

**Digital Nautical Chart
Production Procedures—
Workflow**

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1.0 Getting Started with the Digital Nautical Chart Production Procedures

These procedures outline the steps necessary to complete end-to-end geodatabase production for Digital Nautical Charts (DNC). To begin, there must be a place to store the data. In the past, this was a set or many sets of files that a limited number of people could access and edit. With the geodatabase as the data store, the data is seamless and can be viewed and edited by multiple people. This minimizes the efforts required to bring file-based datasets into a single data store for seamless usability. The sources may include both image and vector in any number of projections, which do not need to be physically projected to a common projection to be usable in ArcMap.

The Production Mapping tools streamline the editing environment by allowing access to most edit tools with one click. Through the Production Mapping menu, the ArcMap surround can be easily modified for the current task.

Data quality is ensured through several methods. In-process automated quality control is built into the database model and controls the available attribute values for many fields. Production Mapping extends the in-process automated quality control and includes tools that can be used to discover and log data errors for review and correction cycles. Both automated and manual quality controls are employed to ensure high-quality data.

Once the database has been populated, it can then be used as input for creating hard-copy and digital products. ESRI Nautical Solution can be used to create map products with standard surround elements as well as reference systems and title information.

With the addition of the Production Mapping tools, tasks are streamlined by making the tools used to complete the task available with one click. Some of the tools on the Production Mapping toolbars are available through standard ArcMap menus, but most are not available with one click. The Production Mapping environment, with the additional Production Mapping tools, can be quickly adjusted to the task, which streamlines the process.

There is an implied order to database production and the following production procedures. While quality control is discussed after data editing, it does not have to be implemented only at the end of production. Quality control processes should be run in process as needed to ensure the data is extracted properly throughout the project. The order in which features are extracted should be planned as part of a project process plan.

2.0 The DNC Databases

Whether you are doing maintenance or production work, you have to use a geodatabase. With Digital Nautical Chart (DNC), you have four scale-specific geodatabases. It is important that you choose the correct scale (Harbor, Approach, Coastal, or General).

The geodatabase (GDB) is a geographic database that provides services for managing geographic data, which include validation rules, relationships, and topological associations. A geodatabase contains feature datasets and is hosted inside a relational database management system (RDBMS). Both enterprise and personal geodatabases are supported.

In a browser, navigate to the template GDBs located in the Nautical Solution directory:

- For 32-bit machines – <Installation location>\Program Files\ESRINautical\Desktop10.0\Dnc\Schemas\Built
- For 64-bit machines – <Installation location>\Program Files(x86)\ESRINautical\Desktop10.0\Dnc\Schemas\Built

The template GDBs are called DNCA_10.0.0.0.mdb, DNCC_10.0.0.0.mdb, DNCG_10.0.0.0.mdb, and DNCH_10.0.0.0.mdb for the different product scales.

Note: The version information at the end of the file name represents the release the model was associated with. It is recommended that you always use the latest version. The first two values, 10, represent the major release value. The second value represents the minor release value. The third value represents the service pack value, and the fourth value represents a patch. For example, 93.0.1.0 represents 9.3 Service Pack 1.

3.0 DNC Vector Sources

Existing vector data may be the initial input for the geodatabase. Many kinds of vector data can be used as input. These may include coverage, shapefile, computer-aided design (CAD), or geodatabase data. In some cases, the data may not have a defined projection, which needs to be defined before it is usable.

3.1 Projecting

If your data has a defined projection that is different from the feature dataset, the data loader in ArcCatalog automatically projects the data on import. If the data does not have a defined projection, the coordinate system information can be defined within ArcMap. Otherwise, it may be necessary to project the data before importing. Project the data by simply changing the projection of the data frame to the desired projection and export the layer using the data frame properties.

In some cases, the data may not be in a useful coordinate space such as scanner or digitizer units, which most often are inches or microns. Provided the data has some reference points, such as known locations of road intersections or ticks that represent x- and y-coordinates, the data can be transformed into real-world coordinates with the spatial adjustment tools.

3.2 Loading Geodatabase, Coverage, and Shapefile Data

The ArcMap **Load Data** tool can be used to import data into a specific feature class. As part of the load, a query can be applied to load specific data from the source dataset. Data may be loaded into a specific subtype and attribute fields can be remapped; however, only one feature class can be loaded at a time. With Production Mapping, many sources can be batch loaded into one or many feature classes during a single execution. Not only can many sources be loaded at one time, but the cross-reference database allows features and values to be mapped during loading. This is especially useful for data that is collected to a standard. Production Mapping does not project data when loading, so the source data must be in the same projection as the target feature class before loading. Because this is a batch loading process, it is accessed through ArcCatalog.

3.2.1 Loading Data into a Geodatabase

With Production Mapping, you can load data into a geodatabase using a template that corresponds to the data model or product specification you are using. This template, called a cross-reference database, contains mapping information between the data being loaded (the source workspace) and the database into which the data is being loaded (the target workspace). The cross-reference database contains the names of the source and

target feature classes, as well as the WHERE clauses that determine which features are loaded into the feature classes based on subtypes.

Using the **Data Loader** tool, you can load data from one geodatabase, coverages, or set of shapefiles into another geodatabase that may or may not have the same schema. This can append data to existing databases or load them into an empty schema. The target workspace must contain the schema referenced in the cross-reference database, at a minimum.

The loading process is completed in a series of steps that are presented in a wizard. The first part of the process requires you to navigate to the cross-reference database, the source workspace, the target workspace, and an output location for the log file that will be created. This sets up the mapping information between the data that is going to be loaded and the database into which the data is going to be loaded. The log file is generated as a text file that contains the results of the loading process for each subtype.

The next part of the process is to choose the feature classes that are going to be loaded into the target database. You can choose to load either all or only some of the features from the source workspace. You can choose to perform all the dataset mappings located in the cross-reference database or only a subset. The list in the Data Loader wizard is dependent on the DatasetMappings table in the cross-reference, not the actual feature classes contained in the source or target.

The last part is actually loading the data. After the data is loaded, a log file of the results is also generated that allows you to see the number of features that have been loaded.

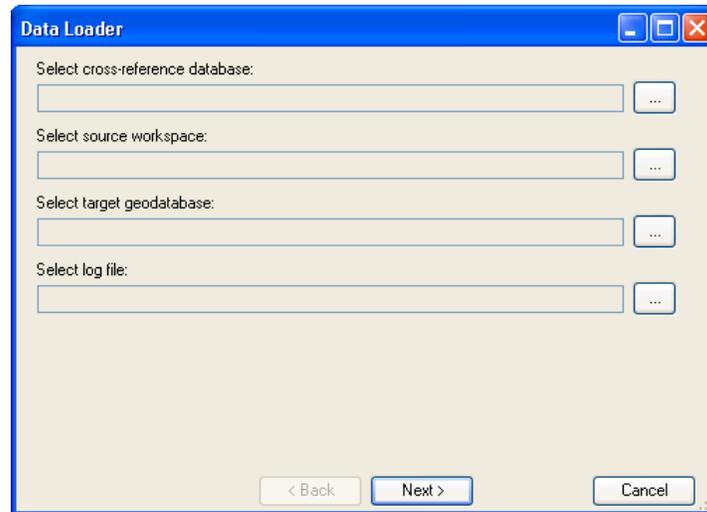
Before using Data Loader, it is recommended that you do the following:

- Verify that the datasets listed in the SourceDatasets and TargetDatasets tables match the feature classes in the source and target workspace.
- Verify that the fields listed in the SourceFields and TargetFields tables match the fields in the source and target workspaces.
- Validate the source and target workspaces against the cross-reference database using the Preload Validate tool.

Steps

1. Open the *Catalog* window.
2. Click the **Data Loader** button  on the *Production Mapping* toolbar.

The **Data Loader** dialog box appears.



3. Click the ellipsis button (...) next to the **Select cross-reference database** field.
The *Select cross-reference database* dialog box appears.
4. Navigate to the appropriate cross-reference database.
 - For 32-bit machines – <Installation location>\Program Files\ESRINautical\Desktop10.0\Dnc\DataConversion
 - For 64-bit machines – <Installation location>\Program Files(x86)\ESRINautical\Desktop10.0\Dnc\DataConversion
5. Click **Add**.
The path to the cross-reference database appears in the Select cross-reference database field.
6. Click the ellipsis button next to the **Select source workspace** field.
The *Select source workspace* dialog box appears.
7. Navigate to the geodatabase that contains the data you want to load.
8. Click **Add**.
The path to the source workspace appears in the Select source workspace field.
9. Click the ellipsis button next to the **Select target workspace** field.
The *Select target workspace* dialog box appears.
10. Navigate to the database into which you want to load the data.
11. Click **Add**.
The path to the target workspace appears in the Select target workspace field.
12. Click the ellipsis button next to the **Select log file** field.
The *Specify log file* dialog box appears.

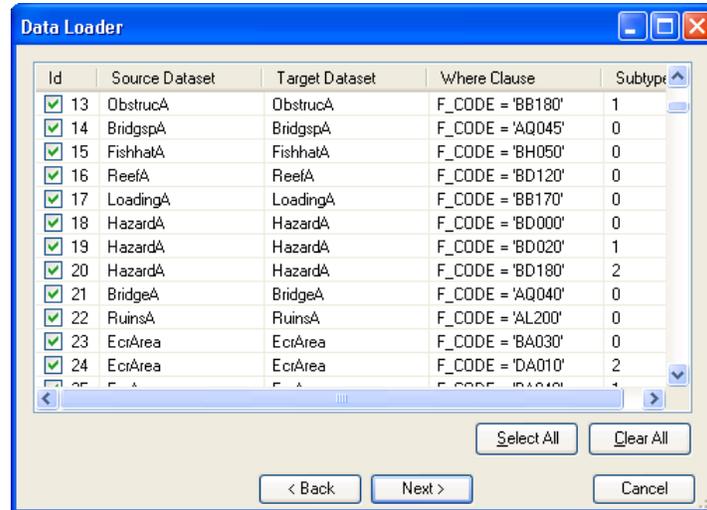
13. Navigate to the directory in which you want to store the log file.

14. Type a name for the file in the **Name** text box and click **Save**.

The path to the log file appears in the Select log file field.

15. Click **Next**.

The **Data Loader** dialog box appears with the names of the source and target feature classes and the WHERE clauses for each subtype.



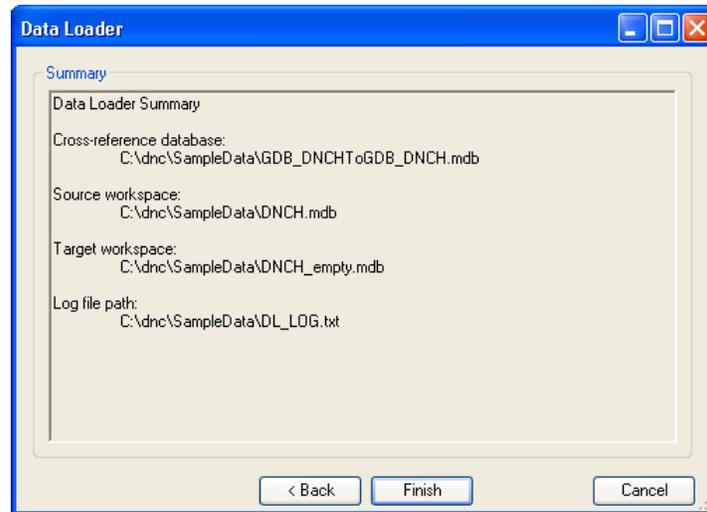
To sort the feature classes by name, click Source Dataset or Target Dataset. This displays them in descending or ascending order, based on their names.

16. Check the check boxes next to the feature classes you want to load into the target workspace.

You can also click **Select All** or **Clear All** to simultaneously select or clear all the check boxes next to the feature class names.

17. Click **Next**.

The **Data Loader** dialog box appears with a summary that shows the cross-reference database, source workspace, target workspace, and log file paths.



18. Click **Finish**.

The *Data Loader* window appears with a progress bar that displays the features and subtypes as they are loaded.

When the loading process is finished, a message appears to notify you that loading is complete.

19. Click **Yes** to view the log file or **No** to close the message and the *Data Loader* progress window.

3.3 Importing Vector Product Format Data

Most maintenance jobs require you to import Vector Product Format (VPF) data. To import VPF data correctly, you should have your geodatabase created with the Ecrtext annotation feature class created and the topology defined.

In working with ArcSDE, always create an import version of your database. That way, if an error occurs during importing, all you have to do is delete that version.

If the data to be imported is in Vector Product Format, the Production Import Export tool can be used to import selected or all VPF feature classes into geodatabase feature classes. The tool is available from ArcCatalog and can be used to import data into an existing geodatabase.

Tips for Importing Data

- Always import your notes when importing your data.
- You can only import one library at a time when importing notes.
- Production does support the creation of a geodatabase through the Production Import Export tool.

3.3.1 How to Import VPF Data

1. In ArcCatalog, load the *Production Mapping* toolbar and click the **Convert VPF Data To Geodatabase** button .

The *VPF Data To Geodatabase* dialog box appears.

2. Select **DNC** as the product type and the appropriate type of scale for the data you are going to be importing.

Ensure that the geodatabase you are importing into was created with the matching schema and knowledge base for the VPF data you are going to be importing.

3. Select **Yes** for **Import Notes/RAT**.
4. Click **Next**.

The *Navigate to VPF Data* dialog box appears.

5. Click the **browse** button.

The *Browse for VPF Data* dialog box appears.

6. Navigate to the VPF library and click **Open**.

Individual libraries are listed in the Select a library to import into the geodatabase box.

7. Choose the library to import.
8. Click **Next**.

The *Navigate to Geodatabase* dialog box appears.

9. If you are working with a personal geodatabase, click the **browse** button, navigate to the personal geodatabase that you want to import the VPF data into, then click **Open**.
10. If working in ArcSDE, navigate to your ArcSDE database and enter the connection properties.
11. Click **Next**.

The *Populate Geodatabase* dialog box appears. This dialog box shows how the features are mapped from VPF to geodatabase feature classes.

12. Click **Finish**.

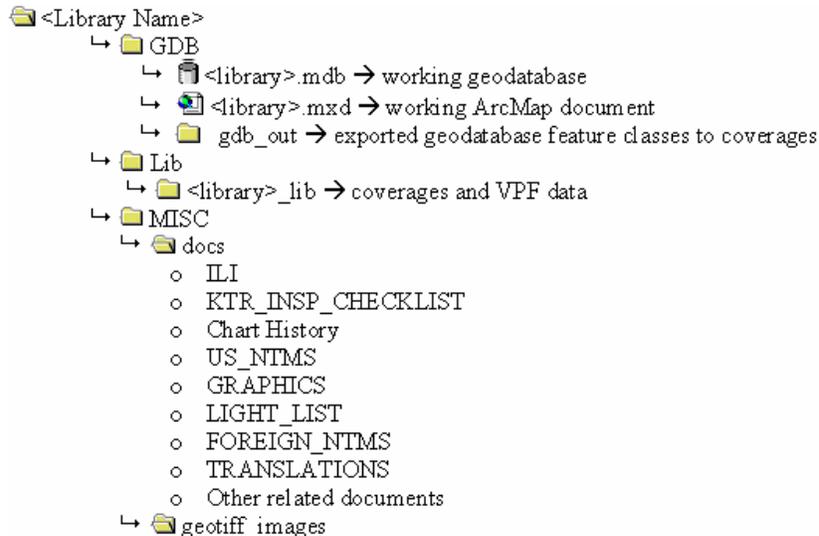
4.0 DNC Editing Considerations

There are many considerations when editing, maintaining, and quality controlling a database. Some things to consider are the purpose of the database, what the intended use is of the data, what scale the data represents, what the target accuracy is of the data extracted, and whether the accuracy target makes sense with the sources available. These are all important things to consider when developing a production plan and quality assurance program. Other things that may be necessary to consider are the diversity and experience of the workforce and its distribution. It is much more difficult to ensure consistency of data extraction and quality control when the workforce is disconnected, which may impact both the production plan and the quality assurance (QA) program.

Before getting started with extraction for DNC, become familiar with the Individual Library Instruction (ILI) provided by the National Geospatial-Intelligence Agency (NGA). The ILI document contains all the standard information regarding the library and any deviations from the normal flow that NGA may request.

4.1 Suggested Directory Structure

An organized, logical, and standard directory structure for DNC data and information storage aids in production flow efficiency.



4.2 Suggested Basic Production Flow

1. Review ILI and prepare the Chart History document.
 - a. Determine the scale of GDB to be produced and get the template GDB.

- b. Become familiar with any deviations from normal production flow for the library.
2. Create DQY.
3. Create ECR features:
 - a. Copy DQY to Ecrarea.
 - b. Cut up Ecrarea into ground surface elements, open water, and islands.
4. Create HYD features:
 - a. Copy open water from Ecrarea to Hydarea.
 - b. Cut up Hydarea into different depth curves.
 - c. Use depth curve areas to create depth lines.
5. Capture OBS features.
6. Capture POR features.
7. Capture CUL features.
8. Capture remaining features.
9. Review/Incorporate NGA List of Lights or U.S. Coast Guard (USCG) Light List.
10. Review/Incorporate Notice to Mariners.
11. Perform extraction quality control (QC).
12. Complete independent QC cycle.
13. Convert to VPF.
14. Complete a VPF validation cycle.

4.3 Prepare Chart History and DQY Worksheet

In the chart history document, you record any feature interpretation or collection decisions that were made during the production of the library. Anything out of the ordinary, such as collecting a feature with no guidance or explaining why information was omitted from one of the sources, would be included in this record. This is a place where you can document everything related to the production of the chart you are working on.

In addition to the Chart History document, there is a form called the DNC Data Quality Worksheet. This worksheet is used to record most of the data quality (metadata) information that needs to be maintained throughout the project. The information entered here is then used to create the Dqyarea.

Record the following information on the DNC Data Quality Worksheet:

| Field Name | Description |
|------------|---|
| SOURCE_ID | Chart identifier, which is your specific chart number. For a foreign source, collect the integer portion of the foreign chart number. |

| Field Name | Description |
|---------------|--|
| NAME | Chart name, which is the name from the title or, if you are working with a plan, the title of the plan. The name of the chart is usually found at the bottom right-hand corner. Enter the name exactly as it appears on the chart. Abbreviation of common terms is allowed. For a foreign source, collect the foreign country's two-letter abbreviation plus the full chart number followed by the chart title. Example: SP425A: Bahia de Alcudia. When a chart name is longer than 40 characters, enter the first 29 characters or slightly fewer to avoid breaking off in the middle of a word and append (See Note) to the end. Then enter the complete chart name in a notes.rat file. Some of the electronic navigation systems require unique names for the source charts in the DQY layer so no duplicates are allowed. |
| EDITION | Found in the lower left-hand corner of the chart. Verify that the edition number and date on the paper chart or supplied imagery match the edition number and date on the corresponding NGA ILI. Report any discrepancies to NGA. The edition number is especially critical for proper processing of Notice to Mariners updates. |
| SCALE | Found in the margin or in a corner of the chart. Leave off the "1:" and enter the scale number only. For example, a scale of 1:250,000 would be entered as 250000. |
| REF_LAT | Found in the margin of the chart, usually with the scale. If it is not on the chart, check the ILI and use the mid latitude from the geodesy report. If neither the chart nor the ILI contains any mention of reference latitude, use the center of the chart as the reference latitude. |
| ABS_HORIZ_ACC | This field should be marked as -9, unless such information is provided in a geodetic report with the ILI. |
| ABS_VERT_ACC | This field should be marked as -9, unless such information is provided in a geodetic report with the ILI. |
| DATUM | Hydrographic datum as shown on the chart (e.g., Mean Lower Low Water). This information may also be abbreviated (e.g., MLLW). |
| LINEAGE | Descriptive information that is found under the main title of the chart (e.g., From South Korean charts in 1991). If some chart information is unclear or unknown, specify that the information is unclear or unknown (for example, First Edition Date unclear or unknown). If more than 100 characters are needed, enter the first 89 characters or slightly fewer to avoid breaking off in the middle of a word and append (See Note) to the end. Then enter the complete chart lineage in a notes.rat file. |
| SOURCE_INFO | Usually found under a designation such as SOUNDINGS IN METERS on the chart, and usually in black with a note next to it (e.g., Soundings corrected for sound velocity). Also include the contour interval for topographic features if it is designated on the chart. The contour interval note includes the supplemental information. The sound velocity note is always first and the height and contour information last. If both the height and contour information cannot fit, attach each separately as a DQY note. |
| COMP_DATE | The first edition date found on the top center of the chart (month, date, and year). The date is the first of the month unless the chart is the first edition; then the date matches the print date. A zero should precede all single-digit days or months. If the first edition date is unclear or unknown, collect as all zeros or all spaces. |

| Field Name | Description |
|---------------------------|--|
| PRINT_DATE | Chart edition date found in the lower left-hand corner of the chart. |
| CONTROL POINT COORDINATES | These are the control points used to georeference the chart. These coordinates can be stored by exporting the coordinates during the georeferencing process. |

4.4 Data Dictionary

The database design must be understood to effectively extract data that is meaningful to the database. The data dictionary contains all the required features and the attributes that are used to describe the features. The database design reflects the data dictionary, and much of the content of the data dictionary is contained in the feature class domains. ArcGIS 10 help includes a digital data dictionary of the product(s) that is installed. Navigate to the "Data dictionaries and extraction" guidebook from the main ArcGIS 10 help to find the product data dictionary.

4.5 Set Up the ArcMap DNC Production Environment

1. Launch ArcMap and load the following toolbars:
 - Editor
 - Production Editing
 - Production Editing Advanced
 - Nautical DNC
 - Production TOC Manager
 - Production Symbology
 - Feature Cache
 - Versioning
2. Add the *Topology* toolbar to your desktop.
3. Identify from the ILI what type of library you are creating (Harbor, Approach, Coastal, or General).
4. Copy the template geodatabase (DNCA_10.0.0.0.mdb, DNCC_10.0.0.0.mdb, DNCG_10.0.0.0.mdb, or DNCH_10.0.0.0.mdb) to your library data storage location and rename the GDB to something meaningful such as the library or chart name.

The template GDBs can be found here:

- For 32-bit machines – <Installation location>\Program Files\ESRINautical\Desktop10.0\Dnc\Schemas\Built
- For 64-bit machines – <Installation location>\Program Files(x86)\ESRINautical\Desktop10.0\Dnc\Schemas\Built

Note: The version information at the end of the file name represents the release the model was associated with. It is recommended that you always use the latest version. The first two values, 10, represent the major release value. The second value represents the minor release value. The third value represents the service pack value, and the fourth value represents a patch. For example, 93.0.1.0 represents 9.3 Service Pack 1.

5. Click the **Add Data** button.

The *Add Data* dialog box appears.

6. Navigate to the DNC feature dataset and click **Add**.

When first starting a new production library, you need to have all possible feature classes loaded. For a QC or maintenance library it won't be necessary to have all the feature classes in your ArcMap session. You remove unpopulated feature classes by clicking the **Remove Empty Layers** button from the *Production TOC Manager* toolbar.

7. Repeat steps 5 and 6 to add your georeferenced image.
8. Save your .mxd.

Tips:

- It is important to save your data often as you are editing and adding data to your geodatabase. In addition to this, save your .mxd as you create unique symbology and label definitions for your data or add bookmarks. One way to create this as a habit is to save your .mxd every time you save your data.
- Your library name helps you to identify what type of database you are creating. For instance, a library named H1417794 is a Harbor scale library included within CD 14. The first two numbers after the letter(s) indicate the CD the library belongs to.

5.0 Create the Dqyarea

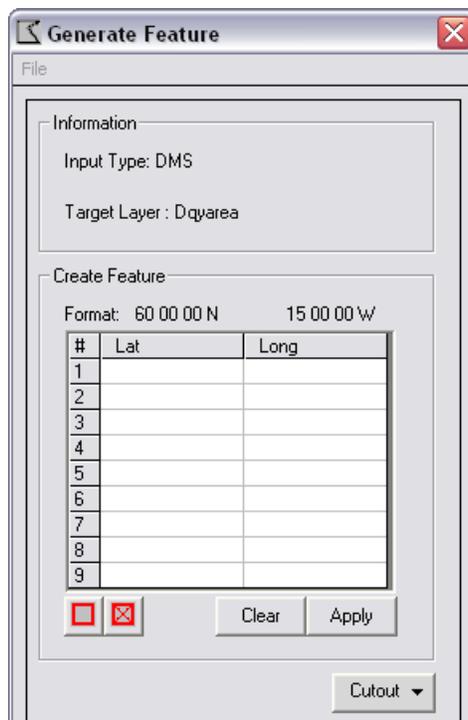
When collecting a new chart, you are given a set of coordinates that defines your collection area. These coordinates are used to create your Dqyarea feature. This should be the first feature you collect for your new chart. Once your Dqyarea feature has been collected, you may add notes with the **Notes Editor** tool or start to create other features. The Dqyarea feature is used to trace new features that share its boundary.

You need to use the **Create Dqyarea** tool to generate your feature.

5.1 How to Create Dqyarea Features

5.1.1 Creating Dqyarea Features from Coordinate Input

1. If necessary, start an edit session.
2. Make sure Dqyarea is the active target layer in the *Create Features* window.
3. In ArcMap, click the **Create Dqyarea** button  on the *Nautical DNC* toolbar. The *Generate Feature* dialog box appears.



Note: You must be in an edit session.

4. Input degrees/minutes/seconds (DMS) coordinates into the Create Features table in the following format:

Lat: 77 18 8 N Long: 102 24 5 W

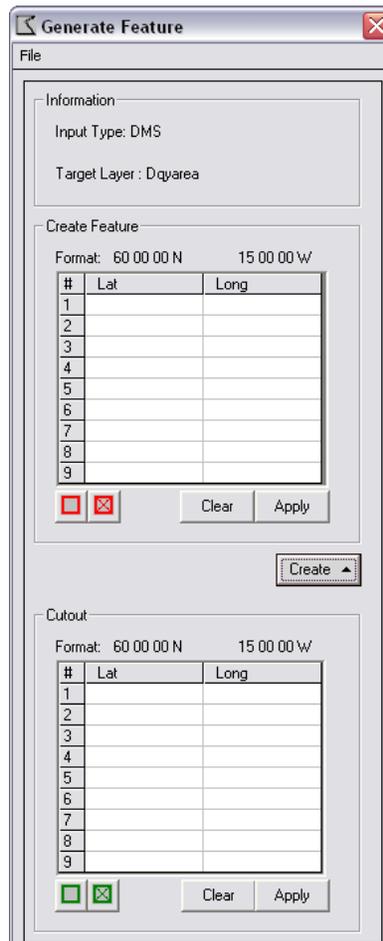
5. Click **Apply** to create a Dqyarea feature with the specified coordinates.
6. Use the *Update Attributes* window to modify the attributes of the newly created Dqyarea feature.

Tips:

- Coordinates for Dqyarea features and cutouts can be saved to a file by clicking **File** and clicking **Save**. Coordinates from these files can be loaded into the tables by clicking **File** and clicking **Load**.
- Click **Clear** to clear all values from the table.

5.1.2 Creating a Cutout

1. Make sure Dqyarea is the active target layer in the *Create Features* window.
2. Click **Cutout** on the *Generate Feature* dialog box. The Cutout area appears.



3. Input DMS coordinates into the Cutout table in the following format:

Lat: 77 18 8 N Long: 102 24 5 W

4. Click **Apply**.
5. To add multiple cutouts to a Dqyarea feature, repeat steps 3 and 4.

Tips:

- Coordinates for Dqyarea features and cutouts can be saved to a file by clicking **File** and clicking **Save**. Coordinates from these files can be loaded into the tables by clicking **File** and clicking **Load**.
- Click **Clear** to clear all values from the table.

5.1.3 Attributing Dqyarea

- SOURCE_ID: Chart identifier (your specific chart number).
- NAME: Chart name (the name from the title; if working with a plan, the name will be the title of the plan, not the chart). The name of the chart is usually found at the bottom right corner. Enter the name exactly as it appears on the chart; abbreviating common terms is allowed.
- EDITION: Found in the lower left corner of the chart. Edition number is especially critical for proper processing of Notice to Mariners updates.
- SCALE: Found in the margin or in a corner of the chart. Leave off the "1:" and enter the scale number only (e.g., 250000).
- REF_LAT: Found in the margin of the chart, usually with the scale. If not on the chart, check the ILI and use the mid latitude from the geodesy report. If neither the chart nor the ILI contains any mention of reference latitude, use the center of your chart as the reference latitude.
- ABS_HORIZ_ACC: This field should be marked as -9 unless such information is provided in a geodetic report with the ILI.
- ABS_VERT_ACC: Same as ABS_HORIZ_ACC.
- DATUM: Enter hydrographic datum as shown on the chart (e.g., Mean Lower Low Water). This may also be abbreviated (e.g., MLLW).
- LINEAGE: Enter any description that is found under the main title of the chart (e.g., From South Korean charts in 1991).
- SOURCE_INFO: Usually found under a designation such as SOUNDINGS IN METERS on the chart and usually in black with a note next to it (e.g., Soundings corrected for sound velocity). Also include the contour interval for topographic features in this field if designated on the chart. If there is no room for both, put the contour note in the data quality notes.rat file. The contour interval note will include the supplemental information.

- **COMP_DATE**: First edition date from the top center of the chart (month, date, and year). The date is the first of the month unless the chart is the first edition, in which case the date matches the print date. A zero should precede all single-digit days or months.
- **PRINT_DATE**: Found in the lower left corner of the chart.

6.0 Georeferencing and Using DNC Image Sources

There are several types of raster data that may be used as a source for feature extraction. Some may originate from satellite imagery, flown imagery, aerial photography, or a scanned image of an existing map. Regardless of origin, the raster must be accurately georeferenced to be useful.

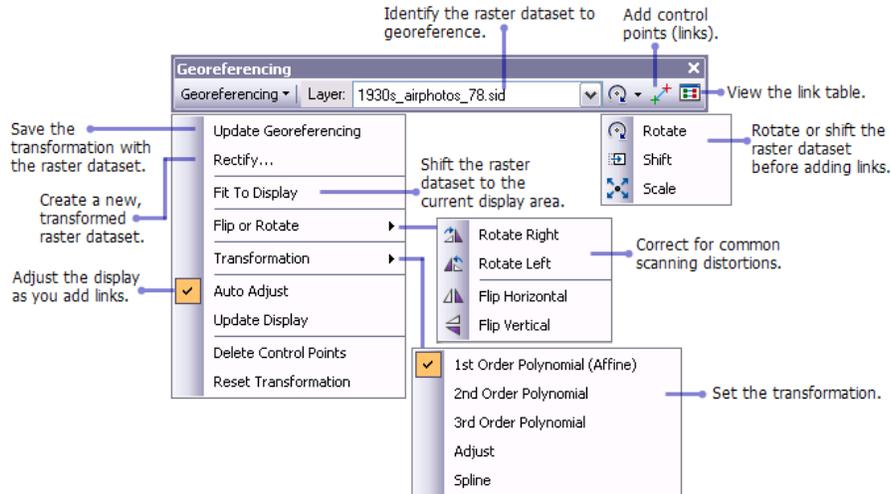
All raster datasets are in some coordinate space. This coordinate space may be the real-world coordinate system or image space. Since almost all raster datasets represent some real-world location, it is best to have that dataset in a real-world coordinate system that best represents it. Converting a raster dataset from a non-real-world coordinate system (image space) to a real-world coordinate system is called *georeferencing*.

Typically in DNC, a chart has been scanned and needs to have real-world coordinates applied to it for extraction or maintenance purposes. To attach the real-world coordinates, you first add control points to the scanned chart, then rectify the image. Before you begin, investigate either the hard- or soft-copy chart and identify locations where the meridians and parallels intersect; these intersections are what you use to do the referencing. You may want to copy the coordinates and convert them to decimal degrees before you begin georeferencing as it saves you some time to have all possible coordinates in a table you can reference easily.

Note: If the coordinate is either W or S, the decimal degrees equivalent will be a negative value.

6.1 Georeferencing Toolbar

The image below shows the *Georeferencing* toolbar.



Georeferencing toolbar buttons and their functions

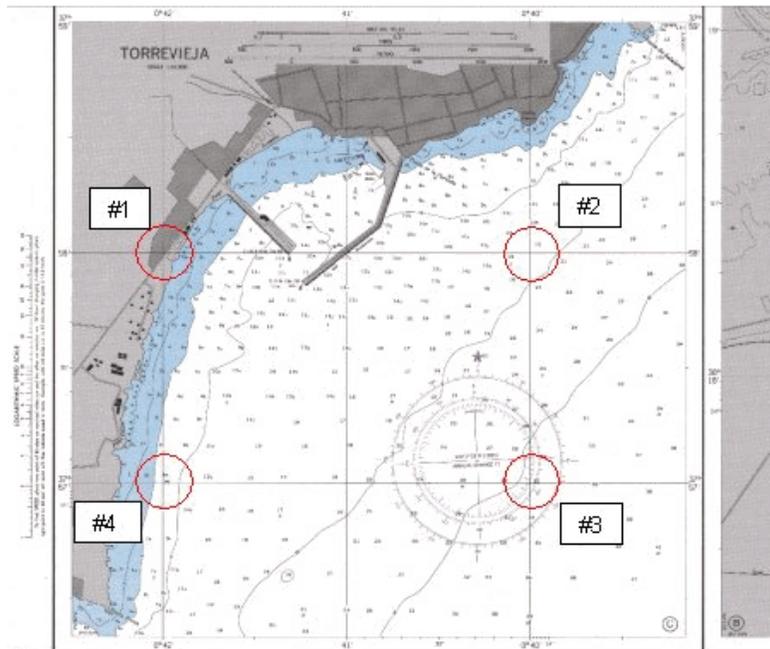
| Button Name | Function |
|--|--|
|  Rotate | Rotates the source layer |
|  Shift | Shifts the source layer |
|  Scale | Rescales the source layer |
|  Add Control Points | Allows you to select control points from a layer and add them to the map |
|  View Link Table | Shows links and errors in tabular form |

Georeferencing toolbar buttons described

6.2 Georeferencing a Raster Dataset

When georeferencing, you should identify the four outermost latitude-longitude crossings on your chart. These are the first four locations at which you enter control points.

Normally these four points fall in the corners of your chart. Exact upper right and lower left coordinates are usually given on the chart; however, the longitude-latitude crossings give a more exact location for the initial referencing. This way you can be certain that you are referencing the same location in both the raster dataset and aligned datasets.



Steps

1. In ArcMap, add the layers residing in map coordinates, then the raster dataset you want to georeference.

Adding the data with the map coordinate system first is a good workflow, so that you do not need to set the data frame coordinate system.

2. To display the **Georeferencing** toolbar, click **Customize** on the main menu, point to **Toolbars**, then click **Georeferencing**.
3. In the table of contents, right-click a target layer (the referenced dataset) and click **Zoom to Layer**.
4. From the **Georeferencing** toolbar, click the **Layer** arrow and click the raster layer you want to georeference.
5. Click **Georeferencing** and click **Fit To Display**.

This displays the raster dataset in the same area as the target layers. You can also use the **Shift**  and **Rotate**  tools to move the raster dataset as needed. To see all the datasets, adjust their order in the table of contents.

6. Click the **Add Control Points** button  to add control points.
7. To add a link, click a known location on the raster dataset and click a known location on the data in map coordinates (the referenced data).

You can also add your links in the **Magnification** window or the **Viewer** window. When working with two raster datasets, you can open the Image Analysis window

and adjust the transparency or turn layers on and off in the table of contents to view each image as you add your links.

Tip: Press ESC to remove a link while you're in the middle of creating it.

Note: The Rotate and Shift tools are not available after you place the first link.

8. Add enough links (at least four) for the type of transformation.
9. Click the **View Link Table** button  to evaluate the transformation.
You can examine the residual error for each link and the RMS error. If you're satisfied with the registration, you can stop entering links.
10. You can delete an unwanted link from the *Link Table* dialog box.
11. Click **Georeferencing** and click **Update Georeferencing** to save the transformation information with the raster dataset.

This creates a new file with the same name as the raster dataset but with an .aux.xml file extension. It also creates a world file for some of the file formats, including .tif and .img files.

Note: You can permanently transform your raster dataset after georeferencing by using the **Rectify** command (click **Georeferencing** and click **Rectify**) or the **Warp** tool.

6.2.1 Georeferencing Images with Existing Spatial Information

Occasionally, the National Geospatial-Intelligence Agency (NGA) provides images that have already been georeferenced. In this case, use the project-on-the fly capabilities of ArcMap.

- Load the DNC geodatabase layers you are going to be working on.
- Load the image.

By loading the geodatabase layers, the coordinate system for the data frame is set to geographic coordinates in the WGS 1984 datum because that is the information attached to the database. When you choose to load an image with a different projection or datum, ArcMap recognizes it and projects the image to the coordinate system of the data frame. You can check the data frame coordinate system by opening the *Data Frame Properties* dialog box.

If you were to open the image first and then bring in the geodatabase layers, you can easily change the coordinate system to GCS WGS 1984. It is always important to do new collection, corrections, maintenance activities, and other tasks in the native units of the geodatabase you're working with. There are many times throughout these activities that you may want to switch projections (QC, Notice to Mariners), but always be sure to return the data frame coordinate system to WGS 1984 once that task is complete.

1. Right-click the data frame and choose **Properties**.

The *Data Frame Properties* dialog box appears.

2. Choose the **Coordinate System** tab.

The current coordinate system is shown in the window.

3. Navigate to the Predefined\Geographic Coordinate Systems\World directory and choose the GCS WGS 1984 coordinate system.
4. Click **Apply**.

The current coordinate system is updated with the new projection.

5. Click **OK**.

6.2.2 Applying a Shift

When it is necessary to apply a shift to the chart, there are two methods you can use:

- Apply the shift to the coordinates of the tick marks when georeferencing the image. With each coordinate pair entered, take into account the shifts necessary to bring the data to the WGS 1984 datum.
- Do not apply the shifts when georeferencing the data. Enter the coordinates exactly as shown on the scanned chart.

With the second method, when defining the spatial reference of the image, you need to choose the geographic projection, but then choose the appropriate datum for the coordinates entered. This way, ArcMap recognizes the image is in a different datum and project it for use during production.

7.0 DNC Database Validation Configuration

Maintaining quality data is of utmost importance to any hydrographic organization or agency, which is why the Nautical Solution offers a variety of ways to run quality control checks on your data while stored in the geodatabase. Data quality is relevant to several aspects of the nautical geodatabase.

During your data collection efforts, the attribute values you enter for a specific feature can be checked through the runtime validation functionality. When you use the Data Reviewer checks, the existing data is validated via the check configuration stored within the batch job file. However, when you create or modify a feature within the nautical geodatabase using Feature Manager, a series of runtime checks is performed based on the attribute values entered within the Create and Update tabs. These runtime checks are stored in reviewer batch jobs. This requires that you have a product library with a product class defined.

7.1 Product Library Configuration

1. Copy and unzip the template DNC Product Library (DNC_PRODUCT_LIBRARY_10.0.0.0.zip) to your working folder.

The location of the template DNC Product Library is different depending on your operating system:

- On Windows XP – <Installation location>\Documents and Settings\All Users\Application Data\ESRI\Production10.0\ProductLibraryFiles
- On Windows Vista, Windows 7 and Windows Server 2008 – <Installation location>\ProgramData\ESRI\Production10.0\ProductLibraryFiles

Note: The version information at the end of the file name represents the release the model was associated with. It is recommended that you always use the latest version. The first two values, 10, represent the major release value. The second value represents the minor release value. The third value represents the service pack value, and the fourth value represents a patch. For example, 93.0.1.0 represents 9.3 Service Pack 1.

2. In ArcMap, click **Customize** on the main menu, point to **Production**, then click **Product Library**.
3. From the *Product Library* window, right-click **Product Library** and select **Properties**.
4. In the **Product Library Properties** menu, click the cell next to **Workspace** in the Product Library section and click the ellipsis button (...) that appears. The *Please browse to the location of the Product Library Workspace* dialog box appears.
5. Navigate to the product library database.

6. Click **Open**.

Note: If the Upgrade Workstation dialog box appears, click Yes to upgrade the geodatabase you want to use as the product library. The Product Library Workspace Upgrade window appears and displays a progress bar while the geodatabase is updated. The Production Properties dialog box appears once the process is complete.

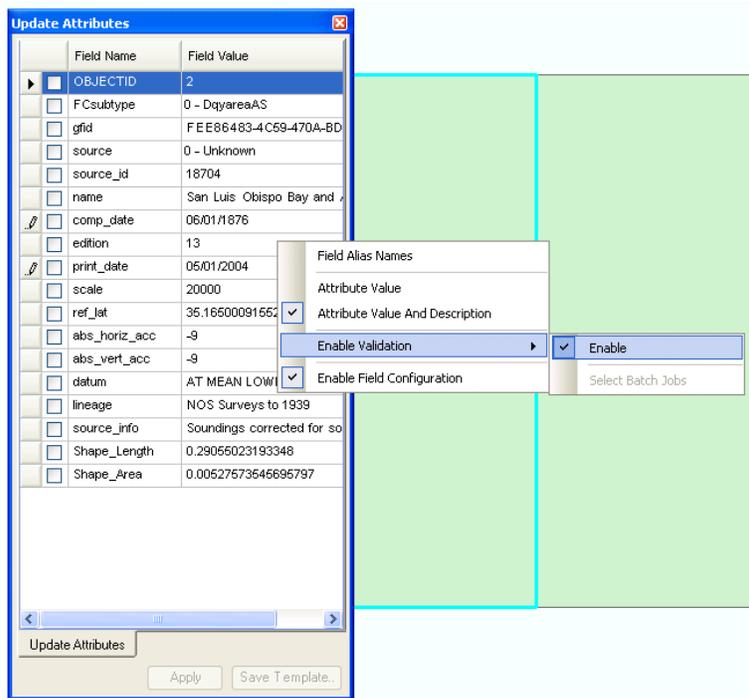
7. Click **OK**.

7.2 Enabling Runtime Validation

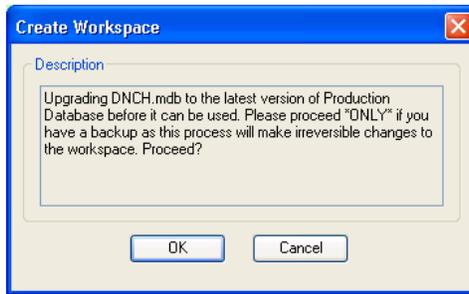
For runtime validation to be initiated, a populated production database—the DNC<scale> template you are working with—must include certain tables.

Note: The tables cannot be added while you are editing data.

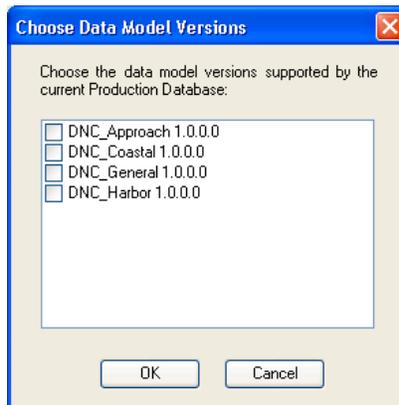
1. Verify that you are not in an edit session and select any feature.
2. Click the **Update** tab in the *Manage Features* window.
3. In the *Update Attributes* window, right-click to uncheck the **Enable Validation** option.



4. Again, in the *Update Attributes* window, right-click to check the **Enable Validation** option.
5. Click **OK**.



6. When prompted, choose the appropriate data model version from the menu. Click **OK**.



8.0 Feature Collection

When collecting features, it is critical that you maintain coincident geometry. The best way to do this is to collect large areas first. Always start with the *Dqyarea*, then use those boundaries to collect other coincident features. The best method and most widely used is the **Trace** tool.

When features are collected, they may be attributed before or after they are created. You use the **Create Features** window to set the attributes before you collect a feature, or you may choose a template. You may also set the attributes after the creation of the feature by using the Update Features mode and updating the existing feature's attributes. All features, unless specified, are created with default attribution.

When collecting features that have values in units other than meters, you need to convert them using the **Units Conversion** tool. Always input what you see on the chart. There is one important exception, however. If you have character fields that require values of units to be converted, you must convert them manually. The Units Conversion tool only works with numeric fields. You must also manually convert all note table entries.

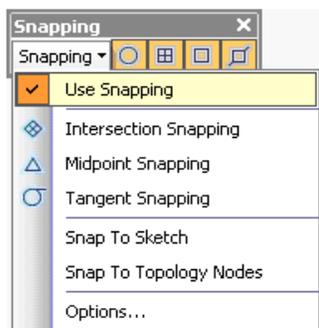
Tips:

- You can use shortcut keys to perform certain functions from within the editing environment of ArcMap.
- When sketching features, think about how you are collecting other features that connect to the feature you are currently collecting. Remember to place vertices at key intersections. This allows you to snap new features more easily.

8.1 Snapping Environment

Snapping allows you to create features that connect to each other so your edits are more accurate, with fewer errors. When snapping is turned on, your pointer will jump, or snap to, edges, vertices, and other geometric elements when your pointer is near them and within a certain tolerance. This enables you to position a feature easily in relation to the locations of other features.

All the settings you need to work with snapping are located on the **Snapping** toolbar. Snapping is not limited to being used while editing, as it is utilized in other areas of ArcGIS, such as georeferencing and the Measure tool on the Tools toolbar. By default, snapping is enabled, and the active snapping types are points, endpoints, vertices, and edges. You can turn on or off individual types from the Snapping toolbar. To turn off snapping completely, click the **Snapping** arrow and remove the check mark next to **Use Snapping**.



When you are editing, there are two snapping environments available to you. The default environment uses the Snapping toolbar, but you can instead choose to use the editing classic snapping environment. With classic snapping, you can set up snapping on a layer-by-layer basis.

The editing classic snapping environment refers to the snapping functionality that was available during an edit session in ArcGIS 9 and earlier using the **Snapping Environment** window. In classic snapping, snapping settings are specified by choosing a layer and snapping type (vertex, edge, or end) in the Snapping Environment window. This snapping functionality is off by default and has been replaced with the Snapping toolbar, which provides a flexible, easy-to-use snapping environment with more snapping types, more options, and better feedback than classic snapping. Since there may be some scenarios where you need to access the classic snapping environment, such as when performing raster snapping with the ArcScan for ArcGIS extension, you have the option to switch to classic snapping.

You enable editing classic snapping on the **Editing Options** dialog box and use the **Snapping Environment** window to turn on snapping for individual layers and snap types.

Many of the feature geometries captured for DNC are dependent on other features. The snapping environment, therefore, becomes an important aspect of collection. When setting up the snapping environment, it is recommended that only snap to vertex be used. The major exception is Dqyarea, which uses snap to edge because there are only corner vertices when the feature is first captured. Also, note that the order of feature classes in the snapping environment menu is the snapping priority that ArcMap uses to determine which feature it snaps to first.

To easily identify vertices on existing features while adding new geometry, use the V key. The V key highlights vertices on nearby features with a hollow square. Using this tool helps ensure coincidence between dependent features.

It is also important to keep these dependencies in mind during the beginning stages of extraction. For instance, as you are digitizing the shoreline, consider reef, pier, obstruction, and other areas that may ultimately share that edge, and add vertices where these areas meet.

8.2 Area Features

Area features should be the first features collected. There are two good reasons for this. First, many DNC features build off of one another or are coincident with large polygons. Collecting them first allows you to use certain tools such as the Trace tool to share coincident geometry when capturing the smaller features. Second, you should collect area features first because many of the topology rules rely on area features.

Since all the feature classes have been generated for use during setup, it is just a matter of setting the correct target layer in the *Create Features* window. Always create Dqyarea first and work inward, collecting the largest areas first. Usually your land and water areas are the largest. The **Trace** tool is the best method for collecting your area feature while maintaining coincident geometry.

As you become more familiar with the defined topology rules, you learn how they might benefit you. Some rules actually create the features you want, while others do not. This could be beneficial depending on the complexity of your chart.

It is also important to remember which features cannot overlap one another. Topology finds most of these errors for you, but you still must understand the concept in order to fix these errors. When collecting area features, it is important to keep a theme-based approach. Just as you could not overlap features within the same coverage (except limits) in Nautical Solution Workstation, you cannot do this within the geodatabase. The reason is that you must export to coverages to convert to VPF.

Use the *Production TOC Manager* toolbar to group your layers accordingly. If you are collecting features that exist within the same theme, they must not overlap, so keep the layers in the theme visible during collection. Use the *Cut Polygons* tool or other methods to ensure no features overlap. There is an exception: limits may overlap one another.

A completely theme-based approach does not ensure that features do not violate certain spatial relationships. A good example of this is land and water. Ground surface and open water exist in the same theme (ECR), so it should be easy to ensure that they do not overlap. However, depth areas, which are in the theme HYD, are a water feature, and these must not overlap land features either. It is necessary to consider these relationships during collection. These are the same rules as in Workstation, except that you are dealing with feature classes instead of coverages. If you follow the production flow strategy outlined above, you will minimize the number of errors created by overlapping features.

Tips:

- Do not rely on topology to fix all your errors. It is faster to collect features the right way first.
- Remember to enter the values as they appear on the chart, except for character fields. Use the **Units Conversion** tool to convert values that are in units other than meters.

8.3 Hydarea

When collecting Hydarea features, you are required to code the CVL and CVH values along with ACC on each feature you create. Currently there is no automation tool for this.

When coding large depth areas that might be shoals or deeps, you need to find the highest or lowest sounding value. To help with this query, use the Select By Location tool located on the Selection menu.

1. Select the area you want to query.
2. With your new feature selected, click **Select By Location** from the **Selection** menu.
3. For **Target layer(s)**, check **SoundP**.
4. For **Source layer**, choose **Hydarea** from the drop-down list.
5. Click the **Spatial selection method** arrow and choose **Target layer(s) features are completely within the Source layer feature** from the drop-down list.
6. Click **Apply**.
7. Click **Close**.
8. Click the **Statistics** button. If necessary, the Statistics button can be added by clicking **Customize** on the main menu > **Customize Mode** > **Commands** tab > **Highlight Selection**. Drag the Statistics tool to the toolbar of choice.
9. Click the **Field** arrow and choose **hdp**.
10. In the *Update Features* window, make sure you have your feature selected and enter the correct CVL and CVH values.

Note: Remember to enter the values as they appear on the chart except for character fields. Use the Units Conversion tool to convert values that are in units other than meters.

8.4 Line Features

Once you have created all your area features, most of your line features can be created using the **Trace** tool. Always have your target layer set in the *Create Features* window.

If you have to sketch a new line without using existing geometry, do not use the stream mode. This will generate too many vertices, which will cause unwanted validation errors. Also, place vertices where you will need them for snapping other features to that location.

Keep in mind the theme-based approach when collecting line features. Lines must intersect other features from line feature classes when they exist in the same theme. Just the opposite applies too. If they do not exist in the same theme, they do not have to intersect. When collecting features that must intersect, use the **Create and Intersect**

Features button on the *Create Features* window. For example, when you create roads or railroads, these features must not only intersect themselves but also each other because they exist within the same theme.

Tips:

- Always have your snapping environment set while using the Trace tool. This ensures that you snap to existing vertices or endpoints.
- You may use the Copy/Paste option to duplicate geometry between line feature classes.
- Remember to enter the values as they appear on the chart except for character fields. Use the **Units Conversion** tool to convert values that are in units other than meters.

8.5 Point Features

Point feature classes have been created during the geodatabase setup process. When collecting point features, all you have to do is set the correct target layer in the *Create Features* window.

Tips:

- Never snap features to point features. This generates VPF validation errors.
- Remember to enter the values as they appear on the chart except for character fields. Use the **Units Conversion** tool to convert values that are in units other than meters.

8.6 Annotation (Ecrtext)

Annotation can either be imported into the geodatabase or it can be created during an edit session. Either way, you must first have an annotation feature class. For DNC, regardless of scale, you need an annotation feature class named Ecrtext.

When collecting Ecrtext, you must have a valid Dqyarea feature. If not, generate your dqyarea feature. The Dqyarea feature is required to calculate the correct size of the annotation collected. Therefore, annotation can be collected anytime during the production process as long as Dqyarea exists.

8.6.1 About Adding Annotation

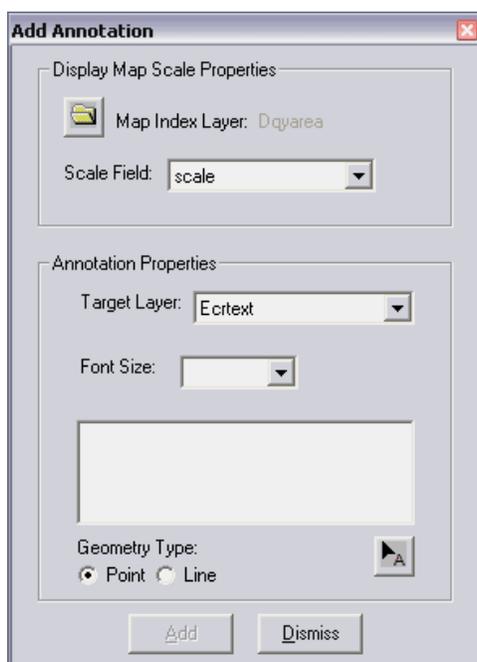
The Digital Nautical Chart data model allows the collection of text features stored in an annotation feature class, Ecrtext. This feature class stores geographic places, not normally appearing as features on a map, which have names that are required to be placed on a

map. The size and shape of these annotation features are required to be representative of their respective hard-copy source text features.

A geodatabase annotation feature class requires that a reference scale be set, which is applied to all text collected in that feature class. However, a DNC library can be composed of multiple charts of varying scales. The **DNC Annotation** tool allows that flexibility by calculating the true size of an annotation feature based on the scale of the Dqyarea (chart) feature class in which it resides.

8.6.2 How to Use the Add Annotation Tool

1. Make sure the Ecrtext feature class is in the table of contents and open for editing.
2. Click the **Add Annotation** button  on the *Nautical DNC* toolbar. The *Add Annotation* dialog box appears.



3. For **Map Index Layer**, click the **browse** button  and browse to the Dqyarea feature class from the geodatabase currently being edited.
4. Click **OK**.
5. Choose **scale** from the **Scale Field** drop-down list.
6. Choose **Ecrtext** from the **Target Layer** drop-down list.
7. Choose an appropriate font size for the text features being collected.
8. Type the text to be added into the text box.
9. Choose either **Point** (single-point horizontal text) or **Line** (diagonal or splined) option for **Geometry Type**.

10. Click **Add**.
11. Click in the ArcMap display to add annotation features with the specified properties. For point text, click in the middle of the desired placement location on the map. For line text, digitize a sketch line over the desired placement location.

8.7 Editing Topology

Editing features that participate in a topology is similar to editing simple features—in fact, you can use the same sketch tools to create new features that participate in a topology as you would use for features that do not. When you want to modify a feature that shares edges or nodes with other features in the topology, use the **Topology Edit** tool.

When collecting features, it is necessary to consider the topological relationships that the new feature may have. If any shared edges need to be modified during a later edit session, you'll want the coincidence to be complete between features to use the topology editing tools available. Using the **Trace** tool and other snapping agents helps to ensure these relationships.

8.8 General Guidance

Following are things to keep in mind while editing features:

- You can only select features that are checked in **List by Selection** and are visible.
- Manage your snapping environment effectively.
- Just because you cannot see it does not mean it is not there. You may have your drawing order set incorrectly.
- Use the **Create and Intersect Features** button on the *Create Features* window to create line features that must intersect one another.
- Remember shortcut keys while editing in ArcMap.
- Always use the **Topology Edit** tool when editing features with coincident geometry.

9.0 Notes

Note tables are not mandatory but must be specific to a thematic layer (e.g., CUL, DQY, ECR, ENV, HYD). These thematic layers are made up of feature classes within the geodatabase. Whether you are collecting new features or modifying existing features, you must use the **Notes Editor** tool.

Notes can be modified anytime during an edit session. Notes are only specific to one database; that is, you cannot share notes between geodatabases. You can, however, share notes within a thematic layer but not between thematic layers. When working in a geodatabase, a note table represents each <thematic layer>notestable. There is also a notes join table, which contains the link between the feature's GFID and the note table row ID.

If you are entering a note that requires unit conversion, you must manually convert the units before entering the note.

9.1 Breaking the Note Link

It is important to keep in mind that if you attach a note to a feature and change that feature's GFID, you will lose the link created in the notes join table. The only way to change the feature's GFID is to create that feature again. This can be done many ways; but remember, if the GFID changes, the notes join table must be updated. To update the notes join table, use the **Notes Editor** tool and attach the note to the new feature.

9.2 Note Migration

If you have to migrate your data into another geodatabase, you need to migrate your note tables too. To do this, use the **Notes Migration** tool.

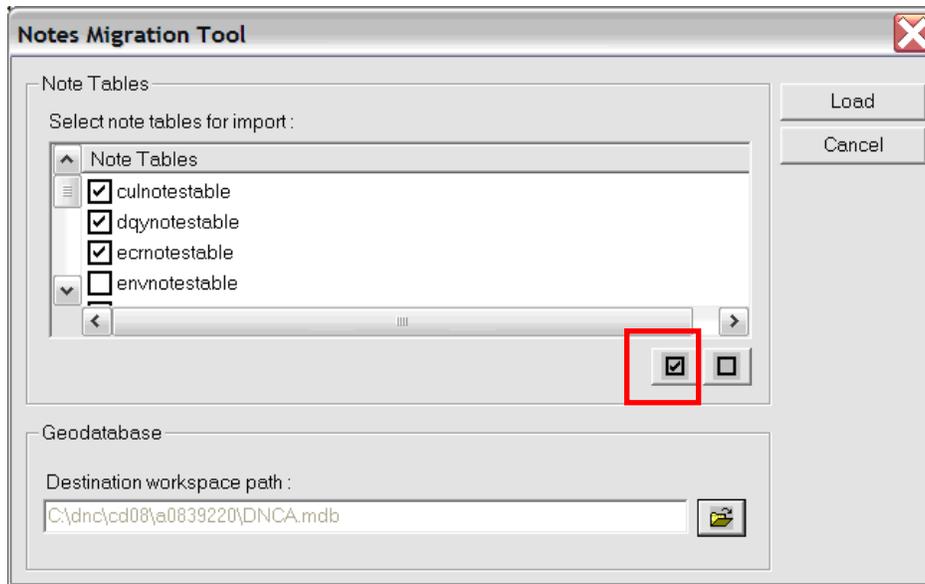
9.2.1 How to Use the Notes Migration Tool

1. Load features from the source geodatabase to the target geodatabase using Data Loader.
2. In ArcCatalog, click the source geodatabase containing the note tables to be migrated.
3. Click the **Notes Migration Tool** button  on the *Nautical DNC* toolbar.

The *Notes Migration Tool* dialog box appears. The available note tables appear in a scrolling list.

4. Check the check boxes next to the note tables you want to migrate or click the **Select All** button.

5. Browse to a destination geodatabase. This is the database into which you loaded your data using **Data Loader**.



6. Click **Load**.

Tip: The note tables must already exist in the destination geodatabase. If not, you will receive an error message listing which tables did not migrate.

9.3 Importing Notes

When importing VPF data, you must import your notes at the same time. To do this, use VPF Importer with the **Import Notes** option. If you do not do this during import, you are not going to be able to import your notes at a later time. There is no option to just import notes without the data. However, you can import your data a second time into a separate geodatabase, then migrate those note tables into your production geodatabase using the **Notes Migration** tool. This step requires you to use the **Notes Editor** tool to attach those notes to the correct features manually.

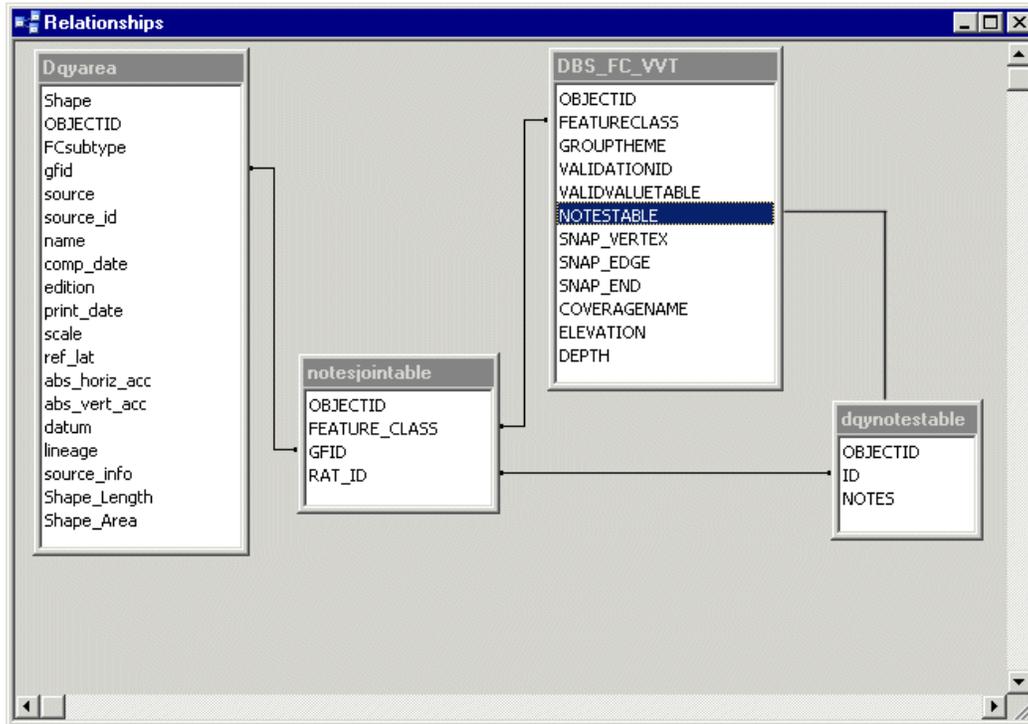
9.4 Note Table Anatomy

The notes join table (NJT) controls which features are related to which notes.

The feature class contains a field called GFID, which is the unique identifier for each feature in the geodatabase.

The DBS_FC_VVT table establishes the link between the feature class and which note table to populate.

The note table stores the note information in a binary large object (BLOB) field that can only be viewed with the **Notes Editor** tool.



9.5 The Notes Editor

The Notes Editor can be used to add, delete, or modify notes associated with individual features.

Nautical charts often contain textual information that is associated with the chart but cannot be captured as separate features (e.g., margin notes, warnings, and cautions). This information is referred to as chart notes, which are linked to the Dqyarea feature class. These notes can also be associated with a feature on the charts as a related attribute. Both types of notes are captured in note-related attribute tables.

Note tables are not mandatory but must be specific to a thematic layer (a VPF grouping of feature classes, MIL-PRF-89023, page 5). Managing which feature class belongs to which thematic layer is done automatically. Twelve note tables and one notes join table exist in the database.

Whether you are editing existing data or creating new data, you need to be able to modify or add note information. The Notes Editor allows you to do this.

The DNC product specification allows a feature to be linked to descriptive text stored in a related attribute table, notes.rat. In the ESRI Nautical Solution, these notes can be added, modified, or deleted using the Notes Editor.

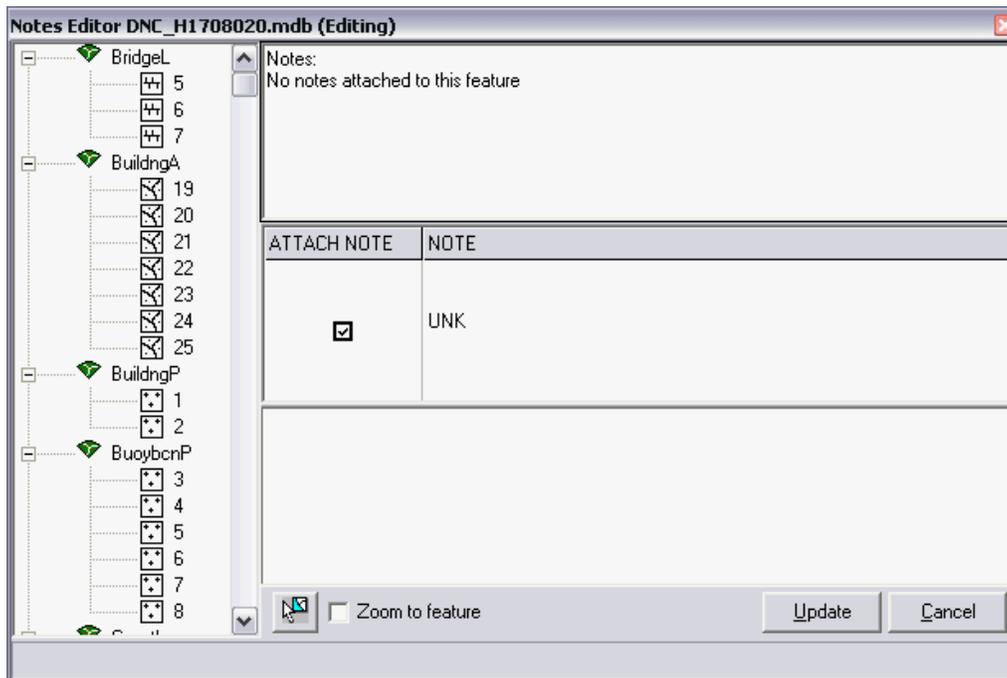
9.5.1 Starting the DNC Notes Editor

The **Notes Editor** tool can be accessed from the *Nautical DNC* toolbar.

1. Click the **Notes Editor** button  to begin the note editing process.

If layers from more than one workspace are loaded in the table of contents, you will be informed that the Notes Editor displays notes from the source workspace of the topmost layer in the table of contents. If you are currently editing, the Notes Editor uses the note tables from the edit workspace.

The *Notes Editor* dialog box appears. Selected features are shown in the left-hand Catalog tree. If there are no features selected, both windows are blank.

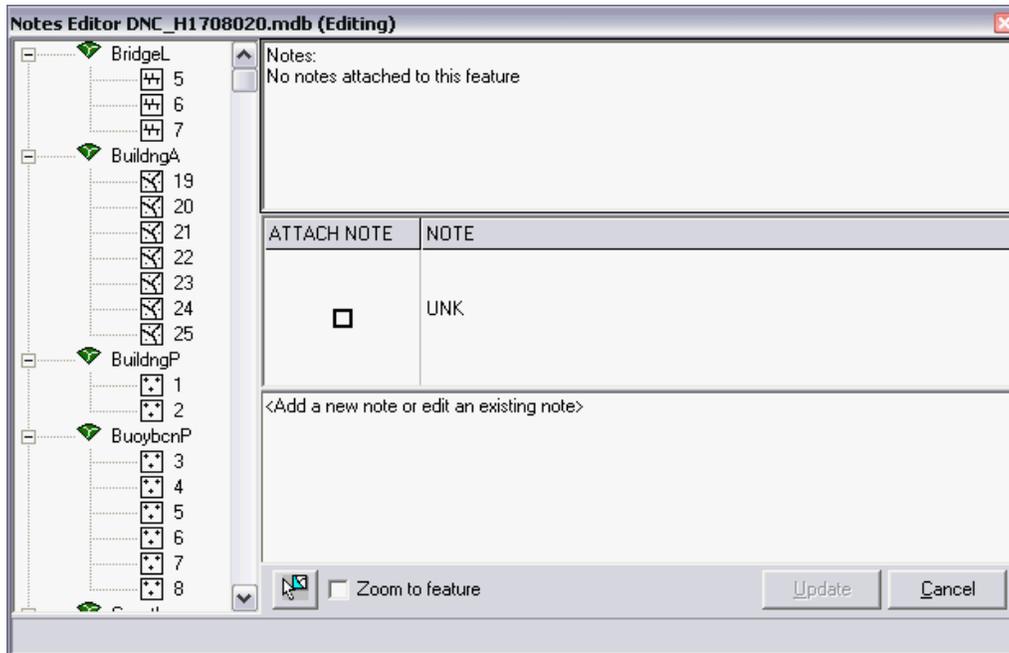


2. Click a feature ID in the Catalog tree to access that feature's notes. If the feature contains no notes, a message displays, "No notes attached to this feature."

Tip: If you are viewing the notes in read-only mode outside an edit session, the Notes Editor displays notes from the source workspace of the data layers in the table of contents.

9.5.2 Adding Notes

1. Right-click the feature requiring a note in the left-hand Catalog tree and choose **Add/Edit Note**.



2. Type the note text in the bottom text box and click **Update**. The note is moved to the top window and the check box is checked in the center window, signifying that the text has been attached to the feature.

Tip: Do not press ENTER. The lines are appended together and separated by a semicolon.

9.5.3 Deleting Notes

1. Right-click the feature requiring a note in the left-hand tree view and select **Add/Edit Note**.

All the notes for a group theme, HYD for example, are stored in a single table. These notes are listed in the center window. The notes attached to the feature in question will be checked.

2. Find the unwanted note in this list and uncheck the box.
3. Click **Update**. The updated note list for the feature will appear in the top window with the unwanted note removed from the list.

Tip: The unwanted note will still appear in the checklist. Although it is not attached to this particular feature, it may still be linked to another feature in this group theme.

9.5.4 Editing Notes

1. Right-click the feature requiring a note in the left-hand Catalog tree and choose **Add/Edit Note**.

All the notes for a group theme, HYD for example, are stored in a single table. These notes are listed in the center window. The notes attached to the feature in question are checked.

2. Right-click the note to be edited and click **Edit Note**.
3. Modify the textual information in the bottom text box and click **Update**. The updated note list for the feature appears in the top window.

Tip: This note may be attached to other features in this group theme. For this reason, it is recommended that modifying the textual content of a note be done by adding a new note to a feature with the desired text, then unchecking the previous note with the undesired text.

10.0 DNC Quality Control

Data quality is regulated by a QA program through QC processes. QA is defined as an all-encompassing management approach that combines technical aspects of quality, qualitative methods, and human resources in a system designed to meet the customer's expectations. QC is an individual task or set of tasks performed at a given level of the production process aimed at ensuring integrity of a product, output, or action.

Similar to editing processes, QC does not have a prescribed time in the production process other than as a last step before data delivery. However, this does not mean that's the first time QC is performed. QC can be performed in process and at any time during production. Some QC is inherent in the database and occurs on the fly, such as attribution with domains, while other processes must be applied such as minimum feature detection and visual data validation. Early detection and feedback are essential in successfully producing high-quality, cost-effective data.

10.1 Domains

Part of the geodatabase design is defining attribute domains. They are used to control allowable attribute values, which facilitate feature attribution and on-the-fly QC. Domains themselves are not a quality control task; however, they control the allowable inputs to a field and are therefore implied quality control.

10.2 Data Rendering

The features in the layers may be rendered in several ways to facilitate feature extraction, attribution, and quality control. Layers are rendered with random symbols that may include subtypes if the feature class has them. Within the properties of a feature class, specific attributes can be used to assign symbols to features. This can be very useful for ensuring feature attribute consistency.

10.3 Label Expressions

The two most common label expressions are available on the *Nautical DNC* toolbar. They both display attribute fields in the upper right corner of the feature and modify the feature symbol. These label expressions should be used when you want to view these attributes on-screen or to create a quality control plot.

The SoundP label expression labels your Hydrographic Depth (HDP) or Hydrographic Drying Height (HDH) fields based on the Sounding Category (SND) value. It displays numbers to one decimal, rounding 0.25 and 0.75 to the next higher single decimal.

The BotcharP label expression labels your bottom characteristics based on the following field order, from left to right: Physical Surface Characteristics (PSC), Material Composition Category (MCC), Secondary Material Characteristics (CSM), Material Composition Secondary (MCS), Underlying Material Characteristics (UMC), and Material Composition Underlying (MCU).

10.3.1 Labeling Your Layers

In ArcMap, click either the **Label BotcharP Layers** button  or the **Label SoundP Layers** button  on the *Nautical DNC* toolbar.

Tip: You can label multiple SoundP or BotcharP layers within your ArcMap session.

10.3.2 Turning Your Labels Off

In the table of contents, right-click the layer you do not want to display labels. Uncheck the **Label Features** option.

Tip: If you want to turn your labels back on, repeat the above step.

10.4 Creating a Sounding Points Plot

1. Symbolize the shoreline (CoastL) with a thin, green line.
2. Right-click the SoundP layer in the table of contents and click **Properties**. The *SoundP Layer Properties* dialog box appears.
3. Choose the **Symbology** tab.
4. Choose to symbolize the points with a unique value.
5. Choose **exs** from the **Value Field** drop-down list.
6. Click the **Labels** tab.
7. Check the **Label Features in this layer** check box.
8. Choose **Define classes of features and label each class differently** from the **Method** drop-down list. The class name appears as the default.
9. Click **Rename**.
10. Type *Ordinary Sounding* in the text box.
11. Click **SQL Query**. The *SQL Query* dialog box appears.
12. Define this class to be all sounding values with $[snd] = 9$.
13. Click **OK**.
14. Choose **hdp** from the **Label Field** drop-down list.

15. Click **Symbol** to set the text symbol properties to match the parameters outlined below.
16. Repeat steps 9–15 for the following classes:

| Class Name | SQL Query | Label Field | Text Symbol |
|-------------------|-------------|-------------|------------------------------|
| Ordinary Sounding | [snd] = 9 | hdp | 39 (default text) |
| Slant Sounding | [snd] = 10 | hdp | 39 (italicized text) |
| No Bottom Found | [snd] = 2 | hdp | 39 (bold, red text) |
| Drying Heights | [snd] = 1 | hdh | <u>39</u> (underlined text) |
| Other | [snd] = 999 | hdp | 39 (bold, green text) |

Note: Use the **Add** button to add new label classes.

17. Click **OK** when you are finished creating the label classes. Your changes and the sounding point labels are accepted.
18. Right-click the data frame and choose **Properties**. The *Data Frame Properties* dialog box appears.
19. Click the **Coordinate System** tab.
20. Set the projection for the data frame to match the hard-copy chart on which you are performing quality checks.
Before accepting the new projection, change the central meridian and reference latitude to match the paper chart.
21. Click **Modify**. The *Projected Coordinate System Properties* dialog box appears.
22. Edit the **Central_Meridian** and **Standard_Parallel_1** values so they are specific to your chart.
23. Click **OK** when you are done modifying the values.
24. Switch to layout view. You can switch to layout view by clicking the **Layout** button in the lower left-hand corner of the data frame.
25. Type the chart's scale in the text box on the *Standard* toolbar.
26. Select the print location and set the paper size to **ANSI E** or a size that fits the chart you are creating.
27. Align the data frame to fit the page and the data. You may want to change the orientation of the page from portrait to landscape.
28. Add the following items to the layout:
 - Title information, including the chart number, date, and technician initials
 - Legend

- Green text stating the chart is UNCLASSIFIED/LIMITED DISTRIBUTION

29. Print the chart.

11.0 Topology and DNC

Topology is only enforced when you validate it. When the topology is validated, the following occur:

- Clustering

The cluster tolerance is the minimum distance between vertices of features that are not coincident. Vertices that fall within the cluster tolerance are defined as coincident and snapped together during the clustering process.

- Cracking

During cracking, vertices are added at the intersection of feature edges. For example, where two polylines cross, or where a polyline crosses the edge of a polygon, vertices are created both within and between feature classes.

- Rule validation

Once the data has been clustered and cracked, the topology rules are validated and errors are logged.

During the setup process, you defined your topology. Now you must plan to use that topology during your production or maintenance cycle. Topology not only validates your database based on spatial relationships, but it also helps maintain coincident geometry by allowing you to edit shared geometry. This especially becomes crucial during the maintenance stage when you have all of your features collected, but then you must go back and edit your shoreline or other feature that contains geometry coincident with numerous other features. The topology stores these relationships and allows you to select all the required features and edit them at the same time.

Note: Always make sure you have the correct feature selected when using the topology fixes. If you make a mistake, just use the Undo button and validate the area again to log the error. The Undo button does not undo the topology error table, just the edits.

11.1 Validation

Topology can be used anytime. However, it is important to keep a few things in mind. Validation takes the longest when you run it for the first time. This is because it is checking every feature in the database. Every subsequent time it only checks the dirty areas (areas where edits took place). This speeds up the process. Also, you should be aware of your rule base. If you have rules that are defined to require specific features to exist in order to validate another feature, you get false errors. For example, if a rule depends on the existence of Dqyarea but you validated before that feature was created, you have a lot of errors that would not exist if you created the feature first.

Note: You should only validate after your chart has been collected and after you have made topological edits.

11.1.1 How to Validate Topology

1. Load the *Topology* toolbar.
2. Verify that DNC_Topology is the selected topology on the toolbar. If you have set up map topologies, there may be more than one choice.
3. Validate topology by choosing the method to use.
4. To view the errors, click the **Error Inspector** button. A blank table appears.
5. Check the **Errors** and **Exceptions** check boxes for personal geodatabases. The **Visible Extent** check box should only be selected if you are working with an ArcSDE database.
6. Click **Search Now**. The table is populated with all the errors found during validation.
7. Right-click an error. You are given a shortcut menu with many options that include zooming to and selecting the offending feature. The topology errors are highlighted in red. When you select an error, the outline of the topology error turns black.

In the shortcut menu, you can mark an error as an exception. A rule in DNC that almost always has an exception is that the boundary of GroundSurfaceElementAS in Ecrarea must be covered by CoastL. Where the GroundSurfaceElementAS meets the Dqyarea edge, there is no coastline, so this error is marked as an exception.

Depending on what stage of production you are in, you may or may not want to correct the error when it is identified. The shortcut menu gives correction options that automatically fix the problem when chosen.

11.2 Error Inspector

Once you have made edits to a feature that participates in a topology and validated your edits, you may see one or more topology errors. You can manage topology errors with Error Inspector. Error Inspector lets you view topology errors in a table that tells you the rule violated, the feature class or classes involved in the error, the geometry of the error, the feature IDs of the features involved in the error, and whether or not the error has been marked as an exception. You can sort the errors by any of the fields in the table, so you can work with all of the errors of a given type. You can also limit the errors shown in the table to errors of a given type, errors that occur in the currently visible map extent, or errors that have been marked as exceptions.

In addition to letting you view and sort errors, Error Inspector lets you select errors, pan or zoom to selected errors, and apply topology fixes of various types to errors.

Note: Always make sure you have the correct feature selected when using the topology fixes. If you make a mistake, just use the Undo button and validate the area again to log the error. The Undo button does not undo the topology error table, just the edits.

12.0 Data Validation and DNC

ArcGIS Data Reviewer is a data quality control management application that simplifies many aspects of automated and visual spatial data quality control tasks, resulting in a more efficient and consistent review process. Through a series of tools, ArcGIS Data Reviewer is used to identify where geometric corrections, extraneous feature edits, and feature attribution changes must be made to the spatial data and its attributes, as well as digitize the locations of missing features. Defects are logged in a portable table that can be passed from the QC specialist to the editor who is going to implement the required changes to the database.

ArcGIS Data Reviewer serves as a reviewing tool that allows you to manage quality assurance of your data. It allows you to run individual checks or batch jobs (groups of checks) as well as spatially track and record anomalies discovered through visual data review.

12.1 QC Management

Part of QC management is defining the extent of the data to validate during the Reviewer session. Using the **Create Polygon Grid Wizard** tool, you can generate a grid that represents the area of interest you want to review. The grid allows you to divide an area of interest into smaller visual extents that can be used with checks.

The polygon grid can also be used with the *Reviewer Overview Window* to manage which grid cells have been reviewed and which have not. Since the grid represents a specific extent in your map, you can use the Reviewer Overview Window to navigate the different parts of the grid on your map.

12.2 Automated Quality Control

ArcGIS Data Reviewer contains many checks that can be used to validate your data. The checks are divided into several categories based on the type of validation they perform. For example, the Spatial Parameter Evaluation category contains checks that allow you to evaluate spatial parameters of features such as the number of parts, extent, and number of vertices.

These checks can be configured individually and run against a specified area of interest in your map. You can run the checks on entire feature classes, your current visual extent, or a selected set of features or based on a definition query that has been set for the feature class.

12.2.1 Spatial Parameter Evaluation

The checks in the Spatial Parameter Evaluation category allow you to evaluate the sizes of features and other similar aspects. For example, you can evaluate the number of parts or vertices features in a feature class contain, as well as the number of times features from one feature class intersect another.

12.2.2 Default

The checks in the Default category ensure that features' basic geometry is valid. For example, you can verify that line features have at least two vertices and polygons three vertices and that there are no nonlinear segments in a feature. The Reviewer session can be configured to automatically run checks in this category on any features run in a batch job to ensure basic data integrity.

12.2.3 Feature on Feature

The checks in the Feature on Feature category evaluate the relationships between features from at least two different feature classes or between a feature class and a table. For example, using these checks you can evaluate the way features spatially relate to each other in terms of the way they intersect. You can also compare attributes in a nonspatial table with attributes of features in a specified feature class.

12.2.4 Database Validation

The checks in the Database Validation category provide a way for you to validate conditions defined in your database. For example, you can search for features that have null subtypes or invalid domain values. You can also validate relationship classes and geometric networks.

12.2.5 Duplicate Geometry

The checks in the Duplicate Geometry category find features with vertices that are too close and features that completely overlap each other. For example, you can find vertices within a single feature that are within a tolerance of each other or features of the same geometry type that are collocated.

12.2.6 Topology

The checks in the Topology category use a database topology and the topology graph to evaluate the relationships between topologic features in the map. For example, you can find dangles on polylines, orphaned topology edges, and unnecessary nodes and polygon boundaries in your map's topology.

12.2.7 Table

The checks in the Table category evaluate attribute field values and find records or features based on criteria you specify. For example, you can ensure that the values for a specific feature class attribute are all unique, search for strings based on a regular expression, or find features based on combinations of attributes.

12.2.8 Z-Value

The checks in the Z-Value category provide different ways for you to evaluate ranges of z-values as well as continuity. For example, you can find z-values that are within a specified range or evaluate z-values to ensure they are trending in one direction.

12.2.9 Polygon

The checks in the Polygon category allow you to evaluate various polygon properties. For example, you can find sliver polygons and evaluate polygon perimeters and areas based on requirements in a product specification.

12.2.10 Polyline

The checks in the Polyline category allow you to evaluate various polyline properties. For example, you can ensure that polylines are of a certain length and that there are not any cutbacks.

12.3 Collective Data Review

The checks can be grouped into a batch job, which is a collection of checks that can be run using **Batch Validate**. Using Batch Job Manager, checks can be added to a batch job and grouped accordingly. A single check can be included in a batch check several times, each one with a different feature class or spatial parameter inputs. Once you are finished configuring checks for your batch job, you can save it as a Reviewer batch job (.rbj) file. This allows you to reuse the collection of checks on different databases that contain the same feature classes and to distribute the configuration to many users for consistency in the QC process.

The batch jobs can be run against the database using Batch Validate. This tool allows you to define the extent to use with the batch job—the selected set of features, the current extent, entire feature classes, or features that can be used based on a definition query—and validate your batch job against that extent before running it to ensure the feature classes referenced in the batch job are currently in the map. When the batch job is run, the returned features and table records are automatically written to the Reviewer table.

DNC-specific attribute (DNC<scale>_Attribute_Checks_10.0.0.0.rbj) and spatial (DNC<scale>_Spatial_Checks_10.0.0.0.rbj) batch checks can be found under:

- For 32-bit machines – <Installation location>\Program Files\ESRINautical\Desktop10.0\Dnc\BatchJobs
- For 64-bit machines – <Installation location>\Program Files(x86)\ESRINautical\Desktop10.0\Dnc\BatchJobs

Note: The version information at the end of the file name represents the release the model was associated with. It is recommended that you always use the latest version. The first two values, 10, represent the major release value. The second value represents the minor release value. The third value represents the service pack value, and the fourth value represents a patch. For example, 93.0.1.0 represents 9.3 Service Pack 1.

The attribute checks are applied on the fly during the editing runtime validation process and are associated with the product library. You will be required to run spatial checks using ArcGIS Data Reviewer.

12.4 Import Topology Errors into a Reviewer Table

When reviewing the data, it is not the responsibility of the quality control specialist to correct discovered errors. **Export Topology Errors To A Reviewer Table** will add the topologic errors discovered when validating topology to the current Reviewer error table.

12.5 Visual Quality Control

Visual quality control consists of manually reviewing the data for anomalies, which range from simple miscoded features due to source interpretation to extraction density differences. Rendering the features with specific symbols can help detect miscoded features, while viewing the data at a smaller scale can help detect extraction density problems. There are many other types of problems that can be detected as well.

With ArcGIS Data Reviewer, you can manually view the data in your map and add records to the Reviewer table in a number of ways. You can use the Notepad tools to digitize missing point, line, and polygon features in the map. For example, if a road is missing, you can use the **Line Notepad** tool to draw the missing road. The feature is then written as a record in the Reviewer table and can later be given the attributes of a road.

You can also select features in the map and write them to the Reviewer table as necessary. The **Browse Selected Features** dialog box allows you to individually view features in the current selection and individually commit them to the Reviewer table by clicking the **Commit To Reviewer Table** button or all at once by clicking **Write All**. This tool writes individual records to the Reviewer table.

The **Commit To Reviewer Table** tool can also be used apart from the *Browse Selected Features* dialog box. For example, if you are using the *Reviewer Overview Window*, you can go to a specific cell and use the **Commit To Reviewer Table** tool to write individual features to the Reviewer table.

13.0 Ancillary Data Sources

There are three sources that should be referenced when completing a DNC library: NGA List of Lights, USCG Light List, and the Notice to Mariners. These ancillary data sources have updates to chart information that should be included in the delivery.

13.1 NGA List of Lights and USCG Light List

Two references used for DNC production are the NGA List of Lights and the USCG Light List. These data sources contain the latest light, beacon, and buoy information for navigable waters. The NGA List of Lights has world coverage, while the USCG Light List covers only the United States and its territories. The datasets can be found either in hard copy from NGA directly or can be queried on these Web sites:

- NGA List of Lights: <http://www.nga.mil>
- USCG Light List: <http://www.navcen.uscg.gov/pubs/LightLists/LightLists.htm>

14.0 Notice to Mariners

When a nautical chart has an update issued that calls for modifications, a Notice to Mariners (NTM) is issued with specific instructions on how to apply the changes. This information is typically stored on the issuing agency's Web site. The **NTM Parser** tool generates a comma-delimited file based on information downloaded from the NTM.

The **Notice To Mariners** tool then allows you to apply the NTM corrections quickly and accurately. Using this tool allows you to individually choose which corrections to implement and automatically modifies features as needed. You can add, remove, relocate, and select features. You can review and verify modifications as well as export a modified file for later use. It also allows you to add comments and track who made corrections and who verified the corrections.

Note: It is recommended that you create one file per chart and name the NTM text file <chart>.txt. For continuous maintenance, you may want to append existing NTM files.

Note: NTM coordinates are always given in the projection and horizontal datum of the chart.

Note: The linear units defined in the projection properties must match the units given in the NTM.

14.1 Parsing Notice to Mariners Files

The **NTM Parser** tool parses the Notice to Mariners information downloaded from the NGA Web site into a comma-delimited format that can be used as input for the **Notice To Mariners** tool. To find Notice to Mariners for the chart you are updating, browse the Products and Services portal on the NGA Web site at www.nga.mil.

Once a document has been parsed, it is not necessary to rerun **NTM Parser** unless errors were encountered and the parsing was not properly completed. Once a document has been parsed, it is not recommended that you make any changes or edits to it, but instead add/update it through the **Notice To Mariners** tool. This parser tool only works for text documents saved from the NGA Web site and will not work with other countries' posted Notice to Mariners.

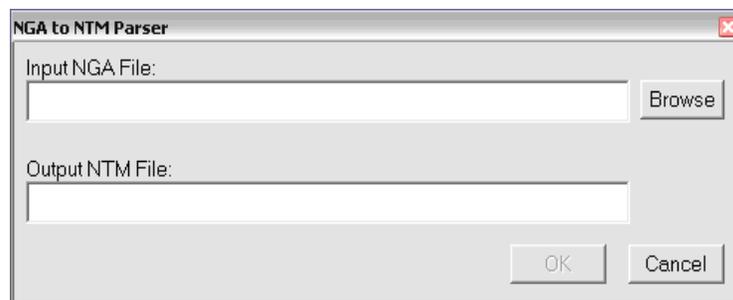
14.1.1 How to Use the Notice To Mariners Parser Tool

1. Navigate to the NGA Web site and download the Notice to Mariners file specific to your production work.

You must specify what notices you want to download by entering the chart number and the range of dates. Once you have specified your query, you must select the value

for **Output Options** as **Tab Delimited**, with **Display coordinate values** as **degree, minute, second** and **PC** in the **For platform** area.

2. Click **Search**.
3. In the new window that appears, click the **here** hypertext to display the query results.
4. Click **Save** to store the text document on your local drive, and rename the file if necessary.
5. Open the .txt file in Notepad, and under the **Format** pull-down menu, uncheck the **Word Wrap** check box.
6. In ArcMap, click the **Notice To Mariners Parser** tool  on the *Nautical DNC* toolbar. The *NGA to NTM Parser* dialog box appears.



7. Click **Browse** or type in the location of the saved text document in the **Input NGA File** text box.
8. The **Output NTM File** field is automatically set to the same location that stores the input file, and the file is automatically named <input_file_name>_out.tab. However, you can rename this file and redirect its output location if you want.
9. Click **OK** to parse the file.

When the process is complete, the *NTM Parser* dialog box appears, informing you of the location of the output file and log file. You are informed if the parser encountered any errors or anomalies such as notes.

10. Click **Yes** to view the log file or click **No** to close the dialog box. The output file is now ready to be used by the **Notice To Mariners** tool.

Note: A log file is created for the file that has been parsed. Refer to it to see if there were any errors when parsing the NTM file.

Note: It is recommended that you visually check the output file before using the NTM tool.

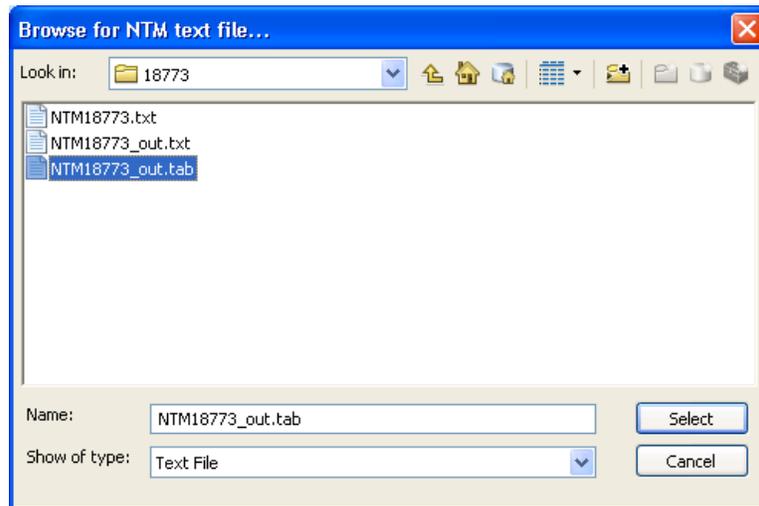
Note: An example of a .tab pre-parsed NTM file is located at:
For 32-bit machines – <Installation location>\Program Files\ESRINautical\Desktop10.0\Dnc\Schemas\NTM
For 64-bit machines – <Installation location>\Program Files (x86)\ESRINautical\Desktop10.0\Dnc\Schemas\NTM

You can use this to determine whether or not your NTM file was parsed properly if errors were encountered when parsing the NTM file.

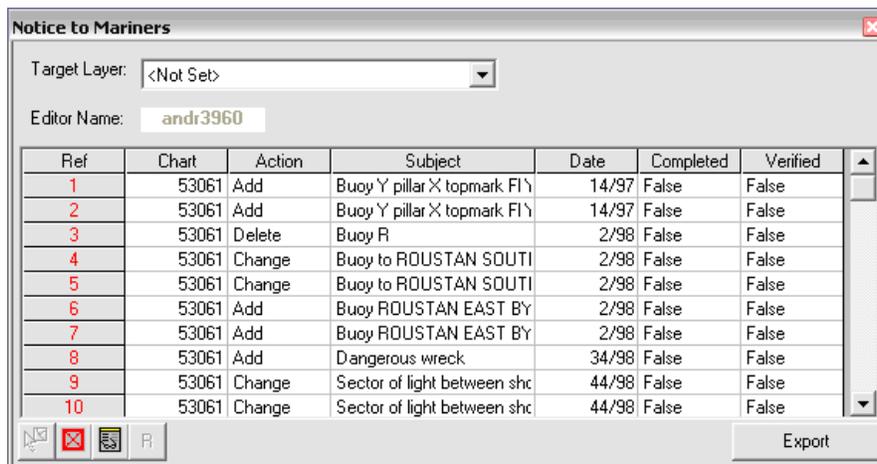
14.2 Implementing Notice to Mariners Changes

14.2.1 Launching the Notice To Mariners Tool

1. In ArcMap, click the **Notice To Mariners** tool  on the *Nautical DNC* toolbar. The *Browse for NTM text file* dialog box appears.



2. Browse to the location of the parsed NGA text file or a manually created text file and click **Select**. The *Notice to Mariners* dialog box is launched and can be docked where you would like it.



3. If necessary, start an edit session .

4. Click the **Target Layer** arrow to choose a target layer. This overrides your current ArcMap target layer in the table of contents.
5. Click a number in the **Ref** column to choose the notice to apply.

Tips

- The NTM application has its own Selection tool  that will only select features from the current Target Layer set on the Notice to Mariner form.
- You can turn the columns displayed in the NTM window on and off with the Toggle Column Visibility  button.
- To save any status changes such as Completed, Editor, Edit Date, or Comment, you must export your file; otherwise, all tracking changes will be lost. You are prompted to save these changes and export the text file when you click the Close button  to close the NTM window.
- When you perform an edit action that will be tracked by ArcMap, you must save your edits for changes to be preserved. The Undo and Redo tools only impact edits, not changes made to the Notice to Mariners table. You can manually change the edit status using the Status action if you undo a function such as Add or Delete performed by the NTM tool.
- It is recommended that you leave the red marker X's that the NTM creates when you "locate" a feature. This way you can keep track of features that might have multiple notices from one text file, and therefore you keep the most recent corrections for that feature. You can remove the markers at any time by clicking the Remove Marker button  at the bottom of the Notice to Mariner window.
- For creating a new light sector, it is recommended that you create a point feature, and then use the Generate Light Sector geoprocessing tool to complete the light sector.

14.2.2 Selecting a Feature in the Target Layer

1. Click the **Target Layer** arrow to choose a target layer.
2. Right-click a reference number for a notice that is not adding a new feature.
3. Click **Select**. The feature that corresponds with the reference number appears.

Note: If no features can be found, a message box appears that informs you no features can be found within 10 percent of the extent shown in the XY field. A red X marker appears at the x,y location of the extent searched. You can change the search radius by changing the pixel size on the *Selection Options* dialog box.

14.2.3 Locating a Feature

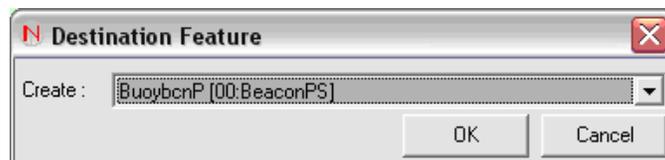
Right-click the reference number for the correction and click **Locate**.

A red X appears at the location designated in the XY field.

14.2.4 Adding a Feature

1. If necessary, start an edit session.
2. Launch the **Notice To Mariners** tool.
3. Select a target layer.
4. Right-click the reference number and click **Locate**. ArcMap zooms to the coordinate point and marks it with a red X marker.

5. Right-click the reference number and click **Add**. The *Destination Feature* dialog box appears.



6. Click the **Create** arrow and choose a feature class subtype.
7. Click **OK**. The new feature appears in the map display.

Note: The new feature added has default attributes, and you will need to attribute it according to the notice.

14.2.5 Relocating a Feature

1. If necessary, start an edit session and launch the **NTM** tool.
2. Select a target layer.
3. Right-click the reference number and click **Relocate**. A message box appears that designates the from and to locations for the feature.
4. Click **OK**.

Tips:

- For relocating a feature, it is important to keep in mind that the selection buffer is 10 percent of the extent shown in the XY field, and it's helpful not to be zoomed in too close.
- If a feature can't be found within the given coordinates, the tool will prompt you to select a feature (provided that the correct target layer is set) and to click the **R** button  to relocate the feature.

14.2.6 Changing the Completion Status of a Correction

1. Click the **Target Layer** arrow and choose a target layer.
2. Right-click the reference number for which you want to change the status and click the status that applies. The possible statuses are Complete and Incomplete. A reviewer may want to change the status from one to the other to keep track of changes.

Note: The reference number changes from red to black when the status is updated to Complete so that you can keep track of the corrections you have already applied.

14.2.7 Changing the Verification Status of a Correction

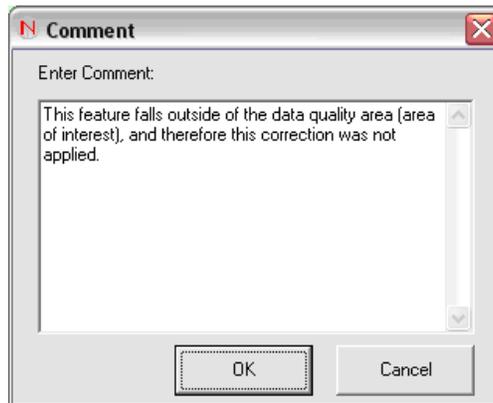
1. Right-click the appropriate reference number and click **Verify**.
2. Click the new verification state. The possible verification states are Verified (True) and Unverified (False).

If you are the same person who marked the status as completed and changed the Verified status from false to true, you will receive the warning message below. However, the status is still updated.



14.2.8 Adding a Comment to a Correction

1. Right-click the reference number for which you want to add a comment and click **Comment**. The *Comment* dialog box appears.



2. Type a comment in the **Enter Comment** text box. You have a limit of 255 characters.
3. Click **OK**. The *Comment* window closes.

14.2.9 Changing the Fields That Appear in the Notice to Mariners Dialog Box

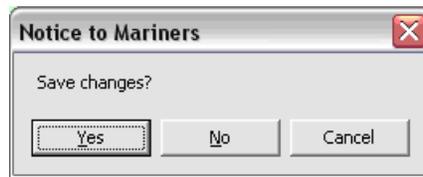
1. Click the **Toggle Column Visibility** button  on the *Notice to Mariners* dialog box.
2. Check the check boxes next to the columns that you want to display.
3. Uncheck the check boxes next to the columns that you do not want to display.
4. Click **OK** when you are finished. The *Notice to Mariners* window is refreshed with your new selections.

14.2.10 Clearing the Red Marker from the Map Display

Click the **Remove Marker** button  on the *Notice to Mariners* dialog box. All red Xs are removed from the data display.

14.2.11 Exporting the Notice to Mariners File

1. Either click the upper-right close **X** or click **Export**. If you click the upper-right close **X**, the following message box appears:



2. Click **Yes**.
3. Choose a location for the file.
4. Type a name in the **File name** text box.
5. Click **Save**. A copy of the NTM file is saved in the location you designated. If you clicked the close **X**, the *Notice to Mariners* dialog box closes.

15.0 Unit Conversion

Many nautical charts have elevation units in feet and depths in units other than meters, such as fathoms and fractions, fathoms and feet, and feet. When this occurs, use the units shown on the chart to collect your elevation and depth attributes. That is, what you see on the chart is what you enter as your value when attributing a feature. This makes quality control more efficient and accurate.

Once a chart is ready to be edgematched or converted to VPF, all the units should be converted to meters. This allows accurate edgematching.

It is important to remember that once you convert your units, you are not allowed to convert those features again. With the **Units Conversion** tool, you can not only convert based on your Dqyarea extent but are also allowed to have a selected set of features.

Original unit values are moved to a field called orig_<item> in the feature table. This field can be labeled in the display for visual quality control purposes. By default, all the orig_<item> fields are -99999, except when importing your data with the VPF Importer; then they will default to 0. Once converted, the **Units Conversion** tool will not run on features with orig_<item> not equal to -99999 or 0.

Convertible Fields

| FEATURECLASS | ELEVATION | DEPTH |
|--------------|-------------|---------|
| AqueductL | OHC | |
| BridgeA | MVC,OHC,SHC | |
| BridgeL | MVC,OHC,SHC | |
| BuoybcnP | EOL | |
| CanalA | WID | HDP |
| CanalL | WID | |
| DangerA | | HDP |
| DangerP | | HDP |
| HazardA | | HDP |
| HazardP | HDH | HDP |
| Hydarea | | CVH,CVL |
| Hydline | | CRV |
| IndustP | HGT,ZV2 | |
| IndustA | ZV2 | |
| LightsP | EOL | |
| MaritimA | WID | HDP |
| MaritimL | WID | HDP |
| Misciwya | WID | |
| PipelinL | DEP,HSB,OHC | |
| PowerL | OHC | |
| ReefA | HDH | HDP |
| Relline | ZV2 | |
| Relpoint | ZV2 | |
| RouteA | | HDP |
| RouteL | | HDP |
| RuinsA | HDH, HGT | HDP |
| RuinsP | HDH | HDP |
| SnowiceP | HGT | |
| SoundP | HDH | HDP |
| SeparthA | WID | |
| SeparthL | WID | |
| SweptA | | HDP |
| SweptL | | HDP |
| TunnelL | | HDP |

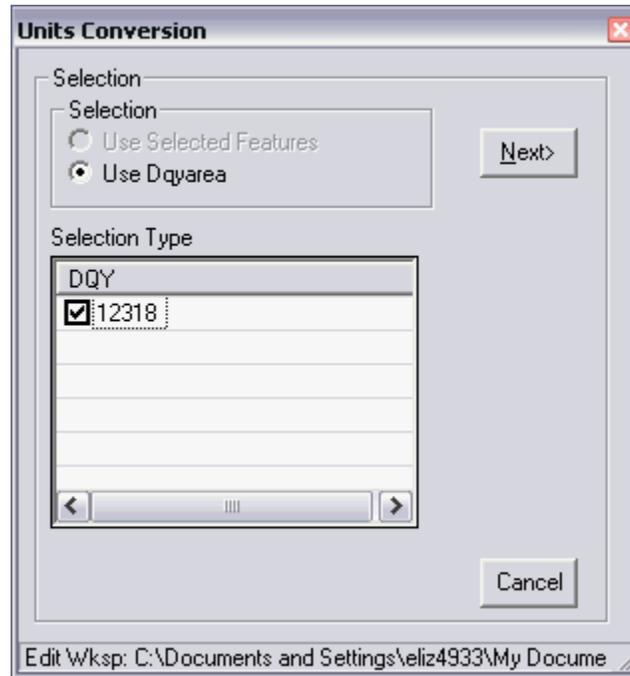
Tip: If your elevations are in feet, all features with field HDH are converted using Standard Conversion Table 4. All other elevation fields use Standard Conversion Table 1.

15.1 How to Perform Unit Conversions

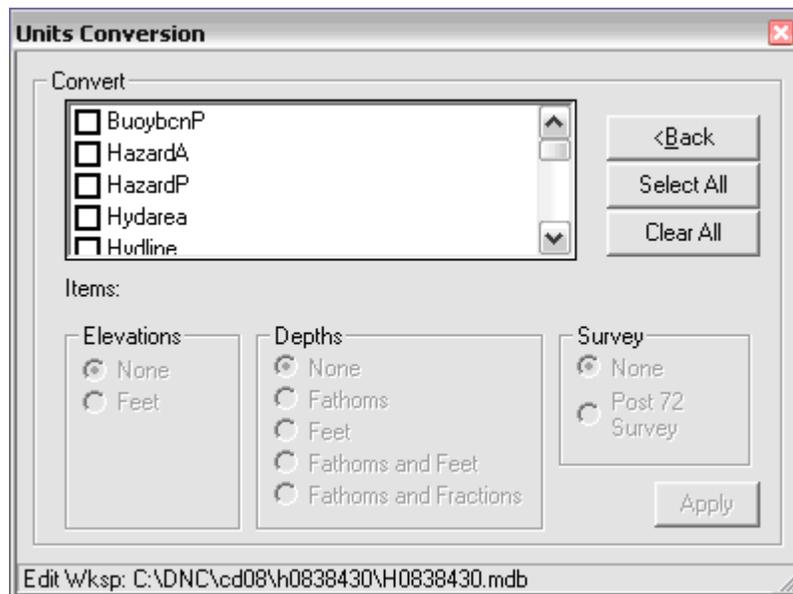
If you want to use a selected set, you must have your features selected before you open the *Units Conversion* tool dialog box.

1. On the *Nautical DNC* toolbar in ArcMap, click the **Units Conversion** button .

Note: You must be in an edit session.



2. If you are not using a selected set, choose the **Use Dqyarea** option. A list of Dqyarea features will be displayed with check boxes.
3. Select the Dqyarea features with which you want to define your conversion.
4. Click **Next**.



5. Selected feature classes containing convertible fields will be displayed in a list box. Check the check boxes for the feature classes to be converted.

6. Choose a conversion method for elevations and/or depths, or click **None** if you do not want that type of conversion. When choosing a conversion method, it will be run on every feature class you have checked.
7. Click **Apply** to run the units conversion.
8. Click **Yes** to view the log file once the conversion is complete.

Tips:

- If you choose the **Use Dqyarea** option but later decide you want to select features, you must close the dialog box and select your features first.
- Only the feature classes that exist in your map will be selected.
- A log file will be generated listing the features that were converted.

16.0 Data Migration

When producing nautical charts, you collect each individual chart in its own geodatabase. Depending on your library, you might have to join these individual charts together. You could also have a situation in which you need to reproduce only one chart in a multichart library. This could require two geodatabases, one for production and a second for maintenance. Depending on your situation, you may need to migrate your data into a single geodatabase before you can edgematch it.

Data migration is also important when you have an enterprise system. You might use a personal geodatabase to collect your data, but you might store and maintain that same data in an ArcSDE geodatabase. The only way to get your data into the enterprise system is to use Data Loader. This tool takes data from one geodatabase and appends it to an existing geodatabase. With DNC, you could also have associated note tables. If so, you have to migrate your note tables too.

16.1 Edgematching

If the data is in several sources, it can be adjusted before it is loaded or imported into the master database. The spatial adjustment tools let you rubbersheet and edgematch features in your map from different layers. It is always a good idea to run your QC tools again after you edgematch your data.

With the data in one library geodatabase, it is easy to quickly adjust features along Dqyarea edges. The main things to consider during this process are symbolizing data in a meaningful way and the snapping environment.

16.1.1 Symbolizing the Data

During edgematching, it is more efficient to be able to quickly identify the attributes of the features being snapped. The easiest way to identify where the attributes match between features is to symbolize or label them in a meaningful way. A quick way to symbolize the data is to utilize the DNCH.mxd, DNCA.mxd, DNCC.mxd, or DNCG.mxd templates.

Tip: To avoid altering the template DNC<scale>.mxd files, be sure to make a copy.

16.1.2 Snapping

During the edgematching process, all the settings you need to work with snapping are located on the **Snapping** toolbar. When snapping is turned on, your pointer will jump, or snap to, edges, vertices, and other geometric elements when your pointer is near them and within a certain tolerance. This enables you to position a feature easily in relation to the locations of other features.

16.1.3 Editing Topology

During edgematching, many features have topological relationships that need to be maintained (for example, Hydline and Hydarea). A way to easily maintain these relationships during edgematching is to use the topology editing tools. For example, these tools allow the user to move or reshape the coastline and all associated features (including the open water, ground surface elements, depth curve areas, and any other feature with shared geometry).

16.1.4 General Edgematching Considerations

When edgematching a feature class, it is important to keep the relationships between features in mind. Remember that during edgematching, relationships between features can be destroyed when features are moved.

The goal is to create a seamless representation of the library data. When resolving discrepancies, follow these general guidelines:

- Move small-scale data to large-scale data if the adjoining charts have different scales.
- New editions take precedence over older editions.
- If both sources have the same edition and the same scale, split the difference.
- Always use feathering when moving one arc to meet another. This avoids sharp angles.
- Always ensure that you maintain coincidence between features.
- If you have to merge two features and those features have two different notes associated with them, you need to take this into consideration. Remember when you merge or unsplit features, only one feature's GFID is preserved. If that remaining feature has a note that is no longer valid, you must use the Notes Editor to attach the correct note.

16.1.5 Feature Class-Specific Edgematching Considerations

When edgematching your data, you should be aware of certain situations for the following feature classes.

- Dqyarea

Do not dissolve the boundaries between these features.

- Ecrtext

Delete duplicate annotation that occurs across Dqyarea boundaries.

■ Hydarea

- When dissolving boundaries, only join areas with the same closing band.
- If two areas have the same closing band but one area is ACC = 1 and the other is ACC = 2, the ACC = 2 area takes precedence.
- When edgematching areas with CVL or CVH values associated with soundings, always update to the area with the shallowest or deepest value.
- When moving depth areas, make sure you do not place sounding points on the wrong side of the area.

■ Hydline

When moving depth curves, make sure you do not place a sounding point on the wrong side of the curve.

■ Obstructions in General (e.g., wrecks, rocks)

When edgematching these area features, their attribute codes might be slightly different. However, they still need to be merged with the most hazardous combination taking precedence. For example, one feature has TXT = Rock and another feature has TXT = Rocks. The feature with TXT = Rocks takes precedence since multiple rocks are more hazardous to the mariner.

■ All Point Feature Classes

- Check all point feature classes for duplicate points along the Dqyarea boundary. This could also apply for all line and area feature classes.
- Make sure that no point features are misplaced when moving line or area features.

16.2 Migrating Your Geodatabase

The first step for edgematching is to combine all the chart datasets into one master, library geodatabase using **Data Loader**. Data Loader allows data to be copied from one geodatabase and appended to an existing geodatabase. A mapping template is used to map one feature class to another between the geodatabases. The template files have been provided here:

- For 32-bit machines – <Installation location>\Program Files\ESRINautical\Desktop10.0\Dnc\DataConversion
- For 64-bit machines – <Installation location>\Program Files(x86)\ESRINautical\Desktop10.0\Dnc\DataConversion

This template contains a mapping file that maps the source's feature class to the destination's feature class.

Many libraries are made up of multiple charts. Typically, these charts are collected individually from each other and, once complete, joined together to make the final library geodatabase. To create an output database, you can use one of the following methods, then use Data Loader to migrate all your data:

- Start with an empty output geodatabase and load all the data into it.
- Start with a copy of one of the geodatabases to be joined as the output geodatabase and append the rest of the data to it.
Once you have migrated your data, you need to migrate your note tables.

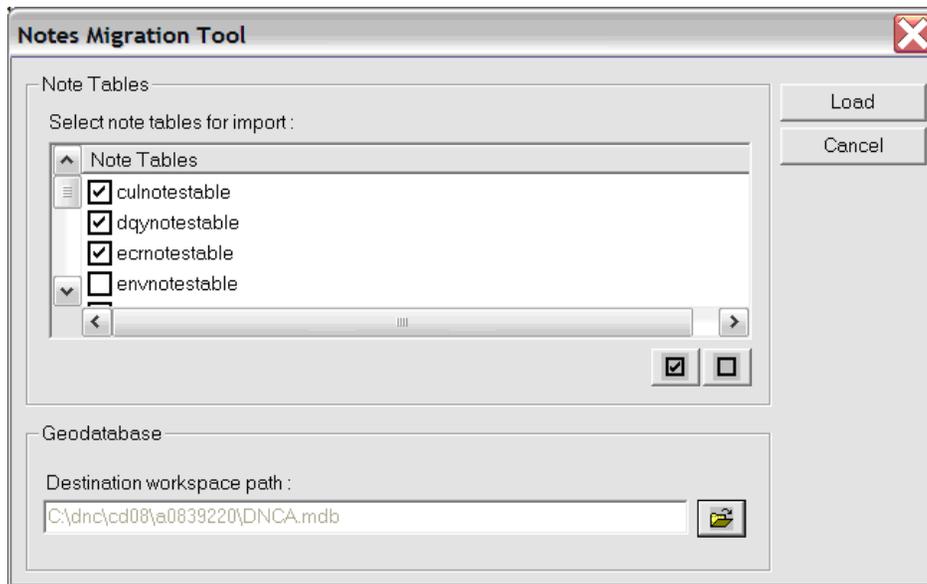
16.3 Migrating Your Note Tables

When loading DNC data from one geodatabase to another, the features themselves are loaded, while any notes.rat tables are left behind in the source geodatabase. These notes need to be loaded into the target geodatabase and reattached to their respective features. This is done through the **Notes Migration** tool found on the *Nautical DNC* toolbar in ArcCatalog.

The migration actually appends to existing note tables in the destination geodatabase. Since all the notes are linked by the GFID and the GFID is unique for all features produced by ESRI Nautical Solution, the notes will automatically be referenced in the new geodatabase. This is because the note join table contains the GFID of each feature that has a note.

16.3.1 How to Use the Notes Migration Tool

1. Load features from the source geodatabase to the target geodatabase using Data Loader.
2. In ArcCatalog, click the source geodatabase containing the note tables to be migrated.
3. Click the **Notes Migration Tool** button  on the *Nautical DNC* toolbar.
4. The *Notes Migration Tool* dialog box appears. The available note tables appear in a scrolling list.
5. Check the check boxes next to the note tables you want to migrate or click the **Select All** button.
6. Browse to a destination geodatabase. This is the database into which you loaded your data using Data Loader.



7. Click **Load**.

Tip: The note tables must already exist in the destination geodatabase. If not, you will receive an error message listing which tables did not migrate.

17.0 Export to Coverages

When your data is ready to be converted to VPF, you must first export your geodatabase to coverages. There is one consideration you should keep in mind before doing this. The **Geodatabase To Coverage** tool works on the entire geodatabase. That is, if you run the export option on a geodatabase that contains more data than you want to export, you first have to clip the desired data into another geodatabase. Now you are ready to export.

17.1 Remove Duplicate Notes

Before exporting to coverages, run the **Remove Duplicate Notes** tool in ArcCatalog on the geodatabase to be exported. This is especially important for library geodatabases that have been created by joining many datasets together and in ArcSDE databases. It is good practice to run the tool before exporting.

17.1.1 About the Remove Duplicate Notes Tool

The **Remove Duplicate Notes** tool will remove multiple occurrences of the same note to reduce the size of the geodatabase. Although the DNC Product Specification allows duplicated records in a theme's notes.rat table, the output Vector Product Format database must be made as compact as possible.

17.1.2 How to Use the Remove Duplicate Notes Tool

1. In ArcCatalog, select the geodatabase on which you want to perform the task.
2. Click the **Remove Duplicate Notes** button  on the *Nautical DNC* toolbar. A progress bar appears, then closes when the task has completed.

Note: The Remove Duplicate Notes tool can only run successfully if the geodatabase is not loaded into an open ArcMap session.

17.2 Export to Coverages

You also have the option to only export specific layers, or you may export the entire geodatabase. Use the **Geodatabase To Coverage** tool to export your geodatabase to coverages.

17.2.1 About Exporting Feature Classes to ArcInfo Coverages

There are two options for creating ArcInfo coverages from geodatabase feature classes:

- Export selectable layers to a single ArcInfo coverage by clicking the **Selectable Feature Layers in Map** option on the *Production Mapping GDBToCoverage: Data Input Mode* dialog box.

Choosing this option allows you to select the output coverage as well as the tolerance for the selectable layers.

- Click the **Mapping Table** option on the *Production Mapping GDBToCoverage: Data Input Mode* dialog box to use a mapping table, such as the geodatabase DBS_FC_VVT table, to define feature class input and coverage output.

Choosing this option enables the **Mapping Table** text box, which allows you to browse to the mapping table you want to use.

About Exporting to Coverages When You Are Not an Administrator

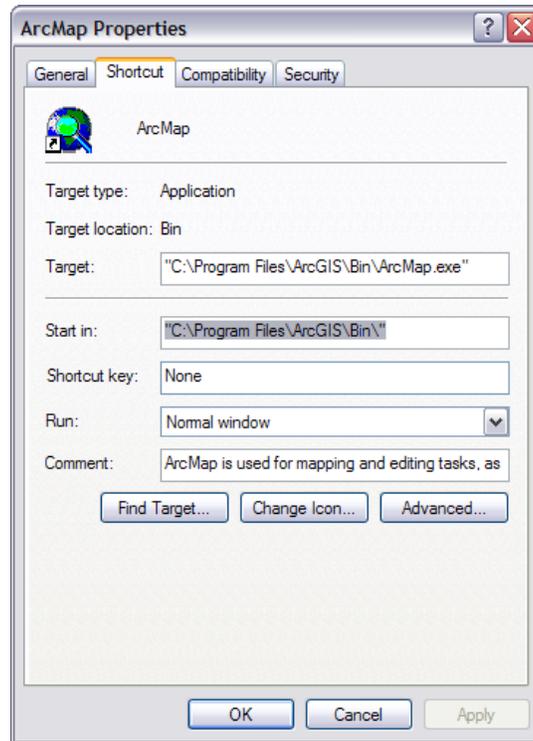
If you attempt to export feature classes to coverages when you are not an administrator, you may receive an error message. When this happens, you will need to change the directory in which ArcMap starts on the *ArcMap Properties* dialog box. The path in the **Start in** text box needs to be a directory for which you have read and write privileges. For example, this could be `$\Documents and Settings\[login]\`.

Once the **Start in** path is changed, you can export the geodatabase to coverages.

1. Right-click the **ArcMap** item on the **Start** menu or the shortcut on your desktop and click **Properties**.

The *ArcMap Properties* dialog box appears.

2. If necessary, click the **Shortcut** tab.



3. Change the path in the **Start in** text box to a directory to which you can read and write.
An example of a directory would be C:\Documents and Settings\[user name].
4. Click **OK**.

17.2.2 How to Export Feature Classes to Coverages

Creating an ArcInfo Coverage Using Selected Layers

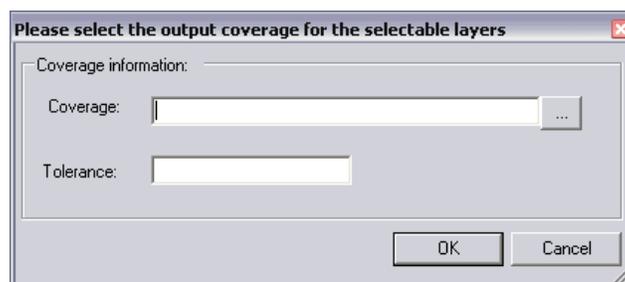
1. Verify that the geodatabase layers you want to convert to coverages are loaded in ArcMap.
2. Click the **List By Selection** button  on the ArcMap table of contents. The **List By Selection** dialog box appears.
3. Choose the layers to be included in the coverage.
4. Click **Close**.

Note: You will need to know which feature classes belong in the ArcInfo coverage to receive the correct output coverage.

5. Click the **Production Editing** pull-down menu on the *Production Editing* toolbar and click **Geodatabase to Coverage**. The *Production Mapping GDBToCoverage: Data Input Mode* dialog box appears.



6. Click the **Selectable Feature Layers in Map** option, if necessary.
7. Click **OK**. The *Please select the output coverage for the selectable layers* dialog box appears.



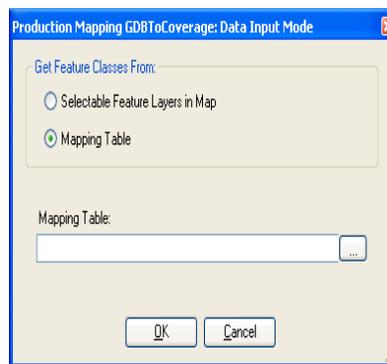
8. Click the ellipsis button (...) next to the **Coverage** text box.
9. Navigate to the directory in which you want to create the coverage.
10. Type a name for the output coverage in the **Name** text box on the *Please enter name of coverage to create* dialog box.
11. Click **Save**.
12. If necessary, type a value in the **Tolerance** text box. The default cluster tolerance is zero.
13. Click **OK**.

Creating an ArcInfo Coverage Using a Mapping Table

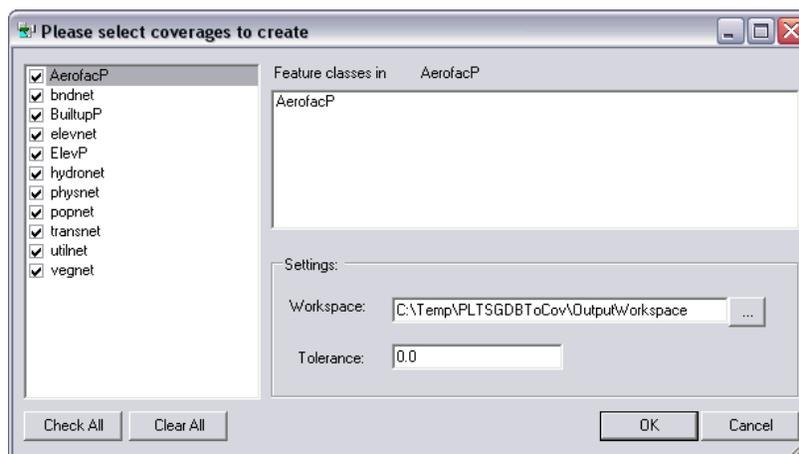
1. Click **Production Editing** on the *Production Editing* toolbar and click **Geodatabase to Coverage**. The *Production Mapping GDBToCoverage: Data Input Mode* dialog box appears.



2. Click the **Mapping Table** option. The **Mapping Table** text box becomes available.



3. Click the ellipsis button (...) next to the **Mapping Table** text box and navigate to the DBS_FC_VVT table for the geodatabase you want to export.
4. Choose the file and click **Select**. The Mapping Table text box is populated with your selection.
5. Click **OK**. The *Please select coverages to create* dialog box appears.



6. Check the check boxes next to the feature classes and coverages you want to export.
7. Click a coverage or feature class name in the list to view its available feature classes.

8. Click the ellipsis button next to the **Workspace** text box.
9. Navigate to the workspace to which you want to export the coverages.
10. Click **OK**.
11. Type a value in the **Tolerance** text box.
12. Click **OK**.
13. View the log file.

17.3 Export to Notes Table

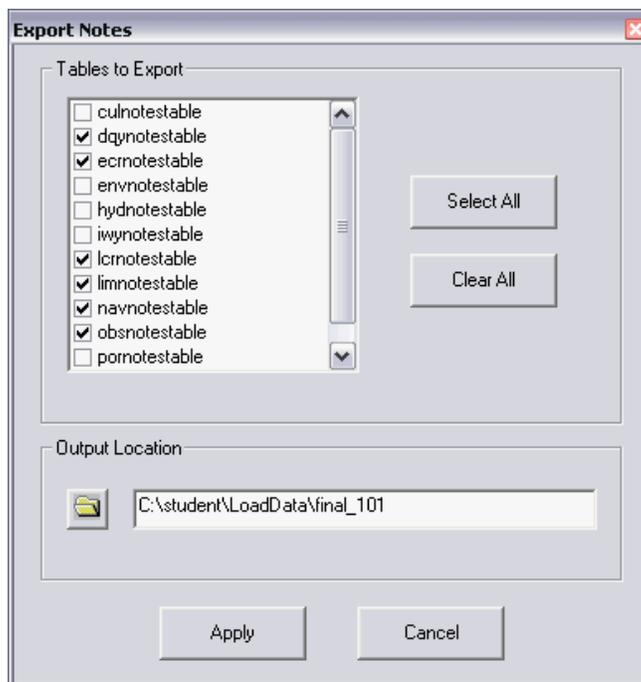
You also need to export your note tables to a coverage workspace. Use the Export NOTES.RAT tool.

17.3.1 About Exporting Notes.rat

Conversion to VPF is done through the VPFKit tools available in Nautical Solution Workstation. These tools require DNC notes.rat tables as stand-alone text files that will be directly exported to VPF. Utilizing the **Export NOTES.RAT** tool on the *Nautical DNC* toolbar in ArcCatalog will create these notes.rat text files.

17.3.2 How to Use the Export NOTES.RAT Tool

1. In ArcCatalog, highlight the geodatabase containing the notes.rat records to be exported.
2. Click the **Export NOTES.RAT** button  on the *Nautical DNC* toolbar.
The *Export Notes* dialog box appears. In the geodatabase, the notes.rat tables are stored in layer/group theme-specific tables.
3. Check the check boxes next to the tables you want to export or click **Select All**.



4. Browse to an output location.
5. Click **Apply**.

Tips:

- An ASCII file will be created for each note table exported. It will be named with a .txt extension. For example, the geodatabase note table hydnotestable will be exported and named hydnotestable.txt.
- The geodatabase notes join table will be exported to an INFO table in the same output location. It will be named notes.njt. This table will be used to reattach note IDs to ArcInfo coverages created from the same DNC geodatabase.
- It is recommended that the output location be the same workspace specified during export to coverage.
- Once these coverages and related notes have been exported, click **Restore Geodatabase Note Info** from the *PLTS Nautical Solution Workstation DNC Database Production* toolbar to restore the note-to-feature links.

18.0 Vector Product Format

Export to VPF is supported through a two-step process. The geodatabase data is first exported to the ArcInfo coverage format and processed to match the workstation coverage requirements, then Nautical Solution Workstation can be used to export the coverage data to VPF.

From the desktop Production Mapping menu, you can create ArcInfo coverages from the feature classes that participate in the theme GDB model. In most cases, several feature classes are necessary to build single-theme coverages. If the geodatabase extent does not match the spatial requirements of the VPF library, it may be necessary to batch clip the feature classes before exporting. Once the coverages have been exported, they need to be prepared to meet the workstation coverage requirements as defined in "Preparing GDB Export Coverages for VPF Conversion." Once they meet the workstation coverage requirements, the VPF conversion process may begin.

18.1 Preparing GDB Export Coverages for VPF Conversion

18.1.1 Restoring Geodatabase Note Information

Note information for the features captured in the geodatabase must be transferred to the coverage features. There are several steps to complete this process. First the notes must be exported from the geodatabase.

1. Open Nautical Solution Workstation for DNC.
2. Click **System** on the main menu and choose **Change Workspace**.
3. Set the workspace to the location where the notes were exported.
4. Click **Database Production DNC**, point to **Product Finishing**, and click **Restore Geodatabase Note Info**.
5. Move the note tables to be processed into the Action List area and click **Apply**.
6. Select the workspace that contains the coverages that the notes relate to.
7. Click **OK**.
8. Select the notes.njt file. This file is located where the notes were exported.
9. Click **OK**.

18.1.2 Creating a VPF Export Library

The exported coverages need to be processed to ensure the correct coverages exist with the proper topology, items, and item definitions as defined by the workstation coverage model. However, to do this, you must tell the system which specification the coverages

should match. Therefore, the VPF export library and metadata information must be completed before the coverages can be corrected to match the model.

1. Click **Database Production DNC**, point to **Product Finishing**, and click **Vector Product Format (VPF)**.
2. Click **VPF** on the main menu, point to **Library Info**, then **DNC_[scale of the library]**, and click **Create a new DNC_[SCALE] ArcInfo Library**. A message box appears.
3. Click **Yes** to confirm the creation of a new DNC library.
4. Fill in the new library name in the dialog box that appears.
5. Type a location for the library in the **New Library Name** text box. You can right-click in the text box to browse to a desired location.
6. Choose the **Create EXPORT Library** option.
7. Type the name of the DQYNET coverage you exported from the geodatabase in the **Pre-Index/Prototype cover** text box. You can right-click to browse to the location.
8. Type the database name in the **VPF Database Name** text box.
9. Type a library name in the **VPF Library Name** text box.
10. Choose **1996 Digital Nautical Chart Data** from the VPF Product Type list.
11. Choose **No** for **Is the Data being created from sheets**.
12. Click **Create Library**.
13. Choose **Yes** for **Create an Index with the library**. A message box appears once the library is created.
14. Click **OK**.

18.1.3 Editing the Metadata File

The exported coverages need to be processed to ensure the correct coverages exist with the proper topology, items, and item definitions as defined by the workstation coverage model. However, to do this the system must know which specification the coverages should match. Therefore, the VPF export library and metadata information must be completed before the coverages can be corrected to match the model.

1. Open the *Library Manager* dialog box for the library to be updated.
2. Click **Library Administration** and click **Show Library Metadata Files**.
3. Click the .lib file in the left window.
4. Click **Library Administration** and click **Edit Metadata File**. A message box appears.

5. Click **Yes** to edit the .lib file.
6. Scroll down to the Browse Library information section. This is where the Notice to Mariners information is updated.
7. Set the .lib\$lib_ntm variable to the week/year of the latest Notice to Mariners update.
8. Set the .lib\$lib_ntm_date variable to the publication date of the Notice to Mariners edition. Your NTM date should look something like 20050818.
9. Scroll down to the VPF FILE INFO section. This section contains a list of the themes that can be captured for the library.
10. On the &s .meta\$catlayers row, make sure you delete any theme that is not going to be included in your library.

For example, if env is not in your dataset, your row should only include cul, ecr, hyd, iwy, lcr, lim, nav, obs, por, rel, dqy, tileref, and libref.

It may be necessary to open ArcCatalog to identify which themes have data. It is important that the themes remain in the order they are currently listed, so if it is necessary to add one back in, find its position in the example list, then enter it in the active list.
11. Set the .meta\$catlayers variable to be the list of themes included in the library.
12. Save the document and close the editing window.
13. If prompted, click **Yes** to remove any formatting and save the document as text only.

18.1.4 Processing the Geodatabase Output Coverages

1. Ensure the current workspace is the workspace that contains the coverages that were output from the geodatabase.
2. Click **System** on the main menu and click **Change Workspace**.
3. Change the workspace location if necessary.
4. Click the **Library Manager** menu for the appropriate library, point to **ArcInfo Library Tools**, and click **Process GDB Output coverages**. The *Set Pick List* dialog box appears.
5. Choose to process all the coverages in the list.
6. Click **Apply**. This process takes a few minutes. A message box appears once the processing is complete.
7. Click **OK**.

18.1.5 Copying the Coverages

Once the coverages have been prepared, they can be copied to the joined/final location in the VPF export library structure for VPF finishing.

1. Click the **Database Production DNC** menu, point to **Commands**, and click **Coverage Manager**. The *Coverage Manager* dialog box appears.
2. Click **Copy Many**. The *Copy Many Coverages* dialog box appears.
3. Browse to the location of the geodatabase output coverages.
4. Leave the **NONE** option selected for **Extensions on the coverages**.
5. Choose the **ALL** option next to **Coverages to be copied**.
6. Browse to the joined/final workspace in the library directory.
7. Click **Copy**. The *Coverage Manager* dialog box becomes inactive while copying the coverages, then active again when the process is finished.
8. Click **Dismiss** to return to the main menu.

18.1.6 Finishing the Notes

The notes that are exported need to be unique in the note table. However, each feature that has a note is exported to the <theme>.notes.rat.dat table. This table needs to be cleaned so that there is only one record for each unique note, then the note IDs of the features in the coverages need to be recalculated to match the new note ID.

1. Open Windows Explorer and navigate to the directory where the notes were exported. For all the themes that had attached notes, there is an associated <theme>.notes.rat.dat file.
2. Create a Notes folder under the [library]_lib directory.
3. Copy the <theme>.notes.rat.dat files to the [library]_lib/notes directory.
4. Create a cross-reference spreadsheet for each <theme>.notes.rat.dat file.

Make sure there is a column for the note ID (ID), a second ID or cross-reference ID (ID2), and a note column (NOTE). Populate each spreadsheet with the notes in each of the <theme>.notes.rat.dat files. If there is no ID, the ID number matches the order in the file. For example, record 1 is note 1, and so on.

5. Remove duplicate notes in the <theme>.notes.rat.dat files.
6. Populate the ID2 column with the new note ID in the <theme>.notes.rat.dat tables.

If there are no IDs listed, the ID matches the order of the notes in the file. For example, note 1 is ID 1, and so on. This serves as the cross-reference file for calculating the new note IDs for the features in the coverages.

7. Ensure the current workspace is the workspace that contains the coverages.
8. In ArcEdit, edit the coverages that had duplicate notes in the <theme>.notes.rat.dat files.
9. Renumber the NOTES item for the affected features by calculating the ID for the new note ID (ID2) by using the ID based on the cross-reference spreadsheet. The old ID value is listed in the ID column, and the ID value to calculate to is listed in the ID2 column.

18.1.7 Creating Coverage Routes and Regions

The final step in preparing the coverages is formatting the coverages and creating route and region subclasses from the coverage polygon and line features.

Formatting the Coverages

1. Click the **Database Production DNC** menu, point to **Product Finishing**, and click **Format Cover**. The *Format Cover* dialog box appears.
2. Click the **ALL** button to process all coverages.
3. Type the library name in the **Enter ArcInfo Library** text box and press ENTER.
4. Click **Apply**. A message box appears once the process is finished.
5. Click **OK**.

Creating Feature Classes

1. Click the **Database Production DNC** menu, point to **Product Finishing**, and click **Create Feature Classes**. The *Create Feature Classes* dialog box appears.
2. Click the **ALL** button to process all coverages.
3. Type the library name in the **Enter ArcInfo Library** text box and press ENTER.
4. Click **Apply**. A message box appears once the process is finished.
5. Click **OK**.

18.1.8 Running the Coverage Consistency Report

The consistprep2 process establishes proper coverage topology, removes unwanted pseudo nodes, tests for unnecessary lines, and calculates null values based on each F_CODE. The output report lists detected errors that need to be corrected before creating coverage routes and regions.

1. Click **Database Production DNC** on the main menu, point to **System**, and click **Command Line Tool**.

2. Type `consistprep2` in the input box and press ENTER.
3. View the watch file `consistprep2.wch` and search for errors. The watch file is located in the workspace that contains the coverages. To find the file, click the **System** arrow.

18.2 Converting the ArcInfo Library to VPF

Once the steps for preparing the coverages have been completed, the [online help for ESRI Nautical Solution Workstation](#) can be used to provide guidance on completing the VPF export process, which includes creating the LIBREF layer, inserting the data into the library tiles, converting the coverages to VPF, and exporting the browse library.

Appendix A

Digital Nautical Chart Production Procedures—Supplement

Appendix A—Production Procedures—Supplement

A.1 The DNC Databases

Whether you are doing maintenance or production work, you have to use a geodatabase. With Digital Nautical Chart, you have four scale-specific geodatabases. It is important that you choose the correct scale (Harbor, Approach, Coastal, or General). To set up your geodatabase correctly, you must follow a few steps. Once you have completed the setup process for your specific scale, you can leave this scale-specific geodatabase on a server to be replicated at a later date.

The geodatabase is a geographic database that provides services for managing geographic data, which include validation rules, relationships, and topological associations. A geodatabase contains feature datasets and is hosted inside a relational database management system. Both enterprise and personal geodatabases are supported.

In a browser, navigate to the template GDBs located in the Nautical Solution directory:

- For 32-bit machines – <Installation location>\Program Files\ESRINautical\Desktop10.0\Dnc\Schemas\Built
- For 64-bit machines – <Installation location>\Program Files(x86)\ESRINautical\Desktop10.0\Dnc\Schemas\Built

The template GDBs are called DNCA_10.0.0.0.mdb, DNCC_10.0.0.0.mdb, DNCG_10.0.0.0.mdb, and DNCH_10.0.0.0.mdb for the different product scales.

Note: The version information at the end of the file name represents the release the model was associated with. It is recommended that you always use the latest version. The first two values, 10, represent the major release value. The second value represents the minor release value. The third value represents the service pack value, and the fourth value represents a patch. For example, 93.0.1.0 represents 9.3 Service Pack 1.

A.2 The Architecture of a Geodatabase

The geodatabase storage model is based on a series of simple yet essential relational database concepts and leverages the strengths of the underlying database management system (DBMS). Simple tables and well-defined attribute types are used to store the schema, rule, base, and spatial attribute data for each geographic dataset. This approach provides a formal model for storing and working with your data. Through this approach, Structured Query Language (SQL)—a series of relational functions and operators—can be used to create, modify, and query tables and their data elements.

You can see how this works by examining how a feature with polygon geometry is modeled in the geodatabase. A feature class is stored as a table, often referred to as the base or business table. Each row in the table represents one feature. The shape column

stores the polygon geometry for each feature. The contents of this table, including the shape when stored as a SQL spatial type, can be accessed through SQL.

| OBJECTID * | SHAPE * | PROPERTY_I * | Res | Zoning_simple | SHAPE_Length | SHAPE_Area |
|------------|---------|--------------|-----------------|---------------|--------------|---------------|
| 1 | Polygon | 5001 | Non-Residential | <Null> | 3597.780813 | 112552.418591 |
| 2 | Polygon | 5002 | Non-Residential | <Null> | 814.855837 | 18488.417709 |
| 3 | Polygon | 1003 | Residential | Residential | 489.655523 | 12815.591379 |
| 4 | Polygon | 1004 | Residential | Residential | 521.761248 | 14036.135346 |
| 5 | Polygon | 1005 | Residential | Residential | 453.479649 | 9816.352665 |



However, adding spatial types and SQL support for spatial attributes to a DBMS is not enough on its own to support GIS. ArcGIS employs a multitier application architecture by implementing advanced logic and behavior in the application tier on top of the geodatabase storage model. This application logic includes support for a series of generic geographic information system (GIS) data objects and behaviors such as feature classes, raster datasets, topologies, networks, and much more.

A.2.1 The Geodatabase Is Object Relational

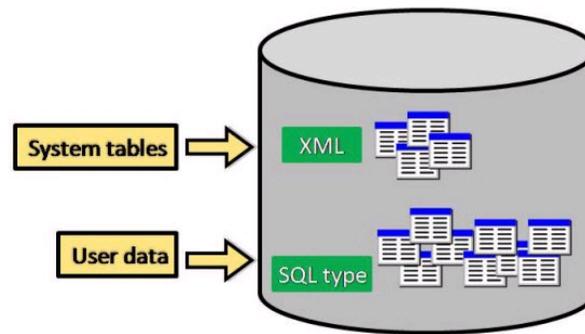
The geodatabase is implemented using the same multitier application architecture found in other advanced DBMS applications; there is nothing exotic or unusual about its implementation. The multitier architecture of the geodatabase is sometimes referred to as an object-relational model. The geodatabase objects persist as rows in DBMS tables that have identity, and the behavior is supplied through the geodatabase application logic. The separation of the application logic from the storage is what allows support for several different DBMSs and data formats.

A.2.2 Geodatabase Storage in Relational Databases

At the core of the geodatabase is a standard relational database schema (a series of standard database tables, column types, indexes, and other database objects). The schema is preserved in a collection of geodatabase system tables in the DBMS that defines the integrity and behavior of the geographic information. These tables are stored either as files on disk or within the contents of a DBMS such as Oracle, IBM DB2, PostgreSQL, IBM Informix, or Microsoft SQL Server.

Well-defined column types are used to store traditional tabular attributes. When the geodatabase is stored within a DBMS, spatial representations, most commonly represented by vectors or rasters, are generally stored using an extended spatial type.

Within the geodatabase, there are two primary sets of tables: system tables and dataset tables.



- **Dataset tables**—Each dataset in the geodatabase is stored in one or more tables. The dataset tables work with the system tables to manage data.
- **System tables**—The geodatabase system tables keep track of the contents of each geodatabase. They essentially describe the geodatabase schema that specifies all dataset definitions, rules, and relationships. These system tables contain and manage all the metadata required to implement geodatabase properties, data validation rules, and behaviors.

The internal structure of these tables was restructured beginning with the ArcGIS 10 release. The information related to the schema in the geodatabase, which prior to ArcGIS 10 was stored in over 35 geodatabase system tables, was consolidated into four main tables:

- **GDB_Items**—A listing of all items contained within a geodatabase such as feature classes, topologies, and domains
- **GDB_ItemTypes**—Contains a predefined list of recognized item types, such as Table
- **GDB_ItemRelationships**—Contains schema associations between items such as which feature classes are contained within a feature dataset
- **GDB_ItemRelationshipTypes**—Contains a predefined list of recognized relationship types such as DatasetInFeatureDataset

The dataset and system tables work together to present and manage the contents of a geodatabase. For example, when viewed in the underlying storage format, a feature class is simply a table with a spatial column. However, when accessed through ArcGIS, all the rules stored in the system tables are combined with the underlying data to present it as a feature class with all the defined behavior.

A.2.3 Additional Tables

Depending on what type of geodatabase you are using and in which DBMS it is stored, the set of system tables may vary. ArcSDE geodatabases have a different set of system tables than file geodatabases, which have a slightly different set than personal geodatabases. For ArcSDE geodatabases, the different system tables are defined in the

"System tables of a geodatabase" topic for each specific DBMS. The different tables stored in file and personal geodatabases are not detailed, since you would not need to interact with most of these tables.

A.3 Geodatabase XML

Geodatabase Extensible Markup Language (XML) represents ESRI's open mechanism for information interchange between geodatabases and other external systems. ESRI openly publishes and maintains the complete geodatabase schema and content as an XML specification and provides example implementations to illustrate how you can share data updates between heterogeneous systems.

XML interchange of geospatial information to and from the geodatabase is greatly simplified using the geodatabase XML specification. External applications can receive XML data streams including the following:

- Exchange and sharing of full (as well as portions of) geodatabase schemas
- Exchange of complete lossless datasets
- Interchange of simple feature sets (much like shapefile interchange)
- Exchange of change-only (delta) record sets using XML streams to pass updates and changes among geodatabases and other external data structures

Geodatabase XML is the primary interchange mechanism for data sharing among ArcGIS users as well as external users.

There are three types of XML documents that can be created in ArcGIS: a Workspace document, a RecordSet document, and a Data Changes document.

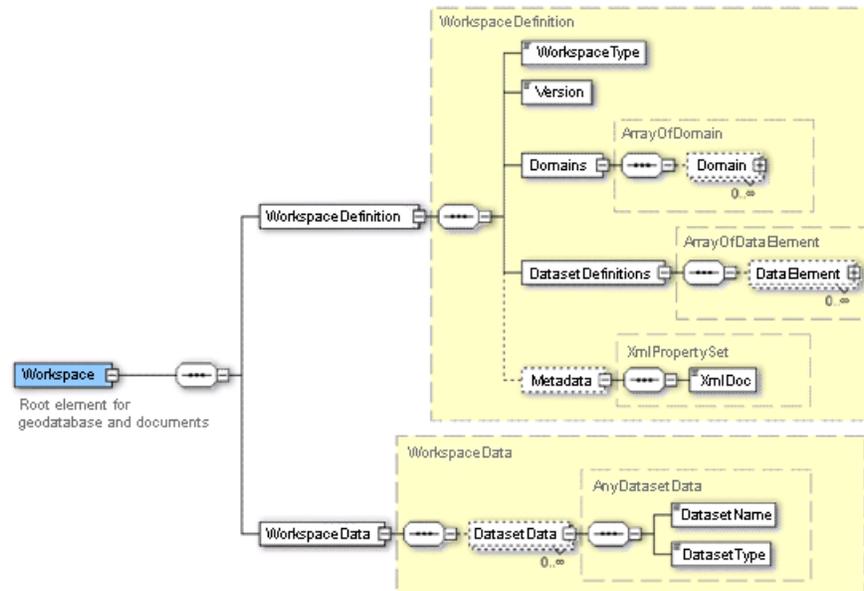
A.3.1 The Geodatabase XML Workspace Document

XML Workspace documents hold all the contents of a geodatabase or any subset of the content. XML Workspace documents include all the schema information and, optionally, the data as well.

XML Workspace documents are used to share schema information, exchange feature datasets and all of their contents, and exchange datasets and all associated data elements that have relationships to a dataset selected for export.

The schema, relationship, and behavior information exported as part of the WorkspaceDefinition element includes all simple and custom features data, participation in networks and topologies, network connectivity and topology rules, simple and composite relationships, and any other information associated with the geodatabase datasets. Therefore, all behavior associated with the geodatabase is preserved and can be re-created when the XML document is imported.

The XML Workspace document contains two elements: `WorkspaceDefinition` and `WorkspaceData`.



Using `WorkspaceDefinition` and `WorkspaceData`, workspace documents contain the schema of a geodatabase and, optionally, data from its tables. Having the definition separated from the actual data offers a few benefits. A software agent can read only the definition section of the document to discover what it contains, and by making the data section optional, a workspace document can be used to transfer only schema information.

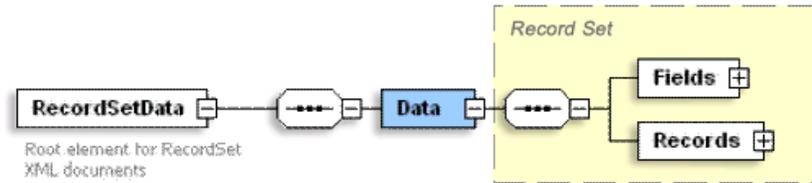
In the case of tables and feature classes, the name of the data element in the definition section corresponds to the name of the table data in the data section. Other datasets, such as topologies, geometric networks, or feature datasets, appear only in the definition section (no data is exported for them).

A.3.2 The Geodatabase RecordSet Document

The geodatabase RecordSet document is used to export the rows from a single feature class or table as simple features or attribute records.

Exporting to a RecordSet document is analogous to exporting to a shapefile. The rows are exported as records, and no additional geodatabase-related information is written to the output file.

For example, topologies and other feature dataset information is not exported. Relationships to features in other tables are not exported.



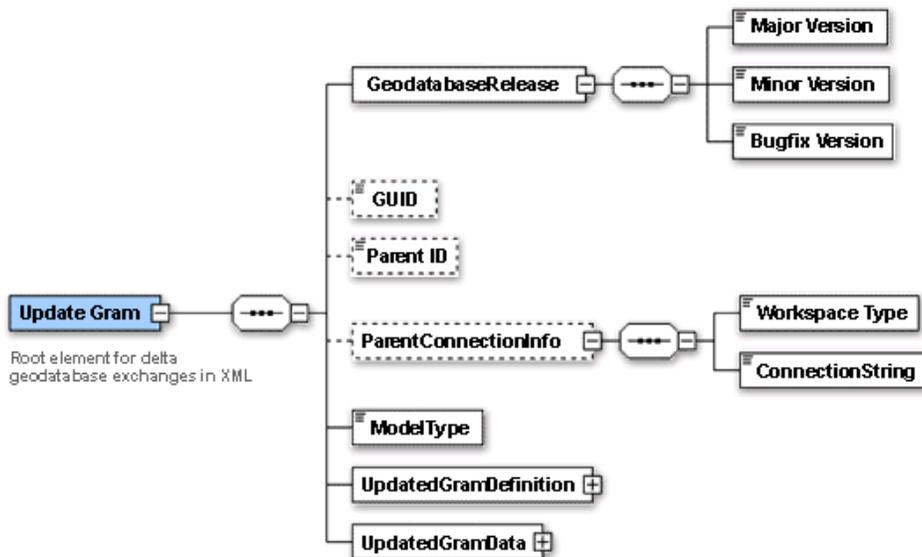
A.3.3 The Geodatabase XML Data Changes Document

As part of geodatabase transaction and version management, you may want to share and work with change-only record sets. The XML Data Changes document is used to share changes or updates among geodatabases and between the geodatabase and external systems. It does this by only distributing changes that can be tracked in the geodatabase using versioning.

The ArcGIS disconnected editing framework allows you to check data out of a database into a separate geodatabase and edit the data without having a live connection to the parent database. Once editing is done, it is possible to export only the changes (not all the data) to an XML file. This file can be used to subsequently check in the changes to the parent database.

This is also a key part of geodatabase replication.

The primary information of a data changes document is UpdateGram in which only changes are delivered as part of the XML document.



A.3.4 Using Geodatabase XML in ArcGIS Desktop and Geoprocessing

ArcGIS Desktop and the geoprocessing framework in ArcGIS contain a number of functions to import and export geographic data. Some typical tasks that you can perform in ArcGIS with geodatabase XML include the following:

- Share geodatabases using XML.
- Copy whole geodatabases or subsets such as feature datasets and all related information sets.
- Copy individual tables or rasters.
- Synchronize the contents across multiple geodatabase replicas.

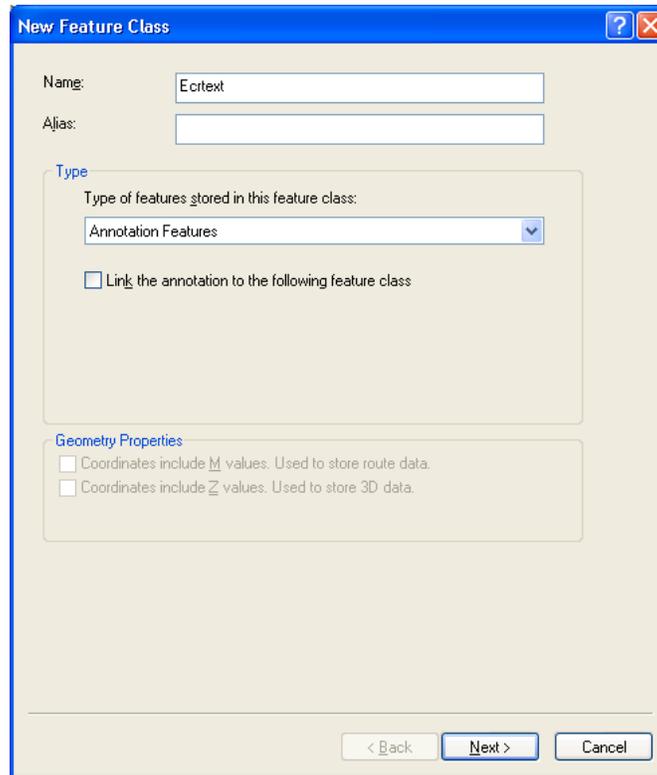
For example, using ArcCatalog or the Catalog window in ArcMap, you can right-click a geodatabase or feature dataset in the Catalog tree and create an XML Workspace document. The XML Workspace document can be used to share a geodatabase schema or to copy the contents, rules, objects, and behaviors to another geodatabase.

Using geoprocessing in ArcGIS, you can perform a number of operations to synchronize and share changes across geodatabases.

A.4 Create the Ecrtext Annotation Feature Class

When creating your annotation feature class, make sure you are inside the feature dataset.

1. In ArcCatalog, navigate to your geodatabase and open the DNC feature dataset so that the feature classes show in the **Contents** tab.
2. With the **Contents** tab active, right-click **New** and click **Feature Class** (do this only inside your feature dataset).
3. Name the feature class `Ecrtext` and select **Annotation Features** in the **Type of features stored in this feature class** list.



This is the same naming convention as VPF. Without this name, none of the Production Mapping tools can use the feature class.

4. Click **Next**.
5. Set your reference scale to the scale based on the product:
 - Harbor: 25000
 - Approach: 75000
 - Coastal: 300000
 - General: 750000
6. Click the **Map Units** arrow, choose **Decimal Degrees**, and leave the **Require symbol to be selected from the symbol table** check box unchecked.
7. Click **Next**.
8. Rename Annotation Class 1 to Ecrtext.
9. Click **Next**.
10. Set the following items:
 - Global Feature Identifier (GFID)—Set **Type** equal to text. Set **Field Properties Length** equal to 38.
 - f_code—Set **Type** equal to text. Set **Field Properties Length** equal to 5. Select **Domain dncn_ZD040**.
 - nam—Set **Type** equal to text. Set **Field Properties Length** equal to 255.

11. Click the shape field to view the field properties.
12. Change **Grid 1** to equal 0.5. (It should currently be set to 1000.)
13. Click **Finish**.

A.5 Topology in ArcGIS

This topic applies to ArcEditor and ArcInfo only.

In geodatabases, topology is the arrangement that defines how point, line, and polygon features share coincident geometry. For example, street centerlines and census blocks share common geometry, and adjacent soil polygons share their common boundaries.

Addressing topology is more than providing a data storage mechanism. In ArcGIS, topology includes all the following aspects:

- The geodatabase includes a topological data model using an open storage format for simple features (feature classes of points, lines, and polygons), topology rules, and topologically integrated coordinates among features with shared geometry. The data model includes the ability to define the integrity rules and topological behavior of the feature classes that participate in a topology.
- ArcGIS includes topology layers in ArcMap that are used to display topological relationships, errors, and exceptions. ArcMap also includes a set of tools for query, editing, validation, and error correction of topologies.
- ArcToolbox includes geoprocessing tools for building, analyzing, managing, and validating topologies.
- ArcGIS includes advanced software logic to analyze and discover the topological elements in the feature classes of points, lines, and polygons.
- ArcMap includes an editing and data automation framework that is used to create, maintain, and validate topological integrity and perform shared feature editing.
- ArcGIS software logic, available in the ArcGIS Desktop, ArcGIS Engine, and ArcGIS Server products, can navigate topological relationships, work with adjacency and connectivity, and assemble features from these elements. Identify the polygons that share a specific common edge; list the edges that connect at a certain node; navigate along connected edges from the current location; add a new line and burn it into the topological graph; split lines at intersections; and create resulting edges, faces, and nodes, and so on.

ArcGIS has a number of pathways for defining and creating a new topology. The primary method involves the use of tools in the Catalog window or ArcCatalog. Once you know how to create a topology, you can automate this work using a suite of geoprocessing tools. These alternative methods are described in this section.

A.5.1 Creating a Topology Using the Catalog Window or ArcCatalog

Here is the process used to create a topology using ArcCatalog:

1. Right-click the feature dataset to which you want to add a topology, point to **New**, then click **Topology**.
2. Click **Next**.
3. Name the new topology and specify the cluster tolerance. The default value will be set to the x,y tolerance of the feature dataset. A good default value is 0.001 meters or its equivalent in the units of your spatial reference (for example, 0.003281 feet if your units are in feet or 0.0000000556 degrees if your units are in latitude-longitude as decimal degrees).
4. Click **Next**.
5. Choose the feature classes that will participate in the topology. You will be shown a list of all the feature classes in your feature dataset.
6. Click **Next**.
7. Set the coordinate accuracy ranks for each feature class in the topology.

If one or more of your feature classes contain coordinate z-values, click **Z Properties** to set the z-ranks. The z-tolerance is used to distinguish the z-height, or elevation of vertices within the tolerance of one another. For example, two adjacent features of different heights might share a common edge between them. However, only their x,y vertices are colocated, not their z-value or height. The z-tolerance helps process this information correctly during validation and clustering operations. The default z-tolerance value is the same default value as the x,y tolerance (0.001 meter in real-world units).

8. Click **Next**.
9. Add the series of topology rules that help you structure the spatial relationships between features and to control and validate how features share geometry.
10. Click **Next**.
11. Review the summary and click **Finish**. You have now added the new topology to your feature dataset. You will be asked if you would like to validate your topology in your feature dataset now. If you have data in your feature classes, you can choose **Yes**.

A.5.2 Creating a Topology Using Geoprocessing

ArcToolbox contains a series of geoprocessing tools for topology. The Topology toolset is located in the Data Management toolbox.

These tools can be used to build scripts for creating and modifying geodatabase topologies. Scripts can be useful for automating a series of tasks and for building repeatable workflows.

A.5.3 An Overview of the Topology Toolset

This topic applies to ArcEditor and ArcInfo only.

Topology is a collection of rules that, coupled with a set of editing tools and techniques, enables the geodatabase to more accurately model geometric relationships. ArcGIS implements topology through a set of rules that define how features may share a geographic space and a set of editing tools that work with features that share geometry in an integrated fashion. A topology is stored in a geodatabase as one or more relationships that define how the features in one or more feature classes share geometry. The features participating in a topology are still simple feature classes—rather than modifying the definition of the feature class, a topology serves as a description of how the features can be spatially related.

The Topology toolset contains a set of tools that can be used to create and manage a geodatabase topology.

| Tool | Description |
|--|---|
| Add Feature Class To Topology | Adds a feature class to a topology. |
| Add Rule To Topology | Adds a new rule to a topology. |
| Create Topology | Creates a topology. The topology will not contain any feature classes or rules. |
| Remove Feature Class From Topology | Removes a feature class from a topology. |
| Remove Rule From Topology | Removes a rule from a topology. |
| Set Cluster Tolerance | Sets the cluster tolerance of a topology. |
| Validate Topology | Validates a geodatabase topology. |

Topology tools

A.6 ArcSDE Geodatabases

This topic applies to ArcEditor and ArcInfo only.

When you need a large multiuser geodatabase that can be edited and accessed simultaneously by many users, the ArcSDE geodatabase provides a good solution.

ArcSDE geodatabases work with a variety of DBMS storage models (DB2, Informix, Oracle, PostgreSQL, and SQL Server), taking full advantage of the underlying database architecture. The ArcSDE technology provides the ability to manage a shared, multiuser

geodatabase, as well as support for a number of critical version-based GIS workflows involving simultaneous multiuser editing, distributed geodatabases, and historical archiving.

Data in an ArcSDE geodatabase can be either versioned or nonversioned. If the geographic data is versioned, it can be edited in a specific version of the geodatabase. On the other hand, editing nonversioned data is the equivalent of performing standard database transactions. When you edit nonversioned data in an ArcMap edit session, you edit the data source directly.

A.7 Personal Geodatabases

A personal geodatabase is a Microsoft Access database that can store, query, and manage both spatial and nonspatial data. Because they are stored in Access databases, personal geodatabases have a maximum size of 2 GB. Additionally, only one person at a time can edit data in a personal geodatabase.

You create personal geodatabases in ArcGIS.

Personal geodatabases are made up of nine system tables plus user data. User data can be stored in the following types of datasets:

- Feature class
- Feature dataset
- Mosaic dataset
- Raster catalog
- Raster dataset
- Schematic dataset
- Table (nonspatial)
- Toolboxes

Feature datasets can contain feature classes as well as the following types of datasets:

- Parcel fabrics
- Feature-linked annotation
- Geometric networks
- Network datasets
- Relationship classes
- Terrains
- Topologies

Personal geodatabases can also contain domains, use subtypes, and participate in checkout/check-in replication and one-way replicas.

A.8 Preparing to Edit DNC Data

Whether in a personal or an ArcSDE geodatabase, editing in ArcMap is essentially the same. However, there are a few more considerations when working with an ArcSDE geodatabase. An ArcSDE geodatabase can have many editors accessing the same data; therefore, it is important to work within a version. With the **Versioning** toolbar in ArcMap, versions can be created, managed, and selected. Be sure to read all the online help information on working with a versioned geodatabase to understand how to access and view the updates made to the different versions that each editor may be working with. Along with adding data and editing in a version, there are other preparations for editing that may be done as well. The main Production Mapping editing interface is composed of the following toolbars: **Production Editing** and **Production Editing Advanced**. By docking each of the toolbars around the data frame, the edit and display tools are accessible with a single click during editing.

A.9 Editing Environment

The ArcMap environment accommodates many tasks from data automation to analysis and map production. There are many dockable toolbars that are not exposed and must be exposed when required for a given task. Through the Customize menu, the ArcMap environment can be quickly adjusted. Select a task within the **Customize > Toolbars** environment, and toolbars are automatically added and removed to better accommodate the task. The **Customize > Customize Mode** menu also provides quick access to Production Mapping commands, such as **Feature Class To Coverage**, that are less often used. The Customize menu can also be used to support other task requirements.

A.10 Adding Data

To edit a feature class, it must be in the table of contents. If you are working with a personal geodatabase, you can simply use the **Add Data** tool. If you are accessing data from an ArcSDE service, you need to make a database connection before you can add data. When working with a version, you must change the layer to your version before editing.

There are two ways to add a feature class to a version:

- Add the feature class in ArcMap. Select the table of contents source tab, right-click the database name, and click **Change**. Select your version.
- A database connection can be set so that any data added from the connection is automatically added to a version. Create a database connection in ArcCatalog and fill in the appropriate connection information and version. When data is added through the connection, it is automatically added to the selected version.

A.11 Managing the Table of Contents

There may be many feature classes of many types in the ArcMap table of contents (TOC). Because ArcMap draws features from the bottom of the TOC, feature order in the TOC is important. There may be many feature class order scenarios that make sense during editing. *Production TOC Manager* can be used to remove empty feature classes, alphabetize them, and organize them by type. With Production TOC Manager, having many feature classes in the table of contents is more manageable.

A.12 Data Frame Display Tools

The **Tools** toolbar provides the necessary tools for managing the display of the data. It also houses tools to interactively interrogate features and measure distances in the data frame.

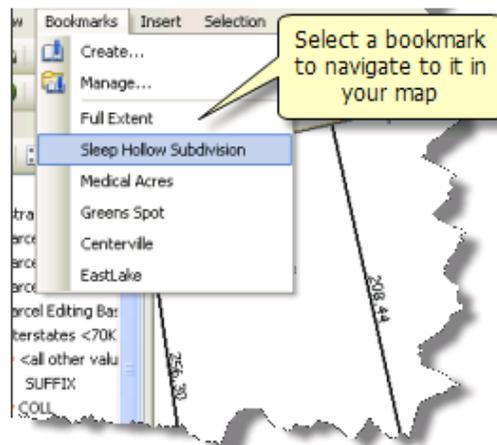
A.13 Spatial Bookmarks

A spatial bookmark identifies a particular geographic location that you want to save and reference later. For example, you might create a spatial bookmark that identifies a study area. As you pan and zoom around your map, you can easily return to the study area by accessing the bookmark. You can also use spatial bookmarks to highlight areas on your map you want others to see.

You can create a spatial bookmark at any time. As a shortcut, you can create bookmarks when you find and identify map features. Spatial bookmarks are defined for working with spatial data in data view; they can't be defined on an area of the page in layout view.

A.13.1 Using Spatial Bookmarks

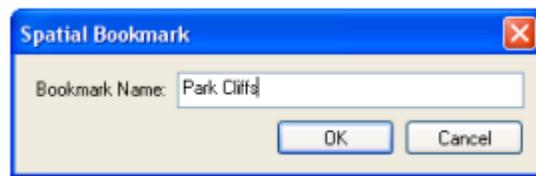
To go to the location of a bookmark in your map display, click **Bookmarks** on the main ArcMap menu and click the bookmark that you want to go to in your map.



Note: If your data frame has a fixed scale so that zooming in and out is unavailable, choosing a bookmark from the Bookmarks menu pans to that bookmark.

A.13.2 Creating a Bookmark

1. Pan and zoom the data frame to your area of interest.
2. Click **Bookmarks > Create**.



3. On the *Spatial Bookmark* dialog box, enter the name of the new bookmark and click **OK**.

Tip: You can create bookmarks automatically from the selected features or graphics on your map. First, select the features or graphics that you want to create bookmarks from.

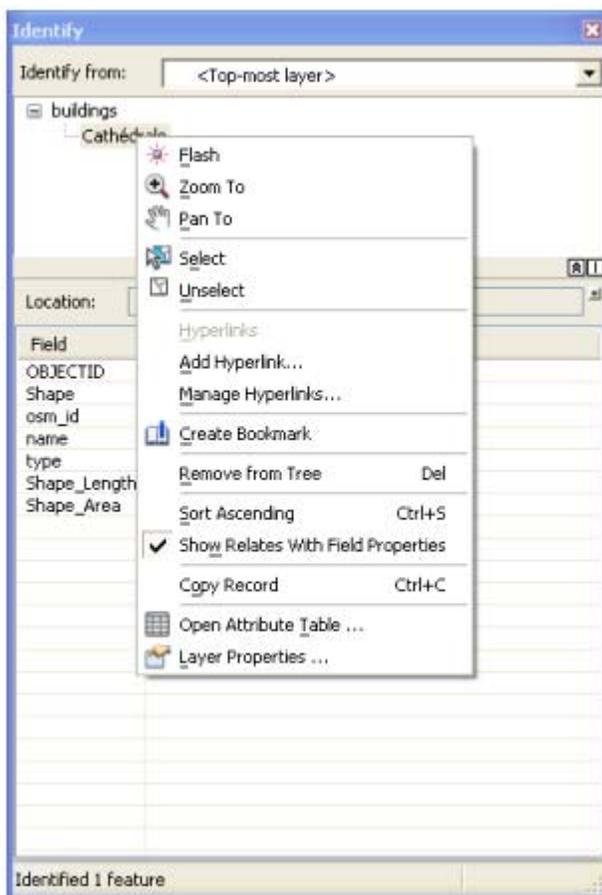
Now click the **My Places** button  on the *Data Frame Tools* toolbar and use the **Add From** menu button in the *My Places* dialog box. Then select the places in the list that you just added if they are not already selected and click **Save Selected** from the **Save** menu button. This creates a places file (.dat) that you can load into *Bookmarks Manager*. When you load places into *Bookmarks Manager*, they are converted into bookmarks.

A.13.3 Creating a Bookmark Using the Identify Tool

When you use the **Identify** tool  to click features and display their attributes, you can create a spatial bookmark. Here are the steps:

1. Click the **Identify** tool and click a feature.

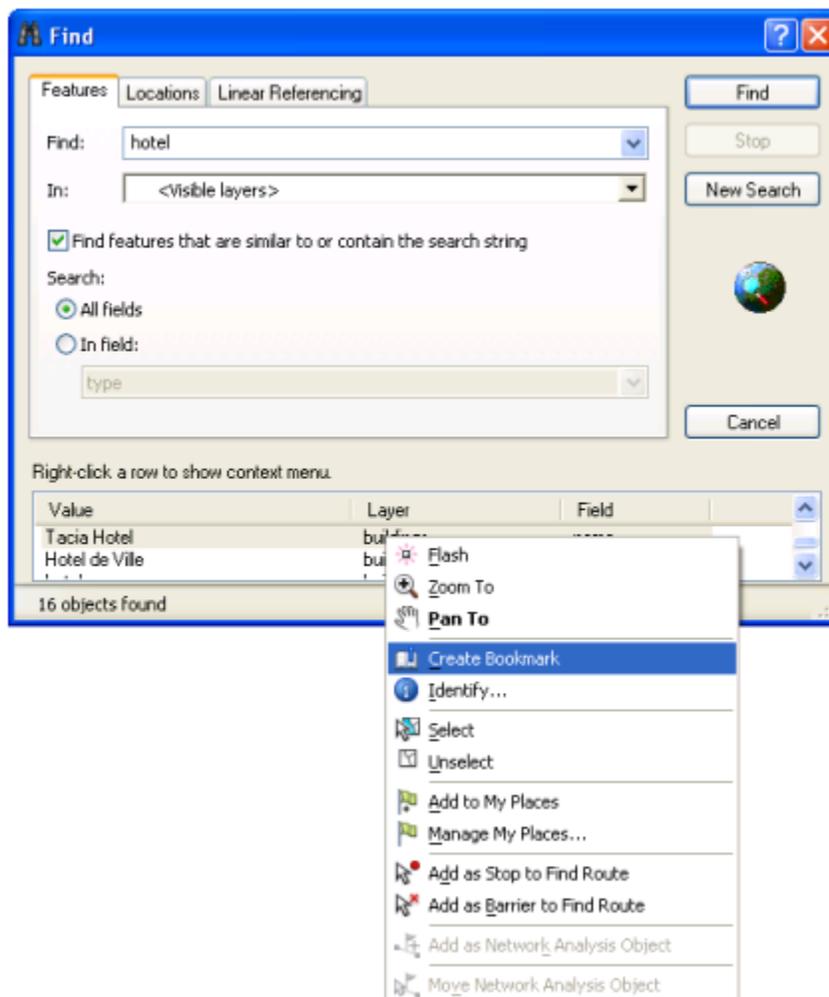
2. On the *Identify* window, right-click the feature for which you want to create a spatial bookmark and select **Create Bookmark**.



This will create a bookmark with an extent that surrounds the feature and names it after the feature.

A.13.4 Creating a Bookmark Using the Find Tool

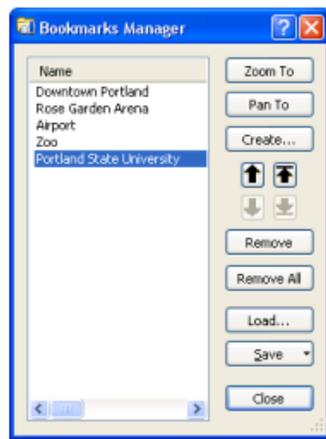
When you use the **Find** tool  and generate a set of matches, you can right-click one of the matches and select **Create Bookmark** as shown here. The bookmark is named after the feature.



A.13.5 Managing and Sharing Bookmarks

Each data frame has its own list of bookmarks, which are stored in the map document. To load bookmarks into another data frame or a different map document, export the bookmarks. Bookmarks are exported to an ArcGIS place file (.dat), which is the same file used with My Places. This allows you to save and load bookmarks into your My Places list and vice versa.

Bookmarks Manager allows you to add, remove, rename, navigate to, save, and load spatial bookmarks. You can also organize and reorder your list of bookmarks. To open *Bookmarks Manager*, click **Bookmarks > Manage**.



A.13.6 Saving and Loading Bookmarks

You can save a series of bookmarks that you have created and share them with other users, who can load them into their maps. For example, you might create a set of bookmarks for areas in your city and share them with other users.

A.14 Polygon Grids and the Reviewer Overview Window

This topic applies to ArcInfo only.

Polygon grids are grids that are created over a specified extent and stored in a polygon feature class. The grid divides the specified extent into cells so that you can systematically review a large dataset. In the polygon grid, individual grid cells are polygon features that can be attributed and selected. This type of grid can be used with applications such as ArcGIS Data Reviewer to divide large extents into more manageable sections and define areas of interest for map series.

These grids can be used during Reviewer sessions to manage both visual and automated quality control. With Data Reviewer, the polygon grid can be associated with the Reviewer table and the grid information associated with individual records. Cells that contain features that have been recorded in the Reviewer table have the QC_GRID field populated with polygon grid information.

With Production Mapping, the polygon grid can be used to define areas of interest for map sheets in a map series. By using the grid cells as individual extents for the map sheets, you can create map sheets with areas that are a standard size and shape.

There are three major steps when creating a polygon grid:

- Defining the workspace.

- Specifying the grid extent—The size of the polygon grid can be defined in several ways: using a bounding box, using selected features, based on the visible extent, or using coordinates.
- Configuring the grid layout—The number of rows and columns in the grid can be defined by specifying numbers of columns and rows or using the coordinate system.

A.14.1 Adding a Grid to the Reviewer Overview Window from the Map

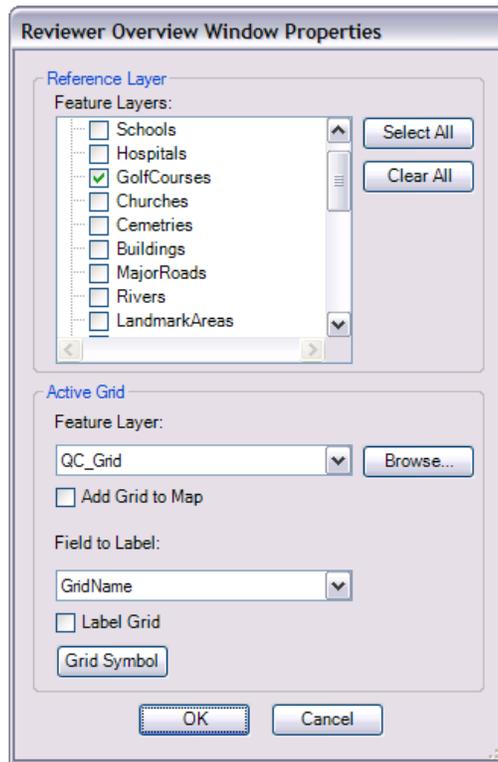
The **Reviewer Overview Window** allows you to load polygon grids and interact with them both within the window itself and the map display. Within the Reviewer Overview Window, you can select individual cells and navigate to their relative locations on the map display. That is, when you select a cell in the grid, you can zoom to the related area in the map. The grid is actually a polygon grid, which acts as a point of reference for the data. Using the grid allows you to divide a large extent into smaller, more manageable parts that can be reviewed individually.

When you initially launch the Reviewer Overview Window, the full extent of the first layer in the ArcMap table of contents is displayed. A rectangle with a hatched pattern represents the visible extent of the data frame.

If the feature layer you want to use as the grid is loaded in the map already, you can choose to use it in the Reviewer Overview Window. This is typically a polygon grid that has been created using the **Create Polygon Grid** wizard.

Steps

1. Click the **Reviewer Overview Window** button  on the **Data Reviewer** toolbar.
The **Reviewer Overview Window** appears as a docked window in ArcMap.
2. Right-click inside the **Reviewer Overview Window** and click **Properties**.
The **Reviewer Overview Window Properties** dialog box appears.
3. Check the check boxes next to the feature classes you want to use as reference layers in the **Feature Layers** list.
The last feature class in the table of contents is used by default.



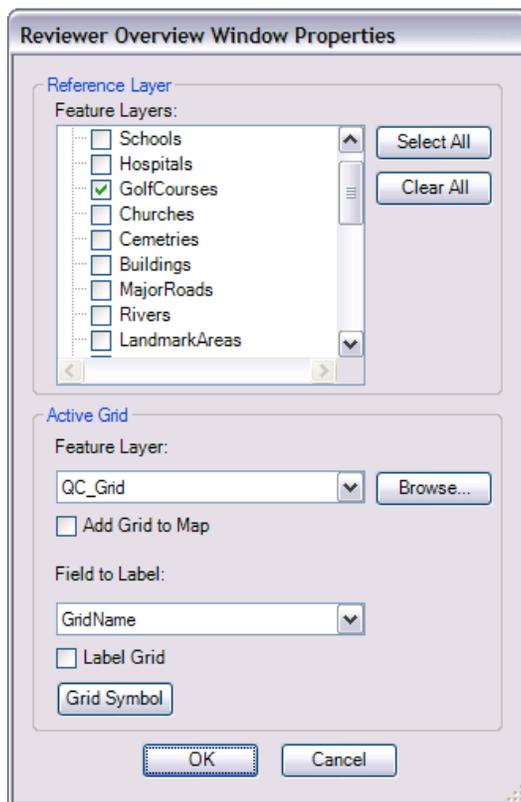
4. Click the **Feature Layer** arrow in the Active Grid area and choose the polygon grid that is loaded in the map.
5. Click **OK**.

A.14.2 Adding a Grid to the Reviewer Overview Window from a Database

You can add a grid to the window from a database. This is typically a polygon grid that has been created using the **Create Polygon Grid** wizard. This allows you to save the grids in a workspace that is separate from the data you want to view in the map.

Steps

1. Click the **Reviewer Overview Window** button  on the **Data Reviewer** toolbar.
The **Reviewer Overview Window** appears as a docked window in ArcMap.
2. Right-click inside the **Reviewer Overview Window** and click **Properties**.
The **Reviewer Overview Window Properties** dialog box appears.



3. Check the check boxes next to the feature classes you want to use as reference layers in the **Feature Layers** list.

The last feature class in the table of contents is used by default.

4. Click **Browse** next to the **Feature Layer** list in the Active Grid area.

The *Choose Polygon Grid* dialog box appears.

5. Navigate to the polygon grid you want to use.
6. Click **OK**.

The grid name appears in the **Feature Layer** list.

7. To add the grid to the map, check the **Add Grid to Map** check box.

The grid is added to the *Reviewer Overview Window*.

8. Click **OK**.

A.15 Feature Cache

If you're working with data stored in a geodatabase, creating a feature cache can often speed up common ArcMap tasks. The feature cache allows you to temporarily store the features in the current map display in ArcMap in your local machine's memory. Because

retrieving the features from local memory is a fast operation, using the feature cache will often result in performance improvements.

The feature cache only stores features in geodatabases (and ArcIMS feature services). The feature cache is most useful when you are working within a specific area of a map.

For example, if you are working with data in an ArcSDE geodatabase that serves features over a network, features in the current extent must be retrieved from the source database each time your display is updated. Using a feature cache reduces the load on your network and the geodatabase since ArcMap accesses this information from your computer's memory (RAM). Since features are cached on the client, it reduces the number of queries the client needs to execute on the server.

Some of the activities that can often benefit from a feature cache include drawing large or complex datasets; labeling, editing, and selecting features; retrieving the same features for multiple layers on a map; and drawing features using a definition query. Labeling, for example, can be a slow and costly process, requiring multiple round-trips to the data source as the label engine attempts to place the maximum number of labels on the map.

A.15.1 Using the Feature Cache Tools

ArcMap has tools to help you build and work with the feature cache. These tools are found on the *Feature Cache* toolbar.



| Button | Name | Function |
|---|------------------------|---|
|  | Build Feature Cache | Builds a cache of the features in the current map extent |
|  | Empty Feature Cache | Empties the feature cache |
|  | Toggles Auto-Cache | Toggles the automatic creation of the map's feature cache |
|  | Set Auto-Cache Scale | Sets the maximum scale for automatically creating the map cache |
|  | Clear Auto-Cache Scale | Clears the automatic cache maximum scale |
|  | Show Feature Cache | Displays the extent of the feature cache |
|  | Zoom to Feature Cache | Zooms the map to the extent of the feature cache |

You can create a feature cache by clicking the **Build Feature Cache** button . You can also use the automatic cache (autocache) function to automatically update the feature cache whenever you move outside the currently cached extent.

The autocache can be useful if you are working in a series of different geographic areas and don't want to rebuild the cache for each area. It is also convenient when you don't know the exact boundaries of the area you want to cache.

Since autocaching may hinder performance, you should set an autocache minimum scale. A feature cache will be created automatically unless the map is zoomed out beyond the minimum scale. For example, suppose you set 1:50,000 as the minimum scale. When the map is zoomed in to 1:14,500, the feature cache will be created automatically, but when the map is zoomed out to 1:75,000, the feature cache will not be rebuilt.

For geodatabase data, the advantages of the feature cache are most pronounced when the data source is an ArcSDE geodatabase. In a multiuser environment, consistent use of the feature cache in ArcMap can significantly improve the overall performance of the system by reducing the number of queries to the geodatabase, the number of features retrieved from the geodatabase, and the overall network traffic. Care must be taken, though, when using feature caches to edit in multiuser, nonversioned edit sessions.

In addition, there may be a minor performance gain with a feature cache for file or personal geodatabases, such as when editing features with large numbers of vertices or accessing the data over a network.

The feature cache is most useful when you are working within a specific map extent. Work that requires frequent panning and zooming across a large area will not usually benefit from a feature cache.

A.15.2 Creating a Feature Cache

1. Pan and zoom your map to the area where you will be working.
2. On the main menu, click **Customize > Toolbars > Feature Cache** to add the *Feature Cache* toolbar.
3. Click the **Build Feature Cache** button  to create a feature cache for the current map extent.

Tip: Because the feature cache is stored in your computer's RAM, building a cache for a large area with many features may consume a large amount of memory and can take some time. You can cancel building the map cache by pressing the ESC key.

When working with a feature cache while editing, the rules when you stop editing are that if edits are saved, the feature cache is maintained, and if edits are not saved, the feature cache is cleared. If the edit operation is aborted, whether it is by using Stop Editing or within the current edit session, the feature cache is cleared.

A.15.3 Viewing the Extent of the Cached Area

Click the **Show Feature Cache** button  to view the extent of the current feature cache.

The currently cached area will flash on the map.

- If the **Show Feature Cache** button is green, you are using the feature cache. Green indicates that you are completely within the cached extent and are using cached data.
- If the **Show Feature Cache** button is red, part of your current display extent is outside the cached area. You are no longer using cached data.
- If the button is unavailable, you are completely outside the cached area. You are no longer using cached data.

Tip: If any part of your current display extent is outside the cached area, you are no longer using the data cached on your computer. To use the feature cache again, you'll need to build a new cache, use autocache, or return to the cached extent.

A.15.4 Working with an Autocache

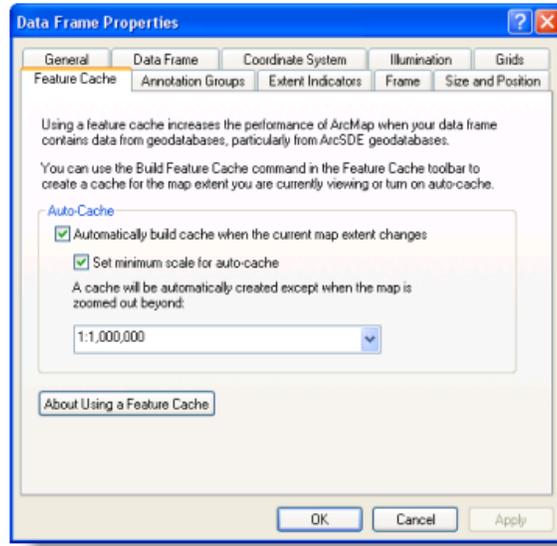
Feature caches are used with very large feature classes containing hundreds of thousands of features. However, to maximize their effectiveness, it's important to set the cache areas for your map. If you have multiple work areas and are working with a large feature class, you can use an autocache to ensure efficient performance.

Turning on autocaching enables you to work with a number of areas in your map and automatically cache the features in each of these working areas. A key step is to set a minimum map scale. Automatic feature caching will be turned off when you zoom out past this map scale. This allows you to navigate and move between various work areas on your map. When you zoom out beyond the minimum map scale, autocaching will be turned off. Feature caching will automatically be turned on again once you zoom in beyond the minimum map scale.

Steps

1. On the *Feature Cache* toolbar, click the **Toggles Auto-Cache** button  to turn it on.
2. Next, set the minimum autocache scale. This is the map scale where the autocache will automatically turn off if you zoom out beyond it. To do this, zoom your map to the desired autocache scale. In most cases, you can set the map extent for one of your typical working areas. Then, click the **Set Auto-Cache Scale** button .

Tip: You can also set auto-cache properties on the *Data Frame Properties* dialog box on the **Feature Cache** tab.



A.16 Set Selectable Layers

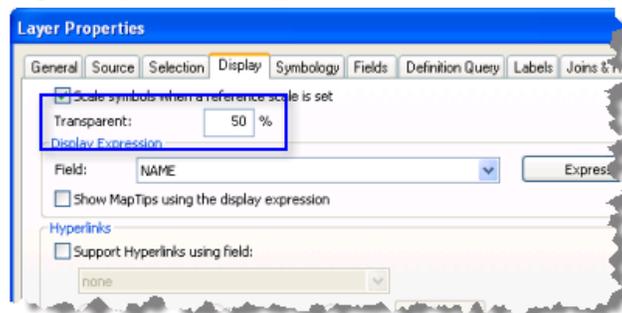
Selecting features identifies the features on which you want to perform certain operations such as move, delete, or copy. You can choose which layers are selectable by using the

Production Set Selectable Layers button . Setting selectable layers allows you to select features from one or many layers without necessarily having the particular layer selected in the TOC. This is especially useful when viewing many themes while only being interested in working with a specific few.

A.16.1 Setting Layer Transparency

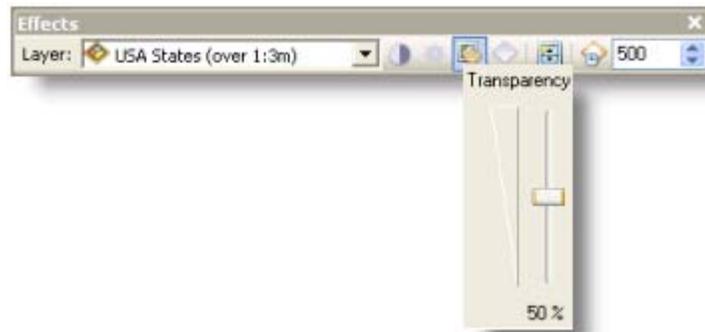
Transparency can be used for any symbolization type, but it is especially useful for drawing raster layers with other layers on your map. Adding transparency to the top layers allows you to see them while still viewing underlying layers.

You can set layer transparency on the **Display** tab on the *Layer Properties* dialog box.



You can also set layer transparency using the Effects toolbar as described in the following steps:

1. Click **Customize > Toolbars > Effects** on the main menu.
The *Effects* toolbar appears.
2. Click the **Layer** arrow and select the layer that you want to appear transparent.
3. Click the **Adjust Transparency** button  and drag the slider bar to adjust the transparency.



Tips:

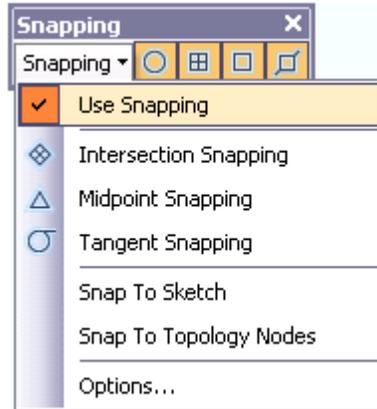
- For layers using a single symbol or for layers displayed by category, you can set the transparency of individual features using field values to set percent transparency.
- You can set transparency for group layers. In these cases, it will take into account the transparency settings of each sublayer in the overall group layer transparency.
- You can use the **Swipe Layer** tool  and **Flicker Layer** tool  on the *Effects* toolbar to interactively reveal what is underneath a particular layer.

A.17 About Snapping

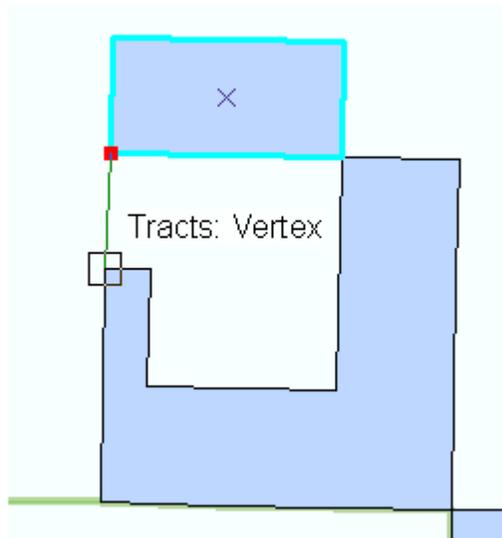
Snapping allows you to create features that connect to each other so your edits are more accurate, with fewer errors. When snapping is turned on, your pointer will jump, or snap to, edges, vertices, and other geometric elements when your pointer is near them and within a certain tolerance. This enables you to position a feature easily in relation to the locations of other features.

All the settings you need to work with snapping are located on the *Snapping* toolbar. Snapping is not limited to being used while editing, as it is utilized in other areas of ArcGIS, such as georeferencing and the **Measure** tool on the *Tools* toolbar. By default, snapping is enabled, and the active snapping types are points, endpoints, vertices, and edges. You can turn on or off individual types from the *Snapping* toolbar. To turn off

snapping completely, click the **Snapping** menu and remove the check mark next to **Use Snapping**.



When snapping is enabled, the pointer icon changes as you move around and pause on various features on your map. Each snapping type (vertex, edge, endpoint, intersection, and so on) has its own feedback, which matches the icons on the Snapping toolbar. For example, the cursor is a square when you are snapping to a vertex and becomes a box with diagonal lines when you are snapping to an edge. By noting the cursor appearance and the SnapTip text that pops up, you can immediately determine the layer you are snapping to and which snapping type is in use.



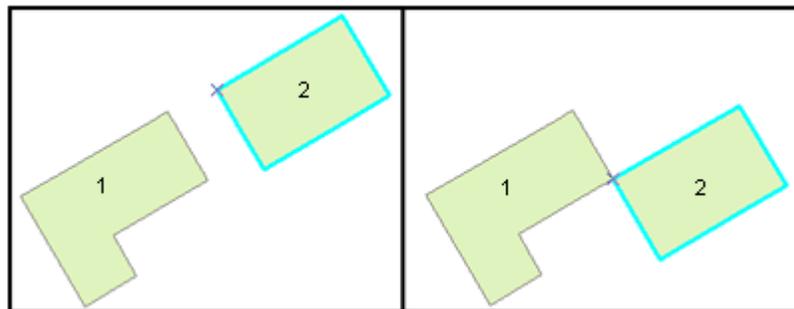
To help you distinguish the icons on the **Snapping** toolbar, rest your pointer on a button; note that a piece of text pops up (a ToolTip) near your pointer with the name of the button, and a description appears in the status bar at the bottom of the application. In addition, you can change the appearance of the buttons on the toolbar so the icons display with their names or the buttons display as text only without any icons. To do this, click the **Customize** menu and click **Customize Mode**. While the **Customize** dialog box is

displayed, right-click an icon on the **Snapping** toolbar and click either **Text Only**, **Image Only** (the default), or **Text and Image**. This tip applies to any toolbar in ArcGIS.

A.18 Snapping while Editing

Snapping is useful with many editing operations, such as creating polygons that do not overlap or have gaps between them, drawing lines that connect to each other, or placing a point exactly along an existing line. For example, suppose you are creating a new segment of an electric line that begins from an existing transformer; you want to ensure that the vertex of the line connects precisely to the transformer. Snapping makes this type of task accurate, quick, and easy. You can snap to any feature layer in your map, not just ones you are currently editing. This allows you to snap to features in a computer-aided design drawing, coverage, feature class from another geodatabase, and so on.

You can use snapping to move one or more features to a precise location in relation to another feature. For example, with snapping, you can move a polygon feature representing a new building and, when it is moved within the snapping tolerance, have one of its corners jump, or snap, precisely to the corner of an existing building. To do this, make sure the buildings have vertex snapping enabled, and move the new building's selection anchor to its corner vertex. Then drag the new building until the selection anchor snaps to the corner vertex of the existing building.



The graphic shows two buildings, with one of them (building 2) selected. The left side of the graphic shows that building 2's selection anchor has been moved from its default place in the center of the feature to one of its corners. The right side shows the same buildings, but with building 2 snapped and moved to the corner of building 1.

Normally, the selection anchor is in the center of selected features. To move a selection anchor, use the **Edit** tool and hold down the CTRL key while you rest your pointer over the selection anchor (the x). When the pointer turns into the move pointer , click the selection anchor and drag it to the new location.

If you have multiple snap types active, the sequence in which the snapping occurs is determined automatically. The highest priority is given to snapping to sketch elements.

A.18.1 Choosing the Snapping Environment to Use for Editing

When you are editing, there are two snapping environments available to you. The default environment uses the Snapping toolbar, but you can instead choose to use the editing classic snapping environment. With classic snapping, you can set up snapping on a layer-by-layer basis.

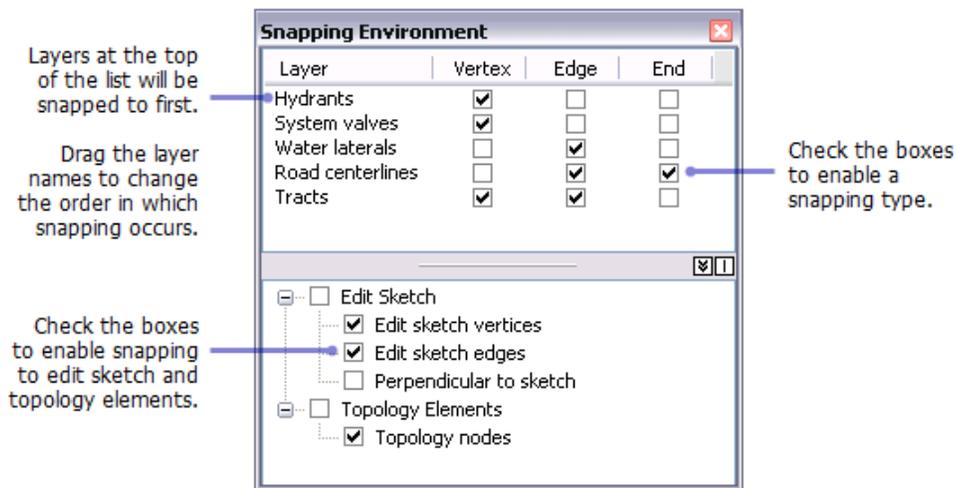
The editing classic snapping environment refers to the snapping functionality that was available during an edit session in ArcGIS 9 and earlier using the Snapping Environment window. In classic snapping, snapping settings are specified by choosing a layer and snapping type (vertex, edge, or end) in the Snapping Environment window. This snapping functionality is off by default and has been replaced with the Snapping toolbar, which provides a flexible, easy-to-use snapping environment with more snapping types, more options, and better feedback than classic snapping. Since there may be some scenarios where you need to access the classic snapping environment, such as when performing raster snapping with the ArcScan for ArcGIS extension, you have the option to switch to classic snapping.

You enable editing classic snapping on the *Editing Options* dialog box and use the *Snapping Environment* window to turn on snapping for individual layers and snap types.

Note: While classic snapping is enabled, editing tools only use the classic snapping environment. However, georeferencing tools, the Measure tool, and other nonediting tools continue to use the snap settings on the Snapping toolbar.

A.18.2 Enabling Snapping (Classic Snapping)

You enable editing classic snapping on the Editing Options dialog box and use the Snapping Environment window to turn on snapping for individual layers and snap types.



Steps

1. Click **Editor** on the main menu and click **Options**.
2. Click the **General** tab.
3. Check **Use classic snapping**.
4. Click **OK**.
5. Click **Editor**, point to **Snapping**, then click **Snapping Window**.
6. Click the vertex, edge, and end boxes for the layers to which you want to snap.
7. When you have selection layers or other instances of multiple layers referencing the same data source, only one layer pointing to that data source will be listed in the **Snapping Environment** window.
8. Drag the layer names to arrange them in the order in which you want snapping to occur. Snapping occurs first in the layer at the top of the list, then in each consecutive layer down the list.
9. Check the boxes at the bottom panel of the window to enable snapping to edit sketch or topology elements.

You can close the window or leave it open while you work. The snapping settings you change are effective immediately.

A.18.3 Enabling Snapping

Snapping can be enabled on the **Snapping** toolbar.

Steps

1. Add the **Snapping** toolbar to ArcMap.
2. Click **Snapping** on the **Snapping** toolbar and click **Use Snapping**.
3. Click the buttons on the **Snapping** toolbar to perform point, end, vertex, or edge snapping. These snap types are enabled by default.
4. Click the **Snapping** menu to enable other snapping types.

A.18.4 Disabling Snapping

These steps are used to turn off snapping altogether. If you want to disable a single snapping type, such as only turning off snapping to points, click the appropriate button on the Snapping toolbar.

Steps

1. Add the *Snapping* toolbar to ArcMap.
2. Click **Snapping** on the *Snapping* toolbar and click **Use Snapping**.
3. If there is a check mark next to **Use Snapping**, uncheck **Use Snapping** to disable snapping.

Snapping is disabled when there is no check mark next to **Use Snapping**.

A.18.5 Setting the Snapping Tolerance

The snapping tolerance is the distance within which the pointer or a feature snaps to another location. If the element being snapped to—such as a vertex or edge—is within the distance you set, the pointer automatically snaps to the location. You set the default snap tolerance value in pixels.

For example, to make a new electric utility line snap to an existing electric line's end, first make sure end snapping is enabled (in other words, the **End Snap** button is highlighted on the *Snapping* toolbar). When the pointer comes within the snapping tolerance of the existing line and you click to create the first vertex of the new line, it will be snapped to the existing line's endpoint. Since the start point of the new line is coincident with the end of the existing line, your electric lines are modeled as being connected.

Steps

1. Click the **Snapping** menu on the *Snapping* toolbar and click **Options**.
2. Type the desired number of pixels in the **Tolerance** box.
3. Click **OK**.

A.18.6 Setting the Edge Snap Properties

Steps

1. Click the **Spatial Adjustment** menu and click **Options**.
2. Click the **Edge Match** tab.
3. Click the **Source Layer** arrow and choose a source layer.
4. Click the **Target Layer** arrow and choose a target layer.
5. If you only want one link for each destination point, check the check box.
6. If you want to prevent duplicate links, check the check box.
7. Check **Use Attributes** if you want to use attributes to enhance the edgematch.
8. This can assist in the creation of links by ensuring they connect to features that share common attribute values.

9. If you chose to use attributes, click the **Attributes** button.
 - a. Match the source and target layer fields.
 - b. Click the **Add** button.
 - c. Click **OK** when finished matching fields.
10. Click **OK** to close the *Adjustment Properties* dialog box.

A.18.7 Snapping to a Specific Feature while Editing

You can snap on the fly to specific features. By specifying a feature and the part of the feature to which you want to snap, your next vertex will automatically be placed regardless of the other snapping settings.

This functionality is available with the Snapping toolbar snapping or the editing classic snapping environment.

Steps

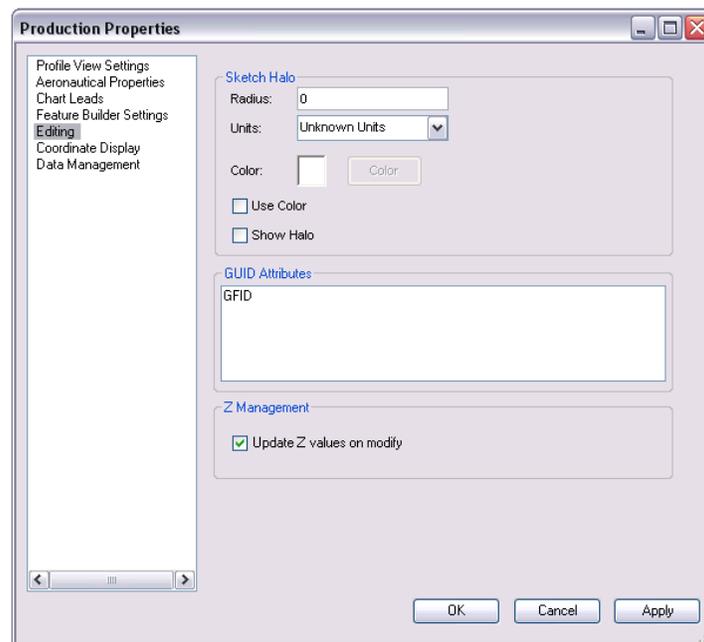
1. While digitizing on the map, right-click the feature you want to snap to; point to **Snap to Feature**; then click either **Endpoint**, **Vertex**, **Midpoint**, or **Edge**. This will place a vertex at the nearest location that matches your choice.
2. If nothing happened, move the pointer closer to the element you want to snap and try again.

A.19 Configuring the Sketch Halo

In many collection guidance specifications, it is necessary to collect only a conspicuous representation of dense features, for example, buildings or road networks. Many guidance specifications have an explicit distance that must exist between features to maintain the scale representation of the specification. The sketch halo properties allow you to create a sketch halo that follows the sketch tool pointer to facilitate the collection of such features. Currently, the sketch halo can only be constructed in the native map units of the data frame's projection.

Steps

1. Start ArcMap.
2. On the main menu, click **Customize > Production Properties**.
The *Production Properties* dialog box appears.
3. Click **Editing**.
The editing properties appear.



4. Type a value in the **Radius** text box using projection units as the unit of measurement.

Note: For geographic projection, this is Decimal Degrees.

5. Click the **Units** arrow and choose a unit of measurement.
The default is the display units, but the halo is built in native projection units.
6. Check the **Use Color** check box if you want to choose a color to use with the sketch halo.
7. Click **Color** to choose a color.
8. Check the **Show Halo** check box.
9. Click **OK**.

A.20 A Quick Tour of Editing

The primary pieces of the editing user interface include the Editor toolbar and several windows and dialog boxes that are opened from it.

A.20.1 Editor Toolbar

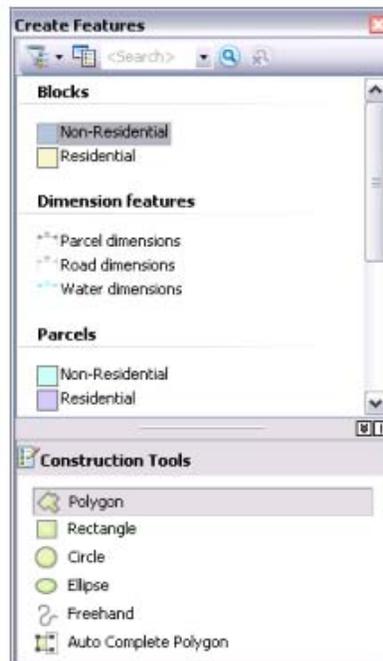
The **Editor** toolbar contains the various commands you will need to edit your data. From the Editor toolbar, you can start and stop an edit session, access a variety of tools and commands to create new features and modify existing ones, and save your edits. To edit data, you need to add the Editor toolbar to ArcMap by clicking the **Editor Toolbar** button on the **Standard** toolbar.



A.20.2 Create Features Window

Anytime you create features on the map, you start with the *Create Features* window. Choosing a feature template on the Create Features window sets up the editing environment based on that feature template's properties; this action sets the target layer in which your new features will be stored, activates a feature construction tool, and prepares to assign the default attributes to the feature you create. To reduce clutter, templates are hidden on the Create Features window when layers are not visible.

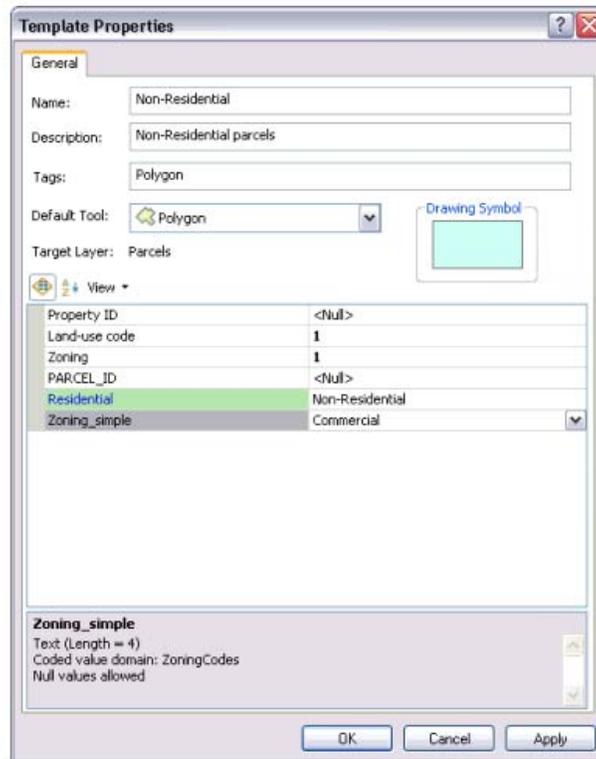
The top panel of the Create Features window shows the templates in the map, while the bottom panel of the window lists the tools available to create features of that type. The availability of the feature creation tools, or construction tools, depends on the type of template you have selected at the top of the window. For example, when a line template is active, you can see a set of tools for creating line features. If you choose an annotation template instead, the available tools change to those that can be used to create annotation.



A.20.3 Template Properties Dialog Box

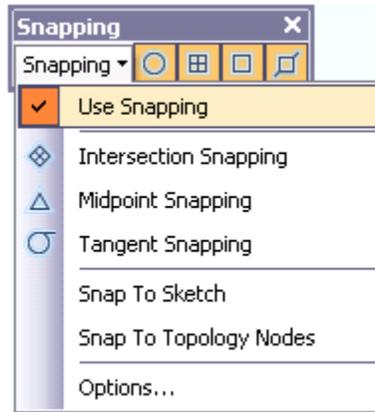
Feature templates define all the information required to create a new feature: the layer where a feature will be stored, the attributes a new feature will be created with, and the default tool used to create that feature. Templates also have a name, description, and tags

that can help you find and organize them. You can specify and review these and other settings on the *Template Properties* dialog box.



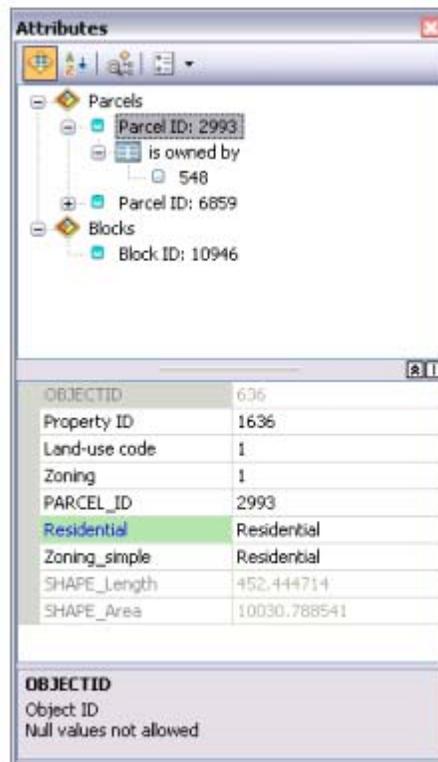
A.20.4 Snapping Toolbar

Snapping allows you to create features that connect to each other so that your edits are more accurate and have fewer errors. With snapping, your pointer will jump, or snap to, edges, vertices, and other geometric elements when it nears them. This enables you to position a feature easily in relation to the locations of other features. As you move your pointer around the map, it snaps automatically to points, endpoints, vertices, and edges. All the settings you need to work with snapping are located on the *Snapping* toolbar, including enabling and disabling snapping types and setting snapping options. The main snap types are buttons on the toolbar, but additional ones are available on the *Snapping* menu.



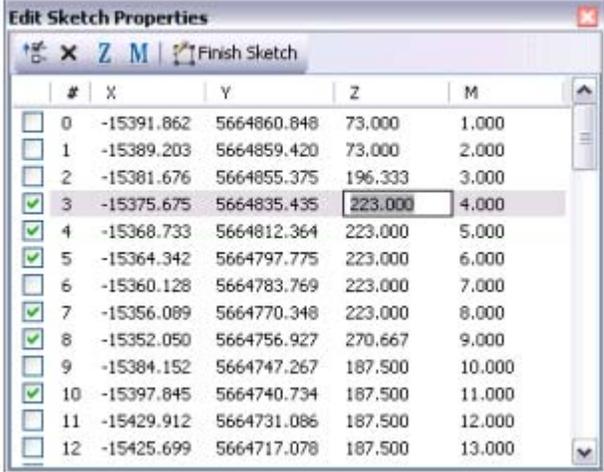
A.20.5 Attributes Window

The Attributes window displays attributes of selected features and allows you to edit the values. The top panel of the window shows the layer (by its display expression) to which the selected feature or features belong, while the bottom panel shows the attribute values of that feature—including any related or joined information. The properties and order of fields reflect the settings on the **Fields** tab of the **Layer Properties** dialog box. For example, if you turn off the visibility for a field, set a field alias name, or change how numbers are displayed in a field, these changes will all be reflected in the **Attributes** window. You can also set a field to be read-only, which means that you can view but cannot edit that field, regardless of the file or database permissions.



A.20.6 Edit Sketch Properties Window

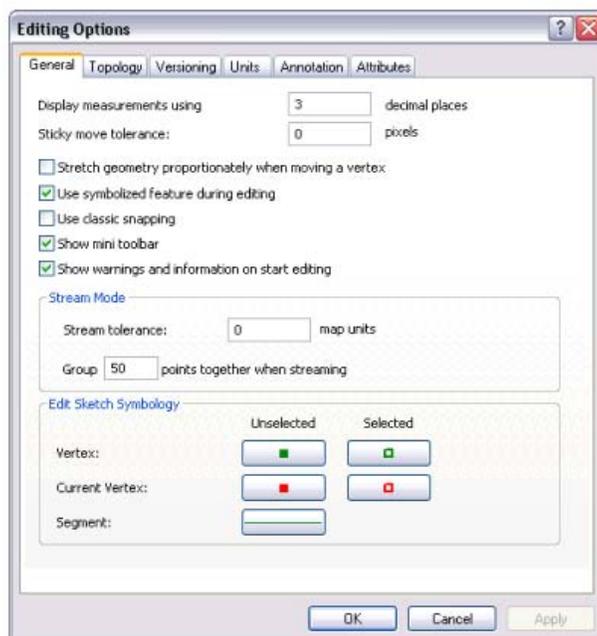
Vertices can store additional attributes besides x,y locations. The attributes include m-values and z-values, which are often used to store information about route measures and elevation. These attributes are added and modified using the *Edit Sketch Properties* window. You can open the window by selecting a feature with the **Edit** tool, double-clicking it, then clicking the **Sketch Properties** button on the *Editor* toolbar.



| # | X | Y | Z | M | |
|-------------------------------------|----|------------|-------------|---------|--------|
| <input type="checkbox"/> | 0 | -15391.862 | 5664860.848 | 73.000 | 1.000 |
| <input type="checkbox"/> | 1 | -15389.203 | 5664859.420 | 73.000 | 2.000 |
| <input type="checkbox"/> | 2 | -15381.676 | 5664855.375 | 196.333 | 3.000 |
| <input checked="" type="checkbox"/> | 3 | -15375.675 | 5664835.435 | 223.000 | 4.000 |
| <input checked="" type="checkbox"/> | 4 | -15368.733 | 5664812.364 | 223.000 | 5.000 |
| <input checked="" type="checkbox"/> | 5 | -15364.342 | 5664797.775 | 223.000 | 6.000 |
| <input type="checkbox"/> | 6 | -15360.128 | 5664783.769 | 223.000 | 7.000 |
| <input checked="" type="checkbox"/> | 7 | -15356.089 | 5664770.348 | 223.000 | 8.000 |
| <input checked="" type="checkbox"/> | 8 | -15352.050 | 5664756.927 | 270.667 | 9.000 |
| <input type="checkbox"/> | 9 | -15384.152 | 5664747.267 | 187.500 | 10.000 |
| <input checked="" type="checkbox"/> | 10 | -15397.845 | 5664740.734 | 187.500 | 11.000 |
| <input type="checkbox"/> | 11 | -15429.912 | 5664731.086 | 187.500 | 12.000 |
| <input type="checkbox"/> | 12 | -15425.699 | 5664717.078 | 187.500 | 13.000 |

A.20.7 Editing Options Dialog Box

You can set preferences for editing in ArcMap on the *Editing Options* dialog box, which is opened by clicking the **Editor** menu and clicking **Options**. You can set the units and number of decimal places used for entering measurements, which symbols and toolbars are displayed while editing, and so on.



A.21 Editing Tools for DNC Data Extraction and Maintenance

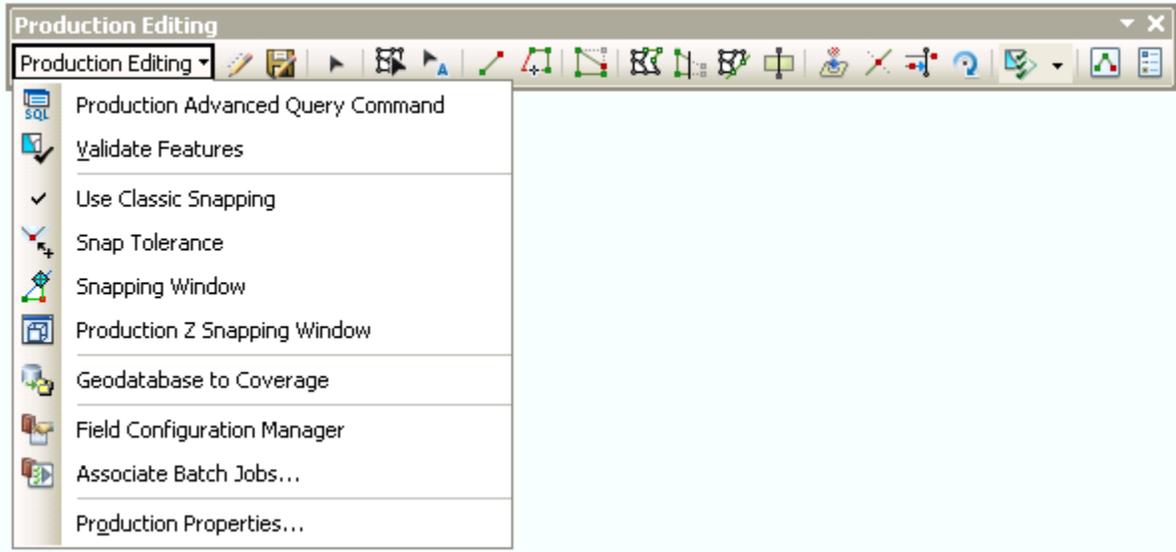
The data added to the map document may come from many databases. You can only edit one collection of datasets (one database) at a time. Both geodatabases or shapefiles can be edited. If your map contains more than one database, when you choose Start Editing, you are prompted to choose which one you want to edit. Any layer from the edit database can be the target for modifications, while any layer in the document can be selected and interrogated.

Editing data can be accomplished through various methods, and the process may be different depending on the data and the data type. The Production Mapping tools streamline the editing environment by allowing access to most edit tools with one click. The following sections describe tools that can be used at various times and in various orders during extraction and maintenance. It is up to you to understand the data requirements, tools, and processes available to make appropriate decisions when extracting the different data.

Several toolbars house the editing tools, which are displayed as commands. The tools are dynamically enabled based on satisfying the tool requirements. For instance, Modify Selected Feature requires that one and only one feature be selected for modification because the editor can only modify one feature at a time. Therefore, Modify Selected Feature is enabled only if you have started editing and only one feature is selected. The Production Mapping editing interface is composed of the following toolbars: Production Editing, Production Editing Advanced, and Editor. By docking each of the toolbars around the data frame, the edit and display tools are accessible with a single click during editing.

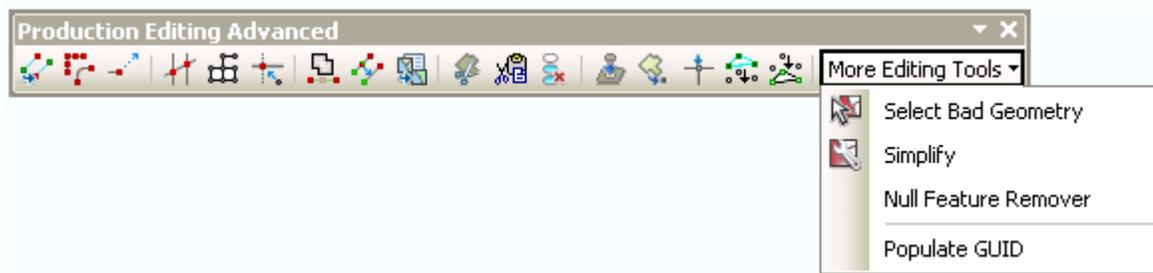
A.21.1 Production Editing Toolbar

The *Production Editing* toolbar is used for most of your basic editing such as starting the edit session and creating or modifying features. From the Production Editing toolbar, you can configure validation rules and field display or validate the selected features.



A.21.2 Production Editing Advanced Toolbar

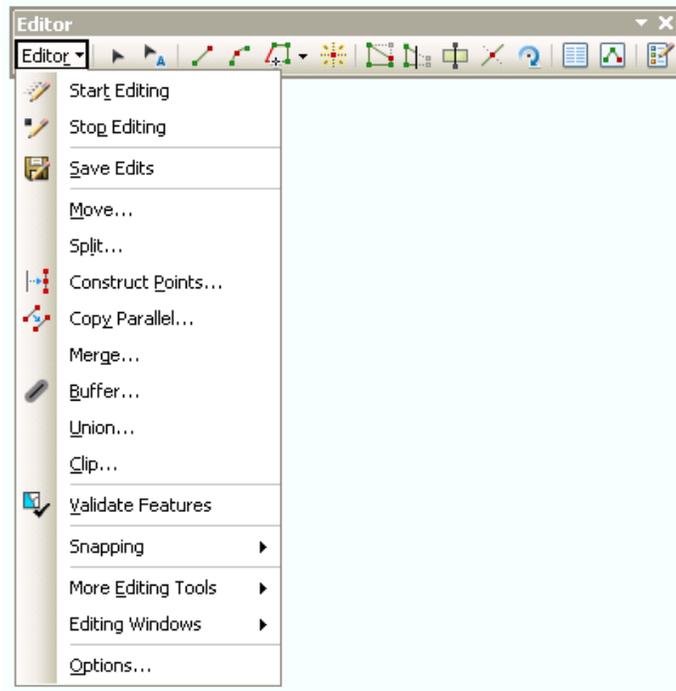
The *Production Editing Advanced* toolbar provides many edit tasks to help you quickly create or update data. Tools like **Batch Intersect**, **Batch Unsplit**, and **Dissolve** allow you to split or logically merge features in batch. Tools like **Points To Line Or Polygon** and **Point At Intersection** allow you to create new features based on the geometries of existing features.



A.21.3 Editor Toolbar

The *Editor* toolbar contains the various commands you will need to edit your data. From the Editor toolbar, you can start and stop an edit session, access a variety of tools and commands to create new features and modify existing ones, and save your edits. To edit

data, you need to add the Editor toolbar to ArcMap by clicking the **Editor Toolbar** button  on the *Standard* toolbar.



When using the editing tools, there is not necessarily an explicit order of use because the editing task drives what tool should be used. It is important to understand the task and the available tools and choose a process that best accomplishes the task.

A.22 Start and Stop Editing

Before you can edit a feature, ArcMap must be in edit mode. If there are layers from many databases in the table of contents, you are prompted to select a database for editing. Only one database at a time can be in edit mode. Once you start editing, you must stop editing a database to edit a different database. If you are working within a version of an ArcSDE database, you may want to reconcile your version before starting to edit the data.

A.22.1 Starting an Edit Session (Start Editing)

There are two ways to start an edit session: by clicking the **Editor** menu on the *Editor* toolbar or by right-clicking a layer in the table of contents.

When you use the Editor menu to start editing and have multiple workspaces in the map, you need to choose the one you want to edit. The dialog box that appears lists the layers in the map and the workspaces they are from and provides information on which other layers are also part of that workspace.

Another way of starting editing is to right-click a layer in the table of contents, point to **Edit Features**, then click **Start Editing**. This starts an edit session on the workspace containing that layer. For example, if you right-click a layer from a geodatabase and start editing it, you are able to edit all the other layers from that same geodatabase.

Steps

1. Click **Editor** on the *Editor* toolbar and click **Start Editing**.
2. If your map contains editable data from more than one geodatabase or folder, choose the workspace that you want to edit and click **OK**.

The top of the window shows a list of editable layers in the active data frame, and the bottom of the window shows the workspaces containing those layers. Only layers that can be edited are listed.

- Click a layer to view its data source at the bottom of the window. When you click a layer at the top, any other layers in that workspace are also highlighted (the database symbols change color).
- Click a data source at the bottom of the window to view the layers in that data source. If you click a data source at the bottom of the window but no layers are listed, this means there are no editable layers in that data source.

A.22.2 Stopping an Edit Session (Stop Editing)

When you end an edit session, you can save any changes you have made back to the data source, or you can quit editing without saving.

You can also save the edits you have made at any time by clicking **Save Edits** on the **Editor** menu. This keeps the edit session active.

Steps

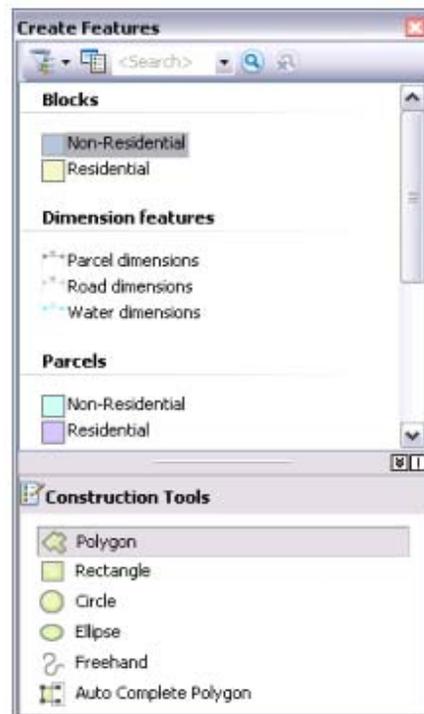
1. Click **Editor** on the *Editor* toolbar and click **Stop Editing**.
2. If you have made any edits since the last time you saved edits, click **Yes** to save them. Clicking **No** discards the edits.

A.23 Create Features Window

Anytime you create features on the map, you start with the *Create Features* window. Choosing a feature template on the Create Features window sets up the editing environment based on that feature template's properties; this action sets the target layer in which your new features will be stored, activates a feature construction tool, and prepares

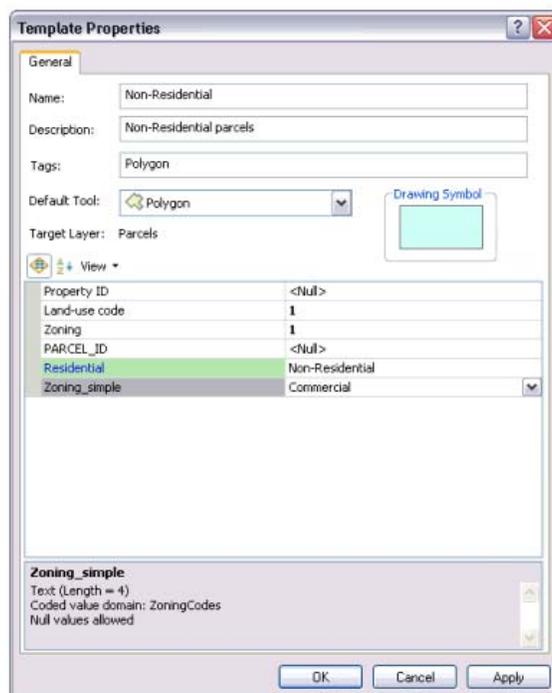
to assign the default attributes to the feature you create. To reduce clutter, templates are hidden on the Create Features window when layers are not visible.

The top panel of the Create Features window shows the templates in the map, while the bottom panel of the window lists the tools available to create features of that type. The availability of the feature creation tools, or construction tools, depends on the type of template you have selected at the top of the window. For example, when a line template is active, you can see a set of tools for creating line features. If you choose an annotation template instead, the available tools change to those that can be used to create annotation.



A.23.1 Template Properties Dialog Box

Feature templates define all the information required to create a new feature: the layer where a feature will be stored, the attributes a new feature will be created with, and the default tool used to create that feature. Templates also have a name, description, and tags that can help you find and organize them. You can specify and review these and other settings on the *Template Properties* dialog box.



A.24 Data Reviewer

Data Reviewer allows you to conduct visual and automated quality review of data in support of database production. The Data Reviewer environment is made up of a series of tools that support the visual review of geodatabase and shapefile data quality. It is used to identify where corrections, additions, and deletions must be made to spatial data and its attributes; analyze data in your geodatabase; and find possible anomalies that exist in your data. Data validation is performed during Reviewer sessions using data checks as well as the analysis tools that are part of Data Reviewer. Features are symbolized in a consistent manner to facilitate interpretation. This software automates and applies a database process to what was formerly a paper trail of quality control error files and corrections.

A.24.1 Reviewer Session Data Storage

Data Reviewer creates a new dataset and table in the geodatabase you are using for a session. The dataset contains point, line, and polygon feature classes that contain features that have been written to the Reviewer table. The Reviewer dataset can be stored in any existing geodatabase, including the production geodatabase, or a separate file or personal geodatabase created specifically for review. If stored in an enterprise or ArcSDE database, the Reviewer dataset tables and feature classes support versioning.

A.24.2 Storing the Reviewer Workspace in an ArcSDE Geodatabase

The following process outlines the steps for setting up a Reviewer workspace when working with ArcSDE geodatabases. Since access to the database tables is controlled by database permissions, it will be necessary to initialize the Reviewer workspace as the database owner and grant privileges to the appropriate ArcSDE users so they can access and work with Reviewer sessions.

Step 1: Create a Reviewer workspace in the ArcSDE geodatabase.

The ArcSDE user that has owner privileges must start a new Reviewer session in the ArcSDE workspace where the Reviewer dataset will be stored.

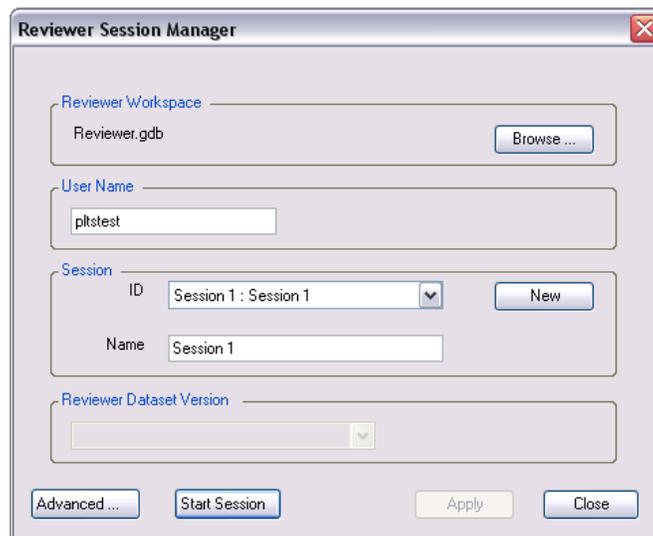
When you start a Reviewer session, you are prompted to choose a workspace, which is a geodatabase that can contain the data you want to review or be a separate database that only contains the Reviewer dataset information, depending on your organization's workflow. By default, the user name is the Windows login name for the current user. You can also provide a custom name for the current Reviewer session.

The first time a database is used to store Reviewer information, a new dataset and tables are added to your database to accommodate the individual Reviewer sessions. All future sessions write to these same tables.

Steps

1. Start ArcMap.
2. Click the **Reviewer Session Manager** button  on the *Data Reviewer* toolbar.

The *Reviewer Session Manager* dialog box appears.

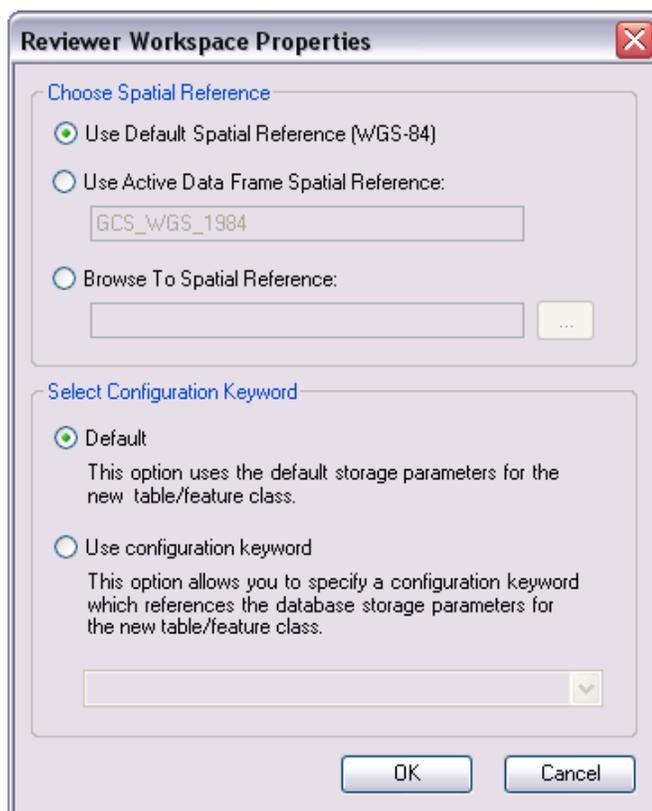


3. Click **Browse** in the Reviewer Workspace area.

The *Reviewer Workspace* dialog box appears.

4. Navigate to the geodatabase in which the Reviewer dataset is going to be stored.
5. Click **Add**.
6. Click **New** to start a new Reviewer session.

The *Reviewer Workspace Properties* dialog box appears.



7. Choose an option for the spatial reference.

- Use Default Spatial Reference (WGS-84)—Sets the Reviewer dataset's spatial reference to GCS_WGS_1984. This is the default spatial reference for ArcMap.

Note: In most cases using the Nautical Solution, choosing the Use Default Spatial Reference (WGS-84) option is suggested.

- Use Active Data Frame Spatial Reference—The Reviewer dataset's spatial reference matches that of the active data frame.
- Browse To Spatial Reference—Sets the Reviewer dataset's spatial reference to one you choose.

Note: If you choose Browse To Spatial Reference, the New Spatial Reference wizard appears so you can choose the spatial reference you want to use with the Reviewer dataset.

Note: The spatial reference selected for the Reviewer dataset should match the spatial reference of the data you are validating. This allows the error geometry to be stored in the feature classes within the Reviewer dataset.

8. If necessary, choose the **Use configuration keyword** option in the Select Configuration Keyword area to choose a different configuration keyword for the database.
9. Click the **Use configuration keyword** arrow and choose a configuration keyword.
The keywords available in the drop-down list are dependent on what the database administrator has specified in the DBTUNE table as configuration keywords.
10. Click **OK**.
The **ID** and **Name** text boxes are automatically populated in the Session area of the *Reviewer Workspace* dialog box.
11. If necessary, type a custom name for the current Reviewer session in the **Name** text box.
By default, the name matches the ID.
12. Click the **Reviewer Dataset Version** arrow and choose the geodatabase version to be used.
The geodatabase version you choose from the list is the one in which the Reviewer table records are going to be stored.
13. Click **Start Session**.
The button appears to be selected, and its name changes to End Session.
14. Click **Close**.

Step 2: Set the dataset and tables as versioned.

The ArcSDE user that has owner privileges must set the following as versioned in ArcCatalog:

- RevDataset (feature dataset)
- RevBatchJobSummary table
- RevTableConfig table
- RevTableLocation table
- RevTableMain table
- RevCheckRunTable

Step 3: Grant permissions to the dataset and tables.

The ArcSDE user that has owner privileges must grant SELECT, UPDATE, INSERT, and DELETE privileges to the following for all users that will be accessing Data Reviewer:

- RevDataset (feature dataset)
- RevBatchJobSummary table
- RevTableConfig table
- RevCheckRunTable
- RevTableGUIProperties table
- RevTableLocation table
- RevTableMain table
- RevTableSession table
- RevAdminLocation table

Step 4: Grant select permissions for the remaining Reviewer tables.

The ArcSDE user that has owner privileges must grant SELECT privileges to the following tables for all ArcSDE users that will be accessing Data Reviewer:

- RevAdminCustomFields
- RevAdminDescriptions

Tips for Granting Permissions

- Only grant an ArcSDE user SELECT, UPDATE, INSERT, and DELETE privileges to the RevAdminCustomFields table if the ArcSDE user has privileges to modify the database schema.
- Only grant an ArcSDE user SELECT, UPDATE, INSERT, and DELETE privileges to the RevAdminDescriptions table if you want the ArcSDE user to be able to add customized error descriptions. Note that all other ArcSDE users accessing the Reviewer dataset will see the customized error descriptions.

Step 5: Configure cache tables for users.

For enterprise geodatabases (Oracle and SQL Server) that create cache tables to store feature selections in ArcMap that are greater than 100, the ArcSDE user that has owner privileges must create the cache table for each ArcSDE user.

Steps

1. Grant CREATE TABLE permissions for the user.
2. In ArcMap, select more than 100 features in the workspace that contains the Reviewer session information.

This automatically creates the cache table.

3. Remove CREATE TABLE permissions as appropriate.

Once this process is complete, you will have created a Reviewer workspace that can be used by the appropriate people in your organization who are working with ArcSDE data.

A.24.3 Data Analysis Tools

Data can be analyzed both visually and in terms of a geodatabase's contents. ArcGIS Data Reviewer includes data checks that can be used to validate many different aspects of a database. These aspects include feature geometry, topology, relationship classes, and spatial relationships between geometries.

A.24.4 Checks in Data Reviewer

ArcGIS Data Reviewer offers many checks that can be selected from the drop-down list on the Data Reviewer toolbar. These checks allow you to perform geometric and attribute validation as well as ensure data integrity. All the validation checks can be applied to an entire feature class or database, features within the current extent, or only the selected set of features. You can also use a SQL query WHERE clause to limit which features to evaluate for a particular check.

Below are the categories in which the checks are grouped with a brief description of each individual check.

Database Validation checks

| Check name | Description |
|-------------------------------|--|
| Connectivity | Finds features that are part of a geometric network and violate connectivity rules |
| Domain | Validates coded value and range domains to ensure that all values meet domain constraints |
| Relationships | Searches for records that are orphans or have improper cardinality in a relationship class |
| Subtype | Searches for feature classes with improper or null (optional) subtypes |

Database Validation checks

Default checks

| Check name | Description |
|---|--|
| Invalid Geometry | Finds features whose geometry is empty, nothing, or not simple as well as those with empty envelopes |
| Multipart Line | Finds polyline features with more than one path |
| Multipart Polygon | Finds polygon features with more than one part or that contain a hole |
| Non-Linear Segment | Finds polyline features with nonlinear segments such as arcs and curves |
| Polyline or Path Closes on Self | Finds paths and lines in polylines that touch or cross themselves |

Default Checks

Duplicate Geometry checks

| Check name | Description |
|------------------------------------|--|
| Duplicate Geometry | Finds features of the same geometry type that are colocated and optionally share attributes. Features can be either from two different feature classes or within the same feature class. |
| Duplicate Vertex | Finds vertices from the same feature that are colocated or within a specified tolerance of one another. |

Duplicate Geometry Checks

Feature on Feature checks

| Check name | Description |
|---|---|
| Geometry on Geometry | Finds features that have a specific spatial relationship, either from two different feature classes or within the same feature class |
| Intersection on Geometry | Finds features from one feature class that are within a specified tolerance of an intersection between two other features from two feature classes or within the same feature class |
| Polygon Overlap/Gap is Sliver | Finds gaps and overlaps between polygon features from two different feature classes |

Feature on Feature Checks

Polygon checks

| Check name | Description |
|---|---|
| Evaluate Polygon Perimeter and Area | Finds parts, rings, segments, or entire polygons for features whose area or perimeter is within a specified range |
| Invalid Hole Feature | Finds features that have a spatial relationship with holes in a polygon feature class |
| Polygon Sliver | Finds polygons below a specified thinness ratio and whose area is within a specified threshold, optionally |

Polygon checks

Polyline checks

| Check name | Description |
|--|--|
| Cutbacks | Finds segments where the angle between segments in a polygon or polyline is below a specified minimum value |
| Evaluate Polyline Length | Finds polyline segments, polyline parts/paths, or polyline features whose length is within a specified range |

Polyline checks

Spatial Parameter Evaluation checks

| Check name | Description |
|---|--|
| Evaluate Extent | Finds multipoint, polyline, or polygon features that have an extent within a specified size |
| Evaluate Intersection Count | Finds vertices for polyline features that intersect polyline or polygon features in a second feature class a specified number of times |
| Evaluate Part Count | Finds features with a part count that is within a specified range |
| Evaluate Vertex Count | Finds features with a vertex count that is within a specified range |

Spatial Parameter Evaluation checks

Table checks

| Check name | Description |
|--|--|
| Execute SQL | Finds features based on a SQL query WHERE clause run using feature attributes |
| Regular Expression | Finds features where values for string fields do not match the specified format |
| Table to Table Attribute | Finds values that match between feature class attribute fields and table fields |
| Unique ID | Searches for duplicate values in a table or feature attribute field across the entire database |

Table checks

Topology checks

| Check name | Description |
|--|---|
| Find Dangles | Searches for polylines that have dangles within a specified tolerance |
| Orphan | Finds topology edges that are not connected to the topology graph |
| Unnecessary Nodes | Finds adjacent polyline features that share a node and have attribute values that are identical on editable fields |
| Unnecessary Polygon Boundaries | Finds adjacent polygon features that share a boundary and have attribute values that are identical on editable fields |

Topology Checks

Z-Value checks

| Check name | Description |
|---|--|
| Adjacent Vertex Elevation Change | Finds vertices for polyline or polygon features with elevation (z-value) changes greater than the specified tolerance |
| Different Z at Intersection | Finds intersecting polyline features whose difference in elevation (z-value) is greater than a specified tolerance at the point where they intersect |
| Evaluate Z Values | Finds features whose z-values are within a specified range |
| Polygon/Ring Closed | Finds unclosed rings in polygons based on the x-, y-, and z-values |
| Slope Direction Change (Monotonicity) | Finds polylines with vertices that change slope direction according to specified conditions |

Z-Value checks

The checks can also be grouped into Reviewer batch job (.rbj) files, which allow you to run several checks on your geodatabase at the same time. These batch jobs can be run using the **Reviewer Batch Validation** tool.

Other analysis tasks include

- Sampling—You can generate a report on a specified number or percentage of features in your geodatabase from selected feature classes.
- Obtaining a total feature count—You can view the total number of features in your geodatabase according to both feature class and subtype.
- Obtain the frequency of field values—You can view the number of times a particular field value occurs in a particular feature class.

Visual analysis can be managed using the **Reviewer Overview Window**, which allows you to record and view which areas have been reviewed. Polygon grids can be created over the study area, with grid cell size determined either by a specified number of rows and columns or map units. Missing features can be drawn in the map using the **Notepad** and **Flag Missing Feature** tools.

The Reviewer Table

The Reviewer table is a tool that stores all the validation problems that have been found using the checks and allows you to analyze the records further. The initial review status, as well as correction and verification status, is all stored in the Reviewer table.

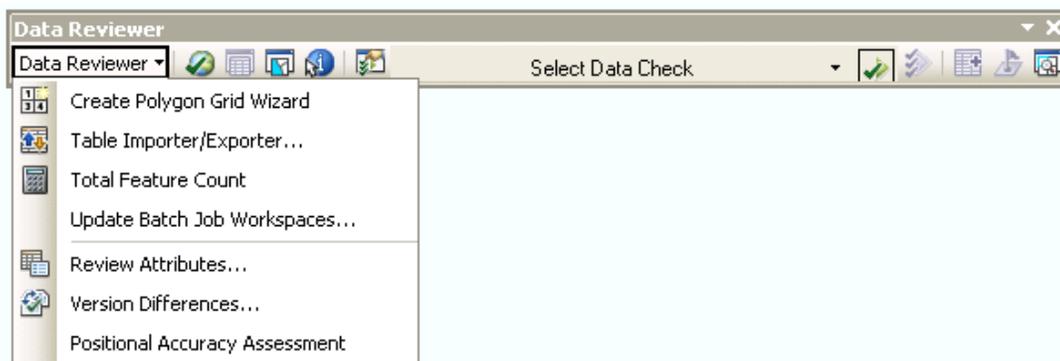
Using tools in the table, you can also

- Select and/or zoom to Reviewer records and associated feature geometries.
- Enter correction and verification information for one or many Reviewer table records.

- Symbolize the records according to their review, correction, and verification status.
- Sort and group records using any of the fields.
- Set table properties.
- Associate a polygon grid with the Reviewer table.
- Generate statistics on records in the Reviewer table.
- Repeat existing table records.
- View the locations of missing features.

The Data Reviewer Toolbar

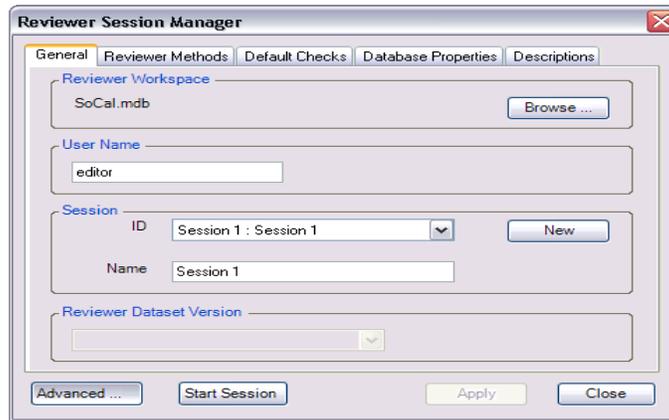
The **Data Reviewer** toolbar in ArcMap provides several tools you can use to manage and run quality control processes on your data. It includes tools for managing Reviewer sessions, configuring checks and batch jobs, and creating polygon grids. The menu on the toolbar contains additional tools that run the **Positional Accuracy Assessment** tool, associate batch jobs with product classes in the product library, and perform other advanced tasks.



Reviewer Session Manager

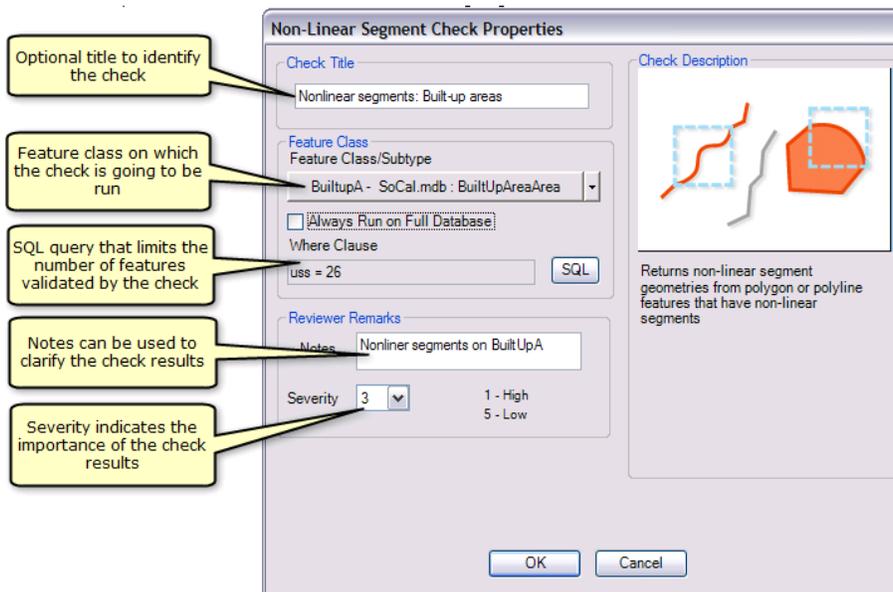
Reviewer Session Manager is used to start and stop Reviewer sessions and configure other properties related to a Reviewer session. Basic properties for a Reviewer session include the Reviewer workspace, or the workspace where you want to store the session information, the user name, and the session ID and name.

You can also specify more advanced properties for the Reviewer session, such as the methods that are going to be used to validate the data, which default checks are run when a batch job is executed, and which workspace you want to use to store the database properties. For example, you can specify which default checks are going to run when you run a batch job and add fields to the Reviewer table that are displayed with other columns in the table.



Checks

The dialog boxes for each check contain parameters that allow you to specify the feature classes and tables on which you want to run the check as well as other information required to run the check. Each check can have different parameters based on the conditions it is going to find.



Composite Check

The **Composite Check Properties** dialog box allows you to check for multiple conditions using the same feature class or table. For example, you can use a composite check to find bridges that do not overlap any roads or railroads.

There can be times when you want to run checks on your data based on multiple conditions, such as features that have relationships with two or more feature classes.

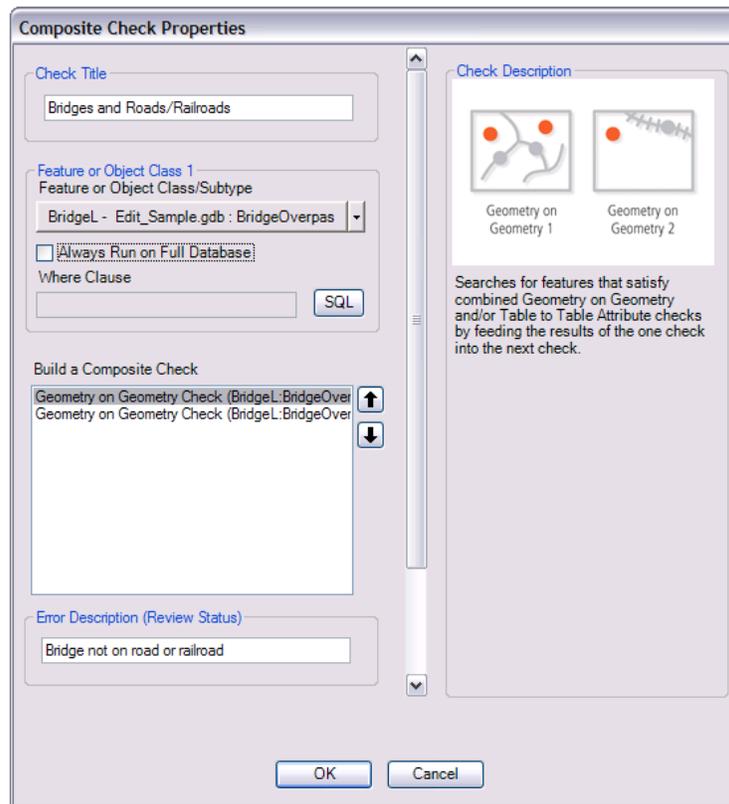
However, if you create separate checks for each condition, you may not necessarily return the results you need.

An example would be finding bridges that are not on top of roads or railroads. If you create a Geometry on Geometry check that finds all bridges that are not intersecting roads, some of the check results could be intersecting railroads. If you create a second Geometry on Geometry check that finds all bridges that do not intersect railroads, some of the check results could be intersecting roads. Therefore, you need to compare the bridges against roads and railroads within one check.

With a composite check, you can check for multiple conditions at once that are based on the same features. In other words, it is a single check that can search for multiple conditions in a single feature class or group of features from a single feature class.

The types of relationships you can find using a composite check are spatial relationships between geometries and relationships between feature attributes and table attributes. The Geometry on Geometry check allows you to find a variety of spatial relationships between features, while the Table to Table Attribute check allows you to compare attribute values for features to table field values.

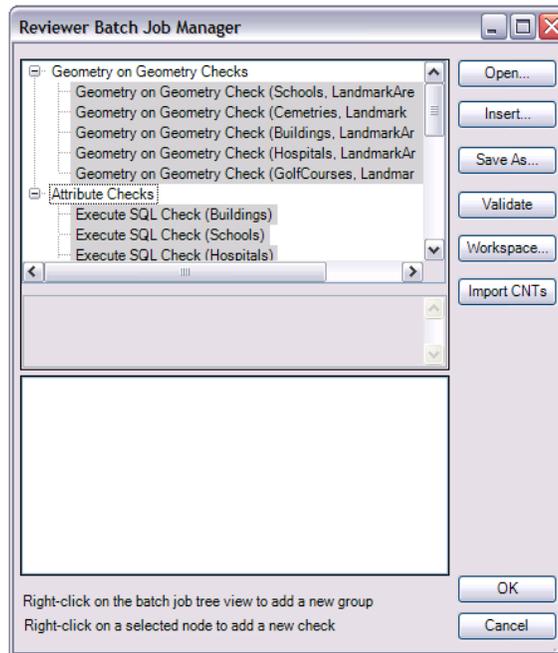
One example would be finding bridges that are not on top of roads or railroads. The first check in the composite check searches for bridges that do not overlap roads, and the second check searches the results of the first check for bridges that do not overlap railroads. Features that would count as results in this check would include bridges that are not near any transportation features or that are beneath a road or railroad feature.



A composite check that checks for bridges on roads and railroads

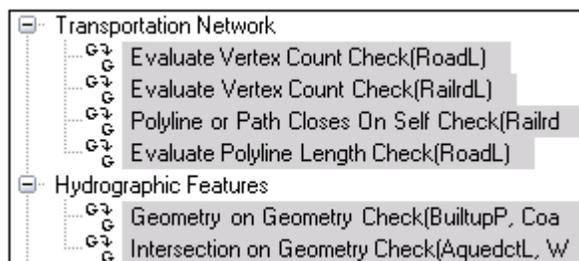
Batch Job Manager

The ***Reviewer Batch Job Manager*** dialog box is used to create, modify, and validate batch jobs, or groups of checks. You can also use Batch Job Manager to import existing condition tables (CNTs) into batch jobs as Execute SQL checks.



Batch jobs can be created in Batch Job Manager. You can create groups in which you can store checks that apply to different aspects of your database. For example, in one group you can have checks that are used to validate the domains and subtypes for a specified feature class and, in a different group, checks for geometry that overlaps. Checks and check groups can be reordered by dragging the check names in the list.

Checks can be duplicated so you do not need to individually configure a check if you want to include it more than once in a batch job. This allows you to easily choose the feature classes on which to run the check.

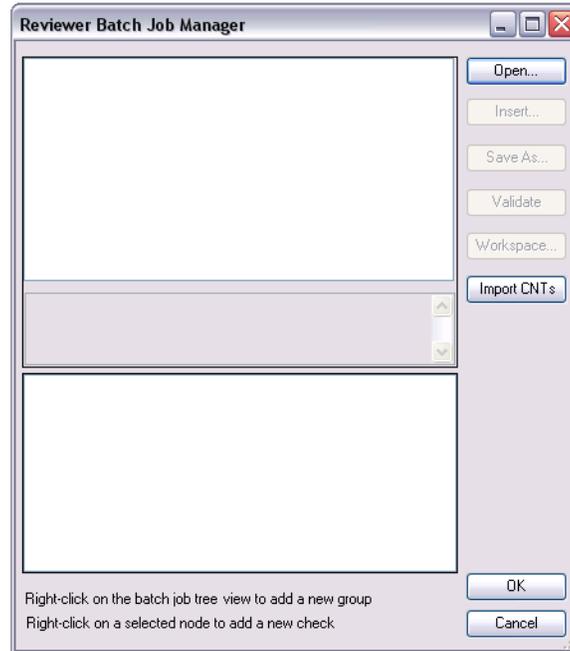


You can also insert a batch job into another one. This can be accomplished by opening one check and inserting another.

Steps

1. Start ArcMap.
2. Click the **Reviewer Batch Job Manager** button  on the *Data Reviewer* toolbar.

The **Reviewer Batch Job Manager** dialog box appears.



3. Right-click the blank area at the top of the dialog box and click **New Group**.
A new group appears in the field.
4. Click the group name to make it editable.
5. Type a new name for the group and press ENTER.
6. Right-click the group, point to **Add Check**, point to the category that contains the check to be added, then click the check name.
The check's properties dialog box appears.
7. Configure the parameters for the check.
8. Click **OK**.
9. Repeat steps 6–8 for each check to be included in a group.
10. Repeat steps 3–5 for each group to be added for a batch job.
11. When you are finished creating groups and adding checks, click **Save As**.
The **Save As** dialog box appears.
12. Type a name for the batch job in the **File name** text box.
13. Click **Save**.
The **Reviewer Batch Job Manager** dialog box appears.
14. Click **OK**.

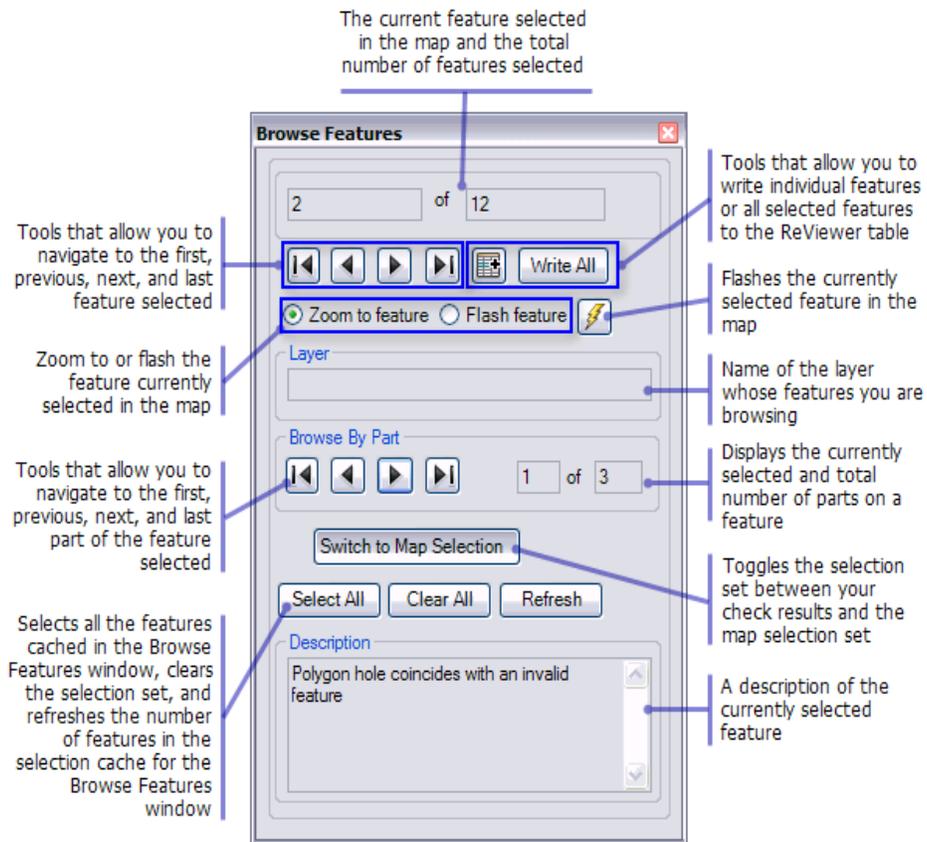
Tips:

- If you configure your session to use default checks, such as Invalid Geometry, do not manually add those same default checks to your batch job.
- It is recommended that you validate a selection set or current extent when the number of features to validate in that set or extent is much smaller than the total number of features in the containing feature class. If the selection set size or current extent encompasses or nearly encompasses the entire feature class, it is more efficient to validate using the full database option.
- Duplicate checks judiciously. The Duplicate Check Generator validates neither WHERE clauses nor the error conditions.
- When updating a batch job using the Set Data Source dialog box, the Apply to all matching datasets option will only update those that have a valid matching dataset in the new workspace. Thus, if the new workspace lacks a particular table, the check referencing that table will not be updated.

Browse Features Window

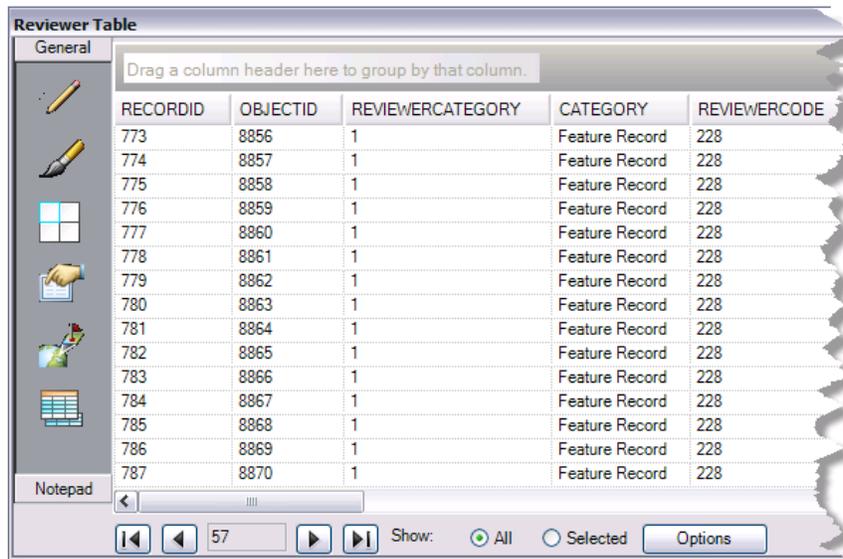
After you run an individual check in Data Reviewer, you can choose to browse the results instead of committing them to the Reviewer table. This allows you to browse the check results with the ***Browse Features*** window, where you can selectively commit features as records in the Reviewer table, or choose to write all the results to the table. For instance, if you run the Execute SQL check on your data and have seven results returned, you could choose to browse the results and only write the features that need to be corrected to the Reviewer table.

The ***Browse Features*** window can also be used for data analysis. You can choose to browse through a selected set of features in the map to visually inspect data. For instance, there could be a polygon or index feature class that could be loaded in the map to represent extents for map documents. Rather than trying to visually inspect all the data at once, you can choose all the features within a smaller extent that could represent your current area of interest.



The Reviewer Table

The Reviewer Table window displays the features that have been found using Reviewer checks and visual review and allows you to work with the records and configure the table. Using the Reviewer table, you can zoom to individual features that have been recorded in the Reviewer table as well as zoom to their individual parts as applicable. The Reviewer table contains the features and database records that are returned by the checks that are run in the form of a batch job or individually. The features that fall within the thresholds defined in the checks are recorded in the Reviewer table so they can be corrected and evaluated as needed. The Reviewer table also contains any features or rows that have been committed through manual or visual review processes.



Tools on the Reviewer Table window

There are several tools that can be accessed in the left-hand pane in the **Reviewer Table** window. The tools under the General bar provide ways for you to work with records in the Reviewer table, including editing the text in table fields. The tools under the Notepad bar allow you to sketch missing features in the map, which are then written to the Reviewer table as records.

The General tools in the Reviewer Table window allow you to perform a variety of functions that involve the Reviewer table and individual records. The tools under the General bar are as follows:

| Button | Name | Function |
|---|------------------------------------|---|
|  | Toggle Edit Table Mode | Toggles the ability to edit field values in the Reviewer table |
|  | Symbolize Reviewer Feature Records | Symbolizes feature records in the Reviewer table |
|  | Grid Selection Tool | Selects cells from a polygon grid linked to the Reviewer table and only shows those records in the Reviewer table |
|  | Reviewer Table Property Page | Allows you to configure properties for the Reviewer table |
|  | Show Record Bitmap | Displays a bitmap of the location recorded by the Flag Missing Feature tool |
|  | Repeat Existing Record | Copies single record's review information to a newly digitized record |

General tools on the Reviewer table and their functions

The tools under the Notepad bar in the Reviewer Table window allow you to draw missing features in the map, which are then stored in the Reviewer table. These tools are as follows:

| Button | Name | Function |
|---|-----------------|---|
|  | Line Notepad | Draws missing line features in the map |
|  | Point Notepad | Draws missing point features in the map |
|  | Polygon Notepad | Draws missing polygon features in the map |

Notepad tools on the Reviewer table and their functions

Data Reviewer Service

The Data Reviewer service is a Windows service that allows you to run batch jobs on a specified dataset once or at regular intervals.

Similar to running a batch job using the Reviewer Batch Validate tool, the Reviewer service validates and runs batch jobs and writes the results to the Reviewer table in a specified Reviewer session. Batch jobs can be scheduled to run once at a specific date and time or to run repeatedly at regular intervals.

Requirements for running the service

Before you can run a batch job using the service, the following criteria must be met for the system and the database:

- A Reviewer session must be set up in the Reviewer workspace.
- An ArcGIS license must be available where the service is installed.
- A configuration file must be available for the service.
- If you are using an ArcSDE geodatabase licensed for ArcGIS Server Enterprise, the Reviewer workspace must exist in the database that is going to be validated using the service. That is, the Reviewer workspace cannot be in a database that is different from the one that contains the data to be validated.

Components of the service

There are two components to the service: the Windows service and the controller, which is a means of configuring the service. The Reviewer service runs in the background as a Windows service under the control of the Windows service control manager (SCM). On startup, the service reads the configuration specifying which batch jobs will be run at which time and at what frequency or interval. The service also performs a regular maintenance cycle to check any batch jobs that are currently executing. In addition, the service listens for a shutdown event from the SCM or another external source, for instance, which it then propagates to any currently executing batch jobs.

The Reviewer service controller provides the means to configure and administer the service and is accessed from the system tray. A context menu pops up from which the various Reviewer service controller dialog boxes can be accessed. The controller is used to create or edit the configuration, specifying which batch jobs will be run when as well as what Reviewer workspace and session should be used to record the batch job errors. In addition, the controller allows you to start and stop the service, as well as view its current status, log files, and batch jobs.

Configuration files

There are two configuration files that are associated with the Reviewer service: the service configuration file and the service job file. The service configuration file controls the configuration of the service itself, such as where it writes the log files and the job status; the location of the service job configuration file to be run; and so forth. The service job file specifies the Reviewer batch jobs to be executed. Both of these are XML files.

The Reviewer service interacts with these files by initially searching for the service configuration file, which contains information about which service job is to be run as well as the directory to which the status and log files will be written. The service then parses the referenced service job file, and an internal timer is created and configured according to the schedule information that is part of the file. Each time the timer is launched, the batch jobs referenced in the service job are run.

Permissions and the Reviewer service

The Reviewer service runs using a Windows user account, and this account must have the necessary permissions for the service to run. The list below is a summary of the permissions that need to be granted to the user account:

| Service component | Required permissions | Notes |
|---------------------------------------|----------------------|--|
| Service Configuration files | Modify | It is recommended these files be stored in the config directory of the Reviewer service folder chosen during post install process. The post install process grants the account Modify permission to this folder. |
| Service Job files | Modify | It is recommended these files be stored in the jobs directory of the Reviewer service folder chosen during post install process. The post install process grants the account Modify permission to this folder. |
| Reviewer batch job files (.rbj files) | Read | If the .rbj files are stored outside the Reviewer service folder, you will need to give the user account read access to these files. |
| Reviewer workspace | Modify | The service job references a Reviewer workspace. |

Reviewer service permissions

A.25 Intersect

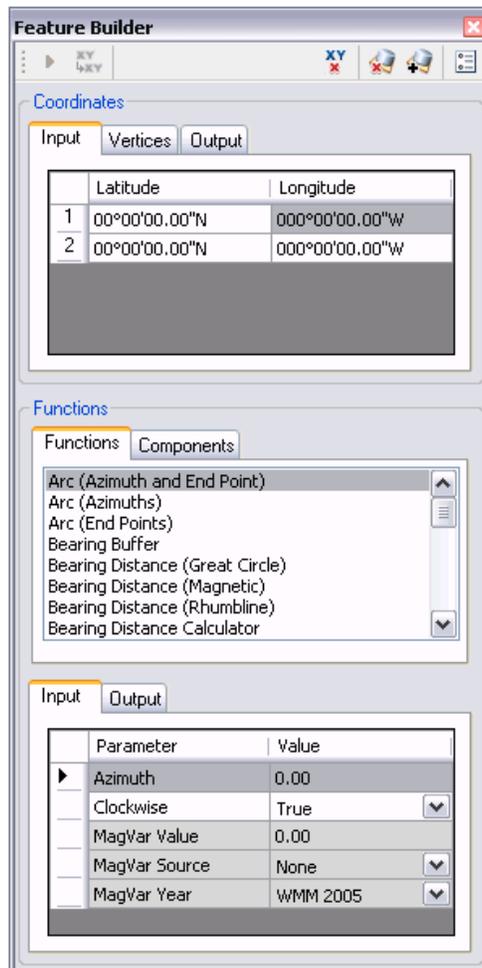
In many cases, a polyline feature class may contain polylines that intersect, which may make attribution and editing difficult.

The Multi-dimensional Intersect tool planarizes geometries so that they are split at all intersections. Polygon geometries are converted to polylines. If points are included in the selection, then the line is split at any point that is within the snapping tolerance specified on the Feature Builder Settings tab.

Steps

1. If necessary, enable the *Production Feature Builder* toolbar by clicking **Customize** > **Toolbars** > **Production Feature Builder**.
2. Click the **Launch Feature Builder** button  on the *Production Feature Builder* toolbar.

The *Feature Builder* window appears in ArcMap.



The Feature Builder window

Tip: The Feature Builder window can be placed anywhere in ArcMap, or in the TOC, with the aid of the arrows showing the possible placement positions.

3. Verify that the Feature Builder Scratch dataset is loaded in your map.
4. Click the **Production Start Editing** button  on the *Production Editing* toolbar.
The edit session starts.
5. Choose the Feature Builder Scratch database as your editing workspace.
6. Select a Feature Builder geometry.
The geometry should be a line or polygon.
7. Click the **Multi-dimensional Intersect** button  at the top of the *Feature Builder* window.
A series of line segments is created.

A.26 Modify Features

When the Edit tool is active and you are editing the shape of a feature, the Edit tool pointer changes from a black arrow to a white arrow to show you can directly select vertices and modify segments. The black arrow pointer is shown when you are working with whole features rather than the individual vertices and segments that make up the feature.

Steps

1. Click the **Edit** button  on the *Editor* toolbar and click the feature.
2. Click **Edit Vertices**  on the *Editor* toolbar, or simply double-click the edge with the **Edit** tool. When you are working with the vertices of a feature, the *Edit Vertices* toolbar appears, providing an easy way to select vertices, add and delete them, and modify segments.

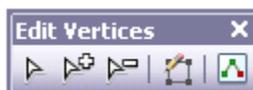
Below are some of the ways you can edit vertices and segments with the **Edit** tool.

| | |
|---|---|
| Insert a vertex | Click the Add Vertex tool  on the Edit Vertices toolbar. You can also right-click a segment and click Insert Vertex , or hold down the A key and click. |
| Insert a vertex and move it in one step | Hold down A and click and drag the new vertex. |
| Delete a vertex | Click the Delete Vertex tool  on the Edit Vertices toolbar and click the vertex to delete. You can also right-click a vertex and click Delete Vertex , or hold down the D key and click. |
| Delete multiple vertices | Click the Delete Vertex tool  on the Edit Vertices toolbar and drag a box around the vertices to delete. You can also hold down D and drag a box, or press BACKSPACE, to delete selected vertices. |
| Move a vertex by dragging it | Select one or more vertices and drag and drop them to the new location. |
| Move a vertex by a relative x,y distance | Select one or more vertices, right-click, then click Move . |
| Move a vertex to an absolute x,y location | Right-click the vertex and click Move To . |
| Change the segment type | Right-click a segment; point to Change Segment ; then click either Straight , Circular Arc , or Bézier . |
| Change the shape of an arc segment | Click and drag an arc segment, or press the R key and type a radius. |

3. Right-click anywhere on the map and click **Finish Sketch**.

A.26.1 The Edit Vertices Toolbar

The **Edit Vertices** toolbar provides quick access to some of the most commonly used commands when editing vertices. It appears on-screen whenever either the **Edit** tool or the **Topology Edit** tool is active and you are editing the vertices of a feature or topology edge. The toolbar floats the first time it appears but can be docked after that.



When the Edit tool is active and you are editing the shape of a feature, the Edit tool pointer changes from a black arrow to a white arrow to show you can directly select vertices and modify segments. The black arrow pointer is shown when you are working with whole features rather than the individual vertices and segments that make up the feature.

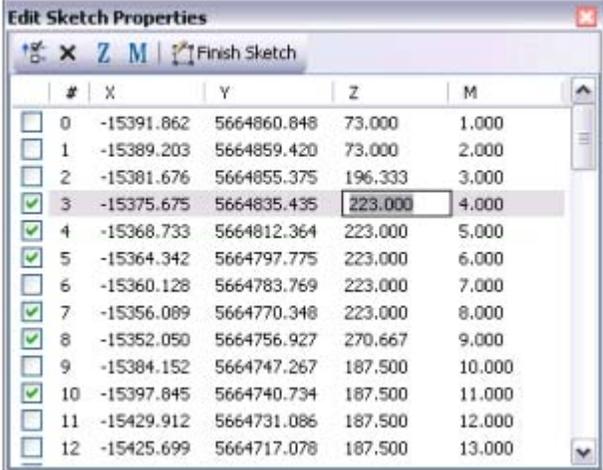
The **Edit Vertices** toolbar allows you to select vertices and add and remove them easily. When you are done modifying the vertex, finish the sketch.

- The **Modify Sketch Vertices** tool  allows you to select vertices and edit segments.
- To add a vertex, click the **Add Vertex** tool  and click the segment at the location where you want to insert it.
- To delete a vertex, click the **Delete Vertex** tool  and click the vertex to delete. To delete multiple vertices, drag a box around them.

To hide the *Edit Vertices* toolbar temporarily, click the **Close** button in the corner or press SHIFT+TAB. To show the toolbar again, press the TAB key.

A.27 Using the Edit Sketch Properties Window

You can use the *Edit Sketch Properties* window to view and edit the coordinates, m-values, and z-values of the vertices that make up a feature. You can choose which vertices are modified by checking the boxes in the Edit Sketch Properties window or by selecting the vertices on the map. In addition, the Edit Sketch Properties window allows you to sort the order of vertices and navigate to them. If a feature has multiple parts (a multipart feature), vertices are grouped under the part to which they belong.



The screenshot shows the 'Edit Sketch Properties' window with a table of 13 vertices. The table has columns for vertex number (#), X, Y, Z, and M. The Z and M columns have input fields. Vertex 3 is selected, and its Z value is 223.000 and M value is 4.000. Other vertices have their Z and M values set to 73.000, 196.333, 223.000, 223.000, 223.000, 270.667, 187.500, 187.500, 187.500, and 187.500 respectively.

| # | X | Y | Z | M | |
|-------------------------------------|----|------------|-------------|---------|--------|
| <input type="checkbox"/> | 0 | -15391.862 | 5664860.848 | 73.000 | 1.000 |
| <input type="checkbox"/> | 1 | -15389.203 | 5664859.420 | 73.000 | 2.000 |
| <input type="checkbox"/> | 2 | -15381.676 | 5664855.375 | 196.333 | 3.000 |
| <input checked="" type="checkbox"/> | 3 | -15375.675 | 5664835.435 | 223.000 | 4.000 |
| <input checked="" type="checkbox"/> | 4 | -15368.733 | 5664812.364 | 223.000 | 5.000 |
| <input checked="" type="checkbox"/> | 5 | -15364.342 | 5664797.775 | 223.000 | 6.000 |
| <input type="checkbox"/> | 6 | -15360.128 | 5664783.769 | 223.000 | 7.000 |
| <input checked="" type="checkbox"/> | 7 | -15356.089 | 5664770.348 | 223.000 | 8.000 |
| <input checked="" type="checkbox"/> | 8 | -15352.050 | 5664756.927 | 270.667 | 9.000 |
| <input type="checkbox"/> | 9 | -15384.152 | 5664747.267 | 187.500 | 10.000 |
| <input checked="" type="checkbox"/> | 10 | -15397.845 | 5664740.734 | 187.500 | 11.000 |
| <input type="checkbox"/> | 11 | -15429.912 | 5664731.086 | 187.500 | 12.000 |
| <input type="checkbox"/> | 12 | -15425.699 | 5664717.078 | 187.500 | 13.000 |

Note: To add m- or z-values to a vertex, you must have specified that the feature class be able to store them when you created the feature class. If you did not set this property, you need to create a new feature class and import the existing features into it.

Steps

1. Click the **Edit** button  on the *Editor* toolbar and double-click the feature you want to edit.
2. Click the **Sketch Properties** button  on the *Editor* toolbar.
When the **Edit** tool or a construction tool is active, you can press the P key as a shortcut to open the window.
3. Check the boxes for the vertices you want to modify in the *Edit Sketch Properties* window. You can also use the **Edit** tool to drag a box around a vertex on the map to select it. Selected vertices appear as white boxes on the map.

4. When working in the *Edit Sketch Properties* window, you can do the following:

| | |
|---|--|
| Change a value | Click a cell for an x-coordinate, y-coordinate, m-value, or z-value and type a new value. |
| Add a vertex at the midpoint of a segment | Right-click a vertex and click either Insert Before (adds a vertex before the vertex you right-clicked) or Insert After (adds a vertex after the vertex you right-clicked).  Note: Insert Before and Insert After cannot be used when the vertex list is being sorted by selected vertices since it does not reflect the actual vertex order. |
| Change a value | Click a cell in the table and type a new value for the x-coordinate, y-coordinate, m-value, or z-value. |
| Change one or more z-values | Check the boxes next to the vertices you want to edit, or select them on the map. Click the Z button and type a new value. |
| Change one or more m-values | Check the boxes next to the vertices you want to edit, or select them on the map. Click the M button. You can either clear the m-values (they become NaN values) or type a new m-value. |
| Flash a vertex on the map | Click the vertex, or right-click it and click Flash . |
| Zoom to a vertex | Right-click the vertex and click Zoom To . |
| Pan to a vertex | Right-click the vertex and click Pan To . |
| Delete a vertex | Right-click the vertex and click Delete , or check the box next to it and click the Delete button. |

5. When you are done, click **Finish Sketch**  on the *Edit Sketch Properties* window.

A.28 Flip Edit

The **Production Flip Selection** tool allows you to reverse the direction of multiple polyline features at one time. For example, when one or more polyline features that have been digitized from left to right are selected, clicking the Production Flip Selection button changes the linear flow right to left.

Steps

1. Start ArcMap.
2. If necessary, start an edit session.
3. Click the **Select** button  and select at least one polyline feature.
4. Click the **Production Flip Selection** button  on the *Production Editing Advanced* toolbar.

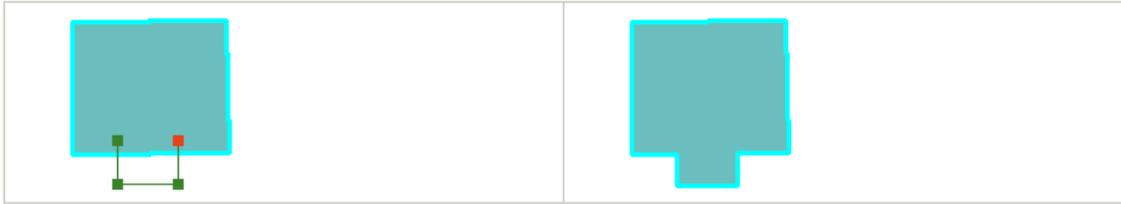
The direction of the selected feature is reversed.

A.29 Reshape Features

A.29.1 Reshaping a Polygon

The **Reshape Feature** tool lets you reshape a polygon by constructing a sketch over a selected feature. The feature takes the shape of the sketch from the first place the sketch intersects the feature to the last.

When you reshape a polygon, if both endpoints of the sketch are within the polygon, the shape is added to the feature.



If the endpoints are outside the polygon, the feature is cut away.



Tip: If you want to reshape a feature to match another one, you can use the Reshape Feature tool in conjunction with the Trace construction method. Select the feature, click the **Reshape Feature** button, click **Trace** from the palette on the *Editor* toolbar, then follow along the edge to the reshape feature.

Steps

1. Click the **Edit** button  on the *Editor* toolbar.
2. Click the feature you want to reshape.
3. Click the **Reshape Feature** button  on the *Editor* toolbar.
4. Click the map to create a line according to the way you want the feature reshaped.
You can snap the sketch to the selected edge or cross it to indicate where to start and stop reshaping. The sketch must cross (or touch the edge) two or more times for it to be reshaped.
5. To change the shape of the sketch segment, click a construction method type on the *Editor* toolbar or on the *Feature Construction* mini toolbar. Segments can be created using a variety of methods—for example, as straight lines, with curves, or by tracing

the shapes of other features. You can also use keyboard shortcuts or right-click to access a menu of commands to help you place vertices in the sketch.

6. Right-click anywhere on the map and click **Finish Sketch**.

A.29.2 Reshaping a Line

When you reshape a line, the line takes the shape of the sketch you draw.

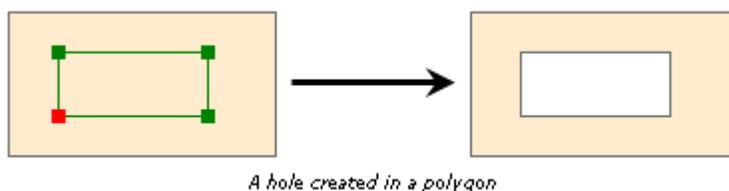


Steps: Follow the steps above in the "Reshaping a Polygon" section.

A.30 Cut Polygon Area

If you are creating polygons for purposes such as land use or soils, you may need to ensure that there is continuous coverage of polygons across your entire area. If an area inside a polygon contains a different type of feature, you may want to cut out a section of the polygon.

The **Production Create Hole** tool creates holes in the selected template polygon layer. You can then create new polygons of a different feature class or subtype to fill the hole area. For example, you can cut out a section of a Scrub Brush area that will later be filled with a Bamboo Cane area.



The Production Create Hole tool uses the current template to determine the features that will be cut; therefore, you must select a template from the same layer as the polygon feature in which you want to create a hole. You can select the template from the **Create** tab on the *Manage Features* window to use the tool.

Steps

1. If necessary, start an edit session.

2. Choose a polygon template on the **Create** tab on the *Manage Features* window.
3. Click the **Production Create Hole** button  on the *Production Editing* toolbar.
4. Drag to draw a polygon that intersects an existing polygon feature.
5. Double-click the end node to finish the polygon.

The new polygon cuts a hole in any feature from the template layer that intersects your edit sketch.

Tip: The polygon you want to create a hole in must belong to the same layer as the currently selected template. For example, to create a hole in the GrassA layer, you must use one of the templates from that specific layer, not another layer that contains vegetation features.

A.30.1 Cutting Holes in Existing Polygons

You can cut holes in existing polygon features to create a donut polygon.

Steps

1. Ensure point snapping is enabled. If it is not, click **Point Snapping**  on the *Snapping* toolbar.
2. Click **Snapping** on the *Snapping* toolbar and click **Snap To Sketch**.
With edit sketch snapping, you can better construct a closed boundary defining the area you want to remove.
3. Click the **Cut Polygons** button  on the *Editor* toolbar.
4. Sketch the area you want to remove. Make sure the end vertex snaps to the first one, so you end up with a closed polygon.
5. To use an existing polygon for the shape of the hole, click **Trace**  on the *Editor* toolbar palette, click the edge of the feature you want to use to cut, and trace around it. As you are tracing, you can change which features are being traced by pointing to them and clicking or dragging.
6. Right-click anywhere on the map and click **Finish Sketch**.
7. You now have two polygons. Select only the inner polygon and press the DELETE key.

The Clip command is another way of using an existing overlapping polygon to cut the shape of the hole. When using this method, keep in mind that all editable features underneath the feature you are using to clip with will be clipped.

Steps

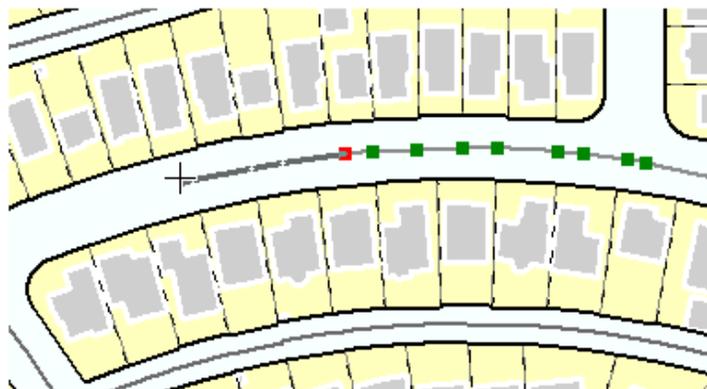
1. Select the inner polygon.
2. Click the **Editor** menu and click **Clip**.
3. Set the buffer distance to 0 and choose to discard the area that intersects.
4. Click **OK**.
5. Delete the inner polygon.

A.31 Trace Tool

Tracing is a quick and accurate way of creating new segments that follow the shapes of other features. You can trace directly on top of a feature or apply an offset value. To trace, use either the **Line** or **Polygon** tool in conjunction with the Trace construction method on the palette on the *Editor* toolbar (or the *Feature Construction* mini toolbar).

Tracing is particularly useful when the features you want to follow have curves or intricate shapes, since snapping is more difficult in those cases. For example, when digitizing a forest boundary that is adjacent to a river, tracing the river is an easy way to create the forest segments shared with the river.

In another scenario, suppose you want to create new lines to represent the road centerlines through a neighborhood. By tracing, you can create new segments that follow the parcel boundaries yet construct an offset value to represent the road centerlines.



When tracing, you can specify several settings. To open the *Trace Options* dialog box, right-click while tracing or press the O key. To trace at an offset, enter a value into the **Offset** text box. If you enter 0, you will trace directly on top of the existing features. This is one way of duplicating segments in existing features. You also can specify to trace only a certain length or set the appearance of the corners—mitered, beveled, or rounded. In addition, you can choose to remove self-intersecting loops. If the offset distance is large enough, self-intersecting loops are created to preserve any shape attribute values.

By checking this option, you automatically remove these loops and drop the associated vertices.

By default, the trace can follow along any feature near your pointer. If you want to trace only features that are selected, hold down the CTRL key while tracing. There is also an option for tracing selected features on the **Trace Options** dialog box. (If you turn on the option, pressing CTRL then does the reverse and temporarily allows you to trace any feature.)

Tip: Rather than trace a feature, you can add the shape of a line or polygon feature to the sketch by right-clicking over the feature and clicking **Replace Sketch**.

Steps

1. These steps can be used to create vertices in either lines or polygons:

| | |
|---------------------------------|---|
| To create a vertex in a line | Click a line feature template in the Create Features window and click the Line tool  . |
| To create a vertex in a polygon | Click a polygon feature template in the Create Features window and click the Polygon tool  . |

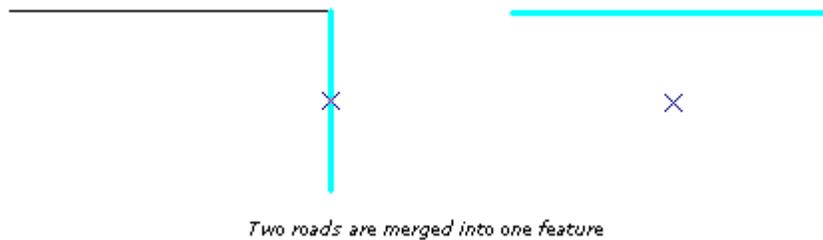
2. Click **Trace**  on the **Editor** toolbar palette.
3. Optionally, right-click and click **Trace Options** or press the O key to set an offset value and other options as desired. If you want to trace directly on top of existing features, enter a value of 0.
4. Click the map to create the first vertex and start tracing.
5. Drag to trace along a feature. If you trace too far or trace in the wrong direction, you can move the pointer backward over what you have traced. If you have clicked to stop the trace and add the vertices, you can click **Undo** to remove all vertices added during the trace. Press ESC if you need to cancel the trace.
6. As you are tracing, you can change which features are being traced by pointing to them and clicking or dragging. If you want to trace only selected features, hold down the CTRL key. When tracing complicated segments, you can press the SPACEBAR to suspend snapping temporarily if you find tracing is too slow.
7. When tracing at an offset, you can press the TAB key to trace on the opposite side of the edge. This simply makes the offset value negative on the **Trace Options** dialog box.
8. To pan the map while tracing, press either the C key or the middle mouse button. You can also use continuous map panning if you are using basemap layers.
9. Optionally, you can switch between tracing and other segment construction methods using the **Feature Construction** mini toolbar or the palette on the **Editor** toolbar. For

example, this allows you to trace, create a straight or curved segment, then return to tracing.

10. Right-click anywhere on the map and click **Finish Sketch**.

A.32 Unsplit None

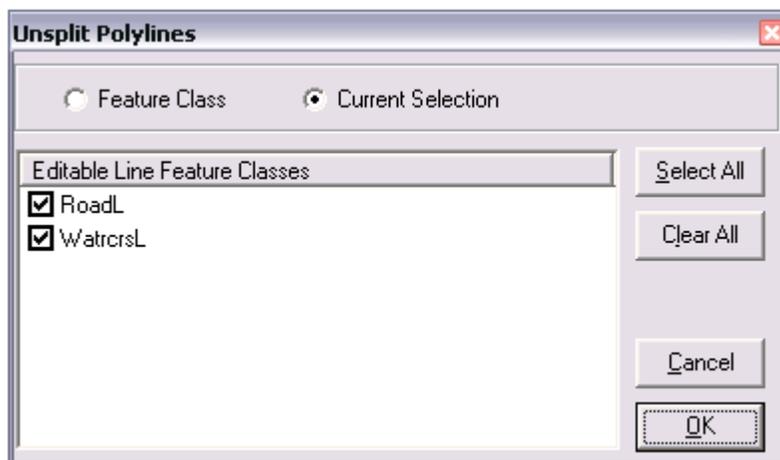
The **Unsplit Connected Polylines** tool is used to unsplit connecting features. Only features that are touching endpoint to endpoint and have the exact attribution on editable fields are unsplit. You can use this tool to merge features that are in the same network or to create a polyline feature from two separate line features. For instance, you can create a single road feature using nearby roads that have similar attributes.



Steps

1. If necessary, start an edit session in ArcMap.
2. Click the **Unsplit Connected Polylines** button  on the **Production Editing Advanced** toolbar.

The **Unsplit Polylines** dialog box appears.



3. Choose either the **Feature Class** or **Current Selection** option.
 - Feature Class—Unsplints the entire feature class
 - Current Selection—Unsplints the current editing selection only

4. Choose the feature classes to unsplit in the **Editable Line Feature Classes** list.

To choose all the feature classes, click **Select All**. To choose specific feature classes, click **Clear All** and check the check boxes next to the layers you want to unsplit.

5. Click **OK**.

A message appears when the unsplit connected features task is complete.

6. Click **OK**.

If z-enabled line features are snapped in x,y but have different z-values, they will not be merged.

A.33 Undo

As you extract and maintain features, you can roll back any changes since the last save. If you are working in a version of an ArcSDE database, you can delete all edits made since the last post by deleting the version without posting your modifications back to default.

A.34 Contour Editing Tools

The **Production Contouring** toolbar contains a suite of tools that allows you to work with digital elevation models (DEMs), automate contour creation by creating contours on multiple rasters at the same time, and find the highest and lowest points on a map. Before creating contours, you often need to prepare the DEMs that you will use when generating the contours. **Set Consistent DEM Symbology** allows you to set the minimum and maximum heights to be rendered so the DEMs are all displayed with the same height values. **Merge and Filter DEMs** merges individual DEMs into a single new DEM and optionally allows you to apply a filter to smooth the z-values throughout the DEMs. The **Create Contours** button creates a contour line feature class. Before creating the contours, you can set options to configure the granularity of the contours to be created and their frequency.

The **Production Contouring** toolbar also has components you can use to enhance the appearance of contours on the map. The **Production Generalize and Smooth** tool allows you to refine the geometry of selected contours to improve the aesthetic or cartographic quality of the contours. The **Contour Symbology Options** button allows you to select a color pattern of five colors that will be used to represent different contour elevations. The **Symbolize Contours** button displays the contours according to the contour symbology options you set. Once symbolized, the pattern of five colors repeats and can be used to visually identify any anomalies in the elevation values of neighboring contours. The **Create Elevation Points From DEM** tool allows you to click a location on a DEM and will populate the elevation value of the point from the elevation of the DEM at that location. The **Create Elevation Points From Contours** tool allows you to select a contour line and will automatically create elevation points at the highest and/or lowest

spots inside the contour based on an underlying DEM. The **Validate Elevation Points** tool analyzes each closed contour and elevation points that fall within the contours, and those that do not conform to the contour interval are output to a report.

A.35 Map Topology

A map topology is a topology that you can impose on simple features on a map during an edit session. Although you cannot create or edit geodatabase topologies with ArcView (only ArcEditor and ArcInfo), you can create and edit map topologies in ArcView.

A map topology allows you to simultaneously edit simple features that overlap or touch each other in ArcMap. You can use the **Topology Edit**, **Modify Edge**, and **Reshape Edge** tools on the **Topology** toolbar to edit the features in a map topology. The features can be in one or more feature classes and may have different geometries. Line features and the outlines of polygon features become topological edges when you create a map topology. Point features, the endpoints of lines, and the places where edges intersect become nodes.

A map topology can be applied to simple features in a shapefile or simple feature classes in a geodatabase. The feature classes that participate in the map topology must be in the same folder or geodatabase. A map topology cannot be applied to feature classes that participate in a geometric network.

A map topology creates topological relationships between the parts of features that are coincident. You can specify the feature classes that you want to participate in the map topology. You can also choose the distance, or cluster tolerance, that defines how close together edges and vertices must be to be considered coincident. When you create a map topology, the cluster tolerance that you specify is used to determine which parts of the features are coincident and which edges and nodes in the topology are shared. The cluster tolerance is typically a small actual ground distance. Setting large cluster tolerances can result in features being collapsed or distorted when vertices with a given feature snap together.

There are two steps to creating a map topology:

1. Specify which feature classes on the map will participate in the topology.
2. Specify a cluster tolerance. The cluster tolerance is a distance within which features will be coincident.

When you have defined a map topology, it is shown on the Topology toolbar in the Topology drop-down list as an entry called <Map Layers>. Only one map topology can be defined for an edit session.

A.35.1 Editing a Map Topology

After you create a map topology, you can use the **Topology Edit** tool to edit the edges and nodes shared by the features. Editing an edge or node shared by two or more different features results in each feature being modified. This lets you move a border to update two forest polygons or move a corner vertex and update several parcel polygons and a few lot boundaries at the same time.

You do not specify any topology rules for a map topology. All edges or vertices of features in the map topology that fall within the cluster tolerance are considered to be topologically shared. You edit shared edges and vertices in a map topology in the same way and with the same tools as you would edit a geodatabase topology. Since there are no topology rules, there is no need to validate a map topology, and there is no creation of error features.

A.35.2 Map Topology Versus Geodatabase Topology

Geodatabase topology is a data object created and stored in a geodatabase. A geodatabase topology defines a set of rules about the relationships between feature classes in a feature dataset. Geodatabase topology is created in the Catalog window or ArcCatalog and can be added to ArcMap as a layer, just like any other data. After editing has been performed on the feature classes, you validate the geodatabase topology to see if the edits break any of the topology's rules. Any errors can be fixed or marked as exceptions. An ArcEditor or ArcInfo license is required to create, edit, or validate geodatabase topology. To use geodatabase topology when you edit data from a geodatabase, the geodatabase topology in which the data participates must be in your map. If you are using an ArcView license, you can open a map containing a geodatabase topology, but you cannot start an edit session on feature classes that participate in a geodatabase topology.

Map topology is temporary and only lasts for the duration of your edit session. Unlike geodatabase topologies, map topologies are not stored permanently or represented as layers in the map. You do not specify any topology rules for a map topology. Since there are no topology rules, there is no need to validate a map topology, and there is no creation of error features.

A.35.3 When to Use a Map Topology

Map topology is useful because it enables you to perform topological editing in situations where you cannot use geodatabase topology:

- Map topology can be defined for shapefiles, which cannot participate in a geodatabase topology.
- If you are using an ArcView license, you cannot create or edit geodatabase topology, but you can define map topology for any data on which you can start an edit session (such as shapefiles and simple feature classes in file and personal

geodatabases). You cannot create map topology on feature classes that participate in a geodatabase topology because you need an ArcEditor or ArcInfo license to edit them.

- If you are using an ArcEditor or ArcInfo license, you can create a map topology for any shapefile or feature class data, including feature classes that participate in a geodatabase topology. For example, you might want to perform topological editing on two feature classes that participate in two separate geodatabase topologies. In this case, you can define a map topology containing both of these feature classes.

A.35.4 Creating a Map Topology

Steps

1. Click the **Map Topology** button  on the *Topology* toolbar.
2. Check the feature classes that will participate in the map topology. All the layers in your current edit session that can participate in the map topology are listed on the dialog box. Layers representing annotation and dimension feature classes and feature classes that participate in a geometric network cannot be included in a map topology and will not be listed.

Note: You cannot edit layers that are projected on the fly using a map topology. To create a map topology, all the layers must have the same coordinate system, which must match the coordinate system of the data frame.

3. Optionally, set a cluster tolerance for the map topology. The default cluster tolerance is the minimum possible cluster tolerance. Increasing the cluster tolerance may cause more features to be snapped together and considered coincident, but this may reduce the spatial accuracy of your data.
4. Click **OK**.

A.36 Other Editing Tools

The Editing tools allow you to apply bulk editing to all (or selected) features in a feature class.

Many of these tools fall into the data cleanup category, for example, after data is captured or digitized with an inadequate precision or lack of a snapping environment resulting in polygon boundaries that are not closed (have gaps) or lines that undershoot or overshoot their intended intersection with other lines. The Editing tools provide rich set functionality to quickly address these types of data quality issues.

| Tool | Description |
|-----------------------------|--|
| Densify | Inserts vertices along line or polygon features. Also replaces curve segments (bezier, circular arcs, elliptical arcs) with densified line segments. |
| Erase Point | Deletes points from the input that are either inside or outside the Remove Features , depending on the Operation Type . |
| Extend Line | This tool extends line segments to the first intersecting feature within a specified distance. If no intersecting feature is within the specified distance, the line segment will not be extended. Tool use is intended for quality control tasks such as cleaning up topology errors in features that were digitized without having set proper snapping environments. |
| Flip Line | Reverses the from-to direction of line features. |
| Generalize | Simplifies the input features using the Douglas-Peucker simplification algorithm with a specified maximum offset tolerance. The output features will contain a subset of the original input vertices. |
| Snap | Moves points or vertices to coincide exactly with the vertices, edges, or end points of other features. Snapping rules can be specified to control whether the input vertices are snapped to the nearest vertex, edge, or endpoint within a specified distance. |
| Trim Line | This tool deletes line segments (dangles) that are shorter in length than a specified dangle length. Only line segments that are shorter than the specified dangle length and do not touch another line at both endpoints (dangles) will be trimmed, unless the Delete Short Features option is used. Tool use is intended for quality control tasks such as cleaning up topology errors in features that were digitized without having set proper snapping environments. |

Within Production Mapping, there are several editing tools that are included with the extension, but there are also ArcMap editing tools included on the toolbars.

The table below lists the ArcMap editing tools on the Production Editing toolbar and where you can find more information about them in the ArcGIS Desktop Help.

| Tool name | Where to find more information |
|----------------------|---|
| Straight Segment | Creating segments by streaming vertices |
| Trace | Creating segments by tracing features |
| Point | Creating point features by clicking the map |
| Edit Vertices | Editing vertices and segments |
| Reshape Feature Tool | Reshaping lines Reshaping polygons |
| Cut Polygons Tool | Splitting a polygon |
| Split Tool | Splitting lines manually |
| Rotate Tool | Rotating a feature |
| Sketch Properties | Using the Edit Sketch Properties window |

A.37 Saving and Committing DNC Edits

Save the edits you have made during an edit session at any time by choosing Save Edits from the Production Editing toolbar. If you quit ArcMap or stop editing, you are prompted to save or quit without saving if any edits were made since the last time you saved. While editing a workspace, you can Doll back any changes since the last save. When you are working with a personal geodatabase, the edits are committed to the database when you save. When you are working with an ArcSDE geodatabase, the edits are saved to the version of the database you were working in. If the edits to the version are acceptable, the version can be reconciled and posted with any parent version or the

default version of the database; otherwise, the version can be dropped along with any edits that took place in it. The versioning tools are available on the Versioning toolbar.

A.38 Versioning: Basic Concepts

This topic applies to ArcEditor and ArcInfo only.

Versioning lets multiple users directly edit a geodatabase without explicitly applying feature locks or duplicating data. The following are the essential facts about versions:

A version is a named state of a geodatabase. You can use versions to represent engineering designs, construction jobs, snapshots in time of geodatabases, and any type of scenario that involves the posing of what-if questions in studying a result.

A version spans a geodatabase and has properties. You can define which objects in a geodatabase are versioned and can selectively specify which feature datasets, feature classes, and tables are versioned. When you specify that a feature dataset is versioned, all its tables and feature classes are automatically versioned.

A geodatabase can have multiple coexisting versions. You can control the visibility of a version to other users by setting its permission. Each version lets you perform the same display and analytic functions as a nonversioned geodatabase.

Differences are only in row state, not in schemas. A version presents you with a seamless view of all the edits applied since the version was created. The row state reflects all added, removed, and modified objects. The row state information about each version is stored (or persists) in the geodatabase. The schema, the definition of tables and their fields, can be modified in a geodatabase; schema changes are applied to all versions of the geodatabase.

Internally, the geodatabase has tables to keep track of modified, added, and removed features for each version, but that is not apparent to you when you use versions. It appears to be an integral copy of a geodatabase.

A default version exists for every versioned geodatabase. The default version can be thought of as the as-built version. It usually represents the nominal state of the geodatabase.

A version can be created from another version. Starting with the default version, you can create any number of versions. Every version, except for the default version, has exactly one parent version.

You can connect to any version. Users will start editing a version based on the project or project stage they are working on. Users can work on any version for which they have been granted permission.

A.39 A Quick Tour of Versioning

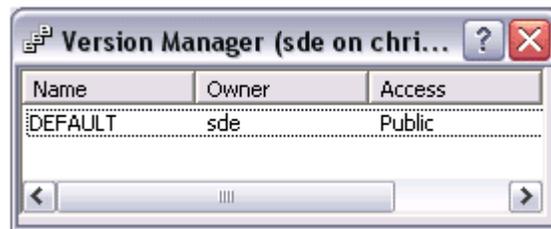
This topic applies to ArcEditor and ArcInfo only.

Versioning allows multiple users to edit the same data in an ArcSDE geodatabase without applying locks or duplicating data.

Users always access an ArcSDE geodatabase through a version. When you connect to a multiuser geodatabase, you specify the version to which you will connect. By default, you connect to the default version.

A.39.1 The DEFAULT Version

Every ArcSDE geodatabase has a default version called DEFAULT; therefore, versioning is always enabled for the geodatabase. It is a fundamental part of how ArcGIS operates and does not need to be installed or configured independently.



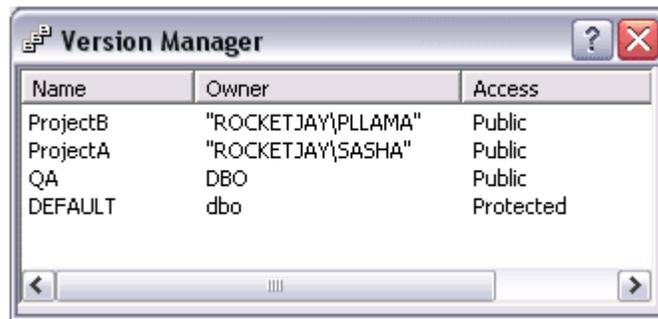
Unlike other versions, the DEFAULT version always exists and cannot be deleted. In most workflow strategies, it is the published version of the database, representing the current state of the system being modeled. You maintain and update the DEFAULT version over time by posting changes to it from other versions. You can also edit the DEFAULT version directly, just like any other version.

The DEFAULT version is the root version and, therefore, the ancestor of all other versions.

A.39.2 Creating Other Versions

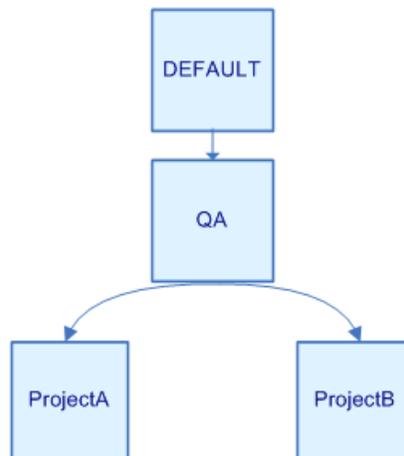
You create a version by creating children or branches from any existing version. You create the first version by making a child version of the DEFAULT version. When the new version is created, it is identical to the DEFAULT version. Over time, the versions will diverge as changes are made to the DEFAULT version and to the new version.

A geodatabase can have many versions. The following is the *Version Manager* dialog box, which is accessed through ArcGIS Desktop. This example shows the DEFAULT version and three other versions: a QA version and project versions, ProjectA and ProjectB.



| Name | Owner | Access |
|----------|--------------------|-----------|
| ProjectB | "ROCKETJAY\PLLAMA" | Public |
| ProjectA | "ROCKETJAY\SASHA" | Public |
| QA | DBO | Public |
| DEFAULT | dbo | Protected |

The following diagram shows how the versions are related. The QA version is a child of the DEFAULT version, and the ProjectA and ProjectB versions are children of the QA version.



Creating a version gives you the false impression that you are creating a copy of the entire geodatabase. This is because each version has all the tables and feature classes in the geodatabase. As you edit a feature class or table in a version, it is no longer the same as the feature class or table in the parent version, so you think you are storing the feature class or table in each version. However, regardless of how many versions you have, each table and feature class is stored only once in the database. ArcGIS leaves each feature class or table in its original format but records any changes in tables referred to as delta tables.

Users can edit all the versions simultaneously. Multiple users can also edit the same version at the same time.

In the versions example above, multiple editors could concurrently edit the ProjectA and ProjectB versions. You would likely have a smaller number of users making changes in the QA version.

A.39.3 How Versions and Versioned Edits Work

Before you can begin performing versioned edits on the data in any version, the datasets must be registered as versioned.

Be aware that registering a dataset as versioned is not the same thing as creating a version. Creating a version creates a sort of "view" of the geodatabase that allows you to edit versioned data and immediately see your changes. Other users connected to the same version will see the changes when they refresh. However, users connected to other versions will not see your changes until you reconcile and post them to an ancestor version. In the example above, once the changes have been posted back to the DEFAULT version, they are visible regardless of the version to which you are connected.

In contrast, registering a dataset (a feature class, feature dataset, or table) as versioned prepares it for versioned editing. When you register a dataset as versioned, two delta tables are created: the A (or Adds) table for insertions and updates and the D (or Deletes) table for deletions. Each time you update or delete a record in the dataset, rows are added to one or both of these tables. A versioned dataset, therefore, consists of the original table (referred to as the base table) plus any changes in the delta tables. The geodatabase keeps track of which version you were connected to when you made the edits that populated the delta tables. When you query or display a dataset in a version, ArcGIS assembles the relevant rows from the original table and the delta tables to present a seamless view of the data for that version.

All edits to the feature class or table, regardless of the version from which the edits were made, are recorded in the same delta tables. Collectively, all the rows in the base, A, and D tables represent all versions of the feature class or table. This means that any one version references only a subset of rows from the three tables. So how does ArcGIS allocate rows in the delta tables to the correct version?

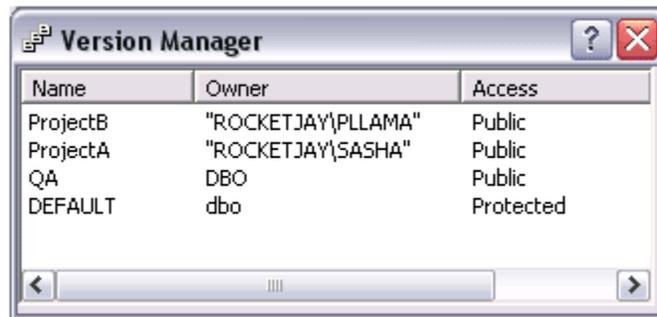
Each row in the A and D tables is marked with an integer identifier called a state ID that references when the row is added to the table. Every time you edit a version, a new state is created and a new row is added to one or both of the delta tables. States can be thought of as being part of a tree structure where each branch records how a version evolves. A sequence of states recording a series of changes from the base table to the current state of a version is called a lineage. When you display or query a version, ArcGIS queries the lineage of a version to get the state IDs, then retrieves the correct records from the A and D tables.

As a geodatabase is edited over time, delta tables increase in size, and the number of states increases. The larger the tables and the more states, the more data ArcGIS must process every time you display or query a version. To maintain database performance, the ArcSDE administrator must periodically run the Compress command to remove unused data followed by the Analyze command to update database statistics.

A.39.4 Permissions and Editing a Version

The owner of the version (the person who creates it) can set permissions for a version to restrict who can view and edit it. The permission options are private (only the owner can view and edit the datasets in the version), protected (any user can view the datasets in the version, but only the owner can edit them), and public (any user can view and edit the datasets, provided he or she has been granted permission on the datasets).

As you can see in the following *Version Manager* dialog box, the DEFAULT version is protected, and the other versions are public.



Tips:

- See "Creating versions and setting permissions" for more information on version permissions.
- You can edit the data in a specific version in ArcGIS by connecting to a specific version and adding data that has been registered as versioned to ArcMap.
- You can also switch the version to which you are connected in ArcMap. See "Changing versions in ArcMap" for more information.

By default, all edit sessions in ArcMap are versioned edit sessions. Therefore, if you have versioned data in your map, you can start editing as soon as you open an edit session. To open an edit session, click **Start Editing** on the **Editor** drop-down list of the *Editor* toolbar.

Edits made to each version apply only to that version. The exception is schema changes. When you change the schema in a version—for example, adding a new field to a table—the change applies to all other versions.

When you are done editing, you reconcile your changes with and post to an ancestor version.

A.39.5 Reconciling and Posting Changes

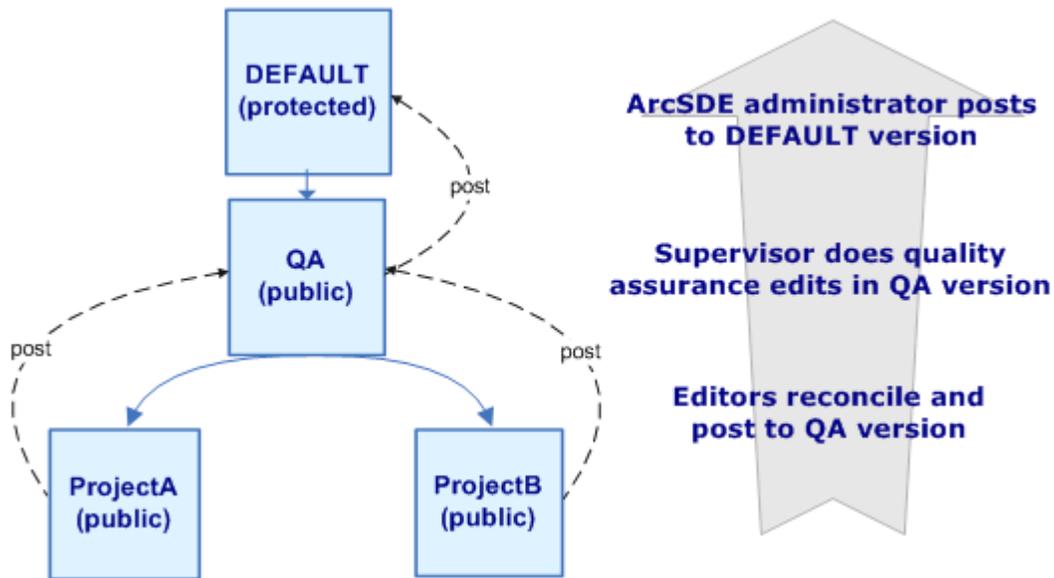
Reconciling and posting integrates your changes into any version that is an ancestor of the version you are working in, such as the parent or DEFAULT version. When you

reconcile, the changes in the version you are editing are compared with the version into which you want to merge them.

When you modify data in a version, no locks are applied to the data. Two editors working on the same data, either in the same version or different versions, can produce conflicts. A conflict occurs when a row differs in the two versions being compared. The reconciling process shows you each conflict and allows you to choose which representation of the row to preserve.

In practice, editing conflicts should be rare because the volume of edits is small compared to the amount of geographic data involved. In correctly designed workflows, the cost of reconciling conflicts is minor when compared to the savings from not having to lock or check out features for the duration of the transaction.

Once you finish reconciling, you can post the changes. This applies the modifications you made into the other version. If you no longer need the version you posted from, you can delete it. Alternatively, you can edit it further and reconcile and post changes again. Based on the privileges assigned to the versions in the QA/Project example, a logical reconciling and posting workflow would go from the project versions to the QA version, then to the DEFAULT version.



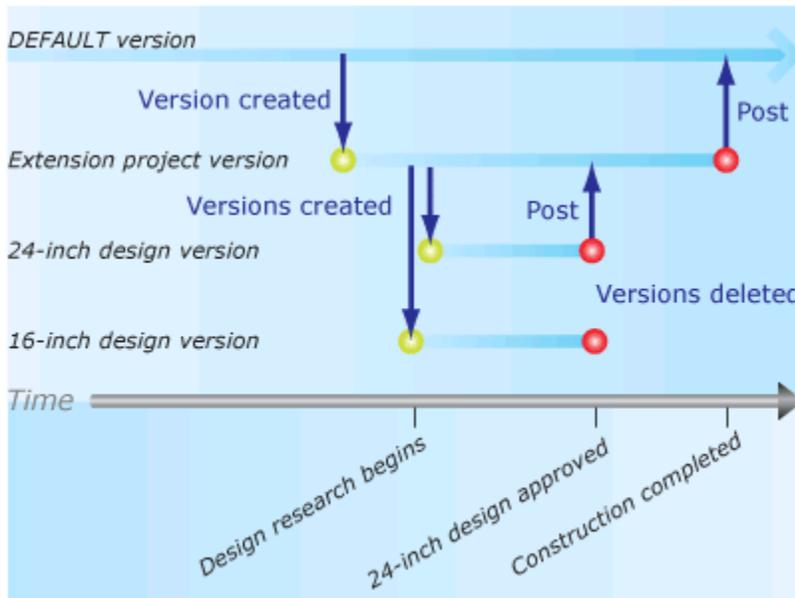
A.39.6 Versions: An Example

To illustrate how versions can be used, follow this scenario from a municipal water utility. The water utility has a geodatabase of features representing the current state of all the water pipes, valves, pumps, and other components of the water system. The utility needs to add a new line extension to the water system.

The utility creates a new version from the DEFAULT version called Extension project, which is to contain the design of the new extension. However, the utility staff are unsure whether to go with a 16-inch or a 24-inch pipe design for the new extension. So, from the Extension project version, they create a version to study the 16-inch design and another to study the 24-inch design.

They eventually discover the 24-inch pipe will serve projected water demand for 12 more years and that the greater initial construction cost is justified. The 24-inch design wins approval, is checked for accuracy, and is posted to the Extension project version.

A few months later, the construction of the new line extension is complete. To update the published version of the database, the Extension project version is reviewed for accuracy, reconciled, and posted to the DEFAULT version.



A.40 Reconcile and Post

A.40.1 Reconcile

This topic applies to ArcEditor and ArcInfo only.

When you reconcile, the version you are editing is updated with changes from the target version. You may notice features changing as insertions, updates, and deletions of any feature or record from the target version are applied to your edit session.

Note: Reconciling only updates the edit version so that ArcGIS can check for conflicts; it does not merge changes into the target version. Once you finish reconciling and reviewing any conflicts, you complete the merging process by posting your changes to the target version.

These instructions assume you are working in ArcMap and are connected to the version you want to reconcile with an ancestor version.

Steps

1. If the **Versioning** toolbar is not already open, click **Customize** on the main menu, point to **Toolbars**, and click **Versioning**.

You may have to scroll down the list of toolbars to see the Versioning toolbar option.

2. Click the **Reconcile** button on the **Versioning** toolbar.
3. Click the target version.
4. Specify how you want conflicts defined.

| Define conflicts at this level | To detect these cases |
|---------------------------------------|---|
| Row | A second user edits the same row or feature, or topologically related features, as you did. The conflict occurs even if you edited different attributes. This is the default. |
| Column | A second user edits the same attribute of a feature or table. |

Options for defining a conflict

5. Specify whether to resolve all conflicts in favor of the edit version or the target version.

If you resolve in favor of the target version, all conflicting features in the current edit session are replaced by their representations in the target version. If multiple users are editing the same version and conflicts are detected, the feature that was first saved replaces the edit session's representation. If you resolve conflicts in favor of the edit version, all conflicting features in the current edit session take precedence over conflicting representations in the target version.

6. Click **OK**.

Tip: It is possible to automate the reconcile and post processes.

A.40.2 Post

This topic applies to ArcEditor and ArcInfo only.

Once you have reconciled and reviewed any conflicts, you can post the changes to an ancestor version.

Tip: Other users reading the target version to which you have posted do not see the results of the post until they refresh their versioned workspaces.

The post operation can only be completed if the target version has not been modified since the reconcile operation was completed. If the target version has been modified in the interim, you will have to reconcile again before posting.

The post operation cannot be undone, since you are applying changes to a version you are not currently editing.

After posting, you may continue to make more edits in your edit session. To apply these changes to the target version, you must perform the reconciliation, conflict resolution, and posting processes again.

Steps

1. If the **Versioning** toolbar is not already open, click **Customize** on the main menu, point to **Toolbars**, and click **Versioning**.

You may have to scroll down the list of toolbars to see the Versioning toolbar option.

2. Click the **Post** button on the **Versioning** toolbar.

If posting marks the end of your project or your part of the workflow, you can delete the version you have been editing. You can delete a version provided all its child versions are first deleted and if you are the owner of the version.

A.40.3 Automated Reconcile and Post

This topic applies to ArcEditor and ArcInfo only.

For large, multiuser editing operations, it is usually best to automate the reconcile and post processes. This helps streamline edit operations, reduce version administration overhead, and ensure all the changes made to versions are automatically propagated through the version tree as required. These two processes can be automated with a batch version reconciliation tool or by implementing a version reconciliation service. Both of these are available as ArcGIS developer samples.

Batch Reconcile

The batch reconcile utility allows an editor or project manager to connect to a versioned geodatabase, select a version, reconcile, and (optionally) post every version beneath that version. If reconciliation and posting are successful—that is, no conflicts were detected—you have the option of deleting the child versions. Any conflicts detected would halt the reconcile process. Conflicts must be addressed in the usual manner using the tools available in ArcMap. This administrative task could be performed at the end of every day or week or at whatever time interval is appropriate. The batch reconcile utility can be customized to start automatically at a predetermined time with some operating parameters that you can configure.

Batch reconcile and post programs work well for organizations with work orders to process at the end of each day or week. The versioning scenarios that would benefit include these:

- Multiple projects
- Multiple projects with a protected, published database
- Multiple projects with subprojects
- Distributed data management, replication, and disconnected editing

Version workflows that are unsuitable for batch reconcile and post include the following:

- Concurrent editing of the DEFAULT version—Since all the reconcile operations are automatic, this does not support batch reconcile and post.
- Projects that progress in phases—Since this would require some specific application logic to determine which versions to reconcile and post with which parent, these are generally unsuitable for batch reconciliation.

Version Reconciliation Services

A version reconciliation service is a program that runs as a background process on a client machine. Once an editor has completed editing a version, the editor submits the version to the reconciliation service. The reconciliation service periodically checks whether versions have been flagged as ready to reconcile. If any such versions are detected, the service will automatically reconcile and post these to their parent versions. The reconciliation service utility can be customized to alter how often the service checks for new versions to reconcile and post.

Automating the version reconciliation process this way helps manage the workflow by delegating the responsibility for reconciling to the reconciliation service. Data editors are then free to continue with other tasks. By streamlining the workflow in this manner, your data editing operations can more easily scale to support additional data and editors.