Project Workflow
West Virginia Hazus-MH Flood Model Building Inventory

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The Polis Center

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PROJECT OVERVIEW

West Virginia University (WVU) is responsible for supporting activities that can prevent or reduce the significant losses that result from disasters. Successful mitigation activities are based on careful assessment of what may occur in the event of a disaster.

In recognition of the importance of planning in mitigation activities, the Federal Emergency Management Agency (FEMA) has created Hazus - a powerful geographic information system (GIS) based disaster mitigation tool. This tool enables communities of all sizes to estimate damages and losses from hurricanes, floods and earthquakes to measure the impact of various mitigation practices that might help to reduce those losses.

The ability of Hazus-MH to generate credible loss estimations is based on high quality information about the buildings and infrastructure at risk to these hazards. While Hazus-MH includes these inventory, the sources from which that information is derived are course in nature and may not accurately represent local conditions.   Local parcel and Computer-Aided-Mass Appraisal (CAMA) data can be used to significantly enhance the quality of the analysis that Hazus-MH performs.   Using a Federal Emergency Management Agency provided grant, The Polis Center has prepared a tool and supporting workflow that describes how to use the tool in order to process parcel and CAMA data into a form that can be consumed by Hazus-MH and used for generating enhanced flood risk assessments.

This workflow describes the detailed processes associated with completing the following tasks.

TASKS

1. Update Hazus inventory assets
    i. Domains and Matrices
    ii. Improvements table
    iii. Building Inventory
    iv. User Defined Facilities
    v. General Building Stock
2. Create Data Sources
    i. Parcel Points
    ii. Flood Boundary
    iii. Census Blocks and Census Tracts

Deliverables submitted by The Polis Center in support of this project include:

1. Building Inventory creation tools
2. Hazus Update tools
3. Data Source processing tools
4. Workflow

FILE MANAGEMENT

BACKUPS

Hazus does not support server-based workflows. Therefore, this project is based on work that is performed on a local drive.

Work performed on local PCs will need to be periodically secured. References to the Q:\drive in this workflow refer to the backup server used at Polis. It is recommended that an equivalent backup location be identified when this workflow is completed outside of Polis.

```
C:\Projects\Hazus_Projects\PDM_WestVirginia   Local project drive
Q:\PDM_WestVirginia                           Backup drive at Polis
```

PROJECT MANAGEMENT

Project documentation is stored under the following directory structure:

```
C:\Projects\Hazus_Projects\PDM_WestVirginia\Project_Management
        Status                      Project management progress reports
        Advisory                    Manuals and User Guide
        Workshops                   Meetings and workshop materials
```

DATA MANAGEMENT

Data sets are managed under the following directory structure:
```
        C:\Projects\Hazus_Projects\PDM_WestVirginia\Data_Management
        Data_Sources                Pre-processed data
        Hazus_Updates               Updated WV statewide tables
        Models                      Analysis data and results
```

Data sources received from various agencies are organized by provider:
```
        C:\Projects\Hazus_Projects\PDM_WestVirginia\Data_Management\Data_Sources
            <County Name>               <County Name> County regional data
            CAMA_Assesment              CAMA Data received from <County Name> WV
            Parcels                     Data received from <County Name> WV
            DFIRM                       Data received from FEMA website
```

Updated Hazus inventory is organized by inventory type and vendor.
```
        C:\Projects\Hazus_Projects\PDM_WestVirginia\Data_Management\Hazus_Updates\<County
    Name>
            User_Defined_Facilities     Hazus User Defined Facilities geodatabase
            Tools                       Hazus Updates FME tools
            General_Building_Stock      bndryGBS geodatabase
```

Model data sets are organized by county. The Model folder contains the results of the analysis as well as the hazard and inventory datasets used as inputs into the model. The modeling is performed in a Hazus Study Region built for each county.

```
        C:\Projects\Hazus_Projects\ PDM_WestVirginia\Data_Management\Models
            <County Name>               <County Name> model results
            Template                    Templates and tools used for modeling

        C:\Projects\Hazus_Projects\PDM_WestVirginia\Data_Management\Models\<County Name>\
            Analysis                    Inventory data, hazards, tools
```

MXD_Documents	Production and final mapping documents
Reports	Workflow, Logs and Process documents

C:\Projects\Hazus_Projects\PDM_WestVirginia\Data_Management\Models\<County Name>\ Analysis

Inventory	Boundaries, Building Inventory, Improvements
Hazards	Flood and surge boundary inputs to model
Tools	Scripts used to develop inventory
Working	Temporary area for work in progress

DOCUMENT MANAGEMENT

The workflow document is maintained by Polis for use by both teams working on the Pre-Disaster Mitigation (PDM) project for West Virginia.

The name of the file is:
    …C:\Projects\Hazus_Projects\PDM_WestVirginia\Data_Management\Models\<County Name>\Reports\Workflow docx

The following abbreviations are used throughout the document:

[TBD]	To Be Determined
[PIO]	Process Improvement Opportunity
[Name]	Contributions required by …
[Rev]	Major revision marker

TASK 1 – PREPARE COUNTY DATA SOURCES

Hazus-MH Vsn 2.2 statewide datasets needs to be updated before the individual county study regions will be made. The General Building Stock needs to be updated on a county by county basis.

The first task is to setup a county folder that contains the source materials, mapping templates, tools, non-Hazus data sets and final reports.

TASK 1.1 - PREPARE DATA SOURCES

TASK 1.1.1 - COUNTY DATA FOLDERS

A \Template folder has been created that contains the data source folder structure and tools used to prepare the source data for each county.

> Copy the county template contents from
> C:\Projects\Hazus_Projects\PDM_WestVirginia\Data_Management\Data_Sources\Template
>
> To
>
> C:\Projects\Hazus_Projects\PDM_ WestVirginia\Data_Management\Data_Sources\<County Name>

> *NOTE: Images in this workflow were captured using Berkeley County as an example. In the workflow procedures we inserted Berkeley where the workflow calls for <County Name>.   Simply insert the name of the county that you are processing.*

TASK 1.1.2 - COUNTY DATA FILES

Template documents need to be setup for each county. Rename all templates and change the file properties. Modify the contents to reflect the active <County_Name>.

- Rename:
  - From: WV_County_*.*
  - To: WV_<County_Name>_*.*
- Update the File Properties on all <County_Name> documents
  - Subject: <County_Name>
  - Author: <Enter your name here>
  - Comments: <Comments>
  - Category: PDM WestVirginia
  - Company: <Your organization name>
- Open each document and replace all occurrences:
  - From: <County_Name>
 - To: active county name (e.g. "Berkeley")

TASK 1.2 - PREPARE MODEL AND WORKING FOLDERS

TASK 1.2.1 – COPY TEMPLATE FOLDER

A \Template folder has been created that contains templates for the project model source materials, outputs, templates and tools to be used for each county. You need to copy the template folder contents and rename the files that they contain so that they are ready for the county that you are modeling.

- Copy the template contents from
  C:\Projects\Hazus_Projects\PDM_WestVirginia\PDM\Data_Management\Models\Template

  to

  C:\Projects\Hazus_Projects\PDM_WestVirginia\Data_Management\Models\<County_Name>

- Copy the county template contents from
  C:\Projects\Hazus_Projects\PDM_West Virginia\Data_Management\Hazus_Updates\Template

  To

  C:\Projects\Hazus_Projects\PDM_ WestVirginia\Data_Management\ Hazus_Updates \<County Name>

TASK 1.2.2 – RENAME TEMPLATE FILES

The template documents need to be renamed for your county.

Rename all templates and change the file properties in all folders and subfolders under C:\Projects\Hazus_Projects\PDM_West Virginia\Data_Management\Models\<County_Name> and under C:\Projects\Hazus_Projects\PDM_ WestVirginia\Data_Management\ Hazus_Updates \<County Name>. Modify the contents to reflect the name of the county that you are modeling.

- Rename:
  - From: WV_County_*.*
  - To: WV_<County Name>_*.*
- Update the File Properties on all <County_Name> documents
  - Subject: <County_Name>
  - Author: <Enter your name here>
  - Comments: /
  - Category: PDM West Virginia
  - Company: Polis
- Open each document and replace all occurrences:
  - From: <County_Name> or <County Name>
  - To: active county name (e.g. "Berkeley")

TASK 1.3 – DOWNLOAD COUNTY DATA FILES

TASK 1.3.1– DATA EXCHANGE

West Virginia University has setup a data exchange FTP site to provide a data portal to exchange parcel and CAMA datasets. Typical data sets to exchange include:

- Inventory sources (CAMA Assessment, Parcel Polygon)

- Supporting documents (WV Appraisal Manual, User Guide)

The FTP site can be accessed by connecting to the Host and entering the Username and Password provided. The connection can be established by downloading FileZilla software which ensures a quick and easy way to download data from FTP site.
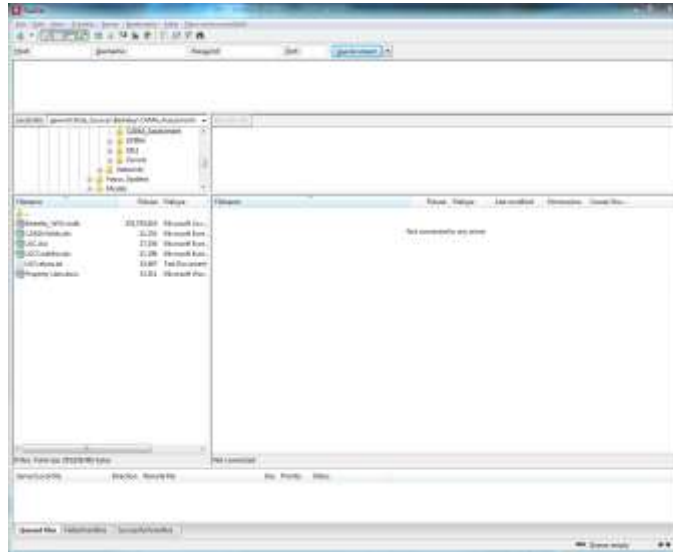
TASK 1.3.2 – DOWNLOAD FILES

1. Download CAMA Assessment geodatabase from the FTP site to

   C:\Projects\Hazus_Projects\PDM_WestVirginia\Data_Management\Data_Sources\<County Name>\CAMA_Assessment\ <County Name>_WVU.mdb

   This database contains CAMA table that is used to create Building Inventory

2. Download the Parcel SHP files from the FTP site to.

   C:\Projects\Hazus_Projects\PDM_WestVirginia\Data_Management\ Data_Sources\County\<<County Name>>\Parcels
   <County Name>_parcel_features.mdb

   Parcel centroids will be linked to 'Improvement' records to determine the locations for the buildings.

3. Download the NFHL Data-County data from the FEMA Map Service Center. (http://msc.fema.gov).

   This data represents the current National Flood Hazard Layer for the county.

4. Save the downloaded data to
        C:\Projects\Hazus_Projects\PDM_WestVirginia\Data_Management\
        Data_Sources\<County Name>\DFIRM

5. The downloaded file will be in WinZIP format. Unzip the file to the \DFIRM folder.

TASK 2 – PREPARE COUNTY INVENTORY DATA

TASK 2.1 – PREPARE BOUNDARIES

Boundaries will be needed to clip buildings to the flood study area and assign the appropriate Census Tract and Block numbers to the Hazus inventory.

TASK 2.1.1 - PREPARE HAZUS BOUNDARIES

Tools have been written to generate County and Census Block feature classes.

1. Start ArcMap and open the MXD named:
   …\Models_<County Name>\MXD_Documents
   WV_<County Name>_DataSources.mxd

2. If not already active, activate the **Data Interoperability** extension under the ArcMap Customize>Extensions menu.
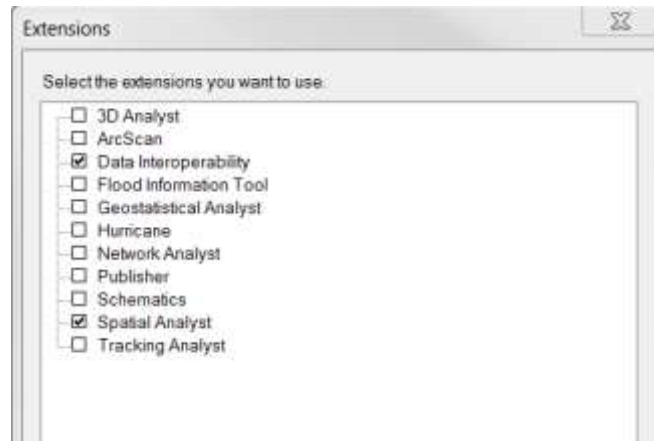
Note: As of the date of this workflow, the Data Interoperability extension and Hazus-MH 2.2 can co-exist on the same machine. However, the Data Interoperability extension must be deactivated in order to actually use Hazus-MH. While inconvenient, this simply means that you need to deactivate the Data Interoperability extension to use Hazus-MH and vice versa.

Note: This workflow references FME. FME, formerly known as Feature Manipulation Engine, is a an integration of Spatial ETL tools for data transformation and translation produce by Safe Software Inc. of Surrey, British Columbia. Esri and Safe Software have a collaborative agreement that allows Esri relevant portions of FME to be made available as the Data Interoperability extension.

3. Open ArcToolbox and add the **WV_<County Name> FME Boundaries** toolbox to ArcTools from:
   …\Models\<County Name>\Analysis\Tools\ WV <County Name>\
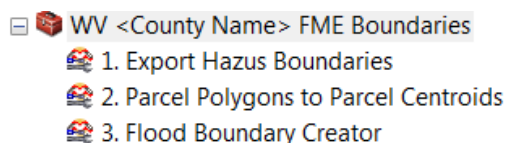
4. Right-click on the **WV <County Name> FME Boundaries** toolbox and select **Properties**. Change 'County' with <County Name> for both the tool **Name** and **Label** to WV <County Name> FME Boundaries.   Click **Apply** and then click **OK**.
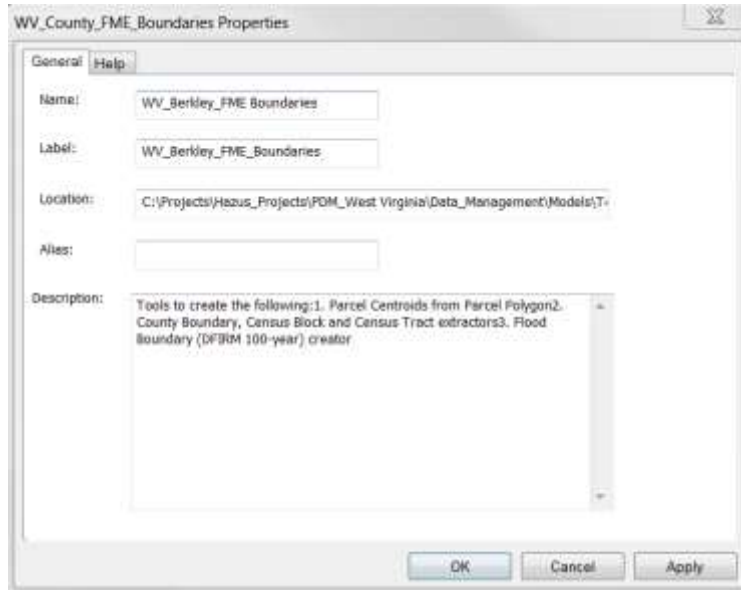
5. Right-click | Edit the **1. Export Hazus Boundaries** tool to open up the FME workbench.
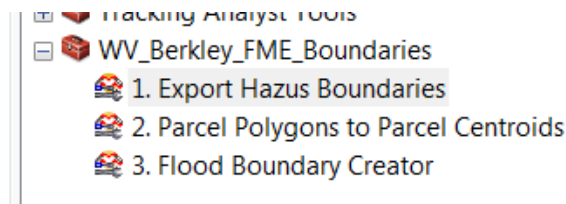
6. Set the input Published Parameters | Source to:
   …\HazusData_22\WV\
   bndrygbs.mdb

7. Set the output Published Parameters | Destination to:
   …\Models\<County Name>\Analysis\Inventory\Boundaries\
   WV_<County Name>_Boundaries_GDB.mdb

8. Right-click on the County_Tester transformer sprocket to open the Tester Parameters. Change the **CountyName** value Right Value parameter as needed to select the county you are modeling.

9. Click **OK** to close the Tester Parameters window.

10. Click the **Save** button to save the changes to the FME script.

11. Run the script and review the log file.

    This script generates census blocks and a county boundary for the study county.

12. Add the county and census block boundary output layers to the MXD and review the results.

13. If the data is correct right-click in the FME workbench log window and choose **Save Text** to save the log file to
    …\Models\<County Name>\Reports\Logs\
    WV <County Name> **Boundaries creator <yymmdd>.txt**

14. Save the changes and exit the FME workbench.

TASK 2.1.2 – PREPARE PARCEL POINTS

Tools have been written to generate a Parcel Points feature class.

1. If necessary, open the MXD named:
    > …\Models\<County Name>\MXD_Documents
    > > **WV_<County Name>_DataSources.mxd**

2. If not already completed, add the **WV_<County Name> FME Boundaries** toolbox to ArcTools from:
    > …\Models\<County Name>\Tools\

3. Right-click | Edit the **2. Parcel Polygons to Parcel Centroids** tool to open up the FME workbench.
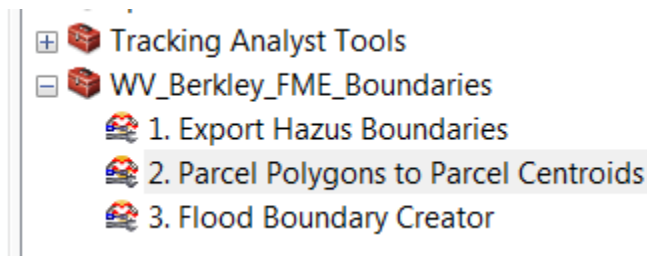
4. Set the input Published Parameters | Source to:
    > …\PDM_WestVirginia\Data_Management\Data_Sources\<County Name>\Parcels\
    > > **<County Name>_parcel_features.mdb**
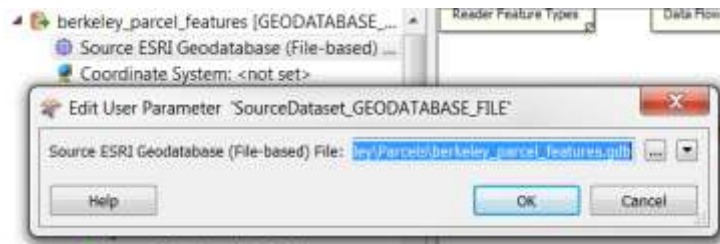
5. Set the output Published Parameters | Destination to:
    > …\Models\<County Name>\Analysis\Working\
    > > **WV_<County Name>_Working_GDB.mdb**
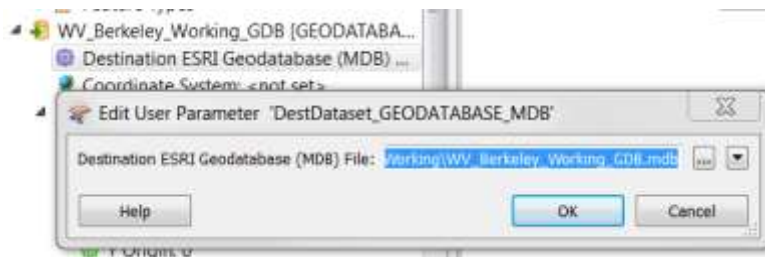
6. Scroll to the end of the script window and click the sprocket symbol on the ParcelPoints output feature class to open the Feature Type Properties window.
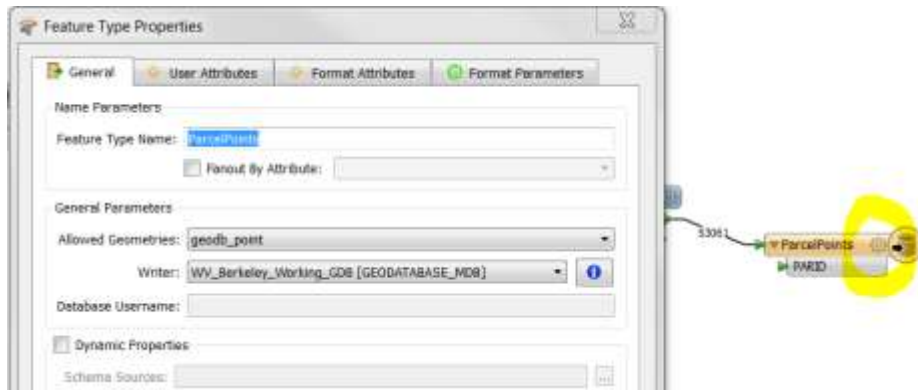
7. Click the **Format Parameters** tab and make sure that Table exists is set to No.

   This is necessary the first time a tool is run. If you choose to re-run the tool you need to change this setting to Yes.

8. Click **Ok** to close the Feature Type Properties window.

9. Click the **Save** button to save the changes to the FME script.

10. Run the script and review the log file.

11. Add the Parcel Points feature class to the MXD and review the results.

   Hint: You may want to add your source polygon features to the map for reference.

12. If the Parcel Points feature class appears correct, save the log file to
   …\Models\<County Name>\Reports\Logs\
   WV <County Name> Parcel Polygons to Parcel Centroids <yymmdd>.txt
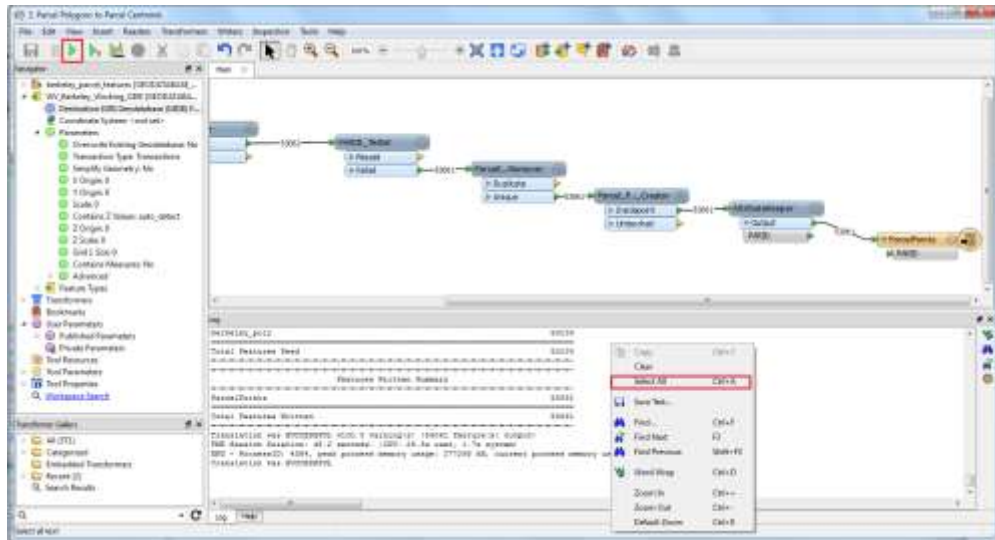
Save the changes to the FME tool and exit the FME workbench.

TASK 2.1.3 - PREPARE FLOOD BOUNDARY

Tools have been written to generate a Flood Boundary feature class. This will be used later in the workflow to select only the buildings that intersect the flood inundation area so that you can more quickly import those buildings into Hazus and conduct a loss estimation study.

IMPORTANT! This script extracts A and AE zones from the DFIRM data to generate the 1 percent flood risk area. If you wish to model a different flood hazard you need to adjust the script as needed to reflect that need.

1. If not already open, open the MXD named:
   …\Models\<County Name>\MXD_Documents
   WV_<County Name>_DataSources.mxd

2. If not already added, add the **WV_<County Name> FME Boundaries** toolbox to ArcTools from:
   …\Models\<County Name>\Tools\

3. Right-click| Edit the **3. Flood Boundary Creator** tool to open up the FME workbench.
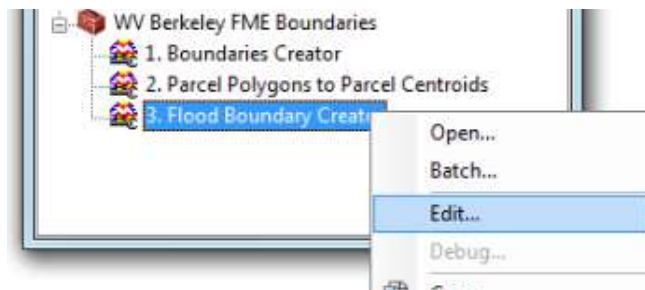
4. Set the input Published Parameters | Source to:
   …\PDM_WestVirginia\Data_Management\Data_Sources\<County Name>\DFIRM\
   S_FLD_HAZ_AR.shp
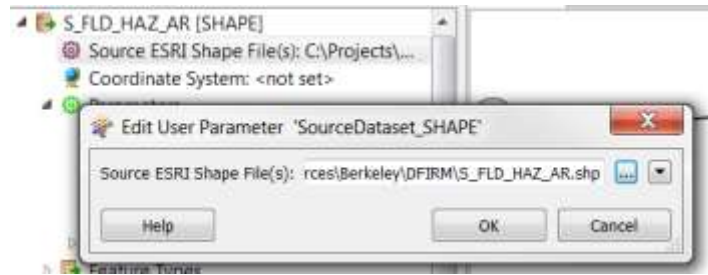
5. Set the output Published Parameters | Destination to:
…\Models\<County Name>\Analysis\Inventory\Boundaries\
WV_<County Name>_Boundaries_GDB.mdb
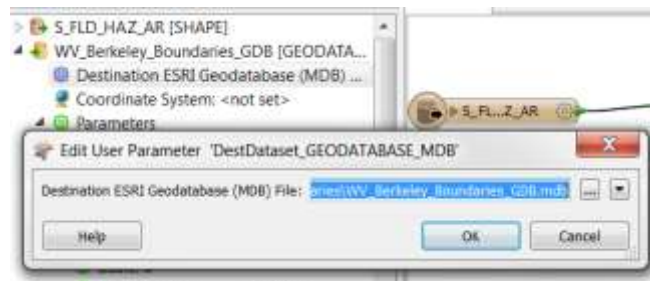
6. Click the Save button to save the changes to the FME script.

7. Run the script and review the log file.

8. Add the output flood boundary to the MXD and review the results.

9. If all OK, save the log file to
…\Models\<County Name>\Reports\Logs\
WV <County Name> Flood Boundary Creator <yymmdd>.txt

10. Save the changes to the FME tool and exit the FME workbench.

11. Save the **WV_<County Name>_DataSources.MXD** and exit ArcMap.

TASK 2.2 - PREPARE BUILDING INVENTORY

IMPORTANT: One of the key components of the inventory update process is identifying domain values that are applied within the county CAMA data and defining how those relate to Hazus required values. This is accomplished in this workflow through the creation of domain and matrix tables. It was assumed in the preparation of this workflow that the matrix tables and domains applied to Berkeley County also universally apply to other West Virginia counties. If this is not the case, it will be necessary to create matrix table appropriate to each county where values are not consistent with those used for Berkeley County as outlined in Appendix 1 and 2.

Building Inventory is a dataset that contains the location of buildings as well as attributes about their design characteristics and use that are needed to conduct a hazard risk assessment. Building Inventory (BI) becomes the foundational feature class for the Hazus General Building Stock (aggregated data) and Hazus User Defined Facilities (individual points).

Typically Building Inventory is created from parcel and assessor databases. This workflow is developed from Parcel centroids (to provide the locations) and CAMA Assessor data (to provide the building attributes) as the primary data sources.

Building Inventory is "generic" – it is a defined schema that has been designed to work with Hazus and other modeling tools across all projects. The scripts are setup for Berkeley County, but may be modified for other counties if necessary.

The workflow to create/maintain Building Inventory starts with the County Parcels. Duplicate Parcel Identifiers (PIDs) are dissolved along common boundaries to account for multi-parcel ownership. Parcel polygons are reduced to points at the centroids of each parcel.

TASK 2.2.1 – CONVERT CAMA SOURCE DATA TO ENHANCED CAMA

For this portion of the workflow you will import a table called Matrix_LUC_hzOccCo table into the FME transformer. This will result in creating a new field with Hazus occupancy classes in the enhanced CAMA table. This serves as an intermediate step to generating Building Inventory.

Below is a screenshot of the matrix table: Matrix_LUC_hzOccCode.

This Matrix_LUC_hzOccCode documents the translation of LUC names to Hazus specific occupancy classes. The West Virginia Appraisal Manual 2014 served as a guide for creating the template version of this table for Berkeley County. The Matrix_LUC_hzOccCode table that was created for Berkeley County is provided in the template located in.

…\Data_Management\Data_Sources\Template\Assessor

> WV_County_Assessor_GDB.mdb
>
> *You may either use the template Matrix_LUC_hzOccCode table, which means that you are assuming that the codes match those for the county that you are modeling, or you may update this table using the instructions in Appendix 1 which outlines steps to create and import the "Matrix_LUC_hzOccCode" table in WV_County_Assessor_GDB.mdb. If you need to update the Matrix_LUC_hzOccCode table to reflect values unique to the county you are modeling, you should complete the process described in Appendix 1 and then return to this point in the workflow.*

Tools have been written to generate enhanced CAMA table. Complete the following tasks to apply these tools.

1. If necessary, start ArcMap and open the MXD named:
   …\Models\<County Name>\MXD_Documents
   WV_<County Name>_BI_Products.mxd

2. This map document opens with no layers displayed. For reference you may want to add the following layers:

   C:\Projects\Hazus_Projects\PDM_West Virginia\Data_Management\Data_Sources\<County Name>\Parces

   - o   Parcel boundaries

   C:\Projects\Hazus_Projects\PDM_West Virginia\Data_Management\Models\Berkley_Test\Analysis\Working\WV_<County Name>_Working_GDB.mdb

   - o   Parcel points

   C:\Projects\Hazus_Projects\PDM_West Virginia\Data_Management\Models\<County Name>\Analysis\Inventory\Boundaries\WV_<County Name>_Boundaries_GDB

   - o   <County Name>DFIRM100

   - o   Blocks

   - o   County

3. If not already added, add the **WV_<County Name> FME BI Products** toolbox to ArcTools from:
   …\Models\<County Name>\Tools\
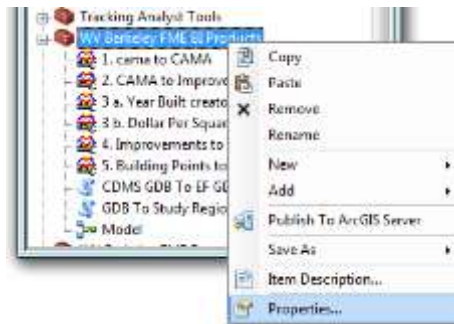
4. Right-click on the FME toolbox and select **Properties**. Change the tool **Label** to **WV <County Name> FME BI Products**.
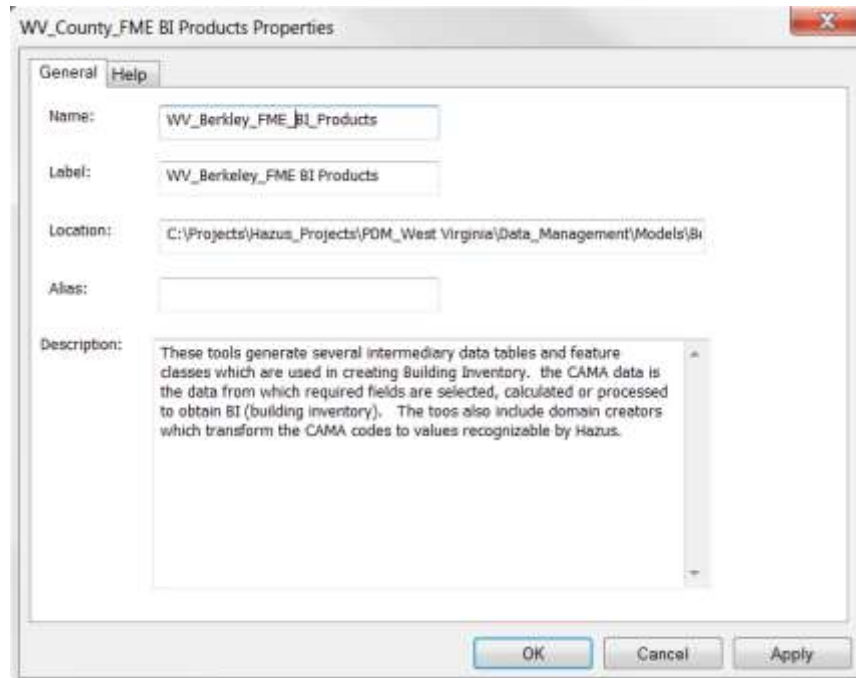
5. Right-click | Edit the **1.cama to CAMA** tool to open up the FME workbench.
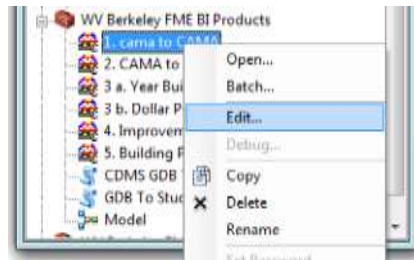
6. Set the input Published Parameters | Source to:
   …\ PDM_WestVirginia\Data_Management\Data_Sources\<County Name>\CAMA_Assessment\

   <County Name>_WVU.mdb

   This is the assumed name of the county provide database containing the assessors CAMA data since this name was used for the Berkeley County source CAMA data.   Change this database name as appropriate for other counties.

7. Set the output Published Parameters | Destination to:
   …\ PDM_WestVirginia\Data_Management\Data_Sources\<County Name>\CAMA_Assessment\

   WV_<County Name>_Assessor_GDB.mdb
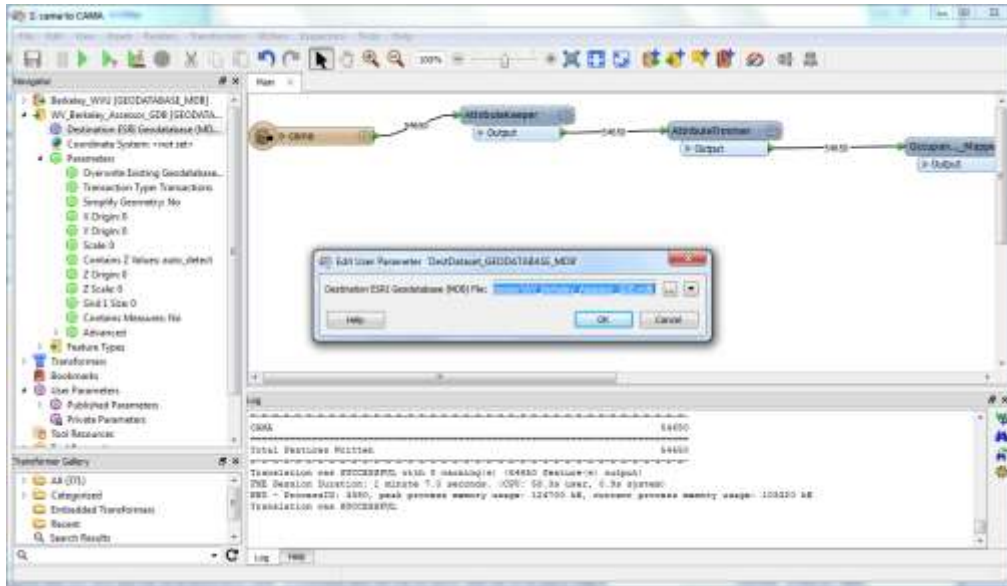
8. Click the sprocket on the CAMA output feature class and then click the Format Parameters tab. Verify that Table Exists is set to No.
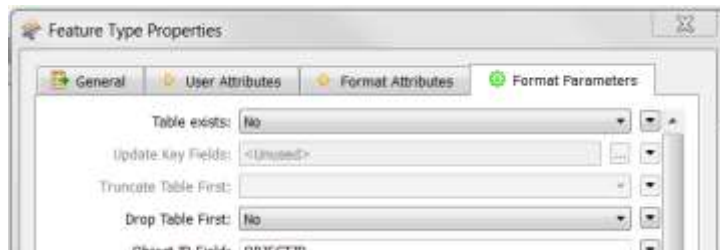
9. Click **OK** to close the Feature Type Properties window.

10. Click the **Save** button to save the changes to the FME script.

11. Run the script and review the log file.

   The log file should reflect the same number of input and output records. For example, for Berkeley County, the source data contained 54,650 records and the Destination data reflected the same count and content.

OBJECTID	ZIP1	ADRSTR	ADRNO	CITYNAME	AREASUM	ADRSUF2	GRADE	hzOccCode	CO
1	UNK	ARDEN NOLLVII	7538	UNK	1990		C	RES1	0
2	UNK	NOLLVILLE	0	UNK	0		UNK	NA	0
3	UNK	ARDEN NOLLVII	7408	UNK	1608		C+	RES1	0
4	UNK	TUSCARORA	B091	UNK	1680		C+	RES1	0
5	UNK	RUSSETT	59	UNK	1232		C	RES1	0
6	UNK	TUSCARORA	B144	UNK	1732		C+	RES1	0
7	UNK	TUSCARORA	0	UNK	0		UNK	NA	0
8	UNK	RUSSETT	B2	UNK	1596		C	RES1	0
9	UNK	TUSCARORA	8224	UNK	1792		C+	RES1	0

Record: 1 of 54650   Search

12. If the output appears OK, save the log file to
…\Models\<County Name>\Reports\Logs\
WV <County Name> cama to CAMA <yymmdd>.txt
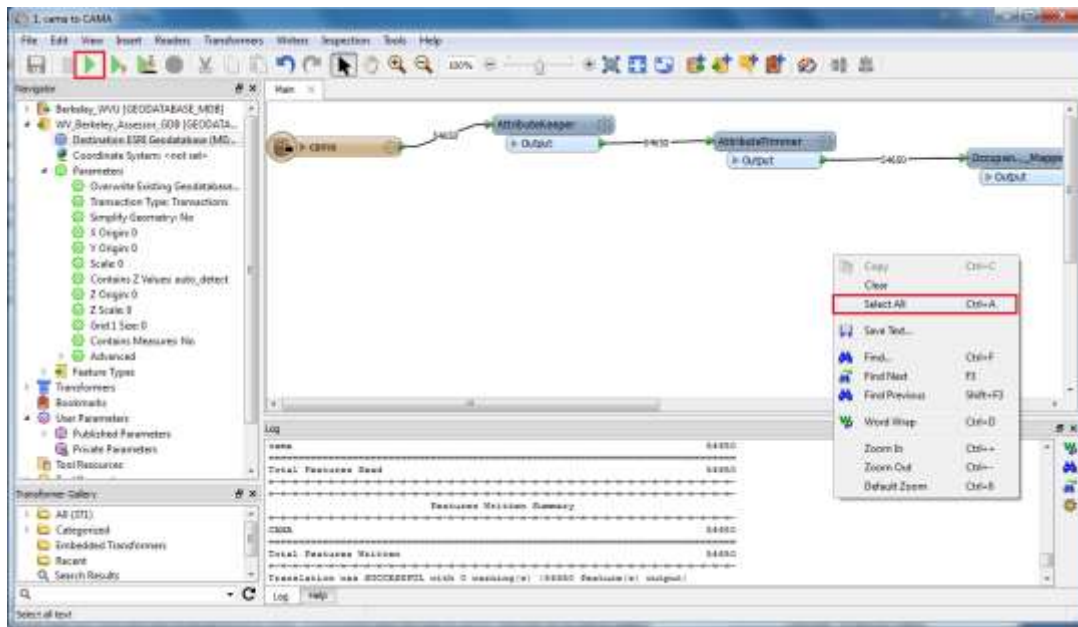
13. Save the changes you made to the FME script and exit the FME workbench.

TASK 2.2.2 – CONVERT CAMA TO IMPROVEMENTS

Creating an Improvements table serves as an intermediate step to creating BI (Building Inventory). The Improvements table consists of domains where the CAMA codes are converted to descriptive attributes. This is achieved by creating MS Access database domain and matrix tables. Refer to the Appendix 1. In addition, the CAMA cost values are aggregated by the occupancy classes. Refer to Appendix 1 Creating ImpCost table for guidance on what assumptions were used.

The matrix table and domains created for this section of the workflow include:

1. **Matrix table**

   ▪ Matrix_LUC_hzOccCode

2. **Domains**:

   ▪ Domain_ImpCondition

   ▪ Domain_ImpType

   ▪ Domain_ImpFoundation

Tools have been written to generate Improvements table.

1. Start ArcMap if necessary and open the MXD named:
…\Models\<County Name>\MXD_Documents
WV_<County Name>_BI_Products.mxd

2. Add the **WV_<County Name> FME BI Products** toolbox to ArcTools from:
…\Models\<County Name>\Tools\

3. Right-click | Edit the **2. CAMA to Improvements** tool to open up the FME workbench.
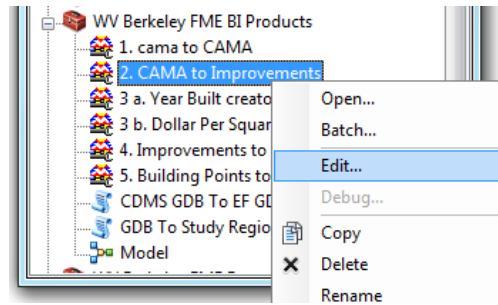
4. Set the input Published Parameters | Source to:
…\ PDM_WestVirginia\Data_Management\Data_Sources\<County
Name>\CAMA_Assessment\
WV_<County Name>_Assessor_GDB.mdb

5. Set the output Published Parameters | Destination to:
…\Models\<County Name>\Analysis\Inventory\Improvements\
WV_<County Name>_Improvements.mdb

6. Click the **Save** button to save the changes to the FME script.

7. Run the script and review the log file.

For Berkeley County the source CAMA data included 54,650 records. The destination data – Improvements records included 44,650 records. This means that that there were 10,000 failed records. Our research showed that these included records without DWELVAL,COMVAL and OBYVAL values. It also included records with LUC codes of 100,123,300,600,604,700 which were deemed inappropriate for the desired modeling purposes.

8. If all appears OK, save the log file to
…\Models\<County Name>\Reports\Logs\
WV <County Name> CAMA to Improvements <yymmdd>.txt

9. Save the changes to the FME script and exit the FME workbench.

TASK 2.2.3 – CONVERT IMPROVEMENTS TO BUILDING POINTS

Tools have been written to generate building points from the improvement data created in the previous task.

1. If necessary start ArcMap. Then open the MXD named:
…\Models\<County Name>\MXD_Documents
WV_<County Name>_BI.mxd

2. Add the **WV_<County Name> FME BI Products** toolbox to ArcTools from:
…\Models\<County Name>\Tools\

3. Right-click | Edit the **3. Improvements to Building Points** tool to open up the FME workbench.
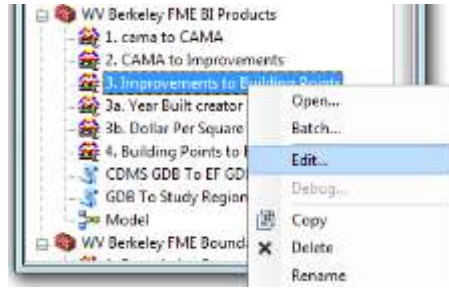
4. Set the input Published Parameters | Source to:
    …\Analysis\Working\
    WV_<County Name>_Working_GDB.mdb

5. Set the second input Published Parameters | Source to:
    …\Models\<County Name>\Analysis\Inventory\Improvements\
    WV_<County Name>_Improvements.mdb

6. Set the output Published Parameters | Destination to:
    …\Analysis\Working\
    WV_<County Name>_Working_GDB.mdb

7. Click the sprocket on the **Building Points** feature class and then click the **Format Parameters** tab. Make sure that Table exists is set to **No**.

    This is necessary the first time a tool is run. If you choose to re-run the tool you need to change this setting to Yes.

8. Click **OK** to close the Feature Type Properties window.
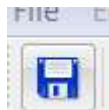
9. Click the **Save** button to save the changes to the FME script.

10. Run the script and review the log file.

11. Add the **Building Points** feature class to the map and review the results. Verify that building points have been generated and that there are no obvious issues with the data output.

    For Berkeley County, the source data included 44,650 improvements. The parcel points included 53,061 points. The join between the parcel points and improvement data yielded 39,219 building points.

12. If that data appears OK, save the log file to
    …\Models\<County Name>\Reports\Logs\
    WV <County Name> Improvements to Building Points <yymmdd>.txt

13. Save the changes to the FME script and exit the FME workbench.

14. Save the changes to the Map document.

TASK 2.2.4 – CONVERT BUILDING POINTS TO BUILDING INVENTORY

The following matrices and domains were created prior to building the FME script for Building Inventory. Domains are tables created in an MS Access geodatabase which give the description of the codes. Matrices are tables created in an MS Access geodatabase which convert the codes into Hazus specific codes.

VERY IMPORTANT! – **This workflow assumes that the same domains and matrix values will be applicable to each county in West Virginia.   If this is not the case, it will be necessary to create domains and matrix tables unique to each county. This process is described in Appendix 2.**

The domains and matrices created for this workflow include:

1. **Domains**:

   - Domain_Year_built

   - Domain_FirstFloorHt: This domain is not created. It is imported into "FirstFloorHt_Mapper" transformer in the "4. Building Points to Building Inventory" FME script.

   The domains which give the description of the attributes present within the BI are used as reference for creating the matrices below. These domains are listed below:

   - Domain_BldgCondition

   - Domain_BldgFoundation

   - Domain_BldgConstruction

2. **Matrices**:

   - Matrx_BldgCondition

   - Matrix_BldgConstruction

   - Matrix_BldgCondition

3. **XFactors_DolSqFt**

Tools have been written to generate a Building Inventory feature class based on the domains and matrix tables as well as the Building Points created earlier in the workflow.

1. Start ArcMap if necessary and then open the MXD named:
   …\Models\<County Name>\MXD_Documents
   WV_<County Name>_BI_Products.mxd

2. Add the **WV_<County Name> FME BI Products** toolbox to ArcTools from:
   …\Models\<County Name>\Tools\

3. Right-click | Edit the **4. Building Points to Building Inventory** tool to open up the FME workbench.
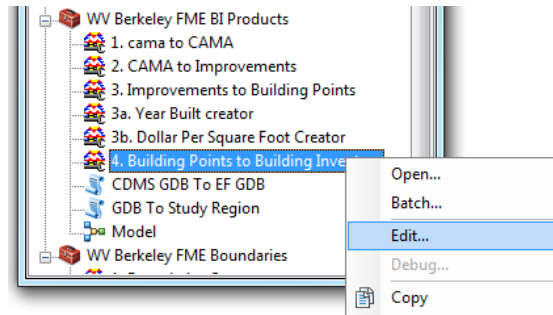
4. Set the input Published Parameters | Source to:
   …\Analysis\Working\
   WV_<County Name>_Working_GDB.mdb

5. Set the output Published Parameters | Destination to:
   …\Models\<County Name>\Analysis\Inventory\Building_Inventory
   WV_<County Name>_BI_GDB.mdb

6. Click the **Save** button to save the changes to the FME script.

7. Run the script and review the log file.

8. Add the output Building Inventory to the MXD and review the results.

9. If the data appears OK, save the log file to
   …\Models\<County Name>\Reports\Logs\
   WV <County Name> Building Points to Building Inventory <yymmdd>.txt

10. Save to the changes to the FME script and exit the FME workbench.

11. Save the changes to the map document and exit ArcMap.

TASK 2.3 – HAZUS UPDATES

TASK 2.3.1 – CONVERT BUILDING INVENTORY TO USER DEFINED FACILITIES

Tools have been written to generate Hazus-MH flood model compliant User Defined Facility inventory.

Note: This tool also generates a Hazus-MH earthquake compliant User Defined Facility inventory table if needed. This workflow does not address importing that table into an earthquake study region but the steps are fundamentally the same as doing so with a flood user defined facility inventory.

1. Start ArcMap and open the MXD named:
   …\Models\<County Name>\MXD_Documents
   WV_<County Name>_Hazus_Updates.mxd

2. For contextual purposes, add the following layers to the map.

   C:\Projects\Hazus_Projects\PDM_West Virginia\Data_Management\Models\<County name>\Analysis\Inventory\Boundaries\WV_<County Name>_Boundaries_GDB.mdb

   o Blocks

    o County

C:\Projects\Hazus_Projects\PDM_West
Virginia\Data_Management\Models\Berkley_Test\Analysis\Inventory\Building_Inventory\
WV_<County Name_BI_GDB.mdb

      o BI

3. Add the **WV_<County Name>FME_Hazus Updates** toolbox to ArcTools from:
   …\Data_Management\Models\Berkeley\Analysis\Tools

4. Right-click | Edit the **BI to UDF** tool to open up the FME workbench.
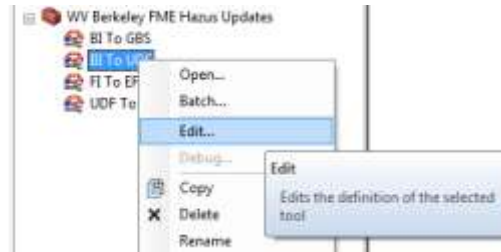
5. Set the input Published Parameters | Source to:
   …\Models\<County Name>\Analysis\Inventory\Building_Inventory
    WV_<County Name>_BI_GDB.mdb

6. Set the second input Published Parameters | Source to:
   …\Models\<County Name>\Analysis\Inventory\Boundaries\
    WV_<County Name>_Boundaries_GDB.mdb

7. Set the output Published Parameters | Destination to:
   …\Hazus_Updates\<County Name>\User_Defined_Facilities
    WV_<County Name>_Hazus_Import_UDF.mdb

8. Click the **Save** button to save the changes to the FME script.

9. Run the script and review the log file.

10. Add the output User Defined Facilities to the MXD and review the results.

11. If all OK, save the log file to
   …\Models\<County Name>\Reports\Logs\
    WV <County Name> Building Inventory to User Defined Facilities<yymmdd>.txt

12. Save the changes to the FME script and exit the FME workbench.

TASK 2.3.2 – CONVERT BUILDING INVENTORY TO GENERAL BUILDING STOCK

Tools have been written to generate General Building Stock.

1. If necessary, start ArcMap and open the MXD named:
   …\Models\<County Name>\MXD_Documents
    WV_<County Name>_Hazus_Updates.mxd

2. Add the **WV_<County Name> FME BI Products** toolbox to ArcTools from:
   …\Hazus_Updates\<County Name>\Tools

3. Right-click | Edit the **BI to GBS** tool to open up the FME workbench.

1. Set the second input Published Parameters |Source to:
…\Models\Berkeley\Analysis\Inventory\Boundaries\
      WV_<County Name>_Boundaries_GDB.mdb

2. Set the first input Published Parameters | Source to:
…\Models\<County Name>\Analysis\Inventory\Building_Inventory
      WV_<County Name>_BI_GDB.mdb

3. Set the output Published Parameters | Destination to:
…\Hazus_Updates\<County Name>\General_Building_Stock
      WV_<County Name>_CDMS_Import_GBS.mdb

4. Verify that the flBldgType_Mapper is properly mapped to the output GBS table.   It should appear as shown below. You do not want to see any red arrow. Green fields in the output table indicate that matching fields have been identified in the input table. If all fields in the GBS table are not shown in green or yellow, you need to map them as shown below by dragging the arrow in the input to the target arrow in the output.
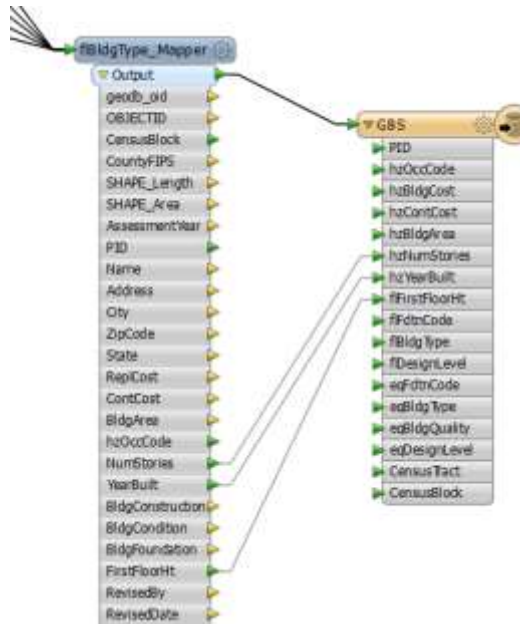
5. Click the **Save** button to save the changes to the FME script.

6. Run the script and review the log file.

7. Add the output GBS table to the MXD and review the results to verify that they look reasonable.

8. If all appears OK, save the log file to
   …\Models\<County Name>\Reports\Logs\
   WV <County Name> Building Inventory to General Building Stock<yymmdd>.txt

9. Save the changes to the FME script and exit the FME workbench.

10. Save your changes the map and exit ArcMap.

Project Workflow: West Virginia Hazus-MH Flood Model Inventory

TASK 3 – UPDATE HAZUS GBS INVENTORY

Hazus-2.2 comes bundled with default inventory data. The Hazus default inventory data is segregated into geodatabases for each State. The State default data is the master from which Hazus Study Regions are extracted. Hazus performs natural disaster analysis against the Study Region.

The Hazus-provided general building stock aggregate data sets valuations are based on 2010 census data and other sources. These data can typically be improved with locally available assessor's data and parcel information such as is the case in West Virginia. Selected aggregate data sets will be updated on a county by county basis prior to modeling.

TASK 3.1 – UPDATE GENERAL BUILDING STOCK DATA

Building Inventory is used to update the aggregated inventory in Hazus prior to modeling. Each BI point represents an assessor record that has been linked to a mapped building location. The default Hazus GBS data is updated using the Building Inventory to re-aggregate each Census Block.

The GBS is updated in Hazus using CDMS. The database which will contain the updated Hazus GBS is:
C:\HazusData_22\WV\bndrygbs.mdb

In the following pages, tasks will be completed to update the Hazus General Building Stock. The GBS records will be generated from the Building Inventory created in Task 2.

TASK 3.1.1 – QUERY "BEFORE" HAZUS GBS

CDMS will be used to query the GBS records currently in Hazus. After the new GBS has been imported into Hazus, the "before" and "after" snapshots should be compared to make sure that the database has been accurately updated and that updates represent an enhancement of the inventory rather than a reduction in quality.

1. Start CDMS.

2. Make sure that the **Current State** is pointing to C:\HazusData_22\WV.

3. Click the **Query/Export Statewide Datasets** button.

4. Choose **County** for Geographic Area.

5. Select **<County_Name>** County.

6. Choose **Aggregated Data** for Data Layer.

7. Choose the **Building Counts by Census Tract, Building Square Footage by Census Tract, Exposure Content by Census Tract**, and **Structure Exposure by Census Tract** Data layers.

   Note that you will be updating both Census Tract and Census Block values but you are only querying Census Tract values for comparison purposes.

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8. Click the **Search** button.

9. Click the **Export to Geodatabase** button and choose **Export all layers**.

10. Save the geodatabases to:

C:\Projects\Hazus_Projects\PDM_WestVirginia\Data_Management\Hazus_Updates\
<County Name>\General_Building_Stock
WV_<County_Name>_CDMS_Export_GBS_Default.mdb

TASK 3.1.2 – LOAD GENERAL BUILDING STOCK INTO THE CDMS REPOSITORY

General Building Stock is loaded into Hazus to replace the default aggregate data. The expectation is that the Assessor data is more accurate than the default GBS.

1. Click the **CDMS Home** button and then select **Import into CDMS Repository from File**.

2. **Browse** to **Select a file for Import** and browse to:

> C:\Projects\Hazus_Projects\PDM_WestVirginia\Data_Management\Hazus_Updates\<County Name>\General_Building_Stock\

> **WV_<County Name>_CDMS_Import_GBS.mdb**

3. Check only the **Earthquake** hazard beneath the Select a File to Import option. This indicates you will provide the attributes to update the earthquake mapping schemes. Selected attributes are available in the building inventory for this purpose. The **Flood** and **Hurricane** hazards are not selected because this release of CDMS does not update those mapping schemes correctly.

   NOTE: You are doing this because CDMS does not use the information in its present release that could be applied to updating flood mapping schemes.

4. Select **Aggregated Data** as the **Inventory Category**.

5. Click on **Import Site Specific Data to Aggregate Data** to replace the existing GBS inventory.

6. Click **Yes** when prompted to acknowledge that all existing data will be replaced.

7. Select **GBS** from the **Input Table Selection** dropdown box and click **OK**.

8. Click the **Load** button on the **Import from Buildings/Parcels: Data Field Matching** panel.

9. Navigate to:

> …\Data_Management\Hazus_Updates\<County Name>\Tools
> and select the mapping table called:
> > **GBS.fmp**
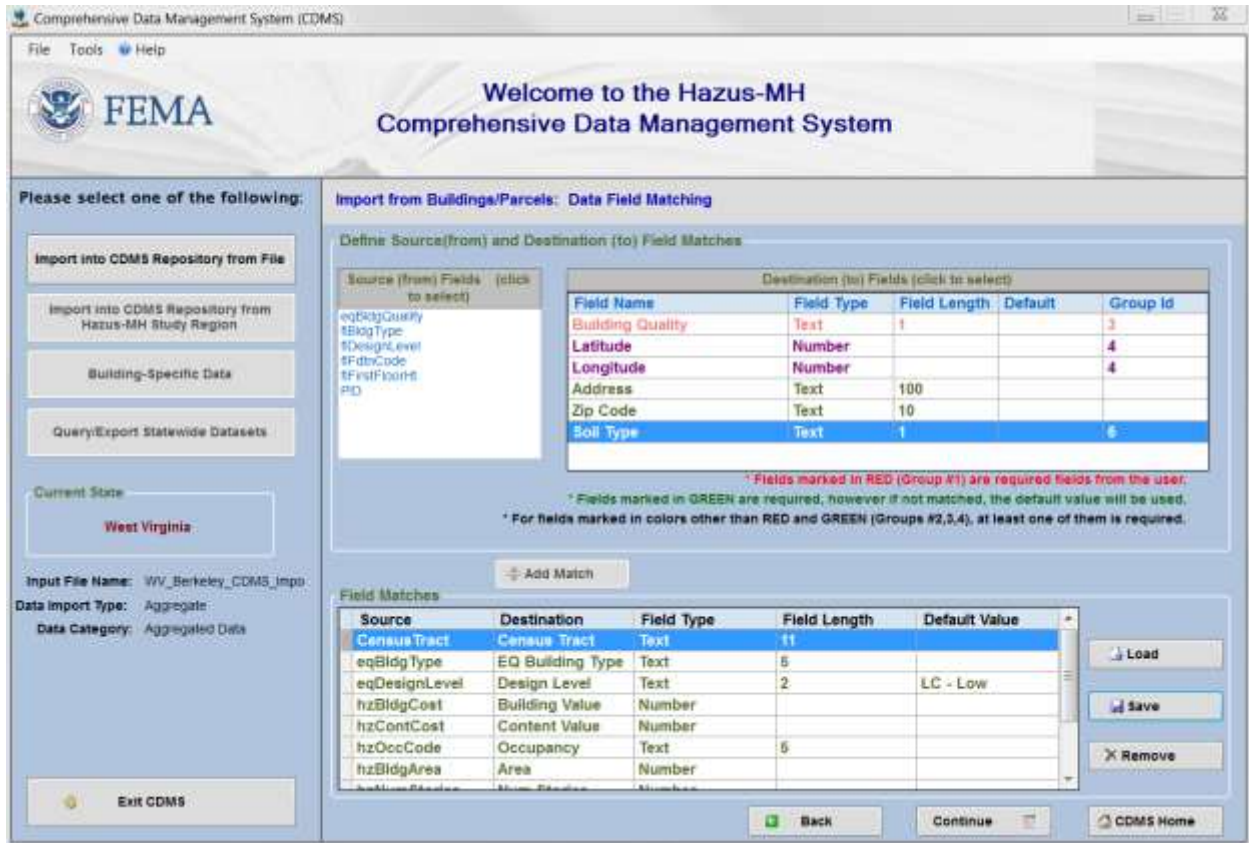
10. Click **Continue**.

11. Click **OK** when prompted to **Categorize Fields**.

12. Click **OK** on the **Area Field Type, Building Value Field Type** and **Content Value Field Type** windows.

13. The NumStories field is numeric. It does not need to be categorized. Just click **OK**.

14. Choose **Year is in 4-digit format** for the Year Built Field Type.

15. The remaining Source values should accurately match the Destination values. Continue Category Matching the following GBS fields:
    Building Quality
    Occupancy Class

16. When prompted, choose **Use system defaults for General Building Type Mapping Schemes**.

17. A **CDMS Data Import Success** message box will appear (assumes the import was successful). Click **OK**, and the results will be available in the **CDMS Repository** as shown below.
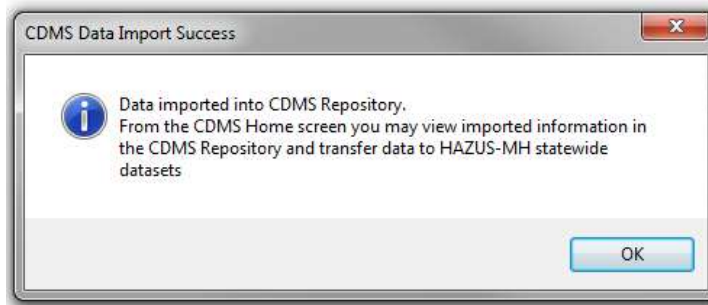
18. Review the imported records by clicking on the **View** button.

19. On the CDMS Repository Home screen, select the **Aggregated Data** layer to transfer to Hazus.

20. Click the **Transfer to Statewide Dataset** button, and select **Yes** to initiate the transfer of data from the repository into Hazus.
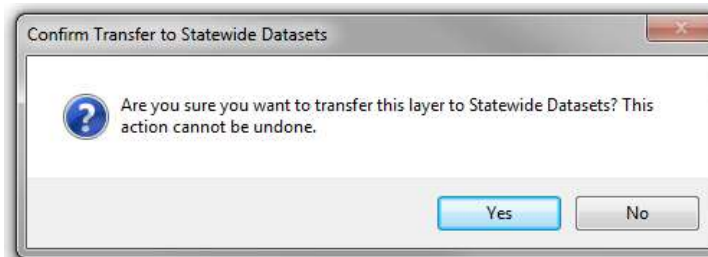
21. **Select All** the available datasets from the **Transfer Aggregated Data to Statewide Databases** dialog box.

22. Set the option to **Update General Building Mapping Schemes**.

23. Set the option to **Process All Tracts/Blocks in County**.

24. Click **OK**.

25. Answer **OK** when prompted to replace the GBS contents from all Tracks and Blocks. The GBS contents of Census Blocks and Tracts not included in the Building Inventory will be set to zero. Only use this option if the Building Inventory reflects the entire county.
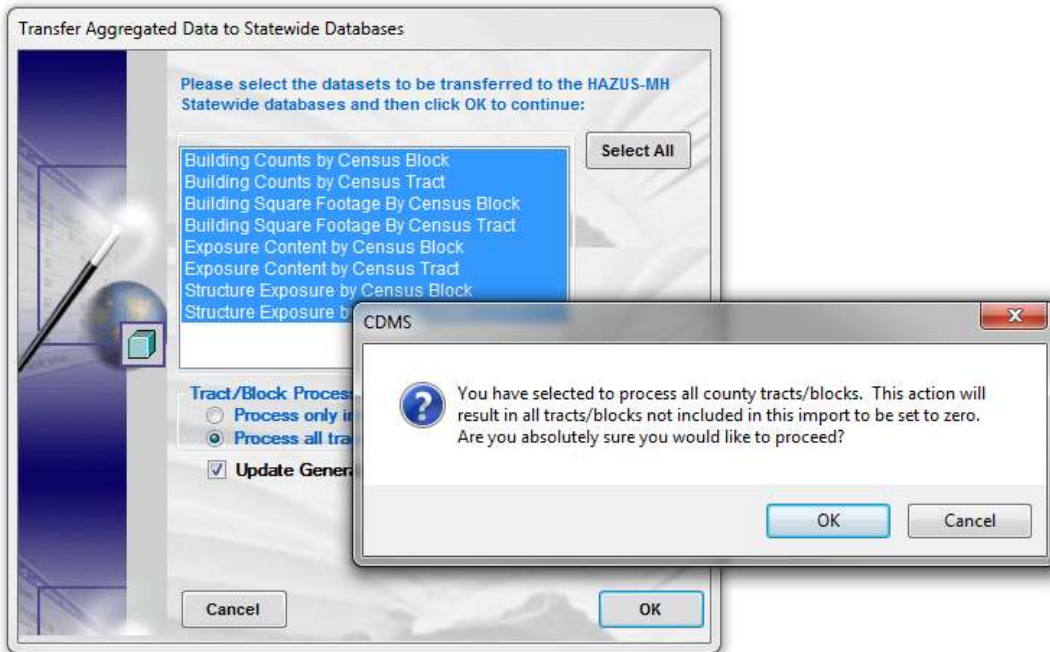
26. Click **OK** when prompted to acknowledge that 1 county will be affected by this transfer.
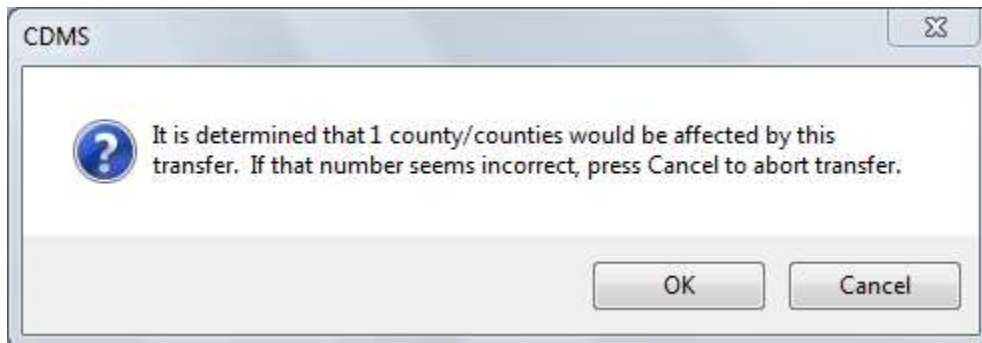
When the process is complete a new record will be added to the Statewide Layer Modification History.
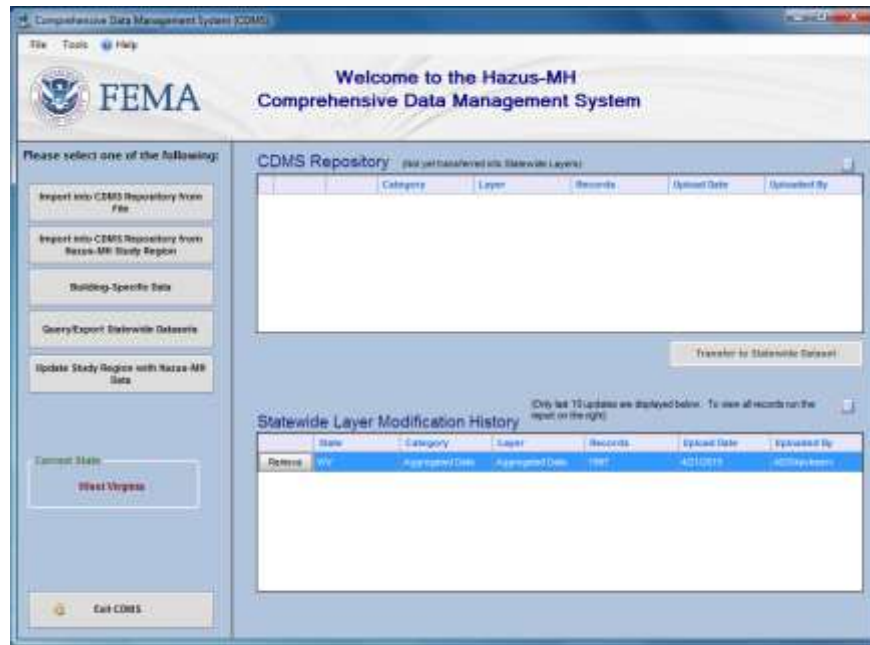
27. Select the Display Statewide Modification History Report icon. Export the PDF to:
    …\Models\County\ <County_Name> \Reports\Hazus\
    WV_ <County_Name> _CDMS_Transactions_<yymmdd>.pdf
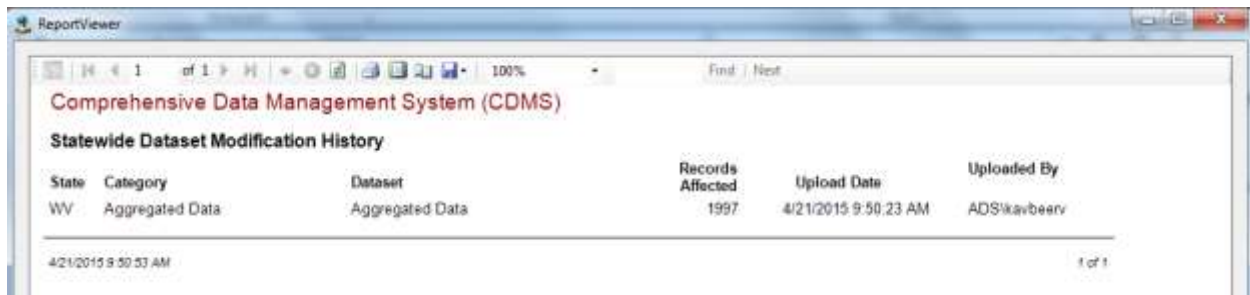
TASK 3.1.3 – QUERY "AFTER" HAZUS GBS

The updated GBS will be compared to the previous values to make sure that the Hazus database accurately reflects the Building Inventory. These steps are only needed if the GBS has been updated.

1. Start CDMS.

2. Make sure that the **Current State** is pointing to c:\HazusData_22\WV.

3. Select **Query/Export Statewide Datasets**

4. **Search By Geographic Area** to **County** from the dropdown list.

5. Select **<County_Name>** and move it to the **Selected Geographical Areas**

6. Set the **Search By Data Layer** to **Aggregated Data** from the dropdown list.

7. Select the following Aggregated Data Layers:
    Building Counts By Census Tract
    Building Square Footage By Census Tract
    Exposure Content By Census Tract
    Structure Exposure By Census Tract

8. Click **Search**.

9. Click on the **Export to Geodatabase** button on the **Search Statewide Datasets** panel.

10. Set the **Export Option** to **Export all layers** when prompted. Click **Submit.**

11. Save the exported Geodatabase file to:

    C:\Projects\Hazus_Projects\PDM_WestVirginia\Data_Management\Hazus_Updates\<County
    Name>\General_Building_Stock

    WV_<County_Name>_CDMS_Export_GBS_Updated.mdb

12. Close CDMS.

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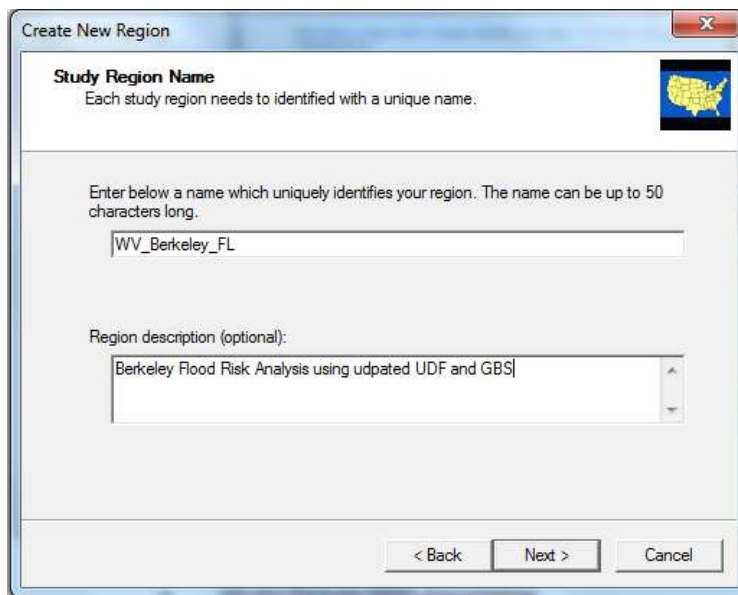
TASK 4 – CREATE A NEW FLOOD STUDY REGION AND IMPORT THE USER DEFINED FACILITIES

In this final task you will first create a new study region.   Because you updated the general building stock already, that updated inventory will be reflected in the study region.   Hazus-MH does not currently support update of user defined facilities with CDMS so you will import those directly into the study region.

TASK 4.1 – CREATE STUDY REGION IN HAZUS

Before running the tool to import User Defined Facilities to the Study Region, create a Study Region named: WV_<County Name>_FL.

1. Start Hazus-MH.

2. Create a Flood Study Region for <County Name>, WV.
   Name: **WV_<County Name>_FL**
   Description: **<County Name> Flood Risk Analysis using updated UDF and GBS**

3. Set the Study Region Hazard Type to **Flood** and create the Study Region.

4. Open the study region that you just created.

TASK 4.2 - IMPORT USER DEFINED FACILITIES TO THE STUDY REGION

1. Navigate to **Inventory | User Defined Facilities**.

2. Right-click in the open area of the User Defined Facilities window and select **Import**.

3. Navigate to …Data_Management\Hazus_Updates\Template\User_Defined_Facilities and select **WV_County_Hazus_Import_UDF.mdb**

4. Select Table **UDF** from the Table List and click **OK**.

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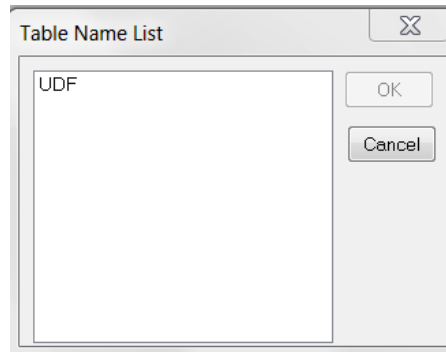
5. In the Mapping window select the **Load** button.
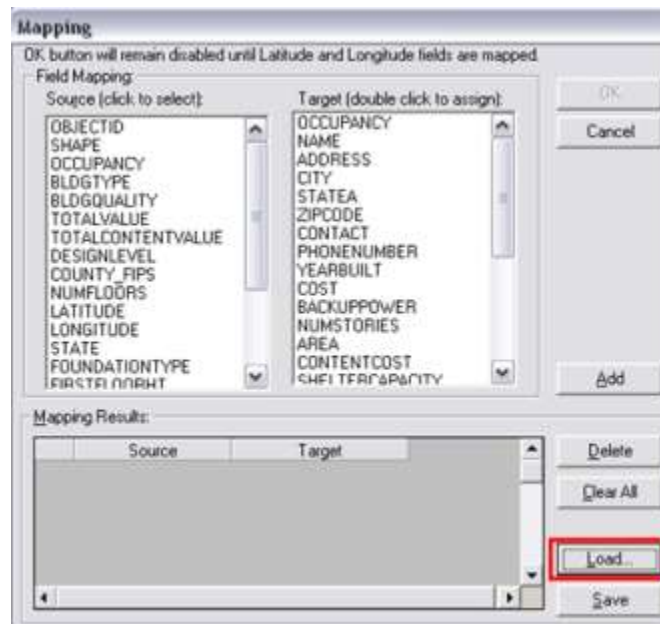
6. Navigate to …\Data_Management\Hazus_Updates\Template\Tools choose **UDF.sav**.

7. Click **OK** to begin loading the UDF inventory.

    NOTE: This method of importing user defined facilities into a Hazus study region is appropriate if you have less than 10,000 facilities. We do not anticipate any county in West Virginia exceeding this number. If you need to import more than 10,000 facilities, other methods of importing the facilities should be considered since the import processing time can considerably increase beyond that amount.

8. When the inventory has finished loading, close the Inventory window then reopen it and click the Map button to verify that it has loaded successfully.

9. You are now ready to use Hazus-MH to perform a flood risk assessment.

APPENDIX 1 FME MATRIX TABLE AND DOMAIN TABLES DEVELOPMENT PROCESS FOR IMPROVEMENTS

The following mapping schemes were applied to create the Improvements table which contains several important attributes used to create Building Inventory.

Firstly, it is important to understand what Domain and Matrix table represent. Domains are tables created in the access geodatabase which give the description of the codes. The description field in the table is keyed in by referring to the specifications or manual. Matrices are tables created in the access geodatabase which convert the Cama codes into Hazus specific codes.

The Pilot assumptions including domain and matrix tables can be customized by County as the requirements change.

I CAMA TO CAMA

Matrix_LUC_hzOccCode

The matrix table "Matrix_LUC_hzOccCode" is created prior to running Cama to CAMA FME script. The purpose of this is to enhance the cama Look-Up Code (LUC) table so that the data can be pre-processed based on the Hazus occupancy classes. The Hazus occupancy codes/ classes serve as a guide to convert the existing cama attributes to Hazus specific attributes.

The source cama LUC table created for Berkeley County was provided in text file format. This text file included LUC code list and the description of the codes. Below is a screenshot of the LUC table text file. The following portion of the workflow assumes that source cama LUC tables would also be provided in this format for other counties.
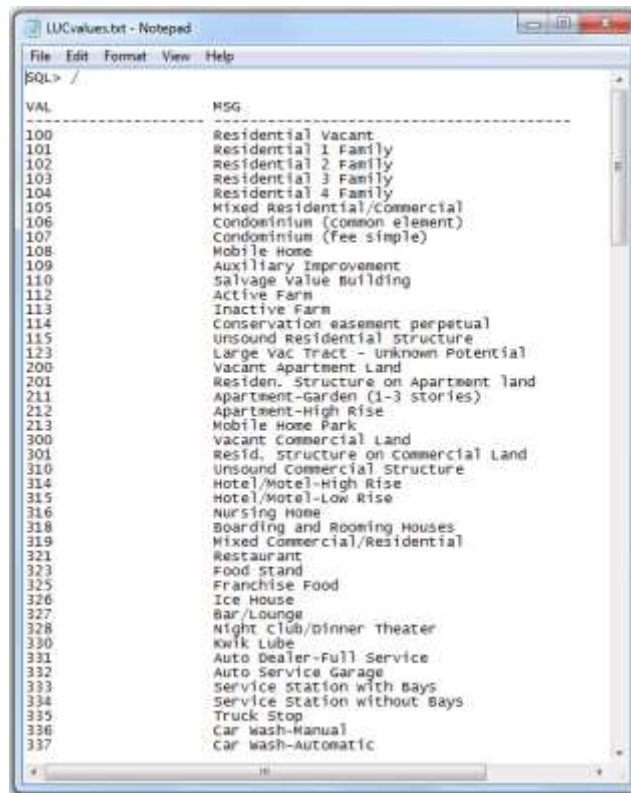
Task 1: Create Matrix_LUC_hzOccCode table

1. Open **WV_<County Name>_Assessor.mdb** located in
   …\PDM_WestVirginia\Data_Management\Data_Sources\<County Name>\Assessor

2. Delete the template **Matrix_LUC_hzOccCode** that is currently in the **WV_<County Name>_Assessor.mdb** database.

3. Import the LUC source text file and rename it to "**Matrix_LUC_hzOccCode**". Rename the fields 1 and 2 with the field names "CAMAOccCode" and "Description" respectively.

4. Add a new field to the **Matrix_LUC_hzOccCode** table that is text format and name it **hzOccCode**.

5. Key in appropriate values in the **hzOccCode** code field by referring to "Domain_hzOccCode" in the "WV_<County Name>_BI_GDB.mdb" located in
   …\PDM_WestVirginia\Data_Management\Models\<County_Name>\Analysis\Inventory\Building_Inventory

   Note: you may wish to consult the following table which relates Hazus-MH Occupancy Codes to Standard Industrial Classification Codes. You can view descriptions of these codes on the OSHA website at https://www.osha.gov/pls/imis/sicsearch.html.

Hazus Label	Occupancy Class	Standard Industrial Codes (SIC)
Residential		
RES1	Single Family Dwelling	
RES2	Mobile Home	
RES3A	Multi Family Dwelling - Duplex	
RES3B	Multi Family Dwelling – 3-4 Units	
RES3C	Multi Family Dwelling – 5-9 Units	
RES3D	Multi Family Dwelling – 10-19 Units	
RES3E	Multi Family Dwelling – 20-49 Units	
RES3F	Multi Family Dwelling – 50+ Units	
RES4	Temporary Lodging	70
RES5	Institutional Dormitory	
RES6	Nursing Home	8051, 8052, 8059
Commercial		
COM1	Retail Trade	52, 53, 54, 55, 56, 57, 59
COM2	Wholesale Trade	42, 50, 51
COM3	Personal and Repair Services	72, 75, 76, 83, 88
COM4	Business/Professional/Technical Services	40, 41, 44, 45, 46, 47, 49, 61, 62, 63, 64, 65, 67, 73, 78 (except 7832), 81, 87, 89
COM5	Depository Institutions	60
COM6	Hospital	8062, 8063, 8069
COM7	Medical Office/Clinic	80 (except 8051, 8052, 8059, 8062, 8063, 8069)
COM8	Entertainment & Recreation	48, 58, 79 (except 7911), 84
COM9	Theaters	7832, 7911
COM10	Parking	
Industrial		
IND1	Heavy	22, 24, 26, 32, 34, 35 (except 3571, 3572), 37
IND2	Light	23, 25, 27, 30, 31, 36 (except 3671, 3672, 3674), 38, 39
IND3	Food/Drugs/Chemicals	20, 21, 28, 29
IND4	Metals/Minerals Processing	10, 12, 13, 14, 33
IND5	High Technology	3571, 3572, 3671, 3672, 3674
IND6	Construction	15, 16, 17
Agriculture		
AGR1	Agriculture	01, 02, 07, 08, 09
Religion/Non-Profit		
REL1	Church/Membership Organizations	86

6. Save the table.

Task 2: Update the Occupancy Mapper transformer

The following instructions provide the method to update the Occupancy Mapper transformer in the **1.cama_to_CAMA FME script** using the matrix table "Matrix_LUC_hzOccCode". The Occupancy Mapper transformer maps the values of the codes to appropriate Hazus occupancy classes

> Once the Matrix_LUC_HzOccCode table has been updated you are ready to import the updated values into the FME tool.

1. Start ArcMap and open **WV_<County Name>_BI_Products.mxd** located in
   …\PDM_West Virginia\Data_Management\Models\<County Name>\MXD_Documents

2. Add the **WV_<County Name> FME BI Products** toolbox to ArcTools from:
   …\Models\<County Name>\Tools\

3. Right-click on the **1.cama_to_CAMA** FME tool and choose **Edit**.

4. Click the sprocket in the upper right corner of the **OccupancyClass** Mapper to open the AttributeValue Parameters window.
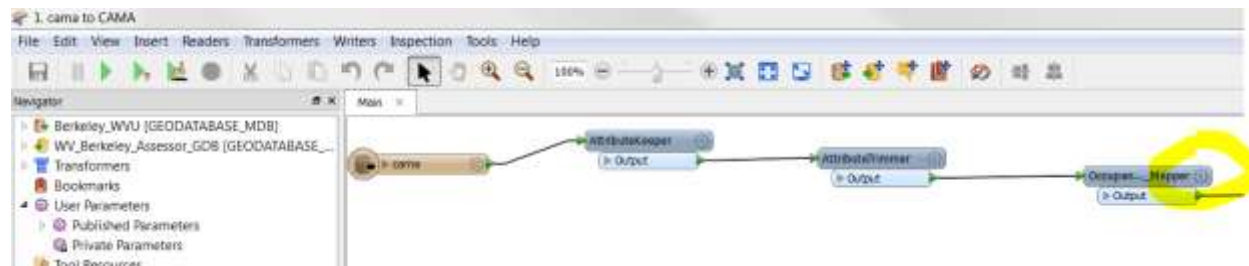
5. **Before completing the next step, make sure the contents in the Source Value and Destination Value fields are empty. In order to do this, click on the first row and press "Delete" on the keyboard. Do this for all the rows.**

6. Click the **Import** button and choose **Source and Destination Values**.
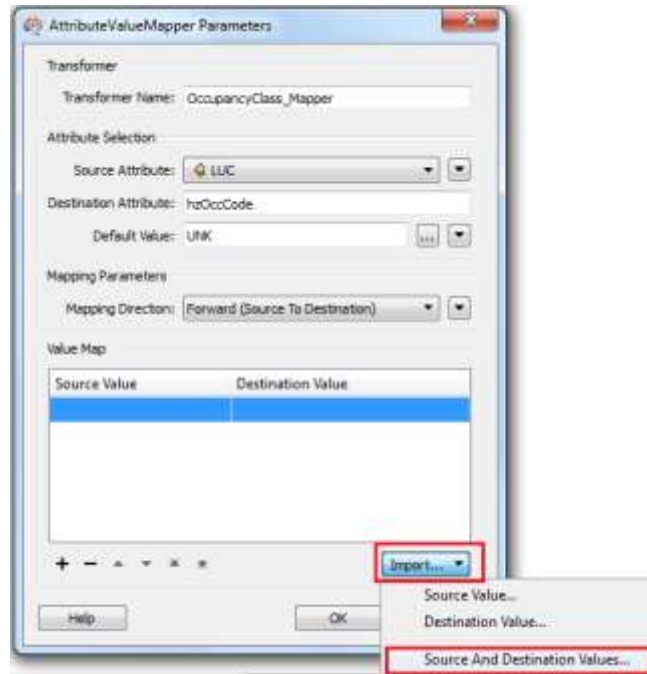
7. Select **Esri Geodatabase (Personal Geodb)** for the Format

8. Click the **Browse** button and browse to **WV_<County Name>_Assessor_GDB.mdb** in …\Hazus_Projects\PDM_West Virginia\Data_Management\ Data_Sources\<County Name>\ Assessor\
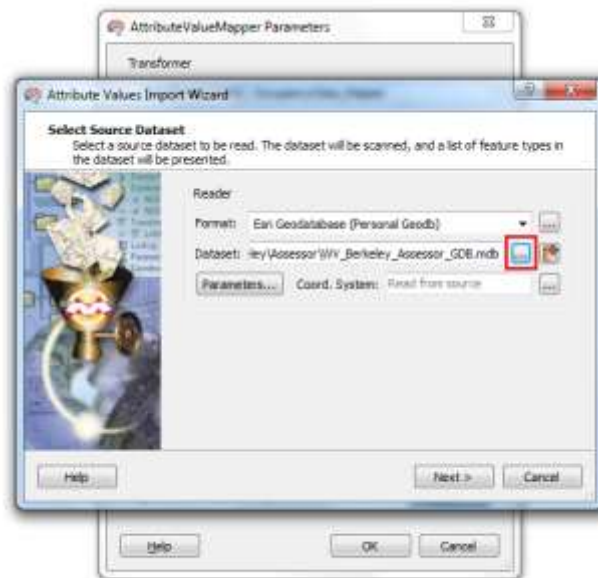
9. Click the **Next** button to access the Attributes Values Import Wizard.

10. Select the feature type **Matrix_LUC_hzOccCode** and click the **Next** button.
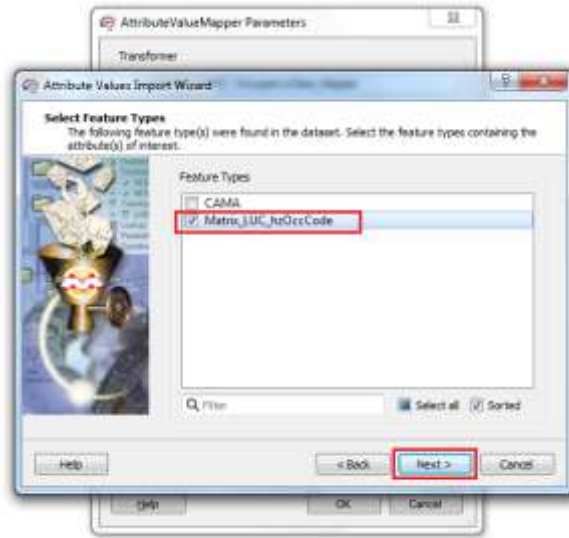
11. For Attributes for Source Value select **CAMAOccCode** as shown below and click the **Next** button.
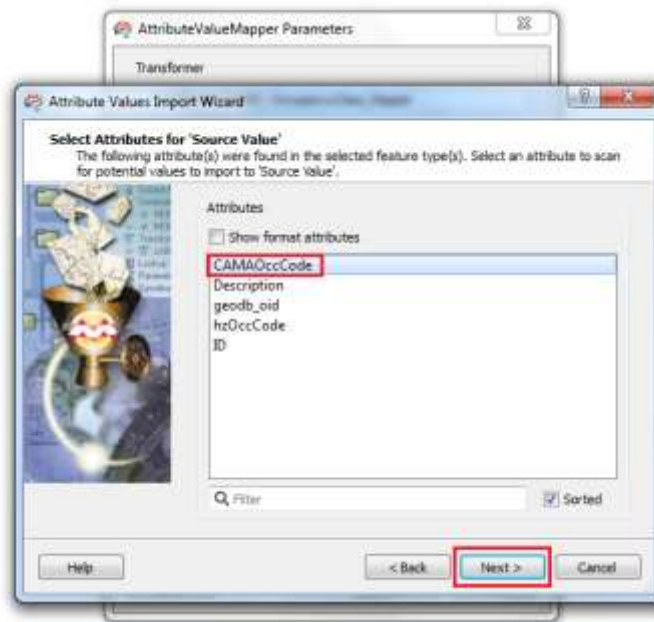
12. Select **hzOccCode** as the Destination Value attribute and click the **Next** button.
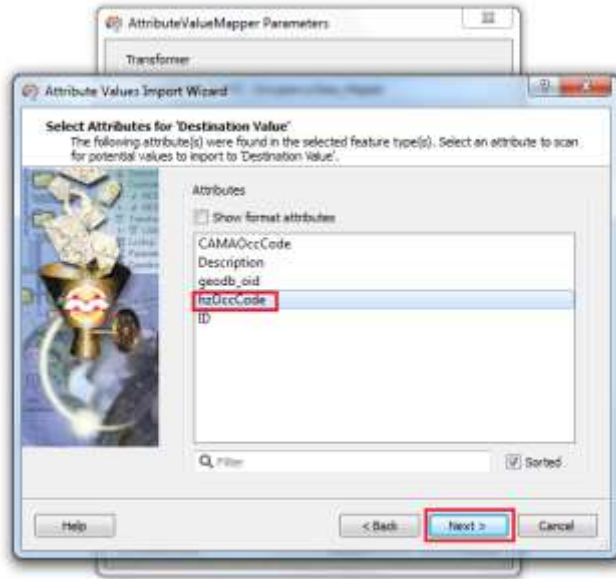
13. Click the **Import** button to import the source and destination value attributes.

14. Make sure under "Attribute Selection" of the "AttributeValueMapper Parameters" window, the following features are updated:

    o Source Attribute is set to "LUC" (this is the attribute from the source data that will be used to convert to hzOccCode)

    o Destination Attribute is named as "hzOccCode"

    o Default Value is set to "UNK"
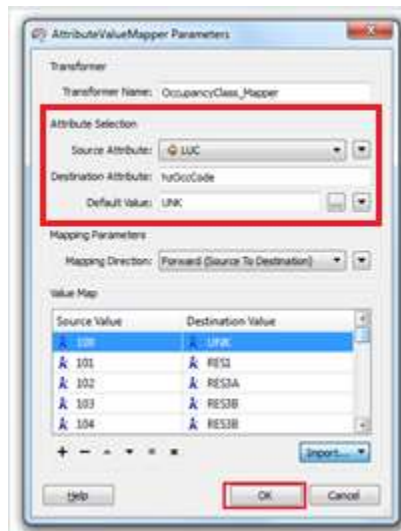
15. The Attribute Value Parameters window is now set for the Transformer "OccupancyClass_Mapper". Click the **OK** button.
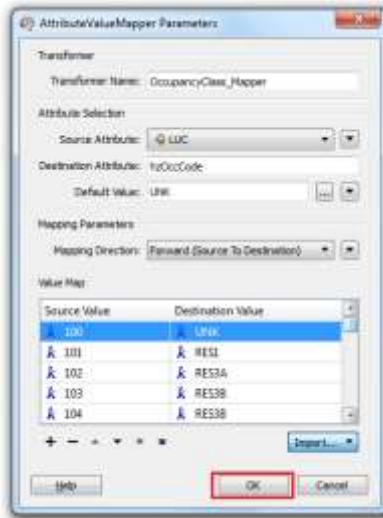
16. The Occupancy Mapper transformer is now updated.

17. Click the **Save** button to save the changes to the script.

18. Close the FME script.

ASSUMPTIONS:

The codes in LUC for which the description are unmatchable with Hazus occupancy class are assigned "UNK". This will be processed in the CAMA to Improvements tool to convert them to appropriate Hazus Occupancy Classes.

II CAMA TO IMPROVEMENTS

The following domain tables are created in MS Access prior to running the CAMA to Improvements tool. The domain tables are exported to WV_<CountyName>_Improvements.mdb; from where they are imported in to the "CAMA to Improvements" FME script. The purpose of creating these domain tables is to convert the CAMA codes to descriptive attributes.

Domain_ImpCondition

Domain_ImpType

Domain_ImpFoundation

For each domain Task 1 outlines creating domain tables and Task 2 outlines importing domain tables into FME script.

Domain_ImpCondition

Task 1: Create Domain_ImpCondition

1. Open **WV_<County Name>_Assessor.mdb** located in
   …\PDM_WestVirginia\Data_Management\Data_Sources\<County Name>\Assessor

2. Create a query in MS Access to find the unique values for Grade.
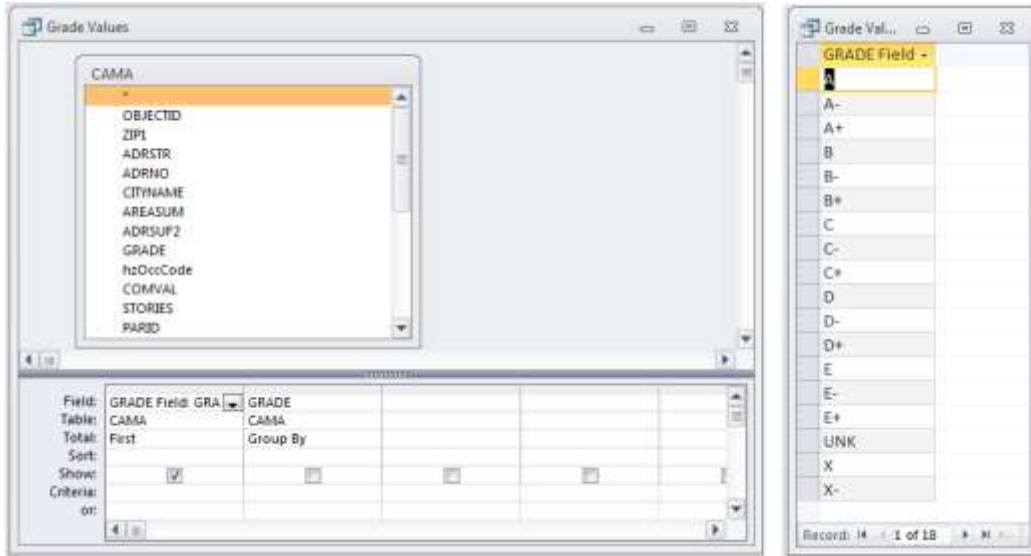
3. Export the table created from the query to WV_<County Name>_Improvements.mdb as **Domain_ImpCondition** located in

> …\PDM_WestVirginia\Data_Management\Models\<County Name>\Analysis\Inventory\Improvements

4. Create a new text field named **ImpCondition**.
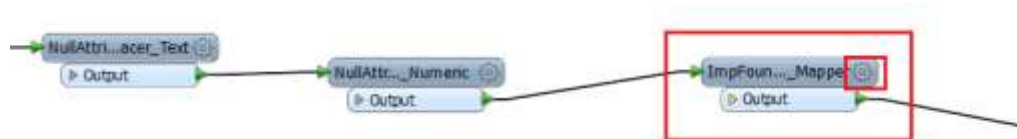
5. Key in values in the **ImpCondition** field based on the West Virginia Appraisal Manual. ("WV Appraisal Manual 2014". Refer to page 21)

6. Save the table.

Task 2: Import Domain_ImpCondition into "Condition_ValueMapper" transformer
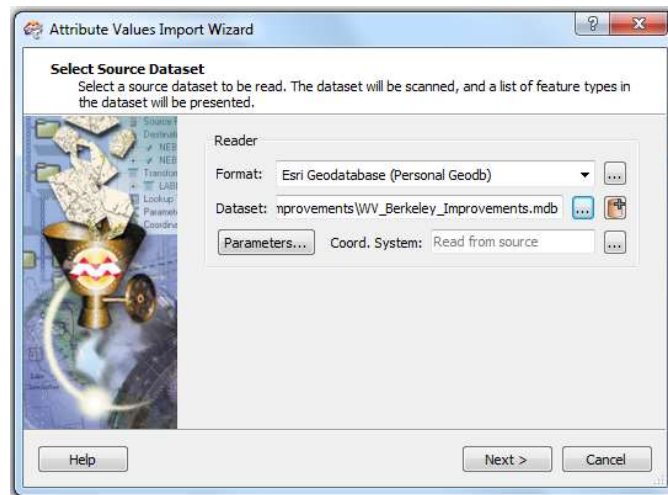
1. Start ArcMap and open **WV_<County Name>_BI_Products.mxd** located in
   …\PDM_West Virginia\Data_Management\Models\<County Name>\MXD_Documents

2. Right-click on the **2.CAMA to Improvements** FME tool and choose **Edit**.

3. Click the sprocket in the upper right corner of the **ImpCondition_Mapper** to open the AttributeValue Parameters window.
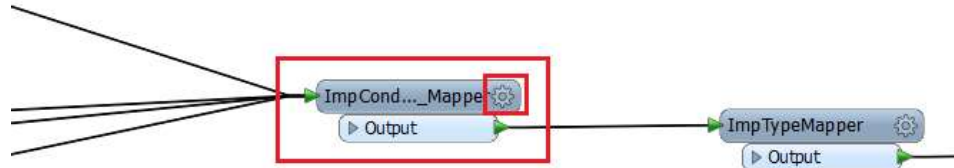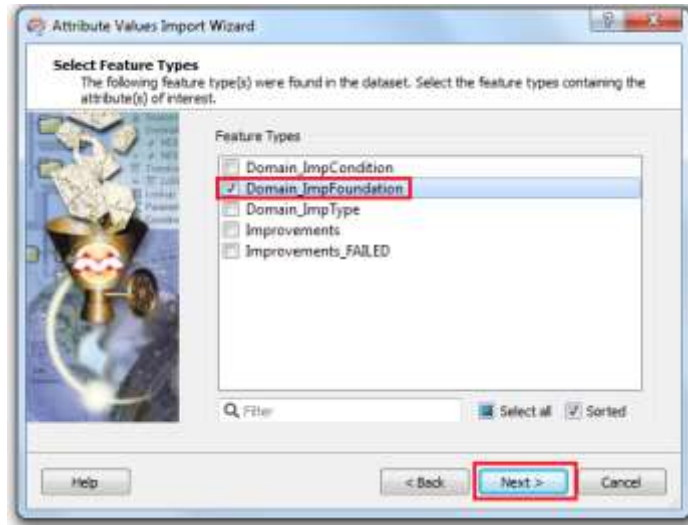
Before continuing make sure the contents in the Source Value and Destination Value fields are empty. In order to do this, click on the first row and press "Delete" on the keyboard. Do this for all the rows.
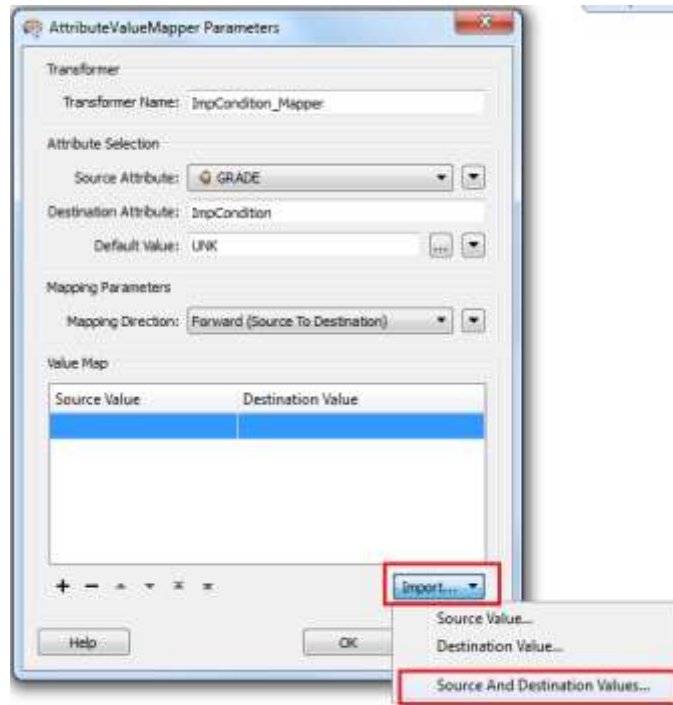

4. Click the **Import** button and choose **Source and Destination Values**.

5. Select **Esri Geodatabase (Personal Geodb)** for the Format

6. Click the **Browse** button and browse to
        …\PDM_WestVirginia\Data_Management\Models\Template\Analysis\
        Inventory\Improvements\
   **WV_<County Name>_Improvements.mdb**
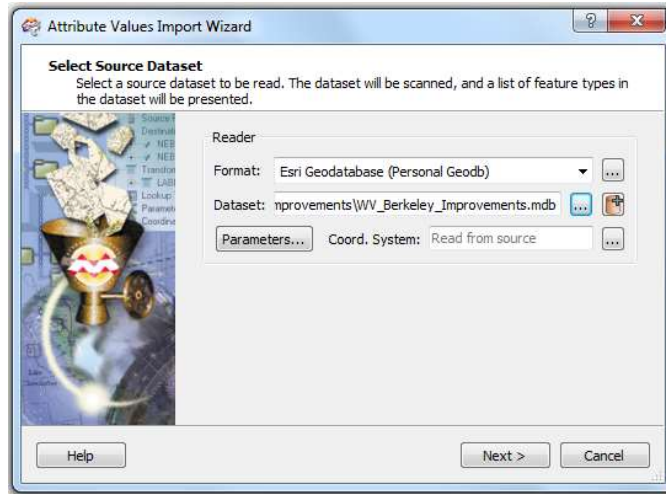
7. Click the **Next** button to access the Attributes Values Import Wizard.

8. Select the feature type **Domain_ImpCondition** and click the **Next** button.
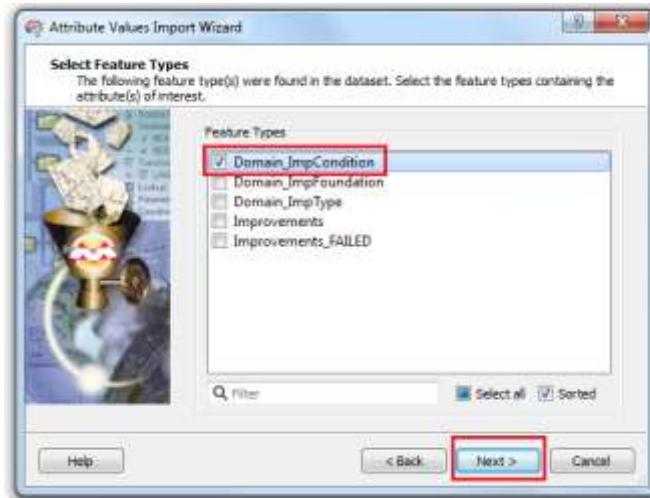
9. For Attributes for Source Value select **CAMA_Grade** and click the **Next** button.
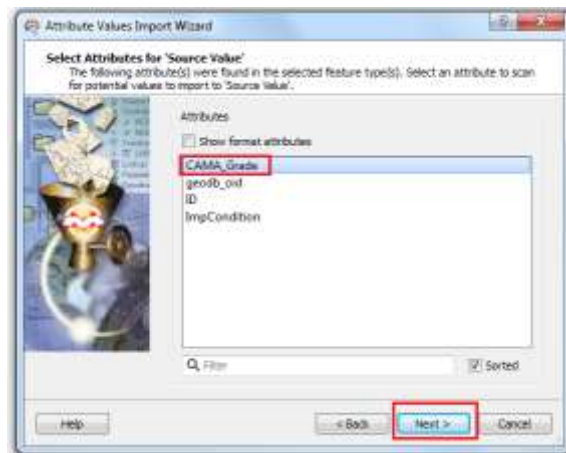
10. Select **ImpCondition** as the Destination Value attribute and click the **Next** button.
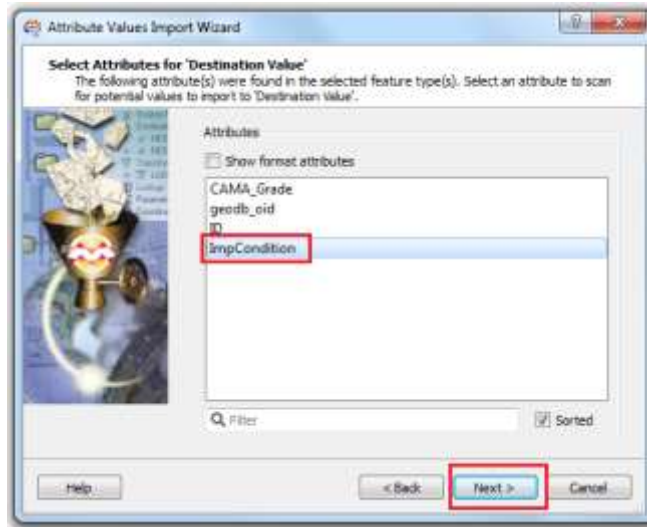
11. Click the **Import** button to import the source and destination value attributes.

12. Make sure under "Attribute Selection" of the "AttributeValueMapper Parameters" window, the following features are updated:

    o Source Attribute is set to "GRADE"

    o Destination Attribute is named as "ImpCondition"

    o Default Value is set to "UNK"
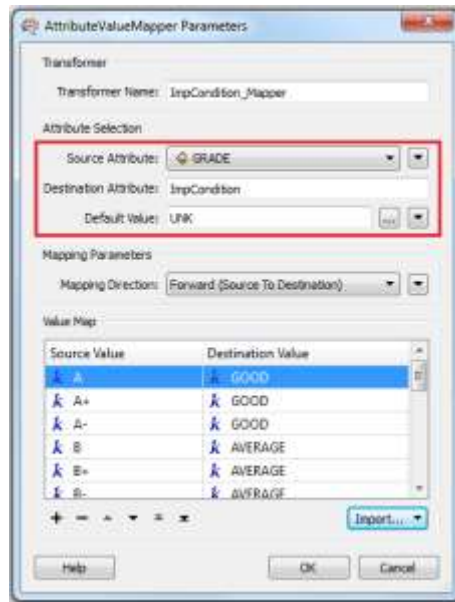
13. The Attribute Value Parameters window is now set for the Transformer "ImpCondition_Mapper". Click the **OK** button.

Domain_ImpType

Task 1: Create Domain_ImpType

1. Open the **WV_<County Name>_Assessor.mdb** located in
   …\PDM_WestVirginia\Data_Management\Data_Sources\<County Name>\Assessor

2. Create an MS Access query to find the unique values for **EXTWALL**.
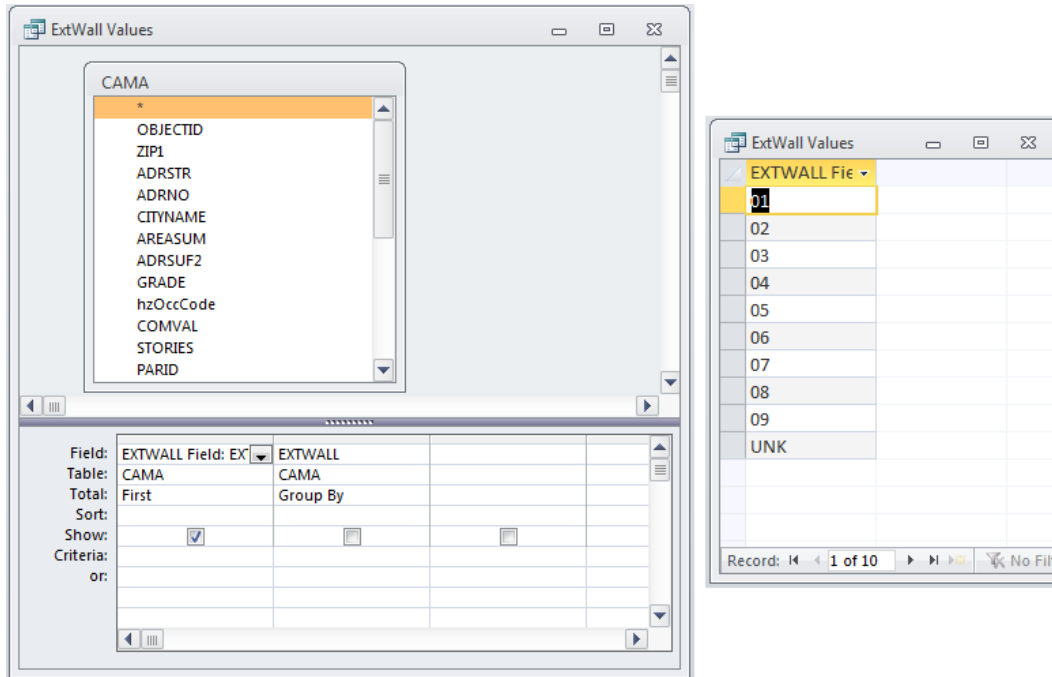
3. Export the table that the query created to **WV_<County Name>_Improvements.mdb** as
   Domain_ImpType

   Located in: …\PDM_WestVirginia\Data_Management\Models\<County
   Name>\Analysis\Inventory\Improvements

4. Create a new text field named ImpType.

5. Key in the values in the description **ImpType** field based on West Virginia Appraisal Manual.
   ("WV Appraisal Manual 2014". Refer to page 56)
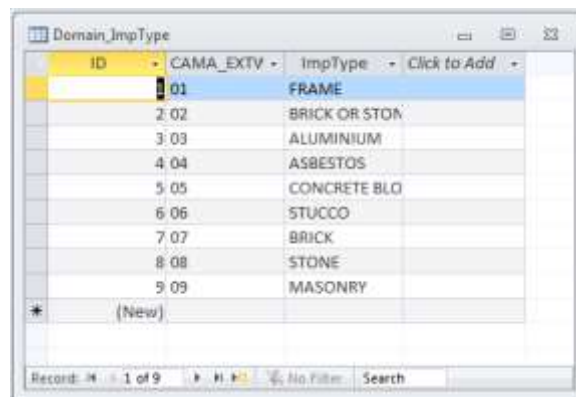
6. Save the table.

Task 2: Import Domain_ImpType

1. Start ArcMap and open **WV_<County Name>_BI_Productss.mxd** located in
   …\PDM_West Virginia\Data_Management\Models\<County Name>\MXD_Documents

2. Right-click on the **2.CAMA to Improvements** FME tool and choose **Edit**.

3. Click the sprocket in the upper right corner of the **ImpTypeMapper** to open the AttributeValue Parameters window.

Make sure the contents in the Source Value and Destination Value fields are empty. In order to do this, click on the first row and press "Delete" on the keyboard. Do this for all the rows.
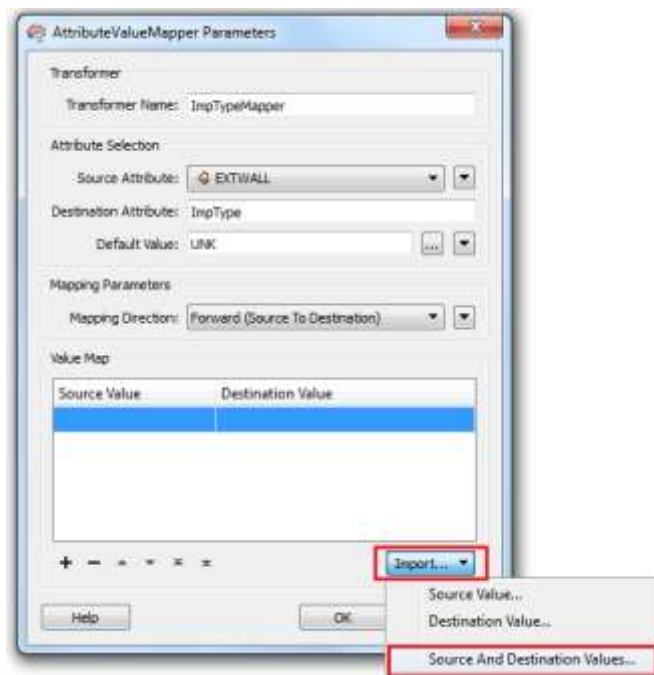
4. Click the **Import** button and choose **Source and Destination Values**.

5. Select **Esri Geodatabase (Personal Geodb)** for the Format.

6. Click the **Browse** button and browse to

   …\PDM_WestVirginia\Data_Management\Models\Template\Analysis\Inventory\Improvements\
   WV_<County Name>_Improvements.mdb

7. Click the **Next** button to access the Attributes Values Import Wizard.

8. Select the feature type **Domain_ImpType** and click the **Next** button.
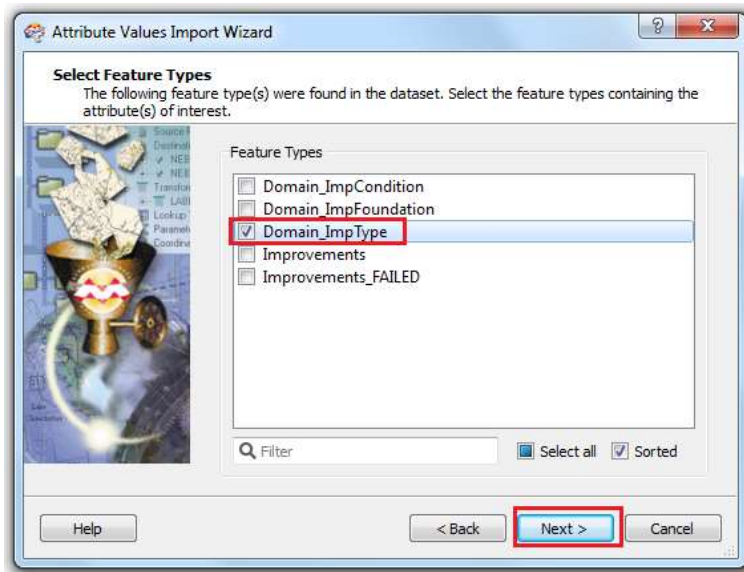
9. For Attributes for Source Value select **CAMA_EXTWALL** as shown below and click the **Next** button.
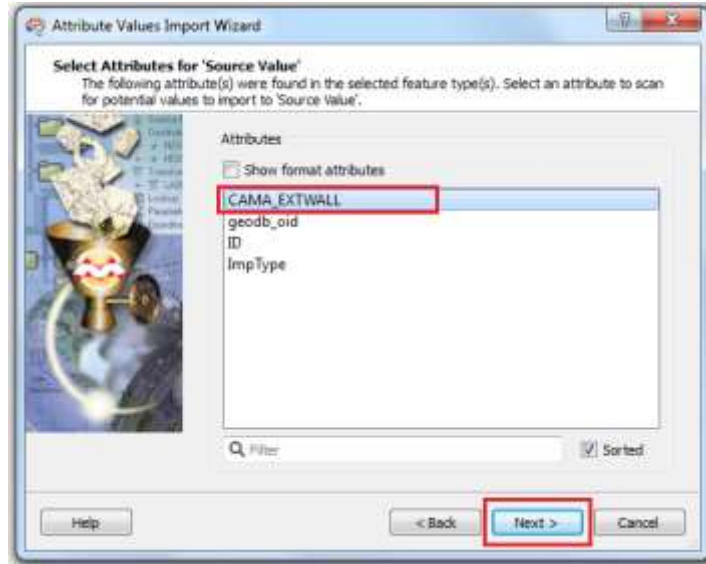
10. For Attributes for Destination Value select **ImpType** as shown below and click the **Next** button.
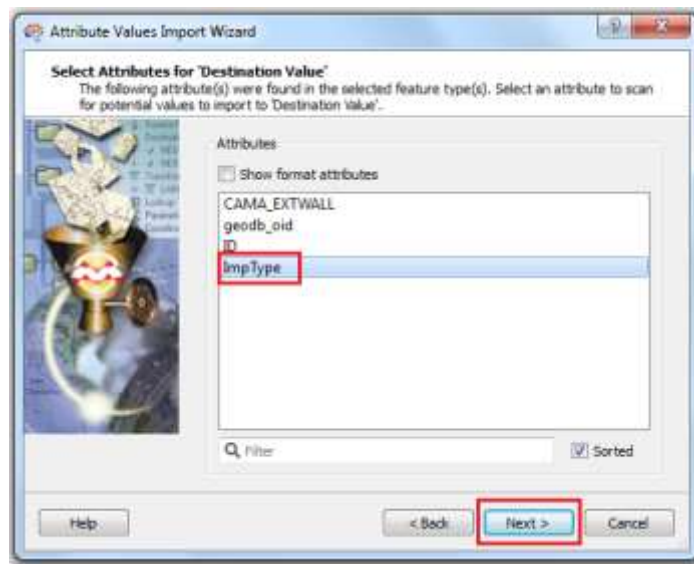
11. Click the **Import** button to import the source and destination value attributes.

12. Make sure under "Attribute Selection" of the "AttributeValueMapper Parameters" window, the following features are updated:

    o   Source Attribute is set to "EXTWALL"

    o   Destination Attribute is named as "ImpType"

    o   Default Value is set to "UNK"
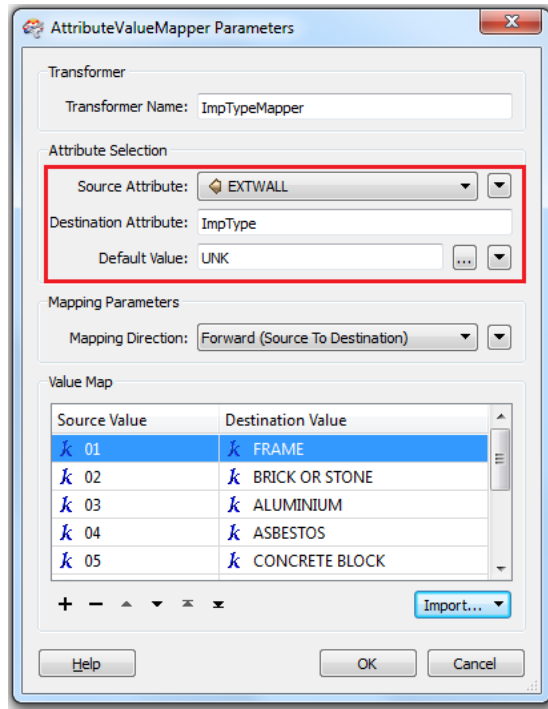
13. The Attribute Value Parameters window is now set for the Transformer "ImpTypeMapper".

14. Click the **OK** button.

Domain_ImpFoundation

Task 1: Create Domain_ImpFoundation

1. Open **WV_<County Name>_Assessor.mdb** located in
   …\PDM_WestVirginia\Data_Management\Data_Sources\<County Name>\Assessor

2. Create an MS Access query to find the unique values for **BSMT**.
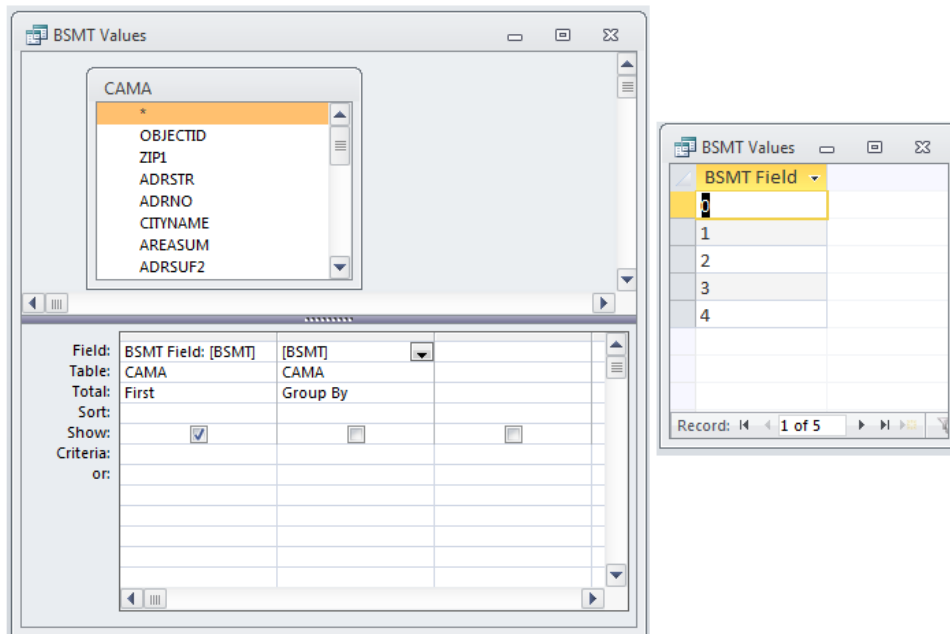
3. Export the table to **WV_<County Name>_Improvements.mdb** as **Domain_ImpFoundation**

> Located in: …\PDM_WestVirginia\Data_Management\Models\<County Name>\Analysis\Inventory\Improvements

4. Create a new text field named ImpFoundation.

5. Key in the values in the description **ImpFoundation** field based on West Virginia Appraisal Manual. ("WV Appraisal Manual 2014". Refer to page 59)

6. Save the table.

Task 2: Import Domain_ImpFoundation

1. Start ArcMap and open **WV_<County Name>_BI_Updates.mxd** located in
   …\PDM_West Virginia\Data_Management\Models\<County Name>\MXD_Documents

2. Right-click on the **2.CAMA to Improvements** FME tool and choose **Edit**.

3. Click the sprocket in the upper right corner of the **ImpFoundationType_Mapper** to open the AttributeValue Parameters window.

Make sure the contents in the Source Value and Destination Value fields are empty. In order to do this, click on the first row and press "Delete" on the keyboard. Do this for all the rows.

4. Click the **Import** button and choose **Source and Destination Values**.

5. Select **Esri Geodatabase (Personal Geodb)** for the Format

6. Click the **Browse** button and browse to

…\PDM_WestVirginia\Data_Management\Models\Template\Analysis\Inventory\Improvements\
WV_<County Name>_Improvements.mdb

7. Click the **Next** button to access the Attributes Values Import Wizard.

8. Select the feature type **Domain_ImpFoundation** and click the **Next** button.

9. For Select Attributes for Source Value choose **CAMA_BSMT** as shown below and click the **Next** button.
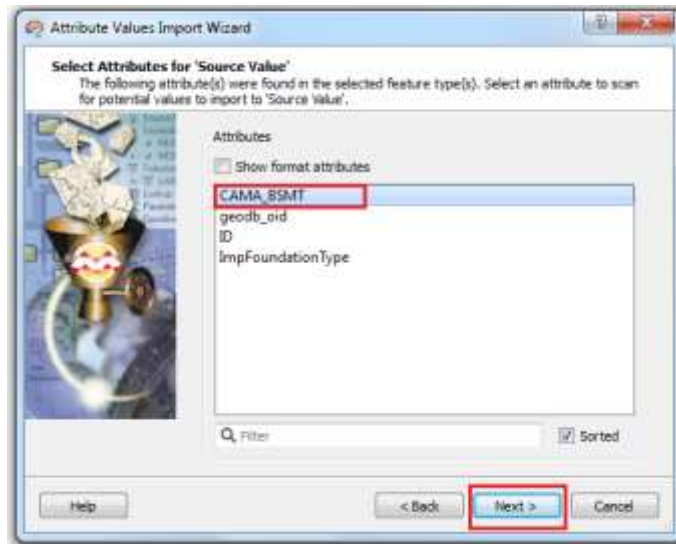
10. For Select Attributes for Destination Value choose **ImpFoundationType** as shown below and click the **Next** button.
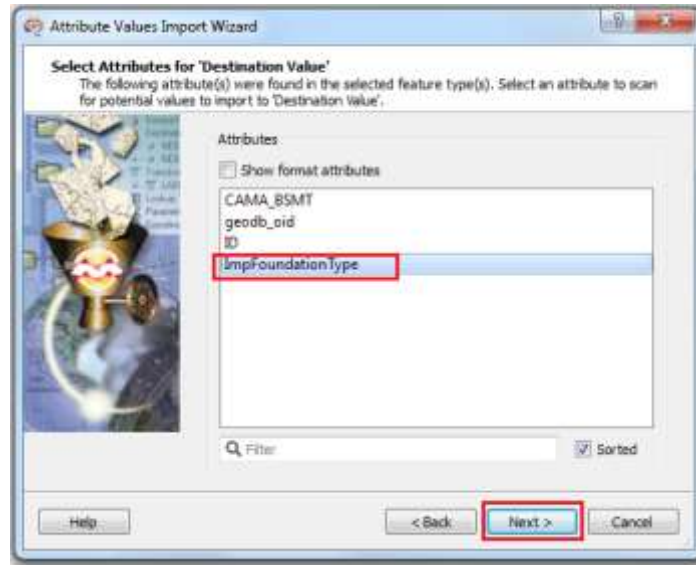
11. Click the **Import** button to import the destination value attributes.

12. Make sure under "Attribute Selection" of the "AttributeValueMapper Parameters" window, the following features are updated:

   o   Source Attribute is set to "BSMT"

   o   Destination Attribute is named as "ImpFoundationType"

   o   Default Value is set to "UNK"
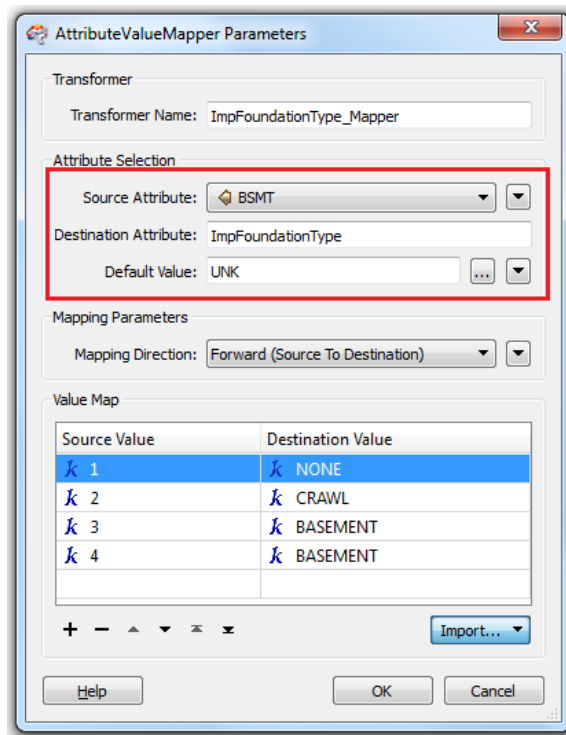
13. The Attribute Value Parameters window is now set for the Transformer "ImpFoundationType_Mapper". Click the **OK** button.

Creating ImpCost from CAMA table

In order to create a single cost field that gives the cost of each building, the following fields from the CAMA table are used for calculating the improvement cost (ImpCost):

1. COMVAL: represents the commercial value.

2. DWELVAL: represents residential or dwelling value

3. OBYVAL: represents other building yard value, which is an additional cost field added to COMVAL and DWELVAL.

The following assumptions were made in the template with respect to building cost for occupancy classes. You may modify these assumptions at your discretion.

- The building cost for commercial occupancy classes are derived from COMVAL and OBYVAL. **Refer to "Other_OccCode_Cost_Cal" in the "2. CAMA to Improvements" FME script.**
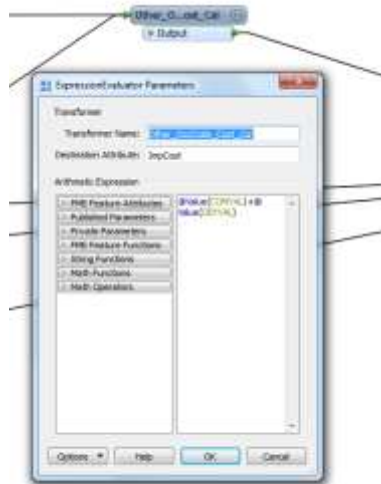
- The building cost for residential are derived from DWELVAL and OBYVAL. **Refer to "RES_Cost_Cal" in the "2. CAMA to Improvements" FME script.**
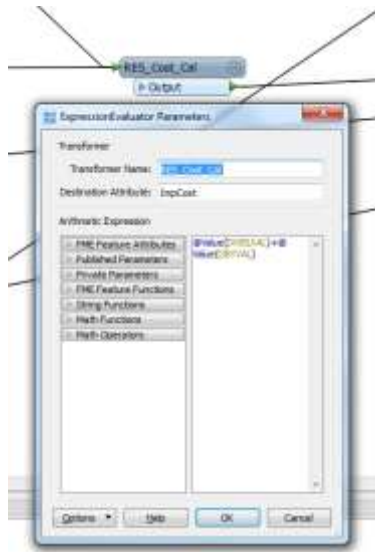
- The building cost for occupancy classes other than commercial or residential are derived from COMVAL+DWELVAL. **Refer to "Other_OccCode_Cost_Cal" in the "2. CAMA to Improvements" FME script.**
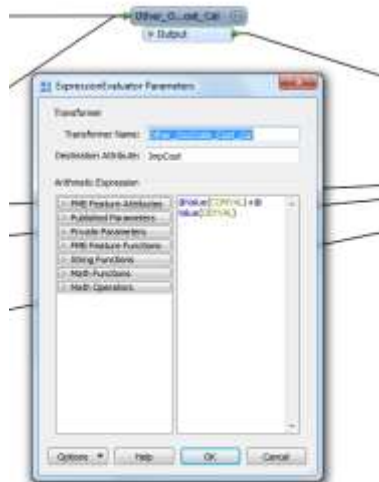
- The undefined or unknown (UNK) occupancy classes are defaulted to commercial or residential based on the cost value provided for those respective records. The following assumptions are made with respect to "UNK" occupancy class assignment:

  o "UNK" Records with COMVAL are assigned COM1 hazus occupancy class

  o "UNK" Records with DWELVAL are assigned RES1 hazus occupancy class

APPENDIX 2   FME MATRIX TABLES AND DOMAIN DEVELOPMENT FOR BUILDING INVENTORY

For the template, the following domain and matrix tables were created and imported into the FME script "**4.Building Points To Building Inventory**" prior to running the FME script. You may update these at your discretion to reflect differences between the pilot county and your county.

Note: Domains are tables created in the access geodatabase which give the description of the codes. Matrices are tables created in the access geodatabase which convert the codes into Hazus specific codes.

1. **Domains**:

   - Domain_YearBuilt

   - Domain_FirstFloorHt: This domain is not created. It is imported into "FirstFloorHt_Mapper" transformer in the "4. Building Points to Building Inventory" FME script.

   The domains below are not created but used as references for creating the matrices: Matrix_BldgConstruction, Matrix_BldgFoundation and Matrix_BldgCondition

   These domains can be found in the "WV_<County Name>_BI_GDB.mdb" located in

   > …\PDM_WestVirginia\Data_Management\Models\<County Name>\Analysis\Inventory\Building_Inventory

   - Domain_BldgConstruction

   - Domain_BldgFoundation

   - Domain_BldgCondition

2. **Matrices**:

   - Matrix_BldgConstruction

   - Matrix_BldgFoundation

   - Matrix_BldgCondition

3. **XFactors_DolSqFt: This table is created using an FME script. It is imported into "ImpArea_Mapper" transformer in the"4. Building Points to Building Inventory" FME script to populate the records without Building Area.**

I. DOMAINS

Domain_YearBuilt
This domain is created to populate the missing or blank year built records in the cama data. The most frequently occurring, or mode, year built per occupancy is used to populate the blank year built. You may modify this for your needs at your discretion.

Task 1: Create Domain_YearBuilt using FME script.

1. Open **WV_<County Name>_BI_Products.mxd** located in
    ...\Data_Management\Models\Berkeley\MXD_Documents

2. Right click | edit **3a. Domain Year Built Creator**.

3. Set the Source file to:
    …\<County Name>\Analysis\Inventory\Improvements\
        WV_<County Name>_Improvements.mdb

4. Set the Destination file to:
    …\<County Name>\Analysis\Inventory\Building_Inventory
        WV_<County Name>_BI_GDB.mdb
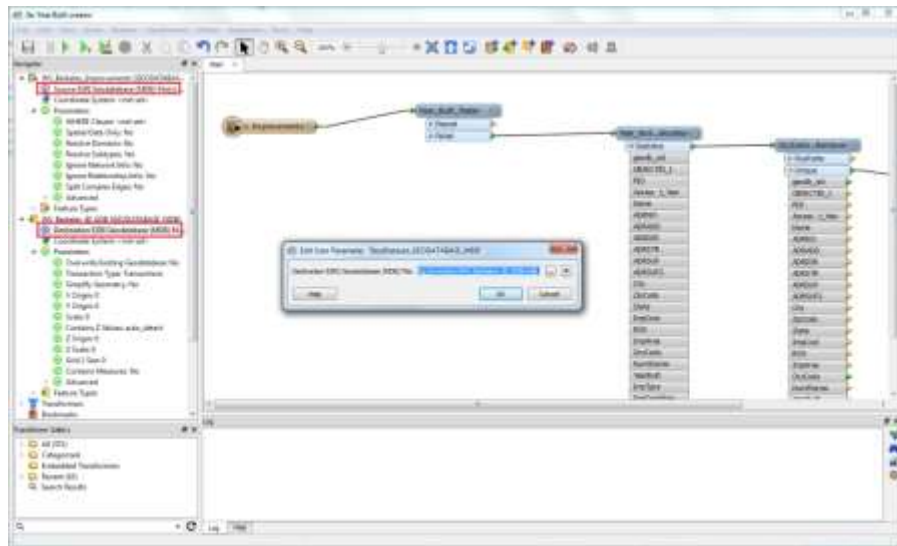
5. The **Year Built Tester** transformer tests for values in Year_Built which are "null" or "0" or "<1800" or "2020".
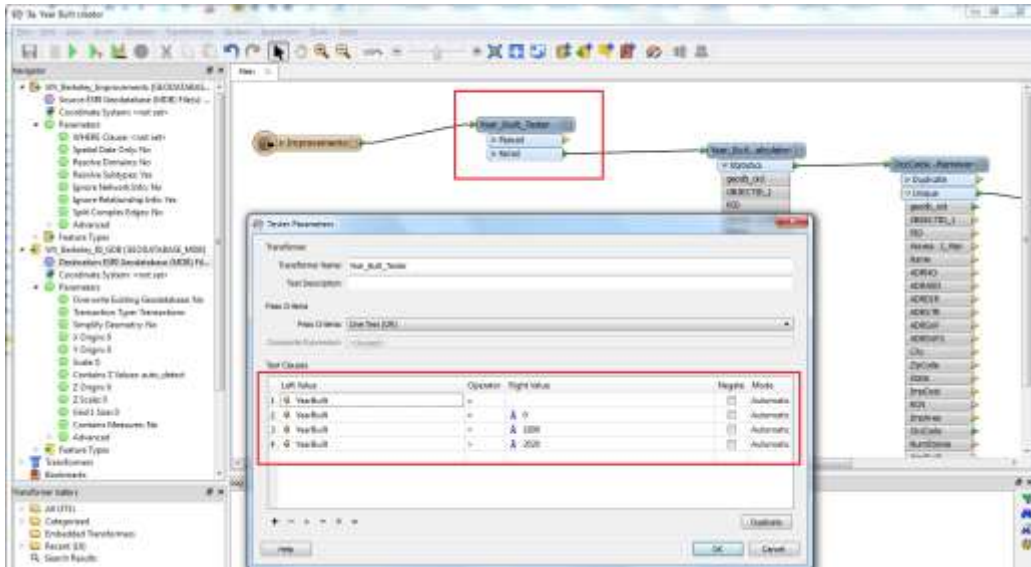
6. The **Year Built Statistics Calculator** calculates the most frequently occurring year built or Mode.
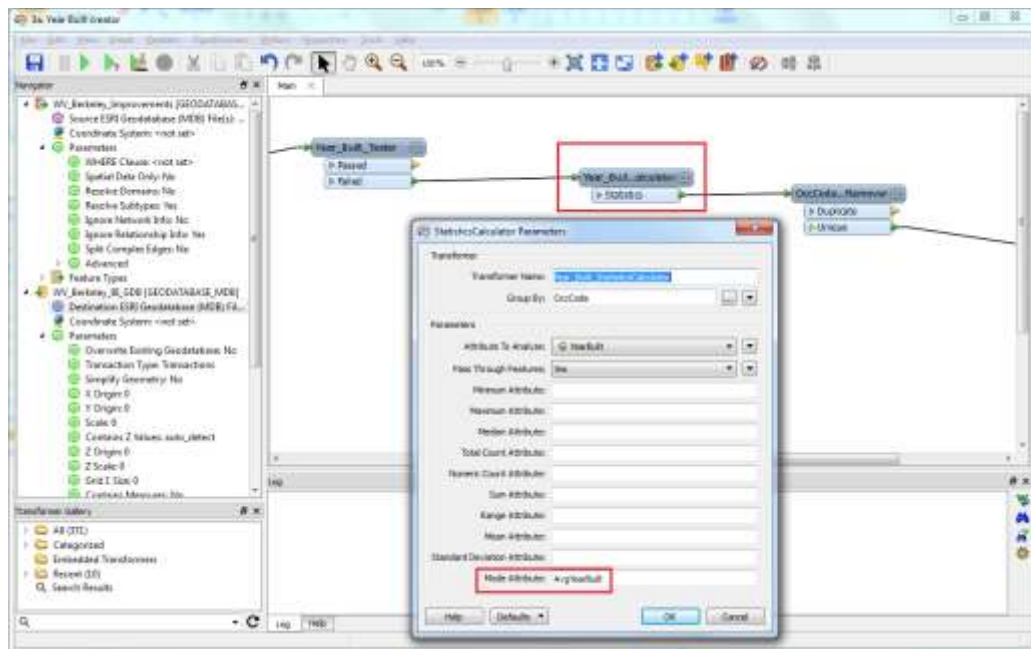
7. The **Occupancy Code duplicate remover** groups the records by Occupancy Code and assigns the Mode year built values to the corresponding occupancy codes.
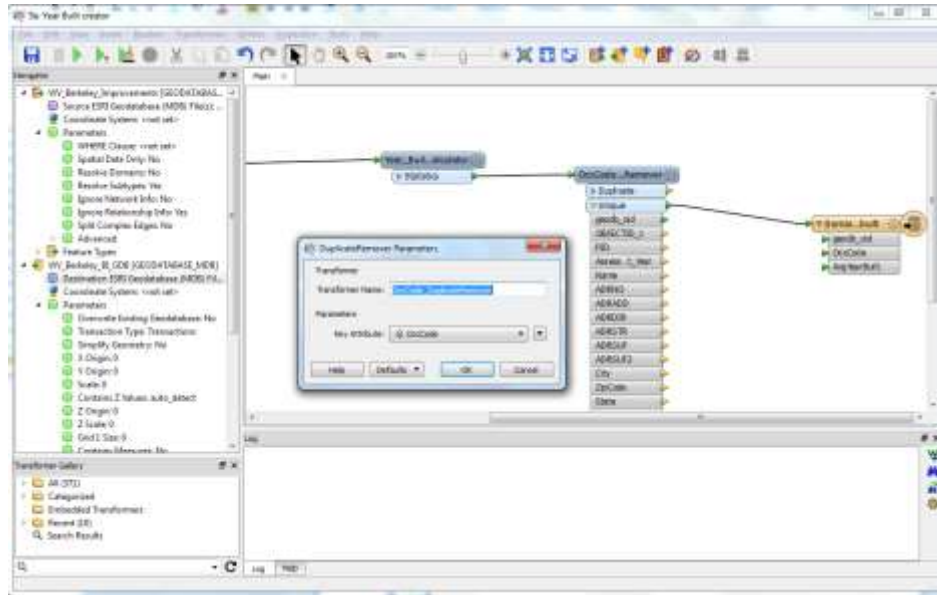
8. Under the **Writers** menu, select **Add Feature Type** and rename it to **Domain_YearBuilt**.

    A new feature type will be added to the destination geodatabase. (refer screenshots below)

9. The destination table **Domain_YearBuilt** contains the Year Built values for the corresponding occupancy classes.
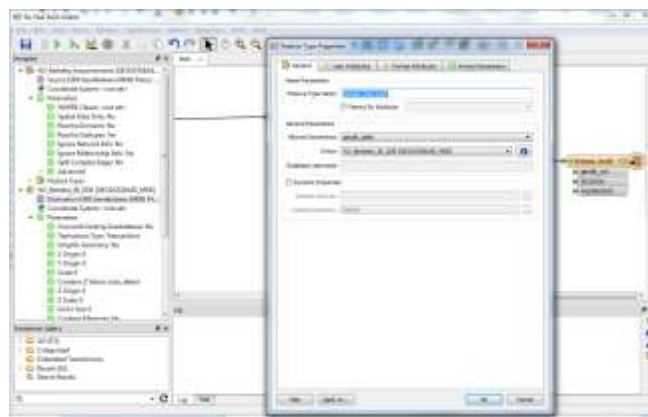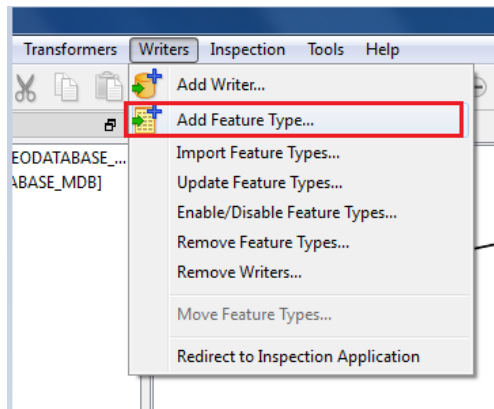
10. Right-click on the transformer **Domain_Year_Built**. Select **Copy attributes from a transformer**. Select **AttributeKeeper** transformer from the dropdown list.
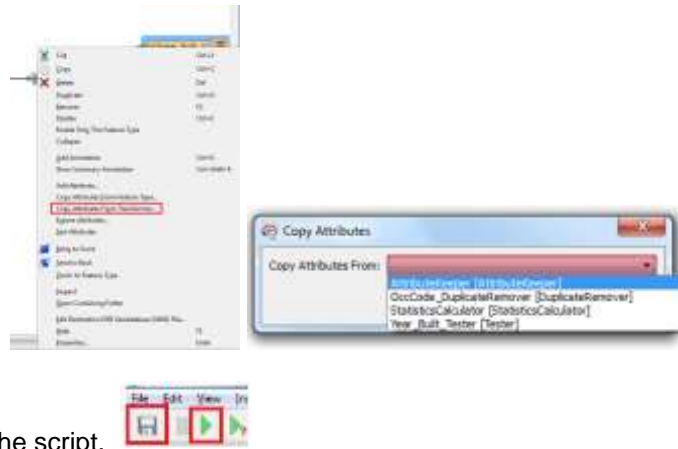
11. Save and run the script.

12. Open the output table **Domain_YearBuilt** from "WV_<County Name>_BI_GDB.mdb".

Task 2: Import Domain_YearBuilt into "YearBuilt_Mapper" transformer in the **Building Points To Building Inventory** FME script.

1. Start ArcMap and open **WV_<County Name>_BI_Products.mxd** located in

    …\PDM_West Virginia\Data_Management\Models\<County Name>\MXD_Documents

2. Right-click on the **4. Building Points to Building Inventory** FME tool and choose **Edit**.

3. Click the sprocket in the upper right corner of the "YearBuilt_Mapper" to open the AttributeValue Parameters window.

Make sure the contents in the Source Value and Destination Value fields are empty. In order to do this, click on the first row and press "Delete" on the keyboard. Do this for all the rows.

4. Click the **Import** button and choose **Source and Destination Values**.
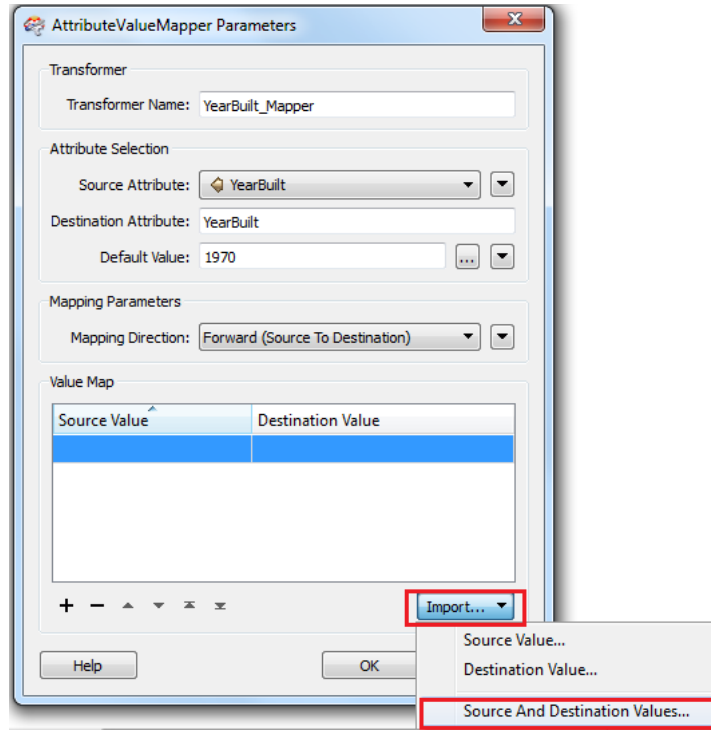
5. Select **Esri Geodatabase (Personal Geodb)** for the format.

6. Click the **Browse** button and browse to
   …\PDM_WestVirginia\Data_Management\Models\<County
   Name>\Analysis\Inventory\Building_Inventory
   WV_<County Name>_BI_GDB.mdb

7. Click the **Next** button to access the Attributes Values Import Wizard.

8. Select the feature type **Domain_YearBuilt** and click the **Next** button.
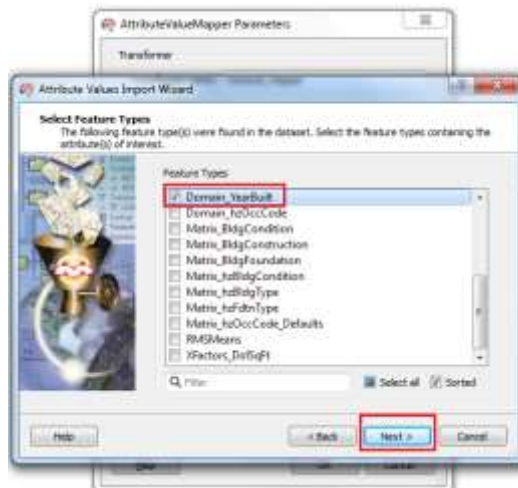
9. For Attributes for Source Value select **hzOccCode** as shown below and click the **Next** button.
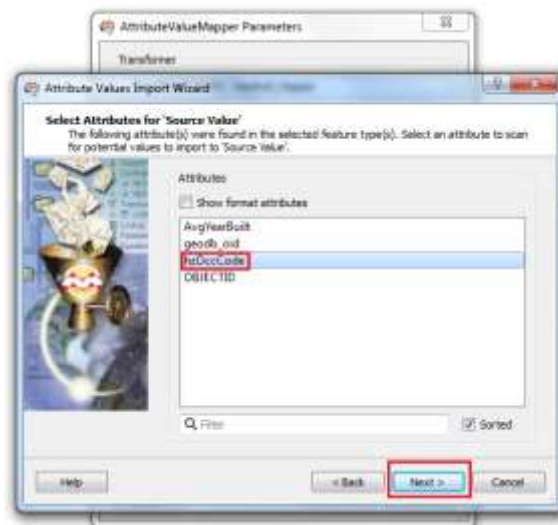
10. Select the feature type **AvgYearBuilt** for the Destination Value and click the **Next** button.
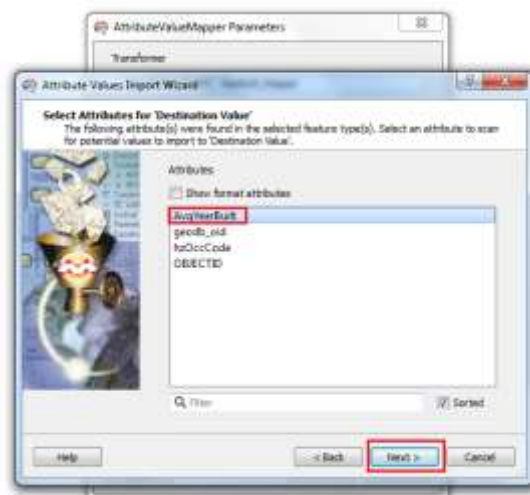
11. Click the **Import** button to import the destination value attributes.

12. Make sure under "Attribute Selection" of the "AttributeValueMapper Parameters" window, the following features are updated:

    o   Source Attribute is set to "YearBuilt"

    o   Destination Attribute is named as "YearBuilt"

    o   Default Value is set to "1970"
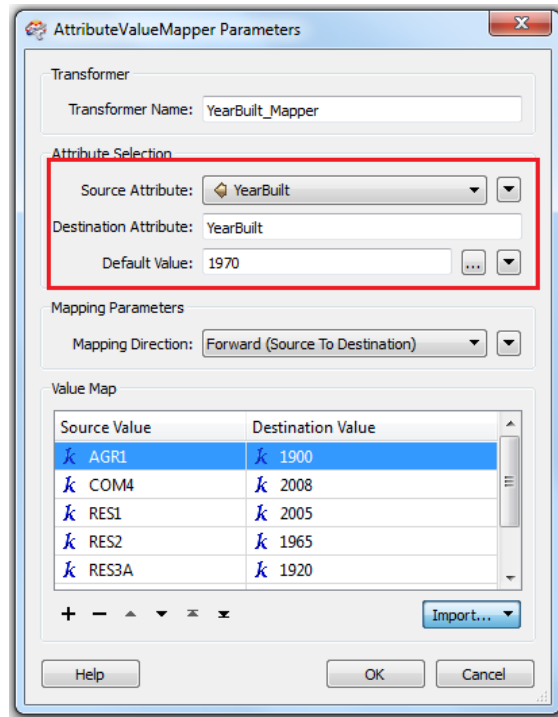
13. The Attribute Value Parameters window is now set for the Transformer "**YearBuilt_Mapper**". Click the **OK** button.

Domain_FirstFloorHt

"Domain_FirstFloorHt" is the domain table located in "WV_County_BI_GDB.mdb" under,

> …\PDM_WestVirginia\Data_Management\Models\<County Name>\Analysis\Inventory\Building_Inventory

Task 1: Import Domain_FirstFloorHt into "FirstFloorHt_Mapper" transformer in the **Building Points To Building Inventory** FME script.

1. Start ArcMap and open **WV_<County Name>_BI_Updates.mxd** located in

> …\PDM_West Virginia\Data_Management\Models\<County Name>\MXD_Documents

2. Right-click on the **4. Building Points to Building Inventory** FME tool and choose **Edit**.

3. Click the sprocket in the upper right corner of the **FirstFloorHt_Mapper** to open the AttributeValue Parameters window.
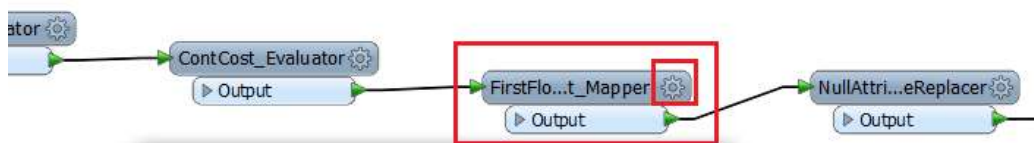

Make sure the contents in the Source Value and Destination Value fields are empty. In order to do this, click on the first row and press "Delete" on the keyboard. Do this for all the rows.

4. Click the **Import** button and choose **Source and Destination Values**.
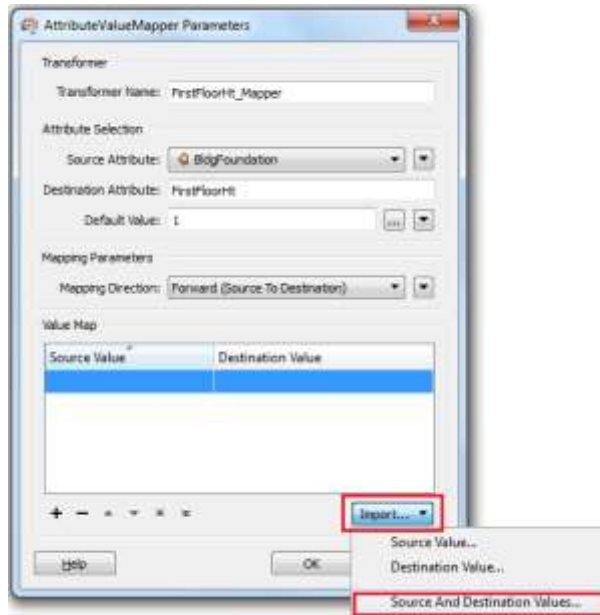
5. Select **Esri Geodatabase (Personal Geodb)** for the Format

6. Click the **Browse** button and browse to
    …\PDM_WestVirginia\Data_Management\Models\<County Name>\Analysis\Inventory\Building_Inventory
    WV_<County Name>_BI_GDB.mdb

7. Click the **Next** button to access the Attributes Values Import Wizard.

8. Select the feature type **Domain_FirstFloorHt** and click the **Next** button.
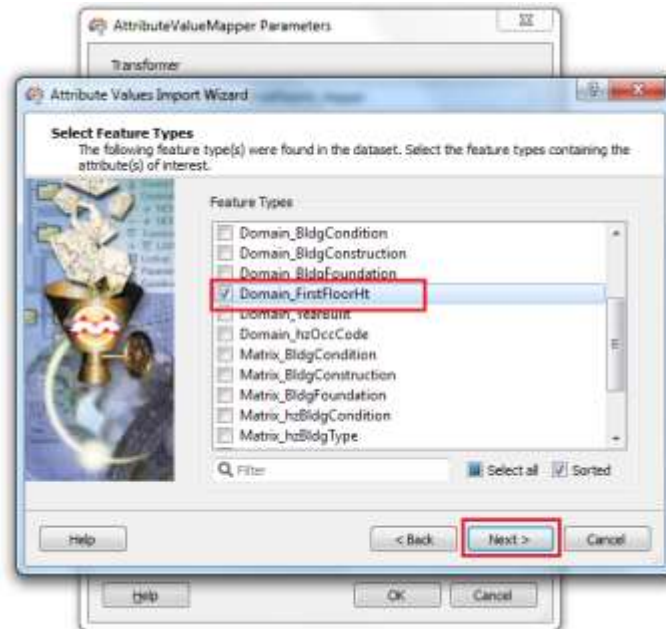
9. For Select Attributes for Source Value select **Description** as shown below and click the **Next** button.
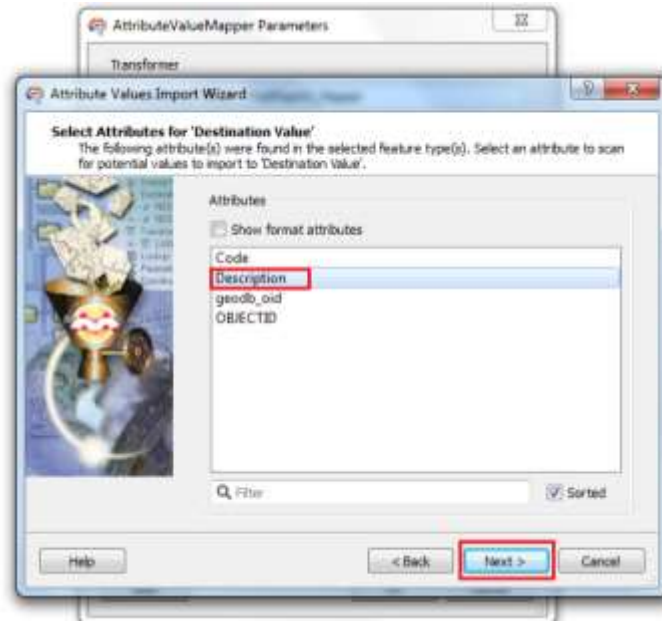
10. Select the feature type **Code** for the Destination Value and click the **Next** button.
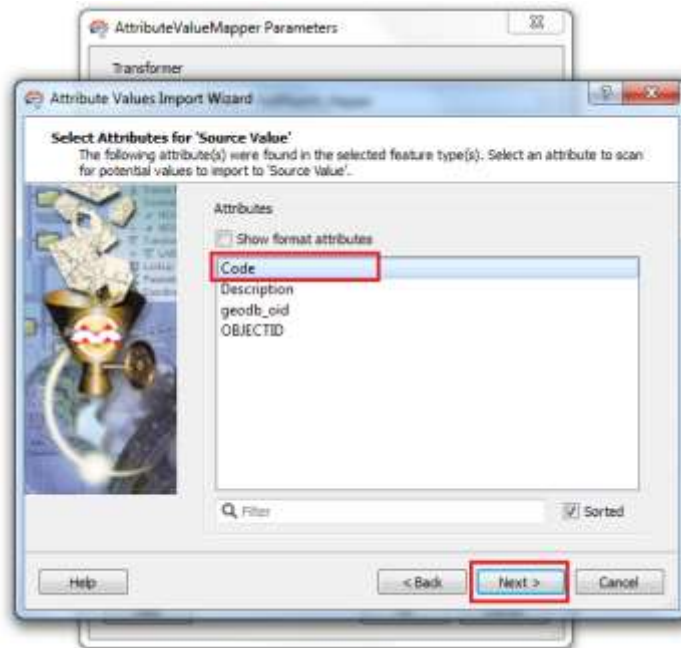
11. Click the **Import** button to import the destination value attributes.

12. Make sure under "Attribute Selection" of the "AttributeValueMapper Parameters" window, the following features are updated:

- Source Attribute is set to "BldgFoundation"

- Destination Attribute is named as "FirstFloorHt"

- Default Value is set to "1"
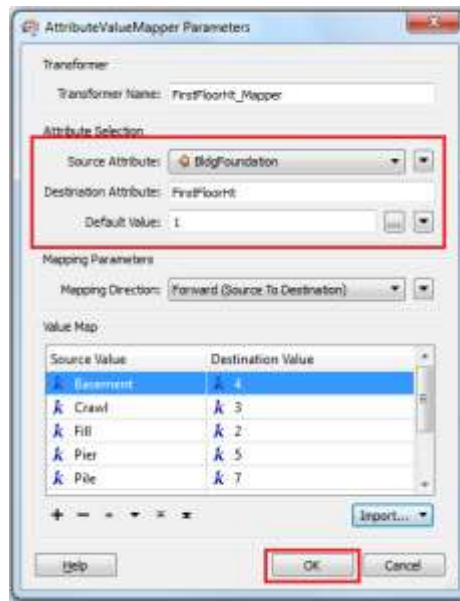
13. The Attribute Value Parameters window is now set for the Transformer "FirstFloorHt_Mapper". Click the **OK** button.

II. MATRICES

The purpose of creating the below Matrix tables is to convert the cama codes into Hazus compliant codes, so that the features can be imported into Hazus for the analyses.

**Matrix_BldgConstruction**

<u>Task 1:</u> Create Matrix_BldgConstruction

1. Open **WV_<County Name>_BI.mdb** located in
    ...\PDM_WestVirginia\Data_Management\Models\<County
    Name>\Analysis\Inventory\Building_Inventory

2. Import the **Domain_BldgConstruction** table from **WV_County_Improvements.mdb** located in
    …\PDM_WestVirginia\Data_Management\Models\<County
    Name>\Analysis\Inventory\Improvements
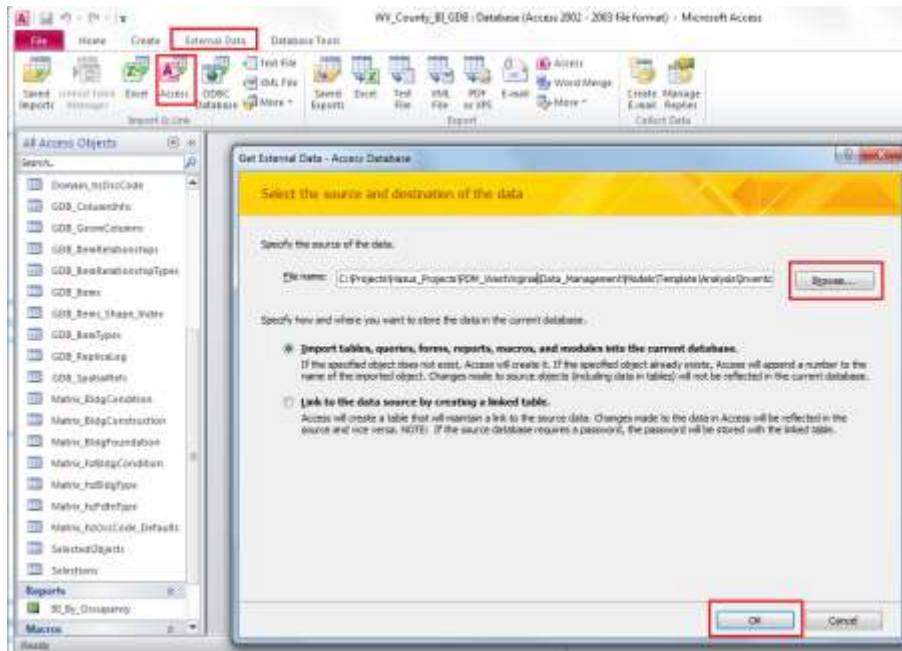
**Note: The purpose of importing the domain table is to inherit the source column "ImpType" which contains the source values that will be converted to Hazus compliant values in the matrix table.**

3. Select the **Domain_ImpType** table and click **OK**.
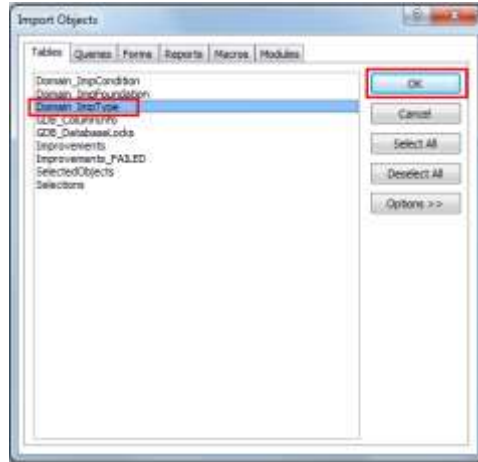
4. The table "Domain_ImpType" is now imported into "WV_County_BI_GDB.mdb".

5. Rename the table name from Domain_ImpType to **Matrix_BldgConstruction** and open the table.

6. Click on the **Design View** button on top left hand corner of the Access window.
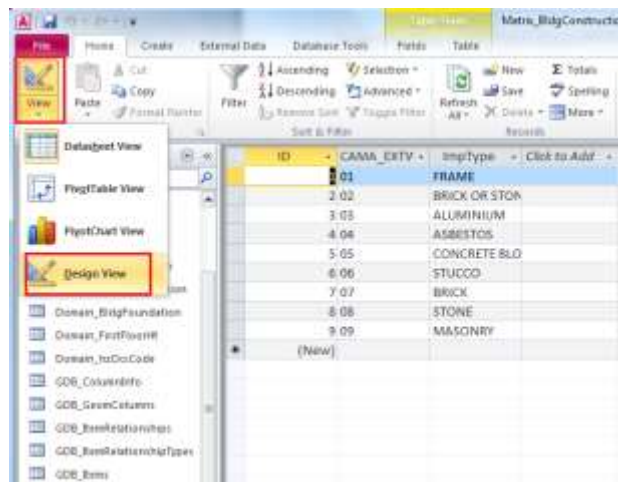
7. Delete the field **CAMA_EXTWALL**.   Rename the field "ImpType" to **Bldg_Extwall**. Also, add another field with the name **BI_BldgConstruction** with the format "text" and length "10". Please see the screenshots below.
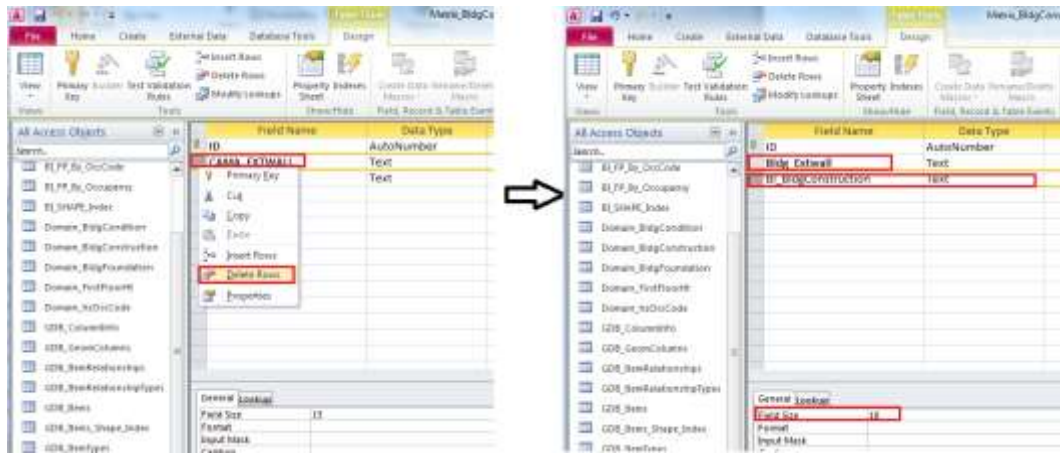
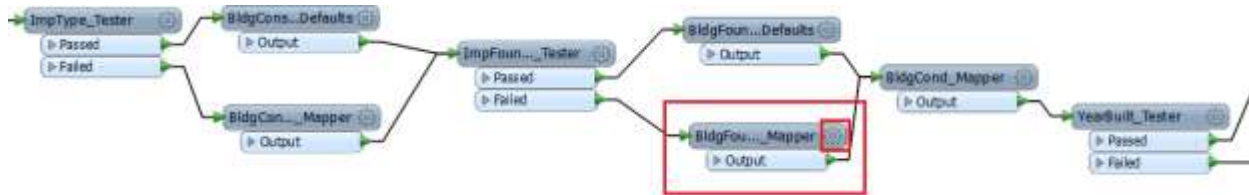8. Refer to the code description provided in West Virginia Appraisal Manual 2014 pages 56 and 57 and, based on your judgement, enter the most probable construction material in the **BI_BldgConstruction** field.

   Note: Also refer to the "Domain_BldgConstruction" table located in "WV_<County Name>_BI_GDB" under

   …\PDM_WestVirginia\Data_Management\Models\<County Name>\Analysis\Inventory\Building_Inventory

9. The complete matrix table should look similar to the one below.
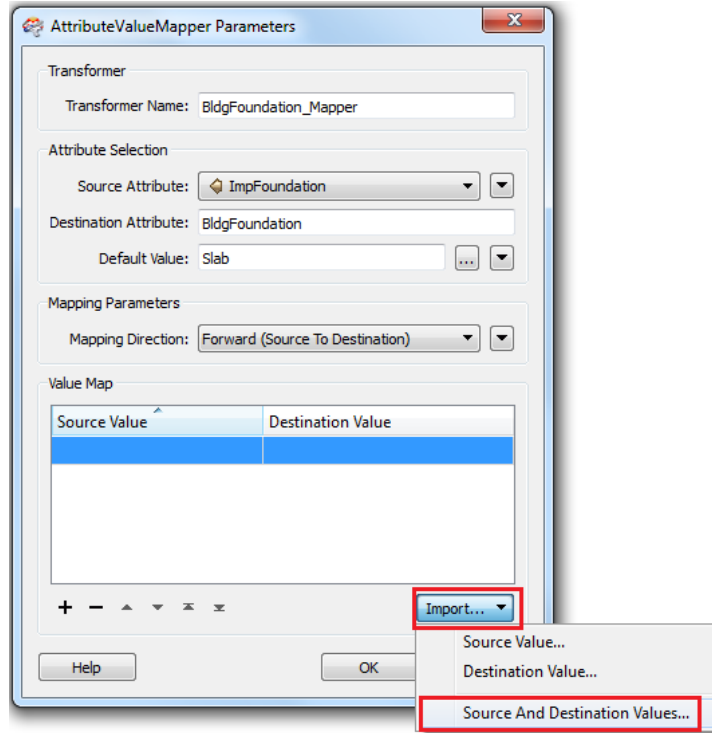

Task 2: In this task you will import the "Matrix_BldgConstruction" in to "BldgConstruction_Mapper" in the "**Building Points To Building Inventory"** FME script.

1. Start ArcMap and open **WV_<County Name>_BI_Products.mxd** located in …\Data_Management\Models\<County Name>\MXD_Documents

2. Right-click on the **4. Building Points to Building Inventory** FME tool and choose **Edit**.

3. Click the sprocket in the upper right corner of the **Building Construction Mapper** to open the AttributeValue Parameters window.

Make sure the contents in the Source Value and Destination Value fields are empty. In order to do this, click on the first row and press "Delete" on the keyboard. Do this for all the rows.

4. Click the **Import** button and choose **Source and Destination Values**.

5. Select **Esri Geodatabase (Personal Geodb)** for the Format.

6. Click the **Browse** button and browse to
   …\PDM_WestVirginia\Data_Management\Models\Berkeley\Analysis\Inventory\Building_
   Inventory
   WV_<County Name>_BI_GDB.mdb

7. Click the **Next** button to access the Attributes Values Import Wizard.

8. Select the feature type **Matrix_BldgConstruction** and click the **Next** button.
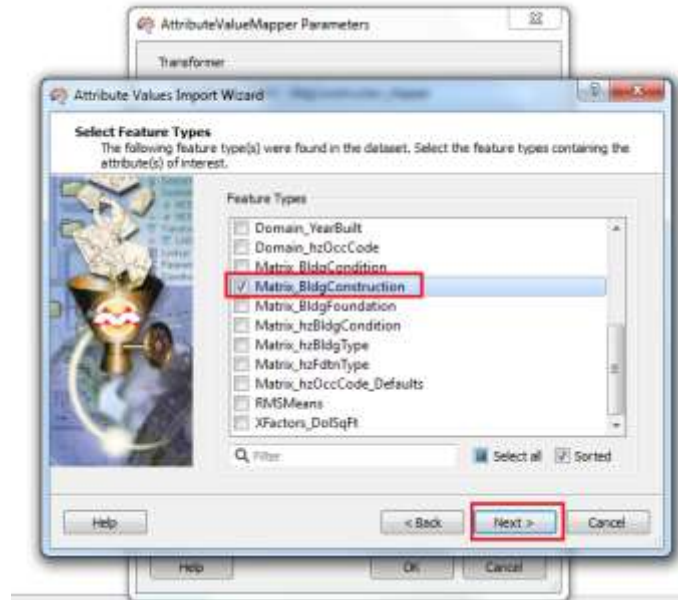
9. For the Select Attributes for Source Value choose **Bldg_Extwall** as shown below and click the **Next** button.
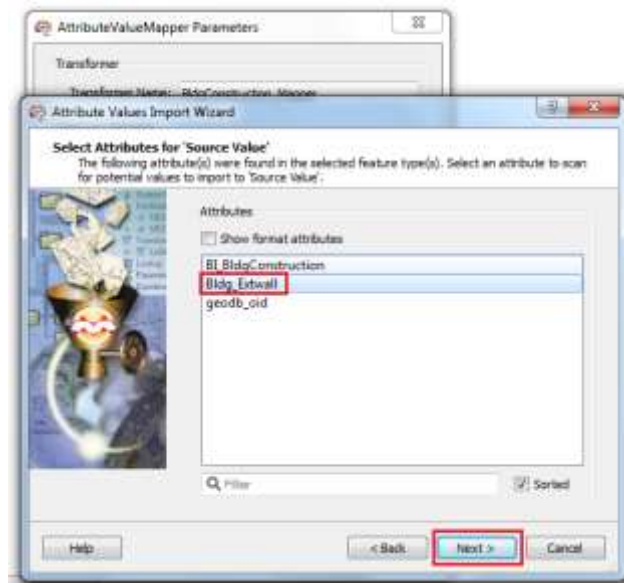
10. Select the feature type **BI_BldgConstruction** for Destination Value and click the **Next** button.
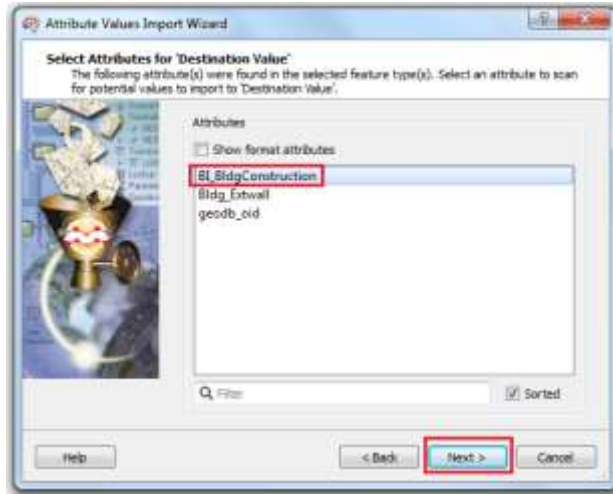
11. Click the **Import** button to import the destination value attributes.

12. Make sure under the "Attribute Selection" of the "AttributeValueMapper Parameters" window, the following features are updated:

- Source Attribute is set to "ImpType"

- Destination Attribute is named as "BldgConstruction"

- Default Value is set to "Wood"
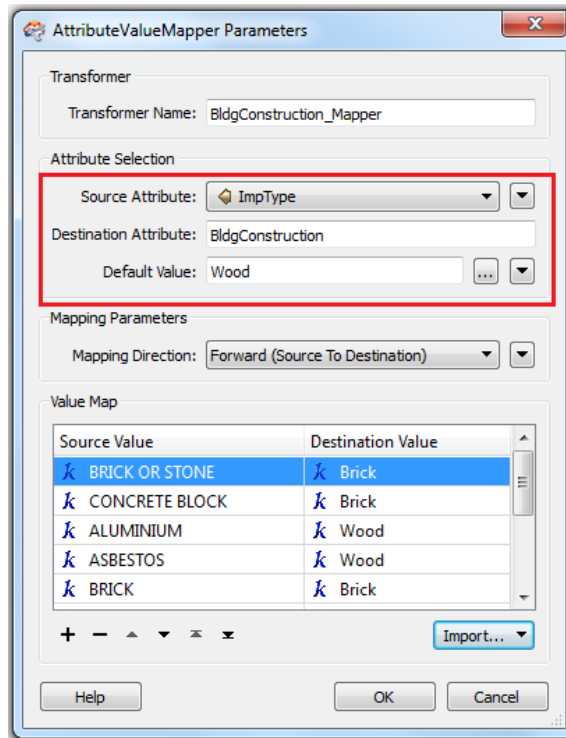
13. The BldgConstruction_Mapper transformer is now updated in the script.

Matrix_BldgFoundation

Task 1: Create Matrix_BldgFoundation

1. Open **WV_<County Name>_BI.mdb** located in
   ...\PDM_WestVirginia\Data_Management\Models\<County
   Name>\Analysis\Inventory\Building_Inventory

2. Import the "**Domain_BldgFoundation**" table from "WV_County_Improvements.mdb" located in
   …\PDM_WestVirginia\Data_Management\Models\<County
   Name>\Analysis\Inventory\Improvements
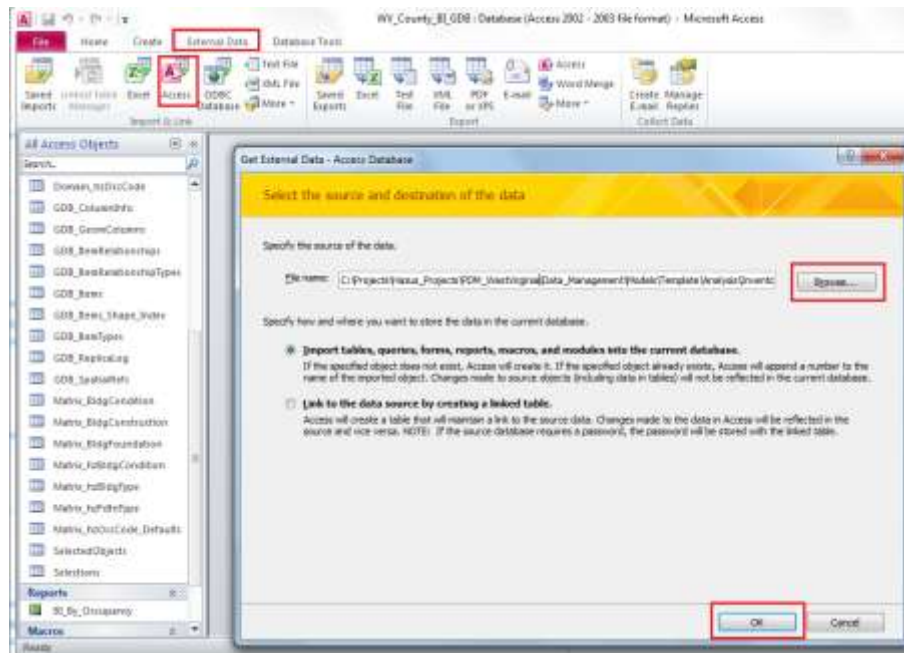
Note: The purpose of importing the domain table is to inherit the source column "ImpFoundation" which contains the source values that will be converted to Hazus compliant values in the matrix table.

3. Select the **Domain_ImpFoundation** table and click **OK**.
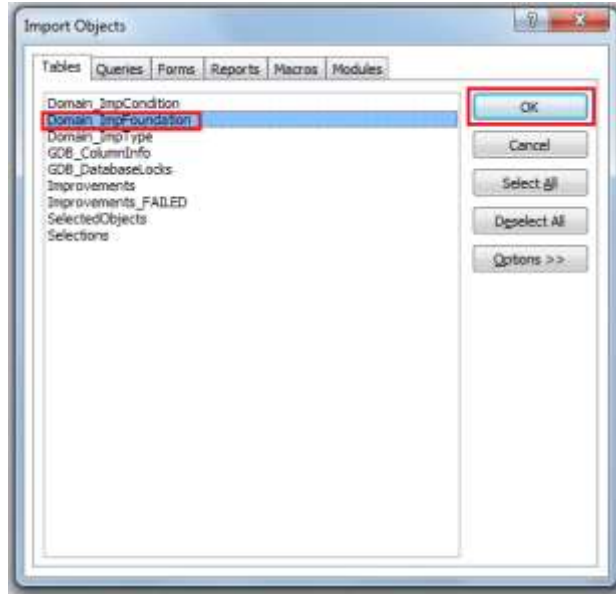
The table "Domain_ImpFoundation" is now imported into "WV_County_BI_GDB.mdb".

4. Rename the table name from **Domain_ImpFoundation** to **Matrix_BldgFoundation** and open the table.

5. Click on the **Design View** button on top left hand corner of the MS Access window.
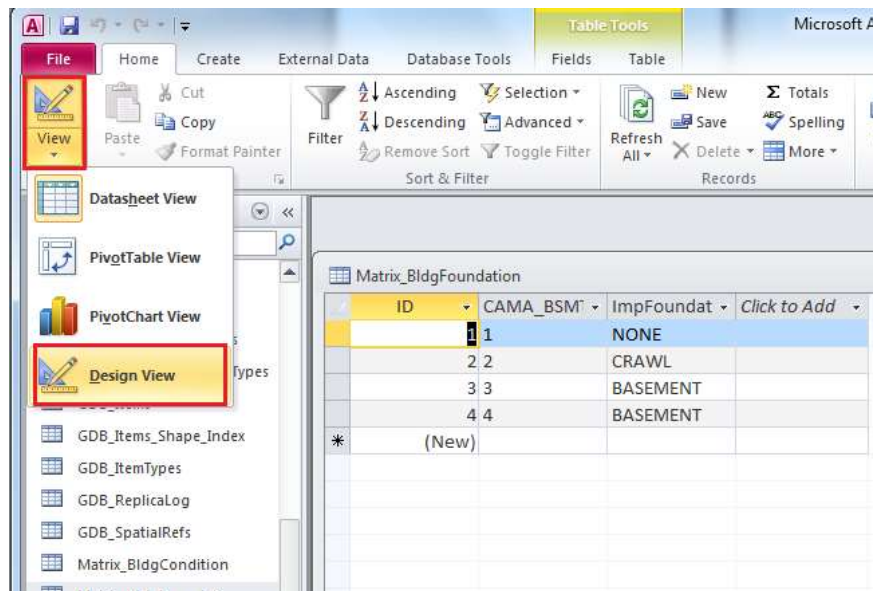
6. Delete the **CAMA_BSMT** field.   Rename the field **ImpFoundationType** field to **Bldg_Bsmt**. Also, add another field with the name **BI_BldgFoundation** with the format "text" and length "10". Please see the screenshots below.
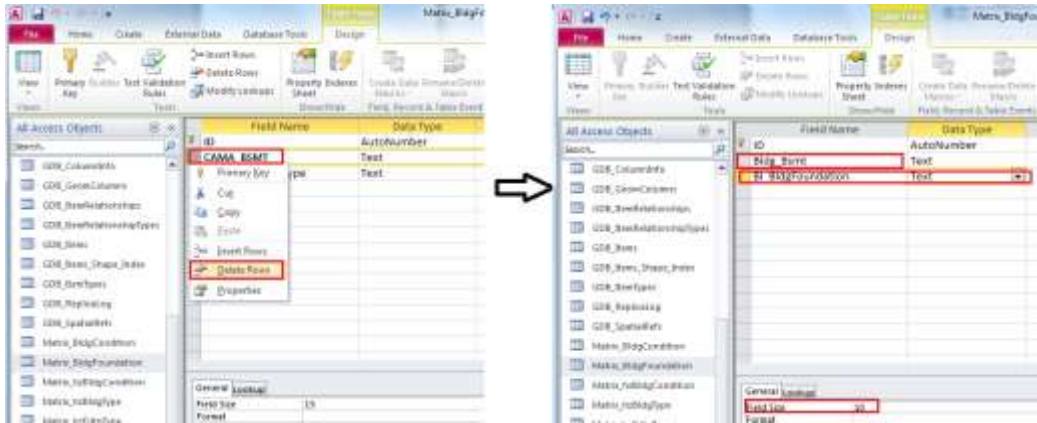
7. Key in values in the **BI_BldgFoundation** field similar to the example shown below.

Task 2: Import the "Matrix_BldgFoundation" in to "BldgFoundation_Mapper" in the "**Building Points To Building Inventory"** FME script.

1. Start ArcMap and open **WV_<County Name>_BI_Products.mxd** located in
    …\PDM_West Virginia\Data_Management\Models\<County Name>\MXD_Documents

2. Right-click on the **4. Building Points to Building Inventory** FME tool and choose **Edit**.

3. Click the sprocket in the upper right corner of the **Building Construction Mapper** to open the AttributeValue Parameters window.

>   **Make sure the contents in the Source Value and Destination Value fields are empty. In order to do this, click on the first row and press "Delete" on the keyboard. Do this for all the rows.**

4. Click the **Import** button and choose **Source and Destination Values**.

5. Select **Esri Geodatabase (Personal Geodb)** for the Format

6. Click the **Browse** button and browse to
   …\PDM_WestVirginia\Data_Management\Models\Berkeley\Analysis\Inventory\Building_
   Inventory
   WV_<County Name>_BI_GDB.mdb

7. Click the **Next** button to access the Attributes Values Import Wizard.

8. For feature type select **Matrix_BldgFoundation** and click the **Next** button.
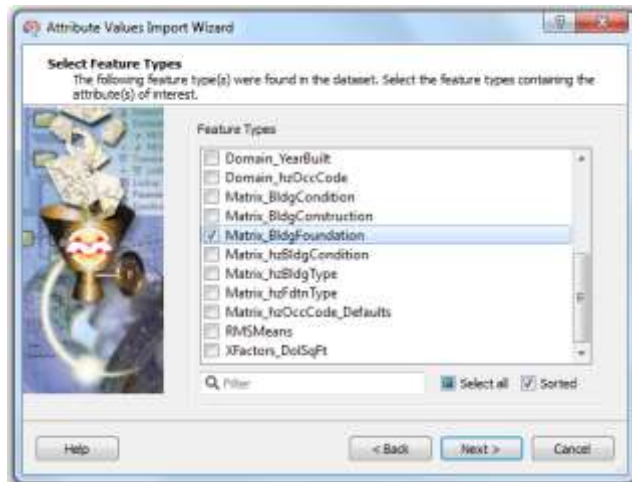
9. For Select Attributes for Source Value choose **Bldg_Bsmt** as shown below and click the **Next** button.
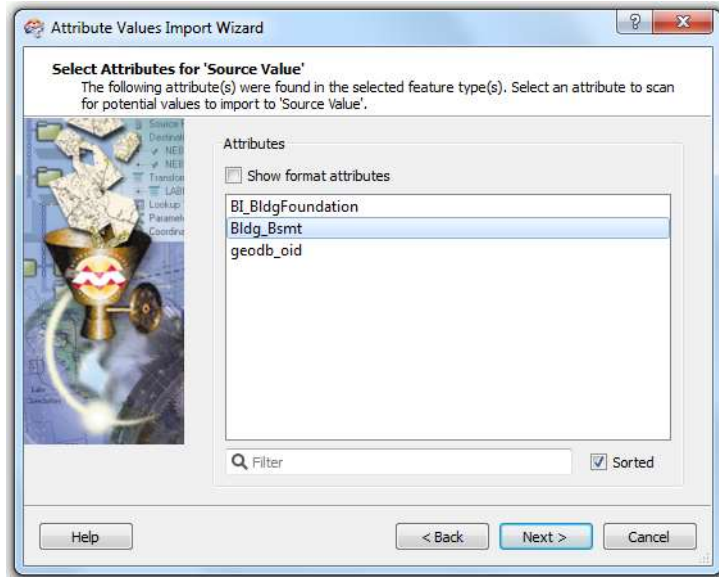
10. Select the feature type **BI_BldgFoundation** and click the **Next** button.
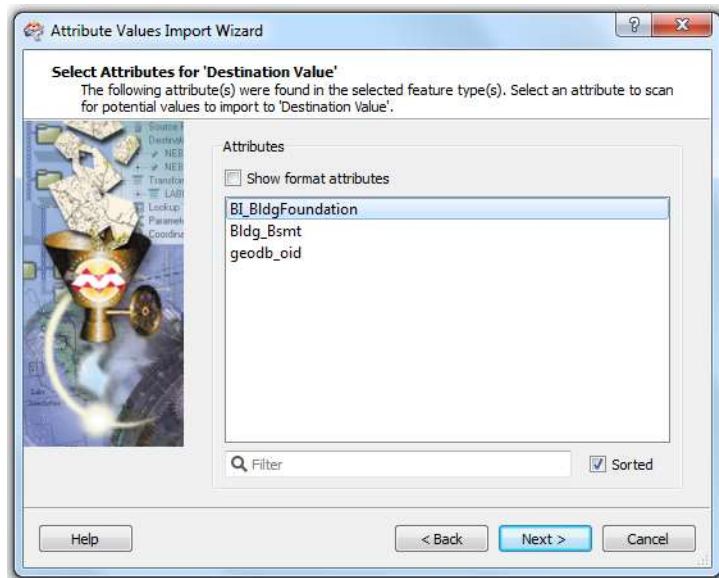
11. Click the **Import** button to import the destination value attributes.

12. Make sure under "Attribute Selection" of the "AttributeValueMapper Parameters" window, the following features are updated:

- Source Attribute is set to "ImpFoundation"

- Destination Attribute is named as "BldgFoundation"

- Default Value is set to "Slab"
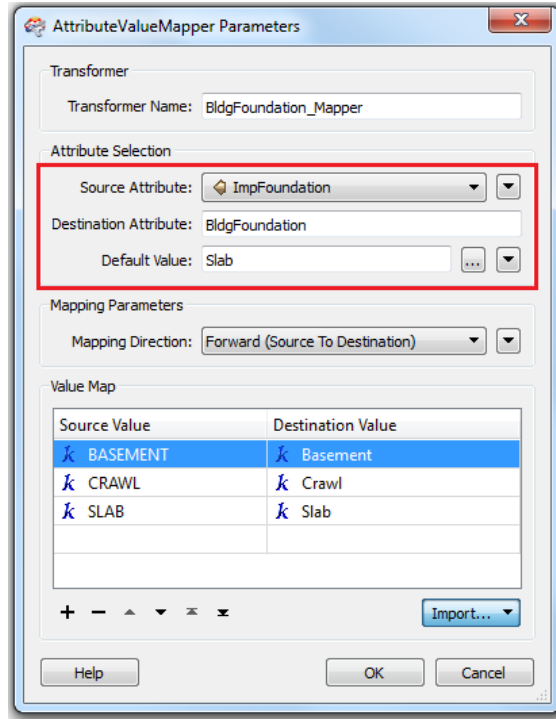
13. The BldgFounation_Mapper transformer is now updated in the script.

Matrix_BldgCondition

Task 1: Create Matrix_BldgCondition

1. Open **WV_<County Name>_BI.mdb** located in
   ...\PDM_WestVirginia\Data_Management\Models\<County
   Name>\Analysis\Inventory\Building_Inventory

2. Import the **Domain_BldgCondition** table from **WV_County_Improvements.mdb** located in
   ...\PDM_WestVirginia\Data_Management\Models\<County
   Name>\Analysis\Inventory\Improvements
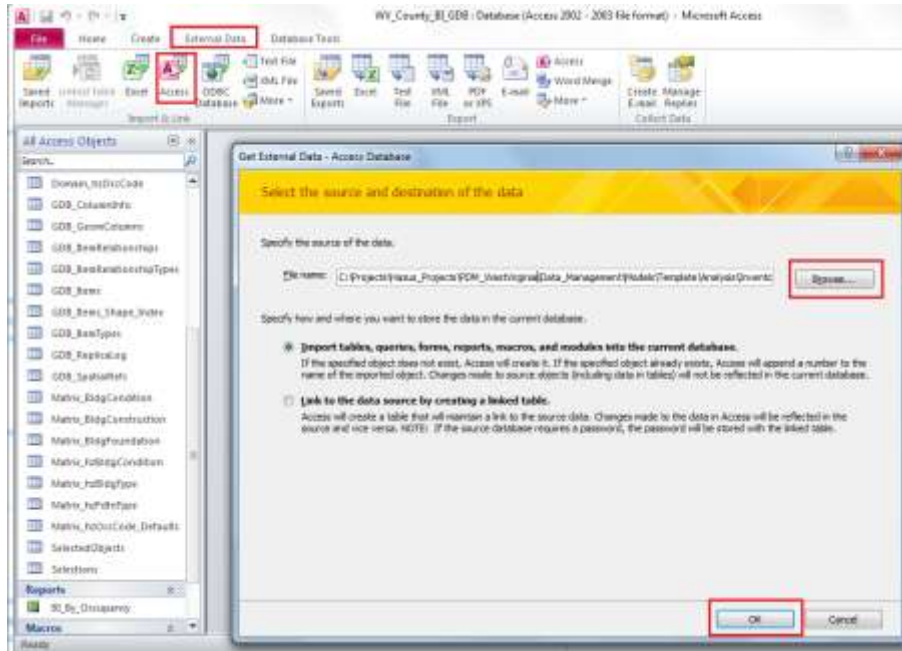
Note: The purpose of importing the domain table is to inherit the source column "ImpCondition" which contains the source values that will be converted to Hazus compliant values in the matrix table.

3. Select the **Domain_ImpCondition** table and click **OK**.
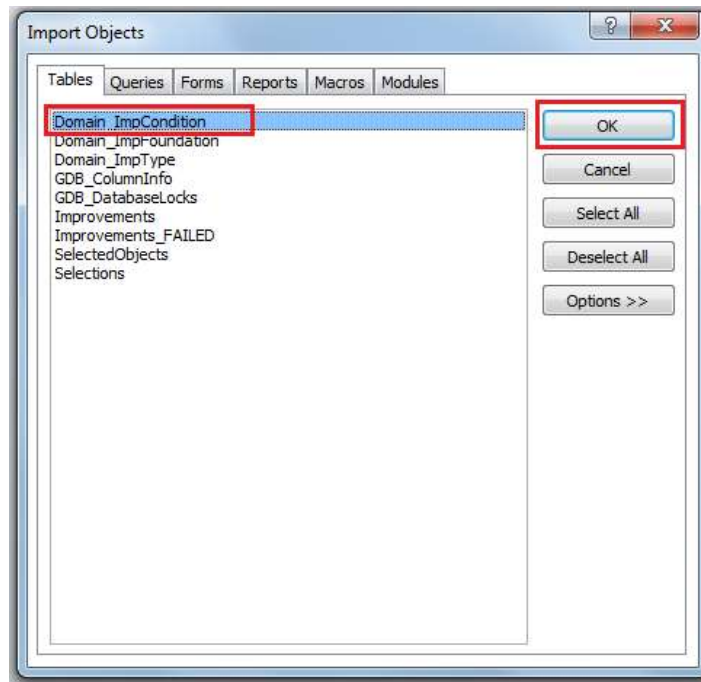
The table "Domain_ImpCondition" is now imported into "WV_County_BI_GDB.mdb".

4. Rename the table name from **Domain_ImpCondition** to **Matrix_BldgCondition** and open the table.

5. Click on the **Design View** button on top left hand corner of the MS Access window.
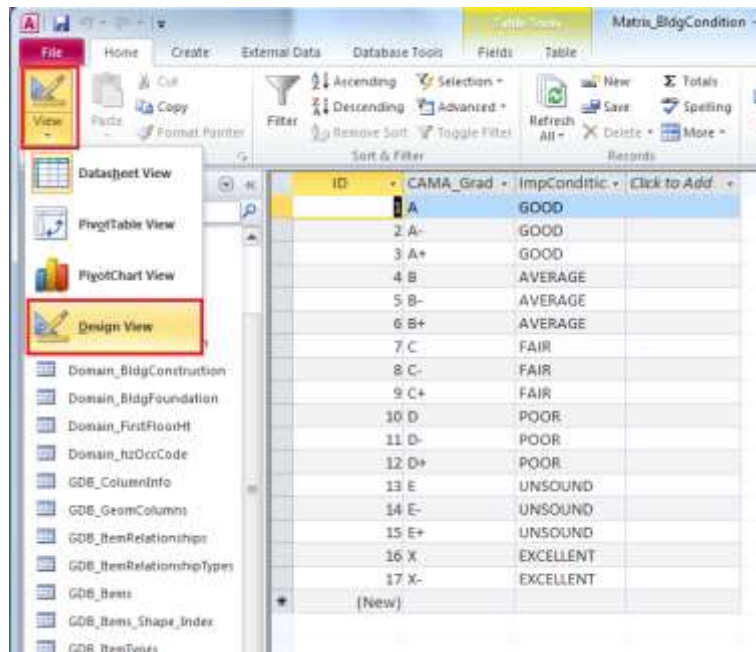
6. Delete the **CAMA_GRADE** field.   Rename the field **ImpFoundationType** to **Bldg_Grade**. Also, add another field with the name **BI_BldgCondition** with the format "text" and length "10". Please see the screenshots below.
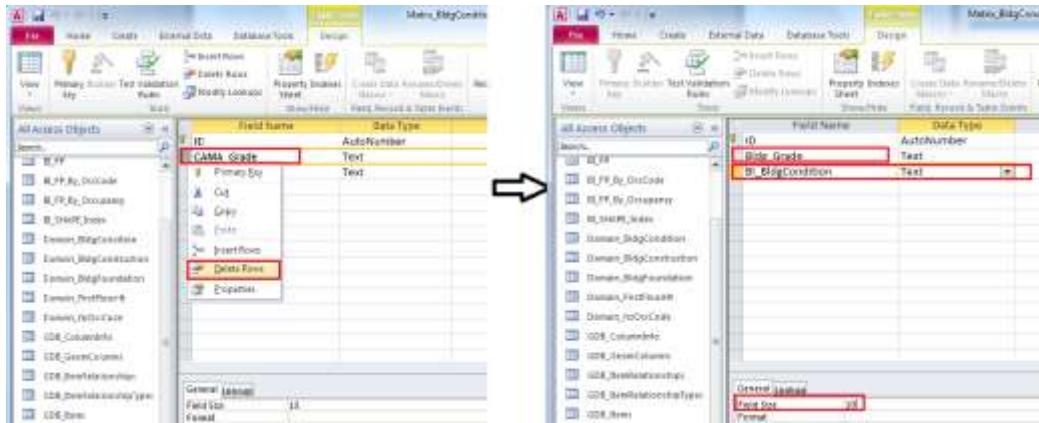
7. Key in appropriate values in BI_BldgCondition. Refer to the code description provided in West Virginia Appraisal Manual 2014 page 47 and based on your judgement enter the condition of the building ranging from Low to Medium to High under "BI_BldgCondition" field.

>   Note: Also refer to the "Domain_BldgCondition" table located in "WV_<County Name>_BI_GDB" under
>
>   …\PDM_WestVirginia\Data_Management\Models\<County Name>\Analysis\Inventory\Building_Inventory

8. Delete any duplicates in the **Bldg_Grade**. The complete matrix table should look similar to the one below.

Task 2: Import the "Matrix_BldgCondition" in to "BldgCond_Mapper" in the "**Building Points To Building Inventory"** FME script.

1. Start ArcMap and open **WV_<County Name>_BI_Products.mxd** located in
   …\PDM_West Virginia\Data_Management\Models\<County Name>\MXD_Documents

2. Right-click on the **4. Building Points to Building Inventory** FME tool and choose **Edit**.

3. Click the sprocket in the upper right corner of the **Building Construction Mapper** to open the AttributeValue Parameters window.

   Make sure the contents in the Source Value and Destination Value fields are empty. In order to do this, click on the first row and press "Delete" on the keyboard. Do this for all the rows.

4. Click the **Import** button and choose **Source and Destination Values**.

5. Select **Esri Geodatabase (Personal Geodb)** for the format.

6. Click the **Browse** button and browse to
   …\PDM_WestVirginia\Data_Management\Models\Berkeley\Analysis\Inventory\Building_Inventory
   WV_<County Name>_BI_GDB.mdb

7. Click the **Next** button to access the Attributes Values Import Wizard.

8. Select the feature type **Matrix_BldgCondition** and click the **Next** button.

9. For Select Attributes for Source Value choose **Bldg_Grade** as shown below and click the **Next** button.
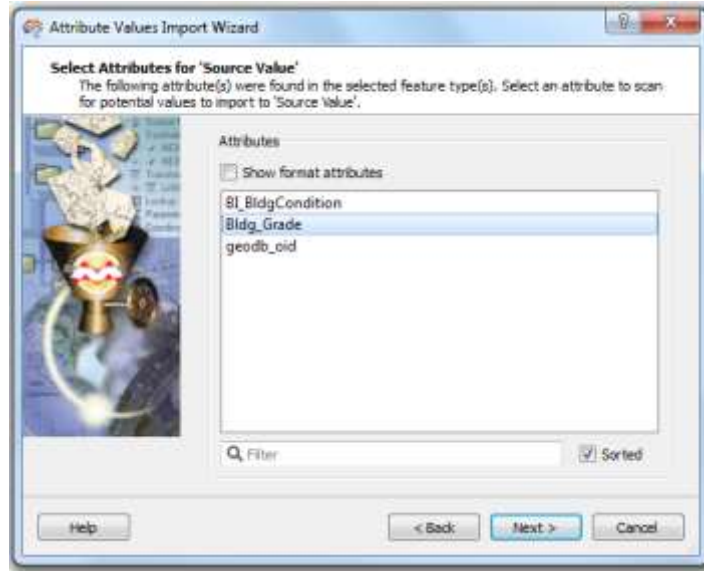
10. Select the feature type **BI_BldgCondition** for the Destination Value and click the **Next** button.
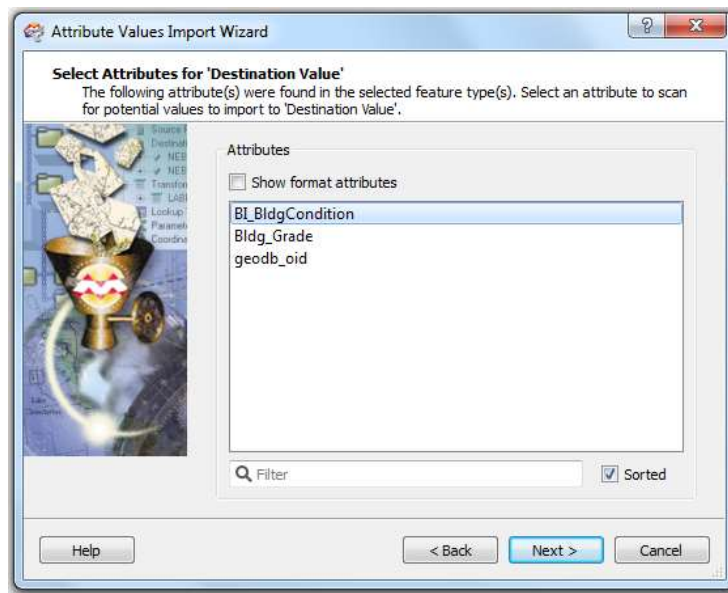
11. Click the **Import** button to import the destination value attributes.

12. Make sure under "Attribute Selection" of the "AttributeValueMapper Parameters" window, the following features are updated:

- Source Attribute is set to "ImpCondition"

- Destination Attribute is named as "BldCondition"

- Default Value is set to "Medium"

The BldgCond_Mapper transformer is now updated in the script.

III. XFACTORS_DOLSQFT TABLE

This table is created to calculate Average Dollar per Square Foot using the Improvements table. It is imported into "ImpArea_Mapper" transformer in the"4 Building Points to Building Inventory" FME script to populate the missing Building Area.

Task 1: Create "XFactors_DolSqFt" table

1. Start ArcMap and open **WV_<County Name>_BI_Products.mxd** located in

    …\PDM_West Virginia\Data_Management\Models\<County Name>\MXD_Documents

2. Right-click | **Edit** the toolbox named **3b. XFactors Dollar Per Square Foot Creator** under WV <County Name> FME BI Products.

3. Set the Source file to:
    …\<County Name>\Analysis\Inventory\Improvements\
    WV_<County Name>_Improvements.mdb

4. Set the Destination file to:
    …\<County Name>\Analysis\Inventory\Building_Inventory
    WV_<County Name>_BI_GDB.mdb
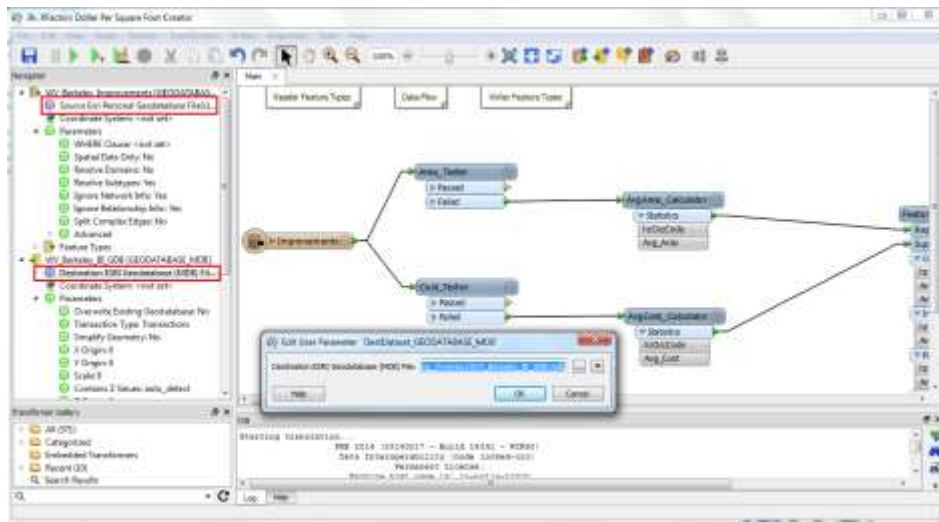
Notes:

- The "AvgArea_Calculator" and "AvgCost_Calculator" transformers calculate the average area and average cost respectively, from the Improvements table, which are grouped by the Occupancy Codes.
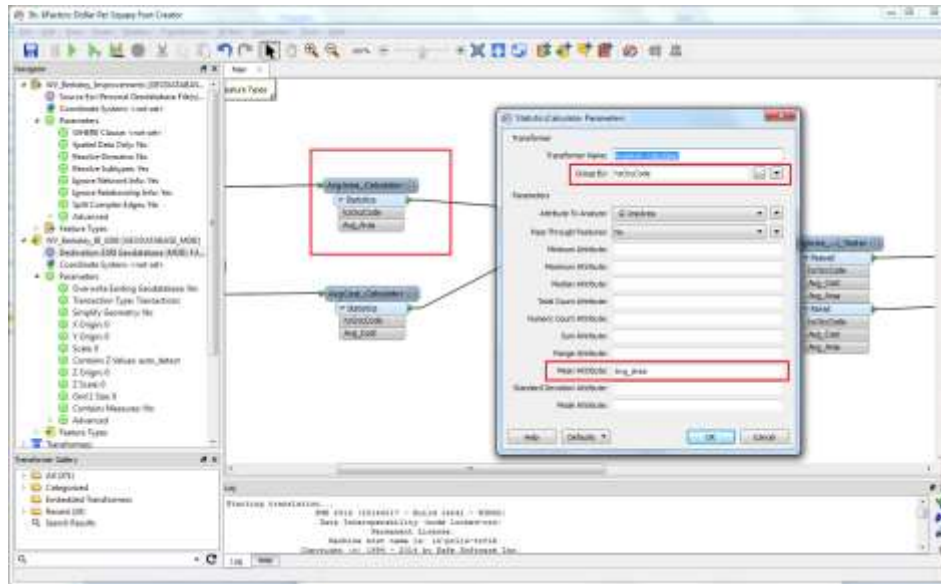
- The Average Cost values and Average Area values are merged into one table using the Feature Merger transformer.

- Cama Dollar per Square Foot (caDolSqFt) is calculated by dividing AvgCost/AvgArea.

- The null values from Average Area are filtered and replaced by Average Area values calculated using RS Means from Hazus data.

Note: RS Means is obtained from Hazus. The instructions on how to obtain RS means is outlined at the end of the <u>Appendix 2</u>. RS means table is created within the "WV_<County Name>"_BI_GDB.mdb.

In the next steps you will import RS Means table into "RSMeans_Mapper" transformer.
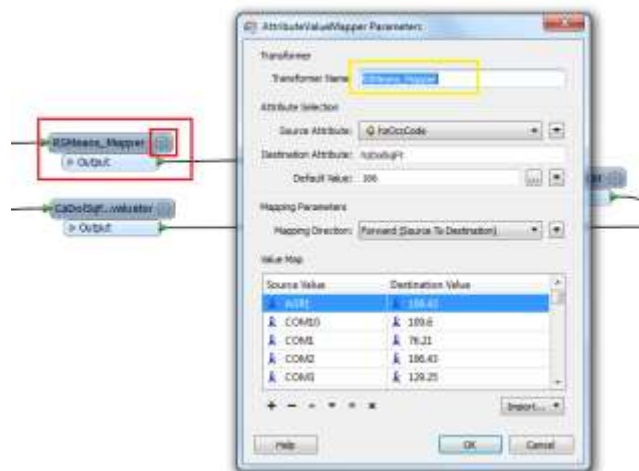
Make sure the contents in the Source Value and Destination Value fields are empty. In order to do this, click on the first row and press "Delete" on the keyboard. Do this for all the rows.

5. Click the **Import** button and choose **Source and Destination Values**.
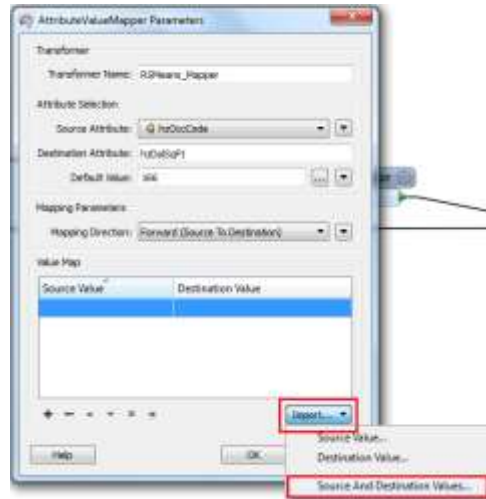
6. Select **Esri Geodatabase (Personal Geodb)** for the Format.

7. Click the **Browse** button and browse to
   …\PDM_WestVirginia\Data_Management\Models\Berkeley\Analysis\Inventory\Building_
   Inventory
   WV_<County Name>_BI_GDB.mdb

8. Click the **Next** button to access the Attributes Values Import Wizard.

9. Select the feature type **RSMeans** and click the **Next** button.
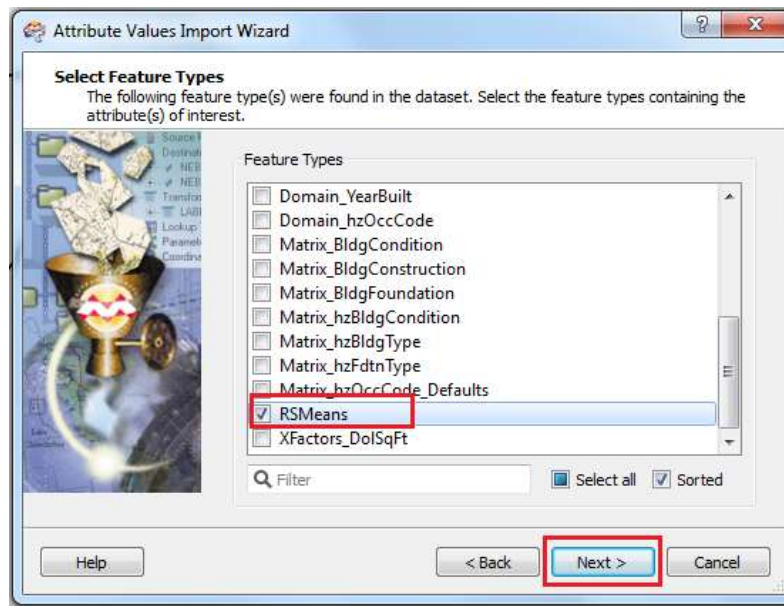
10. For Select Attributes for Source Value choose **hzOccCode** as shown below and click the
    Next button.
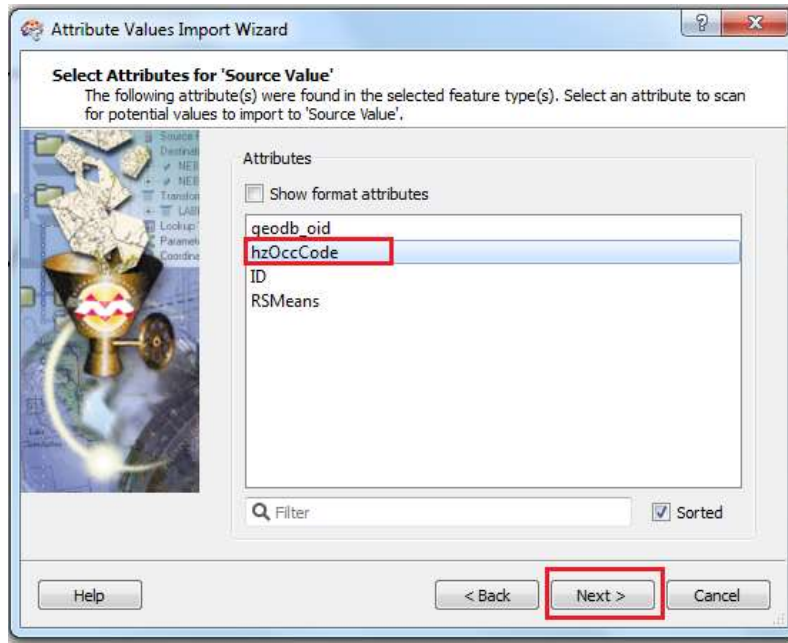
11. Select the feature type **RSMeans** for the Destination Value and click the **Next** button.
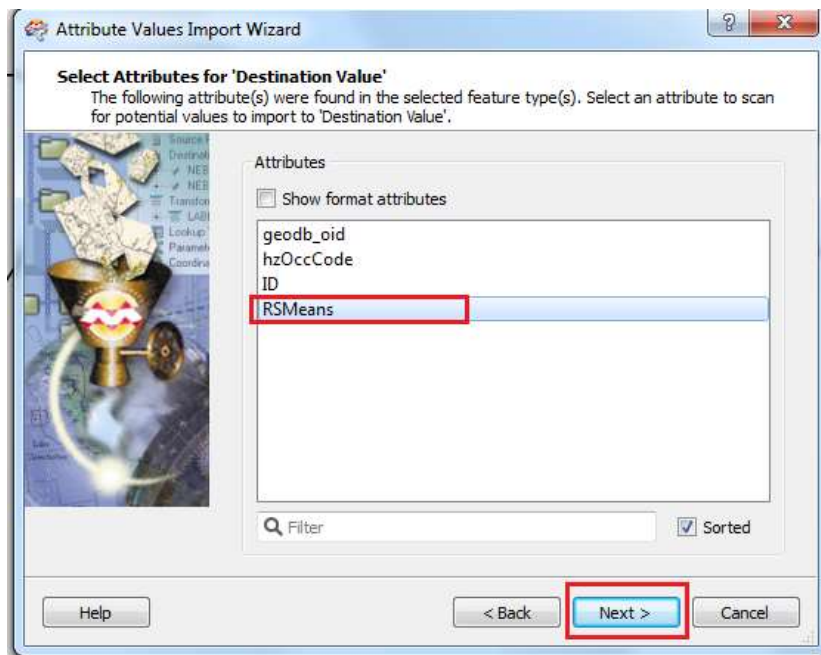
12. Click the **Import** button to import the destination value attributes.

13. Make sure under "Attribute Selection" of the "AttributeValueMapper Parameters" window, the following features are updated:

    o Source Attribute is set to "hzOccCode"

    o Destination Attribute is named as "hzDolSqFt"

    o Default Value is set to "166" (Average of the RS mean values)
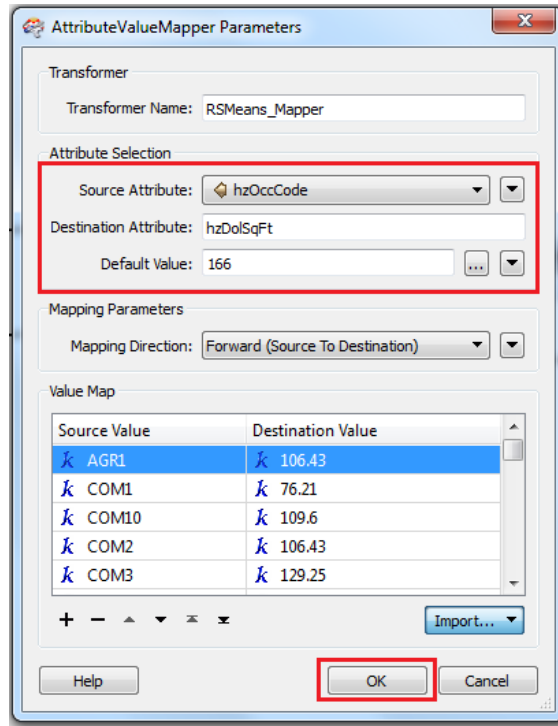
Notes:

- It is assumed that Hazus DolSqFt (obtained from RS Means) is nearly half of Cama DolSqFt. Hence, hzDolSqFt is divided by 2.

- The AvgCost is divided by the resultant CaDolSqFt to obtain missing **AvgArea**.

- The destination table contains AvgCost, AvgArea and CaDolSqFt fields.

14. Under the **Writers** tab, select **Add Feature Type** and name the feature **xFactors_DolSqFt**.

    A new feature type will be added to the destination geodatabase.
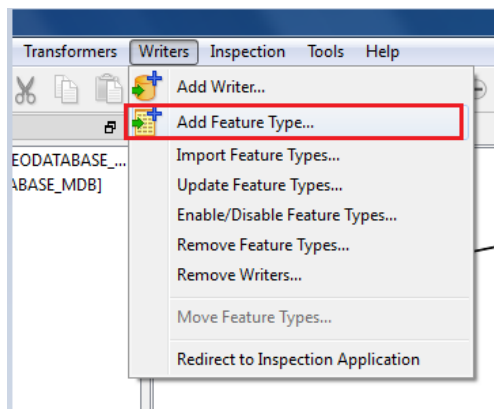
15. Right-click on the transformer **xFactors_DolSqFt**. Select **Copy attributes from a transformer**. Select the **AttributeKeeper** transformer from the dropdown list.
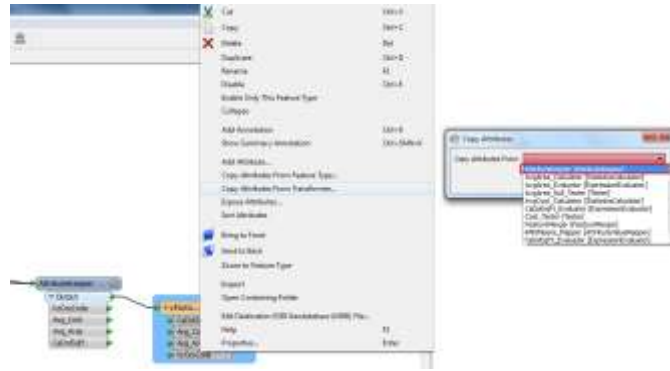
16. Save and run the script.
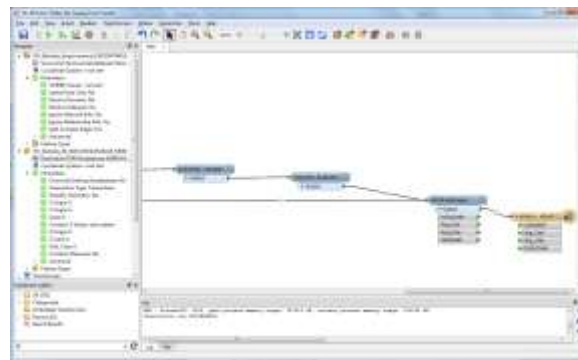
17. Open **WV_<County Name>_BI.mdb** and open the table named **xFactors_DolSqFt**.

Task 2: Import the "xFactors_DolSqFt" in to "ImpArea_Mapper" in the **4. Building Points to Building Inventory** FME script.

1. Start ArcMap and open **WV_<County Name>_BI_Products.mxd** located in
    …\PDM_West Virginia\Data_Management\Models\<County Name>\MXD_Documents

2. Right-click on the **4. Building Points to Building Inventory** FME tool and choose **Edit**.

3. Click the sprocket in the upper right corner of the **ImpArea Mapper** to open the AttributeValue Parameters window.
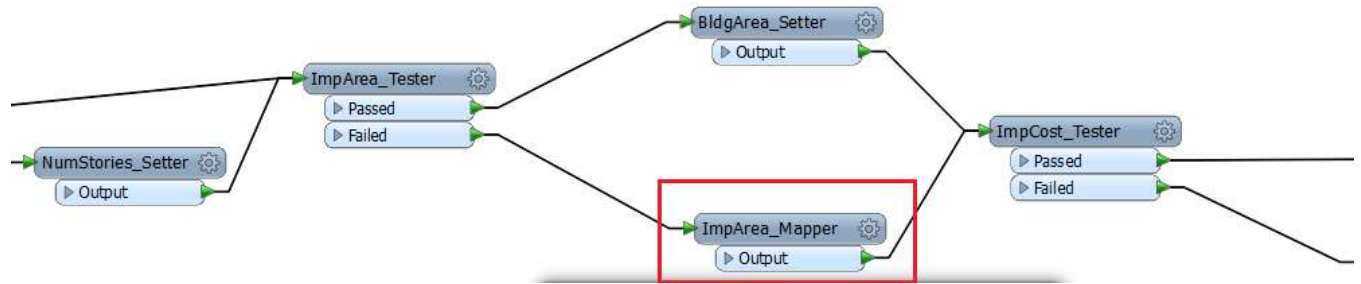
> **Make sure the contents in the Source Value and Destination Value fields are empty. In order to do this, click on the first row and press "Delete" on the keyboard. Do this for all the rows.**

4. Click the **Import** button and choose **Source and Destination Values**.
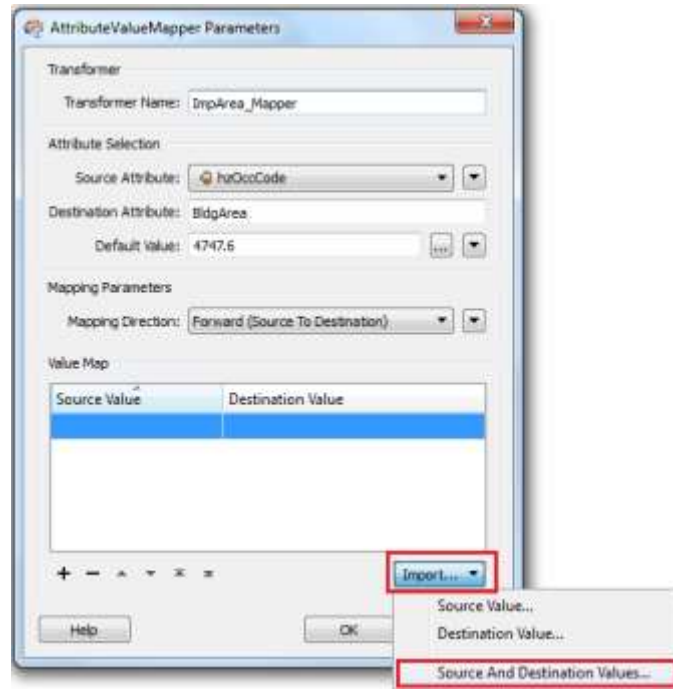
5. Select **Esri Geodatabase (Personal Geodb)** for the format

6. Click the **Browse** button and browse to
     …\PDM_WestVirginia\Data_Management\Models\Berkeley\Analysis\Inventory\Building_Inve ntory
    WV_<County Name>_BI_GDB.mdb

7. Click the **Next** button to access the Attributes Values Import Wizard.
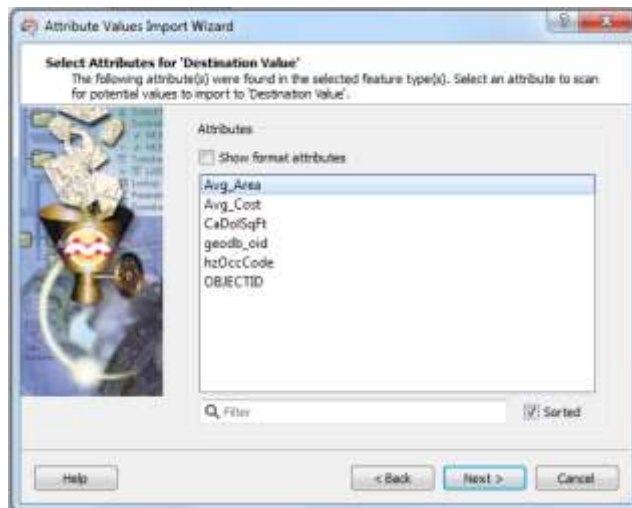
8. Select the feature type **XFactors_DolSqFt** and click the **Next** button.
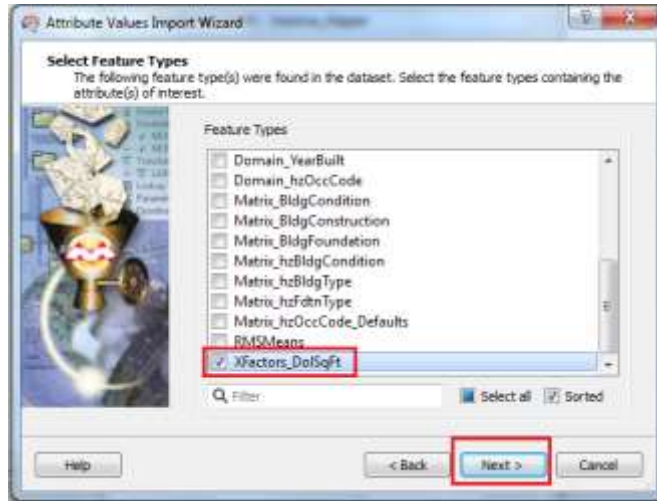
9. For Attributes for Source Value select **hzOccCode** as shown below and click the Next button.
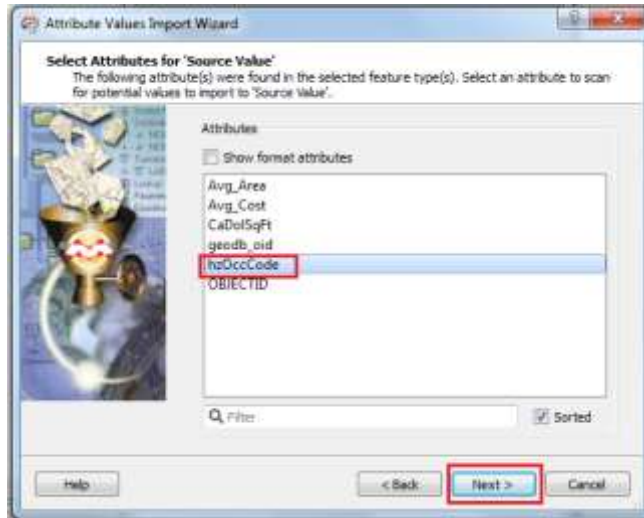
10. Select the feature type **Avg_Area** and click the **Next** button.

11. Click the **Import** button to import the destination value attributes.

12. Make sure under "Attribute Selection" of the "AttributeValueMapper Parameters" window, the following features are updated:

   o Source Attribute is set to "hzOccCode"

   o Destination Attribute is named as "BldArea"

   o Default Value is set to "4747.6" (which is calculated by taking the average of the AvgArea values)
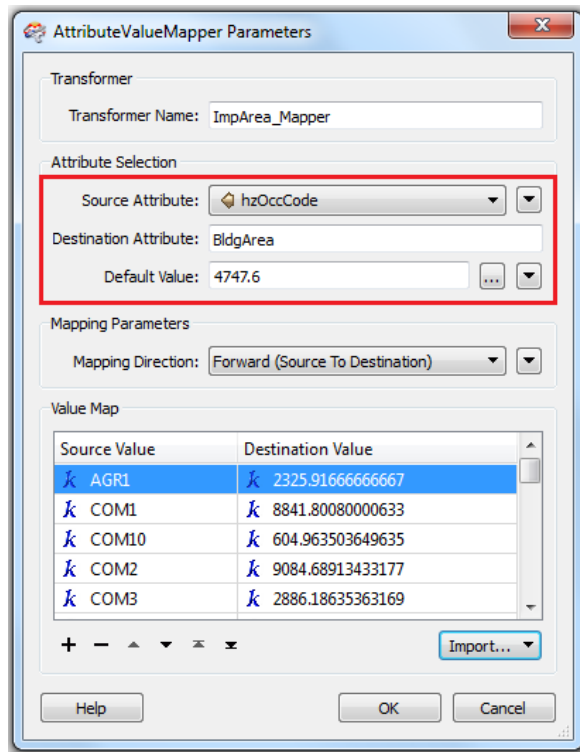
The "ImpArea_Mapper" transformer is now updated in the script.

IV RS MEANS TABLE

The replacement values of the buildings in Hazus database were developed by applying the RS Means for typical building floor areas for each occupancy class.

Source: https://www.fema.gov/summary-databases-hazus-multi-hazard

Purpose of using RS Means: The RS Means data is derived from 2010 Census. This data is used to calculate the following:

- Missing building area values by dividing Average Cost with cama Dollar per Square Foot. Refer to the transformer "AvgArea_Evaluator" in the FME script "3b. XFactors Dollar Per Square Foot Creator"

- Replacement Cost field in the "ReplCost_Evaluator" transformer in the FME script "4. Building Points to Building Inventory"
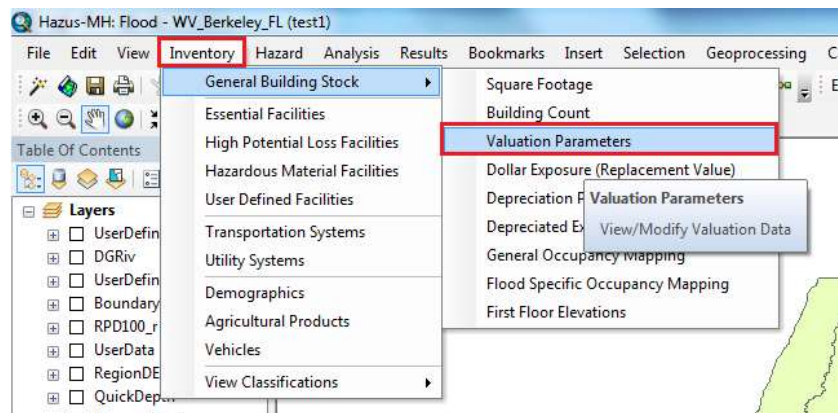
It is very unlikely that you will need to update this table for West Virginia counties. However, the procedure for doing so is provided below.

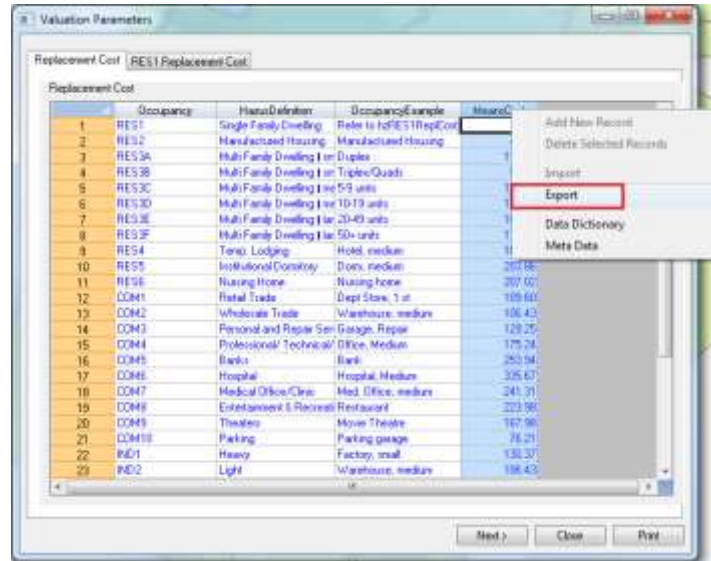Task 1: Export RS Means table from Hazus

1. Open the Hazus Study Region.

   Note: Refer to Task 4.1 which outlines the steps to create a study region in Hazus.
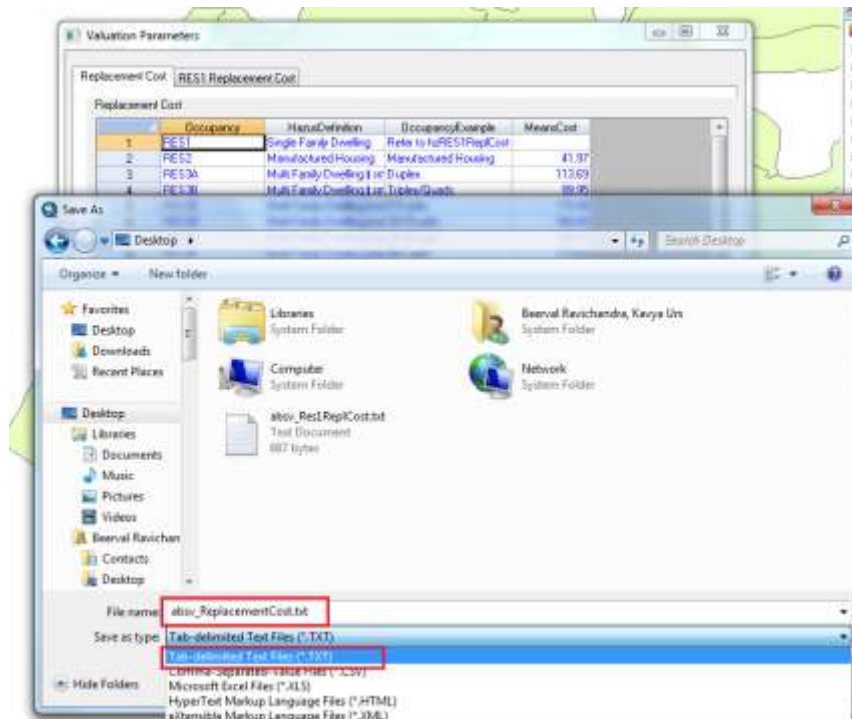
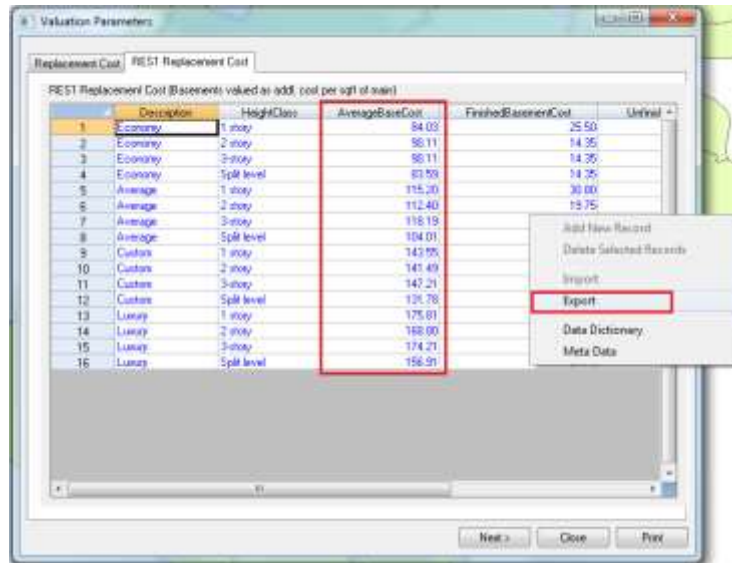2. Under **Inventory/General Building Stock**, click **Valuation Parameters**.

3. Right-click on the **Valuation Parameters** table and choose Export.

4. Export the "Replacement Cost" table in **Tab-delimited** text file format.

5. Export the "RES1 Replacement Cost" table as shown below in.xls format.

6. Open the **RES1 Replacement Cost** table and calculate the average value of **AverageBaseCost** field. This gives the RES1 RS Means value.

7. Import the "**Replacement Cost**" table into "WV_<County Name>_BI_GDB.mdb" located in …\PDM_WestVirginia\Data_Management\Models\Berkeley\Analysis\Inventory\Building_Inventory
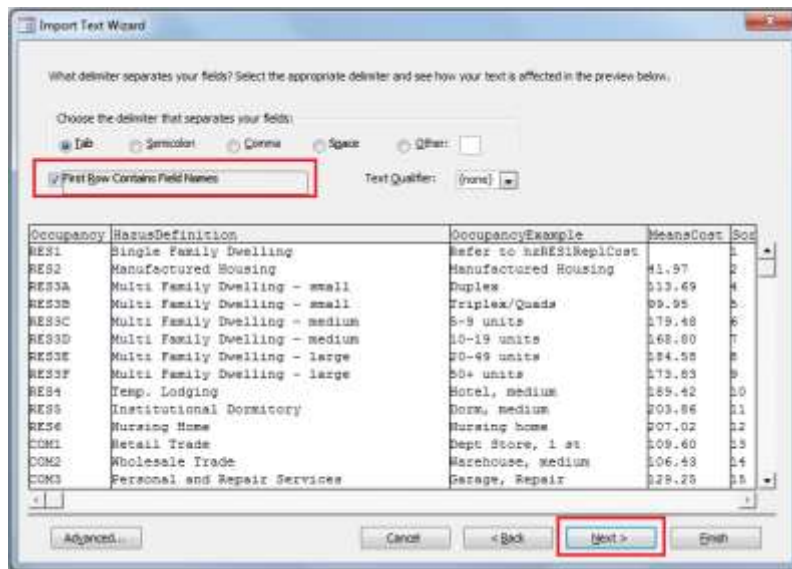
8. Rename the table to **RSMeans** and click **Finish** button.

The table is now imported into "WV_<County Name>_BI_GDB.mdb".
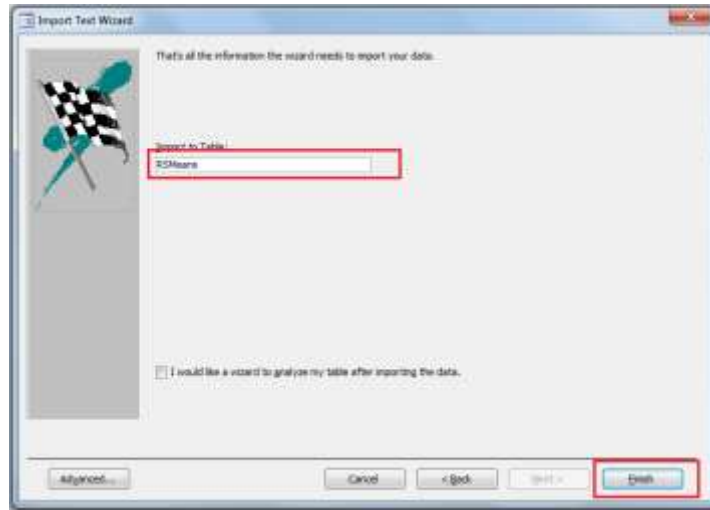
9. The table is now ready to be used in III Create and Import "XFactors_DolSqFt" step 8 of Task 1

APPENDIX 3 ADDITIONAL ASSUMPTIONS

The following additional assumptions were made while creating the tools that generated Building Inventory for the pilot project.

1. NumStories:

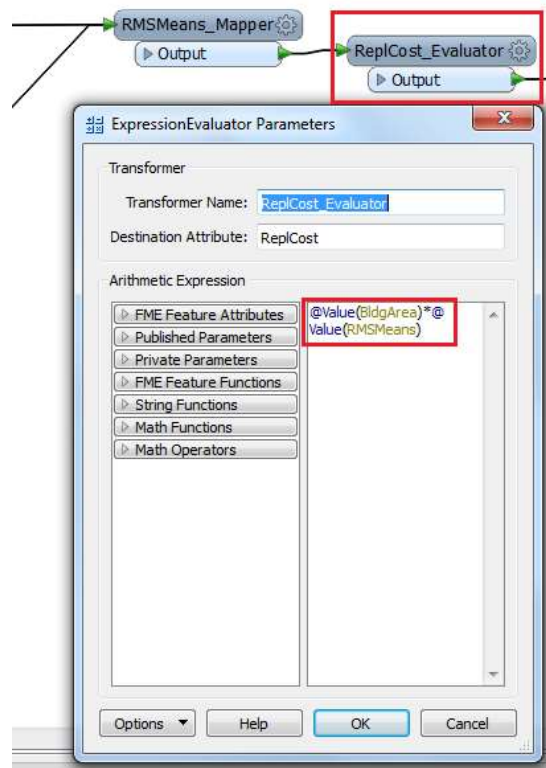   The null values are replaced with 1

2. BldgArea:

   The null values are calculated by using Hazus RSMeans and Cama Avg Cost

   Refer to "3b. XFactors Dollar Per Square Foot Creator" FME script

3. ReplCost:

   The replacement cost field is calculated by multiplying the AvgArea by RSMeans
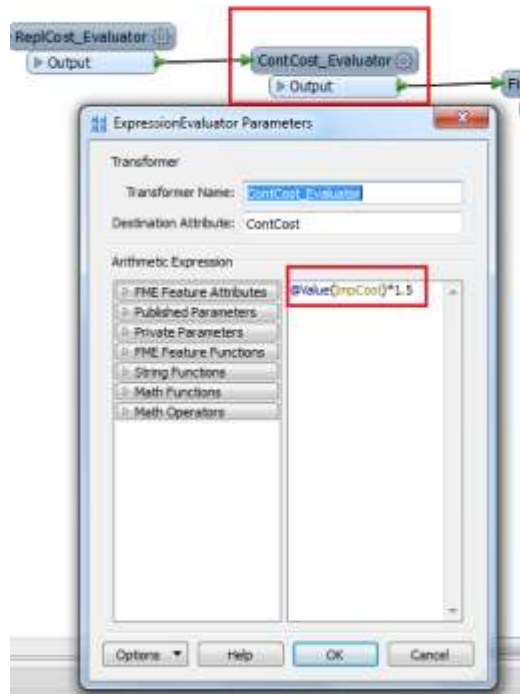
   Refer to "4. Building Points to Building Inventory" FME script

4. ContCost:

   Is calculated by multiplying ImpCost (Cama Building Cost) by 1.5.

   Refer to "4. Building Points to Building Inventory" FME script

5. FirstFloorHt:

    Is obtained from Hazus which is based on the Foundation type.

    Refer to "Domain_FirstFloorHt" located in "WV_<County Name>_BI_GDB" under

    …\PDM_WestVirginia\Data_Management\Models\<County name>\Analysis\Inventory\Building_Inventory