## **Preparing a NFIE-Geo Database for Travis County**

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## Introduction

The National Flood Interoperability Experiment (NFIE) is being undertaken by the academic community and the National Weather Service and its federal partners to demonstrate how a high spatial resolution flood forecasting system for the United States could be developed at the National Water Center, newly opened on the Tuscaloosa campus of the University of Alabama. It is assumed that this new system will cover the continental United States and be based on a high spatial resolution geospatial database that is being assembled to support the NFIE by federal agencies coordinated by the Subcommittee on Spatial Water Data.

The purpose of this exercise is to assemble a local copy called NFIE-Geo of this federal information for Travis County, Texas. More local information about Travis County will later to be added to NFIE-Geo to support flood emergency response planning.

Original data sources for the federal information include:

- 1. National Hydrography Dataset Plus: http://www.horizon-systems.com/NHDPlus/NHDPlusV2\_data.php
- 2. National Flood Hazard Layer: <u>https://msc.fema.gov/portal</u>

Some of this information has been assembled into packaged datasets at: <u>https://www.arcgis.com/home/webmap/viewer.html?webmap=2c30160429984a59873f26b9d118dbfe</u> which can also be found under the title "ArcGIS NFIE Hydro Regions Map" at <u>http://www.cuahsi.org/NFIE</u>

This procedure requires at least 5GB of free space on your computer and access to ArcGIS version 10.2.2. It also requires a good internet connection!

# Step 1. Download and unzip the NFIE data package for the Texas-Gulf Region.

### Go to

https://www.arcgis.com/home/webmap/viewer.html?webmap=2c30160429984a59873f26b9d118dbfe and select the Texas-Gulf region



Click on "Get the Data from HydroShare" and use "Export All" to get everything in one zipped package

Content	
NHD_Catchments.zip	Download (206,1 MB)
NHD_DamEvents.zip	Download (3.4 MB)
NHD_Flowlines.zip	Download (59.0 MB)
NHD_StreamGageEvents.zip	Download (9.0 MB)
RAPID_Parameters.zip	Download (1.4 MB)
WBD_Subwatersheds.zip	Download (25.1 MB)
Weight_table.zip	Download (3.9 MB)
	Export all

The NHD **Catchments, DamEvents, Flowlines, StreamGageEvents**, and **Subwatersheds** are what we'll use for this assignment. Unzip those files. The RAPID Parameters and Weight Table are for hydrologic computations and we'll cover those later.

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Name	Date modified	Туре	Size		
NHD_Catchments	1/28/2015 11:08 A	File folder			
👢 NHD_DamEvents	1/28/2015 11:09 A	File folder			
I NHD_Flowlines	1/28/2015 11:09 A	File folder			
NHD_StreamGageEvents	1/28/2015 11:10 A	File folder			
WBD_Subwatersheds	1/28/2015 11:10 A	File folder			
NHD_Catchments	1/8/2015 5:07 AM	Compressed (zipp	211,008 KB		
NHD_DamEvents	1/8/2015 5:07 AM	Compressed (zipp	3,495 KB		
NHD_Flowlines	1/8/2015 5:07 AM	Compressed (zipp	60,413 KB		
NHD_StreamGageEvents	1/8/2015 5:07 AM	Compressed (zipp	9,192 KB		
RAPID_Parameters	1/8/2015 5:07 AM	Compressed (zipp	1,419 KB		
WBD_Subwatersheds	1/8/2015 5:07 AM	Compressed (zipp	25,680 KB		
🚺 Weight_table	1/8/2015 5:07 AM	Compressed (zipp	3,964 KB		
AE					

# Step 2. Download the National Flood Hazard Layer for Texas and Travis County

Go to the FEMA Map Service Portal https://msc.fema.gov/portal and click on "Search All Products"



Select the State as **Texas** and County as **Travis** in and select a community within that county as **Austin**, **City of** 

# Search All Products

Choose one of the three search options below and optic

Jurisdiction	Jurisdio
State TEXAS	Jurisdictio
County TRAVIS COUNTY	(Ex. Fairfax
Community AUSTIN, CITY OF ▼	]

And hit "Search". Expand the search results to find the most recent National Flood Hazard Layer (NFHL) for your county **NFHLData-County** and download it. Do the same for your **NFHLData-State.** These downloads take a while.

earch F	Results for AUSTIN	I, CITY OF			
ck <u>subscrit</u>	be to receive email notifications	s when products are updated.			
📑 Effecti	ive Products (168) 😯				
Þ	FIRM Panels (42)	L			
Þ	FIS Reports (11) 🕹 DL ALL				
Þ	LOMC (112)				
• •	NFHL Data-State (1)				
+	NFHL Data-State (1) NFHL Data-County (2)				
*	NFHL Data-State (1) NFHL Data-County (2) Product ID	Latest Study Effective Date	Latest LOMR Effective Date	Size	Download
*	NFHL Data-State (1) NFHL Data-County (2) Product ID NFHL_48453C	Latest Study Effective Date 08/18/2014	Latest LOMR Effective Date 10/17/2014	Size 61MB	Download &DL
* *	NFHL Data-State (1) NFHL Data-County (2) Product ID NFHL_48453C NFHL_48453C	Latest Study Effective Date 08/18/2014 09/26/2008	Latest LOMR Effective Date 10/17/2014 04/10/2014	Size 61MB 73MB	Download �DL �DL

Unzip the resulting files. The first is for Travis County, the second for the state of Texas.

100 48453C_20141020	1/28/2015 12:19 PM	File folder
👢 NFHL_48_20150121	1/28/2015 12:19 PM	File folder

## Step 3. Get the 24K NHD for Region 1209

Go to <a href="http://nhd.usgs.gov/">http://nhd.usgs.gov/</a> and select "Go to Pre-Staged Subregions"

Hydrography	
Home	Hydrograph
News	National Hydrography Data Watershed Boundary Datas
Cet Data	Hydrography Data Overview
	Go to the Hydrography Viewer
Stewardship	Go to The National Map - Service Endpoints
	Go to Pre-staged Subregions

Select "File Geodatabase" and "High Resolution" to locate the following list of files. Within this list, select NHD1209\_931v220.zip

01/25/2015	06:53AM	20,291,690	NHDH1205	931v220.zip
01/25/2015	09:24AM	73,040,352	NHDH1206	931v220.zip
01/25/2015	08:43AM	72,732,492	NHDH1207	931v220.zip
01/25/2015	07:44AM	17,834,806	NHDH1208	931v220.zip
01/25/2015	08:25PM	86,367,630	NHDH1209	931v220.zip
01/25/2015	03:49AM	58,765,019	NHDH1210	931v220.zip

Unzip this file to show the NHDH1209.gdb as a geodatabase

## Step 4. Create a NFIE-Geo Database for Travis County

48453C_20141020	2/1/2015 11:57 PM	File folder
WFHL_48_20150121	2/2/2015 12:25 AM	File folder
NHD_Catchments	2/1/2015 11:18 PM	File folder
NHD_DamEvents	2/1/2015 11:19 PM	File folder
WHD_Flowlines	2/1/2015 11:22 PM	File folder
WHD_StreamGageEvents	2/1/2015 11:23 PM	File folder
🕌 NHDH1209.gdb	2/2/2015 12:10 AM	File folder
WBD_Subwatersheds	2/2/2015 12:13 AM	File folder

Ok, now we've got all the required data, lets proceed with building our geodatabase.

Open ArcMap and in the Catalog tab, within the Workspace Directory, Create a New File Geodatabase

		🗄 🧰 TexasGulf			
			Ē	Сору	
		C	ė	Paste	
		[	×	Delete	
<b>E</b>	Folder			Rename	
	File Geodatabase	e	З	Refresh	
	Personal Geodat	aba <u>se</u>		New	<b>ب</b>
	Database Connectio New File Geod		latab	ase	ion
	ArcGIS Server Co	rcGIS Server Conne Create a new		eodatabase.	

And call this NFIEGeo

		🗆 🚞 Assi	Distributed Geod	IdidDdSe 🕨
B	Feature Dataset		New	•
	Feature Class		Imnort	•
	Table	New Feat	ure Dataset	•
	View	Create a	new feature dataset.	Service

And name it Travis. Choose the NAD 1983 (2011) StatePlane coordinate system Texas Central zone.

- NAD 1983 (2011) StatePlane South Dakota S FIPS 4002 (L A DAD 1983 (2011) StatePlane Tennessee FIPS 4100 (US Fe
- NAD 1983 (2011) StatePlane Texas Central FIPS 4203 (US)
- 🖗 NAD 1983 (2011) StatePlane Texas N Central FIPS 4202 (l
- NAD 1983 (2011) StatePlane Texas North FIPS 4201 (US F

This will be the repository and provide a common coordinate system for the information that we've acquired.

## Step 5. Flood Hazard Zone for Travis County

From folder 48453C\_20141020, add the feature class S\_FLD\_HAZ\_AR.shp to ArcMap

Add Data	
Look in: 201	41020 🔹 🛧 🟠 🕻
L_COMM_INFO.dbf	S_LEVEE.shp
L_PAN_REVIS.dbf	S_LOMR.shp
L_SOURCE_CIT.dbf	🖾 S_POL_AR.shp
L_XS_ELEV.dbf	😁 S_PROFIL_BASLN.shp
S_BFE.shp	S_STN_START.shp
S_FIRM_PAN.shp	S_SUBMITTAL_INFO.shp
S_FLD_HAZ_AR.shp	🖾 S_WTR_AR.shp
S_FLD_HAZ_LN.shp	🕶 S_WTR_LN.shp
S_GEN_STRUCT.shp	🕶 S_XS.shp

Under Definition Query, use the Query Builder to select out the "FLD\_Zone <> 'X' which deletes the zone of minimal flood risk

Query Builder	ten interior part of
"DFIRM_ID"	
"VERSION_ID"	
"FLD_AR_ID"	
"STUDY_TYP"	
"FLD_ZONE"	
= <> Like	'A' 'AE' 'AO'
< <= O <u>r</u>	×
_% () Not	
ls	Get Unique Values Go To:
SELECT * FROM S_FLD_	HAZ_AR WHERE:
"FLD_ZONE" <> 'X'	

Which leaves just the areas of flood risk for Travis County



Export these data to your Travis geodatabase and give the resulting feature class the name **Floodplain.** Symbolize this with the symbol for Lake.

Save your ArcMap Document as Travis.mxd



## Step 6. Add a County Boundary

In ArcMap, add data from ArcGIS Online



Search for "USA Counties" and add this layer to your map display



Select the outline for Travis County, and export it to the NFIEGeo geodatabase as **Boundary** 



Now your NFIEGeo database contains both the Boundary and the Floodplain feature classes. Symbolize the boundary as hollow with a Brown color 2pt line weight.



## Step 7. Add your Subwatersheds

From the **WBD\_Subwatersheds** folder, add the **WBD\_Subwatersheds\_12.shp** to ArcMap. This information is from the Watershed Boundary Dataset of the United States. These are also called the HUC12 Subwatersheds because they are uniquely identified by a 12-digit code.

Add Data	9
Look in:	WBD_Subwatersheds
<mark>⊠(WBD</mark>	_Subwatershed_12.shp

Use Selection/Select by Location

Sele	ection	Geoprocessing	Customize	Windows	Hel
5	Select	t By Attributes	2	🖽 🇊 👼	
	Select	t By Location		<u> </u>	
-10 -10	Sel Zo	elect By Location		N 2	
1	Pai	Selects features us of features in anot	ing the locati her layer.	on ial	R
2	Clear	Selected Features		$\overline{}$	~~~
	Intera	active Selection Me	thod 🕨	- En	
	Select	tion Options			2
5	1	5	July 1	 7	A

To select those Subwatersheds that Intersect the Boundary of Travis County

select features from	•				
Target layer(s):					
<ul> <li>□ Boundary</li> <li>☑ WBD_Subwatershed_12</li> <li>□ Floodplain</li> </ul>					
Only show selectable layers in this list					
ource layer:					
🎨 Boundary	•				
Use selected features (0 features selected)					
patial selection method for target layer feature(s):					
intersect the source layer feature	•				

Export the selected features to the NFIEGeo geodatabase as **Subwatershed.** Symbolize them hollow with a Green outline, 2 pt line weight.



## Step 8. Add your Catchments

From the NHD\_Catchments folder, add the NHDCatchments\_12.shp shape file to ArcMap. Use Select by Location to select from the NHDCatchments\_12 feature class those catchments that "have their centroid in the source layer feature" (right at the bottom of the available selection options) the Subwatershed feature class.

select features from	「日時市マ」
Target layer(s):	🝷 🖾 🛛 🙆 Arial
<ul> <li>Subwatershed</li> <li>✓ NHDcatchments_12</li> <li>Boundary</li> <li>Floodplain</li> </ul>	
Only show selectable layers in this list	
Source layer:	15-16-5
🕸 Subwatershed 🔍 💌	
Use selected features (0 features selected)	S. H.K.
Spatial selection method for target layer feature(s):	D. A. A.
have their centroid in the source layer feature	

And Export these to the NFIEGeo geodatabase as **Catchment.** Color them green and make the display visibility 50%.



The result should appear something like this:



## Step 9. Add your Flowlines

From the **NHD\_Flowlines** folder, add the **NHDFlowLine\_12.shp** shape file to ArcMap. Use same Select by Location method as for Catchments to get the flowlines whose centroid lie within the Catchments coverage:

Select By Location ×	ustomize Windows Help
Select features from one or more target layers based on their location in relation to the features in the source layer.	I , I , I , I , I , I , I , I , I , I ,
Selection method:	Find Common Ancestc V K
select features from	Cherry Provent SE
Target layer(s):	Dell' and the
<ul> <li>NHDFlowLine_12</li> <li>Boundary</li> <li>Subwatershed</li> <li>Catchment</li> <li>Floodplain</li> </ul>	
Only show selectable layers in this list	MERCE STAT
Source layer:	
Catchment 💌	
Use selected features (0 features selected)	
Spatial selection method for target layer feature(s):	Letter Contractor
have their centroid in the source layer feature $\qquad \checkmark$	ALL AND

When you try to export the selected flowlines you get an error message:



This is an annoying issue and requires two steps to get around it.

Export the selected flowlines to a shape file called **MFlowline.shp** The prefix "M" is used because these are the flowlines from the **Medium Resolution** or 100K National Hydrography Dataset Plus. Later we'll get the comparable flowlines from the High Resolution National Hydrography Dataset.

		Saving Data
Look in:	🔁 Assignment2	✓ 🏠 🖓 🗰 🕶 😫
48453 NFHL NHD NHD NHD NHD NHD NHD WBD WBD	C_20141020 _48_20150121 Catchments DamEvents Flowlines StreamGageEvents 11209_931v220 Subwatersheds space	
Name:	MFlowline shp	
Save as t	ype: Shapefile	~

Then import this into the NFIEGeo geodatabase

🗆 🧊 NFIE	Geo.g	jdb			
E 🗗 Tr B	iovic P	Сору		]	
	Ē	Paste			
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	×	Delete			_
		Rename			
	з	Refresh			
1		Manage	۲		
, nt		New	۲		
in		Import	×		Feature Class (single)
rshed		Export	۲		Import Feature Class
		Item Description			(single)
	8	Properties			Import a feature class into this geodatabase.

Symbolize the resulting **MFlowline** layer using Graduate Symbols in blue for the attribute **Natur\_Flow** which is an estimate of the Mean Annual Flow in cfs. You can get a sense from this map of the main drainage features of this area – the Colorado River and its tributaries flowing through Austin, and Brushy Creek to the north of Travis County that flows through Williamson County and Round Rock, TX.



### Layer Properties

Joins & Relates				Time		HTM	IL Popup	
General	Source	Selection	Display	Symbology	Fields	Definition Query	Labels	Routes
Show:		•						
Features Categorie Quantities	s ed colors	Fields Value:	Natur	r_Flow	e to show re	Classification Natural E	reaks (Jenks	s)
Graduat Proportio	ed symbols onal symbols	Normaliz	ation: none		~	Classes: 5	✓ Class	ssify
Charts Multiple A	ttributes	Symbol S	ize from: 0.5	5 to: 4			— Tei	mplate —
		Sym F	Range		Label			
		0.	.000000 - 7.77	71000	0.000000 - 7	.771000		
		7.	771001 - 29.4	152000	7.771001 - 2	9.452000		
			9.452001 - 71	.806000	29.452001 -	71.806000		
-		7	1.806001 - 19	8.218994	71.806001 -	198.218994		
335	<u>7</u> 5 /	ا <b>ر</b> ا	98.218995 - 3	084.129883	198.218995	- 3084.129883		

## Step 10. Add your Dams and Streamgages

Use the same process as just described to add **NHD\_DamEvents** and **NHD\_StreamGageEvents** to the map, select the features within the Subwatershed domain, and add them to the NFIEGeo Geodatabase as feature classes **Dam** and **StreamGage**, respectively. The word "Event" is used in the title of these files because when points are located exactly on a flow line, a method called "Linear Referencing" is used in which a point such as a Stream Gage located near a flowline becomes a "Point Event" on the flowline.

Symbolize the Dams as brown triangles and the StreamGages as red dots. Notice how many dams there are in Williamson County – these are flood control dams built by the USDA Natural Resources Conservation Service when this was rural land, but now it is urbanized so these large structures are providing flood protection to a large urban population.



## Step 11. Form the Reach Flood Warning Zones

Now we're going to use the National Flood Hazard Layer for Texas to create reach flood warning zones for each catchment. From **NFHL\_48\_20150210.gdb**, add the **S\_FId\_Haz\_Ar** layer.

		Ado	d Data
Look in: 🗊	NFHL_48_2	20150121.gdb	✓ 📤 🏠 🐼   🇰 🕶   🖴   🖆
L_Comm_Ir L_Cst_Tsct_ L_MT2_LON L_Pan_Revi L_Pol_FHBN L_Source_C L_XS_Elev S_Base_Ind S_BFE	nfo () Elev () MR () s () M () it () ex ()	S_CBRS S_Cst_Tsct_Ln S_FIRM_Pan S_FId_Haz_Ar S_FId_Haz_Ln S_Gen_Struct S_Levee S_LiMWA S_LOMR	<ul> <li>S_Pol_Ar</li> <li>S_Profil_BasIn</li> <li>S_Stn_Start</li> <li>S_Submittal_Info</li> <li>S_Trnsport_Ln</li> <li>S_Wtr_Ar</li> <li>S_Wtr_Ln</li> <li>S_XS</li> <li>Study_Info</li> </ul>
Name:	S_Fld_H	laz_Ar	
Show of type:	Datasets	s, Layers and Results	~

Use a Definition Query to select out the 'X' zone as in Step 6. Notice that the map is blank to the west of Travis County, in Blanco County, and to the east, in Milam County. These counties do not yet have approved Flood Insurance Rate Maps in the National Flood Hazard Layer.



#### Use Search to find the Intersect tool, and select the Intersect (Analysis) version



Select **S\_FId\_Haz\_Ar** and **Catchment** as the layers to be intersected. Leave the output feature class at its designated default location.

6	Intersect	-
Input Features		
Features		Ranks
♦ S_Fld_Haz_Ar		
Catchment		
<		
Output Feature Class		
C:\Users\maidment\Documents\ArcGIS\Default	.gdb\S_Fld_Haz_Ar_Intersect1	

Export the resulting intersected layer to the NFIEGeo geodatabase as **WarningZone**.



Now, let's take a look and see what we have got. Open the attribute table for the StreamGages, and select the stream gage with **Source\_Fea = 08159000**, which is the gage on Onion Creek at Highway 183.

Strea	mG	age		2 mar 20	
٠	Та	ble			
] Dam	0	-   🗄 -   🔓 🎦	2 📲 🛪		
2 Warr	St	reamGage			
	П	FEATURECLA	SOURCE_ORI	SOURCE_DAT	SOURCE_FEA
7 Bour	F	0	United States Geological Survey (USGS)	National Water Information System (NWIS)	08159150
		0	United States Geological Survey (USGS)	National Water Information System (NWIS)	08105886
•		0	United States Geological Survey (USGS)	National Water Information System (NWIS)	08105900
] MFIo		0	United States Geological Survey (USGS)	National Water Information System (NWIS)	08104900
Ni		0	United States Geological Survey (USGS)	National Water Information System (NWIS)	08158400
_ 0.0		0	United States Geological Survey (USGS)	National Water Information System (NWIS)	08158806
- 0.0		0	United States Geological Survey (USGS)	National Water Information System (NWIS)	08158824
- 1.1		0	United States Geological Survey (USGS)	National Water Information System (NWIS)	08158900

Use **Selection/Zoom to Selected Features** to zoom to that location.

	Selection		Geoprocessing	Customize
	<ul><li>Select By Attributes</li><li>Select By Location</li></ul>			
I				
	J.	Select By Graphics		
1	🚭 Zoom To Selected Features			tures
	<b>1</b>	Pan	Zoom To Selecte	d Features
	Σ	Stati	Zoom to the sele	ected
	M	Clea	features in all lay	vers

Export the selected gage to NFIEGeo as OnionCk183, and in the map label it with its Source\_Fea attribute at 14pt type. Similarly label the **Catchment** feature class with **FeatureID** and the **MFlowline** feature class with **COMID** at 10pt type. You'll see that Gage 08159000 is located in Catchment 5781369 which has MFlowline 5781369, which is connected upstream and downstream with similarly labeled flowlines. If you click on the WarningZone feature class, you'll see that its features are particular to this Catchment.



And if you use the Identify tool on the WarningZone, you'll see that it carries the identifier FeatureID = 5781369 that links it to the Catchment containing it.

Ok, that is pretty cool. We have a NFIE-Geo database that can be linked to the NFIE-Hydro flood forecasting model, and we can assess flood risk and color in the WarningZone accordingly.



## Step 12. Adding the 24K NHD Flow Network

What you have just processed for 100K NHDPlus data is adequate for hydrologic computations and forecasting. If we want to add hydraulic modeling, the 24K NHD HydroNetwork is helpful. Go to the NHDH1209\_v31v220 folder, the NHDH1209.gdb geodatabase, Hydrography feature dataset and add the Hydro\_Net geometric network.

		Add Data
Look in:	🗗 Hydrography	✓ 🏠 🗟 🗰 🕶 😫
HYDR HYDR NHDA NHDA NHDA NHDA NHDA NHDA	O_NET O_NET_Junctions Area AreaEventFC Howline Line LineEventFC Point PointEventFC	<sup>III</sup> NHDWaterbody
Name:	HYDRO_NET	

This provides a more detailed flow network where the lines are joined by junctions, and the lines are Subtyped to give a sense of their function in the network. **StreamRiver** is the one we'll mostly be concerned with. **ArtificialPath** goes through waterbodies and streams represented as polygons.



Right click in the gray area at the top of the ArcMap display and add the Utility Network Analyst toolbar. Use Show Arrows, to indicate the flow direction on the network. This is a more sophisticated and detailed view of the flow network that we'll explore further when we study NFIE-River.



## To be turned in:

(1) Prepare a nice map showing the Travis County NFIE-Geo database.

(2) How many Subwatersheds are in this database? How many Catchments? How many Flowlines? How many catchments are there in a Subwatershed, on average?

(3) What is the average area (km<sup>2</sup>) of the Subwatersheds and of the Catchments? The map units are in feet so you'll need to do some conversions here.

(4) What is the average length of the MFlowlines (km)?