

**A REPORT ON  
LAND USE PATTERNS  
IN THE  
SACRAMENTO-SAN JOAQUIN  
DELTA**

December 1993

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State of California  
The Resources Agency  
Department of Water Resources  
Division of Planning

**A Report on Land Use Patterns  
in the Sacramento-San Joaquin Delta**



**December 1993**

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## Foreword

The Sacramento–San Joaquin Delta has been the focal point for a wide variety of water–related issues for decades, generating more investigations than any other waterway system in California. It is the hub from which two–thirds of the State’s population and millions of acres of agricultural land receive part or all of their supplies. The Delta provides habitat for many species of fish, birds, mammals, and plants while also supporting extensive farming and recreational activities. Many different interests have a vital stake in the Delta: farmers, fish and wildlife groups, environmentalists, boaters, people involved with shipping and navigation, and the people and industries that receive water from the Delta and the State’s two largest export systems, the State Water Project and Central Valley Project.

In 1992, two pieces of legislation were enacted to address the need for a coordinated management plan for resources within the Delta. One, SB 1866, established the Delta Protection Commission, with a mandate to prepare a comprehensive long–term resource management plan for the land uses within the primary zone of the Delta. The other, SB 443, required the Department of Water Resources to submit to the Legislature a report on the land use patterns within the Delta. This report is in response to SB 443 and is intended to be an aid to the Delta Protection Commission in preparing the Delta resource management plan.

The report summarizes land uses in the Delta and presents the basic land use data in tables and maps. The categories of land use are summarized by the Legal Delta, the primary and secondary zones of the Delta, and by counties within the Legal Delta. Two different years of land use, 1976 and 1993, are presented, as well as the change in land use between these years.



Edward F. Huntley, Chief  
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## I. Introduction

The Department of Water Resources prepared this report as a requirement of SB 443 (approved September 26, 1992), which added Section 12228 to the Water Code. The legislation requires the Department "to submit to the Legislature, on or before January 1, 1994, a report on land use patterns, within the boundaries of the delta and the lands immediately adjacent to the delta." Funds were authorized by the Department to carry out the project in the spring of 1993.

This report is also a source of information for the Delta Protection Commission, which was created through SB 1866 (approved September 23, 1992). Under this legislation, the commission is "to prepare and adopt, in accordance with prescribed procedures, and thereafter review and maintain, a comprehensive long-term resource management plan for the Delta, which meets specified requirements for the primary zone, as defined." Figure 1 is a map of the Delta, and includes the primary and secondary zones.

This report provides data and maps showing the current land use (1993), historical land use (1976), and land use changes between 1976 and 1993 throughout the Delta. This report provides both spatial and temporal land use patterns information about the Delta.

The information developed in this report was created using computer mapping technology, often referred to as geographic information system (GIS) technology. The Department's Division of Planning used the GRASS GIS with the assistance of University of California at Berkeley. GRASS is an acronym for Geographic Resources Assessment Support System. The Department's 1976 Delta land use survey was digitized and entered into the GIS. The previously digitized 1991 Delta land use survey was transferred from another computer system to the new system, and updated to reflect the land use for 1993. The GIS was used to summarize land use acreage in various ways, to produce maps depicting current and historical land use, and to depict the changes in land use that have occurred in the past 17 years. The 1976, 1991, and 1993 Delta land use surveys were performed by the Department's Division of Local Assistance, Central District.



## **II. Data Collection, Processing And Reporting Procedures**

### **Data Collection**

#### **The Department of Water Resources' Land Use Survey Program**

The Department has operated a land use survey program for more than 40 years. The information generated from this program is used in a number of water planning studies and computer models by the Department, outside agencies, and engineering and environmental consulting firms. Surveys are usually done by county, although they are also done for important regions such as the Delta. The major agricultural counties of California are each resurveyed approximately every seven years.

The surveys use low elevation (5,500 feet) aerial photography. The photography is 35 millimeter natural color slides that cover about one square mile of land at a scale of approximately 1:62,500. From 1,500 to 3,000 slides can be taken for a survey, depending on the size of the survey area. The land use boundaries are delineated from the slides on a USGS 1:24,000 7-1/2 minute quadrangle. If possible, the land use is coded onto the map at the time of projection. These maps are then taken to the field to verify boundaries and positively identify land uses, entering the uses on the map as codes. The land use legend that the Department uses to code the land uses is very detailed and is shown in Figure 2. Specific crops are identified instead of crop types, in the case of agricultural land. Urban land can be identified as residential, commercial, and industrial and can be further detailed as required.

Historically, the maps were processed using the "cut and weigh" technique, which is an accurate and relatively fast method for determining the acreage of the different land uses. To effectively use this technique for summarizing acreage within specific boundaries, these boundaries (county, water district, hydrologic unit, etc.) also had to be drawn on the map. Since the early 1980s, some county surveys were digitized using the Intergraph system. Within the past year, the Department has developed an operational GIS to process new surveys. Maps are digitized (both land use lines and land use codes) and the resulting computer files are transferred into the GIS software. This system is capable of overlaying desired boundaries over the land use layers to summarize land use by county or hydrologic unit and prepare various informative maps.

#### **The 1976 Land Use Survey**

In the summer of 1976, the Department surveyed all six Delta counties (Alameda, Contra Costa, Solano, Yolo, San Joaquin, and Sacramento). Copies of the original survey quads that have areas in the Legal Delta were obtained and digitized. Thirty-six quads were required to map the entire Legal Delta. The land use boundaries of the individual quads were digitized using AUTOCAD, a computer aided drawing software. The land use codes were also entered into the digital file using AUTOCAD. The whole project was digitized using the UTM zone 10 geographic projection.

After quality control checks, where the original maps were compared to the plotted digital maps, the 36 digital files were transferred into the GIS software.

#### **The 1991 Land Use Survey**

In the summer of 1991, the Department's Central District surveyed the Delta to provide data for the drought and the State's Drought Water Bank. This survey was digitized and processed in the Department's Intergraph system. The land use maps were plotted to scale for use as a base for the 1993 survey. Also, the digital files, including the land use boundaries and the land use codes, were transferred from the Intergraph system into AUTOCAD. The files were then transferred into the GRASS GIS. The 1991 survey data was also used to identify permanent crops that were added to the 1993 survey.

## AGRICULTURAL CLASSES

(precede with "i" or "n")

- C - SUBTROPICAL FRUITS
  - 1. Grapefruit
  - 2. Lemons
  - 3. Oranges
  - 4. Dates
  - 5. Avocados
  - 6. Olives
  - 7. Miscellaneous subtropical
  - 8. Kiwi fruits
- D - DECIDUOUS FRUITS AND NUTS
  - 1. Apples
  - 2. Apricots
  - 3. Cherries
  - 5. Peaches and Nectarines
  - 6. Pears
  - 7. Plums
  - 8. Prunes
  - 9. Figs
  - 10. Miscellaneous deciduous
  - 12. Almonds
  - 13. Walnuts
  - 14. Pistachios
- G - GRAIN AND HAY CROPS
  - 1. Barley
  - 2. Wheat
  - 3. Oats
  - 6. Miscellaneous and mixed hay and grain
- F - FIELD CROPS
  - 1. Cotton
- 2. Safflower
- 3. Flax
- 4. Hops
- 5. Sugar beets
- 6. Corn (field or sweet)
- 7. Grain sorghum
- 8. Sudan
- 9. Castor beans
- 10. Beans (dry)
- 11. Miscellaneous field
- 12. Sunflowers
- T - TRUCK AND BERRY CROPS
  - 1. Artichokes
  - 2. Asparagus
  - 3. Beans (green)
  - 4. Cole crops
  - 6. Carrots
  - 7. Celery
  - 8. Lettuce (all types)
  - 9. Melons, squash, and cucumbers (all types)
  - 10. Onions and garlic
  - 11. Peas
  - 12. Potatoes
  - 13. Sweet Potatoes
  - 14. Spinach
  - 15. Tomatoes
  - 16. Flowers and nursery
  - 18. Miscellaneous truck
  - 19. Bushberries
  - 20. Strawberries
  - 21. Peppers (chili, bell, etc.)
- 22. Broccoli
- 23. Cabbage
- 24. Cauliflower
- 25. Brussels sprouts
- P - PASTURE
  - 1. Alfalfa & alfalfa mixtures
  - 2. Clover
  - 3. Mixed pasture
  - 4. Native pasture
  - 5. Induced high water native pasture
  - 7. Turf farms
- R - Rice
- V - VINEYARDS
- S - SEMIAGRICULTURAL AND INCIDENTAL TO AGRICULTURE
  - 1. Farmsteads
  - 2. Feed lots (livestock and poultry)
  - 3. Dairies
  - 4. Lawn areas
  - 5. Cemeteries
- I - IDLE
  - 1. Land cropped within the past three years but not tilled at the time of survey.
  - 2. New lands being prepared for crop production.

### DOUBLE CROPS

First crop indicated by enclosed parenthesis.  
 Examples: (iG) iF6 - irrigated grain followed by field corn.

### INTERCROPPING

Indicated by a fractional symbol.  
 Example: D5/G1 Peaches intercropped with barley

### MIXED LAND USE

Indicated by percentages following land use symbols.  
 Example: iD540 NV 60 Forty percent peaches and 60 percent native vegetation

## URBAN CLASSES

- U - URBAN
  - Used alone when further breakdown is not required)
- UC - URBAN COMMERCIAL
  - 1. Miscellaneous (offices and retailers)
  - 2. Hotels
  - 3. Motels
  - 4. Apartments, Barracks
  - 5. Institutions
  - 6. Schools
  - 7. Municipal auditoriums, heaters, ETC.
  - 8. Miscellaneous high water use
- UI - URBAN INDUSTRIAL
  - 1. Manufacturing, assembling, and general processing
  - 2. Extractive industries
- 3. Storage and distribution
- 6. Saw mills
- 7. Oil refineries
- 8. Paper mills
- 9. Meat packing plants
- 10. Steel and aluminum mills
- 11. Fruit and vegetable canneries and general food processing
- 12. Miscellaneous high water use
- 13. Sewage treatment plant including ponds.
- UR - URBAN RESIDENTIAL
  - One and two family units, including trailer courts (May be used alone when further breakdown is not required)
- UV - URBAN VACANT
  - 1. Unpaved areas
  - 3. Freeways and railroad right of ways
  - 4. Paved areas
  - 6. Airport runways
- RECREATION
- RR - RESIDENTIAL
  - Permanent and seasonal home tracts within a primarily recreational area.
- RC - COMMERCIAL
  - Commercial areas within a primarily recreational area.
- RV - RECREATIONAL VACANT
- RT - RECREATIONAL VEHICLE AND CAMP SITES

## NATIVE CLASSES

- NV - NATIVE VEGETATION
  - 1. Grass land
  - 2. Light brush
  - 3. Medium brush
  - 4. Heavy brush
  - 5. Brush and timber
  - 6. Forest
- NR - RIPARIAN VEGETATION
  - 1. Marsh lands, tules and sedges
- 2. Natural high water table meadow
- 3. Trees, shrubs or other larger streamside or water course vegetation
- 4. Seasonal duck marsh, dry or only partially wet during summer
- 5. Permanent duck marsh, flooded during summer
- NW - WATER SURFACE
  - Lakes, reservoirs, rivers, canals, etc.
- NB - BARREN AND WASTELAND
  - 1. Dry stream channels
  - 2. Mine Tailings
  - 3. Barren land
  - 4. Salt flats
  - 5. Sand dunes
- NS - NOT SURVEYED (SAME AS ABC)
- NC - NATIVE CLASSES UNSEGREGATED

## SPECIAL CONDITIONS

- (A) - ABANDONED ORCHARDS AND VINEYARDS
- (F) - FALLOW LANDS
- (K) - FREEWAYS
- (M) - MILITARY AREAS
- (P) - PARKS
- (S) - SEED CROP
- (T) - TILLED LANDS
- (X) - PARTIALLY IRRIGATED CROPS
- (Y) - YOUNG NON-BEARING ORCHARDS AND VINEYARDS
- (Z) - RECLAMATION

Figure 2. DWR's Land Use Legend

## **The 1993 Land Use Reconnaissance Survey**

There was not adequate time to perform a detailed land use survey of the Delta in 1993; therefore, a less detailed reconnaissance survey was performed. Low elevation aerial color slides were taken of the Delta, and used to update the 1991 plotted quad maps. Land use boundaries and land use codes were edited on the map as required. For this reconnaissance survey, less detailed land use codes were used; Agriculture – cropped, Agriculture – uncropped, Urban, Native Land, and Water Surface. These land uses could be interpreted from the slides, so no field work had to be performed. Since no on-site visits were performed (except in Sacramento County where a detailed land use survey was being performed at the same time), there is a chance that some Agricultural–other crop fields were mapped as Agricultural–uncropped. An example of this might be over-wintered wheat that was harvested and the field disced before the aerial photography was taken, so that the field might show as fallow in the photograph.

After the plotted maps were edited to reflect 1993 land use, the original 1991 digital files were edited using AUTOCAD. Again, after quality control checks, the digital files were transferred into the GIS.

### **Accuracy**

The land use boundaries that have been delineated for each survey are at a scale of 1:24,000. At this scale, a 1/32th of an inch on the delineated map represents 62.5 feet on the ground. Therefore, features such as roads, small water channels, and areas of less than five acres are difficult or impossible to delineate. The actual agricultural acreage, for example, would be a little less than the survey numbers because of the existence of paved roads in the agricultural areas that could not be delineated. (Paved roads and highways are classified as urban use.) Conversely, the urban acreage would be a little larger than the survey acreage due to these roads. The difference is small, probably less than three percent, depending on the amount of roads and development in the area.

The land use delineations have nothing to do with ownership boundaries nor zoning boundaries. The land use boundaries are determined by an experienced land use analyst, based upon observation. The accuracy of the normal land use determination is very high because the survey area is visited by the analyst for positive identification. It is possible that a small amount of incorrect land use determinations could have occurred, due to the fact that there were so many delineated areas (for example, there were over 14,000 delineated areas in the 1991 land use survey).

Quality control procedures were used to ensure that a minimum amount of error would occur. After digitizing the land use delineations and land use codes, a map was plotted and compared to the original hand drawn delineations (on a light table) and corrections made as required. Further, the land use change maps were analyzed closely to determine if the changes were reasonable, and corrections were made.

### **Data Processing**

The data developed in the digitizing phase is known as vector data, consisting of straight lines that connect digitized points. GRASS is a raster processing GIS that uses vector data (created in AUTOCAD) to create raster data (or grid cells). The raster data developed was based on a grid cell size of 25 meters by 25 meters. Within GRASS, every digital quad file was converted to raster data. For each of the three surveys, there were 36 quad raster maps. These maps were then patched together to create three Delta raster maps: 1976, 1991, and 1993.

### **Development of the 1976, 1991, and 1993 Raster Files**

The 1976 raster map underwent a reclassification of land use codes, to transform the detailed codes into aggregated codes. The codes used are as follows:

- 1: Agriculture – Permanent Crops:  
Contains all deciduous fruit and nut trees, subtropical trees, and grapevines.

- 2: Agriculture – Other Crops:  
Contains all non-permanent crops, such as grains, field crops, vegetables, pasture, and alfalfa.
- 3: Agriculture – Uncropped:  
Contains idled land, fallow land, farmsteads, feedlots, and dairies.
- 4: Urban:  
Contains all mapped urban land, including recreational codes, cemeteries, and large lawn areas.
- 5: Native Land:  
Contains all native vegetation, riparian and barren land.
- 6: Water Surface:  
Contains all mappable water surfaces.

The 1991 raster file was also reclassified into the six classifications. This raster map was developed to incorporate the Agriculture – Permanent Crop data into the 1993 raster map. Inclusion of permanent crops in the 1993 raster maps were requested late in the mapping process by the Executive Director of the Delta Protection Commission. Because there was not enough time to actually identify permanent crops for 1993, the 1991 permanent crops were transferred into the 1993 raster map.

The original 1993 raster map was developed using these six codes:

- 1: Agriculture – Permanent crops (empty at first, no 1993 data)
- 2: Agriculture – Cropped:  
Contains all land actively growing an agricultural crop.
- 3: Agriculture – Uncropped:  
Contains idled land, fallow land, farmsteads, feedlots, and dairies.
- 4: Urban:  
Contains all urban land, including recreational codes, cemeteries, and large lawn areas.
- 5: Native Land:  
Contains all native vegetation, riparian and barren land.
- 6: Water Surface:  
Contains all mappable water surfaces.

Using GIS technology, the 1991 permanent crop raster map was transferred into the 1993 raster map and the resulting 1993 map has the same six land use classifications as the 1976 map. The following logic statements were used to create this new raster map:

- (1) If 1991 is 1: Agriculture – Permanent Crops, and 1993 is 2: Agriculture – Cropped, then make the new 1993 1: Agriculture – Permanent Crops.
- (2) If 1991 is 1: Agriculture – Permanent Crops, and 1993 is 3: Agriculture – Uncropped, 4: Urban, 5: Native Land, or 6: Water Surface, make the new 1993 3: Agriculture – Uncropped, 4: Urban, 5: Native Land, or 6: Water Surface, respectively.
- (3) If 1991 is not 1: Agriculture – Permanent Crops, and 1993 is 2: Agriculture – Cropped, make the new 1993 2: Agriculture – Other Crops.
- (4) If 1991 is not 1: Agriculture – Permanent Crops and 1993 is 3: Agriculture – Uncropped, 4: Urban, 5: Native Land, or 6: Water Surface, then make the new 1993 3: Agriculture – Uncropped, 4: Urban, 5: Native Land, or 6: Water Surface, respectively.

Because of the processing required to estimate 1993 acreage from 1991 data, the accuracy of area and location of permanent crops in 1993 may have been diminished somewhat. However, the accuracy of the amount and location of all cropped (permanent and nonpermanent) agricultural land has not been diminished due to this processing.

### Development of the 1976 to 1993 Land Use Change Files

The intent of the land use change map was to provide the amount and location of shifts of agriculture, urban, and native land. Within the GIS, it is an easy task to create a land use change file, based on the 1976 and 1993 land use files. However, using six categories of land use could result in a change map with a theoretical maximum of 30 change categories. In order to prepare a meaningful and readable change map, the original six land use categories for both 1976 and 1993 were aggregated as follows:

Original Category	New Category
1. Agriculture — Permanent Crops	
2. Agriculture — Other Crops	1. Agriculture
3. Agriculture — Uncropped	
4. Urban	2. Urban
5. Native Land	
6. Water Surface	3. Native Classes

Within the GIS, the two raster maps (1976 and 1993) were compared and, using simple algorithms, the computer created a new file of changes. Where no changes had occurred (for example, if the grid cell was still native vegetation), the new classification for that grid cell in the change map was 0. If the grid cell had changed from 3: Native Vegetation to 2: Urban, it was reclassified as 32: NV – Urban. Following are the classifications used in the 1976 – 1993 change raster map.

- 0: No Change
- 12: Agriculture to Urban
- 13: Agriculture to Native Classes
- 21: Urban to Agriculture
- 23: Urban to Native Classes
- 31: Native Classes to Agriculture
- 32: Native Classes to Urban

### Development of Boundaries for Summarizing Land Use Data

For this report, there was a need for summarizing land use data by different boundaries, and by sets of boundaries. The boundaries required are the county boundaries, the secondary zone boundary, and the primary zone boundary. The United States Bureau of Reclamation in Sacramento had previously digitized all the county boundaries in the State, at a scale of 1:24,000, and provided them to the Department. The six counties involved were taken from this statewide digital file and transferred into the GIS.

The exterior boundary of the secondary zone is the Legal Delta. The Department had already digitized this boundary, at a scale of 1:24,000, during the 1991 Delta land use survey. The primary zone was digitized by staff at the University of California, Berkeley, using a map provided the Secretary of State depicting the primary zone, and existing 1:100,000 USGS digital line graphs. Because the map provided by the Secretary of State was a small-scale map, there was no detailed description of the boundary available, and the map produced by UC was

prepared using small-scale, digital line graphs, the primary boundary as digitized and used in this report may not be completely accurate. To be more accurate, a written description of the primary boundary should be prepared, the boundary delineated on USGS 7.5 minute quads, then the boundary digitized. The Department combined these two digital files to create one file containing the primary and secondary zones, and transferred the new file into the GIS.

## **Data Reporting**

### **Development of Land Use Summaries and Maps**

The data collection and processing steps were followed by development of land use reports (acreage summaries) and color maps. The input for these reports and maps were the 1976 and 1993 land use raster files, the 1976-1993 land use change raster map, the county boundary raster map, and the primary and secondary zone raster map. A simple statistical routine was used within the GIS to calculate the acreage of the different land use type, by boundary. Table 1 contains the summary of land use for 1976, Table 2 contains the summary of land use for 1993, Table 3 contains the summary of net land use changes for 1976 to 1993, and Table 4 contains the summary of shifts in land use for 1976 to 1993.

To create color maps, programs were used within the GIS to choose colors for the various land use (and change) raster files and boundaries. Another program was used to create a digital file to be plotted in color using an electrostatic color plotter. Figures 3 through 18 are color maps of the counties, showing the land use for 1976, 1993, and the land use changes, and also contain the acreage summaries. Figures 19 through 21 are color maps of the entire Legal Delta, showing the land use for 1976, 1993, and the land use change.

**Table 1. Land Use Summary 1976**

		Agriculture				Urban	Native Lands	Water Surface
		Permanent Crops	Other Crops	Uncropped	Total			
Alameda	Primary	0	0	0	0	0	0	0
	Secondary	0	2,736	22	2,758	103	1,764	51
	Total	0	2,736	22	2,758	103	1,764	51
Contra Costa	Primary	1,647	19,137	461	21,246	929	9,540	15,077
	Secondary	11,337	24,970	1,077	37,384	14,110	13,189	1,513
	Total	12,984	44,107	1,538	58,629	15,039	22,730	16,591
Sacramento	Primary	7,266	63,711	634	71,611	731	9,832	13,139
	Secondary	217	15,776	329	16,322	3,013	2,727	1,218
	Total	7,484	79,487	963	87,933	3,744	12,560	14,357
San Joaquin	Primary	1,818	158,938	862	161,619	1,938	14,350	10,617
	Secondary	7,874	87,360	1,732	96,966	20,114	9,056	3,244
	Total	9,692	246,298	2,594	258,584	22,052	23,406	13,861
Solano	Primary	754	62,084	375	63,213	154	15,473	7,360
	Secondary	0	0	0	0	1	5,362	994
	Total	754	62,084	375	63,213	156	20,835	8,354
Yolo	Primary	930	58,092	824	59,846	160	11,916	2,665
	Secondary	188	10,568	100	10,856	3,221	1,811	1,299
	Total	1,118	68,660	924	70,702	3,380	13,728	3,964
Legal Delta	Primary	12,416	361,962	3,157	377,534	3,913	61,111	48,859
	Secondary	19,616	141,410	3,259	164,286	40,561	33,910	8,319
	Total	32,032	503,372	6,416	541,820	44,474	95,021	57,178

**Table 2. Land Use Summary 1993**

		Agriculture				Urban	Native Lands	Water Surface
		Permanent Crops	Other Crops	Uncropped	Total			
Alameda	Primary	0	0	0	0	0	0	0
	Secondary	0	2,855	195	3,050	202	1,380	44
	Total	0	2,855	195	3,050	202	1,380	44
Contra Costa	Primary	710	18,872	4,534	24,115	1,114	6,250	15,313
	Secondary	5,840	19,148	6,493	31,482	22,702	9,730	2,282
	Total	6,550	38,020	11,027	55,597	23,816	15,980	17,595
Sacramento	Primary	9,089	53,548	8,571	71,208	1,144	10,649	12,312
	Secondary	505	10,770	1,611	12,886	5,577	3,298	1,520
	Total	9,594	64,318	10,182	84,094	6,721	13,947	13,832
San Joaquin	Primary	3,793	151,460	7,599	162,852	1,941	11,220	12,511
	Secondary	7,424	77,615	6,033	91,073	29,131	5,055	4,121
	Total	11,217	229,075	13,632	253,924	31,072	16,275	16,632
Solano	Primary	1,012	57,167	4,327	62,506	552	15,425	7,718
	Secondary	0	488	973	1,461	46	3,921	929
	Total	1,012	57,655	5,300	63,967	598	19,345	8,647
Yolo	Primary	2,461	41,572	13,088	57,121	267	14,037	3,162
	Secondary	69	6,808	2,678	9,555	4,542	1,882	1,208
	Total	2,530	48,380	15,766	66,676	4,809	15,920	4,370
Legal Delta	Primary	17,064	322,619	38,118	377,801	5,019	57,581	51,016
	Secondary	13,838	117,686	17,984	149,507	62,200	25,265	10,103
	Total	30,902	440,305	56,102	527,309	67,219	82,846	61,119

**Table 3. Summary of Net Changes in Land Use — 1976 To 1993**

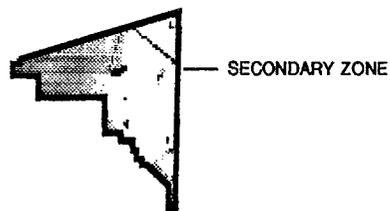
		Agriculture				Urban	Native Lands	Water Surface
		Permanent Crops	Other Crops	Uncropped	Total			
Alameda	Primary	0	0	0	0	0	0	0
	Secondary	0	119	173	292	99	(384)	(7)
	Total	0	119	173	292	99	(384)	(7)
Contra Costa	Primary	(938)	(265)	4,073	2,870	185	(3,290)	236
	Secondary	(5,497)	(5,821)	5,416	(5,902)	8,593	(3,459)	768
	Total	(6,435)	(6,087)	9,489	(3,032)	8,778	(6,749)	1,004
Sacramento	Primary	1,823	(10,163)	7,937	(403)	413	817	(827)
	Secondary	287	(5,006)	1,282	(3,436)	2,564	571	301
	Total	2,110	(15,168)	9,219	(3,839)	2,977	1,387	(525)
San Joaquin	Primary	1,975	(7,478)	6,736	1,233	3	(3,130)	1,894
	Secondary	(450)	(9,745)	4,301	(5,893)	9,017	(4,001)	877
	Total	1,525	(17,222)	11,037	(4,660)	9,020	(7,131)	2,771
Solano	Primary	258	(4,917)	3,952	(707)	398	(48)	358
	Secondary	0	488	973	1,461	44	(1,441)	(65)
	Total	258	(4,429)	4,925	754	442	(1,489)	293
Yolo	Primary	1,531	(16,520)	12,264	(2,725)	107	2,121	497
	Secondary	(119)	(3,760)	2,578	(1,301)	1,322	71	(91)
	Total	1,412	(20,280)	14,842	(4,026)	1,429	2,192	405
Legal Delta	Primary	4,649	(39,343)	34,961	267	1,106	(3,530)	2,157
	Secondary	(5,779)	(23,724)	14,725	(14,778)	21,639	(8,644)	1,784
	Total	(1,130)	(63,067)	49,686	(14,511)	22,745	(12,175)	3,941

#### 4. Summary of Shifts in Land Use — 1976 to 1993

		Agriculture to Urban	Agriculture to Native	Urban to Agriculture	Urban to Native	Native to Agriculture	Native to Urban
Alameda	Primary	0	0	0	0	0	0
	Secondary	37	127	15	0	441	78
	Total	37	127	15	0	441	78
Contra Costa	Primary	303	1,333	82	147	4,424	111
	Secondary	5,421	3,001	378	433	2,168	3,958
	Total	5,725	4,334	459	580	6,592	4,069
Sacramento	Primary	327	1,906	108	80	1,723	273
	Secondary	2,319	1,950	106	72	727	422
	Total	2,647	3,856	214	151	2,450	695
San Joaquin	Primary	521	3,643	671	160	4,734	305
	Secondary	8,884	1,636	952	246	3,694	1,329
	Total	9,404	5,279	1,623	406	8,428	1,634
Solano	Primary	271	3,830	52	23	3,381	202
	Secondary	0	0	0	0	1,461	45
	Total	271	3,830	52	24	4,842	247
Yolo	Primary	78	4,806	4	4	2,159	37
	Secondary	1,133	684	125	97	390	411
	Total	1,211	5,489	129	101	2,549	448
Legal Delta	Primary	1,500	15,518	917	415	16,421	929
	Secondary	17,795	7,397	1,576	848	8,882	6,243
	Total	19,295	22,915	2,493	1,263	25,303	7,171

LAND USE SUMMARY  
ALAMEDA  
1976

	PRIMARY ZONE (ACRES)	SECONDARY ZONE (ACRES)	TOTAL (ACRES)
PERMANENT CROPS	0	0	0
OTHER CROPS	0	2,736	2,736
UNCROPPED	0	22	22
TOTAL AGRICULTURE	0	2,758	2,758
URBAN	0	103	103
NATIVE LAND	0	1,764	1,764
WATER SURFACE	0	51	51
TOTALS	0	4,676	4,676



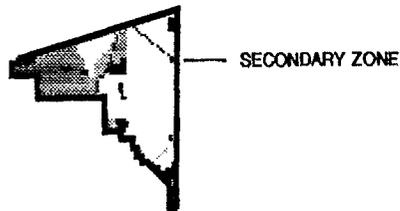
-  Agriculture - Trees and Vines
-  Agriculture - Other Crops
-  Agriculture - Uncropped
-  Urban
-  Native Land
-  Water Surface

N  
↑  
scale = 1:275,000

Figure 3. Alameda County — 1976 Land Use Summary

LAND USE SUMMARY  
ALAMEDA  
1993

	PRIMARY ZONE (ACRES)	SECONDARY ZONE (ACRES)	TOTAL (ACRES)
PERMANENT CROPS	0	0	0
OTHER CROPS	0	2,855	2,855
UNCROPPED	0	195	195
TOTAL AGRICULTURE	0	3,050	3,050
URBAN	0	202	202
NATIVE LAND	0	1,380	1,380
WATER SURFACE	0	44	44
TOTALS	0	4,676	4,676



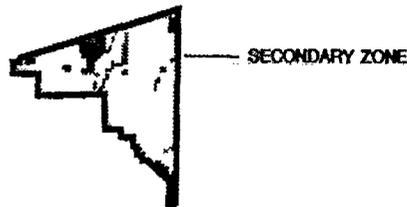
- Agriculture - Trees and Vines
- Agriculture - Other Crops
- Agriculture - Uncropped
- Urban
- Native Land
- Water Surface

N  
↑  
scale = 1:275,000

Figure 4. Alameda County — 1993 Land Use Summary

SUMMARY OF LAND USE CHANGES  
ALAMEDA  
1976 - 1993

LAND USE CHANGES	PRIMARY ZONE (ACRES)	SECONDARY ZONE (ACRES)	TOTAL (ACRES)
AGRICULTURE TO URBAN	0	37	37
AGRICULTURE TO NATIVE	0	127	127
URBAN TO AGRICULTURE	0	15	15
URBAN TO NATIVE	0	0	0
NATIVE TO AGRICULTURE	0	441	441
NATIVE TO URBAN	0	78	78
<b>NET CHANGES</b>			
PERMANENT CROPS	0	0	0
OTHER CROPS	0	119	119
UNCROPPED	0	173	173
TOTAL AGRICULTURE	0	292	292
URBAN	0	99	99
NATIVE LAND	0	(384)	(384)
WATER SURFACE	0	(7)	(7)



- Agriculture to Urban
- Agriculture to Native
- Urban to Agriculture
- Urban to Native
- Native to Agriculture
- Native to Urban
- No Changes

N  
↑  
scale = 1:275,000

Figure 5. Alameda County — Summary of Land Use Changes from 1976 to 1993

LAND USE SUMMARY  
CONTRA COSTA  
1976

	PRIMARY ZONE (ACRES)	SECONDARY ZONE (ACRES)	TOTAL (ACRES)
PERMANENT CROPS	1,647	11,337	12,984
OTHER CROPS	19,137	24,970	44,107
UNCROPPED	461	1,077	1,538
TOTAL AGRICULTURE	21,246	37,384	58,629
URBAN	929	14,110	15,039
NATIVE LAND	9,540	13,189	22,730
WATER SURFACE	15,077	1,513	16,591
TOTALS	46,793	66,196	112,988

N  
↑  
scale = 1:275,000

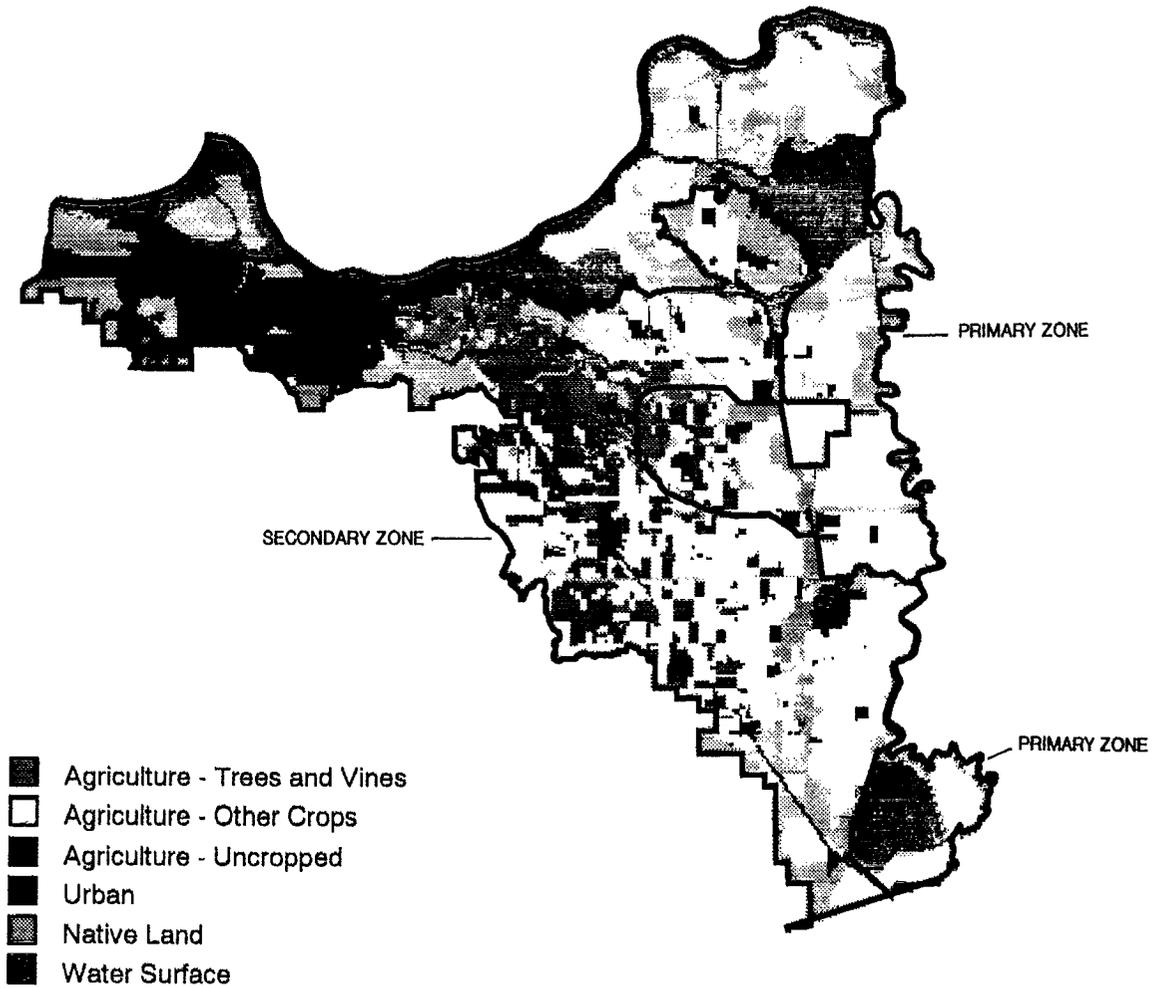


Figure 6. Contra Costa County — 1976 Land Use Summary

LAND USE SUMMARY  
CONTRA COSTA  
1993

N  
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scale = 1:275,000

	PRIMARY ZONE (ACRES)	SECONDARY ZONE (ACRES)	TOTAL (ACRES)
PERMANENT CROPS	710	5,840	6,550
OTHER CROPS	18,872	19,148	38,020
UNCROPPED	4,534	6,493	11,027
TOTAL AGRICULTURE	24,115	31,482	55,597
URBAN	1,114	22,702	23,816
NATIVE LAND	6,250	9,730	15,980
WATER SURFACE	15,313	2,282	17,595
TOTALS	46,793	66,196	112,988

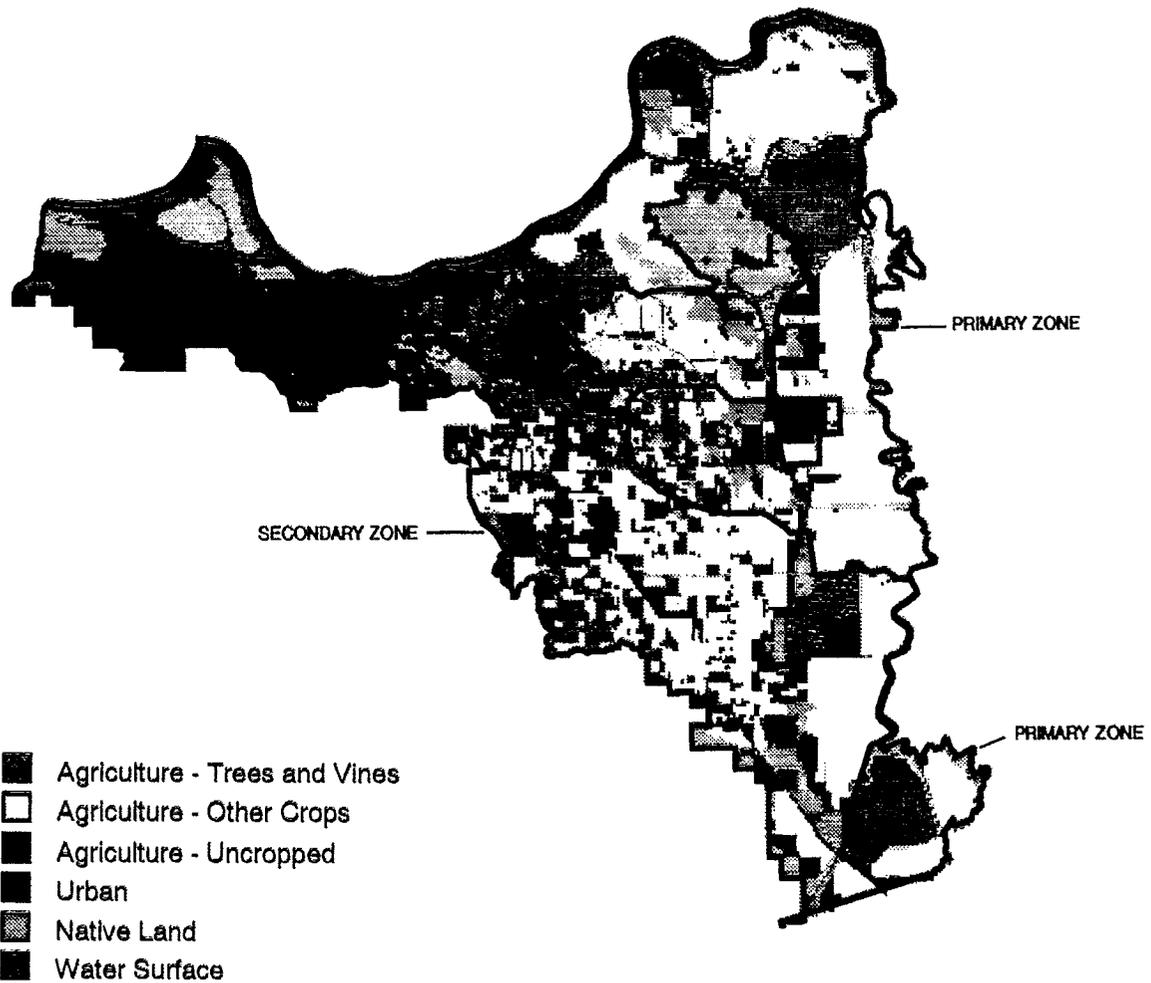


Figure 7. Contra Costa County — 1993 Land Use Summary

SUMMARY OF LAND USE CHANGES  
CONTRA COSTA  
1976 - 1993

LAND USE CHANGES	PRIMARY ZONE (ACRES)	SECONDARY ZONE (ACRES)	TOTAL (ACRES)
AGRICULTURE TO URBAN	303	5,421	5,725
AGRICULTURE TO NATIVE	1,333	3,001	4,334
URBAN TO AGRICULTURE	82	378	459
URBAN TO NATIVE	147	433	580
NATIVE TO AGRICULTURE	4,424	2,168	6,592
NATIVE TO URBAN	111	3,958	4,069
NET CHANGES			
PERMANENT CROPS	(938)	(5,497)	(6,435)
OTHER CROPS	(265)	(5,821)	(6,087)
UNCROPPED	4,073	5,416	9,489
TOTAL AGRICULTURE	2,870	(5,902)	(3,032)
URBAN	185	8,593	8,778
NATIVE LAND	(3,290)	(3,459)	(6,749)
WATER SURFACE	236	768	1,004

N  
↑  
scale = 1:275,000

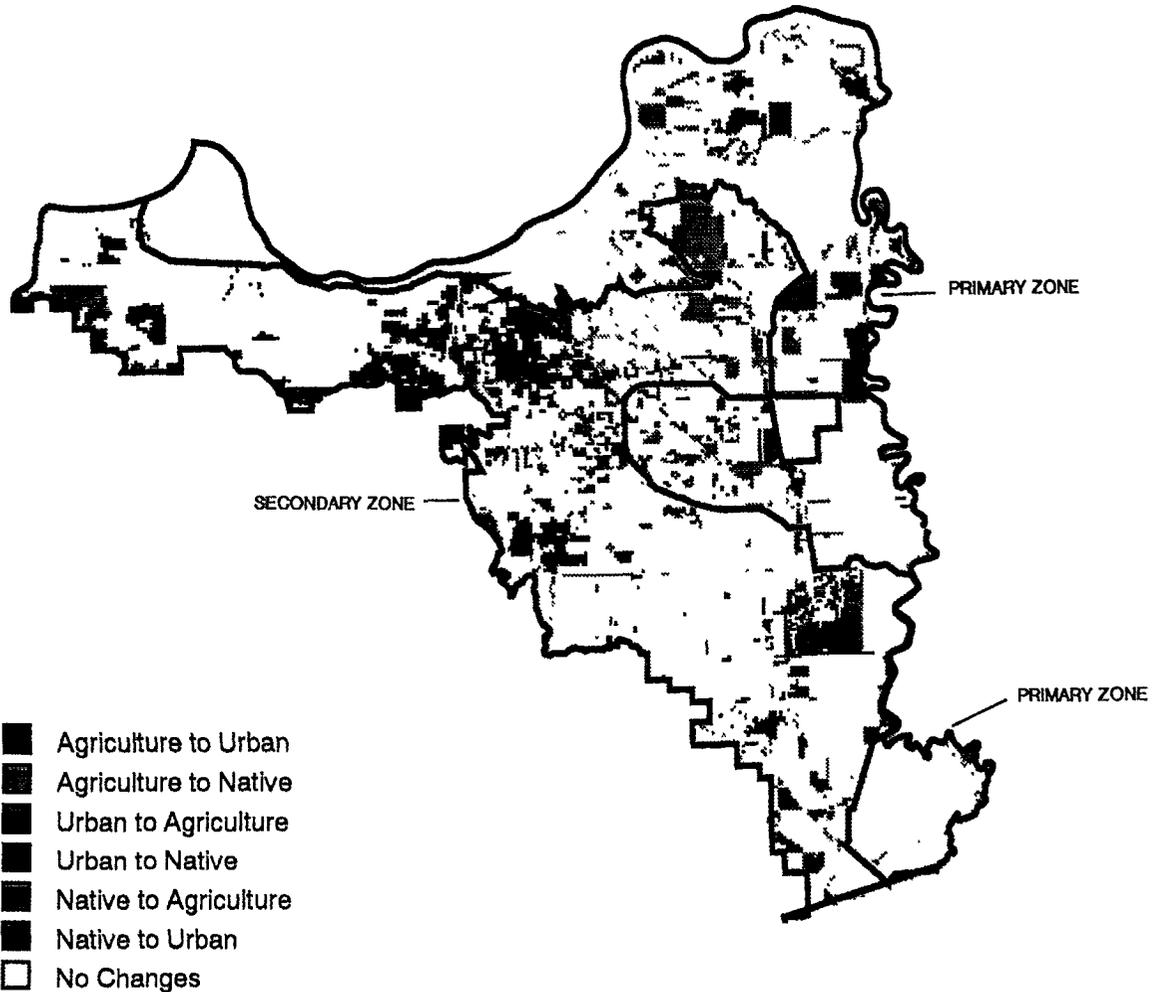


Figure 8. Contra Costa County — Summary of Land Use Changes from 1976 to 1993

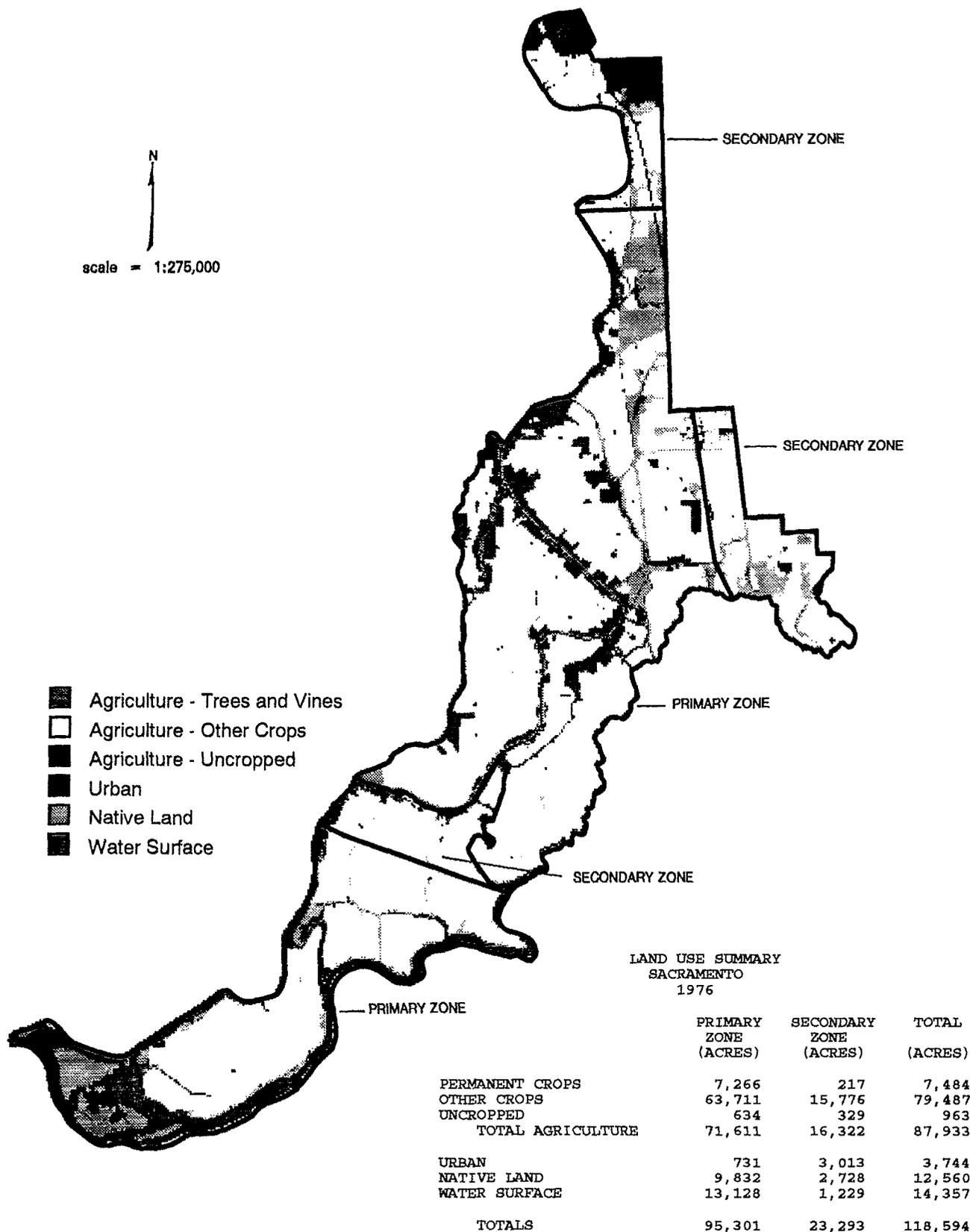
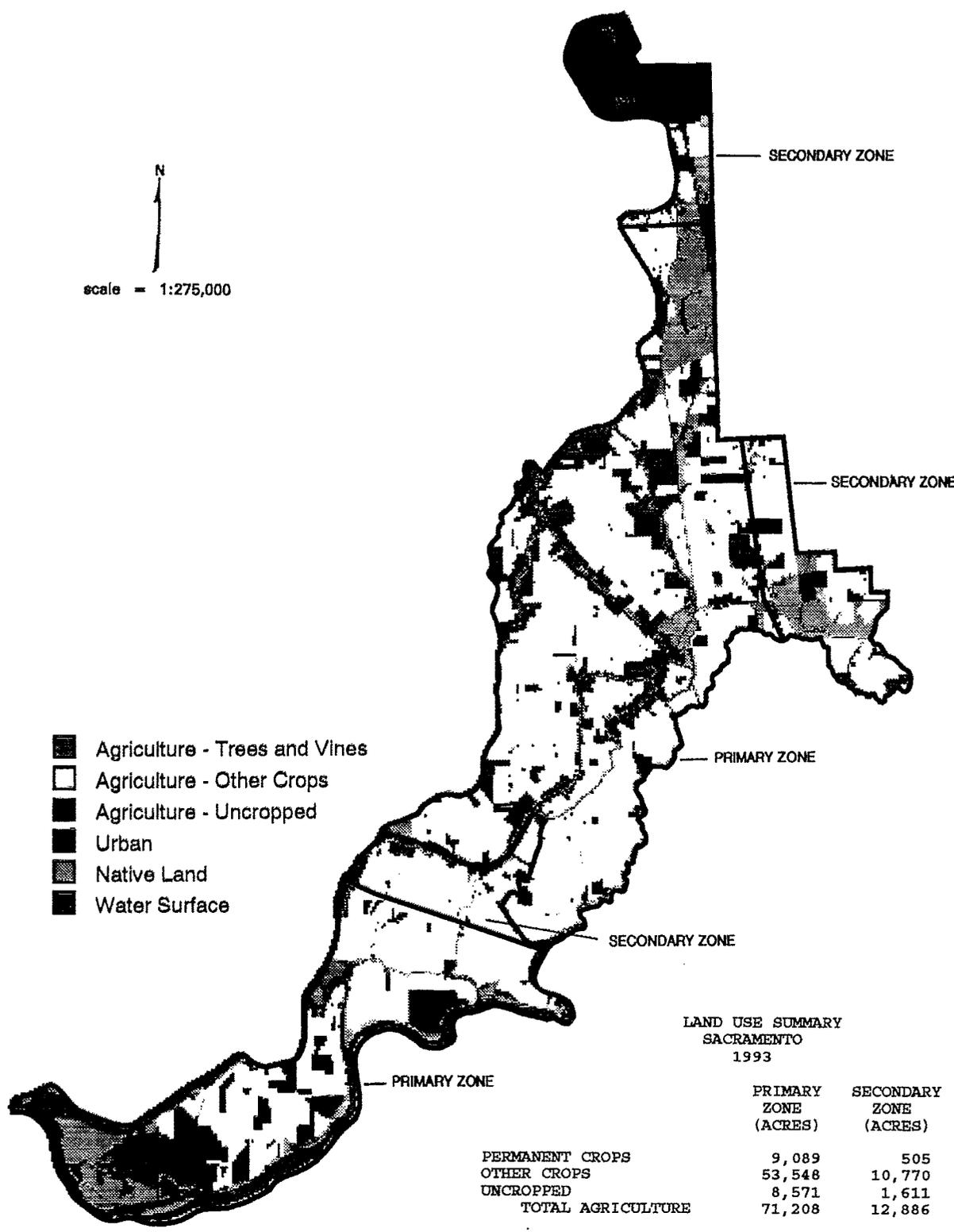


Figure 9. Sacramento County — 1976 Land Use Summary



LAND USE SUMMARY  
SACRAMENTO  
1993

	PRIMARY ZONE (ACRES)	SECONDARY ZONE (ACRES)	TOTAL (ACRES)
PERMANENT CROPS	9,089	505	9,594
OTHER CROPS	53,548	10,770	64,318
UNCROPPED	8,571	1,611	10,182
<b>TOTAL AGRICULTURE</b>	<b>71,208</b>	<b>12,886</b>	<b>84,094</b>
URBAN	1,144	5,577	6,721
NATIVE LAND	10,648	3,298	13,946
WATER SURFACE	12,301	1,531	13,832
<b>TOTALS</b>	<b>95,301</b>	<b>23,293</b>	<b>118,594</b>

Figure 10. Sacramento County — 1993 Land Use Summary

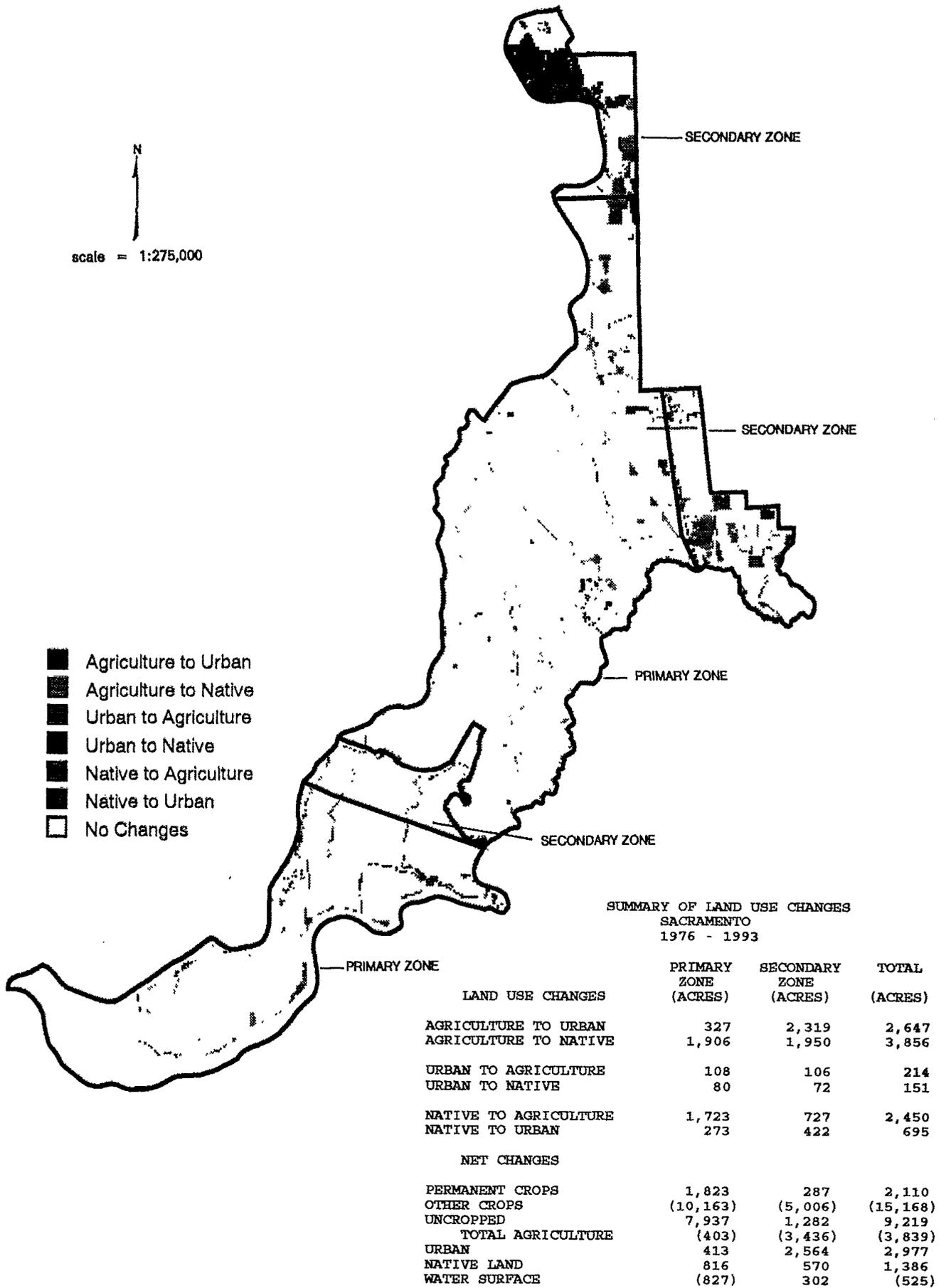


Figure 11. Sacramento County — Summary of Land Use Changes from 1976 to 1993

LAND USE SUMMARY  
SAN JOAQUIN  
1976

	PRIMARY ZONE (ACRES)	SECONDARY ZONE (ACRES)	TOTAL (ACRES)
PERMANENT CROPS	1,818	7,874	9,692
OTHER CROPS	158,938	87,360	246,298
UNCROPPED	862	1,732	2,594
TOTAL AGRICULTURE	161,619	96,966	258,584
URBAN	1,938	20,114	22,052
NATIVE LAND	14,350	9,056	23,406
WATER SURFACE	10,617	3,244	13,861
TOTALS	188,524	129,379	317,902

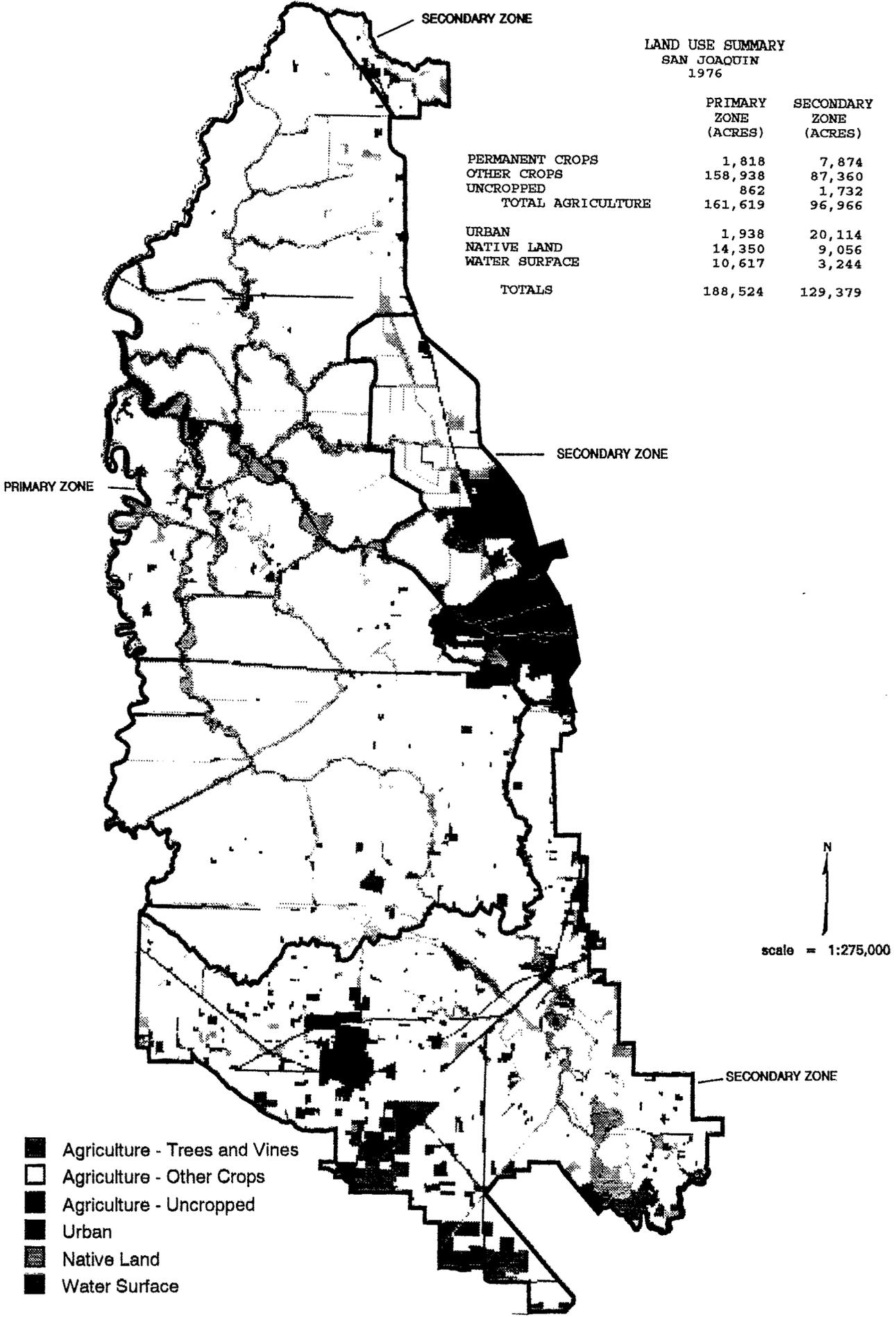


Figure 12. San Joaquin County — 1976 Land Use Summary

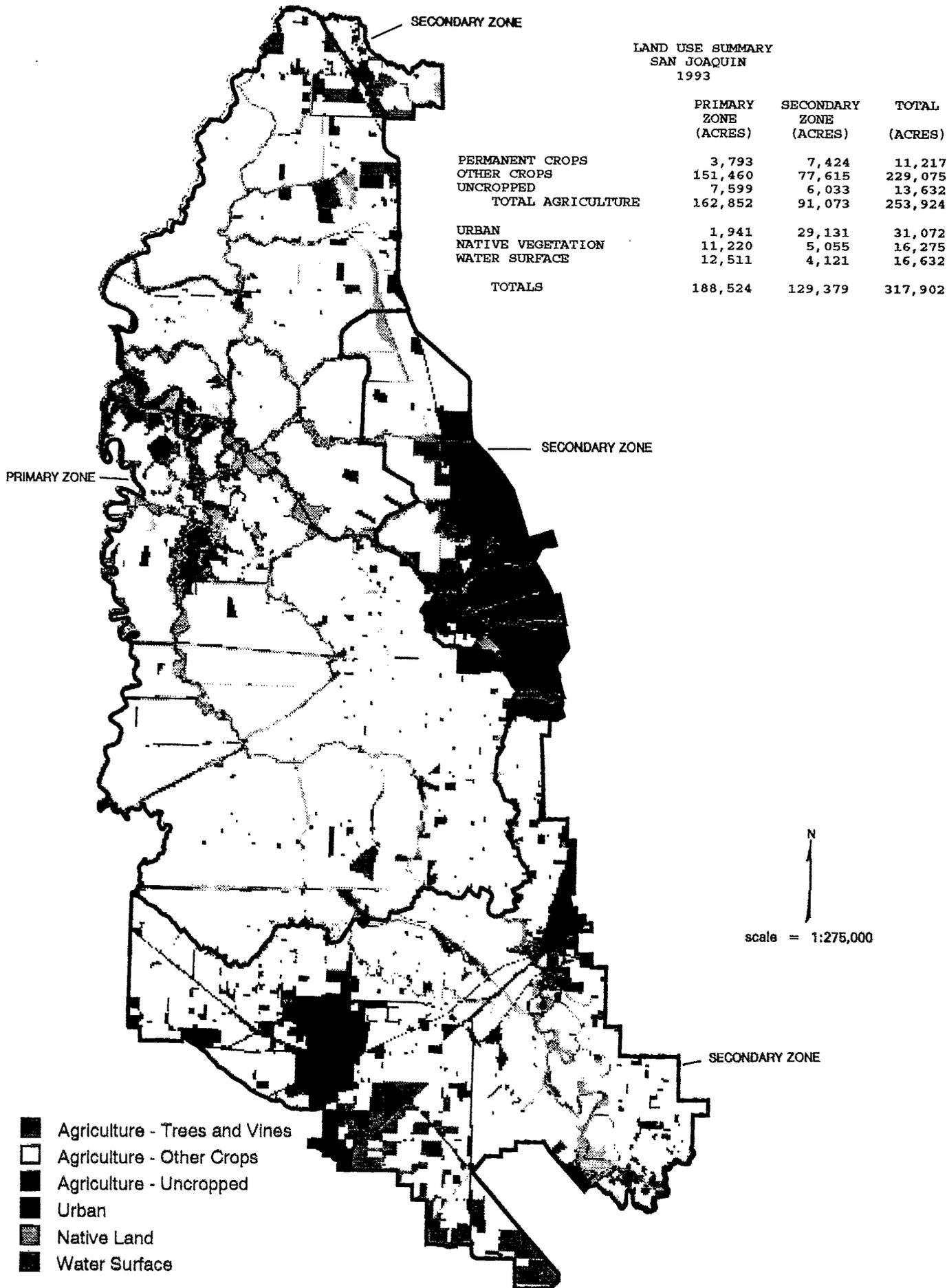


Figure 13. San Joaquin County — 1993 Land Use Summary

SUMMARY OF LAND USE CHANGES  
SAN JOAQUIN  
1976 - 1993

LAND USE CHANGES	PRIMARY ZONE (ACRES)	SECONDARY ZONE (ACRES)	TOTAL (ACRES)
AGRICULTURE TO URBAN	521	8,884	9,404
AGRICULTURE TO NATIVE	3,643	1,636	5,279
URBAN TO AGRICULTURE	671	952	1,623
URBAN TO NATIVE	160	246	406
NATIVE TO AGRICULTURE	4,734	3,694	8,428
NATIVE TO URBAN	305	1,329	1,634
NET CHANGES			
PERMANENT CROPS	1,975	(450)	1,525
OTHER CROPS	(7,478)	(9,745)	(17,222)
UNCROPPED	6,736	4,301	11,037
TOTAL AGRICULTURE	1,233	(5,893)	(4,660)
URBAN	3	9,017	9,020
NATIVE LAND	(3,130)	(4,001)	(7,131)
WATER SURFACE	1,894	877	2,771

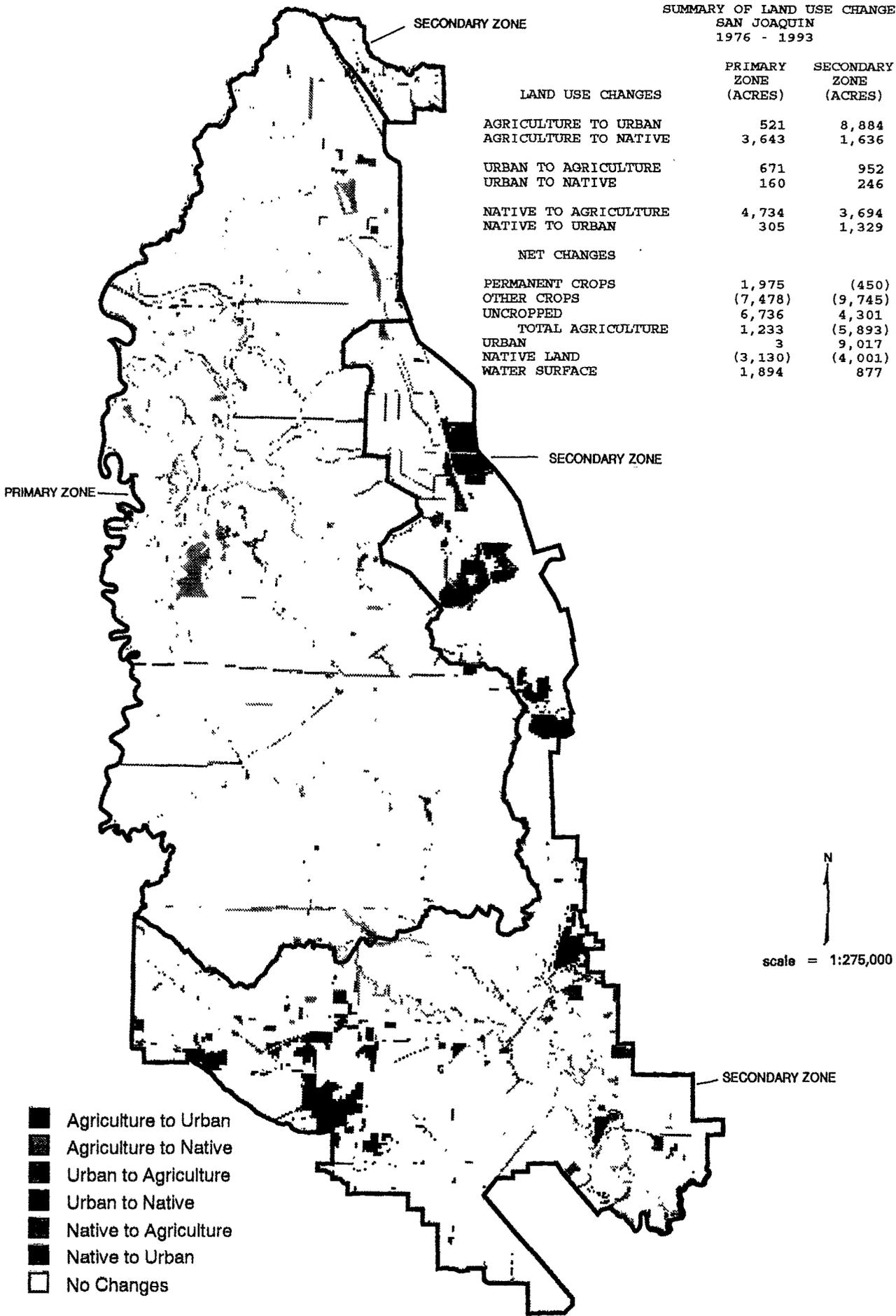


Figure 14. San Joaquin County — Summary of Land Use Changes from 1976 to 1993

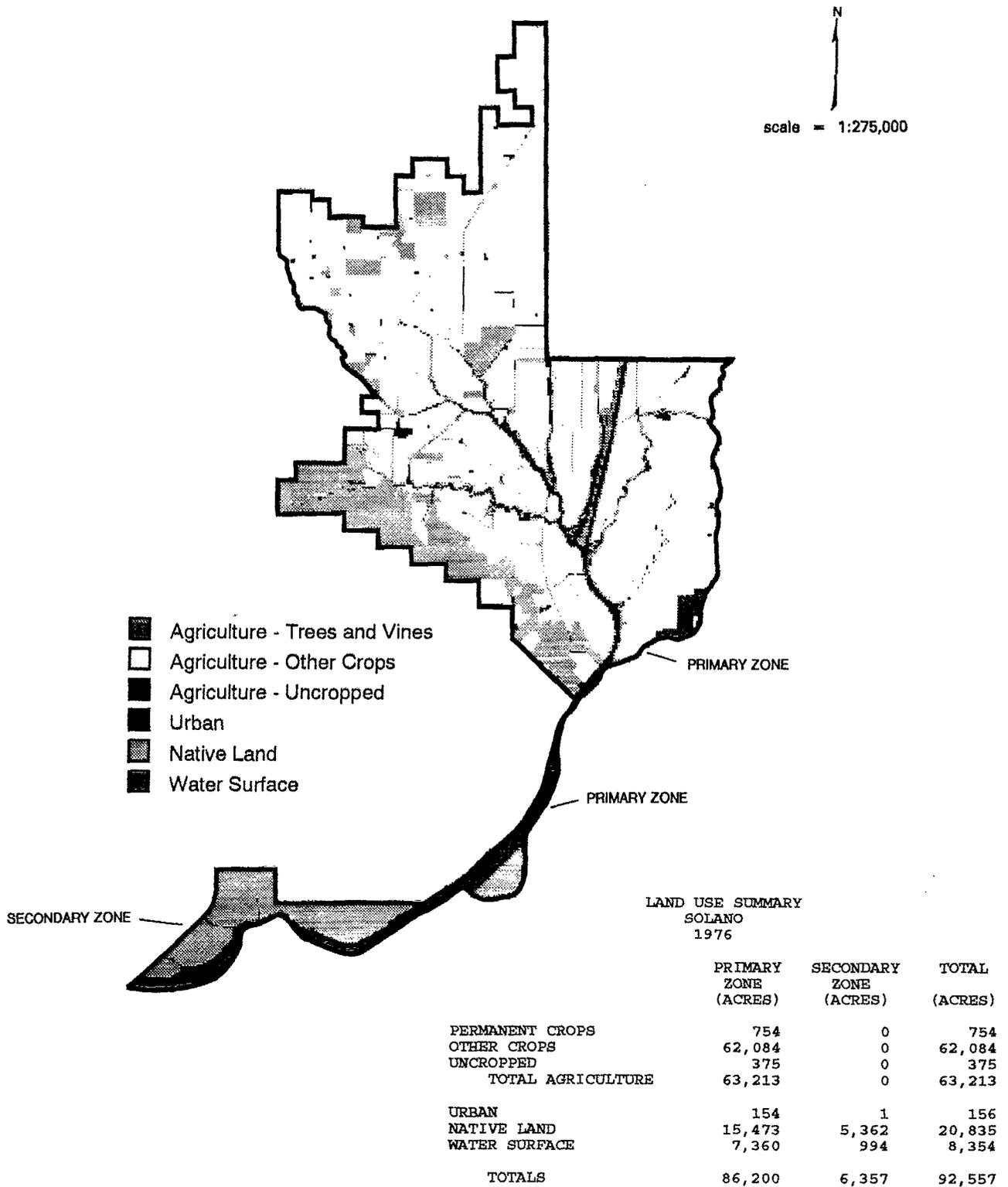


Figure 15. Solano County — 1976 Land Use Summary

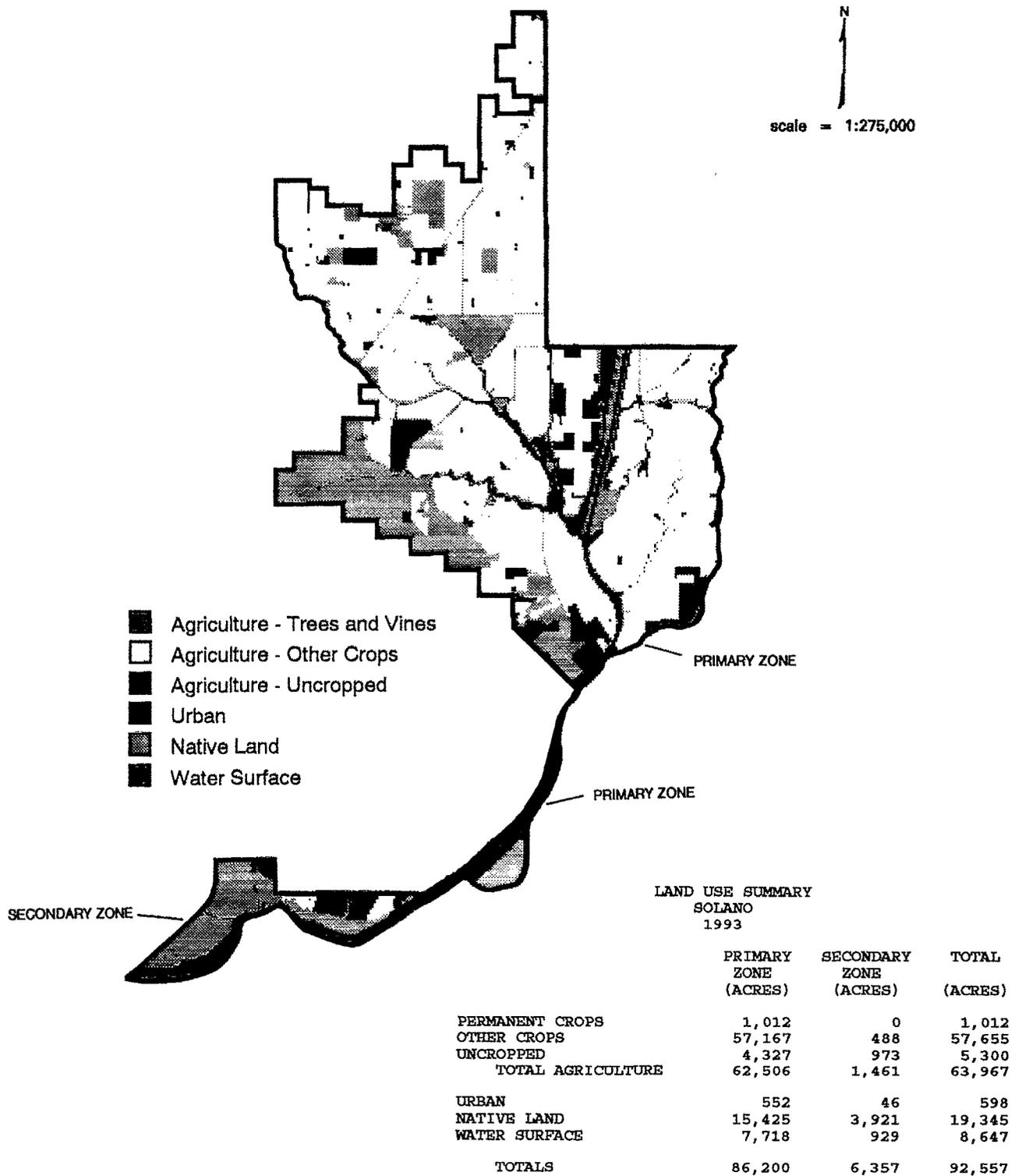


Figure 16. Solano County — 1993 Land Use Summary

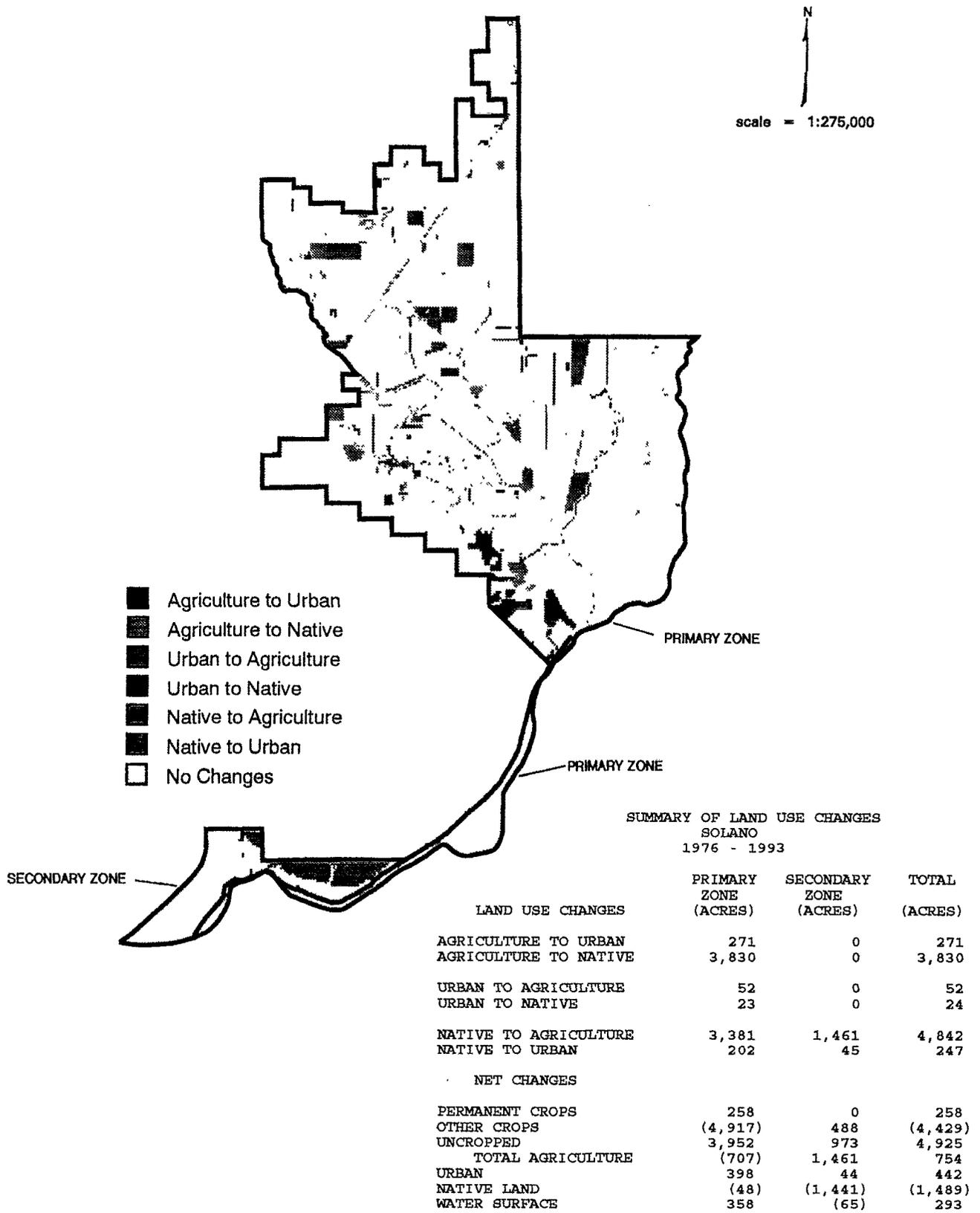
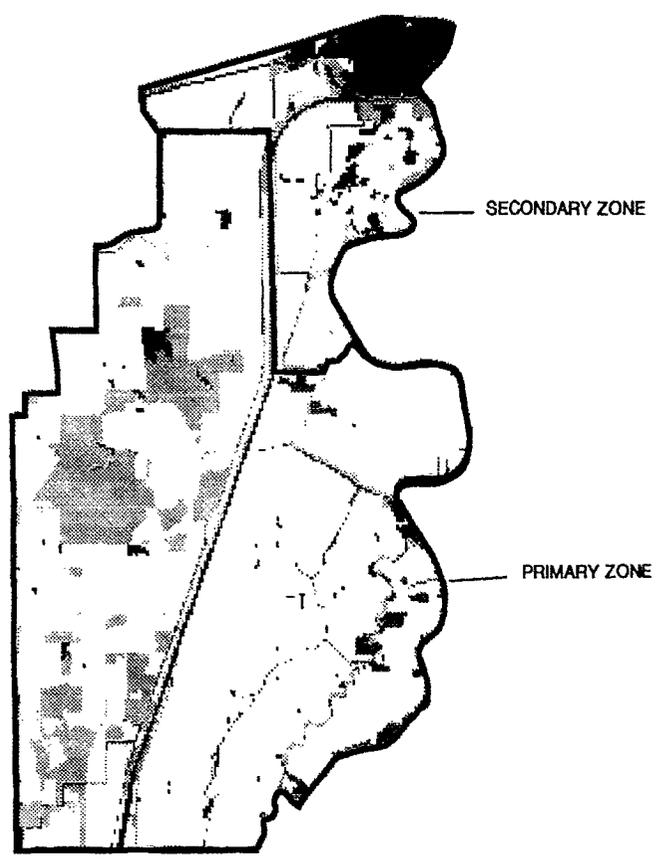


Figure 17. Solano County — Summary of Land Use Changes from 1976 to 1993

scale = 1:275,000



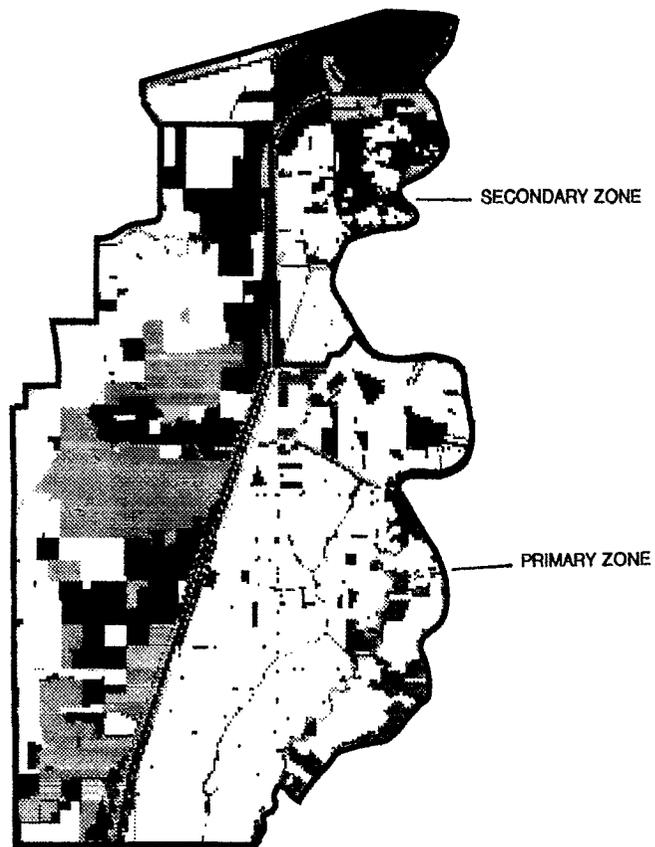
- Agriculture - Trees and Vines
- Agriculture - Other Crops
- Agriculture - Uncropped
- Urban
- Native Land
- Water Surface

LAND USE SUMMARY  
YOLO  
1976

	PRIMARY ZONE (ACRES)	SECONDARY ZONE (ACRES)	TOTAL (ACRES)
PERMANENT CROPS	971	147	1,118
OTHER CROPS	58,366	10,294	68,660
UNCROPPED	852	72	924
<b>TOTAL AGRICULTURE</b>	<b>60,189</b>	<b>10,513</b>	<b>70,702</b>
URBAN	160	3,221	3,380
NATIVE LAND	11,947	1,781	13,728
WATER SURFACE	2,660	1,304	3,964
<b>TOTALS</b>	<b>74,956</b>	<b>16,819</b>	<b>91,775</b>

Figure 18. Yolo County — 1976 Land Use Summary

scale = 1:275,000



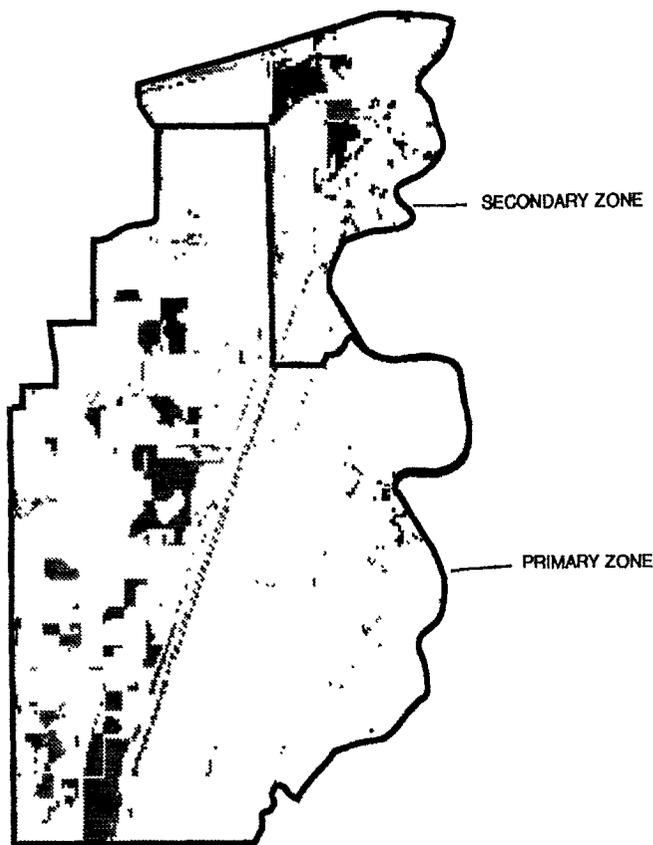
- Agriculture - Trees and Vines
- Agriculture - Other Crops
- Agriculture - Uncropped
- Urban
- Native Land
- Water Surface

LAND USE SUMMARY  
YOLO  
1993

	PRIMARY ZONE (ACRES)	SECONDARY ZONE (ACRES)	TOTAL (ACRES)
PERMANENT CROPS	2,491	40	2,530
OTHER CROPS	41,822	6,558	48,380
UNCROPPED	13,166	2,599	15,766
<b>TOTAL AGRICULTURE</b>	<b>57,479</b>	<b>9,197</b>	<b>66,676</b>
URBAN	267	4,542	4,809
NATIVE LAND	14,053	1,866	15,920
WATER SURFACE	3,157	1,213	4,370
<b>TOTALS</b>	<b>74,956</b>	<b>16,819</b>	<b>91,775</b>

Figure 19. Yolo County — 1993 Land Use Summary

scale = 1:275,000



- Agriculture to Urban
- Agriculture to Native
- Urban to Agriculture
- Urban to Native
- Native to Agriculture
- Native to Urban
- No Changes

SUMMARY OF LAND USE CHANGES  
YOLO  
1976 - 1993

LAND USE CHANGES	PRIMARY ZONE (ACRES)	SECONDARY ZONE (ACRES)	TOTAL (ACRES)
AGRICULTURE TO URBAN	78	1,133	1,211
AGRICULTURE TO NATIVE	4,806	684	5,489
URBAN TO AGRICULTURE	4	125	129
URBAN TO NATIVE	4	97	101
NATIVE TO AGRICULTURE	2,175	375	2,549
NATIVE TO URBAN	37	411	448
NET CHANGES			
PERMANENT CROPS	1,520	(107)	1,412
OTHER CROPS	(16,544)	(3,736)	(20,280)
UNCROPPED	12,314	2,527	14,842
TOTAL AGRICULTURE	(2,710)	(1,316)	(4,026)
URBAN	107	1,322	1,429
NATIVE LAND	2,106	85	2,192
WATER SURFACE	497	(91)	405

Figure 20. Yolo County — Summary of Land Use Changes from 1976 to 1993

LAND USE SUMMARY  
LEGAL DELTA  
1976

	PRIMARY ZONE (ACRES)	SECONDARY ZONE (ACRES)	TOTAL (ACRES)
PERMANENT CROPS	12,457	19,575	32,032
OTHER CROPS	362,236	141,136	503,372
UNCROPPED	3,185	3,231	6,416
TOTAL AGRICULTURE	377,877	163,942	541,820
URBAN	3,913	40,561	44,474
NATIVE LAND	61,142	33,880	95,022
WATER SURFACE	48,842	8,335	57,178
TOTALS	491,775	246,719	738,493

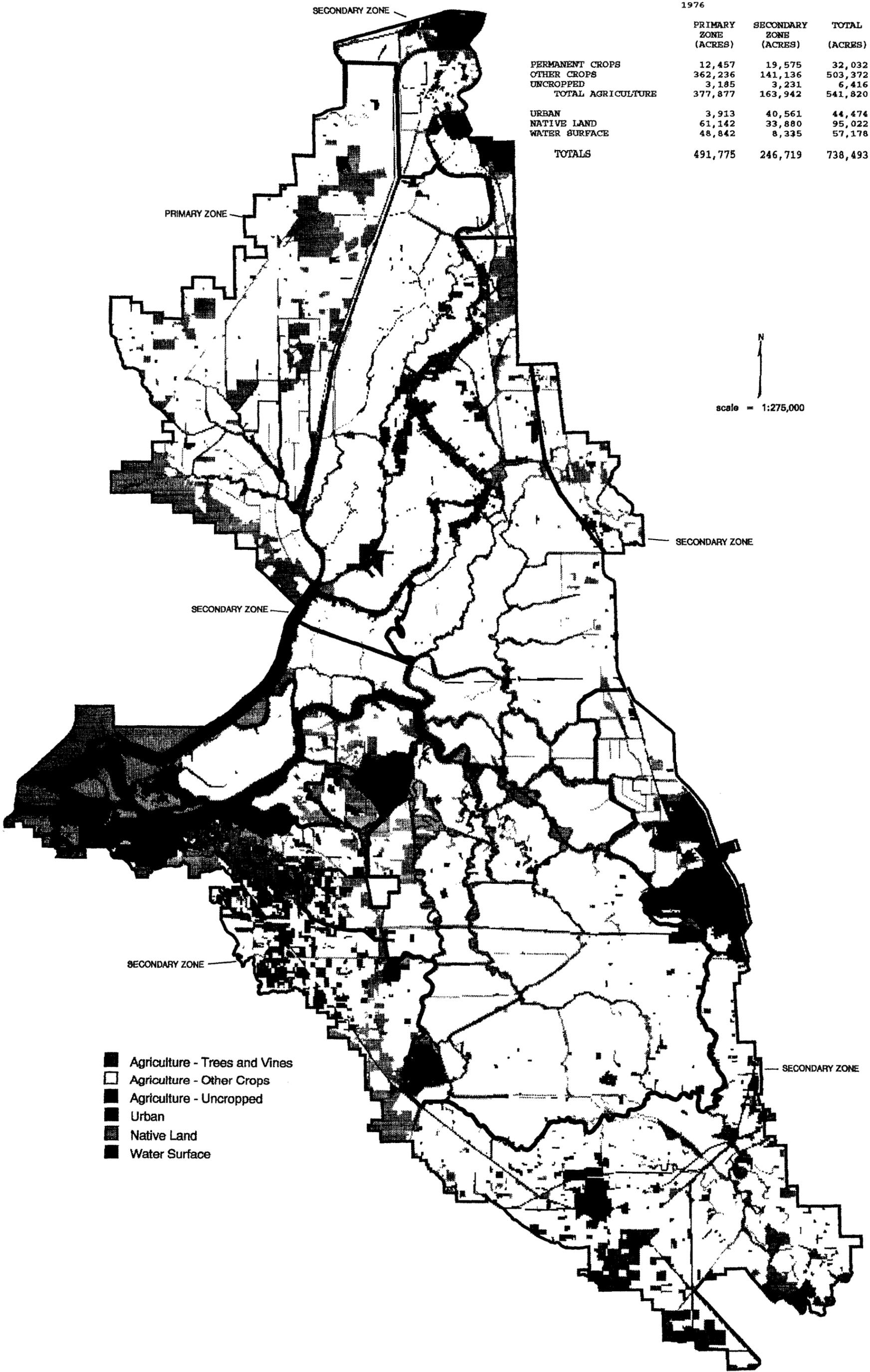


Figure 21. Legal Delta — 1976 Land Use Summary

LAND USE SUMMARY  
LEGAL DELTA  
1993

	PRIMARY ZONE (ACRES)	SECONDARY ZONE (ACRES)	TOTAL (ACRES)
PERMANENT CROPS	17,094	13,809	30,902
OTHER CROPS	322,869	117,436	440,305
UNCROPPED	38,196	17,905	56,102
TOTAL AGRICULTURE	378,160	149,149	527,309
URBAN	5,019	62,200	67,219
NATIVE LAND	57,596	25,249	82,845
WATER SURFACE	51,000	10,120	61,119
TOTALS	491,774	246,718	738,493

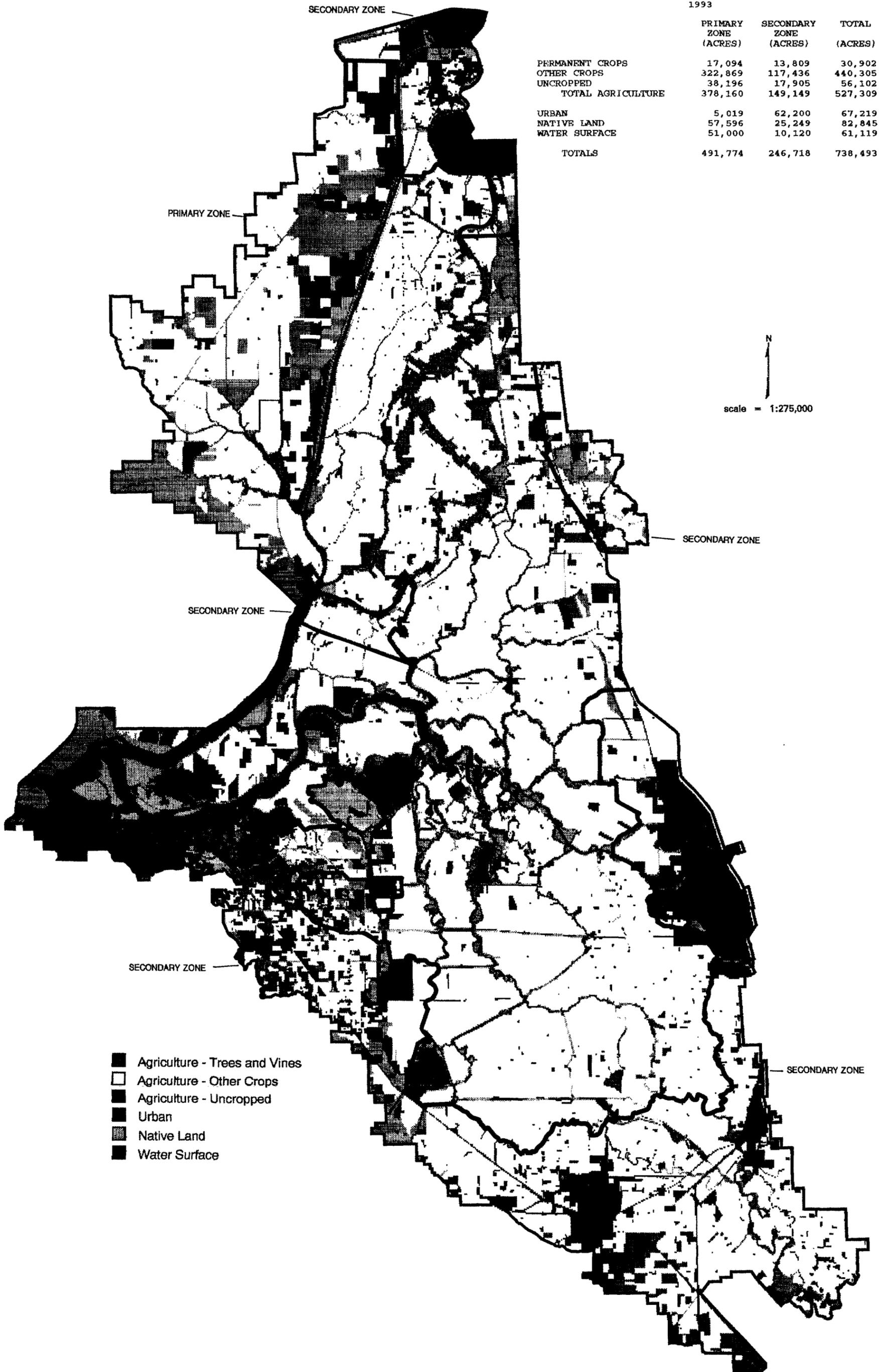


Figure 22. Legal Delta — 1993 Land Use Summary

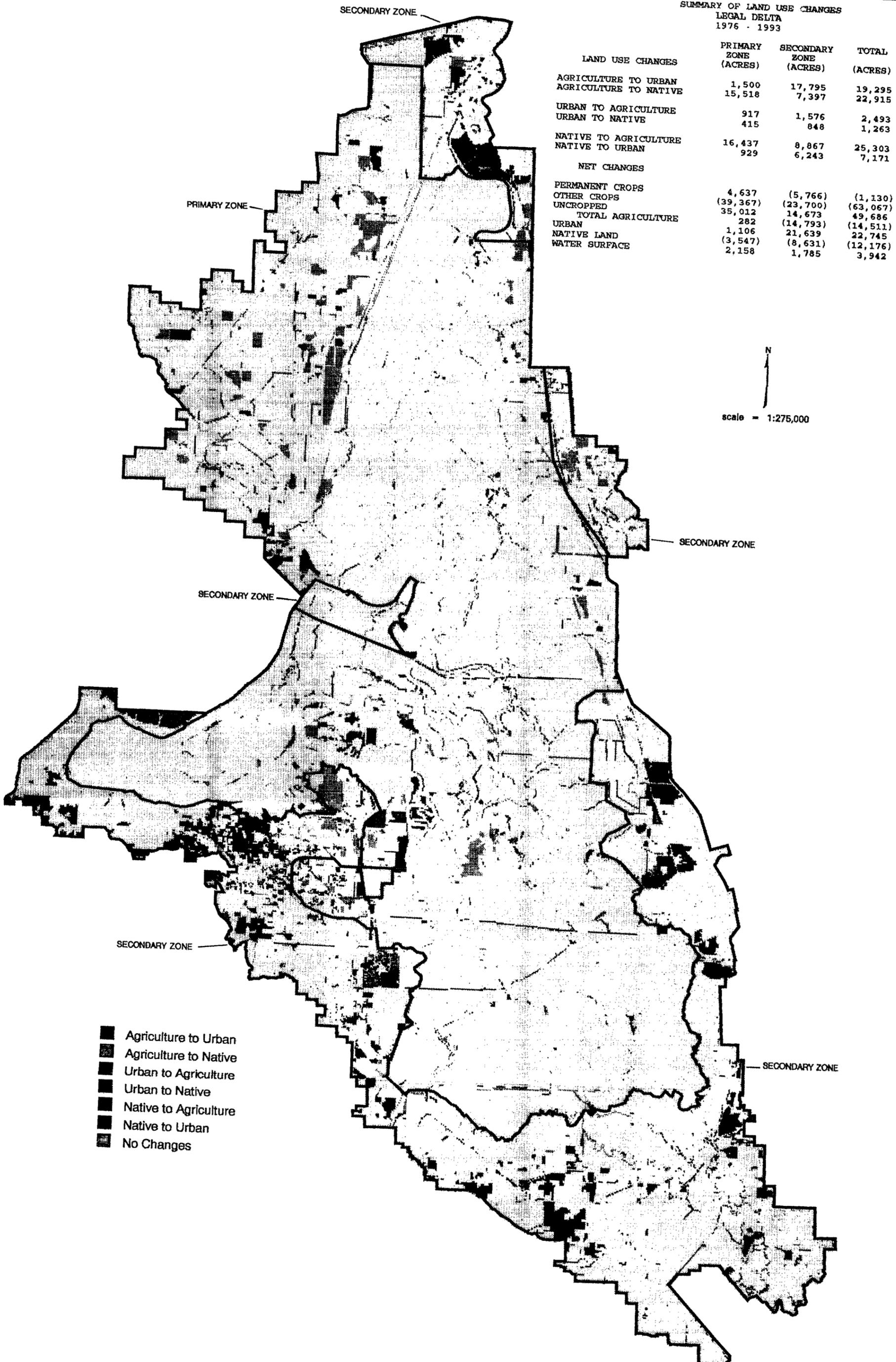


Figure 23. Legal Delta — Summary of Land Use Changes from 1976 to 1993

### III. Results Of The Surveys

The land use acreage summaries for the Legal Delta, counties and Primary/Secondary Zones for 1976 and 1993 are displayed in Tables 1 and 2, respectively. In Table 3, the net land use changes are shown, which identify the net increase or decrease in acreage by land use category. The summary of shifts in land use are in Table 4, and provide data such as the amount of agricultural land which changed to urban land, the amount of agricultural land which changed to native land, etc. The specific and net land use changes are both important for land use planning. For example, the net change in agricultural land might be very small. However, for the same area and time, a large amount of agricultural land may have been converted to urban uses, and a similar amount of native land was converted to agricultural land. The net change was small, but the location of the agricultural and native land has changed.

Figures 3 through 21 contain both maps and acreage summaries by the Legal Delta, by county, and by Primary/Secondary Zone. The figures that depict the land use changes have the specific and net land use changes summarized, and the maps showing the specific changes. It is easy for the reader to view these tables and maps in the figures to determine where land use changes have occurred, and what the net result of the changes were.

The following summarizes land use by major category and the changes that occurred.

#### **Agricultural Land**

In 1993, about 71 percent of the total area in the Legal Delta was classified as agricultural. Permanent crops accounted for only about four percent of the total Delta area. Of the total area in the Primary Zone, about 77 percent (377,801) was classified as agricultural.

Between 1976 and 1993, the total agricultural land in the Delta was reduced by about 14,500 acres, almost all of which occurred in the Secondary Zone. Permanent crops increased by about 4,500 acres in the Primary Zone, but decreased by about 5,800 acres in the Secondary Zone.

The areas where large acreages of agricultural land was reclassified to urban were the Brentwood and Oakley area in Contra Costa County, the Pocket area in Sacramento County adjacent the Sacramento River, the West Sacramento area in Yolo County, and the Stockton and Tracy areas in San Joaquin County. A significant amount of native land (about 25,000 acres) was reclassified to agricultural land, two-thirds of which occurred in the Primary Zone. A similar amount of acreage was reclassified from agriculture to native land, with about two-thirds occurring in the Primary Zone.

#### **Urban Land**

In 1993, there was about 44,400 acres classified as urban land in the Legal Delta, of which about 40,000 acres were in the Secondary Zone.

Urban land had a net increase of about 22,700 acres in the Legal Delta, all but 1,100 acres occurring in the Secondary Zone. About 19,000 acres were reclassified from agriculture, and 7,000 acres reclassified from native lands. In preparing the change maps, areas were identified where urban had been reclassified to both agricultural and native land. Some of these apparent changes include a sewage treatment plant (urban industrial land use) that had since been retired and was reclassified to a native classification. Other changes were small areas in urban settings, originally classified as urban (urban vacant — undeveloped areas in an urban area) then classified as agricultural or native land when it did not get developed into urban uses. Finally, because of the difference in base maps used and the accuracy of drawing and digitizing lines for the two surveys, there are very small changes in land use (urban to agriculture and native) that occur next to urban areas and roads. These small changes are most probably not real changes.

## Native Classes

In 1993 there was a total of almost 83,000 acres classified as native land, of which about 70 percent were in the Primary Zone. The net change in this category is a loss of about 12,000 acres, with about 71 percent of the loss occurring in the Secondary Zone.



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