

TOMPKINS COUNTY LAND USE AND LAND COVER MAPPING PROJECT

Methodology Report



**Prepared for:
Tompkins County Planning Department**

**Prepared By:
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GIS Division
4/13/99**

Version 3

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I. Introduction

The following points define the purpose of the Methodology Report prepared for the Tompkins County Land Use and Land Cover (LULC) Mapping Project:

- To document the exact steps to be taken to produce the 1995 Tompkins County LULC data
- To list all the tools and supporting data, and describe how they will be utilized in the project
- To document the final LULC classification system devised for this project
- To specify all data processing and quality control techniques

Complete documentation of the methodology that will be used during the development of this project is necessary for numerous reasons. First, it is critical that the Planning Department and project staff define and approve the methods of this project to assure that the outcome is consistent with the defined project scope. This document will be used to evaluate and conclude that appropriate data development and quality control tasks will be followed, and that the standards and specifications of the project will be satisfied.

Second, it is important that similar methodology and standards be maintained for future update projects as more recent LULC data is made available and incorporated into a new or revised LULC data set. The future use of this methodology is critical to assure that any new data produced is of the similar structure as the original 1995 LULC data set, and consistency and data integrity are maintained throughout time. The use of this data set will become the foundation of future Tompkins County LULC change analysis projects. The results of geographic statistical analyses, LULC modeling, and other time-based comparative uses of this data set can be accurately qualified if methodology for future update projects is consistently applied.

As a third point, the methodology has been documented to provide future users additional data production details that validate the accuracy of the final outcome of this project. Traditionally, land use and land cover maps have been developed by interpreting aerial photographs, delineating land use and land cover polygons onto a geo-referenced base map, and then digitizing the line-work. As described in this report, the Tompkins County LULC Mapping Project will use an innovative approach occurring entirely within a digital environment. For this reason, the need to document the process has been identified as a project priority and one of the primary goals.

Finally, this methodology may also be useful to other agencies or organizations interested in completing a digital LULC mapping project through a similar process and methodology. The methodology for the

Tompkins County LULC project will be made available and could serve as a basis for other projects.

II. Project Date Definition

The data produced during this project will generally be accurate to the date of the primary USGS DOQQ data set, which is 1994/1995. During the course of the Pilot Project, the field verification tasks determined that a higher degree of change between 1994 and 1999 had occurred in some LULC classes, particularly in the class headings of Agriculture and Residential. It was determined that the project time allowance and budget would not permit for a thorough field check and a full investigation of more recent data that would lead to the final project date definition that is accurate to the current year of 1999. The LULC map will predominantly represent conditions in 1994-1995.

However, a few of the land use classes have proven to be sometimes difficult to interpret based solely on the 1995 DOQQ's. Project staff have been unsuccessful in locating and/or incorporating any secondary data sources that would assist in LULC interpretation of these problematic classes based on the 1995 status date of the project. Therefore, some of these classes will be identified with more recent secondary data sources and/or field verification. The database structure defined by this project will include a separate coding scheme that will allow for the sorting and identification of all instances where the area was interpreted and coded with a 1999 status date. The land use classes which are most likely to be accurate to the 1999 status date include *Ay Other Farms*, and those facilities which include multiple uses of *// Light Industrial*, *Cr Commercial Retail*, *Co Commercial Office*. In each instance of these identified classes, the first preference will be to code these areas to the 1994/1995 project status date. If the analyst is unable to provide an accurate interpretation, the second option reflecting a 1999-status date will be applied.

A 1999 aerial photography project for Tompkins County is proposed for mid April. However, the deliverable from this project is only anticipated to include contact prints and non-rectified images. It was determined that the introduction of the 1999 photography as a secondary data source would further complicate the project and lead to a less accurate data set based on the project date definition of 1994/1995. In addition, it is anticipated that the 1999 color aerial photography will eventually be rectified. With the use of the 1999 rectified images as the primary data source, the entire county could be updated in a digital environment using the same methodology as described in this report.

III. Data and Tools

Primary Data

Name: **Infrared Digital Ortho Quarter Quads (DOQQ's)**

Date: 1994/1995

Scale: 1:12,000; One meter resolution

Format: Digital Ortho-photography original .bip image files

Originator: USGS

Description: Primary data from which the image interpretation and the digitizing of land use classes will be executed. The DOQQ's will be placed as the background image for the LULC interpretation and delineation process. These images will not be altered from their original projection in Universal Transverse Mercator (UTM), datum NAD83. All secondary digital data sets will be projected into the UTM coordinate grid system and therefore align with the primary data.

The USGS aerial photography program, which resulted in the production of these primary data, incorporated a locally maintained geodetic control system. The Tompkins County geodetic control system includes approximately 130 monuments that have and will continue to provide the foundation of positional accuracy for all county planimetric and framework data sets. Positional accuracy of the USGS DOQQ's, as related to Tompkins County data and the geodetic control system was reviewed prior to the start of the project. It was determined that the use of the DOQQ's would adequately serve as the primary data for aerial interpretation. Positional accuracy of these images is appropriate for the scale of the project with the greatest positional deviation at approximately 10 meters.

Secondary Data

Name: **B/W Aerial Photography – 1992 Planimetric Project**

Date: 1991-1992

Scale: 1:12,000

Format: Contact Prints

Originator: Tompkins County/NYSEG – Michael Baker & Assoc.

Description: Secondary data to assist with image interpretation. When an interpretation discrepancy has been identified, or the image analyst needs to review more closely the LULC features, the 9x9 overlapping photos can be viewed with a stereoscope. As an example, tree height and density can be better interpreted with stereo-pairs.

Name: **1998 Tompkins County Parcels**

Date: 1997-1998
Scale: 1:12,000
Format: ArcInfo Coverage
Originator: Tompkins County
Description: Used to identify parcel boundary features. When linked to the Real Property Service (RPS) Database (see next entry), the parcel data will provide a geographic reference to the RPS data. It is recognized that the 1998 parcel data does not accurately represent the configuration of parcels from 1995. Digital tax parcel data for Tompkins County does not exist for the 1995 tax year.

Name: **1998 Real Property Services Database Extract (RPS)**
Date: 12/98 – final property tax role files
Scale: NA
Format: Dbase
Originator: Tompkins County
Description: A series of fields from the RPS database will be used to verify details of parcels. Examples include the property class field and ownership records to help determine and differentiate land uses that are not immediately identifiable from the primary data source, and the calculated acreage filed when determining residential densities. Other RPS data will be useful for interpretation of areas that are not accessible for field checking. It is recognized that the 1998 RPS extract may not include accurate information for parcels as they existed in 1995. Digital tax parcel data for Tompkins County does not exist for the 1995 tax year.

Name: **National Wetlands Inventory (NWI)**
Date: 1981-1992
Scale: 1:24,000
Format: ArcInfo Coverage
Originator: United States Fish and Wildlife Service (USFWS)
Description: This data set will be used only as a guide when identifying the locations and classes of wetland areas in Tompkins County. Line work from this coverage will not be directly incorporated into the 1995 Tompkins County LULC data set.

Name: **Dept. of Environmental Conservation (DEC) Wetlands**
Data: 1984
Scale: 1:24,000
Format: ArcInfo Coverage
Originator: New York Department of Environmental Conservation
Description: This data set will be used only as a guide when identifying locations and classes of wetland areas in Tompkins County

in tandem with the NWI wetland data. This data set only includes wetlands greater than 12 acres in area.

Name: **Tompkins County Road Centerline**
Date: 1999
Scale: 1:12,000
Format: ArcInfo Coverage
Originator: Tompkins County
Description: This data set will be used to display road names and as a query for geographic reference.

Name: **Tompkins County Landmarks**
Date: 1998
Scale: 1:12,000
Format: Shape File, point feature class
Originator: Tompkins County
Description: This data set will be used to assist in locating public institutions such as churches, schools and other county landmarks. Points will be placed as a back coverage while digitizing the LULC polygons. As the points are located within the area being interpreted, the type of land-mark will be identified and the area delineated if it is at least one-half acre.

Name: **USGS Quad Index**
Date: 1998
Scale: 1:12,000
Format: ArcInfo Coverage
Originator: Tompkins County
Description: This data set which outlines the USGS quadrangles will be used to define the areas scheduled for delivery during the data production phase. Production, delivery and review of data sets will occur on a Quad basis.

Name: **Knowledge of Project Image Analyst**
Description: Sharon Heller, the lead image analyst in this project has 12 years of experience with aerial photography interpretation and GIS data development projects. Ms. Heller has lived in Tompkins County for almost 18 years and has extensive knowledge of local land cover and land use activities.

Project Tools – Hardware/Software and Other Equipment

It is essential that advanced computer technology be used to record data most efficiently. The DOQQs are large images that need significant RAM to quickly redraw, zoom in and zoom out. It is recommended that at least

120 megabytes of RAM be used. Slow draw times will increase production time.

A large true color monitor, at least 17" with at least 1152 x 864 pixel screen size with the ability to display millions of colors is necessary for optimal viewing.

ARC/INFO Version 7.1.2 is the GIS software used to display the DOQQ and collect the interpreted land use classes. A three-button mouse is necessary with this software. ArcView will be used to produce layouts of maps to be sent to a Hewlett Packard DesignJet 2500 color plotter. Hard copy maps will be used for editing and for final output.

A 4-power stereoscope is used to view the black and white overlapping aerial photographs in three dimensions to assist in interpretation of land uses and land covers. A lit magnifying lens also aids in interpretation of the black and white aerial photographs.

IV. Final LULC Classification System

The land use and land cover classes developed for this project were initially derived from the Land Use and Natural Resources (LUNR) class definitions from 1969. Land use and land cover mapping was completed for Tompkins County by the LUNR program and it was determined at the early stages of this project that the Final LULC classes must allow for a future comparison to the 1969 LUNR data. A comparative chart relating the LUNR classes with the 1995 LULC classes has been provided in the Needs Assessment Report. Some modifications were made to include classes that were not accounted for in LUNR, as well as modifications to condense similar classes. A needs assessment was conducted which included participation from various organizations who would likely use the Tompkins County LULC data. A questionnaire was completed, summarized, and followed by a facilitated discussion. Recommendations were recorded and incorporated when feasible into the Final LULC Classification System. The final classification system was revised per the results of the needs assessment and the pilot project. *(Please refer to the Needs Assessment and Pilot Project Reports for further details).*

Land Use and Land Cover are not quite the same thing. Land Use refers to the built landscape that has been altered by humankind. Land cover refers to the natural landscapes, such as forest and water. In the Tompkins County LULC Mapping Project, as in the LUNR project, the primary cover, either built landscape or natural cover, will be mapped with the emphasis on built landscape. For example, a ball field may have a land cover of grass, but in this project the land use (Ot) will be mapped since the natural land cover has been altered. Natural land cover may be the dominant land use though other activities are occurring. For example, a deciduous forest may be used to harvest wood, maple syrup, or used for recreation (land uses). In this project, deciduous forest will be mapped as a land cover feature, since forest is the dominant feature. The classes have been developed based on the needs of the county to map both the represented land use and land cover classes.

The minimum mapping unit will be a half-acre as relative to the LUNR project. The LUNR project was mapped and displayed at a scale of 1:24,000 with a minimum-mapping unit of 1 acre. This LULC project is being mapped and displayed at a scale of 1:12,000, therefore the minimum-mapping unit can be as small as a half acre. A minimum mapping unit of a half-acre is also appropriate given the scope of this project in terms of the level of classification and the proposed time frame for completing the project.

Large land use areas such as university campuses and central business districts may also contain other land uses that are at least a half-acre in

area. These areas will be delineated and assigned their appropriate class. For example, a recreational area, such as tennis courts, which are at least a half-acre in size on the Cornell campus, will be delineated and assigned their appropriate *Ot* classification.

Lawns, or manicured grass areas, will predominantly be included in the land use with which they are associated. Some areas delineated as other land use classes may include lawns greater than a half acre in area. If these grass areas are directly related to a specific land use, they will be included within the area of the associated adjacent LULC class, such as residential, institutional and commercial. Excessive grassy areas that are not interpreted to be associated with adjacent LULC areas and are greater than one-half acre will be delineated separately and coded with the Grassland (*Fg*) classification.

Agriculture

All residential areas associated with any of the following Agriculture LULC classes will be delineated as the Residential Low Density (RI) class if the combined areas of residential structure, residential outbuildings, and manicured/landscaped yards are at least one-half acre. Otherwise, residential uses will be incorporated into their associated Agriculture LULC class.

Ac Cropland

Tillable land used for growing cultivated field crops, forage crops, grain, beans, etc. Hedgerows separating defined Ac areas will be delineated as separate classes (*typically Fd, Fm, Fb or Fc*) if they are greater than 20 meters wide.

Ap Pasture

Areas used for grazing. Will be enclosed by fence and may have small trees and shrubs. Will be located adjacent to livestock farm.

At Tree farm

Areas used for cultivating trees, primarily Xmas trees.

- Ai Inactive**
Farmland and fields that appear to be no longer used for farming practices. Fields may appear to be growing over with tall grasses and small shrubs.
- Av Vineyards**
Grape growing farms and pastures which may include winery buildings.
- Ao Orchards**
Farmland dedicated to growing tree products including associated buildings.
- Ah High intensity cropland/horticulture**
Nurseries, including green-houses, vegetable production areas, and other gardens more than a half-acre in size.
- Ad Cattle**
Farmland used for the feeding and milking of dairy cattle as well as for beef cattle. Barn with silos and feedlots are included.
- Af Fishery**
Fishery ponds and associated buildings.
- Ae Horse farm**
Horse barns, feed lot, and animal recreation areas.
- Ay Other farms**
Poultry, sheep, swine, game, mixed animal farms, animal shelters, and farms that produce livestock feeds (granaries).

Forest/Brush/Grass

- Fd Deciduous**
Forested areas where broadleaf trees make up at least 80% of the tree cover.
- Fc Coniferous**
Forested areas where needle trees, such as pine, spruce, fir and hemlock make up at least 80% of the tree cover.
- Fp Forest Plantation**
Rows of mature trees, primarily conifers, planted by man
- Fm Mixed forest**
Forested areas with mixed coniferous and deciduous trees. The ratio of the predominant coniferous or deciduous tree stands must not exceed 80%.
- Fb Brush**
Areas that have considerable growth of shrubs and small trees, but can not be classified as forest. The brush land cover must occupy at least 80% of the delineated area. Forest and grassland may be incorporated into the remaining 20%.
- Fg Grassland**
Open grassy areas with no associated adjacent land uses. May include small amounts of shrubs, trees and brush. The grassland cover must occupy at least 80% of the delineated area. The remaining 20% may be trees, shrubs and brush. Grassland areas may be naturally occurring, or may be regularly mowed.

Water and Wetlands

Wn Natural Lake/Pond

Bodies of water that are not formed by damming creeks. Ponds may be man-made.

Wc Reservoir

Bodies of water that are formed from damming creeks.

Ww Wooded Wetland

Wooded areas that show considerable amounts of water beneath the trees.

Wb Marsh, bog, shrub wetlands

Areas of wetlands that contain grasses, scrub, brush, and are void of tall trees.

Residential

Rh High density residential

Residential land areas with approximately 5 or more dwellings on average per acre. Comprised mainly of urban areas of residential land use patterns including densities ranging from single family structures to multi-unit apartment buildings.

Rm Medium density

Residential land areas with more than 1, but less than 5 dwellings on average per acre.

RI Low density

Residential land areas with a maximum average of 1 dwelling per acre.

Rp Manufactured home park

Residential land areas with a density of 4 or more manufactured homes on average per acre and a designation of the property as a manufactured home park or subdivision.

(Rs) Shoreline development (used only in Sec field)

Homes with parcel access to Cayuga Lake. This LU class will be coded in the Secondary field. Low Density Residential (RI), or Medium Density Residential (Rm) will be coded as the primary land use in the LuLc field.

(Rf) Farm house (used only in Sec field)

Farm headquarters and residence of farm family. Farming activity may or may not be occurring. This LU class will be coded in the Secondary field. Low Density Residential (RI) will be coded as the primary land use in the LuLc field

Commercial

Cbd Central Business District

Commercial/residential centers of city and villages where mixed land uses of Commercial, Public/Institutional, and high density Residential exist. There may be buildings that comprise more than one type of land use, such as a storefront on the first floor, offices on the second floor, and residences on the third floor. Land uses are mixed and are high in density. Any LULC classes that are not Commercial or Residential, and are at least one-half acre in area, will be delineated as per their interpreted class.

Cc Shopping Centers/Malls

Commercial areas that are predominately shopping centers and malls including significant surrounding parking facilities.

Cr Retail

Commercial areas along roadways not associated with distinct commercial centers or large shopping malls. Will include linear highway corridor development, as well as individual retail businesses and services that may exist within residential or industrial areas.

Co Offices

Buildings that contain administrative offices, as well as facilities that include business or technology services that are not predominantly retail orientated. Facilities may be part of a business/technology/industrial park. In some cases medical offices (Ph) may be included if they do not constitute the dominant land use.

Cs Commercial Storage

Indoor and outdoor commercial storage facilities for public rentals and warehouse/storage facilities not associated with adjacent commercial or industrial land uses.

Industrial

Tompkins County does not contain any heavy industry as defined by the LUNR classification system (processing of raw materials, such as oil refineries and mills), except for one lumber mill. The Industrial category has been altered from LUNR to meet the local needs of this project.

Il Light Industry

Facilities and grounds that include activities associated with the manufacturing, processing, fabricating, assembly, finishing, packaging, warehousing, and outdoor storage of products.

la Agriculture Industry

Buildings and facilities associated with agri-business.

lu Utilities

Power plants and substations.

le Extractive

Salt mining operations, gravel pits, rock quarries.

It Communication Towers

Communication tower sites at ground level including areas occupied by guide wires.

Outdoor Recreation

Og Golf Course

Includes driving ranges, club house and greens.

Om Marina/Yacht club

Public and private boat clubs and launching areas including clubhouse and associated buildings and boat yard.

Oc Campgrounds

Public and private camping areas, including areas designated for camping in state and town parks as well as private RV parks.

Ot Stadiums/track/ball fields

Sporting fields that may or may not be associated with schools and parks. Baseball diamonds, tennis courts, running track, soccer and football fields with goal posts, swimming facilities. Motor tracks included.

Oh Hunt clubs

Land areas used specifically for the sport of hunting. May include shooting range and fields for practice of this sport.

Op Parks

Public parks as well as Cornell Plantations including picnic areas, walking/hiking/running trails, playgrounds, manicured lawns, and landscaped areas within park boundaries.

Oe Recreation corridors

Areas characterized as linear recreation ways for uses such as trails and paths associated with outdoor recreation activities and pedestrian connections.

Or Youth & religious camps

Cabins and other buildings associated with summer camps and or religious retreats.

Os Recreational shoreline

Shoreline where land use is recreational lake access. Docks and boat moorings may exist. Consists of rocky shoreline land cover. Boundaries vary with lake levels.

Public/Private/Institutional

Pr Church/synagogue/monastery

Houses of worship. Will be delineated only if the parcel on which the facility(s) is located is at least one-half acre in area.

Pc Cemetery

Cemeteries at least one-half acre in area will be delineated.

Pe Educational

All schools, university and college academic buildings, research facilities, and associated parking facilities and quads. College campuses include other land uses that, if at least one-half acre in area, will be designated as distinct LULC classes. *Pe* will be used only for the academic and research related buildings and the surrounding parking lots and grounds. This class also includes other learning centers such as the Sciencenter, Cayuga Nature Center and the Fingerlakes School of Massage.

Ph Health facilities

Hospital, health clinics, medical offices, and nursing homes.

Pj Correctional facilities

County jail, secure work camps, and other correctional centers.

Pd Solid waste disposal

Waste disposal sites such as recycling centers, landfills, exposed dumps and private junk yards.

Ps Sewage treatment facilities

Facilities whose primary function is the treatment of waste water.

Pw Water management facilities

Facilities whose primary function is management of drinking water.

Pt Water Tank

Tank used as reserve of water, either for drinking water or for filling of fire department trucks.

Pp Public works

Areas that include facilities for highway departments, fire departments, public safety, maintenance buildings, and related storage areas. Public works facilities present on the educational campuses that are at least one-half acre in area will be classified as Pp.

Pf Community center, social hall, fraternal lodge

American Legions, Veterans associations, and community centers where social events, Bingo, pancake breakfasts and chicken bbq fund raisers occur.

Po Governmental office facilities

Includes all local, state, and federal governmental office facilities that are interpreted to be the dominant land use. This class includes courthouses, town halls, and other public service and administrative facilities.

Transportation

Th Highway

The limited access sections of Route 13 that include at least 4 total traffic lanes. Associated interchanges and ramps will also be delineated within this class.

Tr Railroads

Active railroad right of ways including switchyards.

Ta Airport or active airstrip

Includes all public and private airport facilities, hangars, parking facilities, and runways.

Tc Bus depot, fleet storage, garage for public vehicles

Places that store large number of cars, vans, trucks or buses for purposes of public use and transportation. Examples include Cornell's fleet storage, T-CAT, ISCD school bus depot.

Other

DI Disturbed Land

Land that has been cleared of vegetation and the interpretation of any identifiable or defined land use class is not possible.

Db Barren Land

Land that is composed of either rock, gravel or sand, which cannot be cultivated or associated with any other defined land use class.

Da Abandoned

Areas that include buildings and facilities that are interpreted as abandoned or vacant.

V.

Interpretation Issues

The following section presents aerial image interpretation problems and solutions that were identified during the pilot project phase and as the Final Methodology Report was developed. They are listed to clearly state those interpretation issues that may not be resolved to the complete satisfaction of the interpreter and project staff.

Problem: The processing of the DOQQs by Tompkins County has not included the balancing of the images and currently a range of color discrepancy exists between some of the DOQQs. This inconsistency between images is not an unmanageable issue as LULC interpretation occurs at the seams of the images, but is also not ideal.

Solution: The GIS division has received a trial version of ER Mapper 5.5 software that can be used to rectify this problem through a process of color balancing of the images. It is undetermined at this point whether the color balancing of the images will occur. If this step is not taken, current methods of adjusting the brightness on the monitor and a thorough evaluation of color differences between overlapping DOQQs will continue to be used.

Problem: *Ap* Pasture and *Ai* Inactive are sometimes difficult to differentiate from the primary data source and no secondary data source exists to contribute to the level of interpretation.

Solution: When there is question whether an agricultural field should be interpreted as pasture or is inactive agriculture, the primary interpretation is put in the *Lu* field and the secondary interpretation is put in the *Sec* field.

Problem: *Ay* Other Farms may or may not be active. These features appear as farms on the aerial photographs, but upon field verification during the Pilot Project many were found to be inactive farms with a primary Low Density Residential land use (*Rl*).

Solution: Field check/verify *Ay* areas. Classify associated residential polygon as appropriate based on minimum mapping units. Accept field verification and class code as 1999 status date, not 1994/1995 project date definition.

Problem: Mixed residential densities of low, medium, and high (*Rl*, *Rm*, *Rh*) exist for some areas and classes can not be individually delineated down to the minimum mapping unit in these areas.

Solution: In the areas of predominant residential uses the interpreter defines the density and associated classes with the use of RPS data to determine average lot size and average density. The dominant residential class will be defined and delineated for the residential area. Other residential classes within residential mapping areas will only be delineated if they are at least one-half acre in area and are obvious to the interpreter. It is evident that some parcels and areas of residential low density will be incorporated into areas of residential medium and high density, and vice versa.

Problem: // Light Industrial, and/or Cr Commercial Retail, and/or Co Commercial Office land uses may be located in the same building or building complex. Interpretation of a dominant land use within multiple use facilities is difficult.

Solution: Dominant and secondary land uses will be interpreted and coded by the analyst from primary and relevant secondary data sources. Field checks will be completed as needed for identified multiple use facilities. Code *Delta* field if using current land use and accept class code as 1999 status date, not 1994/1995 project date definition.

Problem: Mixed pockets with continuous transitions of land covers exist for some delineated areas defined by the Forest/Brush/Grass LULC classes. In some instances the individual classes within this heading can not be individually delineated down to the minimum mapping unit in these areas.

Solution: The dominant Forest/Brush/Grass class will be defined for the larger area being delineated. Other classes within the area will only be delineated if they are at least one-half acre in area and are obvious to the interpreter. It is evident that some areas of the various classes will be incorporated into larger areas. The solution to this problem will be a subjective call by interpreter based on definitions for these classes.

Problem: The interpretation and delineation of three quarter-quad sections were completed during the Pilot Project Phase. The Preliminary version of the LULC Classification System was incorporated during this phase. Numerous changes to the LULC Classification System have occurred and need to be incorporated into the three quarter-quad sections completed during the Pilot Project Phase.

Solution: The image analyst will systematically compare the Preliminary and Final versions of the LULC Classification

System and identify those classes which have been altered or revised in any manner. A selection of polygons contained within all altered classes will occur. The analyst will then re-interpret, and if necessary, re-delineate those LULC features as defined by the Final LULC Classification System. The Quality Control methodology and process will then be applied.

Problem: NWI secondary data for the northern part of Tompkins County is not complete.

Solution: Prioritize production for the southern Quads of the county. If the new NWI data set for the northern part of county is not available, the project will incorporate the DEC wetland data and field check where possible. Document where different wetland data sets were used and not used in final report.

Tasks Assigned to Intern

It is proposed that an intern will be employed to assist in the delineation of major land use features such as forest boundaries, agricultural lands and water bodies. The intern will be carefully instructed and familiarized with the interpretation of these areas on a DOQQ. He/she will only develop limited linework. The image analyst will then incorporate these lines in further interpretation and add /modify these lines as the interpretation dictates. The image analyst will review all linework to ensure that it has the same integrity and consistency.

In addition, interns may be able to assist in the quantitative review process.

VI. Quality Control

Technical Errors

The *Labelerrors* command is used to identify polygons with more or less than one label. This command lists all polygons that have either no label points or more than one label point. If more than one label point is found in a polygon, the User-ID of each label point is listed.

The label points can be checked in ArcInfo for a label in the *Lu* field by selecting *Lu = ""*. When labels that are selected have no value in the *Lu* field an LULC class will be added.

An additional option to check for missing data in the *Lu* field is to bring the coverage into ArcView as a theme. Open the table and sort the *Lu* field. The empty fields will appear together and can be fixed in ArcView if the DOQQ is brought in as a theme behind the LULC coverage. When a record in a table is selected, the 'zoom to polygon' button can be used in the view window. The correct LULC will be interpreted (use secondary data as necessary) and the table will be updated.

To verify mistakes made during the data entry of LULC codes, the analyst can open the Legend Editor in ArcView for the LULC theme and list the *Lu* field by unique value. Any mistyped LULC codes will become apparent and can be pinpointed and corrected within ArcView when a DOQQ is displayed behind the LULC coverage. By opening the table and sorting the *Lu* field the offending misspellings can be identified using the 'zoom to polygon' button to locate the selected polygon(s). The record(s) will be updated in the table and saved. After verification that the data set is error free and includes all LULC codes from the Final LULC Classification system a Legend (.avl) will be created for future quality control use. As the Legend file is applied, error based data entry codes will appear blank on the map and can be easily identified.

The USGS Quad lines will be assigned a user id of 1 (\$ID = 1). The quad lines, if inadvertently left intact, can be easily selected for elimination or identified for further inspection.

Interpretation Errors

ArcView will allow the analyst to plot a paper map of the data as a choropleth map with the Lu data printed on each colored polygon. This may allow any anomalies to appear. In addition, the analyst will print a paper map of the LULC data in a white line overlaying the DOQQ at 1:12,000 scale with the Lu data printed in white text on each polygon. Focus of this review will be placed on those classes determined to be problematic in the interpretation issue section of this document as well as where labels have been mistyped.

A staff person other than the primary image analyst must study this map for errors. It is important that a second pair of eyes look at the data. Once all the errors are marked, the analyst will go back to the computer and make the corrections.

A hard copy map of the LULC classes with the DOQQ as the background will be plotted with the 'v's in the 'Status' field displayed by adding the LULC data as a second theme and using the query builder to select the polygons marked with the 'v'. These data will be displayed on top of the LULC data, highlighted in yellow to differentiate these polygons from the rest of the LULC data. This hard copy output will be taken into the field for verification.

The Planning Department will review the output and will respond and make corrections as identified and agreed upon. Further quantitative reviews by the Planning Department may result in adjustments and additions to the established quality control measures and tasks.

VII. Fieldwork

When embarking upon the fieldwork component of this project, it is most useful to print out a map at a size and scale that is manageable in a car. One must be able to see the data clearly and the map must be of a manageable size. The data should be displayed that must be checked.

In ArcView, a quarter of a DOQQ prints out reasonably well at 1:12,000 on a page that is 11"x17". The DOQQ should be the background, with the LULC data on top of it, and a layer of the sites where a 'v' has been placed in the status field. Roads and road names should also go on this map.

With maps in hand, the person doing the fieldwork will drive out to the areas that are marked 'v' on the map. The area will be located and the

actual LULC class verified and recorded on the map. Other pertinent notes will be recorded on the map and entered into the *Comments* field upon return to the computer.

Upon completion of the fieldwork, all updates to the coverage will be made and any additional errors that may have been discovered will be edited.