TRACKING AND MANAGING PARCEL CHANGES IN A GEODATABASE FORMAT

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Abstract

In order to take advantage of relational database functionality and ESRI's Geodatabase model, the County of Santa Cruz, California, migrated its decade old GIS from a CAD based mainframe platform to an SDE/SQL Geodatabase. The base layer for the GIS system is the cadastral layer, and our initial challenge was to develop maintenance and tracking procedures for the Assessor's Office to replace the existing CAD based editing. We would like to share our experiences with the GIS community and address the challenges and issues that we have faced and discuss how we have resolved them. The paper will focus on the migration strategy, Geodatabase design, data maintenance procedures, Assessor's map production, our future goals and how this new system is able to meet the needs of an increased number of County departments.

Introduction

The County of Santa Cruz, located on the central coast of California, established its GIS in the early 1990's. The original system was based on digitized Assessor's maps, maintained in AutoCAD and housed on a mainframe platform. The system, representing almost 96,000 parcels, consisted of about 4,500 Assessor's Map Pages, maintained as separate AutoCAD files. Instead of a seamless parcel base, the data was divided between 103 Map Books with a separate AutoCAD file for each book. This tended to cause inadvertent gaps and overlaps in the data. The data was distributed to other departments via mainframe applications and as a countywide shape file compiled from the AutoCAD files. The mainframe platform was not able to support the relational database functionality offered by new GIS applications and therefore limited potential use of the data.
In order to take advantage of the relational database technology and ESRI's Geodatabase model, the County decided to migrate from the mainframe platform to an SDE Geodatabase, where the cadastral data could be kept in a

seamless layer. The conversion process began early in 2003 and was completed in a little over a year.

This paper discusses the Cadastral Feature Dataset with a focus on the:

- Migration strategy,
- Database design,
- Data maintenance procedures,
- Data distribution to other departments and
- Future goals.

Data Conversion and Migration

In converting the AutoCAD data to the Geodatabase, we had the option of using the seamless shapefiles or migrating the CAD data directly from the 103 separate Map Book files. But since arcs are broken into segments in the shapefiles we elected to import the CAD data in order to preserve true arcs that hold valuable survey information.

Prior to migrating the CAD data into the Geodatabase, there was a substantial amount of prep. work that had to be done.

We needed to:

- Clean up and coordinate all the layers in the 103 AutoCAD Book drawings.
- Assemble the 103 Map Books and create seamless layers for the APNs, parcel boundaries and easement lines.
- Extract all the dimension text from the 4,500 Map Pages.
- Extract all the Lot Numbers and Easement text from the Map Pages.
- Assemble all the Map Books that had condominiums and create seamless layers for each of the condominium floors.
- Create a point file from the APNs.

The boundary layers were imported into Personal Geodatabases and used to create the parcel and condominium polygons. A point file was created from the parcel centroids and used to tie in the correct parcel numbers from the APN point file. Topology rules were applied to eliminate the gaps and overlaps from the original AutoCAD files.

Two other feature classes, Blocks and Map Books were created from the parcels in a batch process.

Database Design:
In Geodatabase design, just like any other database design, you have to keep in mind what function the database will serve and how you will be using it. For us, it was important to be able to store all our data in a structure that was as similar as possible to the current structure and allow for editing practices that permitted us to maintain our current workflow. We based our design on the Oakland County, Michigan Data Model that had all the necessary elements. The first steps in the design of the Cadastral Feature Dataset were:
- Define each of the existing data layers.
- Decide how to organize the layers into feature classes.
- Determine the relationship between the individual feature classes.

The Cadastral Feature Dataset we designed consists of 18 different Feature Classes and two topologies.

Cadastral Feature Dataset

Cadastral Topology	DATA TYPE
AssessorsParcels	Poly
Boundary	Line
MapBooks	Poly
TaxCodeAreas	Poly
Blocks	Poly

Condo Topology	
CondoBoundary	Line
Condos	Poly
AnnoAPNCondos	Anno
AnnoAPNumber	Anno
AnnoCondoBoundary	Anno
AnnoDimensions	Anno
AnnoEasements	Anno
AnnoLots	Anno
AnnoMapPage	Anno
Hooks	Point
MiscLines	Line
NewDimensionLines	Line
SectTownRange	Poly

Figure 1. Feature Classes in the Cadastral Data Model.

FEATURE CLASSES IN THE CADASTRAL FEATURE DATASET

The Cadastral Dataset consists of 18 feature classes.

The feature classes can be line, polygon, point or annotation data types.

And

A feature class can only have one data type; for instance, you could not create a polygon feature in a line feature class or a line feature in an annotation feature class

A feature class can be further divided into Subtypes. See Fig. 2.

Boundary

Field Name	Data Type	
OBJECTID	Object ID	Primary Key
RECBNDID	Text	Type of boundary line defined by subtype
RECBNDTYPE	Integer	Describes record boundary as described on deed
RECBNDCALL	Text	Additional information on boundary
RBCOMMENT	Text	Record Basis of Bearing
BOBEARING	Text	Map Source Agent (surveyor or firm)
MAPSOURCE	Text	Source of line (digitized or record information)
SOURCETYPE	Text	Date of record document
SOURCEDATA	Text	
SHAPE	Geometry	
DIRECTION	Text	Direction (meets and bounds)
DISTANCE	Text	Distance (meets and bounds)
RADIUS	Text	Radius
DELTA	Text	Delta
TANGENT	Text	Tangent
ARCLENGTH	Text	Arc length
SIDE	Text	
SHAPE.len	Double	Actual length of digitized lines

RECBNDTYPE (Subtype)

Assessor's Parcel
General Easement
Road Easement
Utility Easement
Utility Easement
Drainage Easement
Well Easement
Right of Way
Lot Line
Miscellaneous
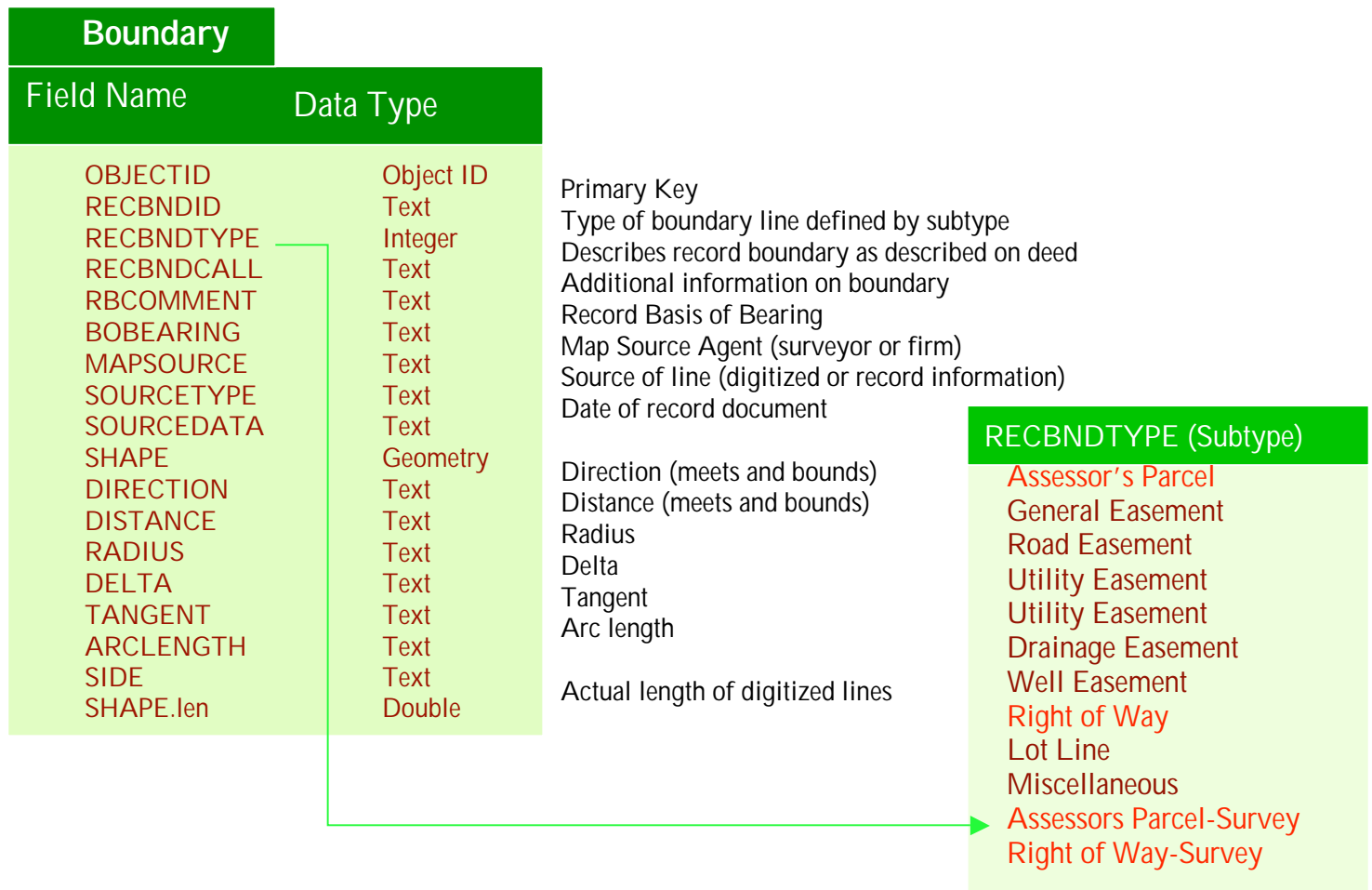Assessors Parcel-Survey
Right of Way-Survey

Figure 2. Break down of the Boundary Feature Class into Subtypes.

The Boundary Feature Class contains all the parcel defining lines, the abandoned parcel lines (lot lines), kept for historical purposes and six different types of easements.

The parcel defining subtypes are Assessor Parcels and R/W, but in order to be able to identify the lines that have been COGOed in from recorded documents, we have added Assessor Parcels-Survey and R/W-Survey. This is important information for the Assessor's editors that need to be aware of whether a line has been COGOed or digitized when they are editing the parcel base.

After editing the boundary features in the Geodatabase, we use the parcel defining lines to create the parcel polygons.

As you saw in Figure 1, there are two different Topologies in the Cadastral Feature Dataset, one for the parcels and a separate one for the condominiums. This was necessary to accommodate the different behaviors of the parcel and condominium feature classes.

Cadastral Topology Rules

AssessorsParcels	Must Not Overlap	
AssessorsParcels	Must Not Have Gaps	
Boundary	Must Not Self Overlap	
Blocks	Area Boundary Must Be Covered By Boundary Of	AssessorsParcels
Boundary: Assessors Parcel	Must Not Have Dangles	
Boundary: Right of Way	Must Not Have Dangles	
Boundary: Assessors Parcel-Survey	Must Not Have Dangles	
Boundary: Right of Way-Survey	Must Not Have Dangles	
Boundary: Assessors Parcel	Must Be Covered By Boundary Of	AssessorsParcels
Boundary: Right of Way	Must Be Covered By Boundary Of	AssessorsParcels
Boundary: Assessors Parcel-Survey	Must Be Covered By Boundary Of	AssessorsParcels
Boundary: Right of Way-Survey	Must Be Covered By Boundary Of	AssessorsParcels
TaxCodeAreas	Must Not Overlap	
TaxCodeAreas	Must Not Have Gaps	
TaxCodeAreas	Area Boundary Must Be Covered By Boundary Of	AssessorsParcels
MapBooks	Must Not Have Gaps	
MapBooks	Must Not Overlap	
MapBooks	Area Boundary Must Be Covered By Boundary Of	AssessorsParcels

Figure 3. Topology rules.

The relationship between the feature classes is defined by Topology Rules. The last step of the editing process, Topology validation, makes sure that all the rules have been followed.

Topology rules can be applied within or between feature classes and even between different data types. For instance, the boundaries of the parcel polygons need to be coincident with the parcel boundary lines, so we set the topology rule "Boundary must be covered by the boundary of Assessor's Parcels". And to avoid overlaps and gaps between the parcel polygons, we set the rules: "Assessor's Parcels must not overlap" and "Assessor's Parcels must not have gaps".

After the parcel edits are done, Topology in the edited area must be validated. If the rules have been violated, an error report is generated and the errors must be fixed or an exception made before the changes can be accepted into the Geodatabase.

Condos

Field Name	Data Type
OBJECTID	Object ID
APN	Text
APNNODASH	Text
DEED_ID	Text
RECORDMAP	Text
SPLITCOMBO	Text
PRCLID	Text
PRCLKEY	Integer
EMISLAYR	Text
FLOOR	Integer
SHAPE	Geometry
SHAPE.area	Double
SHAPE.len	Double

Floor (Subtype)

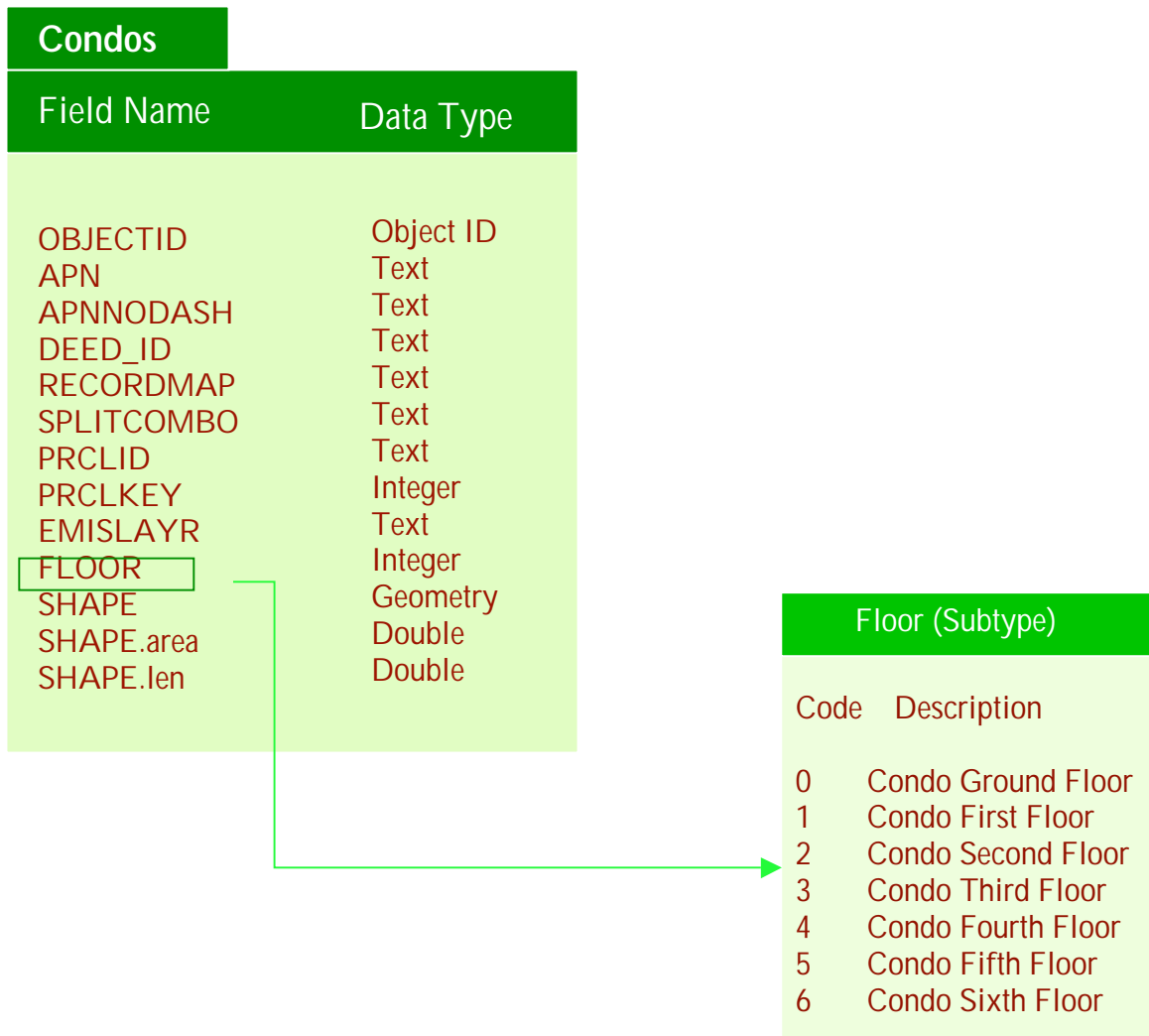| Code	Description
0	Condo Ground Floor
1	Condo First Floor
2	Condo Second Floor
3	Condo Third Floor
4	Condo Fourth Floor
5	Condo Fifth Floor
6	Condo Sixth Floor

Figure 5. Break down of the Condominium Feature Class into Subtypes.

As before, condominiums continued to present a special challenge in this new system and had to be dealt with separately. In order to capture the 3D aspect of the condos and distinguish between units on different floors we

created subtypes to correspond to the floor levels. This was done both for the (line features) condo boundary and (polygons) the condos.

Because the condo polygons are not cut out of the base parcel and don't share its boundary lines, they cannot participate in the same topology so a separate topology was established for the condos, where the only rule is that the condo boundary (line feature) must be covered by the boundary of the condo polygon.

Workflow Design

As mentioned before, we tried to maintain our current workflow to the extent possible in the new ArcGIS system. For the most part we were able to keep the same process in place. The basic workflow for parcel updates stays the same, but our QC process is more effective now.
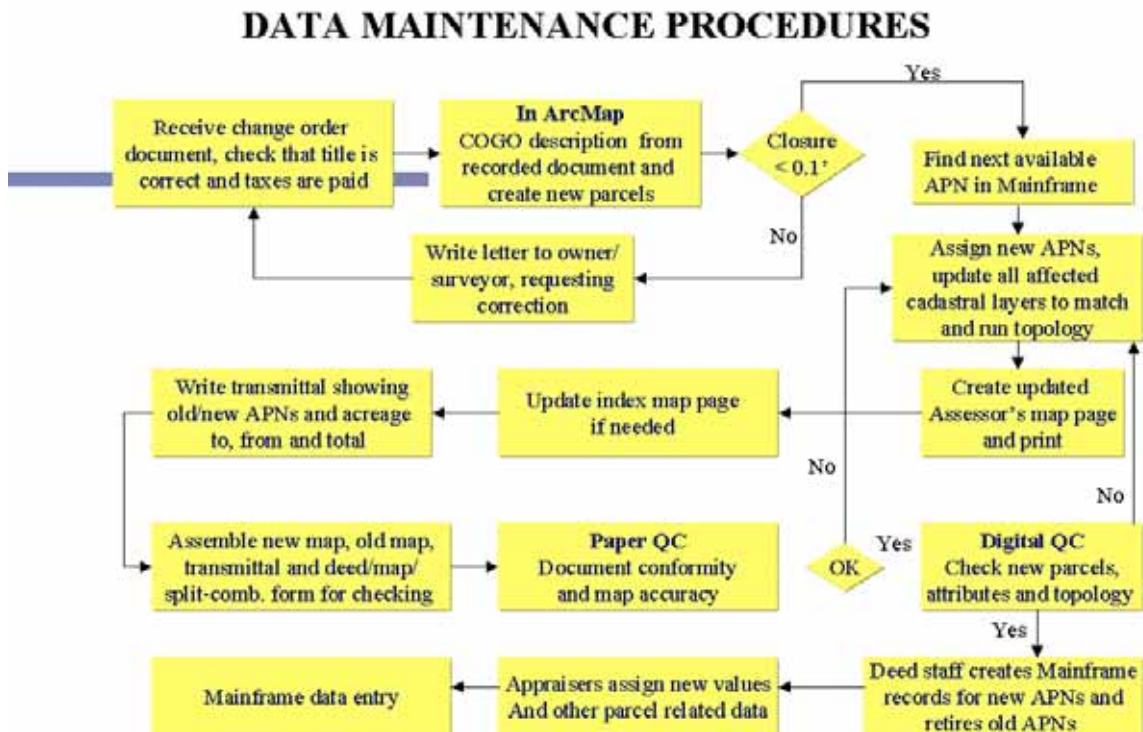

Figure 6. Parcel maintenance workflow.

THE PARCEL EDITING PROCESS

ArcSDEGeodatabase

FEATURE DATASETS

Administrative

Biotic and Natural

Cadastral/Default

County Service Areas &

Cultural Resources &

Etc.

Assessor's Edit Version

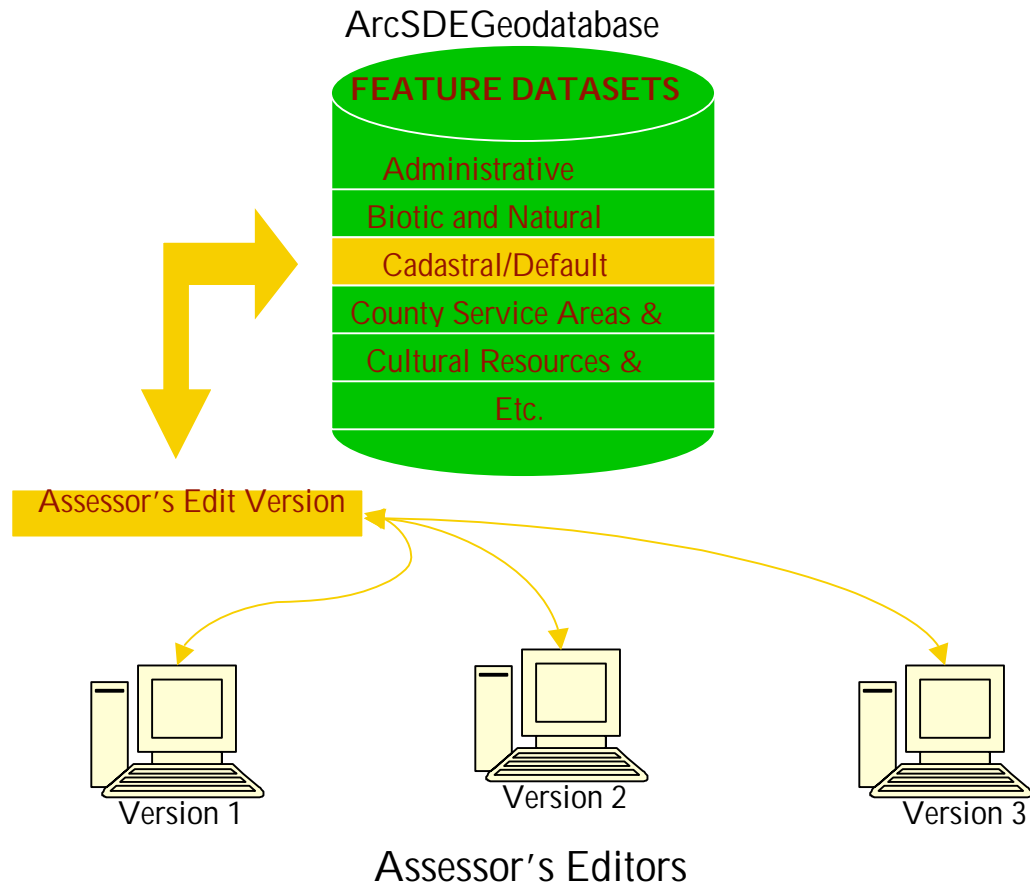Version 1   Version 2   Version 3

Assessor's Editors

Figure 7. Parcel editing flowchart.

We set our Geodatabase up as versioned to allow multiple editors to work at the same time.
At the beginning of an edit period, an edit version is checked out from the Cadastral/Default for the Assessor Drafting staff and serves as a parent version for the individual edit versions. Each editor logs into the Geodatabase with their edit permissions, checks out their own version from the Assessor's Edit version, makes it Protected and works on it exclusively. The edit permissions only allow the editor to edit his/her own version but they are able to view what changes the other editors have made. The edits are saved to the individual versions instead of being saved to the Default Geodatabase version directly. So effectively, the editors are all editing the same data at the same time, but the changes are saved to the individual versions.

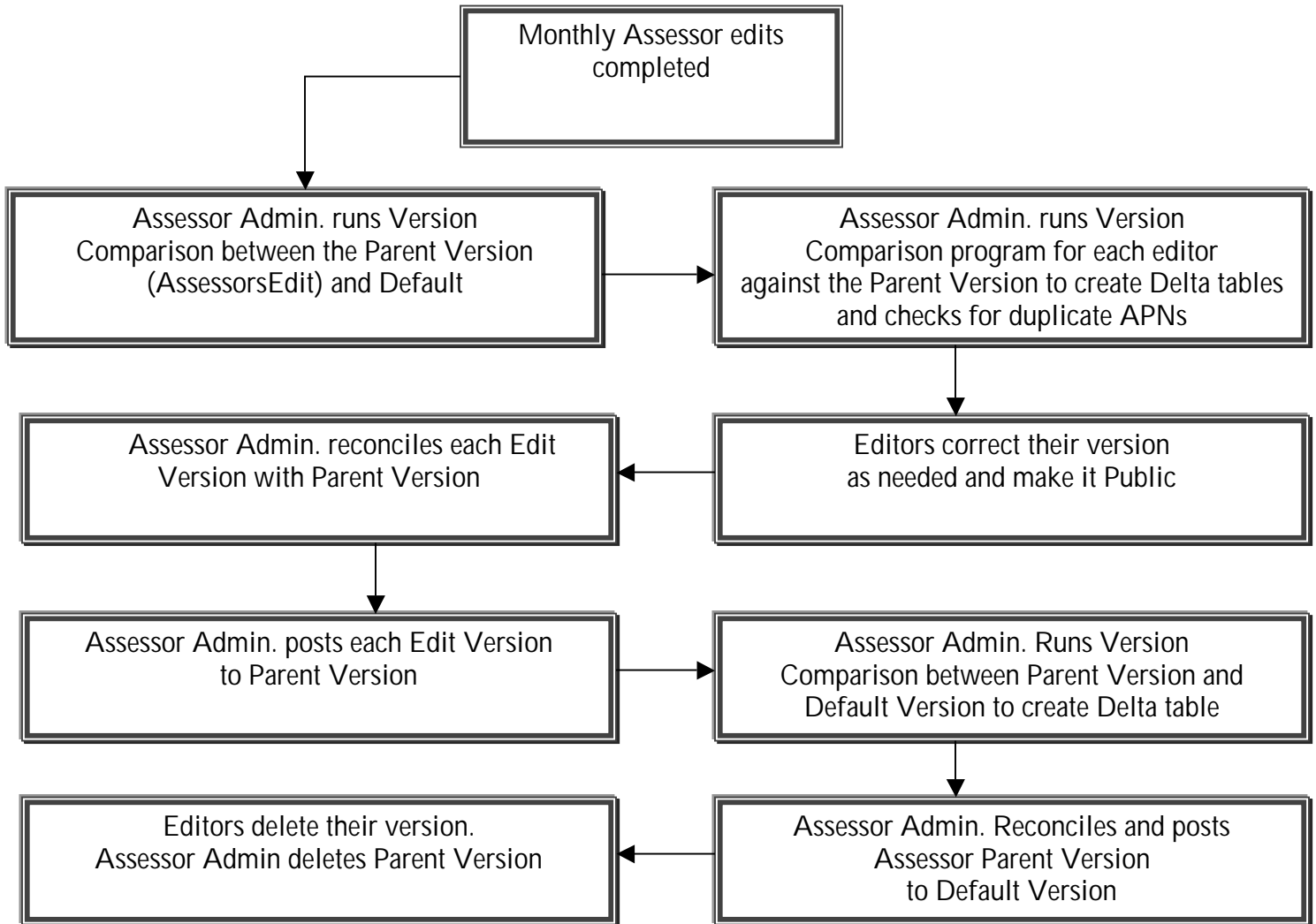# PARCEL CHANGES UPDATED TO GEODATABASE

```
                    ┌─────────────────────────┐
                    │  Monthly Assessor edits │
                    │        completed        │
                    └─────────────────────────┘
```

Assessor Admin. runs Version Comparison between the Parent Version (AssessorsEdit) and Default	Assessor Admin. runs Version Comparison program for each editor against the Parent Version to create Delta tables and checks for duplicate APNs
Assessor Admin. reconciles each Edit Version with Parent Version	Editors correct their version as needed and make it Public
Assessor Admin. posts each Edit Version to Parent Version	Assessor Admin. Runs Version Comparison between Parent Version and Default Version to create Delta table
Editors delete their version. Assessor Admin deletes Parent Version	Assessor Admin. Reconciles and posts Assessor Parent Version to Default Version

Figure 8. Periodic Geodatabase posting workflow.

At the end of the edit period, we run a version a comparison program that compares each edit version with the default version and produces a Delta table for each version that lists all the changes that took place. Each editor verifies that all the edits are in the version correctly and turns the version over for reconciling and posting.

After all the Assessor's edit versions have been posted, a final comparison between the Parent version and the Default version is run to capture all the changes that were made during the edit period. The resulting Delta table is used by the GIS Section in the alignment and overlap process. In addition to the Cadastral Feature dataset, the Geodatabase contains over 200 data layers, maintained by the GIS Division and the Department of Public Works. Many of the layers are dependent on the parcel boundaries and have to be aligned after the Cadastral dataset is updated.

Assessor Map Pages

After editing the Geodatabase, we need to produce map pages to show the new parcel configuration, and again, our objective was to keep the appearance of the new map pages consistent with the old AutoCAD page design. This proved to be a challenge, that at times left us in despair.
We encountered some major obstacles, in particular with the annotation and scale. This was the single most difficult process in this conversion.
With the help of some very knowledgeable and dedicated ESRI staff members and private consultants, we were able to work through our difficulties and have managed to re-create and improve upon the look of our AutoCAD map pages. The map pages produced in ArcMap look better than before with improved font selection and better distinction between line weights and types.

Figure 9. AutoCAD Assessor's Map.

When creating the map pages, we utilize the newly edited data from the Geodatabase as well as data that we import from the original AutoCAD pages.

Figure 10. ArcMap Assessor's Map.

With the aid of a standard definition query (Figure 11.), we select data from the CAD page and label it with the map page number and save it to the Geodatabase. Using the CAD data is (at this point) easier than recreating it and enables us to draw the map faster than creating it from scratch in a standard template.

The data we import from the CAD pages is mostly non-parcel information such as record map references, adjacent map page references, Right of Way lines to show both sides of streets and other page notation. In addition we import the cancelled parcel numbers from the CAD pages since they are not retained as parcel attributes.

We save the map pages as .mxd, and .pdf files and use the .pdf for distribution of electronic and printed maps.

Eventually we will have all the map pages drawn in ArcMap, but at this point, a year and a half later, we only have about 10% of them converted.
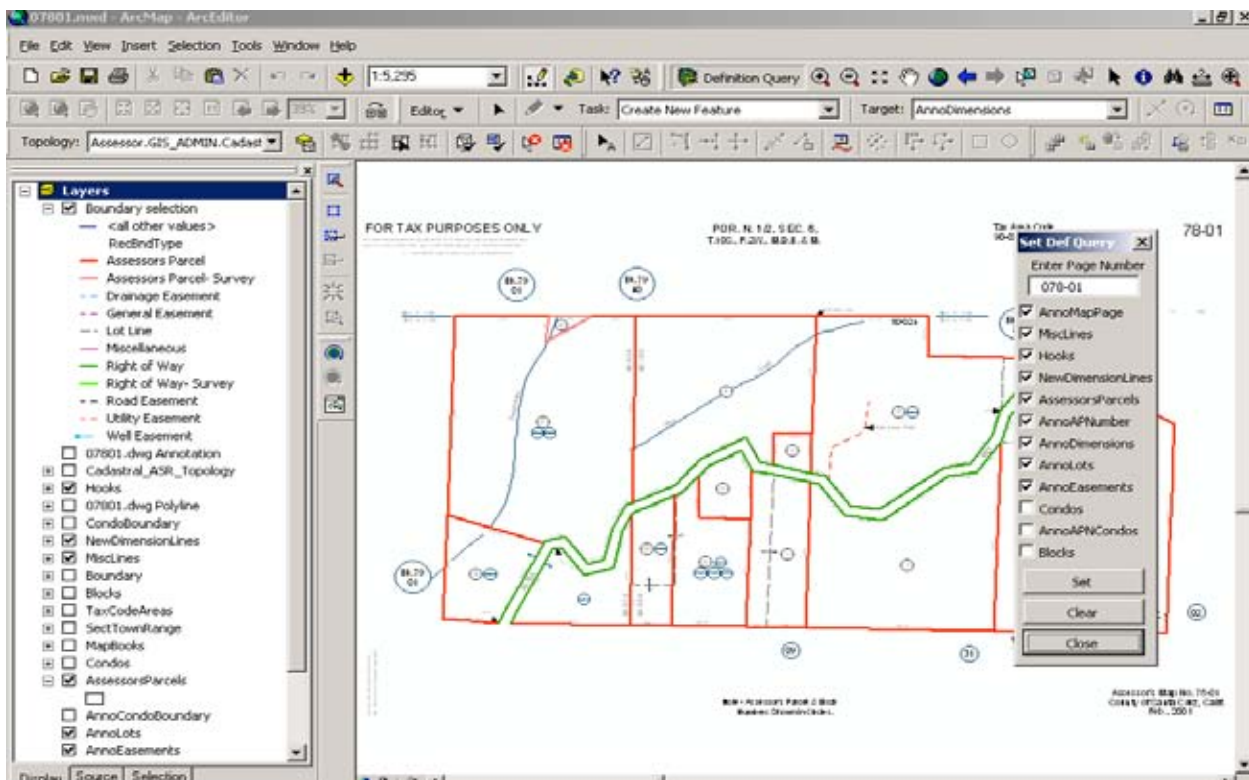
Figure 11. Definition Query.

Data Distribution

In order to make the data more easily accessible to the other County users, we developed a Data Menu Application. The editors access the data by going directly to the Geodatabase through their edit connections, but the other departments that use the spatial data access it through a data menu application. The data Menu Application splits the data up into logical groupings and provides a more intuitive interface for the casual user than accessing the Geodatabase directly. The Geodatabase can't be edited through the Data Menu, but the data is available for mapping projects and analysis. The metadata is also accessible through the Data Menu Application.
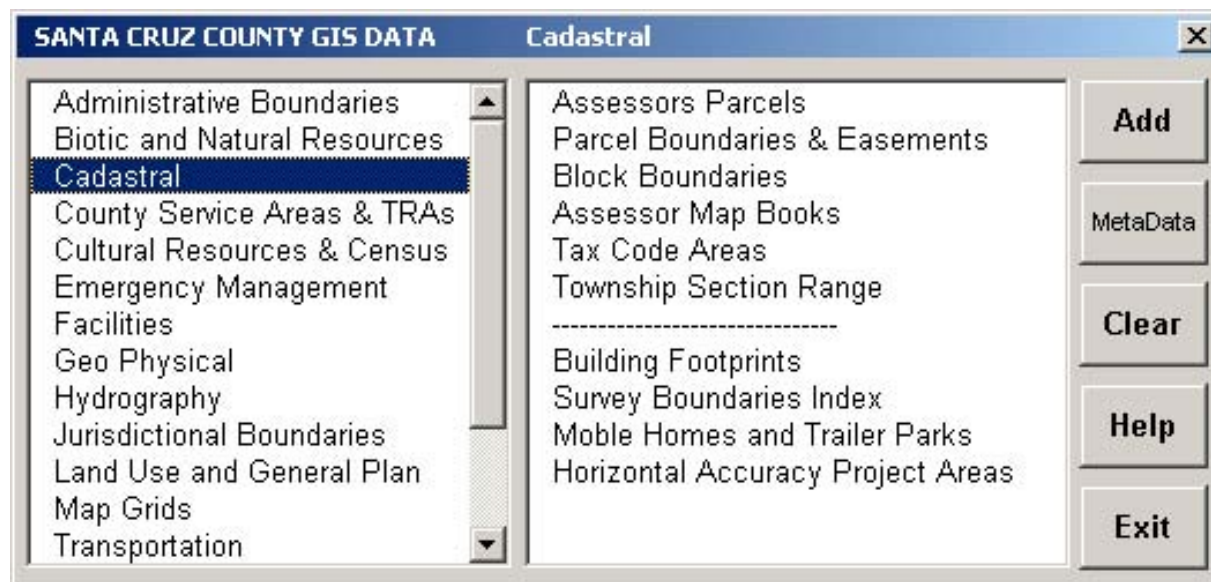

Figure 12. The Data Menu Application.

In addition to the Data Menu Application, the County maintains an Internet application, where users can access the Geodatabase data.

The GIS Section has recently completed a Countywide Needs Assessment for spatial data and as a result more and more departments are becoming interested in updating their technology and taking advantage of the Geodatabase. The URL is: http://gis.co.santa-cruz.ca.us/

Future Goals
In the near future our goals are:
- Increase the accuracy of the entire parcel base. We have recently acquired a county wide aerial coverage that we are currently using to make determination on adjustments of the base. We have contracted out the correction of a portion of the parcel base in a collaborative effort with one of the cities.
- Establish a Monumentation dataset. The Survey department is starting a project to locate property corners and other survey monuments using GPS technology. This dataset will enable us to further adjust the parcel base.
- We will also be working on increasing the automation of the parcel maintenance procedures.
- We are working on an intranet application for the Appraisers, to help them locate comparable sales for assessment appeals. Further down the road, we will also be implementing applications for our public counter to assist our customers in accessing our data.

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