3. State of the Watershed

A detailed discussion of the state of the watershed can be found in the 1.0 General Watershed Information section of the 2010 Cypress Creek Watershed Characterization Report (WCR) (see Technical Reference Document) and is summarized below.

History of the Cypress Creek Watershed

Central Texas has been continuously inhabited since the earliest humans lived in North America over 12,000 years ago, largely as a result of the abundant springs systems found in the region. The nomadic Tonkawa Native Americans inhabited the region between the 13th and 19th centuries. Native Americans and Europeans first made contact during early Spanish gold expeditions in the 17th century. During the 19th century, early Anglo settlers were former soldiers who had fought at the battle of San Jacinto and were given land grants in appreciation by the Republic of Texas. In 1856, William C. Winters bought 34 acres and built the first grist mill in the Cypress Creek watershed. In 1874, Pleasant Wimberley bought the mill and it was renamed Wimberley's Mill. An application for a post office was made in 1880 with the town name Wimberleyville. The post master dropped the "ville" and approved the application, thus creating the town of Wimberley. Soon after, churches and schools opened and the town flourished. An instant draw to the area was the water. The Blanco River, Cypress Creek, and Jacob's Well all flowed with clean, clear water and springs. Today, Wimberley is home to over 6,000 people, many shops and restaurants, and is a popular tourist destination.

In 1943, land was purchased in what is now known as Woodcreek for a resort community. More people bought land and built houses. A golf course, a swimming pool, a hotel and a restaurant were added. The City of Woodcreek was incorporated in 1984. As of 2007, the population of Woodcreek had grown to over 1,600 people.

Geography

Located in central Texas and part of the Edwards Plateau region of the Texas Hill Country, the Cypress Creek watershed has recognizable features of the region. Rugged terrain, narrow canyons, and springs dominate the landscape. Cypress Creek flows through unincorporated portions of Hays County and the cities of Wimberley and Woodcreek. It meets the Blanco River near the Wimberley town center (Figure 6).

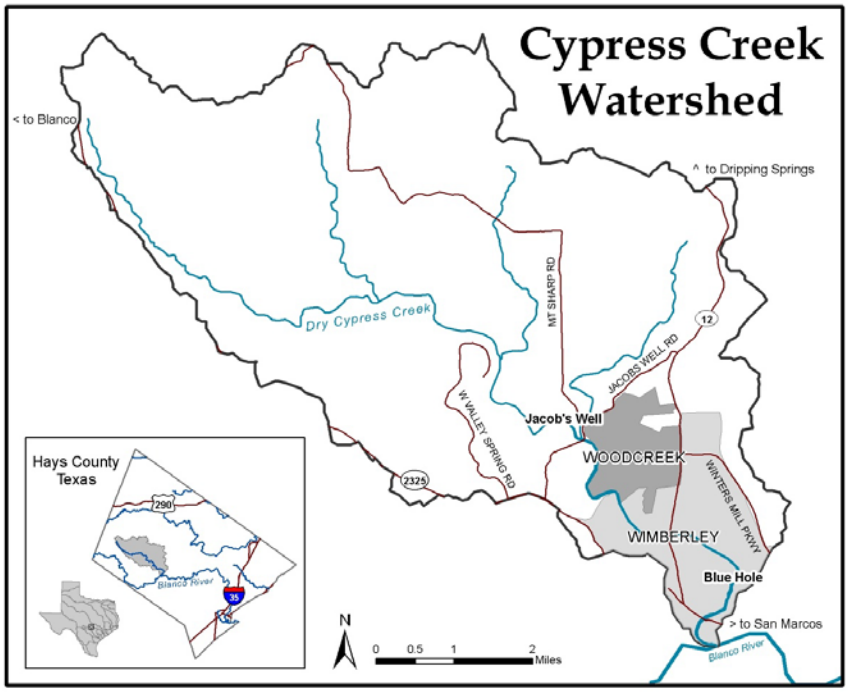

Figure 6. Cypress Creek Watershed, Central Texas

About five and a half miles upstream of the confluence, near the City of Woodcreek, is Jacob's Well, the headwaters of the historically perennial Cypress Creek. Jacob's Well is an artesian spring that is considered the lifeblood of the community as it feeds water to the lower third of the creek.

The Cypress Creek watershed is predominately a karstic limestone region. Karst areas contain soluble rocks, such as limestone, whose structures are dominated by occasionally, but not necessarily, interconnected conduits created by dissolution. Karst areas are highly susceptible to groundwater contamination for several reasons. The dissolved rocks form conduits and channels for underground flow and increase the ability of water to enter into these conduits from the surface. Secondly, the protective rock and soil deposits normally found in non-karst systems are minimal, making the system more vulnerable. Not only is pollution entry into the system a concern, high velocities of groundwater flow through the conduits can also be problematic.

Geologic rock formations in the Cypress Creek watershed are primarily limestone with some Quaternary sediment found along creek beds. The rock strata are identified as basal conglomerates and limestones of the Trinity Group, formed during cyclical development of shallow seas in the Cretaceous. The Trinity Group is comprised of seven formations with distinct characteristics. Hydrogeologically, the formations are recognized as the Lower, Middle, and Upper Trinity Aquifers due to variations in lithology and water production characteristics.

Vegetation on the hilltops is often sparse because of thin layers of topsoil. In the northern portion of the watershed, shallow or disturbed soils support evergreen shrubs and grasses. Woodlands of juniper, oak and mesquite are interspersed along the hillsides and, towards the bottom of the slopes, more native grasses can be found.

The creek and surrounding watershed offers habitat to a diversity of species, including fishes, water fowl, reptiles and amphibians, mammals, and insects. The climate is also typical of central Texas with hot dry summers and rainfall that ranges from infrequent and sparse to heavy downpours and flash flooding.

Urban development has been concentrated in the lower third of the watershed around Woodcreek and the City of Wimberley. Therefore the highest risk for excess sediment flow in the creek due to high slope comes from agriculture (primarily grazing) activities in the upper and northern portions of the watershed, and in bottomland areas the primary source for excess sediment flow results from development activities and land clearing.

Due to the population increases in the past two decades, land use in the Cypress Creek Watershed has shifted from predominantly rangeland and undeveloped land uses to residential land uses. This trend is expected to continue in the future as formerly large acreage holdings are subdivided for both high-density residential (<5 acres) and large lot "ranchettes" (>5 acres). In 2010 the Meadows Center worked with the Stakeholder Committee to develop a future development scenario that depicts a full build-out of existing and platted subdivisions in the watershed. Please see *Land Use Section* on page 34 for further information.

Despite rapid population growth, neither Wimberley nor Woodcreek are subject to Municipal Separate Storm Sewer Systems (MS4) requirements, which include a stormwater management program and "ditches, curbs, gutters, storm sewers, and similar means of collecting or conveying runoff that do not connect with a wastewater collection system or treatment plant." Such infrastructure is required by EPA and TCEQ to transport polluted stormwater runoff in larger communities. None of these surface and source water protection strategies currently exists in the Cypress Creek Watershed.

Water Resources

Jacob's Well, a Middle Trinity Aquifer artesian spring, provides the majority of flow in Cypress Creek and has been described as the "heart and soul" of the Hill Country. Blue Hole, located in Cypress Creek just upstream of Wimberley, is a swimming hole that has been enjoyed by generations of local residents and considered one of the top swimming holes in Texas.

Baseflow to Jacob's Well is artesian flow from the Cow Creek up through the confining Hensel and Lower Glen Rose. The major source of recharge to the Cow Creek occurs west of the Cypress Creek watershed from the downward leakage of water from the Upper and Lower Glen Rose and Hensel where these formations are exposed at the surface and exposed to

precipitation. Groundwater under artesian conditions in the Cow Creek provides the majority, if not all of the base flow at Jacob's Well.

Jacob's Well is an expression of underground water stored in the Trinity Aquifer that discharges at the land surface. During rain events, however, water flows downhill from the distant hilltops in the watershed and into the creek. Once the water is in the creek bed, part of it flows back underground into the aquifer. Cypress Creek's water flow pattern between the surface and subsurface creates a complex interaction between groundwater and surface water. Both urban and rural communities are heavily reliant on groundwater as the primary water supply, but are reliant on the unique surface water characteristics, such as Jacob's Well and Blue Hole, for recreational use and aesthetic value.

Water Quality Data and Monitoring

Routine water quality monitoring data through the Clean Rivers Program (CRP) through December 2009 and TCEQ were used. The TCEQ site data from 1973 to 1999 were compared to data from 2000 to 2009 to evaluate any long-term changes in water quality (see Figure 30).

Stormflow Monitoring: The Cypress Creek Project installed two automatic stormflow monitoring devices along the main creek channel to record stage, sediment, nutrient, and bacteria concentrations during runoff events. The samples were tested for sediment, analyzed in the lab for total suspended solids (TSS), nitrate-nitrogen, total phosphorus, and *E. coli*.

Water Quantity Data: Spring flow data collected by the USGS at Jacob's Well spring (08170990) and streamflow data at the Blanco River gauge (08171000) were used. Historical daily mean flows at the Blanco confluence were estimated based on a comparison between daily mean stage recorded at the confluence and daily mean stage at the USGS. Results from Dedden's stream gauging project in 2005 were also used.

Details on all data, monitoring and methodology are in the Technical Reference Document.

Figure 7. Water Quality and Data Monitoring

Water quality varies considerably between monitoring sites in the perennial portion of the creek (see more on monitoring in Figure 7). In general, the three upper most water quality monitoring sites (Jacob's Well, RR12 north, and Blue Hole) tend to be highly influenced by inflow of groundwater in terms of their water chemistry and concentrations related to flow, while the lower two sites (RR12 downtown and the Blanco confluence) tend to cluster closer together and show more of an influence of local stream conditions and runoff from contributing watersheds (additional information is available in Section 4.2.4 of the Watershed Characterization Report in the Technical Reference Document).

The Cypress Creek Stakeholder Committee' main goal was to preserve water quality in Cypress Creek by mitigating NPS pollution and maintaining adequate flows from Jacobs Well. Concerns included nitrogen, TSS, high bacteria concentrations, Dissolved Oxygen and increased impervious cover from urbanization. Residential land use contributes a large portion of

nonpoint sources of pollution including pet and animal waste, excess fertilizer application and poorly performing septic systems.

Above the artesian headwaters flows in the Cypress Creek (Dry Cypress) are driven by rain events (Figure 8). Storm flow monitoring of the Dry Cypress watershed area indicates the upper watershed has a tendency toward high bacterial and sediment concentrations washing down through the channel after a storm, with occasionally high nitrogen levels as well.

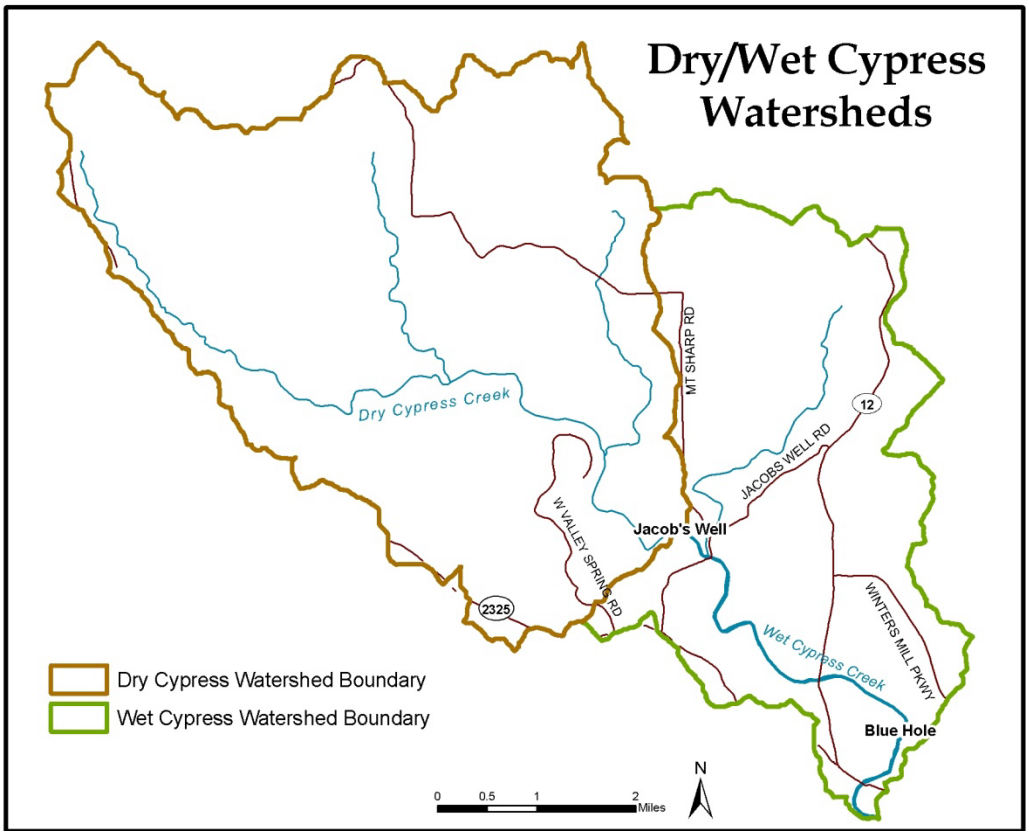

Figure 8. Dry and Flowing Segments Of Cypress Creek

Overall water quality in Cypress Creek is meeting water quality standards set by TCEQ, but shows signs of degradation. Data reveal both spatial and temporal water quality trends that may be due to climate variability, nonpoint source pollution, changes in land use and/or management in the watershed and stressed groundwater levels.

Annual Water Flow - Water Yield

Model results show an average water yield across the watershed of 260.61 mm (annual water flow), meaning that for an average annual rainfall of 879.37 mm (35 in), about 260 mm will flow out of the upland areas to the main stream channel (Figure 9). Model results indicate that a great deal of flow losses occur in the upper portions of the watershed through rapid infiltration and channel loss, or surface water flows converting to groundwater. Some of these flows travel through the shallow subsurface and reappear in downstream channels, while

others are lost to deep percolation and/or utilized by vegetation. Areas that yield the largest amounts of water also have the greatest potential to carry high volumes of pollutants. Simulated yearly average water yield for each subwatershed was used with Event Mean Concentrations for six land uses to estimate pollutant loadings by source for NPS parameters and parameters of concern identified by the Stakeholder Committee. Results of these modeling activities are discussed below in the section titled *Water Quality*.

Management measures exist which may mitigate effects of these natural processes both to protect flows and to protect water quality of surface waters recharging source water supplies. Stakeholders have chosen to include such management measures in their implementation strategy and groundwater-surface water modeling is listed as a necessary tool to understand the relationships and implement future BMPs, if applicable.

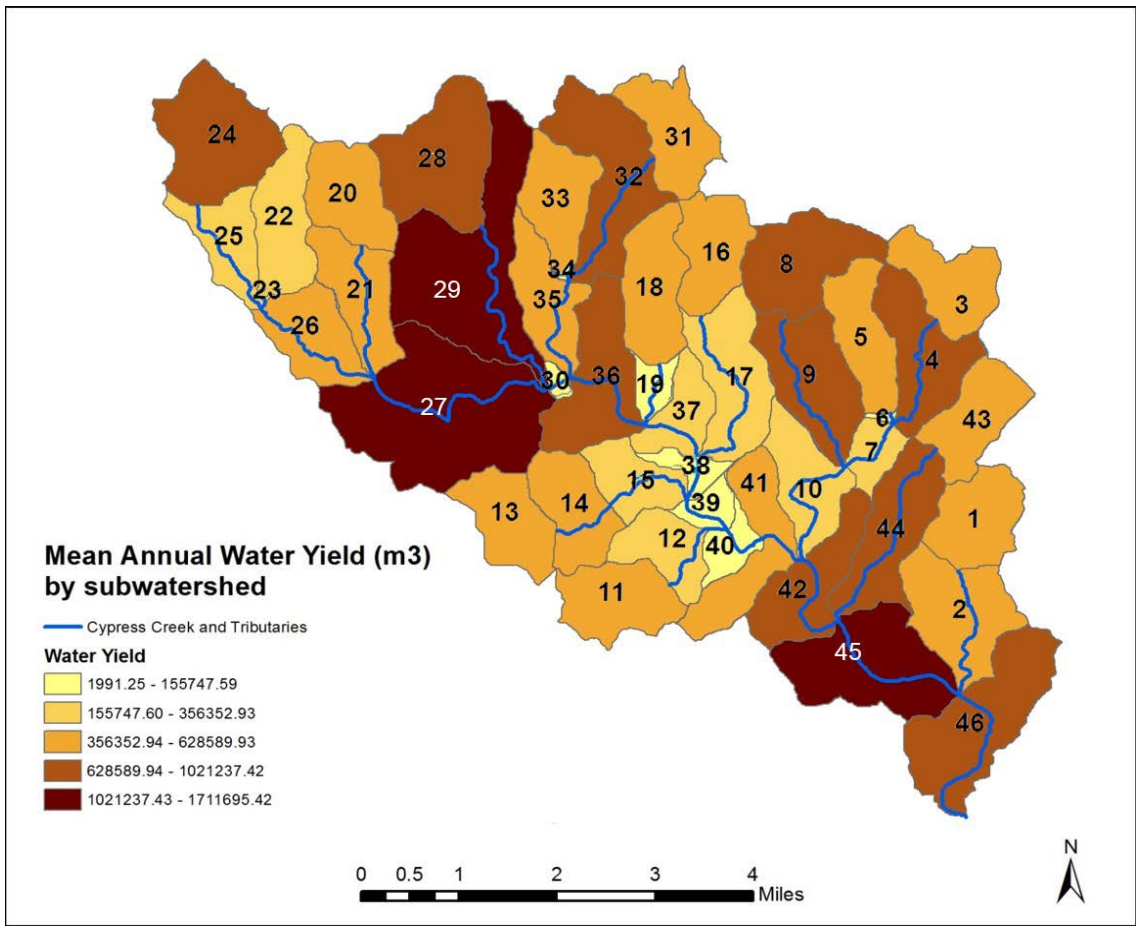

Figure 9. Simulated Average Water Yield by Subwatershed, 2000-2009 via SWAT

Land Use

As of 2009 the majority of land use is made up of open/undeveloped and rangeland, and urbanized land use makes up only 9.2%, most of which is residential (Table 5). Most developed land is concentrated around the wet portion of the cypress creek (Figure 10).

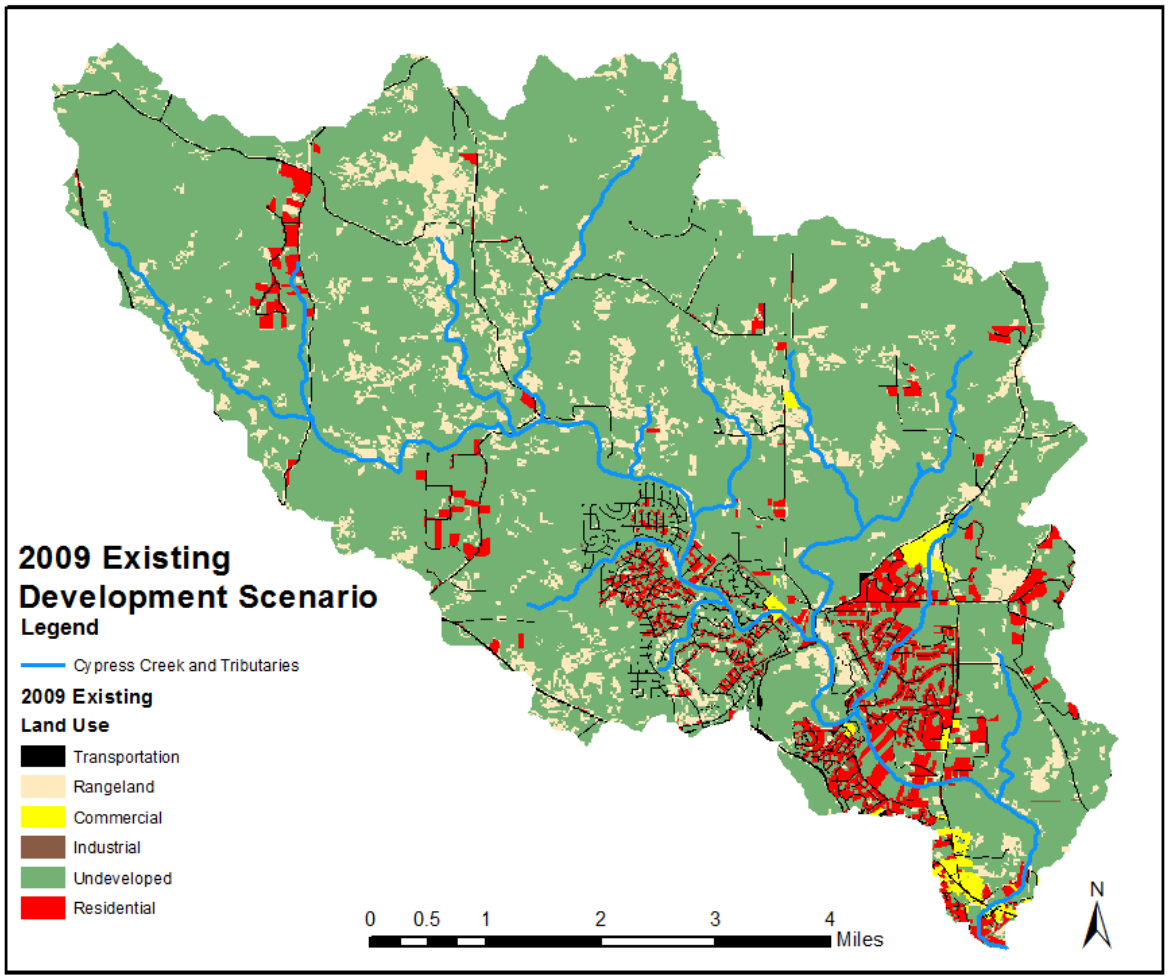

Figure 10. Land Use in Cypress Creek Watershed, 2009

Table 5. Land Use in Cypress Creek Watershed, 2009

2009 Existing Land Use	Area of Watershed
Residential	5%
Commercial	<1%
Industrial	<1%
Transportation	3%
Rangeland	11%
Open and Undeveloped	80%

Hays County is expected to grow by 300% by 2050. Based on data collected in 2009, land use change has been projected to be predominately residential (Table 6), with an increase of 440% (Table 7). In the Future Scenario, development extends into the dry portion of Cypress Creek and into the uplands (Figure 11).

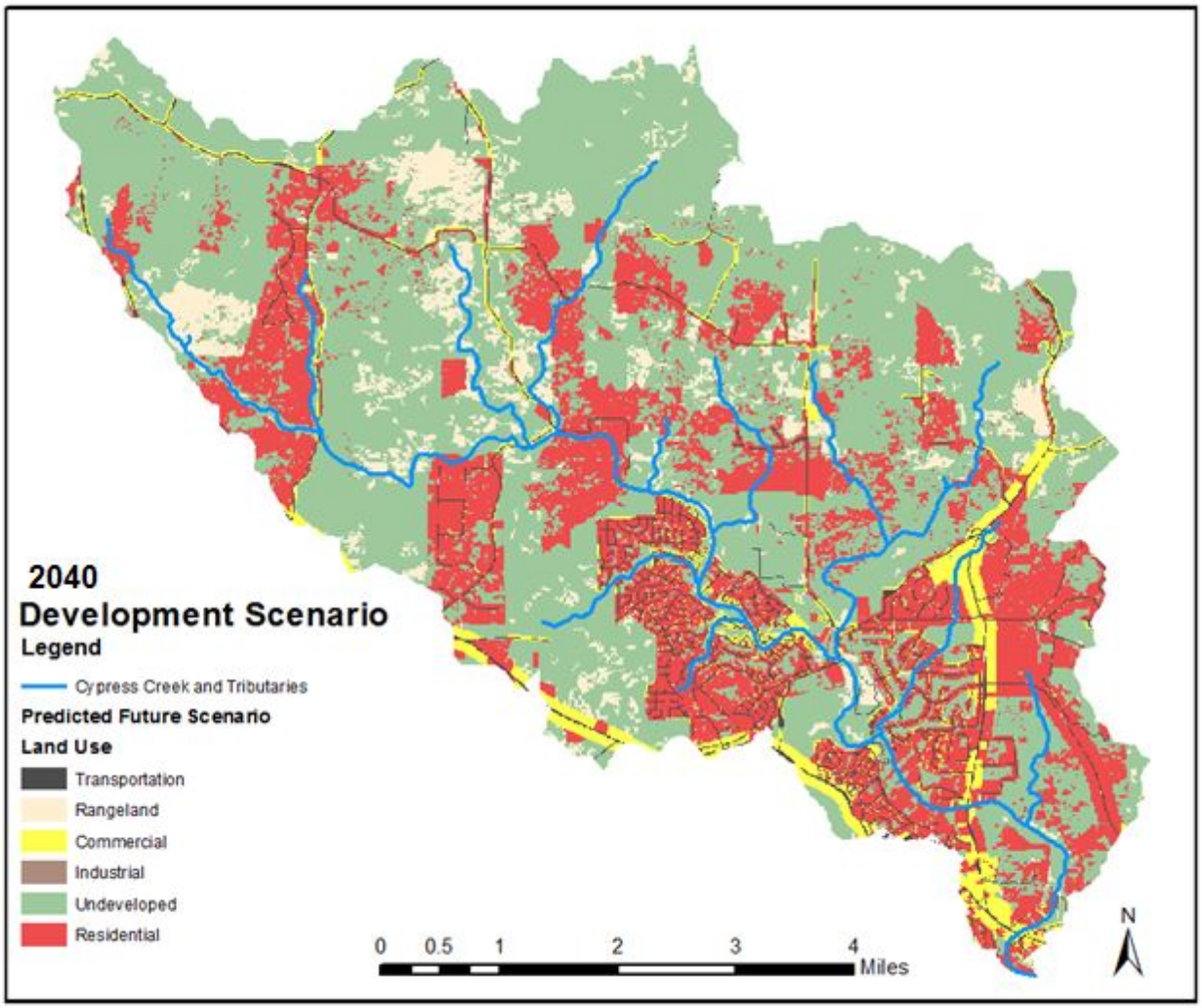

Figure 11. Land use in Cypress Creek watershed, Future Development Scenario (2040)

Table 6. Land Use In Cypress Creek Watershed, Future Development Scenario

Future Land Use	Area of Watershed
Residential	26%
Commercial	5%
Industrial	<1%
Transportation	3%
Rangeland	8%
Open and Undeveloped	57%

Over time the watershed will undergo significant conversions from undeveloped and rangeland to residential and commercial land uses (Figure 12). This is expected to lead to increased impervious cover resulting in increased stormflows and decreased aquifer recharge.

Table 7. Land Use Area Changes In The Watershed.

Existing Land Use Coverage in Cypress Creek Watershed	Existing Area	Future Area	Existing Percent	Future Percent	% Change
Residential	1231.57 Acres	6434.11 Acres	5%	27%	440%
Commercial	200.01 Acres	1235.57 Acres	<1%	5%	400%
Industrial	15 Acres	11.56 Acres	<1%	<1%	0%
Transportation	798.12 Acres	798.55 Acres	3%	3%	0%
Rangeland	2656.78 Acres	1932.66 Acres	11%	8%	[-27%]
Undeveloped	19426.1 Acres	13904.6 Acres	80%	57%	[-29%]
TOTAL	24327.6 Acres	24327.6 Acres	---	---	---

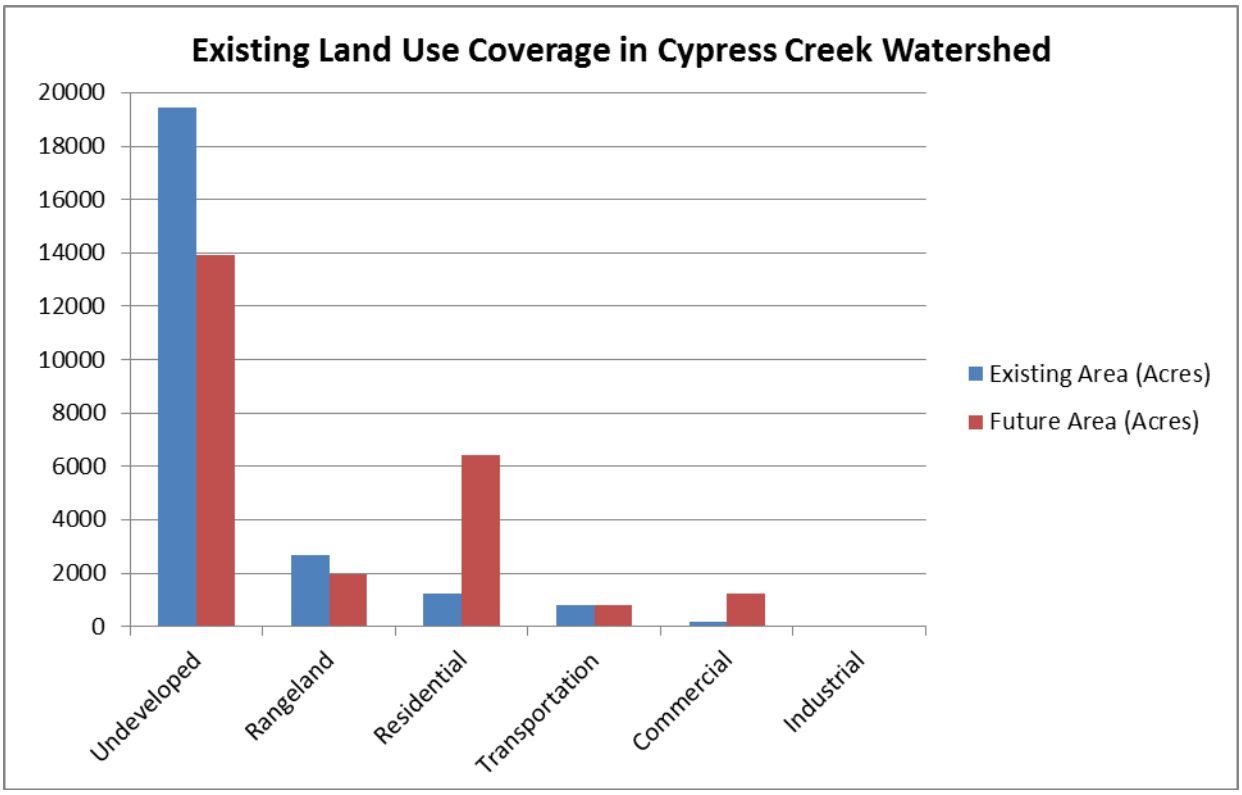

Figure 12. Existing Land Use in Cypress Creek Watershed in Acreage