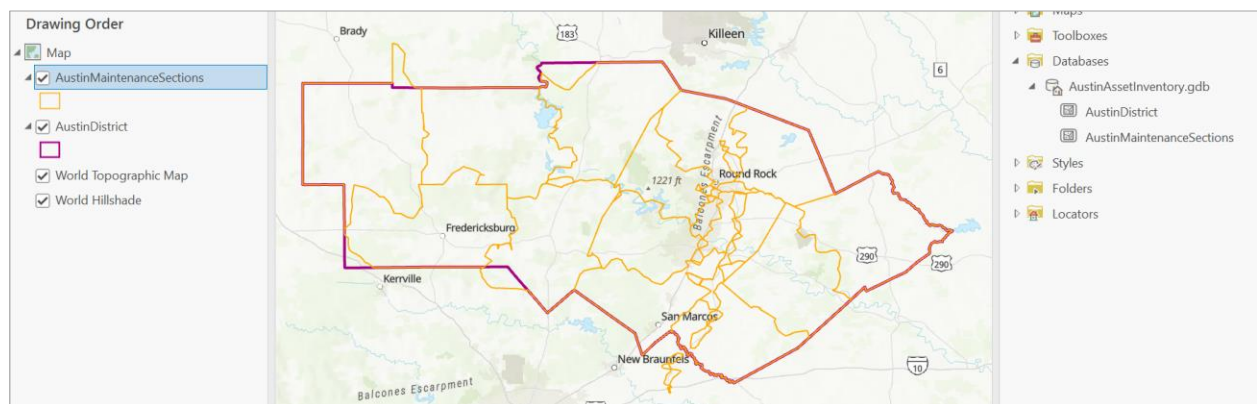


Note that TxDOT has 25 Districts, of which Austin is District number 14.

DIST_ABRVN	DIST_NBR ▲	DIST_NM
PAR	1	Paris
FTW	2	Fort Worth
WFS	3	Wichita Falls
AMA	4	Amarillo
LBB	5	Lubbock
ODA	6	Odessa
SJT	7	San Angelo
ABL	8	Abilene
WAC	9	Waco
TYL	10	Tyler
LFK	11	Lufkin
HOU	12	Houston
YKM	13	Yoakum

AUS	14	Austin
SAT	15	San Antonio
CRP	16	Corpus Christi
BRY	17	Bryan
DAL	18	Dallas
ATL	19	Atlanta
BMT	20	Beaumont
PHR	21	Pharr
LRD	22	Laredo
BWD	23	Brownwood
ELP	24	El Paso
CHS	25	Childress

Add the Maintenance Section Boundaries to an ArcGIS Pro Project. Select by Attributes for **DIST_NM = Austin** and export the resulting selected features to a new feature class **AustinMaintenanceSections**

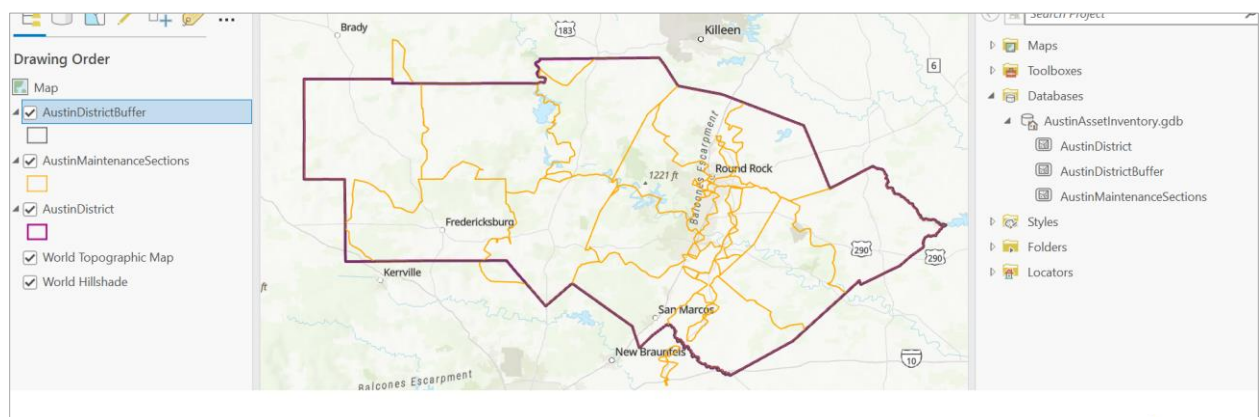


Note that there are some discrepancies between the District Boundary lines and the Maintenance Section Boundary lines. For the purposes of this exercise, it is assumed that the assets to be inventoried will be those within the geographic boundary of the **Austin District**.

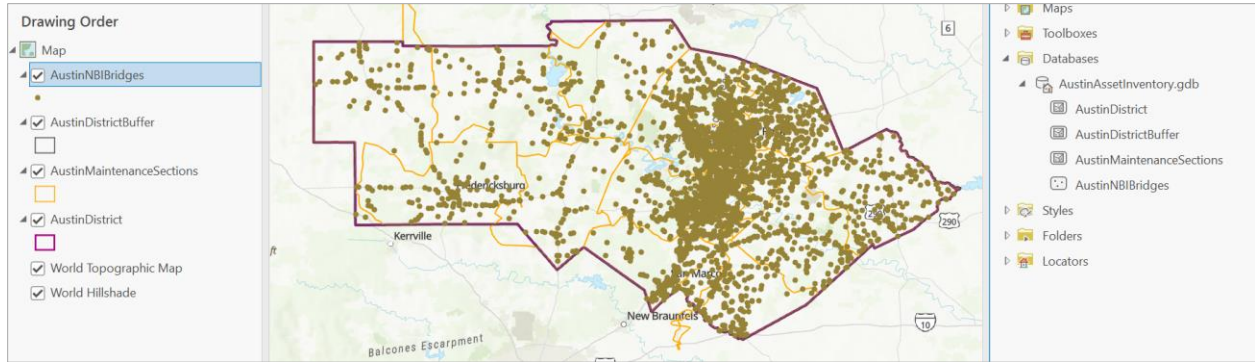
Austin has 16 Maintenance Sections, including a special one for toll roads

DIST_NM	MAINT_SEC_NBR ▲	MAINT_SEC_NM
Austin	1	Bastrop County
Austin	2	Blanco County
Austin	3	Burnet County
Austin	4	Caldwell County
Austin	5	Gillespie County
Austin	6	Hays County
Austin	7	Lee County
Austin	8	Llano County
Austin	9	Mason County
Austin	10	Travis County East
Austin	11	Travis County North
Austin	12	Williamson County West
Austin	13	Williamson County East
Austin	14	Travis County Central
Austin	15	Travis County South
Austin	25	Austin District Toll Roads

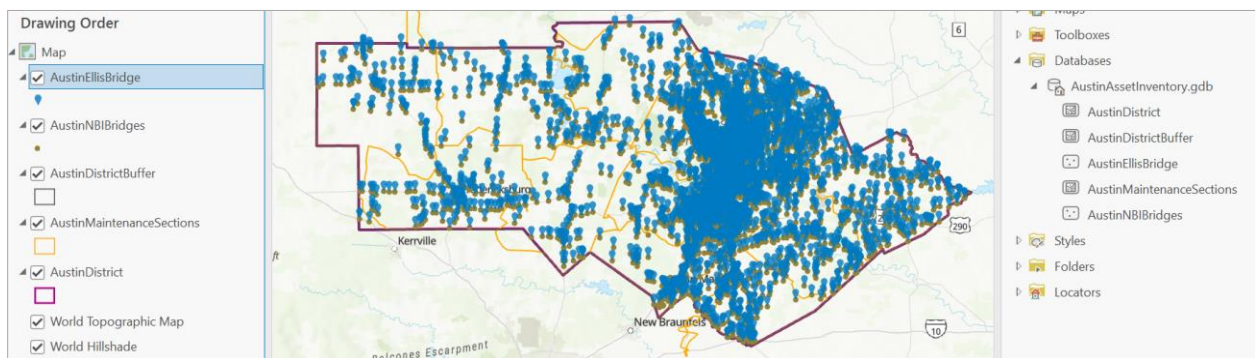
Use Buffer to Establish a 100m buffer **AustinDistrictBuffer** around the Austin District for selection of other data that might just be on the border of the district. Use Dissolve all output features into a single feature.



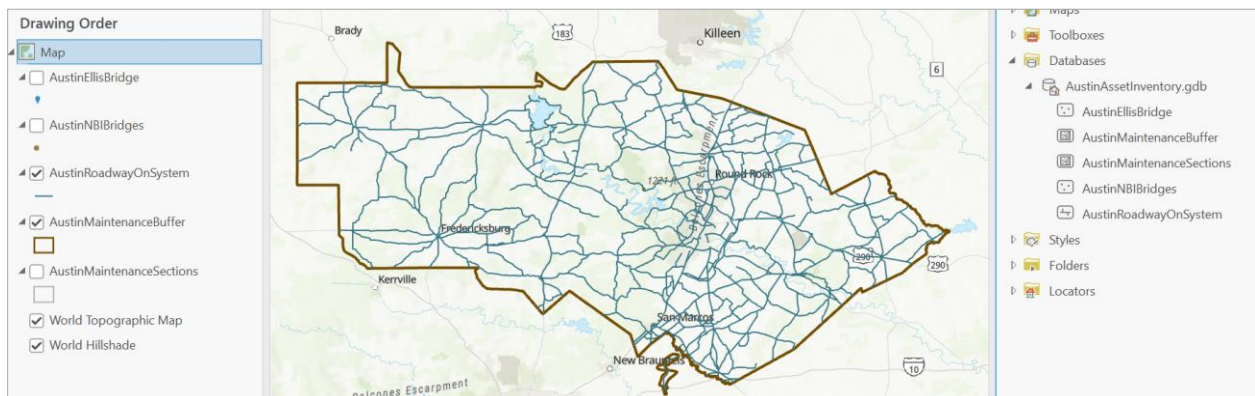
Add the NBI bridges to the map and select those bridges inside the buffer area to become **AustinNBIBridges**. There are 4021 of these bridges.



Add Ellis bridges to the map and select those that lie within the Austin buffer to form an **AustinEllisBridge** feature class. There are 3945 of these bridges.



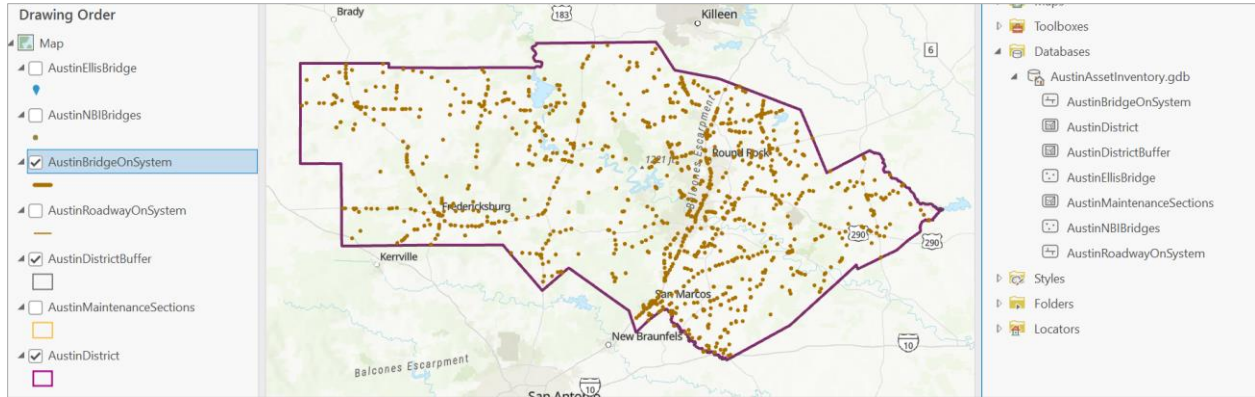
Add TxDOT Roadway Inventory to the map and select roadway lines that lie inside the Austin buffer to create **AustinRoadwayOnSystem**. There are 9482 of these line features.



(3) Determine the Roadway Inventory On System Bridge Lines

This OnSystem roadway inventory has only one line for each roadway, not separate lines for each lane or separated sections of a divided highway.

Use Select by Attributes to select those **AustinRoadwayOnSystem** lines that have **BRDG_STRUC_NBR** is **not null**. This yields 1268 line features.



These line features all have a bridge structure number.

AustinBridgeOnSystem							
Field:	Selection:						
	C_DRCT_TOLL	HWY_DES1	ACES_CTRL	BRDG_STRUC_NBR	MULT_MOD_FCLTY	MED_TYPE	MED_WID
1	<Null>	2	3	141060001614182	<Null>	0	0
2	<Null>	3	3	142460044001006	<Null>	2	450
3	<Null>	2	3	142460044001005	<Null>	0	0
4	<Null>	2	3	140280011502020	<Null>	0	0
5	<Null>	2	3	140110011504009	<Null>	0	0
6	<Null>	2	3	140280011503015	<Null>	0	0
7	<Null>	2	3	140110011504024	<Null>	0	0

There are a large number of attributes on this feature class. Make a new feature layer and eliminate all but the most useful attributes, as listed below.

REC		
RIA_RTE_ID	HWY	MAINT_DIS
RTE_GRID	HSYS	MNT_SEC
GID	HNUM	PBLC_LAND
FRM_DFO		ADMIN
TO_DFO		RDWAY_MAINT_AGCY
		F_SYSTEM

BASE_THCK
CLMT_ZN
SOIL
LEN_SEC
LN_MILES
DVMT

BRDG_STRUC_NBR
141060001614182
142460044001006
142460044001005
140280011502020
140110011504009
140280011503015

Geoprocessing

Delete Field

This tool modifies the Input Table

Parameters Environments

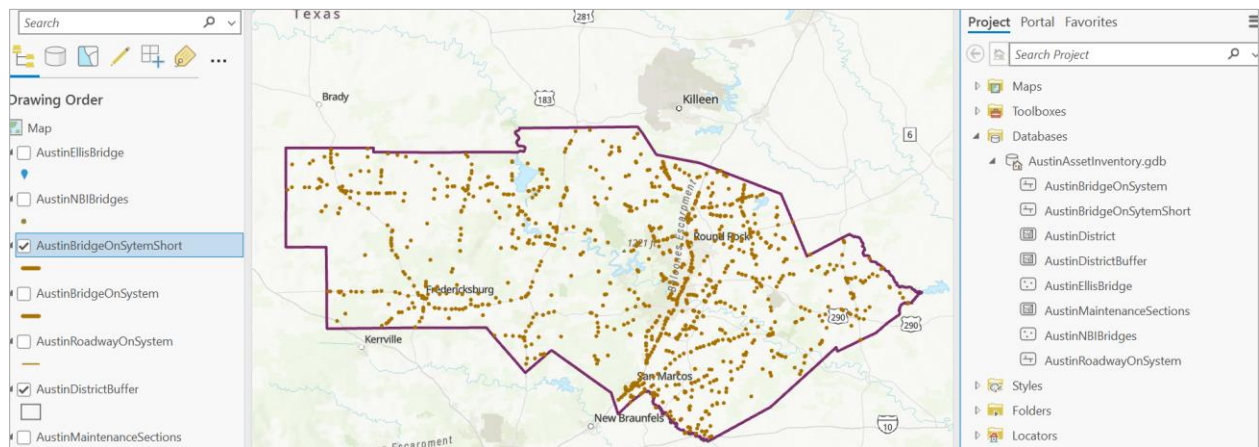
Input Table: AustinBridgeOnSystem

Method: Keep Fields

Field(s): Select All

- REC
- RIA_RTE_ID
- RTE_GRID
- GID
- FRM_DFO
- TO_DFO

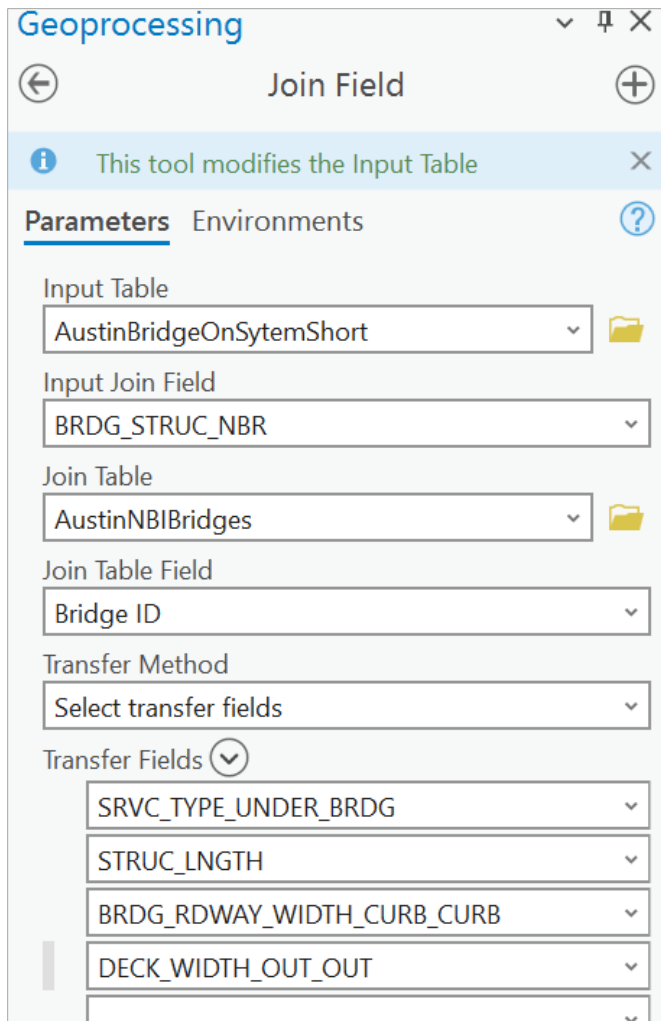
Use Delete Field with Method **Keep Fields** to select out the attributes that need to be kept to create **AustinOnSystemBridgeShort**



Use **Summarize** on the BRDG_STRUC_NBR to determine the number of unique Bridge numbers. There are 1043 unique bridges among these 1268 bridge lines.

(4) Find Bridges over Water

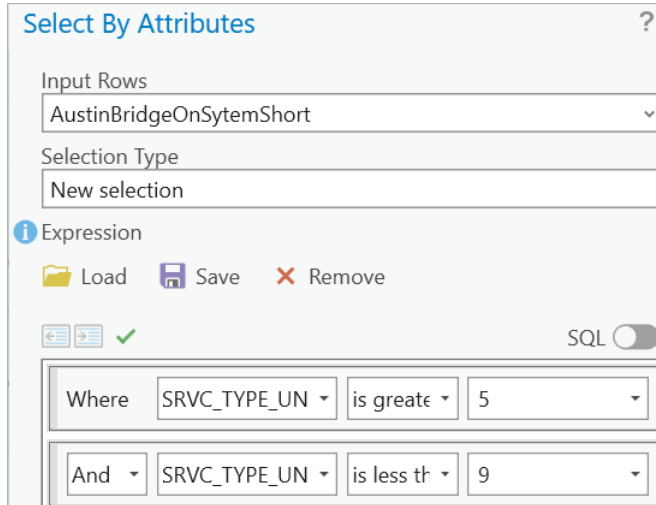
Use **Join Field** to transfer attributes from the NBI Bridge features to these Austin OnSystem bridge lines. Transfer Service Type Under Bridge, Structure Length, Roadway Width and Deck Width attributes.



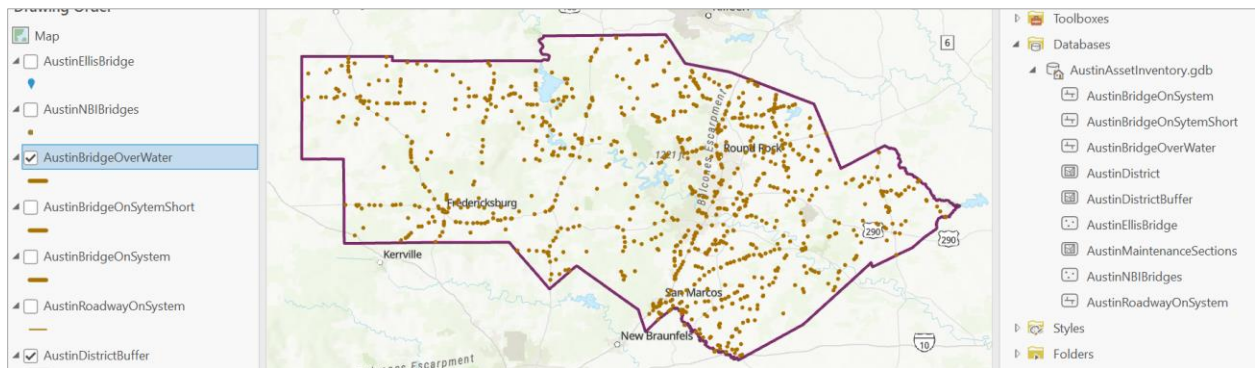
These attributes are added to the bridge lines

SRVC_TYPE_UNDER_BRDG	STRUC_LNGTH	BRDG_RDWAY_WIDTH_CURB_CURB	DECK_WIDTH_OUT_OUT
5	30	37	50
5	21	55	94
5	132	43	46
5	160	38	40
5	44	34	36

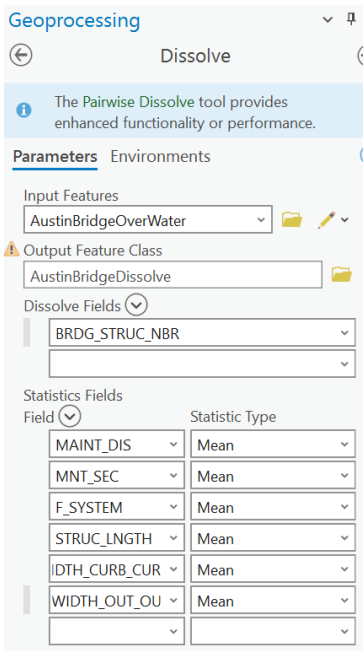
The Service Type Under Bridge is roads over water for values 5 – 9. Select these out. The other bridges are for roads over roads. This creates **AustinBridgeOverWater** line features.



This yields 1068 Austin Bridge lines of 952 are for unique bridge numbers.



Dissolve these out to produce a unique line for each bridge with mean values of key attributes.



This yields 952 **AustinBridgeDissolve** bridge lines with mean attributes that show what FSystem the bridge is on (1 is highest rating), and which maintenance section is responsible for the bridge.

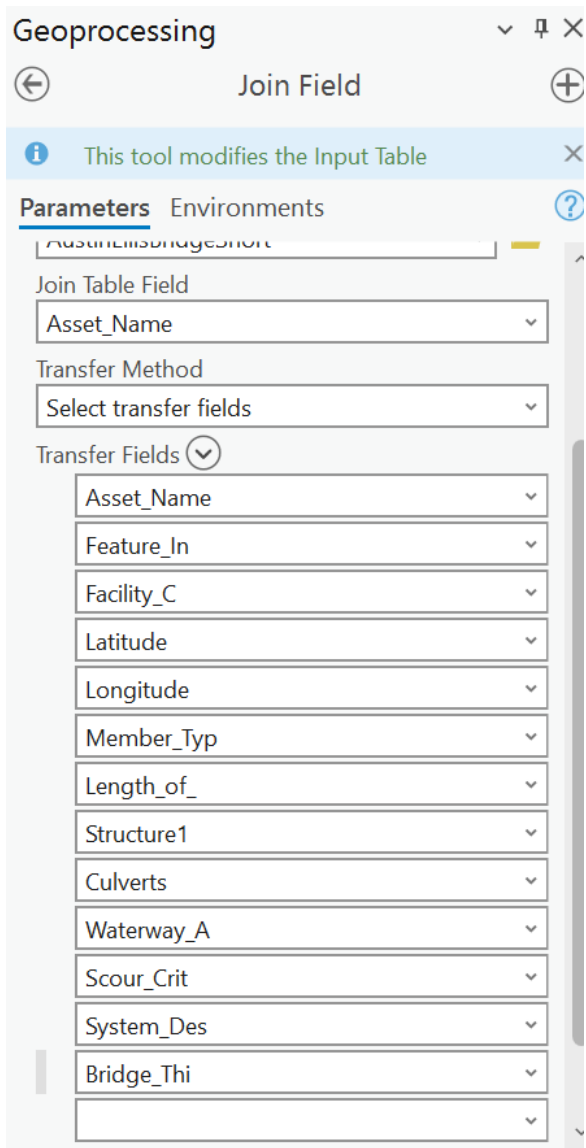
AustinBridgeDissolve X							
Field:		Selection:					
OBJECTID *	Shape *	BRDG_STRUC_NBR	MEAN_MAINT_DIS	MEAN_MNT_SEC	MEAN_F_SYSTEM	MEAN_STRUC_I	
1	1	Polyline M	140110011406484	14	7	3	
2	2	Polyline M	140110011406486	14	7	3	
3	3	Polyline M	140110011504008	14	1	4	
4	4	Polyline M	140110011504009	14	1	4	
5	5	Polyline M	140110011504017	14	1	4	

(5) Add Ellis Bridge attributes

Use Delete Field to eliminate some descriptive attributes in **AustinEllisBridge** to get **AustinEllisBridgeShort** with these attributes

AustinEllisBridgeShort			
Read Only	Field Name	Alias	Data Type
<input checked="" type="checkbox"/>	OBJECTID	OBJECTID	Object ID
<input type="checkbox"/>	Shape	Shape	Geometry
<input type="checkbox"/>	Asset_Name	Asset_Name	Text
<input type="checkbox"/>	Feature_In	Feature_In	Text
<input type="checkbox"/>	Facility_C	Facility_C	Text
<input type="checkbox"/>	Latitude	Latitude	Double
<input type="checkbox"/>	Longitude	Longitude	Double
<input type="checkbox"/>	Member_Typ	Member_Typ	Text
<input type="checkbox"/>	Length_of_	Length_of_	Double
<input type="checkbox"/>	Structure1	Structure1	Double
<input type="checkbox"/>	Deck_Width	Deck_Width	Double
<input type="checkbox"/>	Culverts	Culverts	Text
<input type="checkbox"/>	Waterway_A	Waterway_A	Text
<input type="checkbox"/>	Scour_Crit	Scour_Crit	Text
<input type="checkbox"/>	System_Des	System_Des	Double
<input type="checkbox"/>	Bridge_Thi	Bridge_Thi	Double

Use **Join Field** to transfer these fields onto the AustinBridgeDissolve feature class



This yields 952 bridges and “bridge class culverts” feature lines with Ellis attributes.

	Asset_Name	Feature_In	Facility_C	Latitude	Longitude	Member_Typ
1	140110011406484	GOODWATER CREEK	US 290 EB	30.229713	-97.18225	26
2	140110011406486	MID SPRINGS CREEK	US 290 EB	30.221429	-97.163263	26
3	140110011504008	UPPER CEDAR HOLLOW	FM 20	29.965153	-97.448146	
4	140110011504009	LOWER CEDAR HOLLOW	FM 20	29.985469	-97.438228	
5	140110011504017	LONG BRANCH	FM 20	30.070805	-97.398864	26
6	140110011504021	BEE CREEK	FM 20	29.943599	-97.495331	31
7	140110011504022	ELM CREEK	FM 20	29.955229	-97.464406	31

Lets associate the bridges and culverts with maintenance sections. There are a few bridges for which the MeanMaintenanceSection determined earlier is not an integer because the facility lies across the boundary between two maintenance sections. Go to these visually and edit them so that the numbers are all integer. Use Join Field to add the Maintenance Section

Geoprocessing

Join Field

This tool modifies the Input Table

No pending edits.

Parameters Environments

	MEAN_MNT_SEC ▲	MAINT_SEC_NM
Input Table		
AustinBridgeDissolve	1	Bastrop County
Input Join Field		
MEAN_MNT_SEC	1	Bastrop County
Join Table		
AustinMaintenanceSections	1	Bastrop County
Join Table Field		
MAINT_SEC_NBR	1	Bastrop County
Transfer Method		
Select transfer fields	1	Bastrop County
Transfer Fields ▼		
MAINT_SEC_NM	1	Bastrop County

Now, use Summarize on MAINT_SEC_NM to summarize the number of bridge and culvert assets in each maintenance section

MAINT_SEC_NM	FREQUENCY
Austin District Toll Roads	2
Bastrop County	69
Blanco County	51
Burnet County	63
Caldwell County	79
Gillespie County	76
Hays County	86
Lee County	63
Llano County	81
Mason County	72
Travis County Central	18
Travis County East	43
Travis County North	42
Travis County South	38
Williamson County East	94
Williamson County West	75

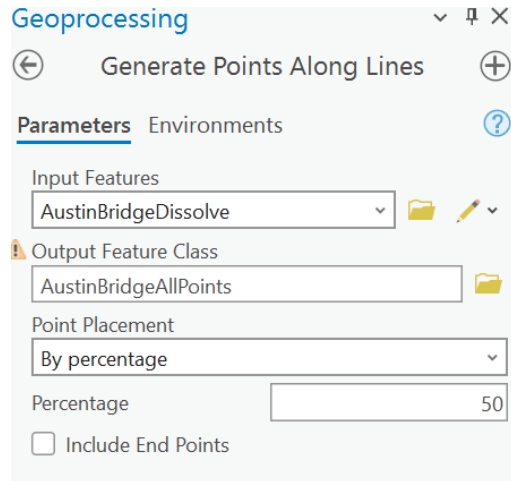
(6) Bridge and Culvert Lines and Points

The Ellis Bridge attributes have a descriptor for Culverts which is equal to N if the structure is a bridge, otherwise it gives the number of culvert pipes. For the Bridge features, there is a Member Type defined for which the bridge thickness is estimated with the Ellis rules.

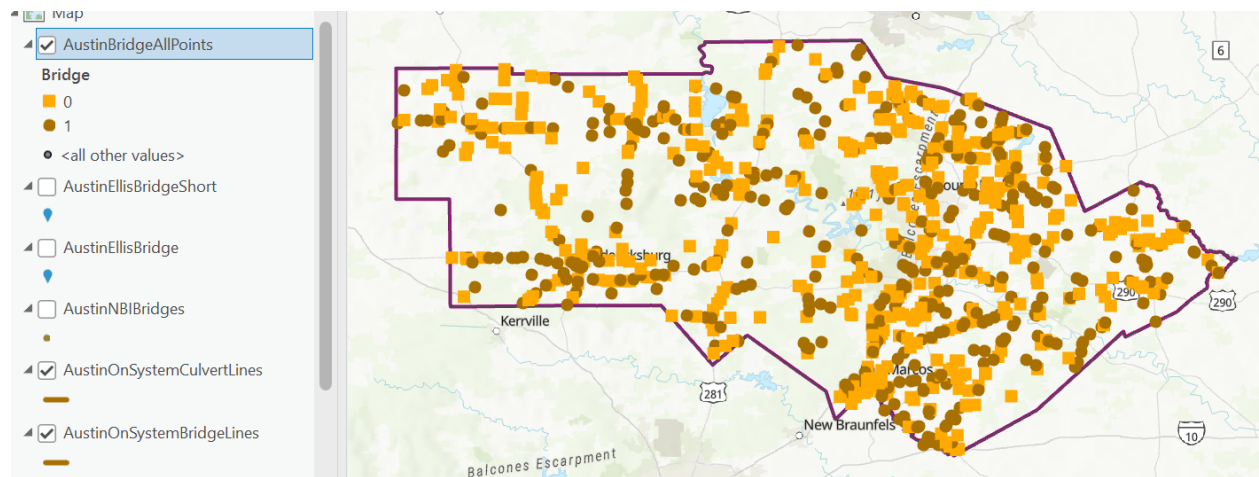
Member_Typ	Culverts
26	N
26	N
	7
	6
26	N
31	N
31	N

Select **AustinBridgeDissolve** for Culverts = N, and export to **AustinOnSystemBridgeLines**. Switch the selection and export to **AustinOnSystemCulvertLines**. This produces 437 bridge lines and 515 culvert lines.

Establish representative points on the centroids of all these lines.



Define an attribute called **Bridge**, which is = 1 for the point being a bridge and 0 for the point being a culvert.

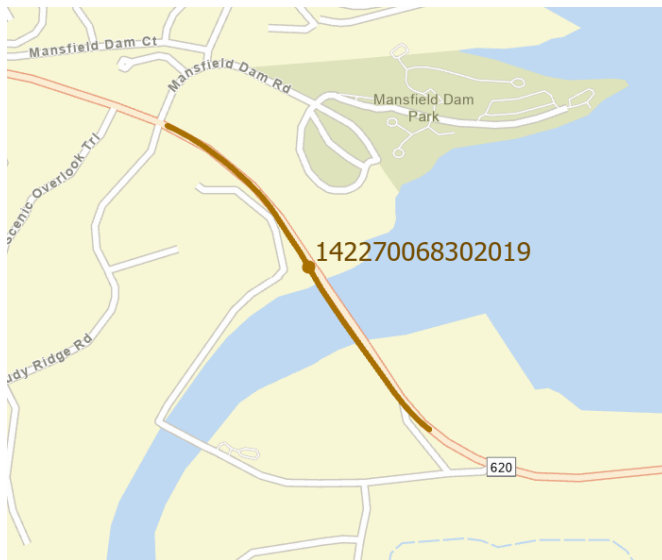


Here is the bridge over the Colorado River at Mansfield Dam.

A summary of this classification of the bridge and culvert assets by maintenance section is below. There are a total of 952 assets identified of which 437 (46%) are bridges and 515 (54%) are culverts.

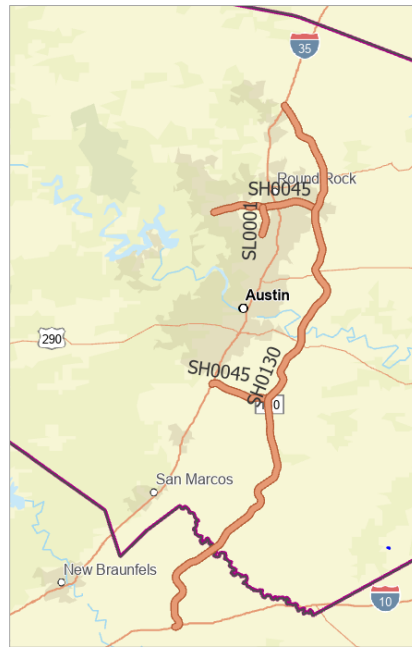
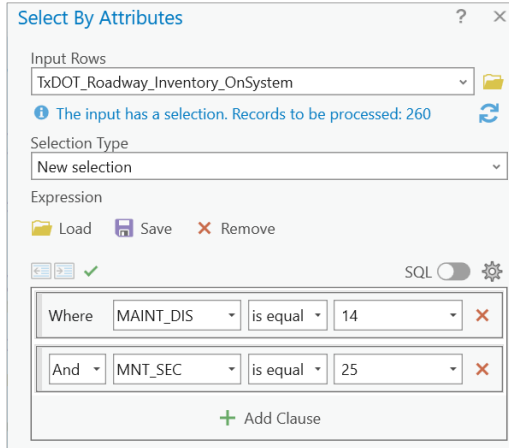
MAINT_SEC_NBR	MAINT_SEC_NM	Bridges	Culverts
1	Bastrop County	38	31
2	Blanco County	25	26
3	Burnet County	35	28
4	Caldwell County	41	38
5	Gillespie County	42	34
6	Hays County	38	48
7	Lee County	30	33
8	Llano County	42	39
9	Mason County	21	51
10	Travis County East	15	28
11	Travis County North	13	29
12	Williamson County West	25	50
13	Williamson County East	48	46
14	Travis County Central	6	12
15	Travis County South	18	20
25	Austin Toll Road	0	2
	Total	437	515

Here is the bridge line and point for the bridge 142270068302019 over the Colorado River on RM 620 at Mansfield Dam.



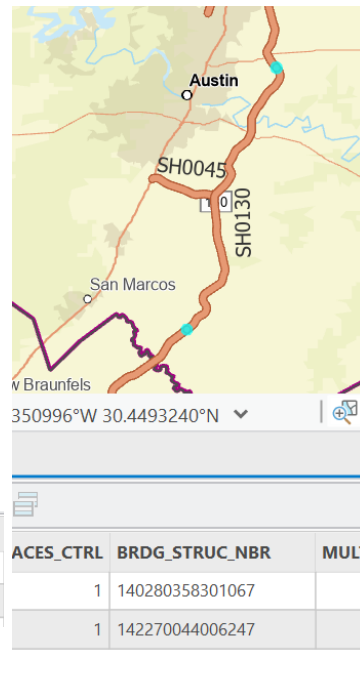
(7) Toll Roads

The Austin District has a special maintenance section for toll roads. This is defined by the routes of the toll roads themselves not just by a specific area of jurisdiction. These can be identified by the query MAINT_DIS = 14 and MNT_SEC = 25. These comprise three roads: SH 130, SH 45, and SL 1 in North Austin.



Austin.

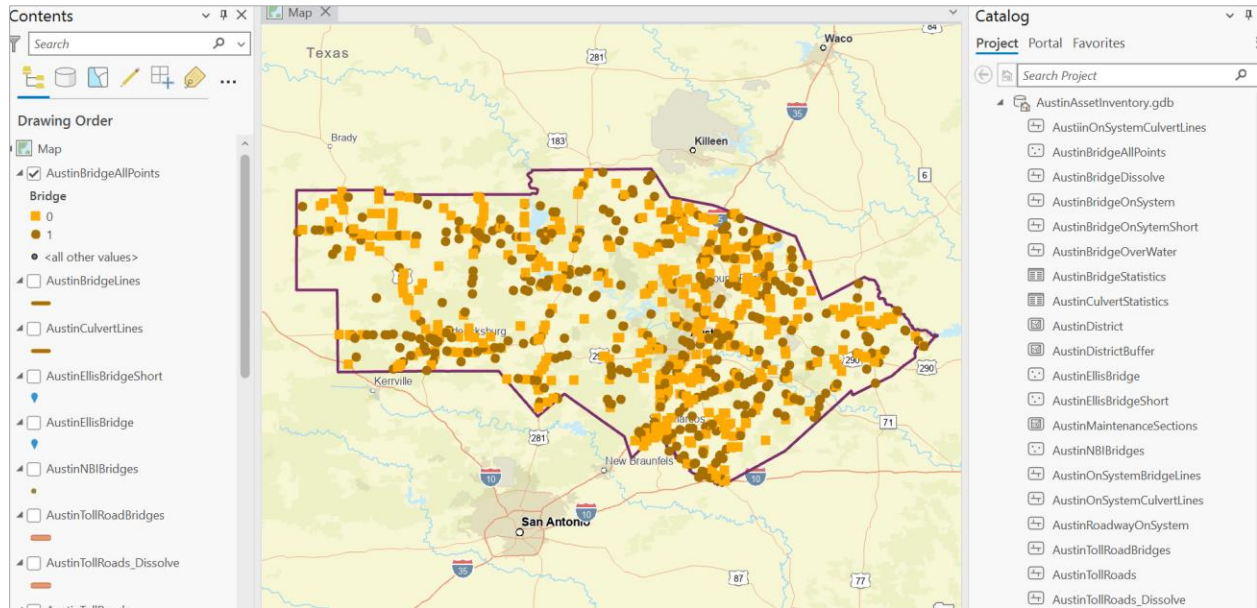
There are just two bridges on SH 130, both classified as culverts, identified on this toll road system, which seems like a very small number given its complexity. These were included in the general bridge inventory compiled earlier so will not be separately accounted for here.



BRDG_STRUC_NBR	Feature_In	Facility_C	Culverts	Bridge_Thi
140280358301067	LITTLE WEST FORK	SH 130 ML	7	3
142270044006247	DRAW	SH 130	6	3

(8) Results

Establish an **AssetsInventoryResults** Geodatabase and copy the bridge and point lines and points to this results geodatabase.



The analysis data and results are at: <https://utexas.box.com/s/aer07ucj5pzb3gd9g6rbxxng6hjuio9j>

Results only at: <https://utexas.box.com/s/0h21qjh4fqs7udi2vpct5bskdqsbixm>