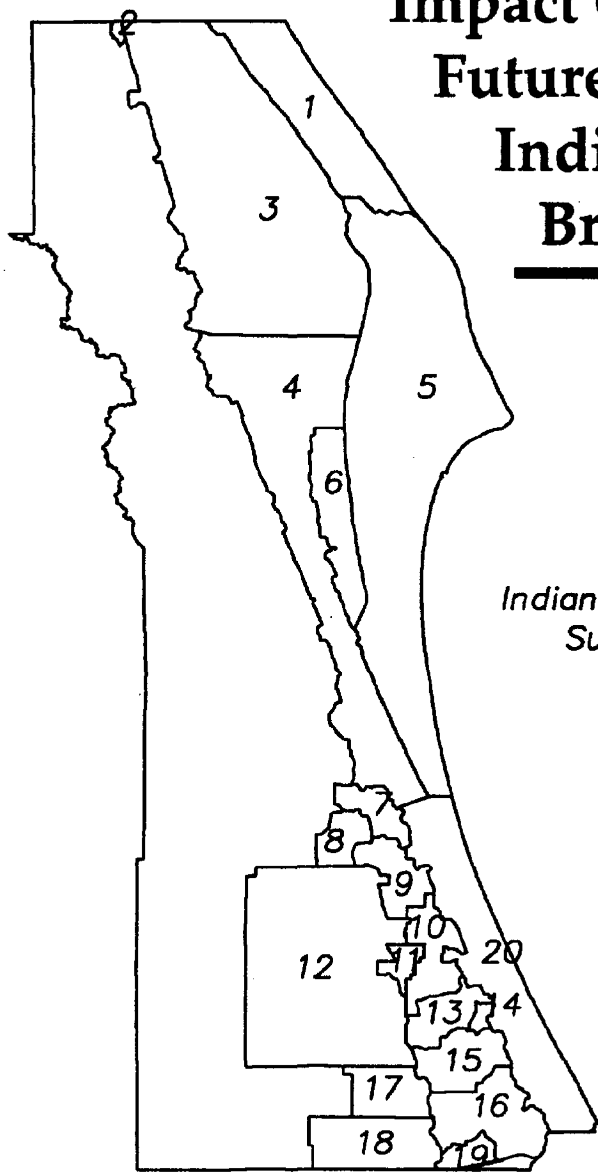
CM-272
Project 3.5
CZ228

Impact Of Proposed Future Land Uses On The Indian River Lagoon, Brevard County

December, 1990

PRELIMINARY DRAFT



Indian River Lagoon Sub-Basins

East Central Florida Regional Planning Council

Principal Investigator:
M. J. Gilbrook

Florida Department of Environmental Regulation
Coastal Zone Management Contract CM - 272

IMPACT OF PROPOSED FUTURE LAND USES ON THE INDIAN RIVER LAGOON, BREVARD COUNTY

A STUDY PREPARED UNDER CONTRACT TO THE
FLORIDA DEPARTMENT OF ENVIRONMENTAL REGULATION
OFFICE OF COASTAL MANAGEMENT

CONTRACT CM 272

DRAFT FINAL REPORT: DECEMBER, 1990

PRELIMINARY
DRAFT

Principal Investigator

Michael J. Gilbrook
Section Chief
Special Projects

East Central Florida Regional Planning Council
1011 Wymore Road, Suite 105
Winter Park, FL 32789

Funds for this project were provided by the Department of Environmental Regulation, Office of Coastal Management, using funds made available through the National Oceanic and Atmospheric Administration under the Coastal Zone Management Act of 1972, as amended.

REPORT DOCUMENTATION PAGE

1. Report No.
2.
3. Recipient's Accession No.

4. Title and Subtitle
Impact of Proposed Future Land Uses on the Indian River Lagoon, Brevard County

5. Report Date
December 1990

6.

7. Author(s)
Michael J. Gilbrook

8. Performing Organization Rept. No.
CM - 272

9. Performing Organization Name and Address
East Central Florida Regional Planning Council
1011 Wymore Road, Suite 105
Winter Park, FL 32789

10. Project/Task/Work Unit No.

11. Contract(C) or Grant(G) No.
(C) NA89AA-D-CZ 228
(G)

12. Sponsoring Organization Name and Address
U.S. Dept. of Commerce/NOAA
OCRM
1825 Connecticut A., N.W.
Washington D.C. 20235

Dept. of Env. Mgmt.
Coastal Management
2600 Blair Stone Rd.
Tallahassee, FL 32399

13. Type of Report & Period Covered
Final

14.

15. Supplementary Notes

16. Abstract (Limit: 200 words)

The Growth Management and Land Development Regulation Act of 1985 (Chapter 163, F.S.) required that all local governments in Florida prepare comprehensive plans which outline thier intended growth pattern over a ten year period. Central to the comprehensive plan is the Future Land Use Map, which pictorially represents the local government's growth strategy. Unfortunately, although each comprehensive plan undergoes review by the Regional Planning Council and the Florida Department of Community Affairs, no mechanism exists to examine the combined effect of all local plans in a county on natural resources. This study used PC ARC/INFO, a Geographic Information System (GIS), to examine the impact of the proposed future land use scenarios in Brevard County on vegetative cover, floodplains and stormwater pollution loadings in the Indian River Lagoon watershed. The analysis revealed that the Indian River Lagoon watershed within Brevard County will experience significant losses in natural vegetative cover and floodplains if the area builds out as proposed. Despite the imposition of stormwater pollution treatment standards by many local governments, the increased development within most sub-basins will cause pollutant loadings to the Indian River to increase.

17. Document Analysis a. Descriptors

b. Identifiers/Open-Ended Terms

Coastal zone management/Growth Management/Chapter 163, F.S./Chapter 9J-5, F.A.C./Brevard County/Indian River/Geographic Information System/GIS/ PC ARC/INFO / Habitat loss/Floodplain encroachment/Stormwater pollution loading

c. COSATI Field/Group

18. Availability Statement:

19. Security Class (This Report)
Unclassified

20. Security Class (This Page)

21. No. of Pages

22. Price

EXECUTIVE SUMMARY

The Growth Management and Land Development Regulation Act of 1985 (Chapter 163, F.S.) required that all local governments in Florida prepare comprehensive plans which outline their intended growth pattern over a ten year period. Central to the comprehensive plan is the Future Land Use Map, which pictorially represents the local government's growth strategy. Unfortunately, although each comprehensive plan undergoes review by the Regional Planning Council and the Florida Department of Community Affairs, no mechanism exists to examine the combined effect of all local plans in a county on natural resources.

This study examined the impact of the proposed future land use scenarios in Brevard County on vegetative cover, floodplains and stormwater pollution loadings in the Indian River Lagoon watershed. The PC ARC/INFO Geographic Information System (GIS) was used to manipulate digital maps of existing land use, future land use, jurisdictional boundaries and floodplains in order to generate areal coverage data. The resulting analyses revealed that the Indian River Lagoon watershed within Brevard County will experience significant losses in natural vegetative cover and floodplains if the area builds out as proposed. Despite the imposition of stormwater pollution treatment standards by many local governments, the increased development within most sub-basins will cause pollutant loadings to the Indian River to increase.

ACKNOWLEDGEMENTS

The following people were helpful in the preparation of this study: Mr. Jim Cameron, SJRWMD, provided the Indian River Lagoon watershed files in AI format. Mr. John Higman, SJRWMD, agreed to allow Florida Institute of Technology to organize their existing land use digitizing schedule so as to best benefit this project's timeline. Mr. Higman was also responsible for allowing the ECFRPC to use some "pre-release" versions of the Indian River existing land use data. Dr. Hillary Swain, Ms. Anne Jackson and Ms. Vicki Larson of FIT were all very helpful in feeding land use data to us as it became available. Finally, Mr. Jim Stoutamire, FDER, deserves special consideration for his assistance as contract manager for this project.

INTRODUCTION

Florida's Growth Management and Land Development Regulation Act of 1985 (Chapter 163, F.S.) requires that all cities and counties prepare a comprehensive plan which is consistent with the State Plan (Chapter 185, F.S.) and the appropriate Comprehensive Regional Policy Plan (CRPP). To ensure compliance, the Florida Department of Community Affairs established minimum criteria to be met in the preparation of local comprehensive plans. Rule 9J-5, F.A.C. identifies the type of data to be collected and analyses to be performed as a prelude to the development of goals, objective and policies.

Local governments located within the coastal zone must prepare a Coastal Management Element as part of their plans. One of the priorities of the element is to restrict development where such would damage or destroy natural coastal resources. Plans for coastal areas, like those of all local government comprehensive plans, must also have a Conservation Element which provides additional protection to natural resources. The background analysis requirements for the Conservation and Coastal Management Elements include assessment of Future Land Uses on the following: (1) floodplains [9J-5.013(1)(a)2.] and areas subject to coastal flooding [9J-5.012(2)(b)]; (2) vegetative cover [9J-5.012(2)(b) and 9J-5.013(1)(1)5.], including wetlands [9J-5.012(2)(b) and 9J-5.013(1)(a)1.]; and (3) impacts to water quality and the accumulation of contaminants in sediments [9j-5.012(2)(b)].

In April and May of 1988, Brevard County and the fifteen (15) cities located within the county submitted their revised Comprehensive Plans to the Department of Community Affairs. These plans were the first in Florida to be submitted under the new growth management legislation and provided an early indication of how local governments would approach the management of future coastal development and the protection of coastal resources under the new law.

The review of these plans revealed a major shortcoming in terms of their ability to assess the full effects of all proposed development on the Brevard County coastal zone. Each comprehensive plan assessed only the impacts caused by development located within its jurisdiction. This process failed to account for concurrent impacts from proposed development in adjacent jurisdictions. Future impacts in any given jurisdiction were measured against existing conditions, and not the condition which would exist if all proposed development in the county were to materialize. Consequently, the cumulative impacts of development and re-development plans on coastal resources in the county were not adequately addressed.

The purpose of this study was to assess some of those cumulative impacts for the Indian River Lagoon watershed within Brevard County. By using PC ARC/INFO, a Geographic Information System

(GIS), digital maps of existing land use, future land use, and floodplains could be overlayed. The results of the GIS overlay analysis, combined with other forms of computerized data processing, would help to reveal the impacts of Brevard County's collective future land use plans on the natural habitat, floodplains and stormwater pollution potential for the area within the Indian River Lagoon watershed.

METHODOLOGY

STUDY AREA

The study area included those parts of Brevard County within the Indian River lagoon watershed, as described in Steward and VanArman (1987). Federal properties (Kennedy Space Center, Cape Canaveral Air Force Station and Patrick Air Force Base) were excluded from the analysis because these areas are not subject to the Local Government Comprehensive Planning and Land Development Regulation Act (s. 163.3161, F.S.). In order to provide more useful statistics for the stormwater pollution loading analysis, the Indian River watershed was further subdivided into twenty (20) sub-basins per Steward and VanArman (1987). A list of the sub-basins appears in Table 1.

OVERVIEW OF GIS ANALYSIS

This study was conducted using PC ARC/INFO, a computerized Geographic Information System (GIS). A GIS allows for the use of computer stored, digital maps in a spatial analysis, similar to the way a computer spreadsheet conducts a numerical analyis. Using a GIS, digital maps may be electronically modified, combined and overlayed to produce new information in a way which would be difficult if not impossible to do by any manual method.

The use of a GIS involves several distinct phases. The first is data collection, whereby the data one wants to use in the study are organized in a fashion suitable for input into the computer. The next phase is data capture. In this phase the data are entered into the computer system in a form suitable for analysis. This step usually involves a digitizing the data using an electronic "tracing" tablet, although other forms of data capture (such as the use of remote sensing data) are also available. Editing errors and re-organizing the data into meaningful data themes or layers also occurs during the data capture phase. The analysis phase follows data capture. Various GIS procedures are employed during the analysis phase in a planned series of steps, often referred to as a model, which are designed to produce the desired results. The model for this study will be described in greater detail below. The last GIS step is the output phase, which involves the production of both tabular data and hardcopy maps.

GIS HARDWARE AND SOFTWARE

Software. The study employed several software products. AutoCAD version 9 was used to digitize spatial data and export files into DXF (Data Exchange File) format for importation into the GIS. The GIS used for this study was PC ARC/INFO Release 3.3, including the supplemental release dated 10/ /89. Tabular data exported from PC ARC/INFO were analyzed with R:base version X.X, and SPSS-PC+ version X.X.

Hardware. A Compaq Model 386/20 microcomputer served as the platform for PC ARC/INFO. The Compaq was an 80386 chip-based, 20 MHz machine equipped with a 60 Mb hard-drive and a 20 Mb, 5.25" Bernoulli cartridge drive. The 60 Mb hard drive supported two, 30 Mb partitions, one for programs and one for data. The Bernoulli cartridge drive was used for data exchange between computers as well as data backup. AutoCAD functions employed both the Compaq and a Wyse Model 12 (80286 based, 12 MHz) computer. The Wyse was also equipped with a 5.25" Bernoulli cartridge drive. Calcomp 9100 digitizing tablets were used for original data entry using AutoCAD, but editing in PC ARC/INFO employed a separate Genius mouse. Hardcopy plots for both AutoCAD and PC ARC/INFO were made on a Calcomp 1043 high-speed, 8-pen plotter.

GIS DATA ENTRY AND FORMAT

Data Collection. Since the data were collected from a variety of sources in various different ways, the data collection process is described under GIS DATA THEMES for each data layer.

Data Capture. Except for those cases where map data were obtained in a digital format from another agency, data were digitized by the ECFRPC using AutoCAD. Paper manuscripts were calibrated using Universal Transverse Mercator (UTM) coordinates. For digitizing from USGS 1:24,000 quadrangle maps, corner UTM coordinates were obtained from digital (AutoCAD) quad boundaries whose corner coordinates were calculated from the original latitude/longitude by the Florida Resource and Environmental Analysis Center (FREAC). Floodplain maps were calibrated using either quad corners, or the coordinates of section line corners digitized from 1:24,000 USGS quadrangle maps by FREAC.

Map data were digitized directly into USGS 1:24,000 quadrangle boundary files. The use of quadrangle files formed using calculated corner coordinates ensured perfect edgematching of quadrangle borders. Polygon borders were digitized individually using the AutoCAD polyline function; polygons were not "closed" in AutoCAD as separate entities. Each polygon was labeled by one or more alphanumeric text strings on either the same layer as the polygon boundary, or on a special, separate layer. For example, future land use polygons appeared on Layer 10, and their labels on Layer 11. All polygon intersections were completed using AutoCAD "snap" functions (i.e., either "end of" or "near to"). Polygon boundary lines were snapped to quad boundaries and to the ends of polygon boundary lines from adjacent quads. To ensure consistent use of a county boundary between all files, the Brevard County boundary was digitized from 1:24,000 USGS quad maps in AutoCAD and inserted into each quad, as appropriate. Floodplains, future land use and jurisdictional polygons were terminated against the county boundary.

Floodplain and future land use data were maintained in separate AutoCAD drawing (DWG) files by USGS 1:24,000 quadrangle. Files were named using a three letter prefix to indicate the data theme (i.e., "FLD" for floodplain and "FLU" for future land use), followed by a three digit index number (e.g., "FLD-042"). Figure 1 illustrates the USGS quads used in the study, and provides an index to the quadrangle numbers.

AutoCAD to PC ARC/INFO Conversion. DXF files were generated using the AutoCAD DXFOUT command. File names followed the same naming convention used for AutoCAD drawing files, except that names carried a "DXF" rather than "DWG" file extension. In addition to the FLU and FLD files, a series of DXF files containing jurisdictional ("JUR") boundaries (i.e., city, county and federal property lines) were generated from line work stored in the FLU drawing files.

DXF files were converted into PC ARC/INFO "coverages" using the PC ARC/INFO DXFARC command. A coverage corresponded to a single DXF file, and used the same naming convention (e.g., the coverage for floodplain quad 42 was "FLD-042"). To complete the conversion into PC ARC/INFO format, polygon label information from the DXF file was associated with its proper polygon in the PC ARC/INFO coverage using various relational operators within PC ARC/INFO (e.g., "JOINITEM"). This last step transfered the text label in each AutoCAD polygon to a value in a new PC ARC/INFO "item" (i.e., database field) generated for that purpose. For example, floodplain identifiers ("UP," "FL" or "N.I.C.") were stored in an item called "FLD-TYPE."

Despite the care taken to snap lines together at intersections in AutoCAD, conversion of DXF files to PC ARC/INFO coverages resulted in coverages which contained numerous incomplete (i.e., "dangling") polygon lines, presumably as a result from mathematical rounding errors in the conversion process. Polygon "node" and "label" errors were corrected using the PC ARC/INFO ARCEDIT function. Finally, edgematching of polygon boundaries across quads was assured using the PC ARC/INFO EDGEMATCH program.

GIS DATA THEMES.

The study required the use of six different GIS "layers" or "themes." A theme represents a single kind of spatial information for the county: floodplains, future land use, existing land use, stormwater pollution loading, federal properties or watershed boundaries. Except for watershed boundaries, each theme consisted of a number of separate PC ARC/INFO quad-based coverages which together cover the entire county (or, at minimum, the study area). The watershed theme consisted of a single coverage which contained watershed sub-basins, and was used to subdivide the remaining themes during the analysis. Each theme is described in more detail below.

Floodplains. The 100 year floodplains ("A" Zones) were digitized directly from FEMA Flood Insurance Rate Maps (FIRMs). Floodplains were labeled "FL" and upland (i.e., non-floodplains) areas were labeled "UP." Areas outside Brevard County were labeled "N.I.C."

for "Not In County." Floodplains were digitized for the entire county, except those areas within the Kennedy Space Center (KSC) or Cape Canaveral Air Force Station (CCAFS). Floodplains digitized within Patrick Air Force Base (PAFB) were later removed using the UPDATE procedure (see Federal Properties, below). Floodplain designations were stored in the item "FLD-TYPE."

Future Land Uses. Future land use maps were obtained from the adopted comprehensive plans of all local governments in Brevard County. Due to the large scale (i.e., small size) of many of the maps, supplemental maps at a smaller scale were requested from the local governments. Once adequate maps had been obtained, the future land use designations of the maps were simplified to a common coding system (Table 2). This simplified scheme represents the minimum future land use categories required in local government comprehensive plans by the Florida Department of Community Affair's "Minimum Criteria Rule," s. 9J-5.XXXX, F.A.C.

Polygons representing areas of common future land use were transcribed to tracing paper overlays registered to USGS 1:24,000 quadrangle maps. In those cases where the absence of features (e.g., roads) on the USGS quad map made the identification of a future land use polygon boundary impossible, the polygon's boundaries were generated by scaling from known locations on the source and quad maps. Municipal boundaries were also identified and drawn on the future land use overlay. Future land use designations were stored in the item "FLU-TYPE." No future land use designations were recorded for the area within KSC, CCAFS or PAFB.

Stormwater Pollutant Loading. The stormwater detention/retention level of service (LOS) for each jurisdiction was obtained from Drainage, Conservation or Coastal Element of each comprehensive plan (Table 3). Each local government was assigned a pollution control rating based on its required level of stormwater treatment: 1 = Retention, 2 = Detention and 3 = None specified. Local governments which specified a drainage LOS in terms of a design storm but had no local ordinance requiring stormwater treatment evidently only required that developed areas drain adequately.

Local government jurisdictional boundary polygons were stored in the JUR series of PC ARC/INFO coverages. Each polygon was labeled with the name of the jurisdiction, which was stored in the "JUR-TYPE" item. The treatment level code (item "SW_TREAT") was related to each local government polygon in the JUR coverages using the relational JOINITEM command.

Existing Land Uses. Existing land use data were obtained from the Florida Institute of Technology. FIT prepared existing land use maps for the Indian River Surface Water Improvement and Management (SWIM) project under contract to the St. Johns River Water Management District (SJRWMD). The maps provided to ECFRPC were intermediate products which had not yet undergone final quality control and editing. FIT and SJRWMD agreed to provide the data to ECFRPC on the understanding that the data may contain minor errors or other discrepancies. Furthermore, ECFRPC agreed that the data would be used for this project only, and would not be re-distributed. Nevertheless, these land use maps constituted the most recent and detailed land use available for the Indian River lagoon watershed in Brevard County. Minor errors in the shape or identification of polygons were considered insignificant for the regional scale analysis conducted here.

Using 1989 black and white aerial photography obtained from the Florida Department of Transportation, FIT transcribed land use polygons to Mylar overlays registered to 1:24,000 USGS quad maps. Polygons were labeled using Level III codes from the Florida Land Use, Cover and Forms Classification System (FDOT, 1985). FIT provided XX quads to ECFRPC in PC ARC/INFO EXPORT format. FIT provided ECFRPC with copies of the original quad overlays for the remaining XX quads, and ECFRPC digitized them in AutoCAD and used DXFARC to convert them to PC ARC/INFO format.

Following importation of FIT's existing land use coverages from PC ARC/INFO EXPORT format, the coverages were renamed to the ECFRPC quad naming convention using the prefix "ELU." Since the existing land use coverages were digitized using Florida State Plane, East Zone coordinates, quads were transformed from State Plane to UTM coordinates using the PC ARC/INFO PROJECT command. Some of the FIT quads were digitized using "hand digitized" quad boundaries, rather than boundaries created from calculated corner points. Although EDGEMATCH was used on these quads to join quad edges, some polygons did not match properly across quad boundaries. However, the resulting discrepancies were considered insignificant for this regional scale analysis.

FLUCCFS Level III land use codes are three-digit numeric values. The first digit indicates the general, or Level I, land use category (e.g., "600" means "wetlands"). The second, Level II, digit provides more detail (e.g., "610" means "wetland hardwood forest"), and the Level III digit indicates the most specific identification (e.g., "612" means "mangrove swamp"). Land use designations were stored in a character item called "LANDCOVER." In order to perform operations on the land use maps at Level I or Level II, it was necessary to create a numeric item for the land use code. The PC ARC/INFO command REDEFINE was used to generate a three digit, integer item called "LC" which contained the same three digit, character information stored in LANDCOVER. Later, LC could be used to RESELECT polygons based on Level I or Level II designations using logical operators (e.g., "greater than," and "less than").

<u>Federal Properties</u>. The boundaries of federal properties (i.e., Kennedy Space Center, Cape Canaveral Air Force Station and Patrick Air Force Base) were converted from AutoCAD to PC ARC/INFO as quad-based coverages using the prefix "FED." These coverages were used to replace detailed floodplains or existing land use polygons with a polygon representing the federal properties using the PC ARC/INFO UPDATE routine. In essence, the FED coverages were used

to "cookie cutter" the federal lands out of the floodplain and existing land use coverages to exclude them from analysis. The UPDATE procedure required that the item specifications in the FED coverages match exactly the items in the coverages to be updated. Consequently, FED coverages contained the items LANDCOVER and LC for updating ELU coverages. The codes "991," "992" and "993" were used to signify KSC, CCAFS and PAFB, respectively. Copies of the FED coverages for quads 92 and 105 were generated using a FLD-TYPE of "PAFB" for use in updating the floodplain coverages for those quads.

Watershed Boundaries. The Indian River watershed boundaries as described in Steward and VanArman (1987) were obtained from the SJRWMD in PC ARC/INFO EXPORT format as a single coverage. Following importation into the ECFRPC PC ARC/INFO system, the boundaries were transformed from State Plane coordinates to UTM using the PROJECT command. A new item, "CZM_BASIN," was added to the coverage for assigning integer values to each sub-basin. The PC ARC/INFO RESELECT command was used to create a new coverage called "BR-BASIN" containing only those sub-basins in Brevard County. Figure 2 illustrates the twenty (20) sub-basins which comprise the part of the Indian River watershed which falls within Brevard County. Table 4 provides a brief description of each basin.

GIS MODELING AND ANALYSIS PROCEDURE

Pre-Analysis Preparations. Several preparatory steps were needed prior to conducting the actual GIS analysis. These steps were essentially the same for each data theme. First, the PC ARC/INFO UPDATE command placed polygons representing federal properties (KSC, CCAFS and PAFB) from the FED coverages for quads 043, 044, 054, 055 065, 067, 078, 079, 092 and 105 into the appropriate ELU and FLD coverages. Next, individual quad-based coverages for the FLD, FLU and JUR themes were assembled into a single, large coverage using the PC ARC/INFO MAPJOIN command. The PC ARC/INFO SPLIT procedure cut those coverages into coverages corresponding to the 20 Indian River lagoon sub-basins in the BR-BASIN coverage. Coverages were named according to the sub-basin number (e.g., "FLD-B01" for floodplains in Basin 1). Finally, sliver polygons of area less than 1,000 m2 (approximately 0.25 acres) were removed using the PC ARC/INFO ELIMINATE function. The entire process is illustrated in Figure XX.

In the case of the ELU coverages, the approximately 20 Mb of hard drive space on the Compaq 386/20 or Bernoulli drives was insufficient to hold the large temporary files which PC ARC/INFO required during the MAPJOIN process. To reduce the size of the contributing quad coverages, new quad coverages containing land use data only within the study boundary were created using the PC ARC/INFO CLIP program. Unfortunately, the files were still too big to MAPJOIN directly even with the extraneous land use removed. Consequently, we disaggregated the BR-BASIN coverage into its constituent sub-basins using the PC ARC/INFO RESELECT command.

These individual basin coverages (named BASIN-XX, where "XX" equalled "01" through "20") were used to CLIP the ELU quads, thereby creating sub-basin "fragments" from various quads. The "fragments" were combined into complete sub-basin coverages using MAPJOIN. This process is illustrated in Figure XX.

Vegetative Cover Impact Analysis. This step required the detection of changes in land use between the ELU and FLU coverages. A Quattro spreadsheet was generated containing all the codes used for the ELU coverages' LANDCOVER item in a single column. In another column, designated "ELU_TYPE," alphabetic codes were assigned to each LC value using a "collapsed" (i.e., generalized) classification scheme like that employed for FLU coverages. New value names were generated for those LC codes which had no corresponding FLU_TYPE code (e.g., "RANGE" for the 300 LC codes, "FOREST" for the 400 codes). A listing of the correspondence between LANDCOVER and ELU_TYPE codes appears in Appendix A. An additional column, "SWR_ELU," was also generated in the spreadsheet table at this time. It will be described further under the Stormwater Runoff Impact Analysis section.

Using a variety of software tools (Quattro, R:base and Wordperfect), the Quattro spreadsheet containing the LC and ELU_TYPE values was converted into an ASCII comma-delimited file. This file was imported into PC ARC/INFO using the ADD FROM command to create the "SWR_ELU.DAT" table. The data within SWR_ELU.DAT were added to the .PAT files of each ELU-BXX (i.e., sub-basin) coverage using the PC ARC/INFO ADDITEM and JOINITEM commands.

Following completion of the JOINITEM procedure, the ELU and FLU coverages were overlayed using the PC ARC/INFO UNION command to create a series of DLU (i.e., "Difference in Land Use") coverages. The DLU coverages contained all the items found in each of the contributing ELU and FLU coverages. A new item, FLU_DIFF, was generated within the PC ARC/INFO TABLES module to mark those polygons for which ELU-TYPE and FLU-TYPE differed. A series of logical selections (Table 5) identified those polygons which would not change in land use/land cover; those polygons were assigned a FLU_DIFF value of "N" for "No" change. The remaining polygons were assigned "Y" values. Land uses which would not change included those for which existing and future land use types were the same, as well as those areas proposed as future conservation ("CON") sites. Wetlands, water bodies and highways in the existing land use data took precedence over future land use assignments which don't include these categories.

To complete the analysis, area data for polygons in all DLU coverages were output into ASCII format using the PC ARC/INFO DUMP routine. These data files were imported into SPSS PC+, which generated cross-tabulation tables between existing and future land use categories. The CROSSTAB function provided row, column and cell totals and percentages for the combined area of polygons which fell within each combination of existing and future land use types. These data were used to determine how much natural vegetation currently existed in each watershed and how much would remain following complete build-out of the future land use plan. The cross-tabulation matrix also allowed for comparative analysis of the various types of conversion (e.g., how much forest land was to be converted to residential, commercial or industrial use). A separate cross-tab analysis was conducted for those records for which the future and existing land uses differed (i.e., FLU_DIFF = "Y").

Floodplain Impact Analysis. The DLU coverages from the Vegetative Cover Impact Analysis were overlayed with the corresponding FLD coverages for each sub-basin using the PC ARC/INFO UNION command to create DFL ("difference in floodplain") coverages. The area data for each polygon in the DFL coverages were output into ASCII format using the PC ARC/INFO DUMP routine. These data files were imported into SPSS PC+, which generated cross-tabulation tables between floodplain category ("UP," "upland" or "FL," "floodplain") and both existing and future land use categories. The cross-tabulation analysis provided an inventory of how much floodplain area remained undeveloped under existing and proposed build-out conditions, as well as what kinds of land uses occurred within flood prone areas under existing and proposed conditions. A separate cross-tab analysis was conducted for those records for which the future and existing land uses differed (i.e., FLU_DIFF = "Y").

Stormwater Runoff Impact Analysis. As was previously described (GIS DATA THEMES, Stormwater Pollution Loading), stormwater treatment codes ranging from one (1) to three (3) were assigned to each local government jurisdiction based on the level of treatment required in its comprehensive plan (Table 3). An INFO table called "SWR_CODE.DAT" containing the jurisdiction name ("JUR-TYPE") and stormwater code ("SWR_CODE") was generated from this list. The SWR_CODE values were attached to jurisdiction polygons in the JUR coverages using the PC ARC/INFO JOINITEM command.

Next, the twenty JUR sub-basin coverages were overlayed with their DLU coverage counterparts to create the SWR series of coverages. The DLU coverages already contained a "SWR_ELU" item which was added to the ELU coverages from the "SWR_ELU.DAT" table (see "Vegetative Cover Impact Analysis," above). The SWR_ELU item held the generalized land use codes used in the assignment of pollution loading factors (see below). SWR_ELU codes were related to their appropriate Level III land use code (i.e., "LANDCOVER") in the SWR_ELU.DAT table, and consequently assigned to each polygon in the ELU coverages based on the LANDCOVER value. Following the UNION operation, a series of logical selections (Table XX) were used to assign the value of "SWR_FLU" to each polygon based on its proposed future land use type.

The area data for each polygon in each SWR coverages were output into ASCII format using the PC ARC/INFO DUMP routine, then imported into a series of R:base relational database files. R:base files were named using the same convention as the PC ARC/INFO coverages from which they were obtained (i.e., "SWR_BXX," where "XX" was the sub-basin number from "01" to "20").

Pollutant loading rates (kg/ha/yr) for various land uses were obtained from SFWMD (1990) and ECFRPC (1985). The data from the SFWMD (1990) study were more detailed, providing a break-down of loading rates for more land use categories than were reported in ECFRPC (1985). Furthermore, the SFWMD study provided loading rates for orthophosphorus, total zinc and total lead which were not provided in the ECFRPC report. Consequently, this study used the SFWMD loading rates, with some supplementation by the ECFRPC data. The loading rate data appear in Table XX.

The pollution loading rate data were imported into an R:base file called "SWR_LOAD." Two copies of SWR_LOAD were generated within R:base, "ELU_LOAD" AND "FLU_LOAD" for existing and future land use, respectively. The LAND_USE item in each file, whose values matched those used in the was renmaed "SWR_ELU" or "SWR_FLU" as appropriate. Using these items, the two pollution loading data tables were independently matched with the R:base files for each sub-basin using the R:base INTERSECT command. Two sets of output files were obtained by this relational operation: a series of stormwater pollution data files based on existing land use ("ESW_BXX"), and a series based on future land use ("FSW_BXX").

MAP PRODUCTION AND OUTPUT

Vegetative Cover Impact Analysis.

Floodplain Impact Analysis.

Stormwater Runoff Impact Analysis.

RESULTS AND DISCUSSION

NOTES ON THE METHODOLOGY.

Computer Limitations.

Importance Of Macros.

VEGETATIVE COVER IMPACT ANALYSIS.

Statistics on the cross-tabulation of generalized existing and future land uses appear in Table XX. Appendix XX provides cross-tabulation results of the detailed Level III existing land use codes against future land use type for those polygons which changed land use.

FLOODPLAIN IMPACT ANALYSIS.

Statistics on the cross-tabulation of flooplain type against generalized existing and future land uses appear in Table XX. Appendix XX provides cross-tabulation results of floodplain type against the detailed Level III existing land use codes against future land use type for those polygons which changed land use.

STORMWATER RUNOFF IMPACT ANALYSIS.

Estimated stormwater pollution loading values for existing conditions appear in Table XX. Table XX provides the pollution loading estimates for the future land use scenario.

LITERATURE CITED

APPENDICES