GIS Technician ALUI Reference Manual

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Last edited: August 4, 2010
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**Introduction**

This document is intended to serve as a reference guide for a GIS technician working on an Agricultural Land Use Inventory (ALUI), providing information and instructions on the tools and practices involved in preparing data for an ALUI. While there should be sufficient detail for a user to be able to perform a task, it is not intended to be an exhaustive or comprehensive guide to the tools and functions described, and should be supplemented with more complete information or documents as provided by ESRI or the Ministry of Agriculture and Lands.

Other sources of information that you may find helpful include:

- AgFocus Field Guide and AgFocus Surveyor’s Guide – to understand the details of what an ALUI is, how it is performed, what kind of data is captured, and how it is captured
- ArcGIS Desktop Help – for more information about different functions in ArcGIS
- MapBook Generation – provides detailed instructions on how to use the MapBook extension

To illustrate the selections a user should take to get to a specific menu option, menu navigation descriptions in this manual will appear like the following example:

*Selection > Interactive Selection Method > Add to Current Selection*

where Selection is the main menu selected, with the submenu Interactive Selection Method chosen, and the Add to Current Selection command being the final item selected.
Environment & Setup

Network Environment and Working Practices

ArcGIS is not installed locally on the machines in the office – rather, it is made available through servers located in Victoria, and accessed through the Desktop Terminal Service. (DTS)
While most of the network drives that you have mapped on your computer are located more locally, in order to have good response time, you will need to work off the W: drive when working with ArcGIS.

One thing to note is that the W: drive has limited space, and is not backed up by computer services. For this reason, all projects and documents are archived on the S: drive. It would be a good practice to make a backup to this drive at the end of a work week because backups occur over the weekend.

In terms of local storage, the only location you have write access to is your personal folder in C:\Users. Your desktop is roaming and stored on the H: drive. You will probably have to map all the network drives and printers on your first day of work. A list of the locations is provided in the documentation you receive on your first day of work.

One aspect of the network environment that you may find problematic is that because the ArcGIS servers are not local, IT support for ArcGIS is also not local. Support for these servers comes from the GeoBC service desk, located in Victoria.

Geodatabases and Domains

When working with ALUI data, all necessary data will generally be grouped into a single file geodatabase. There are some reasons for working in a file geodatabase:

- Prevents concurrent write access on feature classes and feature datasets
- Allows for creation of topologies and domains
- Logically groups related feature classes together in a single location
- Ability to compress to reduce space requirements

New geodatabases can be created in ArcCatalog by right-clicking on a folder and selecting New > File Geodatabase.
Domains allow you to restrict what values can be entered in a field. In order to add domains, you need to open ArcCatalog, right-click on your geodatabase, and select Properties. In the Database Properties window, there is a Domains tab that will let you manage your domains on the database. The properties that you have to set for the domain will vary depending on the field type.

Once you have your domains set up, you can apply them to different fields in the feature classes contained in the geodatabase. This is done by right-clicking on the feature class in ArcCatalog and selecting Properties. In the Feature Class Properties window, you can set the domains onto specific fields by going to the Fields tab. Clicking on a field will make the field's properties appear in the lower portion of the window. If you have a domain set up for the data type of that field, there will be an entry called Domain, which will give you a drop-down menu of all domains available of that data type.

After setting this, when you go into ArcMap and edit the attributes of that feature class, there will be a drop-down menu containing all the domain values you set for the domain.
ArcMap Extensions & Toolbars

There are two extensions that you may make use of over the course of your work:

- **Maplex** – this is an alternate labelling engine that provides different placement options and is used when producing MapBooks
- **XTools Pro** – this extension provides some additional functions that may be unavailable or more complicated to use with the standard ESRI tools

You can enable extensions by going to the Tools menu and selecting Extensions. A list of extensions will be displayed, where enabled extensions have a checked box.

If you are not currently using the Maplex extension, you should turn them off. DTS disables most ArcGIS extension licenses when logging on, with Maplex being an exception. Having this on incurs a cost while ArcGIS is active, so turning it off when it is unneeded lowers costs.
There are also a variety of toolbars that you will find necessary for digitizing and producing maps:

- **TSAT v2.3.1** – adds some commonly used functions into one bar, but mostly used for the Add Library Layers function
- **Topology** – used to create simple topologies, perform edits on features with shared edges/nodes in a topology, validate and inspect errors in a topology
- **XTools Pro** – provides access to the tools in the XToolsPro extension
- **Map Series** – related to the production of MapBooks
- **Editor** – used for editing features
- **Advanced Editing** – adds some specific feature editing options
- **Effects** – provides tools that can be used for visual comparison between orthophotos
- **Spatial Adjustment** – used to perform rubbersheeting and other transformations

If a toolbar you need is not present, you can add it by going View > Toolbars, and clicking on the appropriate toolbar name under the Toolbars submenu.
Finding Data

There are a large number of datasets that are available for use, many of which are accessed through the Add Library Layers function on the TSAT toolbar.

You can either navigate the categories for data you wish to access, or you can also perform a search by keyword by clicking the Search button and entering your keyword.

Some datasets you may find yourself using commonly include:

- **20K base mapping** - this includes many useful layers including water features, transportation, and landmarks of various types
- **DRA digital road atlas** – probably one the most complete road layer available to us
- **Anything under the Imagery category** – all of the orthophotos available to us can be found here. Alternatively, orthophotos can be sourced from the O: drive, but the access and loading times are much slower
ArcMap Settings

You can change some of the editing settings in ArcMap to make the process of digitizing easier and less prone to error. You will need to have the Editor toolbar on to change these settings.

Under the Editor toolbar menu, selecting Options will allow you to edit some specific settings under the General tab:

- Snapping tolerance – defines the distance that the edit cursor will snap to features
- Sticky move tolerance – defines the distance that you need to drag a feature before it can be moved. A higher tolerance will help prevent accidental shifts in the data

While you are in Edit mode, you will also have the option to select the Snapping command, which allows you to change the order of priority between layers for snapping. The highest layer in the list will be the first layer an edit sketch will snap to. You can also specify if you only want to snap to vertices, edges or ends of line segments for different layers.
Modifying Parcel Boundaries

When preparing maps for an ALUI, you generally should not need to change the boundaries of the legal parcels that you are supposed to digitize covers for. However, there may be exceptional circumstances that require you to do so, such as having parcels with poor spatial correlation with the orthophotography. You will need to be in Edit mode in order to use the following tools. This is done by selecting Start Editing from the Editor toolbar menu.

Spatial Adjustment Tools

The Spatial Adjustment toolbar provides the means to perform rubbersheeting, allowing you to tack down specific points and stretch the other areas in specific directions.

Before you can make changes to the layer with these tools, you need to select which layers or features will be affected. This can be done by selecting Set Adjust Data under the Spatial Adjustment toolbar menu.

You can choose to either adjust all features on layers that you choose, or just features that you select.
In order to use the rubbersheet method, you need to select *Adjustment Methods > Rubbersheet* from the Spatial Adjustment toolbar menu.

Rubbersheeting uses two different links to establish how features should be shifted:

- **Identity links** define where features should remain where they are and are, by default, depicted as a black square with a red cross inside.
- **Displacement links** define where features should move to and are, by default, depicted as a black arrow.

This area appears to have good spatial correlation with the orthophoto, so we want to add an identity link to hold the features in this area in place.
The identity link (circled in yellow) acts like a tack in for the rubbersheeting process, holding down the area that should be maintained.

Here, we can see the road casing is very misaligned, which would make digitizing covers problematic, so we want to add a displacement link to fix this area.
The displacement link indicates where the feature should be moved to. You can adjust the positioning and length of a displacement link by using the Select Elements tool. One thing to note is that features farther from links will be less affected than areas closer to the links.

If ArcMap crashes while you are working, you can lose the links you have placed after the last time you saved your mxd. However, you can save the links you have created and reload them.

- The Save Links File command brings up a standard Windows Save dialog box, allowing you to choose a location to save the links file and to name it. After saving, a prompt will ask if you want to save the IDs of the links - this is not a necessary step, but you can do so if you choose to.
- The Open Links File command allows you to browse for your links file and load them into the mxd. NOTE: it is possible to load duplicate links into your map. If you have a complete links file saved, delete the existing links in the map through the View Link Table command before opening a file.

NOTE: it is possible to load duplicate links into your map. If you have a complete links file saved, delete the existing links in the map through the View Link Table command before opening a file to avoid this.
When you have finished putting in your displacement and identity links, you can adjust the features by selecting Adjust under the Spatial Adjustment toolbar menu.

After the adjustment has occurred, the displacement link turns into an identity link. If you are unsatisfied with the transformation result, you can undo the operation using the Undo command except if you saved your edits, in which case the changes are permanent.
Topology Tools

If you already have a covers layer to go with your parcel layer, then you will need to make sure the polygon boundaries of the two layers match up. In this situation, you will need to make sure of the tools in the Topology toolbar to modify the parcel boundaries. In order to use this, you will need to have a topology set up in the feature dataset containing the two layers.

To create a topology, the feature classes that will participate in the topology must be put into a feature dataset. This can be done in ArcCatalog, by right-clicking your file geodatabase, selecting New > Feature Dataset. You will be prompted to select a coordinate system for the dataset. You will also be asked to set tolerance levels for the features, which you can leave as the defaults.
After your feature dataset is created, you can drag in the appropriate layers from your file geodatabase into the feature dataset. To create a topology, right-click on the feature dataset, and select New > Topology. You will be prompted to set some parameters for the topology, as well as the topology rules.

Rules that you should probably add are:

- Covers must not overlap
- Covers must not have gaps
- Parcels must not overlap
- Parcels must not have gaps
- Parcels area boundary must be covered by boundary of Covers

After the topology is created, you can add it as a layer into your mxd.
Here, we have two different parcel layers. The red lines are the current working version, while the blue lines are a more updated cadastre that couldn't be used because it was missing attributes to allow the appropriate data to be joined. We can snap the nodes from the current parcel layer to the ones on the newer one using the Topology Edit Tool.

The Topology Edit tool selects line segments and nodes where line segments meet rather than the complete features. If you want to only select nodes, holding down the N key on the keyboard while making a selection box will ignore line segments.

Double clicking on a line segment with the Topology Edit tool will let you add, delete, and move vertices of the line, indicated by the green boxes. Double clicking elsewhere will complete the changes made to the line. You cannot move the vertices where line segments join, however. Those vertices can only be moved by moving the nodes.
For nodes, after one is selected, you can simply drag it to where you want it. If you select more than one node at a time, clicking and dragging will move all of them simultaneously, showing you how the connected lines will be affected as well. Moving multiple nodes simultaneously can allow you to move a parcel with its shape intact.

One concern with using the Topology Edit tool is moving nodes such that new intersections occur in the lines. This will create more nodes and a more complex geometry that can be difficult to manipulate as intended. As long as you don’t save your edits, you can undo your changes.

While the previously illustrated methods work fine if you need to make some simple adjustments to a line, it can be a lot more tedious if you need to stitch two polygons together. When you have the topology added as a layer in your mxd, errors will show up with thick red lines. In this case, there is a gap between layers at a very small scale.
It would be very time consuming to manually add or remove vertices and snap the two polygons together. Fortunately, as long as there are points that the two polygons are joined at, you can change the change of one polygon to fit the other using some tools in the Editor toolbar.

Because these tools are part of the Editor toolbar, you can make use of edit sketches to change the shape of one of the offending edges to match the other.

The area that we are zoomed into is a portion of a cul-de-sac where one lot was made with a curved line and the other with line segments, causing this gap. The straight line has been selected with the Topology Edit tool, and the other polygon has been selected with the Select Features tool. This allows us to use the Trace tool to go along the selected feature's boundary.

The final result is shown in the inset picture in the black box. You can see the purple highlighted line (the edge that had the topology task performed) now is aligned with the other edge. The topology error (light red) will continue to appear until you re-validate the topology. This can be done with one of the three highlighted buttons on the Topology toolbar. The first button allows you to draw an area that topology should be recalculated, the second validates the topology of the current view extent, and the third validates the topology on the entire dataset.
Digitizing Land Covers

The process of digitizing is subjective because it is, in essence, performing air photo interpretation. Each person may have a different opinion about where a boundary should fall between different features. For this reason, there are some standards that are in place, as well as some practices that should be followed when doing digitization.

Minimum Size and Width

Covers that are digitized for a parcel must meet these two criteria:

- Covers must be at least 500 square metres in area
- Covers must be at least 10 metres apart

One exception to this rule pertains to housing. Previously, it was possible to indicate how many units of housing were present on a single cover. This is no longer possible, so every structure that is used for residence needs to be digitized, which may cause you to create covers smaller than 500 square metres.

Data Used

There are many layers that you should use when digitizing to help determine different covers:

- Orthophotography - Self-explanatory. You can find a variety of different years and areas for orthophotos from the Imagery category of the Add Library Layers function of the TSAT toolbar
- Parcel boundaries - used as the basis for covers layer, usually obtained through local governments or ICIS
- Road layer - the Digital Road Atlas (DRA) contains streets as well as less maintained roads such as forest service roads, and covers the province. This is useful for the final mapping product to orient yourself, as well as for locating a parcel to use Street View in Google Earth or Maps (Found under Physical Infrastructure > DRA_Digital_Road_Atlas in Add Library Layers function of the TSAT toolbar)
- TRIM data - short for Terrain Resource Information Management, the TRIM data has 1:20,000 base mapping across the entire province, containing information about things such as landmarks and water bodies. You may find some layers help you to pick out features you might miss, such as buildings under a tree canopy in the orthophotos (Found under Base Maps > 20K_Base_Mapping in the Add Library Layers function of the TSAT toolbar)
The parcel boundaries that we obtain from local governments or ICIS are modified prior to use for digitizing. To ensure each LOTLNK is unique, all multipart polygons are split into single part before assigning LOTLNK numbers. Additional fields are also added for the purpose of the survey. These include:

- **HA_IN_ALR / ACR_IN_ALR** – the hectares / acres of the parcel within the ALR boundaries. Calculated by clipping parcels layer with ALR layer, calculating the area of the result, and copying that into the working layer.
- **PCT_IN_ALR** – calculated by dividing one of the area in ALR fields with the total area of the parcel.
- **ALR** – a yes/no field, set to Y if some portion of the parcel is in the ALR or N if not, determined from value in PCT_IN_ALR field.
- **Farm_class** – determined by joining parcels layer to BC Assessment databases, with possible values Y, N, or U (unknown).
- **Candidate** – if a parcel is greater than 100 square metres, it is a candidate for surveying.
- **TO_SURVEY** – another yes/no field, the specific details that determine whether or not a parcel will be surveyed varies between areas, usually because other information may be available to narrow the list of parcels that should be surveyed.

The covers layer is then produced by copying the parcels layer and stripping out most of the attribute except for ones with information about LOTLNK, local governments, Indian reserves or area. This layer may be further manipulated if other supplemental data can be used to assist in digitization, such as line work from the Vegetation Resources Inventory (VRI) or field crop data with GPS coordinates from other organizations such as Ducks Unlimited. If so, the initial covers layer may be intersected with some of these other layers to produce some initial covers that will have to be inspected and/or modified by the digitizer when going over the study area.
Digitizing House Areas

When digitizing built areas, try to separate the house from the farm structures. There are a few different things that you can look for or use to assist you in making this determination.

In this example, the top structure is a barn and the bottom structure is a house. Generally, the roof of a house will be more complex, and may have gables present. The shape of the house can also be an indicator – some larger houses may be irregularly shaped, though this is not always the case.

The area surrounding the building is also a good indicator. For the barn, you can clearly see an area that appears to be a corral, while beside the house you can make out a circular object (probably a trampoline) which would help indicate that the nearby structure is probably residential. Also, depending on the imagery and area, you may find that the lawn appears a more vibrant shade of green due to being watered versus rough grass or natural grassland in the rest of the parcel.

Things that you can look for to help distinguish structure type:

- Houses: trampolines, gazebos, pools, patio areas,
- Farm areas: paddocks, riding rings, manure storage, sawdust piles
On this parcel, the house is the building in the lower right hand corner of the built area. The shape of the house is not complex, and is therefore not helpful in determining that it is a house. One thing that does hint at the possibility of it being a residential structure is the vegetation directly surrounding it, whereas the other buildings have none. Residential structures may be separated from farm structures by landscaping (i.e. hedges, trees) to offer some privacy. A tool that may be useful is the Street View feature in Google Earth and Google Maps.

The Street View here from Google Maps helps to show that the building in question is indeed a house. When directly looking at structures, some things you can look out for are chimneys, porches, and garages, which may not be obvious on an aerial photo but can be seen from Street View.
The final delineation of the built structures is shown here. The shape of the house polygon is a bit irregular because the area of lawn fenced in with the house is captured as part of the house. Very large areas of lawn may be separated from the house if deemed significant enough. This is a subjective judgment, but if a lawn area is many times larger than the house itself then it could probably be justified as being a separate polygon.

It may be the case that there is more than one house on the parcel, especially on very large lots. The image to the left shows a small portion of a very large lot, with four housing covers and one farm area cover. As noted in the beginning, every housing structure should be digitized out.

A final note about digitizing homes concerns the driveway. A driveway can be grouped with a house if it is not long enough to be a significant feature and is wide enough to be digitized. However, there may be cases where you do not wish to digitize or group a driveway with the house because it may create adjacent polygons that are not sufficiently large (less than 500 sq. m in area).
Digitizing Farm Areas

When possible, keep all farm structures together as one polygon - in the survey database, there are no distinctions between different farm structures at the cover level. Things that should be grouped into the farm area include barns, stables, corrals, riding rings, manure lagoons and other built objects. Pastures should not be included in the farm area even though they are enclosed areas, because the database allows for different pasture vegetations and irrigation types to be defined.

On this parcel, there is a large rectangular area that has a bare appearance. It probably should not be digitized separately from the farm buildings however, because it has well defined boundaries and is likely constructed, whereas bare areas usually refer to things like piles of fill or dirt parking lots. The area also has an appearance similar to concrete, although on an aerial photo loose gravel will also have a similar appearance. (The area in question is likely an uncovered riding ring)

Like before, we group the area presumed to be lawn with the house. The road leading to the farm area wasn't digitized out because it is not particularly wide and the vegetated area it would divide has a similar visual characteristic.
Here is another example of the delineation of built areas after being updated with field edits. Here, we see some liquid manure storage grouped in with the farm structures. Something to remember is that although you don’t have to digitize out things such as manure or woodwaste storage (because they are farm-related), they need to be noted under the Agricultural Uses in the survey database.

Greenhouses

A slightly different approach is necessary when dealing with greenhouses. In the water demand model, the area of the polygon is used as part of the calculation that determines the water usage, so it is important to digitize out the greenhouse very precisely, specifically the areas that are used for growing (glass/poly covered areas as opposed to attached support facilities). Keep in mind that the 10m minimum poly separation still applies.

Here, we have a parcel with two greenhouse structures. From an aerial photo, greenhouses have a distinct pattern on the roof which makes them relatively easy to distinguish from a regular building.
If we were to digitize this parcel normally, we might end up with something like this, where all the area roughly attached to the farm buildings are grouped together in the polygon.

In this version, the transparent areas of the greenhouse roof have been digitized closely along the boundaries, which is how they should be digitized. On the second greenhouse, there is a portion that doesn’t appear to be covered with glass or polycarbonate, so it has been grouped with the rest of the non-greenhouse areas. The road on top ends up being missed from the group due to the minimum 10 meter separation between polygons. This is an individual judgment – more area could be captured to make that area 10m wide, in effect buffering the road. This is something that may come up commonly when dealing with linear features.
One area that could have also been digitized is shown here. This could be classified as a bare area. However, if you are uncertain about something, it may be better off to not digitize it and let the surveyor decide if something significant is present there.
QC and Verification

Before you hand off a pre-survey geodatabase as completed, you need to ensure that the data is valid to the best of your knowledge. It is likely that the extent of the coverage is too great for you to go and check everything again, and doing so may not catch everything, especially errors in the attribute table. Here is a non-exhaustive list of checks that will catch many important errors that should be not present:

Check For Unverified Covers

While going through everything, you may have missed some small cover or forgotten to mark a cover as completed. Fortunately, it is easy enough to catch these, and this check may also help you find tiny slivers or covers you may have accidently created.

- Join your parcels layer to your covers layer using the LOTLNK field so that you have access to the TO_SURVEY field
Use the Select by Attributes tool to perform the following queries (the exact name of the attributes you select will vary depending on the name of the covers and parcels layers):

"COVER" = 'Blank' AND "TO_SURVEY" = 'Y'

This will select covers that were marked to survey but were not assigned a cover type.

"COVER" <> 'Blank' AND "VERIFY" = 'N'

This will select covers that you looked at but missed marking the verify flag, which would cause some attributes to not be populated by the custom Land Use tools.

**Check For Topology Errors**

It is important that covers do not overlap each other, or have gaps between them, and the same applies to parcels as well (naturally, this doesn’t apply to gaps that are intended such as road casings in a legal parcel layer). Assuming that a topology already exists, you can check for errors in the topology using the Error Inspector, accessed from the Topology toolbar.
You can choose to view errors from a specific rule, or all the rules at once. If you are zoomed into a specific area, make sure to uncheck the “Visible Extent only” checkbox so that you will find errors in the entire dataset, and not sure the area you are presently viewing.

Check For Unique Polygon Numbers

It is necessary for the parcels and the covers on each parcel to have a unique number so that each item can be recorded in the database. While it is not easy to find these duplicates in ArcMap, it can be done easily with Microsoft Access. You will need to export the attribute table of the covers layer in order to bring it into Access. This can be found by clicking the Options button in the attributes table and selecting Export, which will bring up a dialogue box for you to choose a location to save the table to.
In order to find the dbf file you exported, you will have to change the file types being displayed using the highlight dropdown menu, as the application defaults to showing Microsoft Office Access files only.

After opening the database, click on the Create tab at the top of the screen to access the Query Wizard and select the Find Duplicates Query Wizard.
Select one of the unique identifiers for the parcel (either LOTLNK or LOTLNK_LOC) as well as the POLY field to search for duplicates in a combination of these two fields, and press the Finish button to execute the query. If there are any lots that have duplicates, they will appear in the query results. If you do find duplicates in the POLY field, you will have to recalculate the POLY numbers in the appropriate parcels.

The LOTLNK field should always be unique, so if you find a duplicate, check the source layer to make sure that the LOTLNK number wasn’t mistakenly altered. If the source also has a duplicate present, then a new LOTLNK number needs to be assigned to the parcel and covers. Consult with your supervisor if you encounter this issue.