

3.0 Peace River Basins

Each of the nine basins in the Peace River watershed has been characterized in terms of hydrology, water quality, water budget, and land use to provide a comparison of impacts among basins. Low (Q90), median (Q50), and high (Q10) flows at gages in the watershed basins were analyzed to examine historic trends in stream flow. Water quality data from monitoring stations in the basins were also analyzed to evaluate potential historic changes in water quality. Water budgets were prepared to quantify the flux of water in and out of the basins and subsequently assess cumulative impacts from a “pre-development” or “early-development” conditions to modern time to the extent possible.

The largest proportional changes in land use in the watershed were most frequently due to conversions from native upland habitats to improved pasture and generally occurred prior to 1979. While this pattern dominates the watershed, changes in land use at the basin level are very different in some cases. Almost half of the urban development in the watershed is in northern-most basin.

Historical rainfall and stream flow data were analyzed to assess the potential presence of long-term rainfall patterns and evaluate identified patterns and/or seasonal changes in the context of the proposed AMO theory. Conclusions based on the results of time series rainfall data analyses that are relevant to comparisons among basins are summarized here, while a summary of the analyses that apply to the entire watershed is presented in section 4.

Like agriculture, ground water withdrawals for mining processes can alter stream flows in the Peace River. Kissengen Spring, which previously discharged an average of approximately 19 mgd into the upper Peace River, ceased in 1950. The loss of flow was attributed to a progressive decline in the potentiometric surface of the Floridan aquifer that was in turn associated primarily with historic ground water withdrawals for phosphate mining. Phosphate mining withdrawals accounted for an estimated 75 mgd of the 110 mgd of total water withdrawals in southwest Polk County during the years preceding the cessation of flows from Kissingen Spring. Ground water withdrawals for mining operations have been dramatically reduced in recent decades due to conservation and capture of surface waters. For example, ground water withdrawals for mining and industrial uses in Polk County accounted for 81 mgd in 2000, compared with 207 mgd in 1985. Water conservation practices in agriculture and mining have reduced the use of ground water in Polk County by 100 mgd since the 1970s.

3.1 Peace River at Bartow

Hydrology

In the upper watershed, including the Peace River at Bartow, Peace River at Zolfo Springs, and Payne Creek basins, phosphate mining appears to have had an historical major influence on hydrology, water quality, and habitats. Reduced base flows, as well as loss of spring flows, in the upper reaches of the Peace River reflect historic impacts to ground water associated primarily with mining withdrawals, and to a lesser extent agriculture and urban practices, from the

intermediate and the Upper Floridan aquifers. Public supply water use (84 mgd in Polk County in year 2000) now contributes to the reduced base flows, along with mining and agricultural withdrawals.

Seasonal Kendall Tau trend tests were run for each of the three basin USGS stream flow gages using standardized five-year intervals. Trend tests for low (Q90), median (Q50), and high (Q10) flows at the Peace River at Bartow gage all show declines since the 1940s, 1950s, and 1960s (Table 3.1.1). However, none of the tested flow metrics show any statistically significant trends in flows since 1970 (35 years).

Table 3.1.1. Summary Results of Seasonal Trend Tests of Monthly Flow Percentiles for the Peace River at Bartow Basin

USGS Gaging Site	Flow (Percentile)	1935-2004	1940-2004	1945-2004	1950-2004	1955-2004	1960-2004	1965-2004	1970-2004	1975-2004	1980-2004	1985-2004	1990-2004	1995-2004
Peace Creek Drainage Canal near Wahneta	Low (Q90)													
	Mean (Q50)													
	High (Q10)													
Saddle Creek at Structure P-11 near Bartow	Low (Q90)								▲		▲	▲		
	Mean (Q50)													
	High (Q10)													
Peace River at Bartow	Low (Q90)		▼	▼	▼	▼	▼	▼						
	Mean (Q50)		▼	▼	▼	▼	▼	▼						
	High (Q10)		▼	▼	▼	▼	▼							

Note: The direction of an arrow denotes a significant increasing or decreasing trend. Arrows are significant at $p=0.10$ level, and blanks indicate no significant trends in Seasonal Kendall Tau tests corrected for serial correlations. Shaded cells indicate periods prior to USGS gaging data at each location.

Water Quality

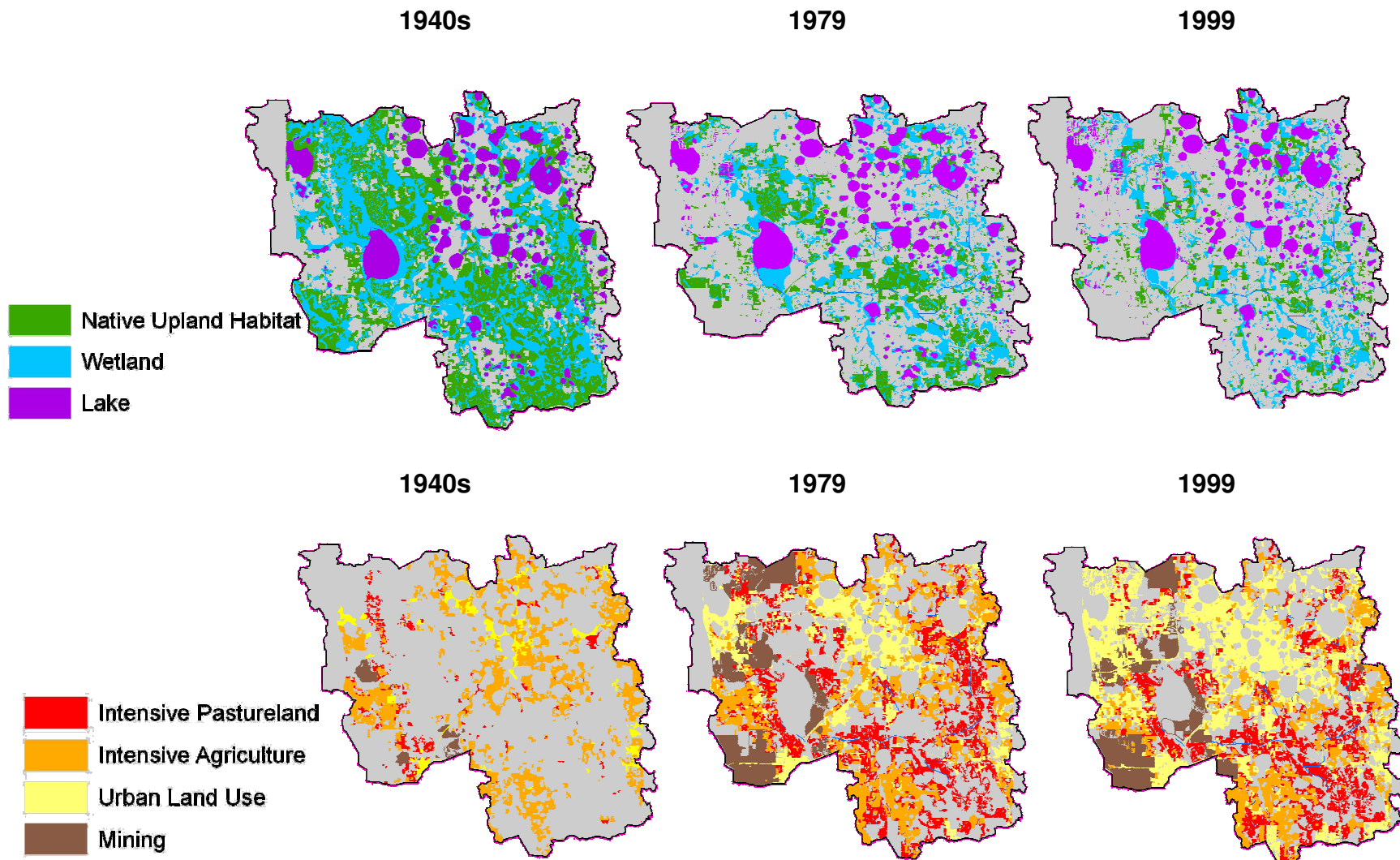
- Lake Hancock water quality has been characterized as “poor”, based on the Florida Trophic State Index, since at least 1970 and the poor water quality has been attributed to urban and agricultural impacts. The FDEP has verified the impaired condition of the lake and levels of total nitrogen, total phosphorus, and biological oxygen demand all exceeded the State threshold screening values.
- A large portion of the organic nitrogen exported from Lake Hancock is a result of nitrogen-fixation by high levels of blue green algae concentrations.
- Instances of low dissolved oxygen concentrations are conspicuous in the upstream portions of the Peace River, and both the frequency and downstream extent of low dissolved oxygen levels increase as discharges from Lake Hancock increase. Flows from the lake via Saddle Creek are characteristically high in total suspended solids, total Kjeldahl nitrogen, total organic carbon, and chlorophyll *a*. The high chlorophyll concentrations (algae) and organic material associated with these discharges result in extreme fluctuations in dissolved oxygen levels in the upper Peace River. During periods of high rainfall, discharges from the lake increase, and the low dissolved oxygen conditions are exacerbated.
- Historical changes in water quality are apparent at the Bartow monitoring site and reflect improving water quality following regulatory and phosphate mining changes that eliminated direct discharges and reduced mining discharges to the Peace River. The most apparent improvements are the marked declines in both total phosphorus and orthophosphate levels that occurred through the 1980s and 1990s. It should be noted, however, that phosphorus concentrations in the Peace River and the Charlotte Harbor estuary are extremely high relative to other freshwater and estuarine systems due to both natural deposits and the historic influences of mined lands.
- Historic improvements in other water quality parameters also reflect reduced ground water discharges and associated reductions in historic mining impacts.
- Results of data analyses suggest that the loss of spring flows due to ground water withdrawals and the reductions in ground water discharges were historically so large that when discharges were reduced, color in the upper river increased, and there was an associated loss of the aquatic plant *Vallisneria americana* (tape grass).
- Changes in water quality suggest that historically high ground water discharges predominantly from mining activities augmented river base flow and masked the declines of natural spring discharges that followed reductions in basin ground water levels.
- Conversely, increasing chloride and potassium levels, which were exacerbated during the recent 1999-2001 drought, are similar to patterns reflecting increased ground water discharges in the southern watershed basins.

Land Use

The Peace River at Bartow basin is the largest in the Peace River watershed and includes 233,761 acres (17 percent) of the watershed. This basin also includes the largest amount of urban land when compared with the eight other basins in the watershed and is one of only two basins in the watershed with a large urban land use component. Land use changes in the basin are mapped in Figure 3.1.1.

Acres of mining in this basin increased from about 2,500 acres in the 1940s to 19,972 acres in 1979, and by 1999 had increased by only five more acres to 19,977 acres. Nearly two-thirds of the basin was developed by 1999 and the greatest increase was due to expansion of urban development that included 26 percent of the basin. Acres of native upland habitat in the basin had decreased from over 72,000 acres in the 1940s to about 20,000 acres in 1999 and represented the largest change in land use. Wetlands made up 34 percent of the basin in the 1940s and only 16 and 14 percent, respectively, in 1979 and 1999, a loss of about 33,000 acres. These conversions were greatest prior to 1979.

Figure 3.1.1. Changes in Land Uses: Peace River at Bartow Basin



3.2 Peace River at Zolfo Springs

Hydrology

Data collected over the past 35 years have often indicated a net loss of stream flow between the Bartow and Fort Meade gages. During drier years, upstream flows exceed downstream flows more than half the time.

- Historically, the dry season potentiometric head was higher than the river bed and ground water flowed into the river channel and the upper river had base flow throughout the year even during the dry season. Potentiometric declines due to ground water withdrawals have caused the river to lose water through a series of karst features to the underlying artesian aquifers during dry periods.
- The karst geology of the upper Peace River is a direct connection between the river and the underlying intermediate and Upper Floridan aquifers that historically produced springs and seeps that maintained the natural base flow of the upper river, primarily between Bartow and Ft. Meade. However, due to excessive ground water withdrawals, the connections are now a conduit for the direct loss of dry season flows into the aquifers.
- Ongoing USGS studies have indicated that most flows are lost from the river to the aquifer in a five-mile interval between the Bartow gage and the location where flow from Kissengen Springs historically entered the Peace River. Recently measured dry season river losses to ground water ranged from 6-30 cfs (averaged 17 cfs).

Seasonal Kendall Tau trend tests for low, median, and high flows at the Peace River at Zolfo gage all show declines since the mid 1930s, 1940s, 1950s, and early 1960s. However, none of the tested flow metrics show any statistically significant trends in flows since 1970 (35 years). Results of trend tests for the individual periods-of-record for each of the three Peace River at Zolfo Springs basin flow gages are presented in Table 3.2.1.

Table 3.2.1. Summary Results of Seasonal Trend Tests of Monthly Flow Percentiles for the Peace River at Zolfo Springs Basin

USGS Gaging Site	Flow (Percentile)	1935-2004	1940-2004	1945-2004	1950-2004	1955-2004	1960-2004	1965-2004	1970-2004	1975-2004	1980-2004	1985-2004	1990-2004	1995-2004
Peace River at Fort Meade	Low (Q90)													
	Mean (Q50)													
	High (Q10)													

Table 3.2.1. Summary Results of Seasonal Trend Tests of Monthly Flow Percentiles for the Peace River at Zolfo Springs Basin

USGS Gaging Site	Flow (Percentile)	1935-2004	1940-2004	1945-2004	1950-2004	1955-2004	1960-2004	1965-2004	1970-2004	1975-2004	1980-2004	1985-2004	1990-2004	1995-2004
Bowlegs Creek near Ft Meade	Low (Q90)													
	Mean (Q50)													
	High (Q10)													
Peace River at Zolfo Springs	Low (Q90)	▼	▼	▼	▼	▼	▼	▼						
	Mean (Q50)	▼	▼	▼	▼	▼	▼							
	High (Q10)	▼	▼	▼	▼	▼	▼							

Note: The direction of an arrow denotes a significant increasing or decreasing trend. Arrows are significant at $p=0.10$ level, and blanks indicate no significant trends in Seasonal Kendall Tau tests corrected for serial correlations. Shaded cells indicate periods prior to USGS gaging data at each location.

Water Quality

There are three long-term USGS/ SWFWMD water quality monitoring locations in this basin with adequate periods-of-records to assess potential long-term changes.

- Comparisons among the river monitoring sites indicate that the marked increases in water color observed following reductions in mining ground water discharges at Bartow were also apparent in the long-term Fort Meade data and to a lesser extent at Zolfo Springs.
- Both mainstream river monitoring sites had long-term declines in total phosphorus and orthophosphate levels similar to those observed upstream at the Bartow location.
- The historic declines in fluoride and strontium levels in the river observed upstream at Bartow were also reflected to a lesser extent at Zolfo Springs.
- Alkalinity, sodium, potassium, and chloride levels at the Zolfo Springs gage indicated long-term increases with historically high levels measured during the 1999-2001 drought.
- Similar long-term increases in conductivity levels and potassium and sulfate concentrations in Bowlegs Creek were apparent during the 1999-2001 drought. This indicates that these changes are also associated with increasing ground water discharges.
- The apparent declines in the measured nitrogen at Zolfo Springs may reflect changes in domestic point source discharges in the Peace River at Bartow and Zolfo Springs basins.

Land Use

The Peace River at Zolfo Springs basin includes approximately 14 percent of the watershed. Most of the watershed (77 percent) is developed, and is made up of mining (33 percent), agriculture (37 percent), and urban (seven percent) land uses. Land use changes are mapped in Figure 3.2.1.

More than three-quarters of the Peace River at Zolfo Springs basin were developed by 1999. Since 1979, the greatest increases were in mining, while acres of agriculture, wetlands, and native upland habitats declined. Acres of native upland habitat in the basin decreased from 107,774 acres in the 1940s (55 percent) to about 16,674 acres (eight percent) in 1999 and represented the largest change in land use in the basin. Wetlands made up 25 percent of the basin in the 1940s and only 15 and 12 percent, respectively, in 1979 and 1999, a loss of about 14,000 acres, most of which occurred by 1979.

3.3 Payne Creek

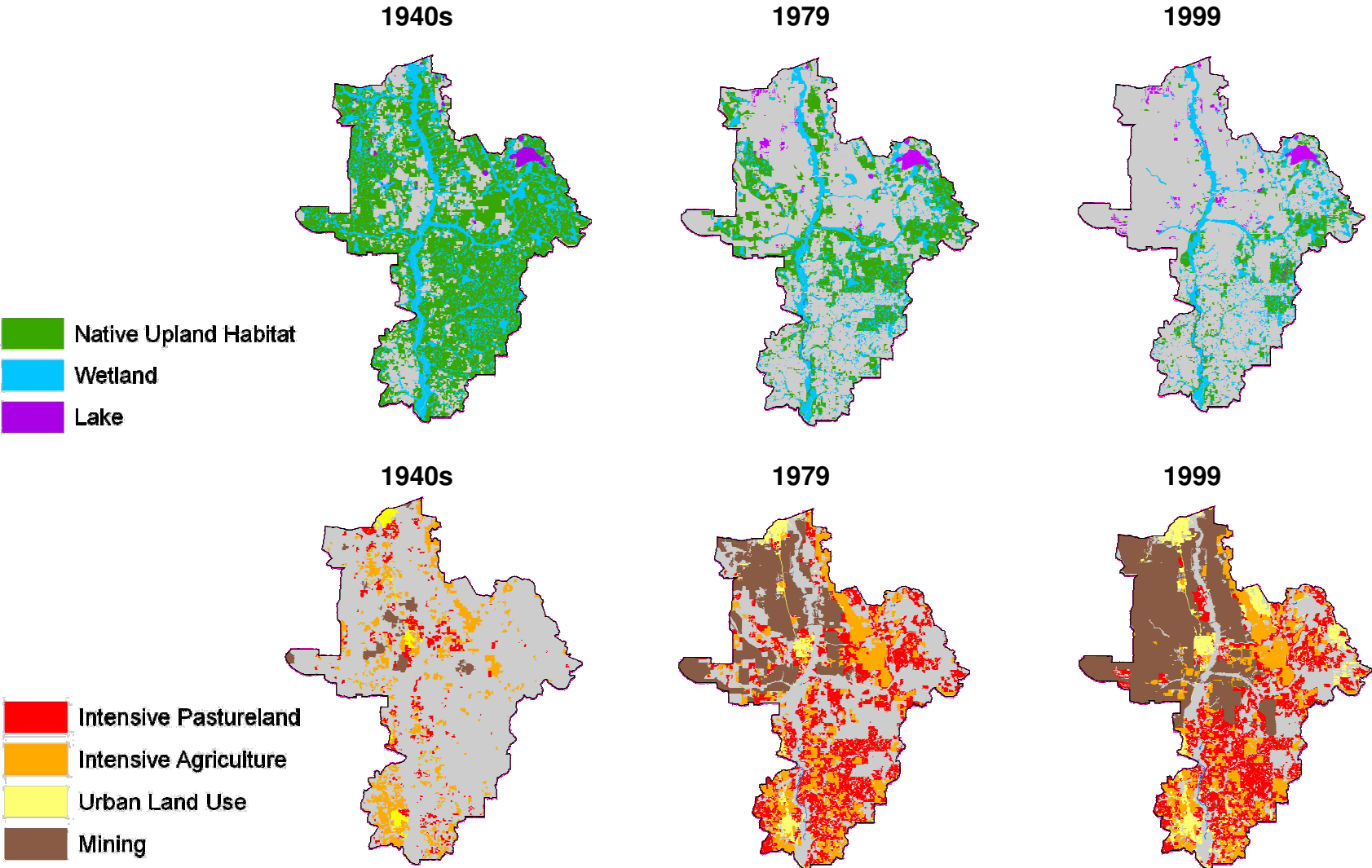
Hydrology

Payne Creek and Little Payne Creek are the main tributaries to the Peace River in this basin and compared with other basins, Payne Creek basin has the largest base flow. Payne Creek base flow is augmented by both mining and power facility National Pollutant Discharge Elimination System (NPDES) ground water discharges. The results of trend analyses are consistent with graphical analyses and suggest increased base flows in the basin over time. However, due to the relatively short period-of-record and the high degree of monthly variability, none of the monthly flow metric patterns were statistically significant after correcting for serial autocorrelation.

Water Quality

- The water quality data from this long-term monitoring location indicates comparatively large historic increases in levels of measured total alkalinity, total dissolved solids, sodium, and sulfate over the period-of-record.
- Relatively smaller increases over the period-of-record in conductivity (specific conductance) and pH levels, as well as calcium and magnesium concentrations, were also apparent.
- Since the 1980s, total phosphorus and orthophosphate levels in Payne Creek have increased.
- These observed long-term changes in water quality in the Payne Creek basin can be attributed to the ground water withdrawals and subsequent discharges due to mining and agriculture.

Figure 3.3.1. Changes in Land Uses: Peace River at Zolfo Springs Basin



Land Use

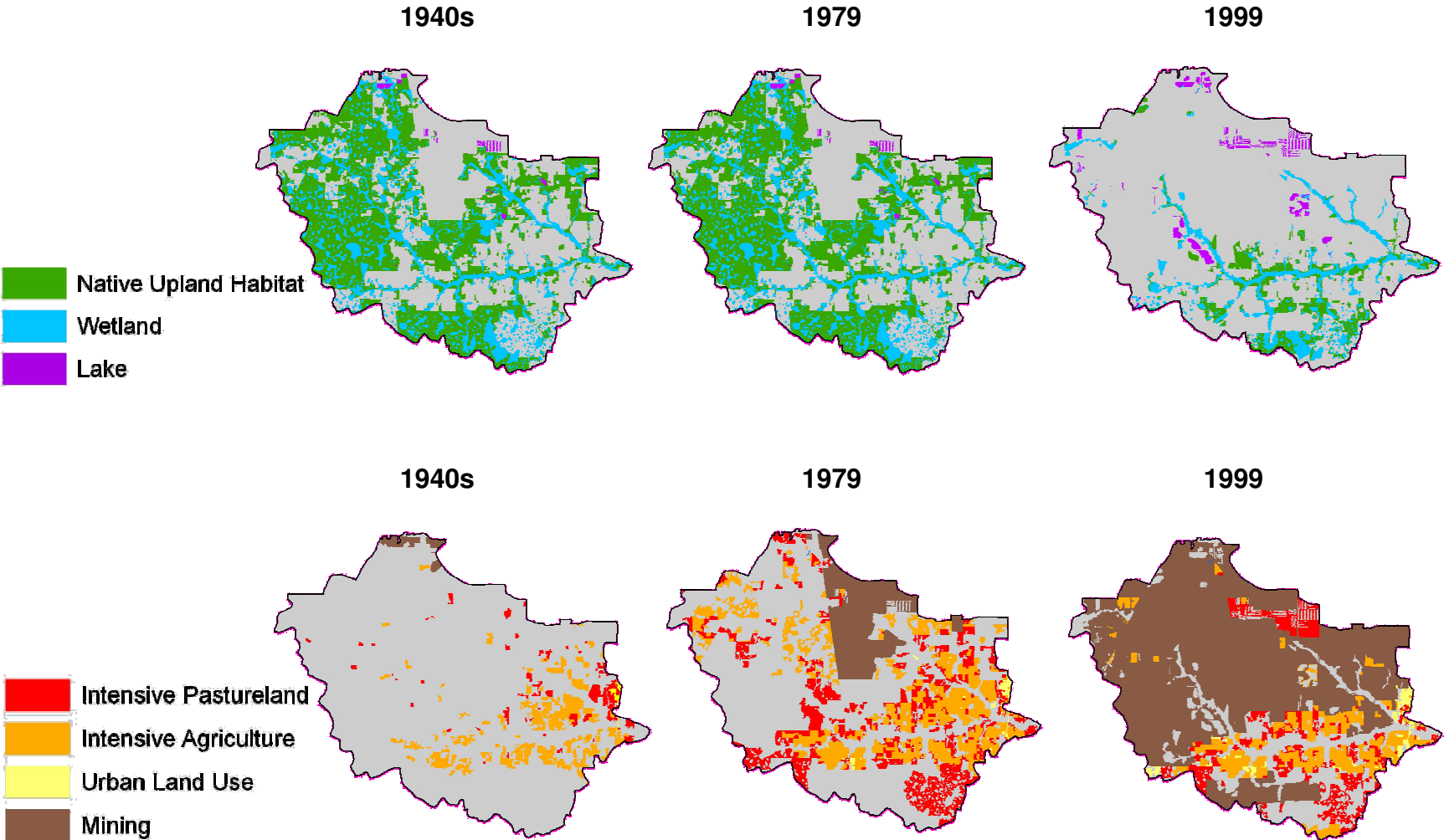
The Payne Creek basin comprises only six percent (79,561 acres) of the Peace River watershed, making it the second smallest basin (next to Joshua Creek). In contrast, this basin includes 41 percent (50,238 acres) of the mined lands in the Peace River watershed and only one basin, Peace River at Zolfo Springs, has more acres of mining (65,324 acres).

Agriculture makes up 18 percent of the basin and urban land uses comprise only one percent of the basin. Land use changes are mapped in Figure 3.3.1.

Eighty percent of the Payne Creek basin was developed by 1999 and conversions to mining were the primary land use change post-1979. Acres of mining in this basin increased from 8,357 acres in 1979 to 50,238 acres in 1999. By 1999, about 16,152 acres of mined lands were identified as totally or partially reclaimed in the basin. Because most mining in the basin occurred subsequent to reclamation regulations, over 11,000 acres in the Payne Creek are also identified as mandatory reclamation lands and only about 3,500 acres are identified as nonmandatory reclamation.

Acres of native upland habitat in the basin decreased from over 51,574 acres in the 1940s to about 5,176 acres in 1999 and represented the largest change in land use in the basin. Wetlands made up 24 percent (18,903 acres) of the basin in the 1940s and only 19 and nine percent, respectively, in 1979 and 1999, a loss of about 10,000 acres. These conversions were greatest before 1979.

Figure 3.3.2. Changes in Land Uses: Payne Creek Basin



3.4 Charlie Creek

Hydrology

Charlie Creek is the major tributary to the Peace River between Zolfo Springs and Arcadia and contributes over half of the intermediate annual inflow to this reach of the river. The results of trend tests support the graphical evidence that base flows in the Charlie Creek basin have been relatively stable and have not significantly changed over time. The graphical results however do suggest a slight decline in minimum monthly flows during the 1960s and a slight increase again over the past decade. While these patterns are not statistically significant, they are consistent with the timing of the wet and dry periods in southwest Florida proposed by the AMO theory.

Water Quality

Water from Charlie Creek enters the Peace River upstream of Arcadia. Historic USGS/SWFMD water quality data for the Charlie Creek basin are available from the long-term monitoring site near Gardner. The observed patterns of water quality changes that have taken place in the Charlie Creek basin are summarized below.

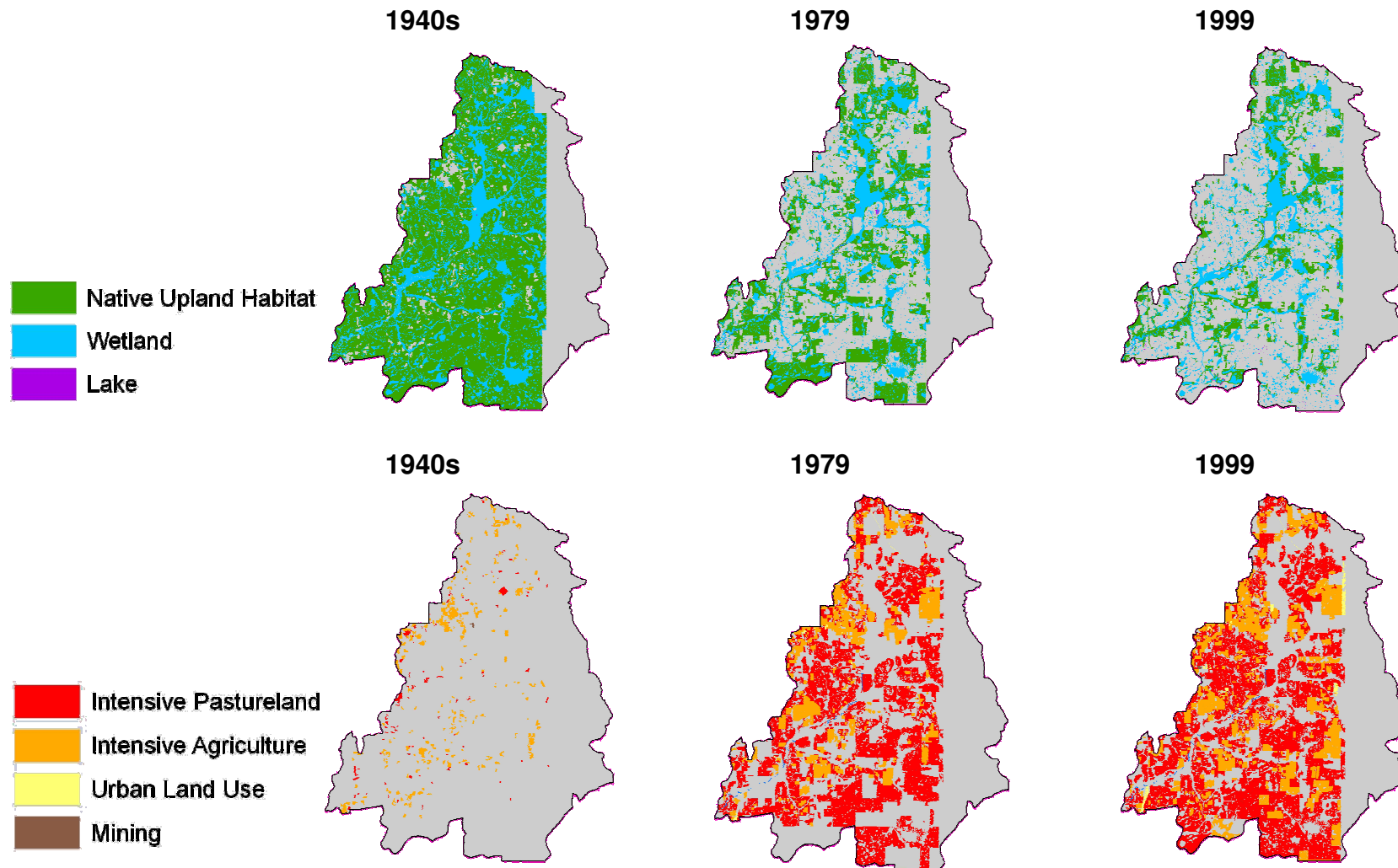
- The time series graphs show moderate increases in calcium, chloride, silica and sulfate concentrations over time. Corresponding, but smaller, increases are also apparent in conductivity levels and concentrations of total dissolved solids and magnesium. These changes probably reflect increases in agricultural ground water discharges.
- Additional observed increases in potassium and inorganic nitrite+nitrate nitrogen are also likely a result of agricultural practices.

Land Use

The Charlie Creek basin includes 173,573 acres (12 percent) of the Peace River watershed. Agriculture lands make up the largest land use in the basin and account for 110,498 acres (64 percent) of the basin. The basin includes one percent of mining and even less urban land uses. Native upland habitats and wetlands make up 35 percent of the basin. Land use changes are mapped in Figure 3.4.1.

By 1999, an additional 22,780 acres of native upland habitats and 2,610 acres of wetlands were converted to agriculture (primarily improved pasture), which expanded to include 64 percent of the basin. Nearly 9,000 acres of improved pasture were converted to intense agriculture. Native upland habitats converted to agriculture totaled 18,830 acres and these habitats decreased from 48 percent to 35 percent of the basin. Sixty-five percent (111,998 acres) of the Charlie Creek basin was developed by 1999 and agriculture remained the primary land use from the 1940s to 1999. Wetlands (9,926 acres) and native upland hardwoods (92,614 acres) were converted to agriculture during this time period, while urban and mined lands together made up only about one percent of the basin.

Figure 3.4.1. Changes in Land Uses: Charlie Creek Basin



3.5 Peace River at Arcadia

Hydrology

The Peace River at Arcadia gage has the longest historic record (1931 – present) of any of the gages in the watershed. Summary results of the trend test for low, median, and high flows at the Peace River at Arcadia gage (Table 3.5.1) indicate declines since the 1930s, 1940s, and 1950s, although none of the trends were statistically significant since 1965, and median and high flows have not shown systematic trends since 1955. Monthly minimum (base) flows over the period-of-record for the Peace River at Arcadia gage indicate both long-term anthropogenic upstream changes as well as differences between the historic wet and dry AMO phases.

Table 3.5.1. Summary Results of Seasonal Trend Tests of Monthly Flow Percentiles for the Peace River at Arcadia Basin

USGS Gaging Site	Flow (Percentile)	1935-2004	1940-2004	1945-2004	1950-2004	1955-2004	1960-2004	1965-2004	1970-2004	1975-2004	1980-2004	1985-2004	1990-2004	1995-2004
Peace River at Arcadia	Low (Q90)	▼	▼	▼	▼	▼	▼							
	Mean (Q50)	▼	▼	▼	▼									
	High (Q10)	▼	▼	▼	▼									

Note: The direction of an arrow denotes a significant increasing or decreasing trend. Arrows are significant at $p=0.10$ level, and blanks indicate no significant trends in Seasonal Kendall Tau tests corrected for serial correlations. Shaded cells indicate periods prior to USGS gaging data at each location.

Water Quality

Relatively consistent data for a number of water quality parameters dating back to the early 1960s are available for the Arcadia monitoring location. Some of the important water quality changes observed in the Peace River at Arcadia basin are summarized below.

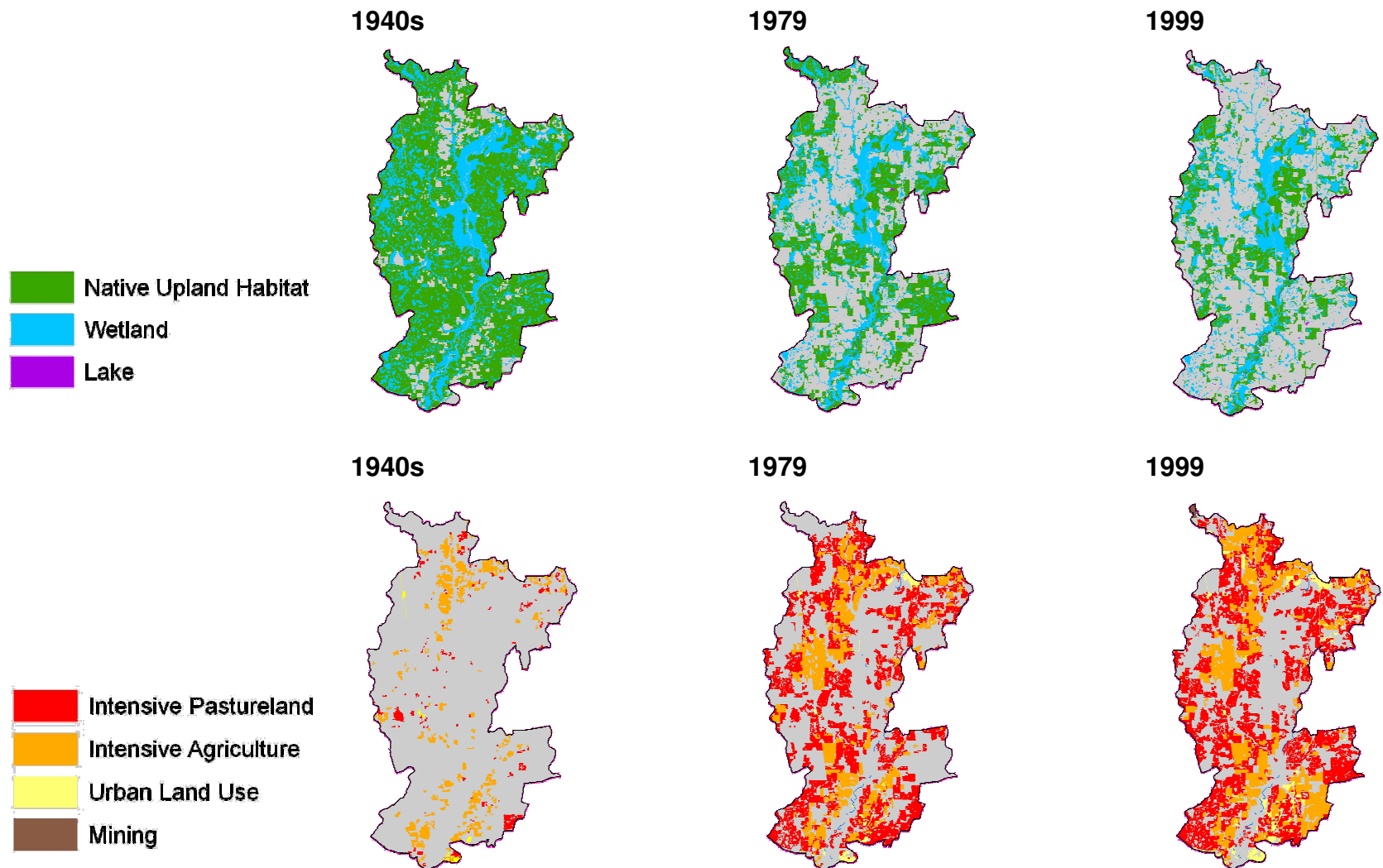
- Marked declines in total phosphorus, orthophosphate, and fluoride levels at Arcadia are similar to the declines observed upstream at Zolfo Springs and Bartow and are attributable to improvements in phosphate mining and processing practices.
- Declines in inorganic nitrogen forms may reflect reduced domestic point source discharges, while long-term increases in pH, total alkalinity, sodium, and chloride concentrations can be attributed to increased ground water discharges in and upstream of the basin.

Land Use

The Peace River at Arcadia basin comprises nine percent (128,186 acres) of the Peace River watershed. Urban land uses make up about three percent of the basin and phosphate mining in this basin is negligible (187 acres). This basin is characterized by large decreases in primarily native upland habitats due to conversions of these habitats to improved pasture and intense agriculture, a trend typical of the watershed in general.

Agricultural lands make up the largest land use in the basin and account for 71,212 acres (56 percent) of the area in the basin. Urban land uses make up three percent of the watershed. Native upland habitats and wetlands still comprise 41 percent of the basin. Land use changes are mapped in Figure 3.5.1. Fifty-nine percent (75,203 acres) of the Peace River at Arcadia was developed by 1999 and agriculture was the primary land use change both pre- and post- 1979. Large numbers of acres of wetlands (26,115 acres) and native upland hardwoods (26,257) were converted to agriculture during this time period. Urban land uses increased to about three percent (3,804 acres) of the basin.

Figure 3.5.1. Changes in Land Uses: Peace River at Arcadia Basin



3.6 Joshua Creek

Hydrology

The southern basins have been characterized by a loss of wetland and native upland habitats as agriculture (rather than mining) transitioned from predominately unimproved pasture to improved pasture, and then to increasing areas of more intense farming such as citrus and row crops. The more intense agricultural land uses rely on increased ground water use and consequently impact hydrology, water quality, and habitats in the southern basins.

Changes to more intense agriculture are reflected in the water chemistry of Joshua Creek, which over recent decades exhibited large increases in characteristics associated with Upper Floridan ground water discharges into the basin's natural stream flows. Summary results of the trend tests for low, median, and high flows at the Joshua Creek near Nocatee gage shown in Table 3.6.1 suggest the degree to which agricultural ground water discharges have increased flows.

Table 3.6.1. Summary Results of Seasonal Trend Tests of Monthly Flow Percentiles for the Joshua Creek Basin

USGS Gaging Site	Flow (Percentile)	1935-2004	1940-2004	1945-2004	1950-2004	1955-2004	1960-2004	1965-2004	1970-2004	1975-2004	1980-2004	1985-2004	1990-2004	1995-2004
Joshua Creek at Nocatee	Low (Q90)					▲	▲	▲	▲	▲	▲	▲		
	Mean (Q50)					▲	▲	▲	▲	▲	▲	▲		
	High (Q10)					▲	▲	▲	▲	▲	▲			

Note: The direction of an arrow denotes a significant increasing or decreasing trend. Arrows are significant at $p=0.10$ level, and blanks indicate no significant trends in Seasonal Kendall Tau tests corrected for serial correlations. Shaded cells indicate periods prior to USGS gaging data at each location.

Water Quality

The historical period-of-record of water quality information for the USGS/SWFWMD Joshua Creek at Nocatee sampling location extends back to the mid 1960s. Historic patterns of water quality changes in the Joshua Creek basin are summarized below.

- Available water quality data indicate comparatively large historic increases conductivity, total dissolved solids, sodium, chloride, and sulfate levels.
- Slightly smaller increases in calcium, magnesium, and silica concentrations also occurred.

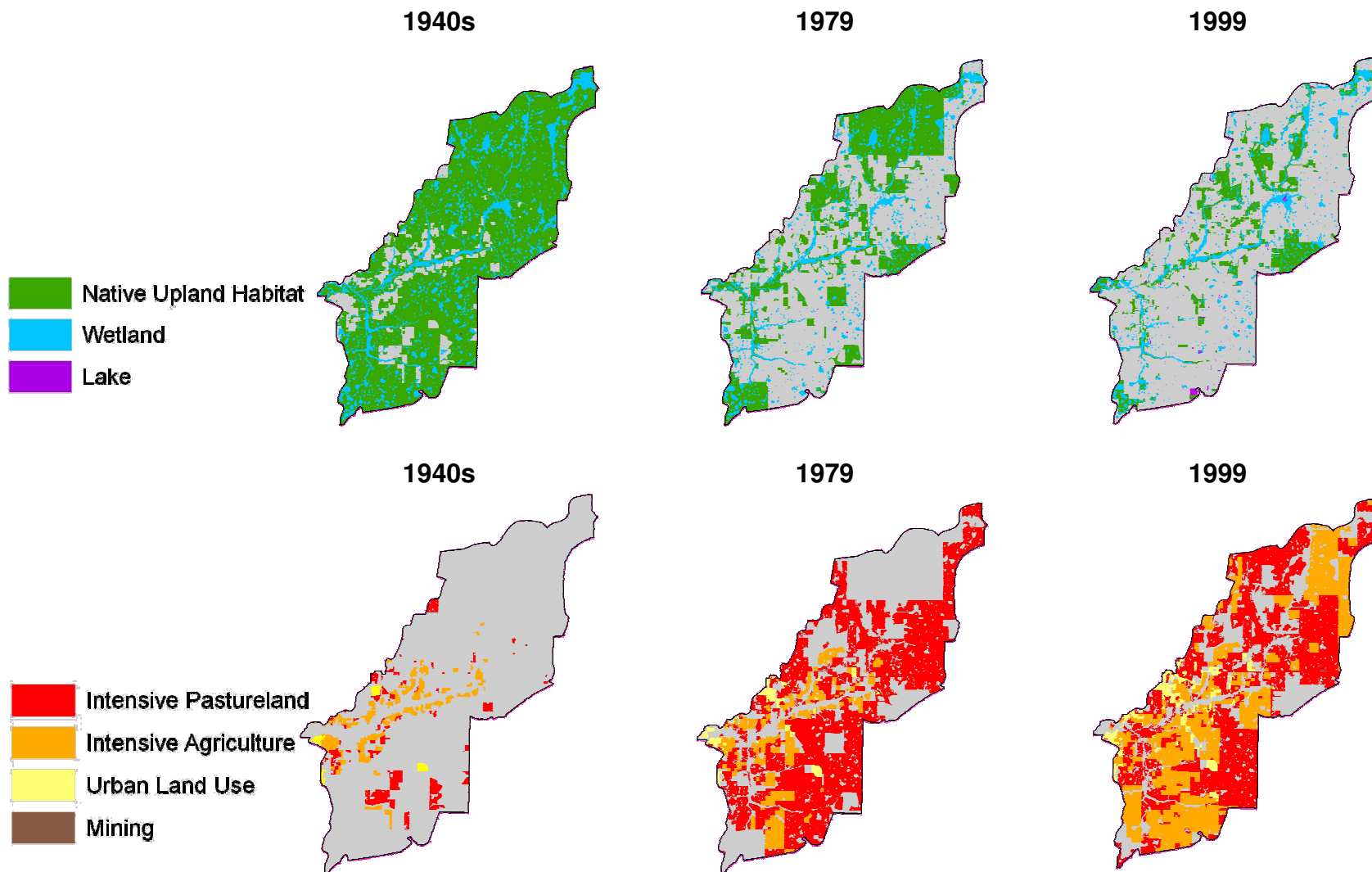
- Observed changes in water quality are attributable to agricultural discharges of mineralized ground water to surface waters.
- The recent large increases observed in inorganic nitrite+nitrate nitrogen in the Joshua Creek basin are also likely attributable to increases in intensive agricultural land uses.

Land Use

The Joshua Creek basin is the smallest basin in the Peace River watershed and includes only 77,391 acres (six percent) of the watershed. This basin has land use characteristics similar to the watershed in general; that is, agriculture is the primary land use (76 percent), most (81 percent) of which was converted from native upland habitats to improved pasture and intense agriculture. The small increase in urban areas in this basin was due to conversions from native upland hardwoods. Land use changes are mapped in Figure 3.6.1.

Over three-quarters of the Joshua Creek basin was developed by 1999 as a result of expanding agriculture. Urban land uses remained low and mining remained absent in the basin. The loss of native upland habitats and wetlands declined from 90 percent to 23 percent of the basin. Conversions to improved pasture were largest pre-1979, while intense agriculture had the greatest increase post-1979.

Figure 3.6.1. Changes in Land Uses: Joshua Creek Basin



3.7 Horse Creek

Hydrology

Horse Creek drains approximately 241 square miles in the western portion of the Peace River watershed and flows approximately 43 miles south into the Peace River near Fort Ogden. However, the base flow in Horse Creek is due predominantly to agricultural ground water discharges.

There are two USGS stream flow gages along Horse Creek. Summary results of the trend test for low, median, and high flows for the two USGS Horse Creek stream gages are listed in Table 3.7.1. While these data do not show statistically significant changes low flows at the upstream gage near Myakka City, the long-term water chemistry data collected from this location indicate that mineralized ground water discharges have increased, especially during the recent 1999-2001 drought. As both the flow and water chemistry data indicate, the influences of ground water discharges augmenting surface flows increases farther downstream at the Horse Creek near Arcadia gage.

Table 3.7.1. Summary Results of Seasonal Trend Tests of Monthly Flow Percentiles for Selected Periods for the Horse Creek Basin

USGS Gaging Site	Flow (Percentile)	1935-2004	1940-2004	1945-2004	1950-2004	1955-2004	1960-2004	1965-2004	1970-2004	1975-2004	1980-2004	1985-2004	1990-2004	1995-2004
Horse Creek near Myakka Head	Low (Q90)													
	Mean (Q50)													
	High (Q10)													
Horse Creek near Arcadia	Low (Q90)								▲	▲				
	Mean (Q50)								▲	▲				
	High (Q10)								▲	▲				

Note: The direction of an arrow denotes a significant increasing or decreasing trend. Arrows are significant at $p=0.10$ level, and blanks indicate no significant trends in Seasonal Kendall Tau tests corrected for serial correlations. Shaded cells indicate periods prior to USGS gaging data at each location.

Water Quality

This basin includes two USGS/SWFWMD water quality monitoring sites. The overall patterns of water quality changes in the Horse Creek basin are summarized below.

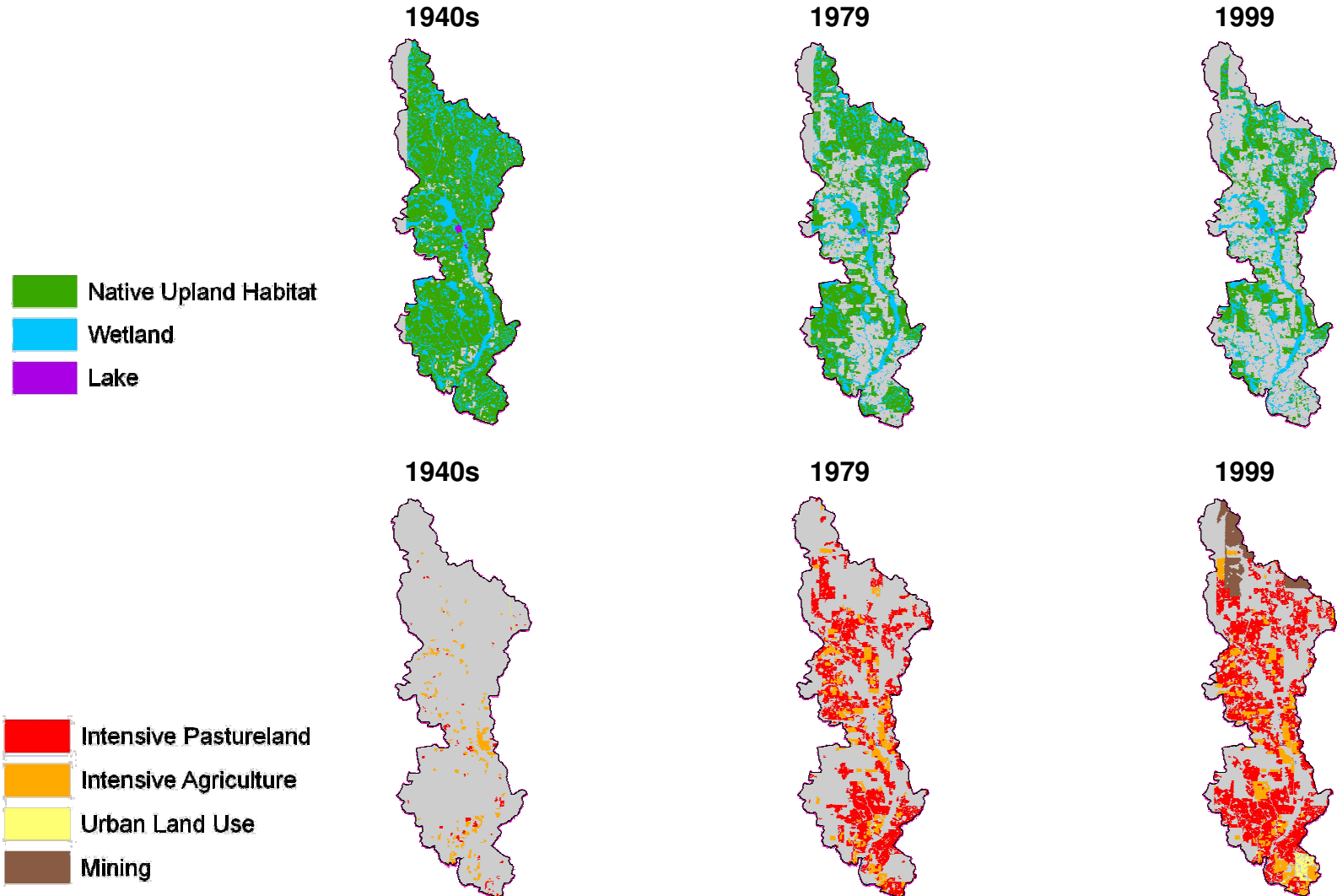
- Time series plots for the upper Horse Creek near Myakka Head station are strongly affected by the limited period-of-record and the influence of the 1999-2001 drought. The increases in phosphorus levels, for example, reflects high concentrations during the drought, and lower concentrations both prior to and following the drought. Similar influences of the drought on chloride and potassium levels are also apparent.
- Even with the relatively limited historic record, water quality data from the Horse Creek near Myakka Head monitoring sites indicate increases in specific conductance and pH, and total dissolved solids, calcium, magnesium, sodium, and sulfate levels.
- Similar, albeit larger, changes in water quality parameters occurred over the historic period-of-record at the downstream Horse Creek near Arcadia monitoring site.
- These observed changes in water quality at both sampling locations are attributable to discharges of mineralized ground water from agricultural activities into Horse Creek, and in the southern watershed in general.
- The long-term data at the downstream site also indicate increases in inorganic nitrite+nitrate nitrogen concentrations during the mid 1980s.

Land Use

The Horse Creek basin is approximately 128,435 acres in size and includes approximately nine percent of the watershed. Developed land uses, primarily improved pasture, make up 69,097 acres (54 percent) of the basin and the remaining 59,053 acres (46 percent) is comprised of native upland habitats and wetlands.

Since 1999, phosphate mining has expanded south from the Payne Creek basin into the northern portion of the Horse Creek basin, while more intensive agriculture and residential/urban development have expanded into the southern portion of the basin. The northern portion of the Horse Creek basin has more natural vegetation when compared with the southern portion, which is primarily pasture and row crops. The Mosaic Company owns 45,000 acres of land in the Horse Creek basin, and over 7,295 acres of this were mined prior to 1999. Land use changes are mapped in Figure 3.7.1.

Figure 3.7.1. Changes in Land Uses: Horse Creek Basin



Acres of mining in this basin increased from zero in the 1940s and in 1979, to 7,295 acres in 1999 when mining comprised six percent of the basin. Approximately 3,790 acres of native upland habitat and 1,363 acres of wetlands were converted to mined lands during this period, all of which are subject to mandatory reclamation. Conversions to urban land uses increased from 46 acres in the 1940s to 109 acres in 1979 and then to 1,596 acres in 1999 and still made up only one percent of the basin.

Nearly half of the Horse Creek basin was in agriculture by 1999, although most of the agricultural increases occurred prior to 1979. Conversions of native upland habitats during this same period of time accounted for all but about 4,000 acres, which was actually due to changes between agriculture classes.

3.8 Shell Creek

Hydrology

Shell Creek enters the Peace River downstream of Arcadia. The Hendrickson Dam is located below the confluence of Prairie Creek with Shell Creek. Summary results of the trend test for low, median, and high flows for the two USGS Shell Creek stream gages are shown in Table 3.8.1. Even with a relatively short continuous record, the increased flows in Prairie Creek have been of such a magnitude that statistically significant trends are readily apparent. Water chemistry data from Prairie Creek over the same time interval clearly indicate that these increases in flows are associated with agricultural discharges of highly mineralized Upper Floridan ground water reaching the creek. Flows at the dam show both long-term increases in low flows, as well as declines associated with the recent 1999-2001 drought.

Water Quality

Several water quality parameters exhibited long-term increasing patterns and were measured at or near historically high levels during the recent 1999-2001 drought.

- Available water quality data indicate comparatively large historic increases in levels of measured conductivity in Prairie Creek and the Shell Creek Reservoir.
- Similar patterns of increasing chloride and silica concentrations have also occurred.

Table 3.8.1. Summary Results of Seasonal Trend Tests of Monthly Flow Percentiles for Selected Periods for the Shell Creek Basin

USGS Gaging Site	Flow (Percentile)	1935-2004	1940-2004	1945-2004	1950-2004	1955-2004	1960-2004	1965-2004	1970-2004	1975-2004	1980-2004	1985-2004	1990-2004	1995-2004
Prairie Creek near Fort Ogden	Low (Q90)										▲	▲		
	Mean (Q50)										▲	▲		
	High (Q10)										▲	▲		
Shell Creek near Punta Gorda	Low (Q90)							▲					▼	
	Mean (Q50)													
	High (Q10)													

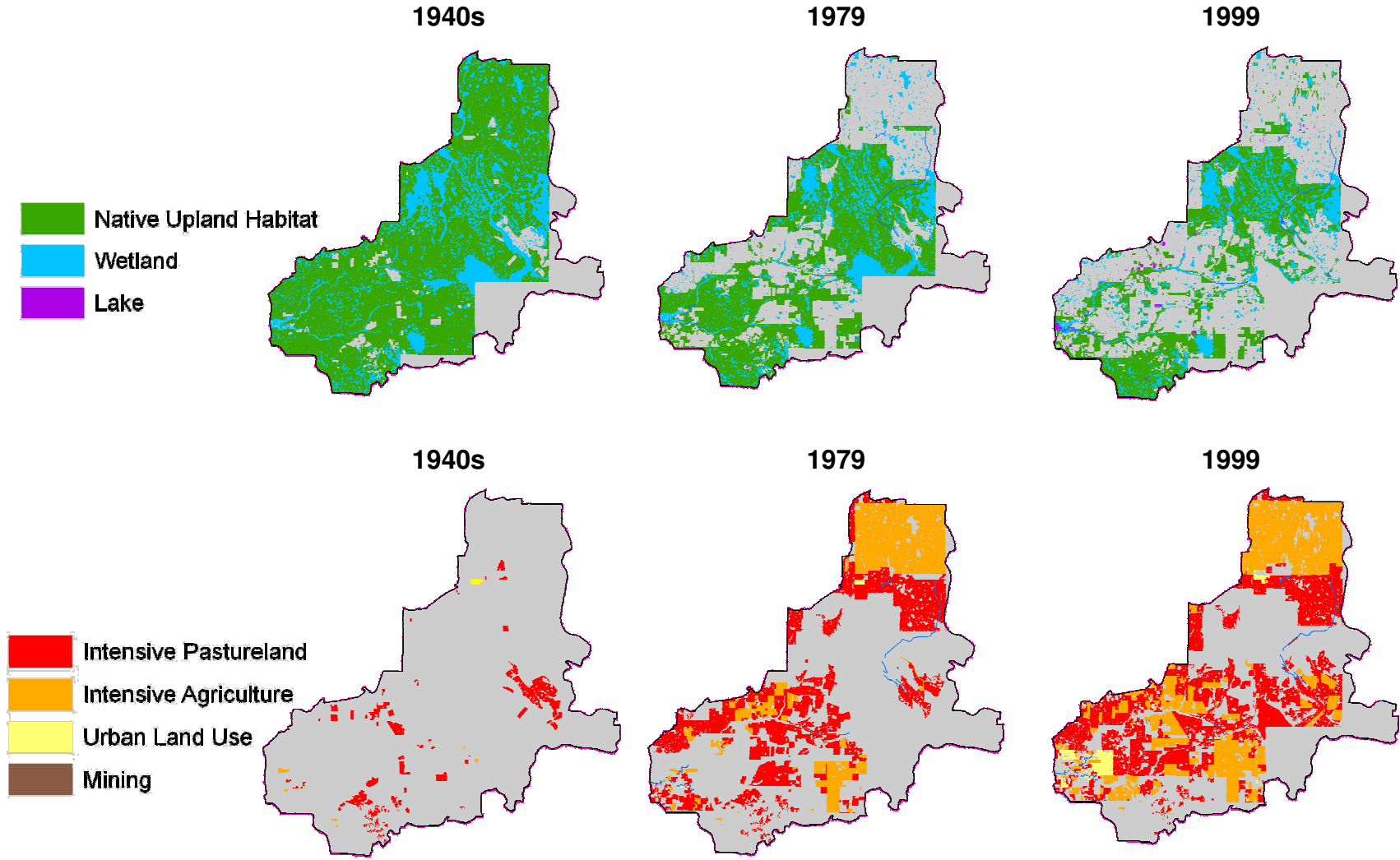
Note: The direction of an arrow denotes a significant increasing or decreasing trend. Arrows are significant at $p=0.10$ level, and blanks indicate no significant trends in Seasonal Kendall Tau tests corrected for serial correlations. Shaded cells indicate periods prior to USGS gaging data at each location.

Land Use

The Shell Creek basin is second only to the Peace River at Bartow basin in size and includes approximately 213,537 acres (15 percent) of the Peace River watershed. Improved pasture and agriculture, in general, comprise the largest land uses in the basin. Sand and shell excavation is negligible (76 acres) and urban land uses make up only two percent of the basin. Land use changes are mapped in Figure 3.8.1.

More than half of the Shell Creek basin was in agriculture by 1999, with most of the agricultural increases occurred pre-1979. Conversions of native upland habitats (96,457 acres) and wetlands (14,680 acres) since the 1940s accounted for 94 percent of the agricultural expansion in the basin.

Figure 3.8.1. Changes in Land Uses: Shell Creek Basin



3.9 Lower Coastal Peace River

Hydrology

This basin is bisected by the Peace River, while Horse, Joshua, Prairie, and Shell creeks drain the eastern and north-central parts of the study area. The location of this basin at the mouth of the Peace River precludes the use of stream gaging stations and therefore hydrology, water quality, and water budget data are unavailable.

Land Use

The Lower Coastal Peace River watershed encompasses 164,571 acres (12 percent) of the Peace River watershed. As described previously, this basin and the Peace River at Bartow basin are the only basins with a large urban land use component. Like most of the watershed, the largest conversions to existing land uses occurred between the 1940s and 1979 rather than post-1979. Land use changes are mapped in Figure 3.9.1.

Over half of the Lower Coastal Peace River watershed was developed by 1999 and approximately 27 percent (44,382 acres) was in urban land use. Conversions to urban land uses increased by 12,279 between 1979 and 1999 and were predominantly from native upland habitats (9,031 acres) and improved pasture (2,266 acres). Acres of agriculture increased little, from 36,349 to 39,673 acres in 1999, making up 24 percent of the land use in the basin. Shell and sand, but not phosphate, mining, accounted for 309 acres in the basin. Fourteen percent of the native upland habitats was converted to urban land uses and 12 percent to agriculture during this time period.

Acres of native upland habitat in the basin had decreased from over 104,741 acres (64 percent) in the 1940s to about 42,132 acres (26 percent) in 1999 and represented the largest change in land use. Wetlands made up 41,197 acres (25 percent) of the basin in the 1940s and only 31,211 acres (19 percent) in 1999. These conversions were greatest before 1979.

Figure 3.9.1. Changes in Land Uses: Lower Coastal Peace River Watershed

