CENTRAL TEXAS GENERAL CONSERVATION PLAN

Draft document
March 2014
Texas A&M Institute of Renewable Natural Resources

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1 Introduction

1.1 Purpose and need

The breeding ranges of the endangered golden-cheeked warbler (*Setophaga chrysoparia*; GCWA) and black-capped vireo (*Vireo atricapilla*; BCVI) overlap across a 38-county area of central Texas where private lands make up more than 90% of the land area with potential breeding habitat. Recent scientific evaluations for the GCWA and BCVI confirmed that loss of breeding habitat continues to occur throughout portions of their ranges (Wilkins et al. 2006, Groce et al. 2010). Habitat loss for GCWA is primarily due to vegetation clearing associated with land development and other changes in land use. For BCVI, the direct loss of breeding habitat to development has also been accompanied by degradation of the habitat caused by overgrazing or overbrowsing, and vegetational succession, and brood parasitism from brown-headed cowbirds (*Molothrus ater*). Given increases in human population and corresponding land fragmentation and conversion (Wilkins et al. 2009, Groce et al. 2010), habitat loss will likely continue through the next few decades.

Numerous habitat conservation plans (HCPs) have been developed in Texas for the GCWA and BCVI since the mid-1990s to facilitate development while addressing potential impacts to one or more endangered species. In recent years, high-growth counties of Williamson, Travis, Hays, Comal, and Bexar—near and between the cities of Austin and San Antonio—have shifted to developing programmatic HCPs to cover larger areas and a variety of activities.

As an additional option to the traditional HCP process, a general conservation plan (GCP) can streamline the section 10(a)(1)(B) permitting process while still providing conservation benefit to the species. GCPs allow the U.S. Fish and Wildlife Service (USFWS or Service) to develop a conservation plan suitable for the needs of an area, complete all NEPA requirements for incidental take permit issuance, and then issue individual permits to landowners who wish to apply for an incidental take permit (ITP) and demonstrate compliance with the terms and conditions in the GCP. Participation in the GCP is voluntary and does not preclude landowners or other entities from developing their own HCPs. Applicants who choose to participate and meet the requirements would subsequently be granted an ITP under the GCP in an expeditious manner.

The Central Texas GCP for the GCWA and BCVI, as an alternative to project-by-project or county-by-county compliance, provides a broad-scale framework in which to assess impacts and coordinate conservation activities throughout the species' ranges. Standardizing mitigation requirements for the entirety of the GCWA breeding range and a significant portion of the BCVI breeding range in Texas can dispel some of the uncertainty faced by developers and other landowners when trying to comply with the Endangered Species Act (ESA) while also allowing for more efficient and coordinated conservation actions and increased recovery benefit to the species.

1.1.1 GCP Goals

The Central Texas GCP (CTGCP) will provide a biologically justified conservation strategy for the GCWA and BCVI that effectively mitigates for incidental take of the species and contributes to each species' recovery. In doing so, the CTGCP will provide a consistent and streamlined process across a large geographic area for non-Federal entities (e.g., private landowners, non-

profits, non-governmental entities, state or local governments) to acquire ITPs in accordance with section 10(a)(1)(B) of the Endangered Species Act.

Although the GCWA and BCVI usually occupy habitats with different vegetation composition and structure (see chapter 3), they can occur in close proximity and their habitat use sometimes overlaps. Thus, projects that encompass both habitat types can be covered by this plan. By including both species under a common conservation and management plan, conservation actions that benefit one species at the expense of the other can be avoided or minimized.

1.2 Regulatory framework

The development of a GCP is managed by the same regulatory requirements as a traditional HCP, including sections of the ESA and related Service policy. Components of a GCP must address the Service's 5-point policy (65 FR 35242), which includes:

1. A description of the biological goals and objectives of the plan;
2. Provisions for adaptive management to address uncertainties or changed circumstances;
3. A monitoring program designed to assess compliance and effectiveness;
4. A clear description of the requested permit duration; and
5. Provisions for public participation in the planning and implementation process.

Section 10(a)(2)(B) of the ESA requires the following criteria to be met before the Service may issue an incidental take permit:

1. The taking will be incidental to otherwise legal activities.
2. Each applicant will, to the maximum extent practicable, minimize and mitigate the impacts of such taking.
3. Each applicant will ensure there is adequate funding to meet their portion of the GCP and include procedures to deal with unforeseen circumstances.
4. The taking will not appreciably reduce the likelihood of survival and recovery of the species in the wild.
5. Each applicant will ensure adherence to other measures that the Service may require as being necessary or appropriate.
6. Each applicant will provide assurances that the terms and conditions required in the GCP will be implemented.

All requirements of the National Environmental Policy Act (NEPA), which includes analysis of the impacts of the proposed action, must also be met for 10(a)(1)(B) incidental take permit issuance. The Service's Habitat Conservation Planning and Incidental Take Permit Processing Handbook (USFWS and National Marine Fisheries Service 1996) and Final General Conservation Plan Policy (USFWS 2007) provide additional details about the necessary contents and process of HCPs and GCPs.

1.3 Basic plan components

1.3.1 Administrative entities

The Service will be responsible for maintaining and implementing the CTGCP, providing incidental take permits to approved applicants, and making any revisions or amendments.

1.3.2 Plan and permit area

The Plan Area for the CTGCP includes 38 counties in central Texas: Bandera, Bell, Bexar, Blanco, Bosque, Burnet, Comal, Coryell, Dallas, Eastland, Edwards, Erath, Gillespie, Hamilton, Hays, Hill, Hood, Jack, Johnson, Kendall, Kerr, Kimble, Kinney, Lampasas, Llano, Mason, McLennan, Medina, Menard, Palo Pinto, Real, San Saba, Somervell, Stephens, Travis, Uvalde, Williamson, and Young Counties (Figure 1.1). These counties encompass all GCWA breeding habitat and approximately one-half of the Texas-portion of BCVI breeding habitat. The Plan Area will be the area included in the CTGCP's overall conservation strategy (includes consideration of GCWA and BCVI habitat distribution, abundance estimates, threats to the species, current conservation activities, etc.) and the area in which CTGCP-related mitigation and conservation activities can occur.

The Permit Area will be the area in which incidental take authorization under the CTGCP can occur (Figure 1.1). Several counties in the Plan Area have existing county-wide HCPs (Travis, Williamson, Hays) or are in the process of developing such HCPs (Comal, Bexar). To limit conflict with these counties and their ability to meet the goals and objectives of their respective HCPs, they are not included in the Permit Area.

1.3.3 Plan and permit duration

Once approved, the CTCGP will be available for use for 15 years. The term for each ITP issued under the CTGCP will last for 10 years. An ITP can extend beyond the CTGCP's duration if needed; that is, an ITP issued in year 15 of the CTGCP will still be valid for 10 years.

1.3.4 Species covered by the plan

Permits acquired under the CTGCP will authorize incidental take of the federally listed golden-cheeked warbler and black-capped vireo (Covered Species) that may result from the Covered Activities discussed in chapter 4. Conservation measures will be implemented under the CTGCP that minimize and mitigate incidental take of these Covered Species. GCWAs generally use mature, mixed oak-juniper woodlands in central Texas as breeding habitat while BCVI breed in a range of deciduous shrub habitats in Oklahoma, Texas, and Mexico. Chapter 3 provides expanded descriptions of the Covered Species.

There is a variety of other federally listed species or species of concern that may occur in the Permit Area, but available information suggests many of these species have little direct overlap with GCWA or BCVI habitat and current limited knowledge of the ecological needs and threats of these species precludes the ability to develop appropriate and effective mitigation strategies. Applicants seeking to participate in the CTGCP must avoid impacts to these non-covered species or, if avoidance is not possible for a particular project, the applicant must seek additional permits with the appropriate agency (i.e., the Service for federally-listed species and Texas Parks and Wildlife Department [TPWD] for state-listed species). Sections 2.3 and 5.5 provide additional information about these species.

Areas designated as critical habitat for any listed species will be excluded from incidental take authorization under the CTGCP.

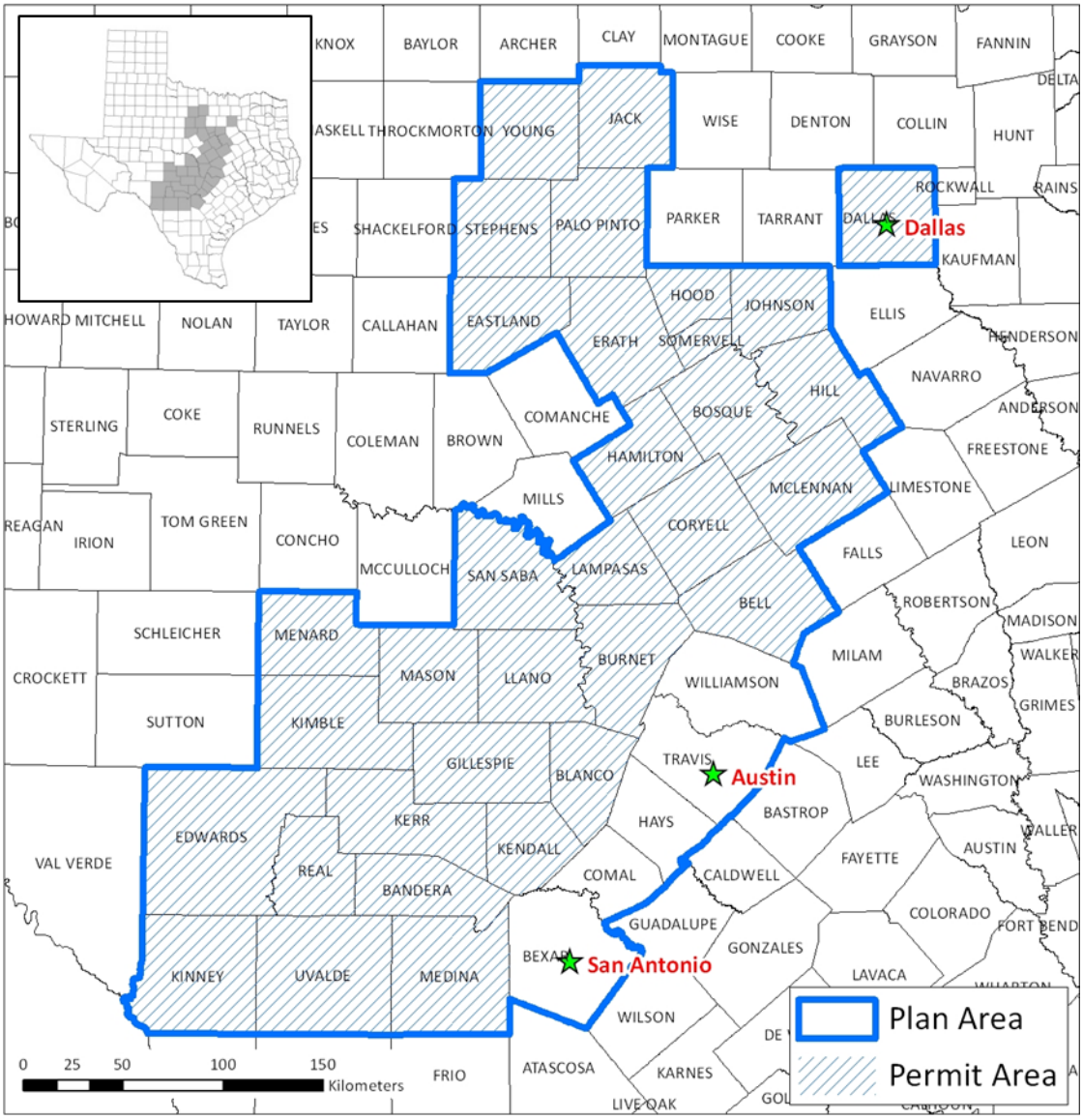

Figure 1.1. Plan Area and Permit Area for the Central Texas General Conservation Plan (CTGCP).

2 Environmental setting

The environmental information below summarizes current resources and land uses in the CTGCP Plan Area to provide context for subsequent chapters. Additional detail about the natural resources in the area can be found in TPWD's Texas Conservation Action Plan Handbooks (TPWD 2012a, b).

2.1 Ecoregions

The 38 counties in the Plan Area encompass 9.6 million ha (37,000 square miles) of land, although the extent of habitat for the Covered Species within the Plan Area is notably less (see chapter 3). The area overlaps two level-III ecoregions (Edwards Plateau and Cross Timbers) and eight level-IV ecoregions, as defined by Griffith et al. (2004; Figure 2.1). Ecoregions are areas with similar ecosystems and environmental resources, delineated as spatial units for research and management, and are useful for describing the natural environment of the Plan Area because each region has relatively distinct geology and vegetation. Level-IV ecoregion descriptions below are from Griffith et al. (2004).

Edwards Plateau

- **Balcones Canyonlands** forms the southeastern boundary of the Edwards Plateau. The Edwards Plateau was uplifted during the Miocene epoch at the Balcones Fault Zone, separating central Texas from the coastal plain. The Balcones Canyonlands are highly dissected through the erosion and solution of springs, streams, and rivers working both above and below ground; percolation through the porous limestone contributes to the recharge of the Edwards Aquifer. High gradient streams originating from springs in steep-sided canyons supply water for development on the Texas Blackland Prairies at the eastern base of the escarpment. This eco-region supports numerous endemic plant species and has a higher representation of deciduous woodland than elsewhere on the Edwards Plateau, with escarpment black cherry, Texas mountain-laurel, madrone, Lacey oak, bigtooth maple, and Carolina basswood. Some relicts of eastern swamp communities, such as baldcypress, American sycamore, and black willow, occur along major streamcourses. It is likely that these trees have persisted as relics of moister, cooler climates following the Pleistocene glacial epoch. Toward the west, the vegetation changes gradually as the climate becomes more arid. Plateau live oak woodland is eventually restricted to north and east facing slopes and floodplains, and dry slopes are covered with open shrublands of juniper, sumac, stool, acacia, honey mesquite, and ceniza.
- **Edwards Plateau Woodland** contains the central part of the Edwards Plateau north of Balcones Canyonlands. It encompasses the portion of the Edwards Plateau that receives sufficient rainfall to support woodland in contrast to the drier portion of the plateau to the west that has open juniper woodland and brush. The profile of the hills is rounded due to increased precipitation and chemical weathering. The dissection is moderate compared to the higher dissection of the Balcones Canyonlands to the south. Historically, the Edwards Plateau was a savanna of grasslands with scattered plateau like oak, Texas oak, Ashe juniper, and honey mesquite. With fire suppression and grazing, Ashe juniper and mesquite have spread, reducing the savanna character of the plateau. The grasslands in this region are considered a southern extension of the mixed grass prairie, expressed as tallgrass or shortgrass dependent upson soil type, moisture availability, and grazing

pressure. Grasses include little bluestem, Texas wintergrass, yellow Indiangrass, white tridens, Texas cupgrass, sideoats grama, seep muhly, and common curlymesquite.

- **Llano Uplift** is actually a basin; in some places, it is 1,000 feet below the level of the surrounding limestone escarpment. It gets its name from the granitic mass that is exposed in the basin. Upland soils are shallow, reddish brown, stony, sandy loams over granite, gneiss, and schist with deeper sandy loams in the valleys. Soils tend to be acidic in contrast to the alkaline soils of the surrounding Edwards Plateau Woodland. The woody vegetation has elements of both the Edwards Plateau Woodland and Cross Timbers, with plateau live oak, honey mesquite, post oak, blackjack oak, cedar elm, and some black hickory present depending on aspect and habitat. Flora normally found in the deserts of west Texas, such as catclaw mimosa and soaptree yucca occur on dry sites. Ashe juniper and Texas oak are generally absent from the Llano Uplift; they are found mainly on the slopes of the limestone escarpment surrounding the basin or on limestone inclusions. Grasses include little bluestem, switchgrass, yellow Indiangrass, and silver bluestem. Dome-like granite hills and outcrops contain unusual plant communities. Although ranching is the major land use, level areas of sandy loam produce wheat, sorghum, and peaches.

Cross Timbers

- **Limestone Cut Plain** includes a stairstep topography in which mesas alternate with broad intervening valleys. The ecoregion is underlain by Lower Cretaceous limestones, including the Glen Rose Formation and Walnut Clay, that are older than the limestone of the Edwards Plateau. The Glen Rose Formation has alternating layers of limestone, chert, and marl that erode differentially and generally more easily than the Edwards Limestone. The effects of increased precipitation and runoff are also apparent in the increased erosion and dissolution of the limestone layer. This eco-region has flatter topography, lower drainage density, and a more open woodland character than the Balcones Canyonlands. The vegetation is similar to that of the Balcones Canyonlands, but less diverse: post oak, white shin oak, cedar elm, Texas ash, plateau live oak, and bur oak are prevalent. Although the grasslands of this region are a mix of tall, mid, and short grasses, some consider it a westernmost extension of the tallgrass prairie, which distinguishes this ecoregion from the Edwards Plateau Woodland. Grasses include big bluestem, little bluestem, yellow Indiangrass, silver bluestem, Texas wintergrass, tall dropsee, sideoats grama, and common curlymesquite.
- **Western Cross Timbers** covers the wooded areas west of the Grand Prairie on sandstone and shale beds. The landscape has cuesta topography consisting of sandstone ridges with a gentle dip slope on one side and a steeper scarp on the other. The soils are mostly fine sandy loams with clay subsoils that retain water. As in the Easter Cross Timbers, the dominant trees are post oak, blackjack oak with an understory of greenbriar, little bluestem, and purpletop grasses. Some researchers contend that these woodland areas would be savanna-like if they experienced fire, although one early account described the Cross Timbers as “an immense natural hedge” or belt of thick impenetrable forest. It is likely there were more prairie openings between the belts of forest. The area has a long history of coal, oil, and natural gas production from the Pennsylvanian sandstone/limestone/shale beds. Deeper soils in the eastern part of this eco-region

support a dairy industry, pastureland, and cultivation of forage sorghum, silage, corn, and peanuts.

- **Carbonate Cross Timbers** is that portion of the Western Cross Timbers that has Pennsylvanian or Cretaceous limestone substrate. This area is not included on some maps of the Cross Timbers, because it does not support the typical oak woodland of the sandstone-based territory surrounding it. The topography of this ecoregion is also somewhat different from that of the Western Cross Timbers as it contains low mountains rather than alternating ridges and shallow basins. The limestone substrate is apparent in the vegetation cover, which has more plateau live oak, honey mesquite, and pure Ashe juniper woodland than in other surrounding Cross Timbers areas. The juniper woodlands are particularly dense. It is presumed that before widespread fire suppression, the area was less wooded and more savannah-like.
- **Grand Prairie** is an undulating plain underlain by Lower Cretaceous limestones with interbedded marl and clay. Although the vegetation of the Grand Prairie is similar to the Northern Blackland Prairie, the limestone of the Grand Prairie is more resistant to weathering, which gives the topography a rougher appearance. Meandering streams deeply incise the limestone surface. The original vegetation was tallgrass prairie in the upland areas and elm, pecan, and hackberry in riparian areas where deeper soils have developed in floodplain deposits or where the underlying clays have been exposed by limestone erosion. The invasive Ashe juniper and, to a lesser extent, honey mesquite have increased since settlement. Grasses include big bluestem, yellow Indiangrass, little bluestem, hairy grama, Texas wintergrass, sideoats grama, and Texas cupgrass. Present land uses include grazing on ridges with shallow soils and farming of corn, grain sorghum, and wheat on the deeper soils on the flats.
- **Eastern Cross Timbers** covers a more confined area than the Western Cross Timbers. The eco-region occurs on sand substrates (Woodbine Sand) lying between the Grand Prairie and Texas Blackland Prairies in eastern Texas. The soils are mainly red and yellow sands that have been leached of nutrients. Post oaks and blackjack oaks have adapted to life in sandy soils and they dominate the overstory, with scattered honey mesquite and grasses, such as little bluestem and threeawn, growing beneath them. Although the rural land use is predominantly cattle grazing, there is some farming for peanuts, grain sorghum, pecans, peaches, and vegetables. Extensive urban development also occurs within this region.

2.2 Water

The CTGCP Plan Area overlaps six major rivers and their associated tributaries, including portions of the Brazos and Colorado Rivers and shorter lengths of the Trinity, Guadalupe, San Antonio, and Nueces Rivers (Figure 2.2). Fifty-six river and stream segments within the Plan Area are designated as “ecologically significant” under the Texas Water Code (TPWD 2012c). Most of the rivers are spring-fed from underlying aquifers. Three of the state’s nine major aquifers are in the Plan Area (Figure 2.3).

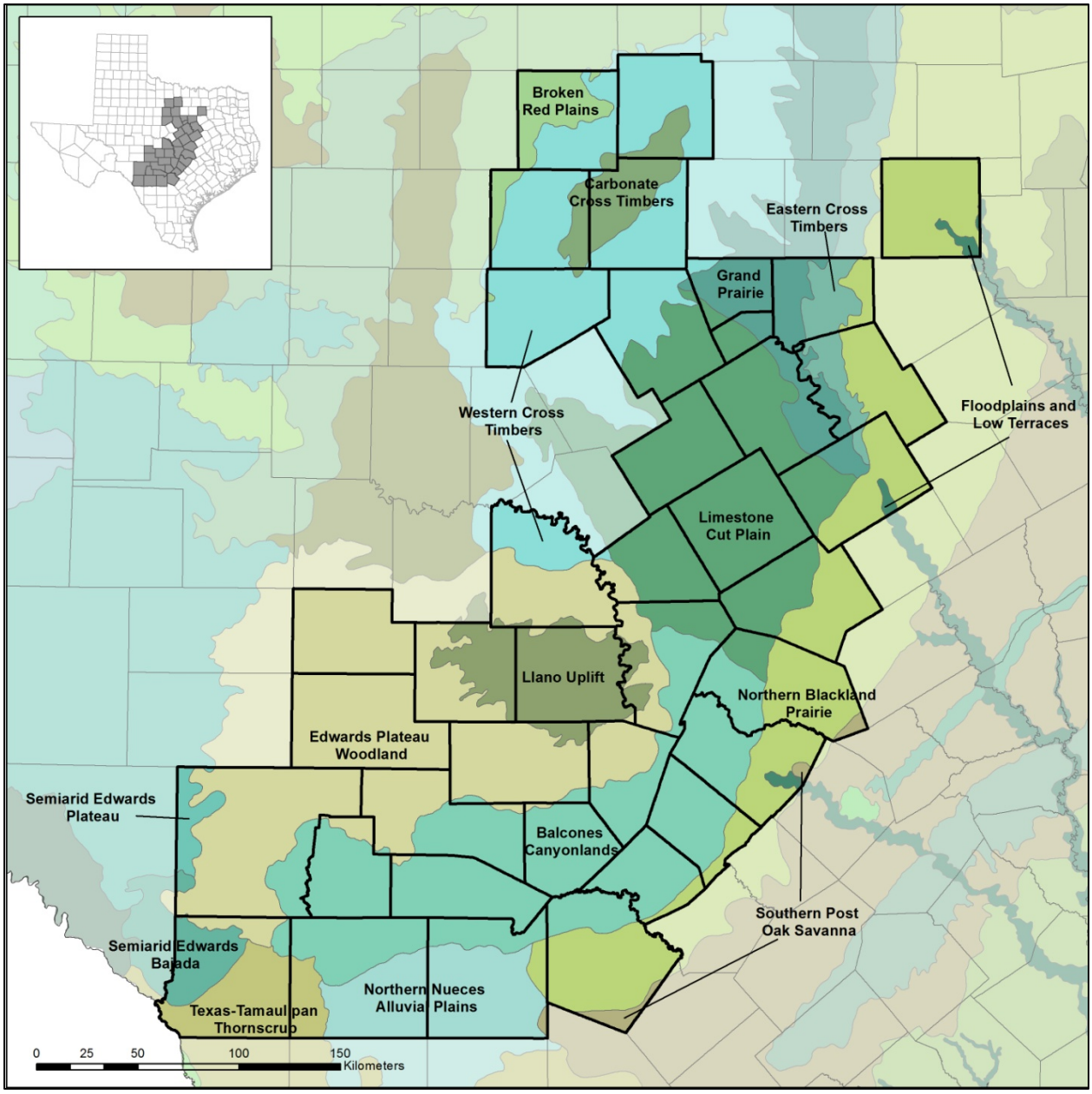

Figure 2.1. Delineations of level-IV ecoregions as per Griffith et al. (2004). Counties in the CTGCP Plan Area are outlined in black.

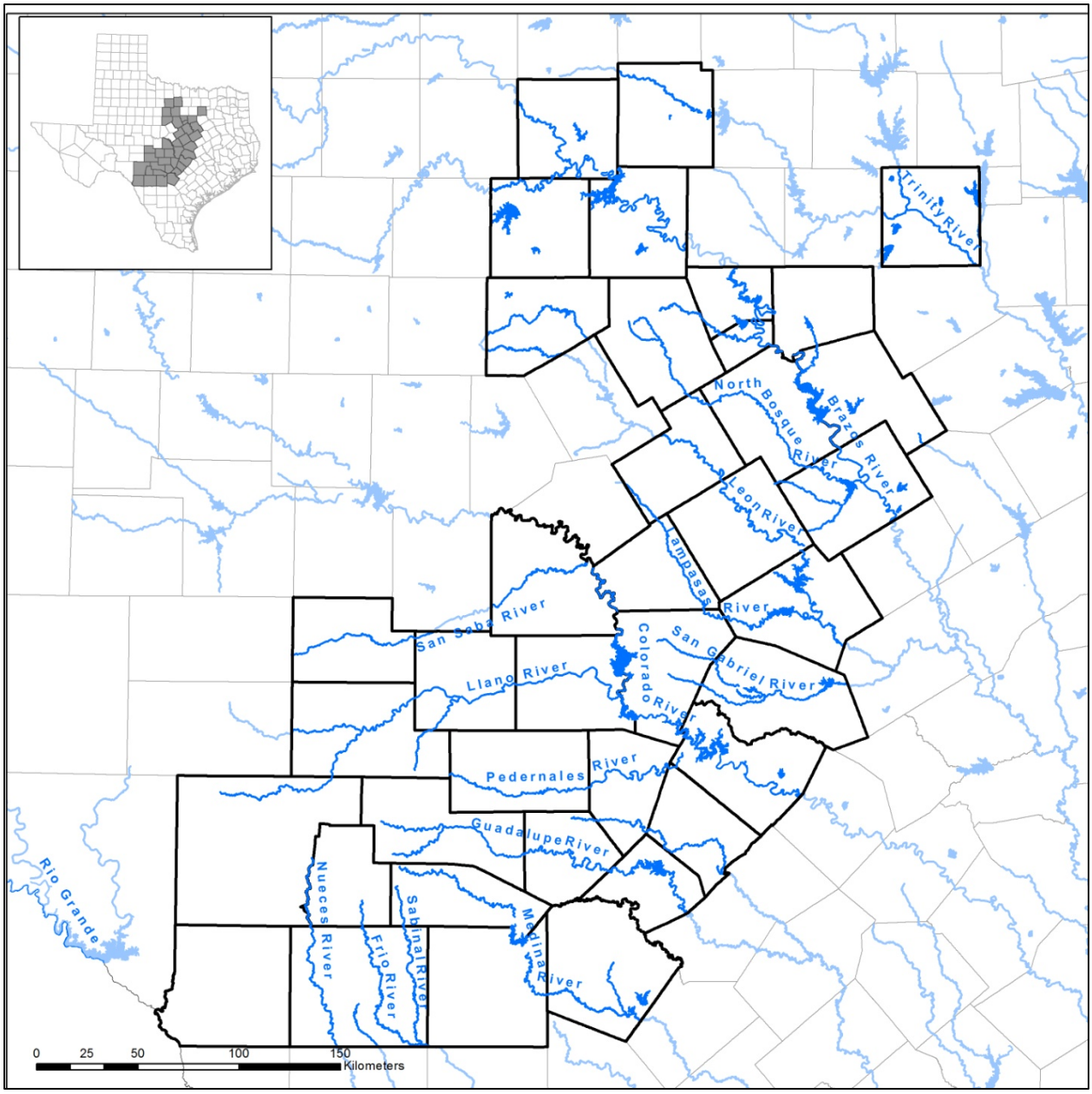

Figure 2.2. Major rivers encompassed by the CTGCP Plan Area. Plan Area counties are outlined in black.

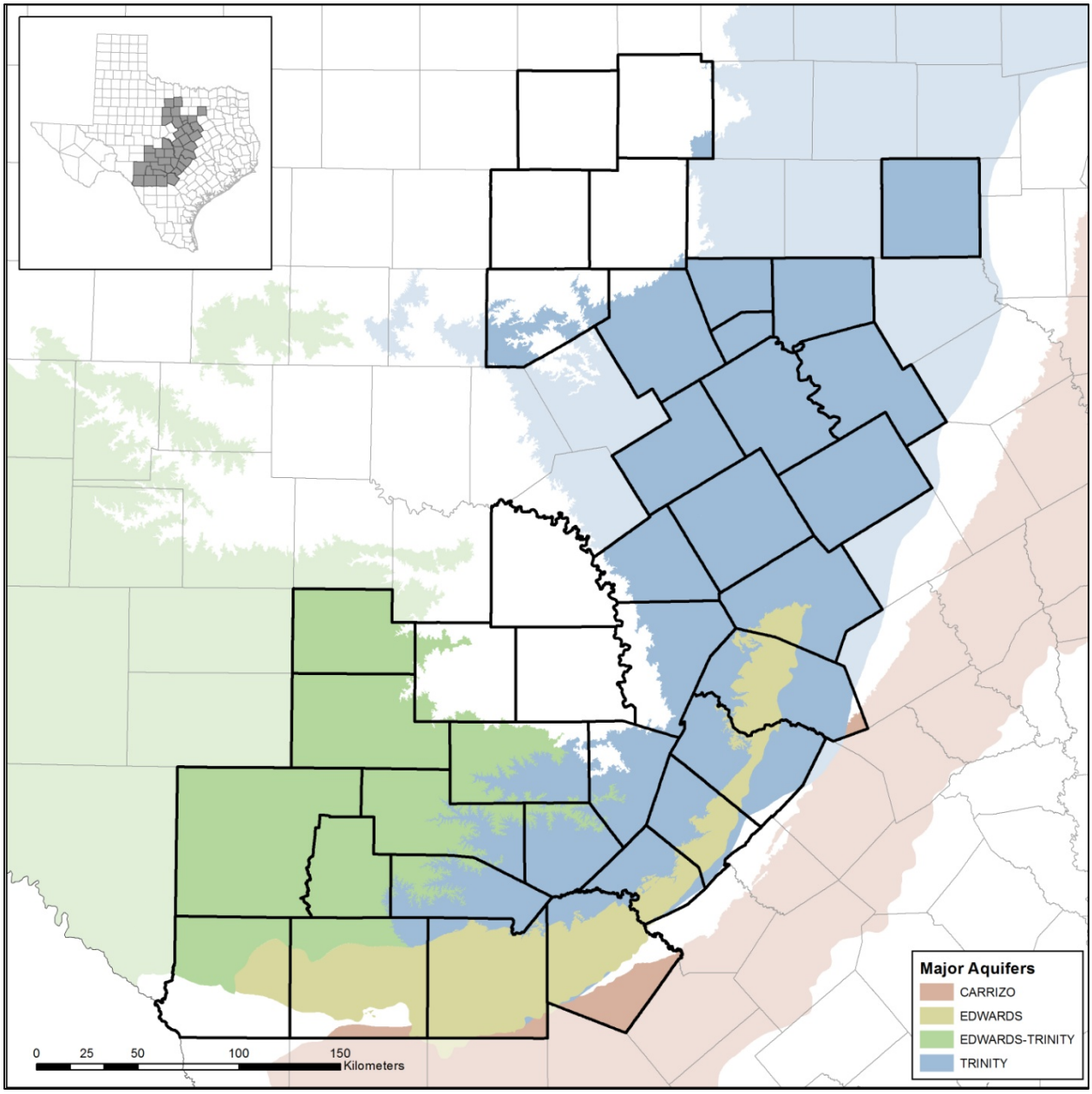

Figure 2.3. Major aquifers underlying the CTGCP Plan Area. Plan Area counties are outlined in black.

2.3 Wildlife

The diverse landscape and natural resources in central Texas provide habitat for an equally diverse array of plant and animal species, with hundreds of mammals, birds, reptiles, and amphibians and thousands more invertebrates, fish, and plants. TPWD's Texas Conservation Action Plan identifies nearly 450 mammal, bird, reptile, amphibian, fish, invertebrate, and plant species of greatest conservation need in the Edwards Plateau and Cross Timbers ecoregions (TPWD 2012d). Within the CTGCP Plan Area, as of early 2013, 82 species are federal- or state-listed or candidates for federal listing (50 in the Permit Area). Thirteen of the state-listed species (10 in Permit Area) along with an additional 13 species (9 in Permit Area) that are currently not listed have been recently petitioned or are under review for possible inclusion under the ESA. Many of these species, however, are unlikely to occur throughout large portions of GCWA or BCVI habitat because of restricted ranges or different habitat use. Additional information for these species—including listing status, habitat use, and range maps—is included in Appendix A.

2.4 Land use and land cover

Estimates of land use and land cover types in the CTGCP Plan Area were based on a geospatial dataset produced by the U.S. Department of Agriculture National Agriculture Statistics Service (USDA 2013; Figure 2.4), which uses satellite and ground truth data at 30-m resolution (Johnson and Mueller 2010). Of the 9.6 million ha encompassed by the CTGCP Plan Area, 36% is categorized as shrubland, 23% as woodland, and 22% as grassland (Table 2.1). Most of the remaining area is either cultivated, which includes cropland, pasture, and hay (8.7%), or is developed at varying levels of intensity (9.1%). Approximately 30% of the total developed area is in Dallas and Bexar counties.

Table 2.1. Hectares of land by category of land use or cover[1] for each county in the CTGCP Plan Area. Data derived from the USDA National Agricultural Statistics Service (USDA 2013).

		Developed						
County	**Cultivated**	**Med-High**	**Open-Low**	**Woodland**	**Shrubland**	**Grassland**	**Other**	**Total**
Bandera	1,359	123	9,168	95,363	88,494	11,284	770	206,562
Bell	76,449	5,898	28,905	54,061	8,368	92,531	15,598	281,811
Bexar	48,746	32,732	86,234	67,676	69,418	9,767	10,747	325,321
Blanco	1,111	218	7,674	61,931	94,976	18,622	235	184,768
Bosque	14,209	209	14,918	76,144	2,004	144,107	8,073	259,666
Burnet	1,633	657	15,323	102,949	83,270	55,174	5,468	264,474
Comal	3,048	1,943	17,923	70,579	37,435	13,429	4,552	148,908
Coryell	22,979	1,567	15,302	67,977	31,598	130,369	3,892	273,684
Dallas	17,415	55,517	91,275	28,260	16	29,838	12,970	235,290
Eastland	34,098	420	20,122	43,493	96,210	45,096	1,928	241,366
Edwards	175	196	6,481	65,964	474,887	1,241	95	549,039
Erath	21,623	585	20,415	68,144	35,911	132,092	3,489	282,258
Gillespie	7,071	291	10,529	68,198	169,880	18,805	139	274,914
Hamilton	17,656	136	11,533	39,294	43,147	103,662	1,203	216,630
Hays	7,046	1,782	16,252	73,657	52,872	22,791	1,569	175,969
Hill	96,513	662	17,313	28,336	4	99,966	12,558	255,352
Hood	2,511	714	13,459	25,196	1,292	64,437	5,503	113,112
Jack	9,587	253	15,092	53,634	12,582	145,609	1,565	238,322
Johnson	30,788	2,111	19,265	29,331	3	105,408	3,225	190,132
Kendall	1,469	275	5,643	63,095	86,720	14,302	235	171,738
Kerr	1,498	761	11,775	96,486	170,814	5,212	340	286,885
Kimble	1,755	284	7,285	56,724	256,042	1,635	264	323,989
Kinney	2,218	398	9,531	20,152	279,563	39,527	2,235	353,624

Lampasas	5,916	344	8,454	43,219	78,022	48,497	492	184,944
Llano	960	293	10,772	66,648	114,177	51,265	6,025	250,139
McLennan	4,196	40	9,885	46,033	164,586	16,419	346	241,505
Mason	104,853	4,354	27,797	26,681	13	95,799	15,102	274,599
Medina	49,653	547	23,004	83,154	164,663	21,658	2,962	345,640
Menard	4,014	73	4,769	5,036	218,915	697	184	233,686
Palo Pinto	8,460	573	19,240	96,251	13,263	108,401	9,059	255,247
Real	276	65	2,917	82,345	92,917	2,734	72	181,325
San Saba	20,018	74	11,878	71,018	151,883	39,281	679	294,831
Somervell	829	205	4,079	19,982	239	22,151	2,256	49,742
Stephens	14,056	213	15,736	46,640	34,869	122,546	4,609	238,669
Travis	29,834	18,037	53,648	81,283	44,758	24,307	13,110	264,977
Uvalde	47,421	559	18,433	65,046	255,605	15,614	1,011	403,688
Williamson	88,926	7,237	36,673	50,949	16,670	84,814	8,591	293,862
Young	38,880	520	16,956	31,065	12,379	138,503	2,830	241,133
Total	839,252	140,865	735,655	2,171,993	3,458,466	2,097,589	163,980	9,607,800
% of total	8.74	1.47	7.66	22.61	36.00	21.83	1.71	

[1] Cultivated = areas characterized by herbaceous vegetation that has been planted or is intensively managed for the production of food, feed, or fiber. Developed Med-High = areas characterized by a high percentage (≥30%) of constructed materials; impervious surfaces account for ≥50%. Developed Open-Low = areas with a mixture of constructed materials and vegetation; impervious surfaces account for <50% of total cover. Other = open water, wetlands, and barren land.

2.5 Conservation lands

While the majority of land within the CTGCP Plan Area is privately owned, a small proportion is owned or managed by several Federal, state, and local agencies or organizations with the purpose of managing and conserving natural and cultural resources, providing recreational opportunities, or dedicated to military training that also allows for protection and conservation of endangered species habitat. The properties are currently under some level of protected status and unlikely to be converted to other uses in the near future. Many of these properties have multiple uses (e.g., recreation, military training) and multiple species or habitats to manage and are not all dedicated solely to the protection or management of GCWA or BCVI habitat.

Currently, about 196,000 ha (486,000 ac) of Federal (Department of Defense, USFWS) and state lands (TPWD) are considered protected to some degree within the CTGCP Plan Area (Table 2.2), with 45% of this land occurring on Fort Hood Military Reservation. These properties are distributed throughout central Texas but with notable concentrations of hectares in Coryell, Bell, Travis, and Bexar counties (Figure 2.5). The Nature Conservancy (TNC) also oversees approximately 33,000 ha in the CTGCP Plan Area according to TNC's Conservation Lands System (CLS) database (Table 2.2). The CLS database includes properties in which TNC has a legal interest, such as a conservation easement or fee-simple ownership. Approximately 24,000 additional ha are managed at the city or county level, primarily in Travis and Bexar, and 2,000 ha by various local organizations or entities.

Because many protected lands overlap one or more counties, hectares in Table 2.2 are divided by GCWA recovery region, instead of individual counties, as a means to show spatial distribution of area, with region 1 in the northern part of the Plan Area and region 8 in the south (see chapter 3 for recovery regions). Not all of the aforementioned lands contain GCWA or BCVI habitat and a few properties, while in Plan Area counties, are likely outside the species' habitat distributions.

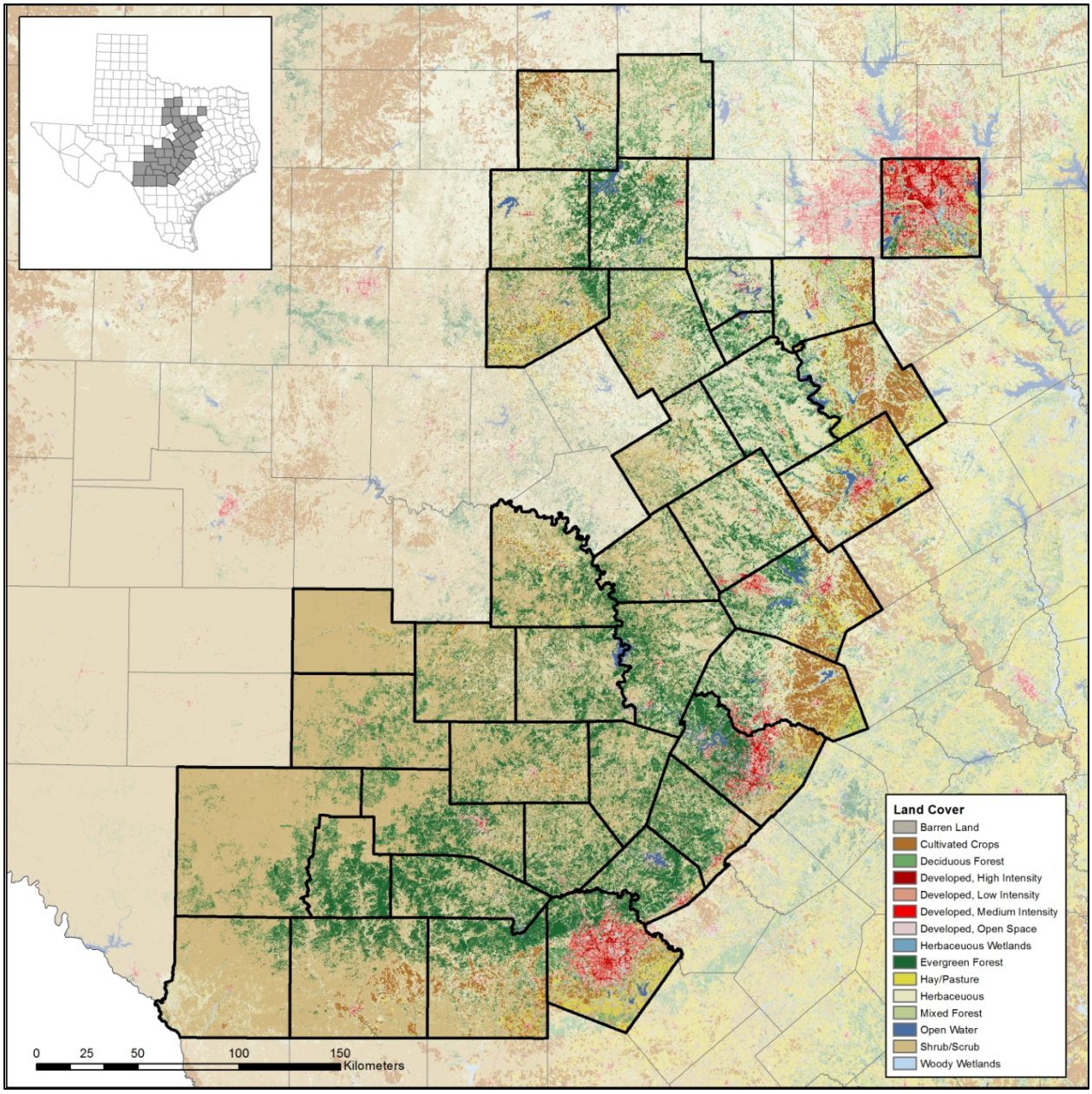

Figure 2.4. Land cover classifications within the CTGCP Plan Area. Plan Area counties are outlined in black. Data from the USDA National Agriculture Statistics Service (2013).

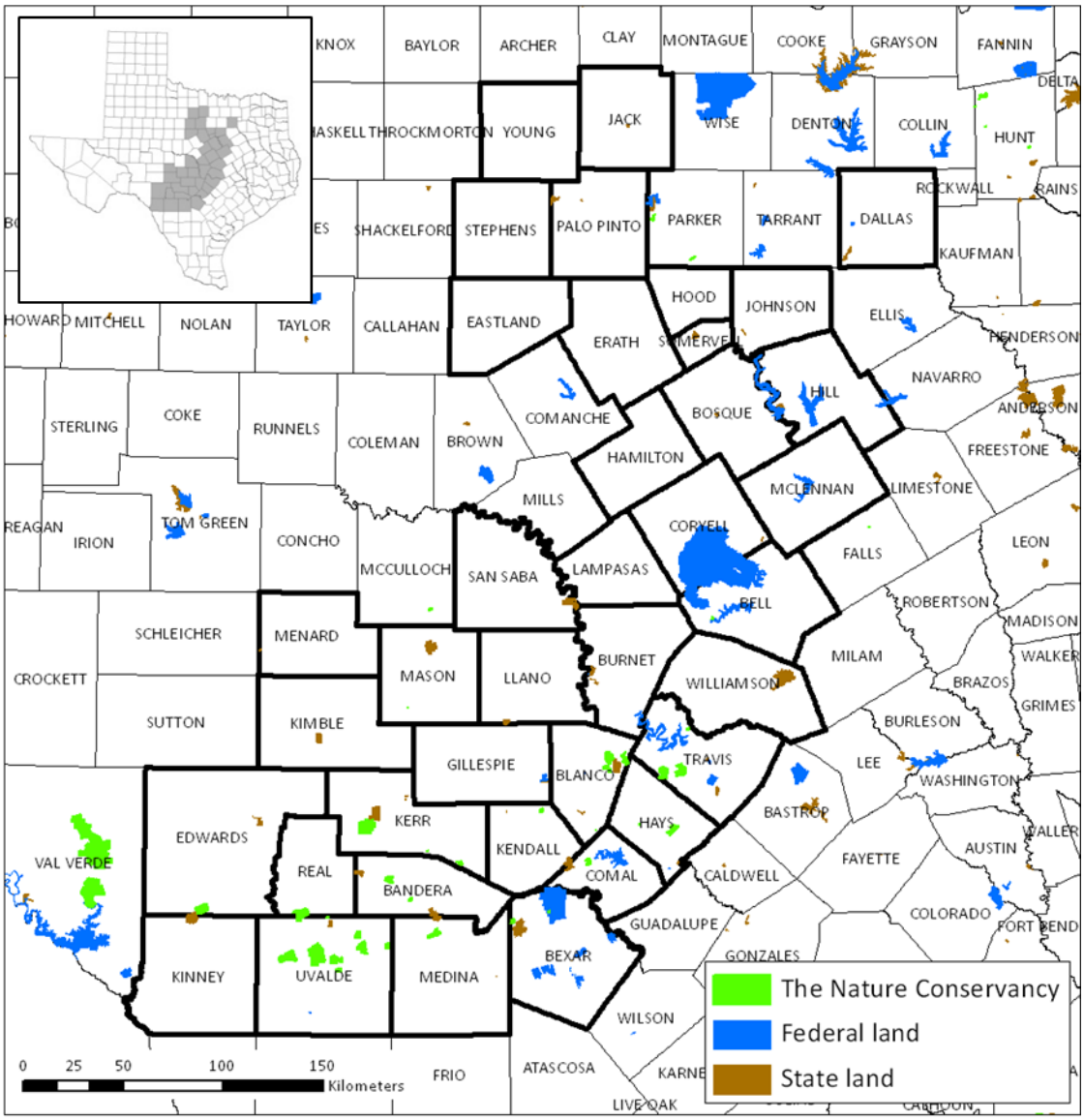

Figure 2.5. Federal, state, and The Nature Conservancy (TNC) lands in the CTGCP Plan Area. Plan Area counties are outlined in black. Data are from USGS Protected Areas Database of the United States (PAD-US) and TNC's Conservation Lands System (CLS) database. Additional Federal lands not shown on the map include Balcones Canyonlands Wildlife Refuge in Travis, Burnet, and Williamson Counties.

Overlaying most of the protected lands on the Texas A&M map of potential GCWA habitat (Collier et al. 2012) suggests approximately 94,000 ha of potential GCWA habitat occur in the properties. Estimates are less certain for BCVI habitat; however, a rough estimate of multiplying number of males on non-private land (Wilkins et al. 2006) by average territory size (4 ha, see chapters 3 and 5) suggests at least 10,300 ha of known habitat occurring under some protected status. Increased interest in conservation banking for GCWA and BCVI in recent years has added additional areas under protected status in Bandera, Burnet, and Kendall counties specifically for the benefit of these species (USFWS 2010, 2011, 2012).

Table 2.2. Area (ha) and percent of Federal, State, and The Nature Conservancy (TNC) lands by GCWA recovery region. Data are from Protected Areas Database of the United States (PAD-US), Balcones Canyonlands National Wildlife Refuge, and TNC's Conservation Lands System (CLS) database.

	Federal		State		TNC		All	
Region	**Total**	**%**	**Total**	**%**	**Total**	**%**	**Total**	**%**
1	0	0.0	934	2.8	0	0.0	934	0.4
2	17,140	10.5	2,333	7.0	0	0.0	19,473	8.8
3	98,800	60.4	330	1.0	85	0.3	99,214	44.6
4	677	0.4	7,260	21.7	2,488	7.5	10,426	4.7
5	18,689	11.4	6,727	20.1	4,736	14.3	22,412	10.1
6	28,146	17.2	5,050	15.1	1,149	3.5	34,345	15.4
7	0	0.0	7,211	21.6	6,418	19.3	13,629	6.1
8	0	0.0	3,566	10.7	18,316	55.2	21,883	9.8
Total	163,452		33,412		33,193		222,318	

2.6 Human population

The Plan Area includes urban, suburban, and rural areas. The Texas State Data Center (TSDC 2012) estimates a current population of 7.1 million people in the Plan Area. Approximately 70% of the total resides in Bexar, Dallas, and Travis Counties (including the cities of San Antonio, Dallas, and Austin, respectively; Table 2.3). A future projection by TSDC, based on a scenario that assumes immigration and emigration are equal, suggests an increase of nearly 30% by 2050 with most of the growth occurring in or near urban centers; the high-growth scenario suggests a 50–60% increase in population.

Table 2.3. Current (2010) and predicted (2050) human population by county in the CTGCP Plan Area. Data are from the Texas State Data Center (2012).

County	**2010**	**2050**	**% change**
Bandera	20,485	17,551	-14.32
Bell	310,235	429,668	38.50
Bexar	1,714,773	2,195,644	28.04
Blanco	10,497	10,000	-4.73
Bosque	18,212	18,406	1.07
Burnet	42,750	44,959	5.17
Comal	108,472	112,457	3.67
Coryell	75,388	94,093	24.81

Dallas	2,368,139	3,257,805	37.57
Eastland	18,583	19,763	6.35
Edwards	2,002	2,098	4.80
Erath	37,890	48,592	28.24
Gillespie	24,837	23,721	-4.49
Hamilton	8,517	8,392	-1.47
Hays	157,107	237,144	50.94
Hill	35,089	38,973	11.07
Hood	51,182	49,203	-3.87
Jack	9,044	9,994	10.50
Johnson	150,934	177,354	17.50
Kendall	33,410	33,669	0.78
Kerr	49,625	47,287	-4.71
Kimble	4,607	4,654	1.02
Kinney	3,598	3,773	4.86
Lampasas	19,677	22,049	12.05
Llano	19,301	14,770	-23.48
McLennan	234,906	282,445	20.24
Mason	4,012	3,715	-7.40
Medina	46,006	52,341	13.77
Menard	2,242	2,074	-7.49
Palo Pinto	28,111	31,983	13.77
Real	3,309	3,098	-6.38
San Saba	6,131	6,344	3.47
Somervell	8,490	9,517	12.10
Stephens	9,630	10,995	14.17
Travis	1,024,266	1,297,403	26.67
Uvalde	26,405	37,440	41.79
Williamson	422,679	494,039	16.88
Young	18,550	20,692	11.55
Total CTGCP Plan Area	7,129,091	9,174,105	28.69
Statewide	25,145,561	32,052,451	27.47

3 Covered species

The CTGCP will cover the incidental take of golden-cheeked warblers and black-capped vireos within the 33-county Permit Area (see chapter 1, Figure 1.1). Both species are federally endangered species (52 FR 37420, 55 FR 53153) and may be affected by the Covered Activities described in chapter 4. Recovery plans were developed in 1991 and 1992 for the BCVI and GCWA, respectively (USFWS 1991, 1992). Critical habitat has not been designated for either species. This chapter is intended to provide a basic understanding of the natural history and status of the Covered Species. The information is compiled mainly from scientific evaluations (Wilkins et al. 2006, Groce et al. 2010) and recent research and publications.

3.1 Golden-cheeked warbler

3.1.1 Physical description and life history

The GCWA is a medium-sized wood warbler, approximately 10 g and 12–13 cm long (Pulich 1976, Ladd and Gass 1999). Mature males have bright yellow cheeks with a thin black stripe extending horizontally from either side of the dark brown eye. The upper breast, throat, and crown are black. The back is black with fringing of olive-yellow, the tail is black above with white underneath, and the wings are black with two white wing bars. The belly is white with black streaking on the flanks. Mature females are similar overall but the back is olive-green and the yellow is paler. Juveniles are similar in coloring to the adult female (Pulich 1976, Pyle 1997).

GCWAs begin arriving on their central Texas breeding grounds in early to mid-March. Males in their second breeding season (ASY) arrive prior to younger males in their first-breeding-season (SY) and females (Pulich 1976, Weinberg et al. 1995). Territory sizes based on spot-mapping and minimum convex polygons range from 0.48–23.15 ha (summarized in Groce et al. 2010). Female GCWAs construct open-cup nests composed primarily of strips of bark from mature juniper trees (> 20 years; Kroll 1980), twigs and leaves from juniper and oak trees, grasses, rootlets, lichen, moss, spider webs, feathers, hair, and fibers (Pulich 1976). Nests typically are located in the upright fork of branches in Ashe juniper, or sometimes various hardwood trees depending upon the local tree composition (Pulich 1976, Ladd and Gass 1999). Clutch size is usually 3–4 eggs. Incubation by the female takes 10–12 days and the young fledge 9–12 d after hatching (Ladd and Gass 1999), usually from mid-April to late-June. GCWAs begin departure from the breeding grounds by mid-June (Pulich 1976, Ladd and Gass 1999); most birds have departed by the end of July (Ladd and Gass 1999), although sightings have occurred into mid-August (City of Austin 2009). Additional life history details can be found in Groce et al. 2010.

3.1.2 Distribution and habitat use

Accumulated records summarized in the 2010 Scientific Evaluation indicate GCWAs have been known to breed in 27 counties in central Texas: Bandera, Bell, Bexar, Blanco, Bosque, Burnet, Comal, Coryell, Edwards, Gillespie, Hays, Johnson, Kendall, Kerr, Kimble, Kinney, Lampasas, Llano, Medina, Palo Pinto, Real, San Saba, Somervell, Travis, Uvalde, Williamson, and Young, though findings of “a probable breeding population” in Young County is sparsely documented (see review in Groce et al. 2010). GCWAs have been observed to occur, but breeding status is uncertain, in Dallas, Erath, Hamilton, Hill, Hood, McLennan, Jack, and Stephens counties. Small amounts of potential habitat occur but GCWA occupancy is uncertain in Comanche, Eastland, Ellis, Mason, Menard, and Mills counties (Groce et al. 2010). Figure 3.1 illustrates the

county-level breeding range of GCWA and delineations of recovery regions established by the Service.

Habitat used for nesting is often, but not always, described as dense, closed canopy, mature stands of Ashe juniper mixed with deciduous trees such as Spanish oak (*Q. buckleyi*), Lacey oak (*Q. glaucoides*), shin oak (*Q. sinuata*), plateau live oak (*Q. virginiana* var. *fusiformis*), post oak (*Q. stellate*), Texas ash (*Fraxinus texensis*), cedar elm (*Ulmus crassifolia*), hackberry (*Celtis* spp.), bigtooth maple (*Acer grandidentatum*), sycamore (*Platanus occidentalis*), walnut (*Juglans* spp.), escarpment cherry (*Prunus serotina*), and southern pecan (*Carya illinoinensis*; Pulich 1976, USFWS 1992, Ladd and Gass 1999). The composition of woody vegetation may vary across occupied nesting habitat, though it always includes a mix of mature Ashe juniper (*Juniperus ashei*) and oak (*Quercus* spp.) where juniper is of sufficient age to provide nesting material and tree species provide necessary food resources. Recent research indicates that in some ecoregions, GCWA may have higher reproductive success in certain ecosites—distinctive land types with specific physical characteristics, such as soil and geologic conditions, which influences the potential vegetation assemblages that can emerge there (Marshall 2011, USDA 2011). Preliminary data suggests this may be due to variations in tree species composition that lead to variation in other habitat parameters such as arthropod availability (Marshall 2011). Other recent research indicates that GCWAs occur and can reproduce successfully in canopy cover lower than previously reported (Ladd and Gass 1999; Campbell 2003; Klassen et al. 2012; Farrell et al. 2012).

Mixed oak-juniper woodlands primarily occur on the eastern half of the Edwards Plateau and southern half of the Cross Timbers ecoregions (Ladd and Gass 1999). Estimates of breeding habitat extent using satellite imagery have ranged from approximately 215,066 to 1.77 million ha (531,440 to 4.37 million ac; Groce et al. 2010). Recent occupancy surveys conducted across the species breeding range estimated 1,124,306 ha (2,778,220 ac) of woodland with >50% probability of occupancy; 940,168 of these ha (2,323,205 ac) had >70% probability of occupancy (Collier et al. 2012; Table 3.1). The differences in estimates of potential habitat are largely due to the variety of approaches used to delineate habitat, as well as the resolution, precision, or generality of the definition of suitable or potential habitat in use (Groce et al. 2010). However, the general areas identified as, and the distribution of, potential habitat are relatively consistent across many delineation methods. The northern portion of the breeding range tends to have relatively small, isolated patches of potential habitat whereas the south and southwestern portions of the range tend to have relatively large, contiguous patches of potential habitat (Groce et al. 2010).

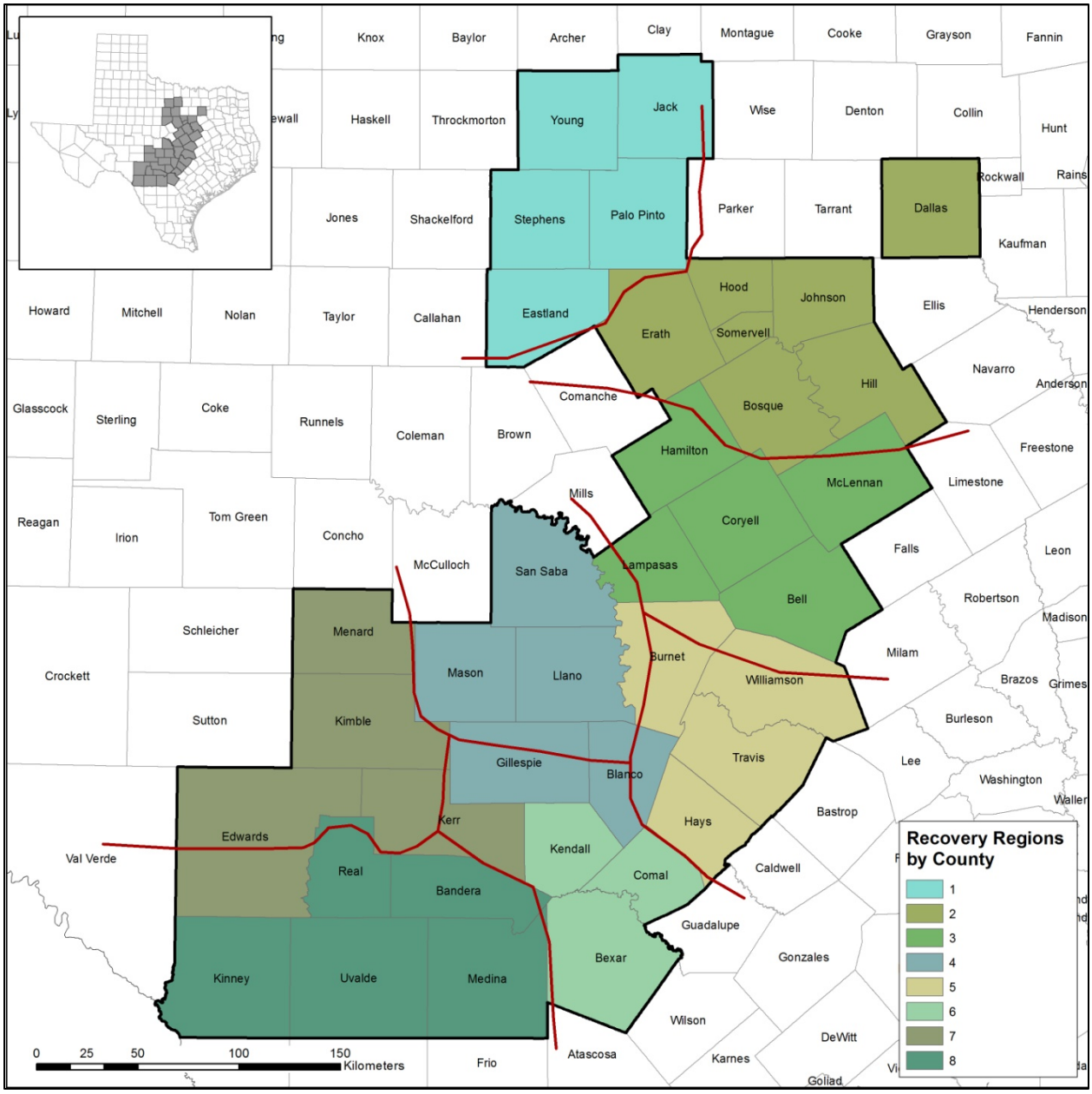

Figure 3.1. County-level distribution of the golden-cheeked warbler breeding range in central Texas. Red lines indicate recovery regions as defined in the Service's Golden-cheeked warbler Recovery Plan (USFWS 1992). Recovery Regions discussed in the CTGCP are categorized as indicated by the shaded colors to facilitate summary of county-level data.

Table 3.1. Hectares of habitat with predicted GCWA occurrence probability in each recovery region based on Collier et al. (2012).

Occupancy probability	Recovery Region 1	2	3	4	5	6	7	8	Total
<10%	30,672	38,785	29,311	51,729	25,721	14,613	8,994	829	200,654
10-20%	13,332	16,884	14,880	22,440	15,293	9,003	9,196	2,411	103,439
20-30%	11,270	14,975	10,956	17,630	12,144	7,264	8,637	3,008	85,884
30-40%	9,411	12,624	10,257	15,122	12,116	6,604	8,516	3,111	77,761
40-50%	11,022	12,113	11,694	17,182	14,968	6,513	9,125	4,037	86,654
50-60%	6,166	10,592	12,263	15,249	15,291	7,648	11,289	3,848	82,346
60-70%	10,134	12,852	15,171	18,136	19,753	8,762	11,323	5,660	101,791
70-80%	13,606	15,846	18,526	23,918	25,736	11,328	17,690	7,707	134,357
80-90%	8,016	10,701	23,138	27,219	39,159	25,619	27,491	14,525	175,868
>90%	0	4,053	21,517	33,323	74,281	60,244	169,289	267,234	629,941
Total	113,629	149,425	167,713	241,948	254,462	157,598	281,550	312,370	1,678,695

The winter range of the GCWA occurs in the highlands of southern Mexico, Guatemala, Honduras, Nicaragua, and El Salvador, typically in highland pine (*Pinus* spp.), pine-oak forests, and cloud forests above 1,000 m elevation. The Central American pine-oak forest ecoregion covers approximately 9.7–11.1 million ha (24.0–27.4 million ac) from southern Mexico into Nicaragua, with the majority occurring in Honduras and Guatemala. About 2.7 million ha (6.6 million ac) of the pine-oak forest ecoregion is estimated to be forested, and 1.95 million ha (4.8 million ac) of this area is considered wintering habitat for GCWAs (see review in Groce et al. 2010). Regular occurrence of the species in northern El Salvador and north-central Nicaragua was confirmed only within the last 5 years (Morales et al. 2008, King et al. 2009, Komar 2010). Increasing survey effort has documented GCWA occurrence in several new areas, suggesting the wintering range may extend further south than Nicaragua (Jones 2005, Jones and Komar 2006, 2007, 2008a, b).

3.1.3 Population status

GCWA population estimates have typically relied on remote identification and quantification of potential habitat, sometimes in conjunction with avian surveys. Breeding population estimates have ranged from approximately 30,000 to 230,000 individuals, based on a variety of methods and datasets used over the years (summarized in Groce et al. 2010). Recent research conducted across the breeding range estimated 263,339 (95% CI: 223,927–302,620) GCWA males range-wide (Mathewson et al. 2012), providing a new context for evaluating status and trends of the species. Estimated density and abundance is higher in the southern recovery regions than in the northern regions, as the southern regions contain a higher percentage of habitat occurring in larger and contiguous patches (Mathewson et al. 2012). Broad-scale trend data for abundance are not available.

As discussed in section 2.5, approximately 94,000 ha (232,000 ac) of potential GCWA habitat occur in areas owned or managed by a variety of Federal, state, county, city entities or organizations. Focusing on 86,506 ha (213,760 ac) of GCWA habitat on conservation,

recreation, or Department of Defense lands, Hatfield et al. (2012) estimated the properties could contain 15,540 (11,591–18,274) male GCWA (Table 3.2).

Table 3.2. Estimated hectares of GCWA breeding habitat and estimated population numbers of male GCWA on protected land in Texas. Numbers are from Hatfield et al. 2012, in which they included 2012 conservation and recreation lands and 2010 Department of Defense lands as protected lands.

Recovery region	Protected habitat (ha)	Population estimate		
			95% CI	
		Mean	Lower	Upper
1	495	74	50	84
2	2,994	449	299	509
3	35,076	5,262	3,508	5,964
4	3,043	570	446	687
5	24,802	4,712	3,720	5,704
6	15,250	2,928	2,313	3,540
7	1,511	484	393	559
8	3,334	1,061	862	1,227
Total	86,506	15,540	11,591	18,274

3.1.4 Threats

The GCWA was listed as federally endangered in 1990 (55 FR 53153). Habitat loss and fragmentation due to juniper clearing, urban encroachment, lack of oak recruitment, and an increasing threat of brown-headed cowbird parasitism, were given as the primary threats at the time of listing. Habitat loss continues to be a primary threat to the species. Urban expansion, including residential and commercial development and related increases in roads and infrastructure, are ongoing in portions of the species range, particularly along the I-35 corridor between San Antonio and Dallas (Figure 3.2). Expansion of energy sector development to support growing populations may also cause loss of woodland areas due to construction of transmission lines and other energy infrastructure (Atkins 2011, SWCA Environmental Consultants 2012). Oil and gas development, particularly in the Barnett Shale in north-central Texas near Dallas-Fort Worth, has shown rapid growth in recent years, much of it moving into the GCWA breeding range (Figure 3.3; U.S. Energy Information Administration [USEIA] 2011, Texas Commission on Environmental Quality 2012). While this development does not appear to have directly impacted GCWA habitat to date (i.e., no HCPs have been filed for GCWA impacts from oil- and gas-related activities), the expansion of development suggests increased probability for oil and gas activities to interface with GCWA habitat.

Loss of oak species due to mortality of mature trees from oak wilt is prevalent throughout the central portion of the GCWA breeding range (Appel and Maggio 1984, Wahl et al. 1990, Appel and Camilli 2006, Stewart 2012). Current occurrences of oak wilt may be an indicator of future oak wilt risk (Figure 3.4; Stewart 2012). In addition, lack of oak recruitment into existing breeding habitat may result from browsing pressure from cattle, goats, and increased densities of white-tailed deer and exotic ungulates (Russell and Fowler 2002, Russell and Fowler 2004, Lockwood 2005; Figures 3.5–3.8). Loss of oaks due to oak wilt and limited oak recruitment

could lead to decreases in overall woody canopy cover in oak-juniper woodlands and lead to shifts in tree species composition that may affect GCWA distribution, density, habitat use, reproduction, or survival (Stewart 2012). Wildfire may be a threat to some GCWA habitat, contingent on current and future weather and climate conditions (Texas A&M Forest Service 2012). Wildfire was likely a part of previous natural disturbance regimes (summarized in Groce et al. 2010) and some wildfire may serve to enhance GCWA habitat quality through thinning of overgrown understory.

Predation is the leading cause of nest failure for most small songbirds (Martin 1992, Martin 1993). Research to date has determined that predator assemblages and activity varies across the species range and in different habitat configurations (Stake and Cimprich 2003, Peak 2007, Reidy 2007), although little is known about how predation influences nest success or reproductive success within those configurations. Most research indicates that where GWCA are present and pairing, reproductive success is relatively high, for example as compared to other small songbirds (Marshall 2011, Farrell et al. 2012, Stewart 2012). Feral hogs (*Sus scrofa*) and nest parasitism by brown-headed cowbirds (*Molothrus ater*) may also contribute to threats but do not appear to be a major factor in habitat use or GCWA reproductive success (USFWS 1992, Engels and Sexton 1994, Stake and Cimprich 2003).

3.1.5 Recovery goals

The GCWA recovery plan has not been updated since 1992. The 1992 recovery plan specifies 5 criteria for the GCWA to be considered for delisting (USFWS 1992):

1. Sufficient breeding habitat has been protected to ensure the continued existence of at least one viable, self-sustaining population in each of eight regions outlined in the plan;
2. The potential for gene flow exists across regions between demographically self-sustaining populations where needed for long-term viability;
3. Sufficient and sustainable non-breeding habitat exists to support the breeding populations;
4. All existing golden-cheeked warbler populations on public lands are protected and managed to ensure their continued existence, and
5. All of the above have been maintained for at least 10 consecutive years.

Population viability analyses suggested a minimum of 1,000 male GCWAs are necessary to maintain viable breeding populations, but recommended 3,000 males for regional recovery goals (USFWS 1996a; Alldredge et al. 2002). More recently, research assessing the genetic diversity of GCWAs has indicated that estimates of allelic richness and heterozygosity are relatively high and similar to those of other warbler species, and that GCWAs do not show metapopulation structure (Lindsay et al. 2008). Thus, GCWAs located in a particular management unit or recovery region do not function as a population distinct from other regions (Morrison et al. 2012). Such recent research suggests some revision of recovery criteria may be necessary, particularly for setting abundance and distribution targets (as specified in criteria 1 and 2) that more accurately represent the ecology and status of the species as it is now understood (Hatfield et al. 2012). Nevertheless, the underlying concepts of maintaining GCWA habitat and numbers throughout the range (i.e., limiting range contraction) are used in the CTGCP conservation strategy in chapter 6.

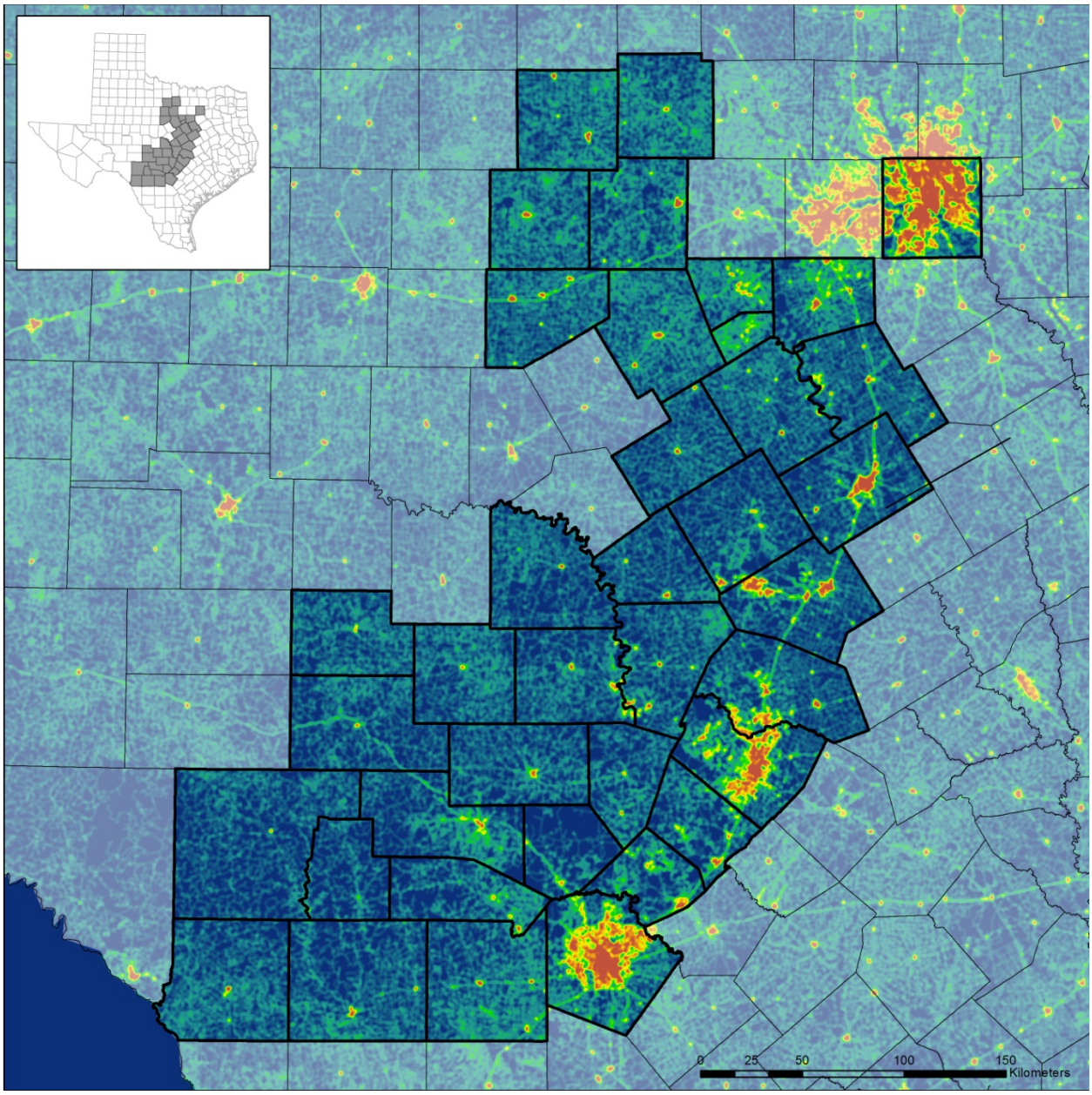

Figure 3.2. Depiction of road density in the CTGCP Plan Area derived from Texas Natural Resources Information System's StratMap data. Plan Area counties are outlined in black. Urban and suburban areas are indicated by the "hot spots" of higher road densities. Major interstate highways within the Plan Area are also noticeable, including I-35, I-20, and I-10 to the east, north, and south, respectively.

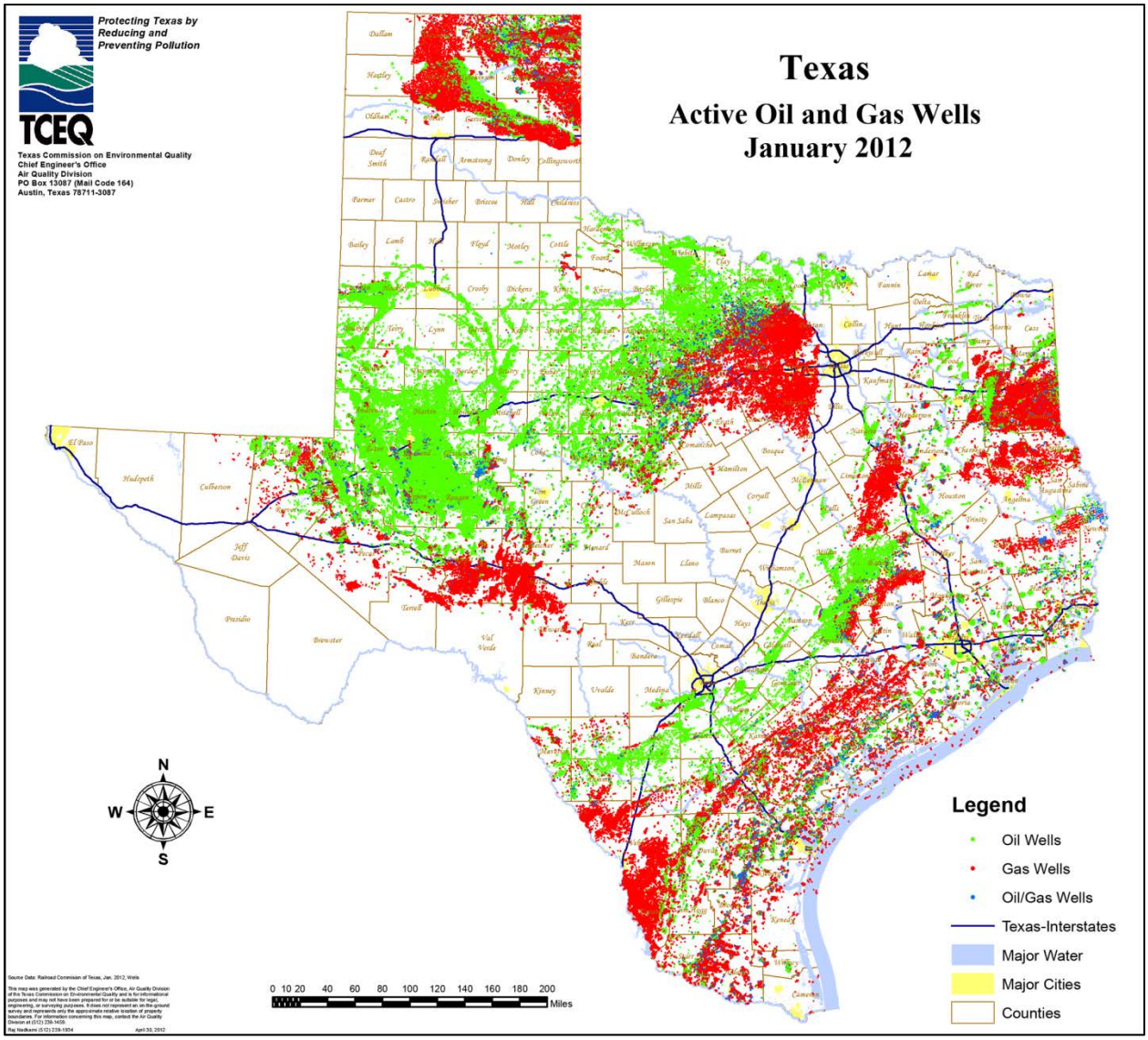

Figure 3.3. Oil and gas well locations in Texas. Image from Texas Commission on Environmental Quality (2012). Counties in the CTGCP Plan Area notably overlapped by well locations include Bosque, Eastland, Edwards, Erath, Hill, Hood, Jack, Johnson, Kimble, Menard, Palo Pinto, Somervell, Stephens, and Young.

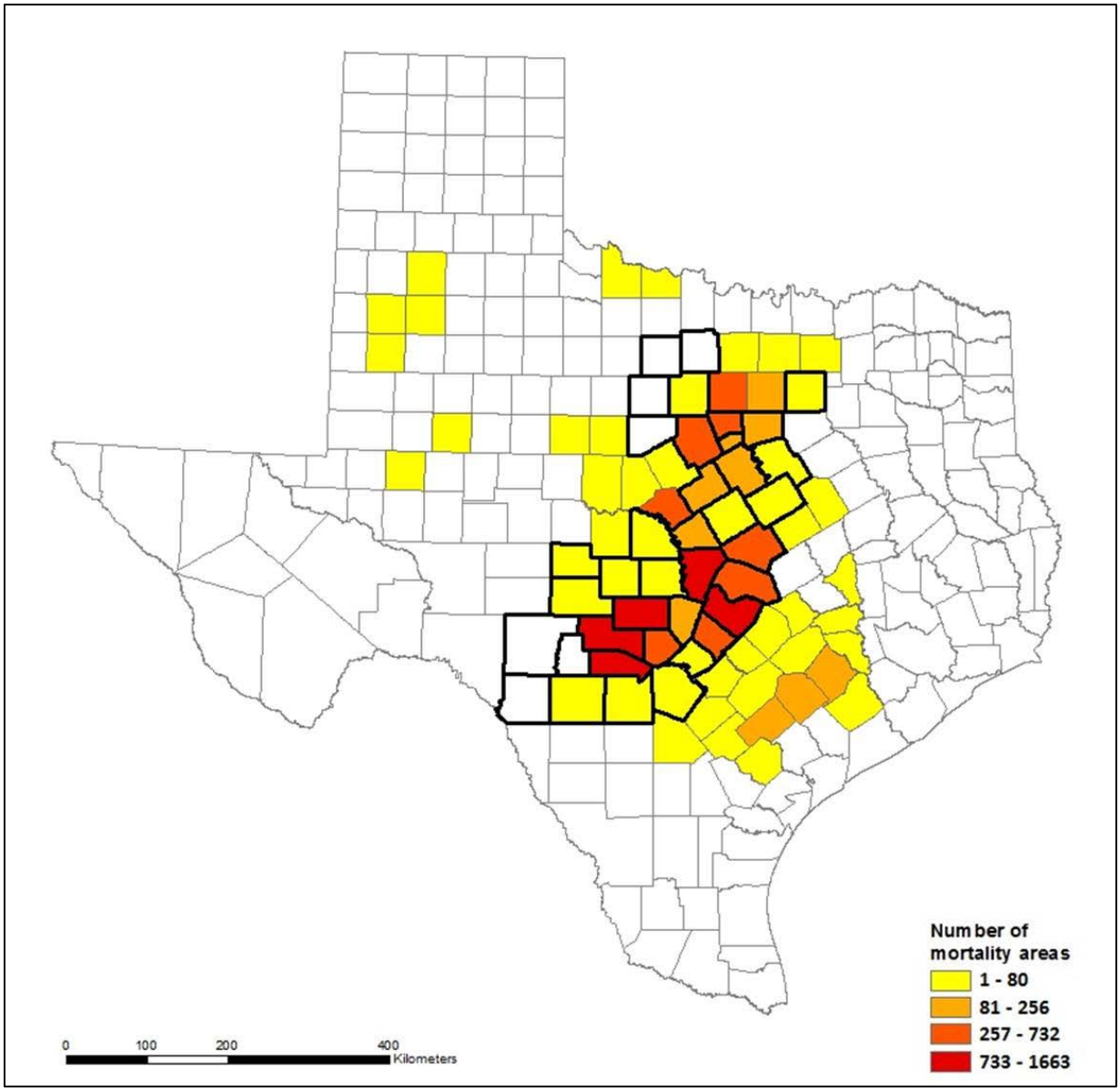

Figure 3.4. Occurrence of tree mortality areas due to oak wilt. Counties in the CTGCP Plan Area are outlined in black. Image revised from the Texas Forest Service (2007).

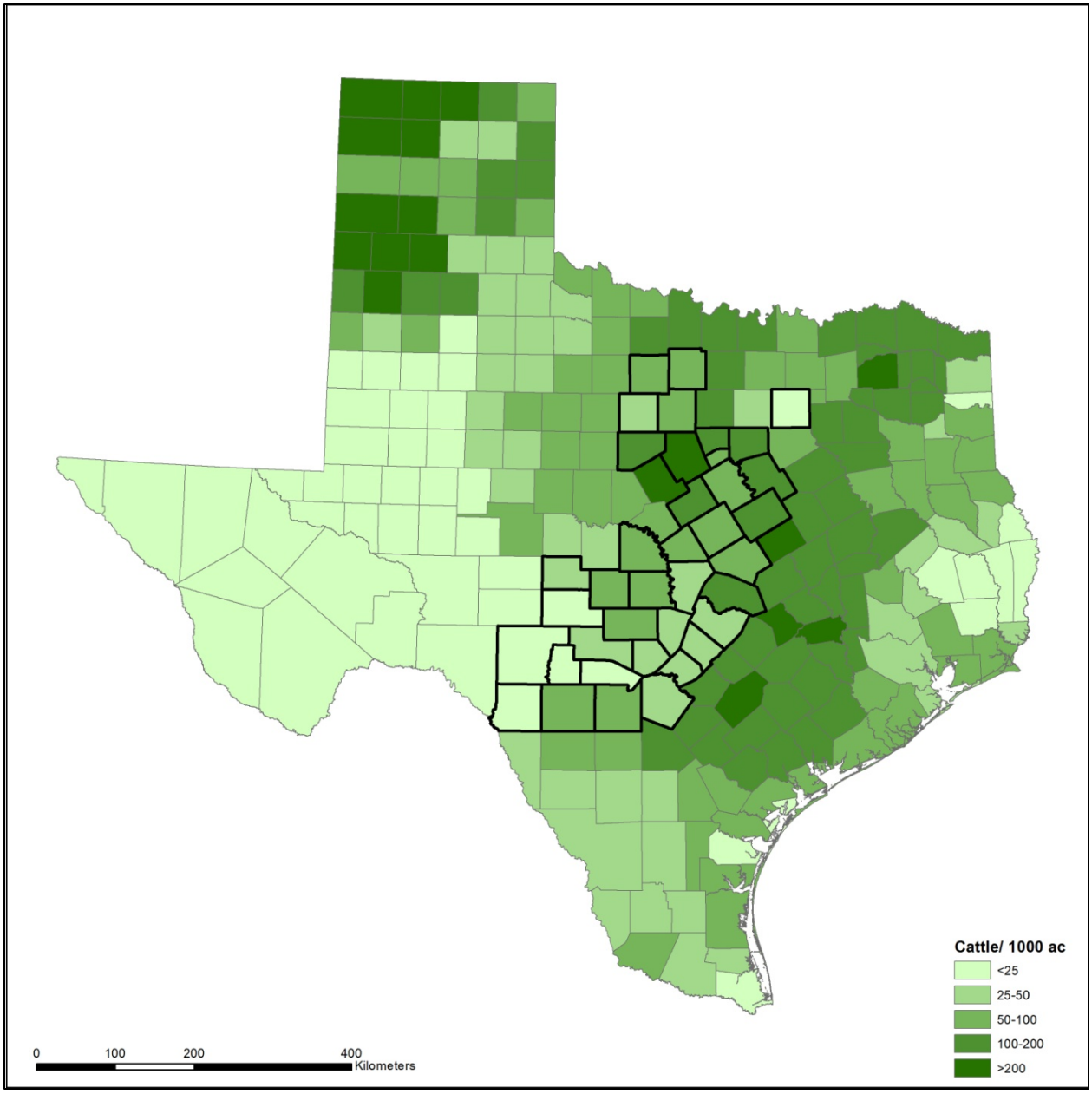

Figure 3.5. Cattle density in Texas, measured in cattle per 405 ha (1000 ac). Counties in the CTGCP Plan Area are outlined in black. Data are derived from the USDA Census of Agriculture (2007).

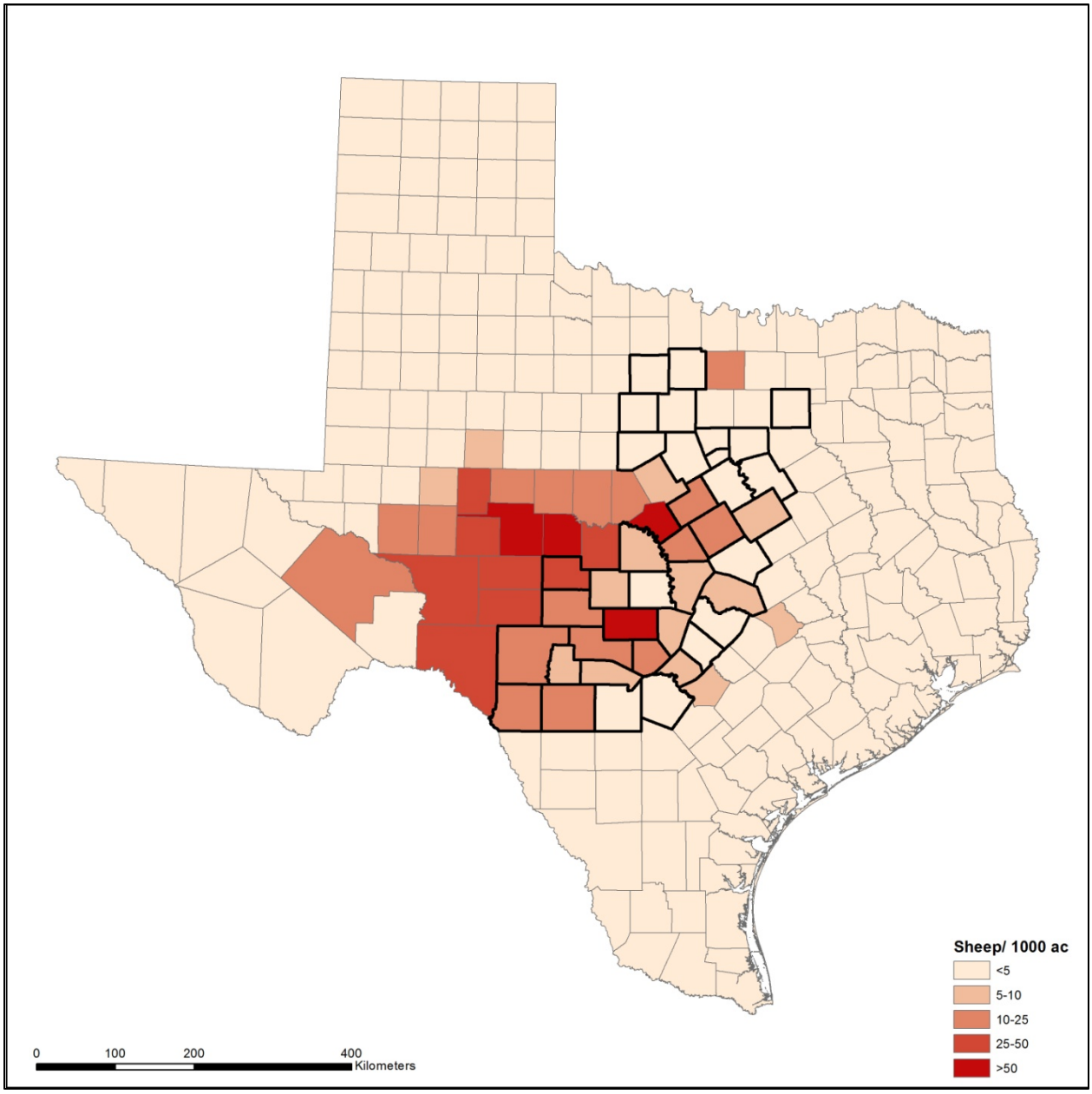

Figure 3.6. Sheep density in Texas, measured in sheep per 405 ha (1000 ac). Counties in the CTGCP Plan Area are outlined in black. Data are derived from the USDA Census of Agriculture (2007).

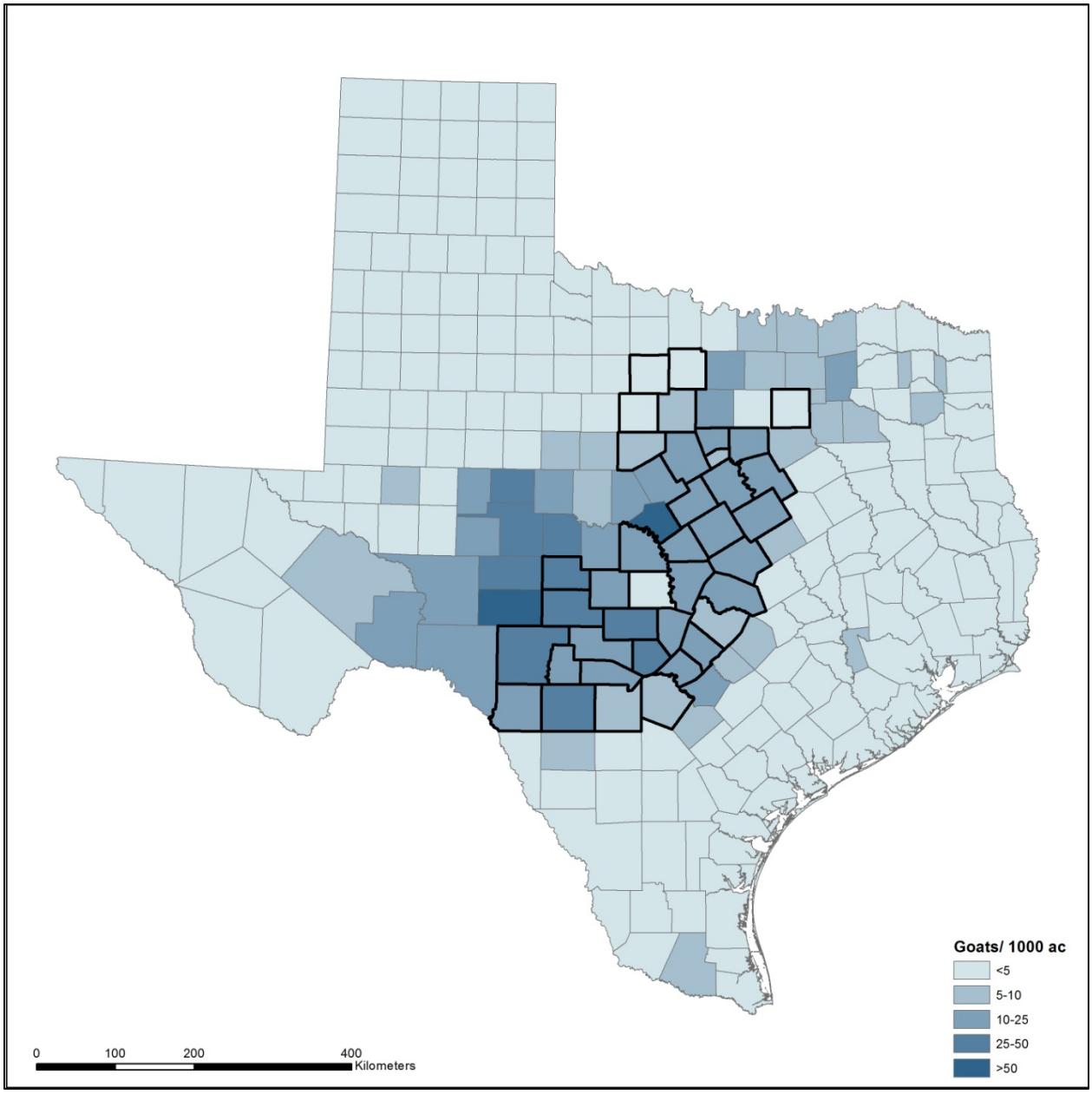

Figure 3.7. Goat density in Texas, measured in goats per 405 ha (1000 ac). Counties in the CTGCP Plan Area are outlined in black. Data are derived from the USDA Census of Agriculture (2007).

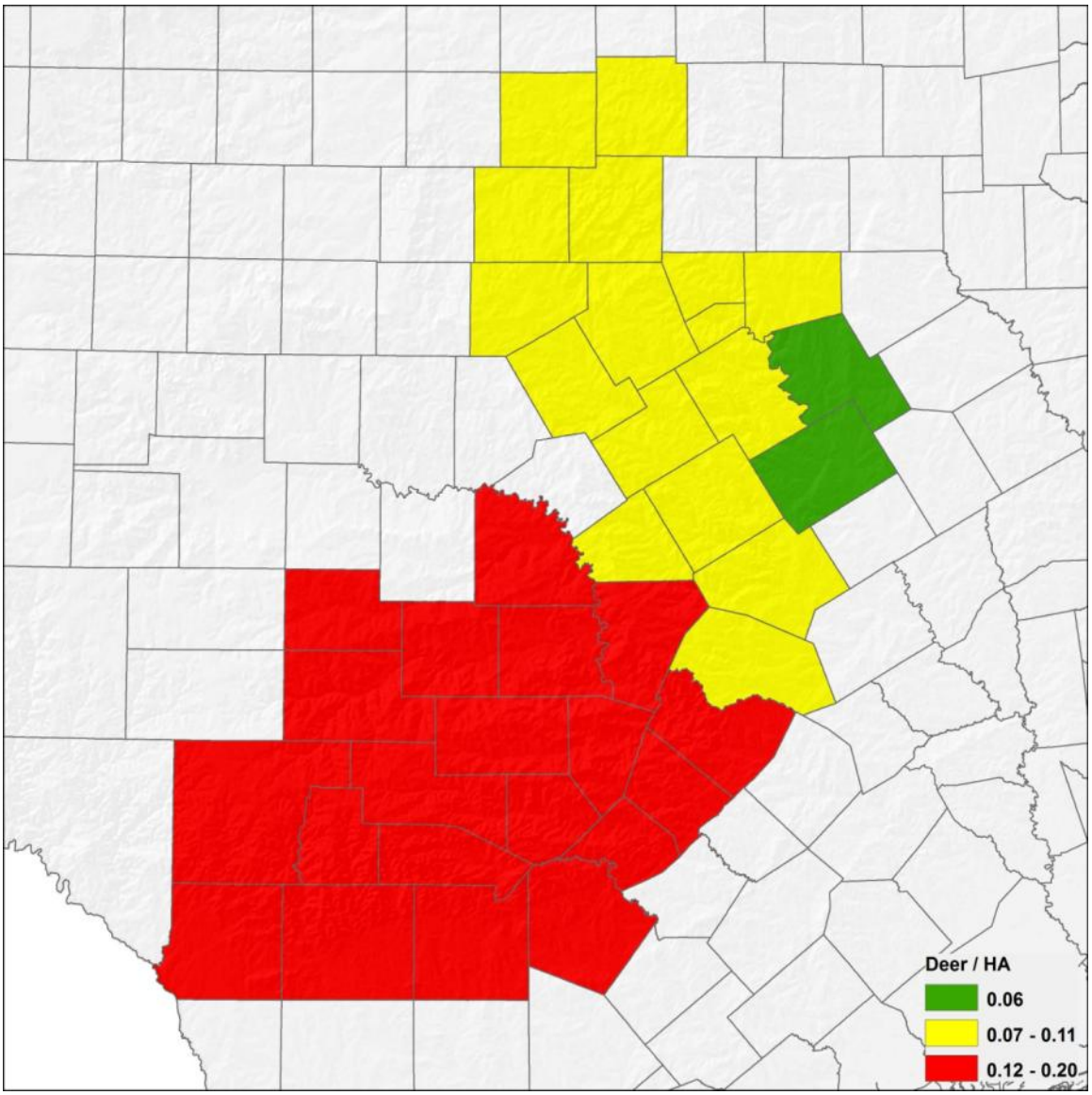

Figure 3.8. Regional deer density estimates, measured in deer per 1 ha (2.47 ac). Data are based on survey estimates by ecoregion (Lockwood 2005).

3.2 Black-capped vireo

3.2.1 Physical description and life history

The BCVI is a small, insectivorous migratory songbird 10–12 cm long (Graber 1961, Grzybowski 1995). BCVIs are sexually dichromatic, with delayed plumage maturation in first-year males (Graber 1961, Rohwer et al. 1980). Mature, after-second-year (ASY) males are mostly olive green above and white below with faint greenish-yellow flanks, black head, with prominent but broken white eye-ring and white lores and throat, black bill and red to copper iris (Oberholser 1974, Grzybowski 1995). Females and immature males are similar but with slate grey substituting for much or all of the black on the head. Second-year (SY) males typically have gray (instead of black) napes, and older females can develop varying amounts of black around their whiter spectacles, sometimes approaching the coloration of SY males. Iris color can be red to reddish brown in adult females, but is brown in hatch year individuals of both sexes (Graber 1961, USFWS 1991, Grzybowski 1995, Pyle 1997).

BCVI arrive on the breeding grounds usually from March to mid-April in Texas and mid-April to early May in Oklahoma (Graber 1957, Grzybowski 1995). ASY males typically arrive about a week or two before females and SY males to select their territories (Graber 1961). Territory sizes range from about 1–10 ha (Grzybowski 1995). Pairs construct cup-shaped nests suspended in forks of trees or shrubs, usually 0.2–3.0 m above the ground (Grzybowski 1995) but nests have also been observed at higher locations (Pope et al. 2013). Clutch sizes typically include 3–4 eggs. Incubation takes 14–17 days, with both males and females sharing incubation duties and feeding nestlings, which leave the nest 10–12 days after hatching (Grzybowski 1995). BCVIs begin to depart from the breeding grounds and migrate to wintering grounds from July to late August and September, with the young birds leaving first, followed by the adult females and then the adult males (Graber 1961, Grzybowski 1995). Additional life history details are in Wilkins et al. 2006.

3.2.2 Distribution and habitat use

The breeding range of BCVI was previously reported to include portions of Kansas, Oklahoma, Texas and central Coahuila, Mexico. Currently, we know the breeding range extends from central Oklahoma south through the Mexican state of Nuevo Leon and into the southwestern part of Tamaulipas (Farquhar and Gonzalez 2005, Wilkins et al. 2006). The wintering range is not well documented but appears to include the Pacific coast of Mexico from Sinaloa to Oaxaca (Graber 1957, Marshall et al. 1985, Wilkins et al. 2006, Vega Rivera et al. 2011). Figure 3.9 illustrates the county-level breeding range of BCVI in Texas and delineations of recovery regions established by the Service.

In Texas and Oklahoma, suitable BCVI habitat is generally characterized by a patchy distribution of low, scrubby growth made up mostly of deciduous woody shrubs and trees of irregular height (Graber 1961). When compared with adjacent habitats, the habitats in BCVI territories have a higher density of deciduous vegetation less than 2 m in height (Grzybowski et al. 1994). BCVI habitat throughout Texas is variable in plant species composition, soil type, geomorphology, rainfall, and other features. Many habitat areas share a patchy or structurally heterogeneous character with vegetation cover generally extending from the ground to 1–3 m in height and covering about 20–80% of the area. However, it is important to note that BCVI have frequently been found to occur, nest, and reproduce successfully in a much broader variety of habitat

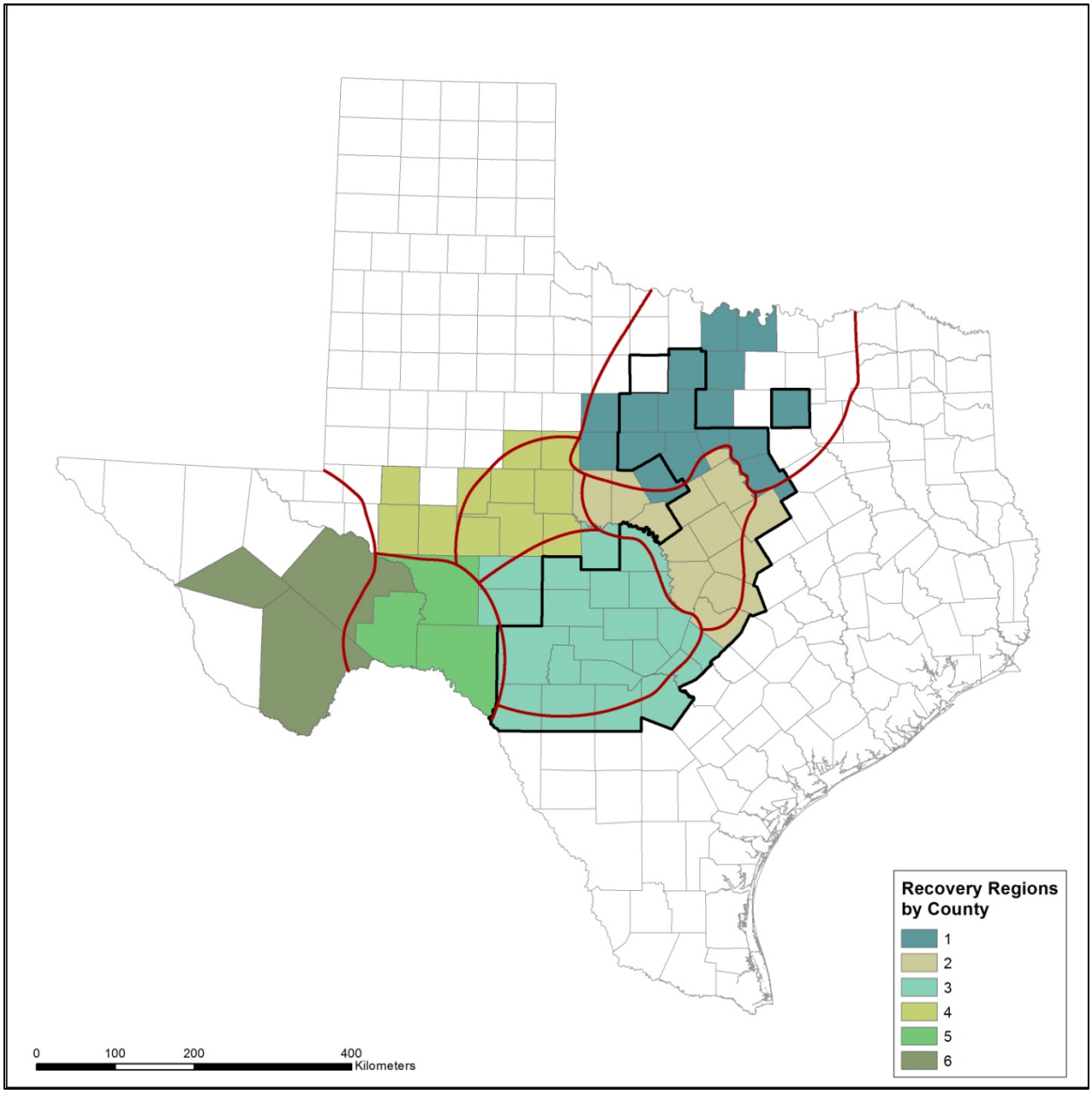

Figure 3.9. County-level distribution of the black-capped vireo's breeding range in Texas. Counties in the CTGCP Plan Area are outlined in black. Red lines indicate recovery regions as defined in the Service's Black-capped vireo Recovery Plan (USFWS 1991). Recovery Regions discussed in the CTGCP are categorized as indicated by the shaded colors to facilitate summary of county-level data.

conditions than is typically described in regulatory guidance and management guidelines (USFWS 1991; Campbell 2003) including areas with higher and lower amounts of woody cover than previously described, and at vegetation heights outside of those typically described (e.g., see Smith et al. 2012, Pope et al. 2013).

While local assessments in determining habitat suitability are possible, success in identifying and estimating habitat and occupancy for BCVI range-wide have been limited, partly due to difficulty of separating suitable from unsuitable BCVI habitat when using remote sensing data (Wilkins et al. 2006). Until 2009, the only Texas-wide estimates of suitable were conducted in the late 1990s (Maresh and Rowell 2000, USFWS 2004). The 53 counties in which surveys occurred were estimated to contain approximately 592,000 ha (1.45 million ac) of potential suitable habitat as defined by the surveyors' categorization, or about 1.97% of the total land area considered (Table 3.3). Texas A&M Institute of Renewable Natural Resources (IRNR) recently developed a preliminary BCVI model in its Texas range using remotely-sensed environmental characteristics such as ecosite, aridity, and profile curvature, and in-field BCVI survey data (McFarland et al. 2012). The resulting raster model, from which non-habitat areas are masked out (such as urban areas and lakes; IRNR unpublished data), is comprised of 200-m^2 pixels each with an associated occupancy probability value (i.e., the probability that a BCVI will occur in a given pixel; Figure 3.10). Table 3.4 provides the estimated amount of area encompassed by each occupancy probability category. Most areas have low predicted occupancy probabilities; there are no pixels in the model with >0.6 probability and the majority of BCVIs detected during surveys were in areas with probabilities <0.2. Although still in development, this work suggests the extent of potential breeding habitat may be greater than previous estimates, from 300,000 ha to possible 3 million ha. Trend data for habitat area are not available.

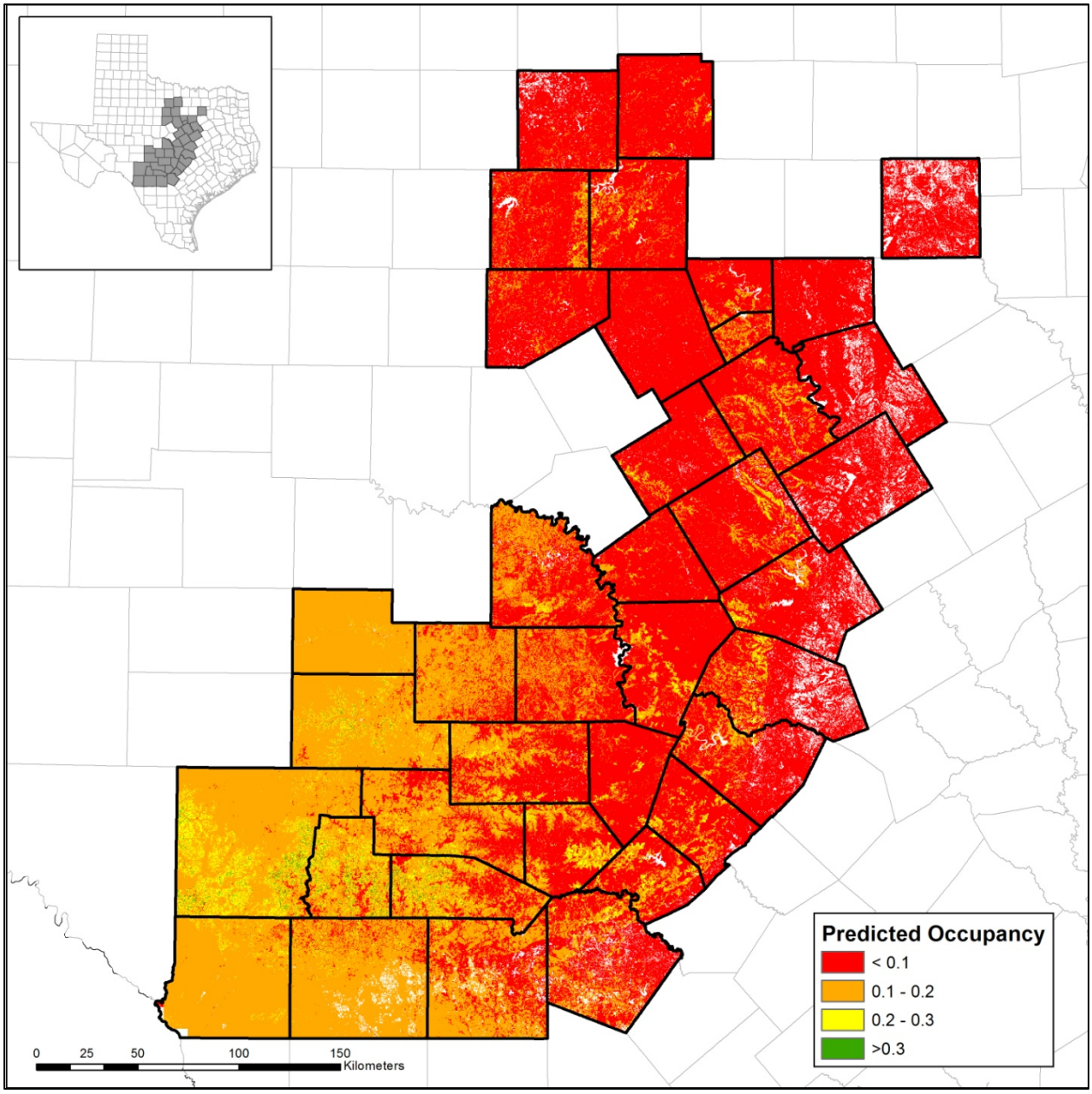

Figure 3.10. Visual representation of the BCVI occupancy model developed by Texas A&M University (MacFarland et al. 2012) clipped to the CTGCP Plan Area.

Table 3.3. Estimated hectares by recovery region of BCVI habitat in their Texas breeding range and relative to the CTGCP Plan and Permit Areas (Maresh and Rowell 2000, USFWS 2004).

Recovery region	Texas range-wide	% of region	CTGCP Plan Area	CTGCP Permit Area
1	20,607	0.26	15,673	15,673
2	51,550	1.64	27,721	21,147
3	275,277	4.63	230,420	199,706
4	50,212	2.1	-	-
5	194,353	8.93	-	-
6	749	0.01	-	-
Total	592,746	1.97	273,814	236,526

Table 3.4. Estimated hectares of BCVI potential habitat by recovery regions within the CTGCP Plan and Permit Areas (McFarland et al. 2012, IRNR unpublished data).

	Occupancy probability				Total ha	
Recovery region	<0.1	0.1-0.2	0.2-0.3	>0.3	All	>0.01
CTGCP Plan Area						
1	1,702,970	122,617	7,335	15	1,832,937	129,967
2	1,569,118	230,791	38,371	219	1,838,500	269,381
3	1,490,997	2,802,366	284,037	25,163	4,602,563	3,111,566
Total	4,763,085	3,155,774	329,742	25,397	8,273,999	3,510,913
CTGCP Permit Area						
1	1,702,970	122,617	7,335	15	1,832,937	129,967
2	1,271,497	171,383	26,531	60	1,469,473	197,974
3	1,139,600	2,686,729	262,424	25,057	4,113,809	2,974,210
Total	4,114,066	2,980,729	296,290	25,133	7,416,218	3,302,152

3.2.3 Population status

As noted above, success in identifying and estimating habitat and occupancy for BCVI range-wide has been limited, thus limiting the ability to generate reliable range-wide estimates of habitat extent and population numbers. Current known BCVI numbers are higher than in the past due in large part to increased survey effort (e.g., more areas surveyed), along with possible increases in breeding populations at Wichita Mountains National Wildlife Refuge, Fort Sill, Fort Hood, and Kerr Wildlife Management Area (Wilkins et al. 2006; Table 3.5, Appendix B). At the time of listing, the largest concentrations of BCVI were thought to occur in the Austin area and Kerr WMA (52 FR 37420). Until recently, known occurrences were concentrated on a small number of public lands on a relatively small fraction of the species' range (Appendix B). Most of the breeding range in the U.S. is comprised of private lands as yet largely unsurveyed. In recent years, additional surveys have provided more information about BCVI detections in southwest Texas and northern Mexico (e.g., McFarland et al. 2012, Morrison and González-Rojas 2014). Recent studies, with the largest number and geographic distribution of sample locations across the BCVI breeding range, predict potential habitat based on probability of occupancy of BCVI and provide some indication of the number of detections across surveyed

lands, but do not provide regional or range-wide abundance estimates (McFarland et al. 2012). Broad-scale trend data for abundance is not available.

Table 3.5. Number of BCVIs detected during in-field surveys, 2000 to 2010, by BCVI recovery region. Includes updates to Wilkins et al. 2006 based on Texas A&M statewide surveys (McFarland et al. 2012). Numbers per property are provided in Appendix B.

Recovery region	Number of BCVI	
	All counties	CTGCP Plan Area
1	22	18
2	2,484	2,465
3	1,936	1,925
4	173	-
5	627	-
6	17	-
Total	5,259	4,408

3.2.4 Threats

The BCVI was listed as federally endangered in 1987 (52 FR 37420). Threats at the time included habitat loss through land use conversion, vegetation succession, grazing and browsing by domestic and wild herbivores, and brood parasitism by brown-headed cowbirds (52 FR 37420, USFWS 1991). Current threats to the species are largely in parallel to those described above for GCWAs. Urban expansion, including residential and commercial development and related increases in roads and infrastructure are ongoing in portions of the species range, particularly along the I-35 corridor (Figure 3.2). Fire suppression is also likely playing a role, although difficult to quantify. Expansion of energy sector development to support growing populations may also cause loss of BCVI habitat due to construction of transmission lines and other energy infrastructure (e.g., Atkins 2011, SWCA Environmental Consultants 2012). However, in some cases, the clearing of woodlands for construction and maintenance of transmission line corridors may result in creation of BCVI habitat within several years (SWCA Environmental Consultants 2012). Oil and gas development, particularly in the Barnett Shale in north-central Texas near Dallas-Fort Worth, has shown rapid growth in recent years (Figure 3.3; USEIA 2011, Texas Commission on Environmental Quality 2012). While oil and gas development does not appear to have directly impacted BCVI habitat to date (i.e., no HCPs have been filed for BCVI impacts from oil- and gas-related activities), the expansion of development suggests increased probability for oil and gas activities to interface with BCVI habitat.

Changes in habitat condition that may result from wildfire suppression, habitat succession, grazing/browsing, and herbivory by abundant native herbivores is a potential concern to BCVI habitat availability and quality. Lack of oak recruitment into existing breeding habitat may result from browsing pressure from cattle, goats, and increased densities of white-tailed deer and exotic ungulates (Russell and Fowler 2002, Russell and Fowler 2004; Figures 3.5–3.8). Although wildfire may be a threat to some BCVI habitat in the short term, wildfire was likely part of previous natural disturbance regimes and may serve to enhance BCVI habitat quality through setting back successional changes in vegetation. Fire suppression may lead to increased

succession and vegetation growth, resulting in changes to vegetation conditions that decrease available habitat for BCVI.

Predation is the leading cause of nest failure for most small songbirds and may lead to low fecundity and low reproductive success (Martin 1992, Martin 1993). Research to date has determined that predator assemblages and activity varies across the species range and in different habitat configurations (Stake and Cimprich 2003, Conkling et al. 2012, Smith et al. 2012). However, the impacts of anthropogenic changes on predation, and resulting nest success, are not well understood. Brown-headed cowbird parasitism presents potentially the greatest threat to BCVI in many portions of its range. Regardless of other habitat and predator conditions, cowbird parasitism is often the major limiting factor on reproductive success for the BCVI (Grzybowski and Pease 2000, Wilkins et al. 2006). Consequently, in regions where parasitism occurs frequently, habitat restoration or other management efforts, in the absence of cowbird control measures, will fail to improve BCVI breeding success.

3.2.5 Recovery goals

The BCVI recovery plan has not been updated since 1991. The 1991 recovery plan specifies 4 criteria that need to be met to consider reclassifying the BCVI from endangered to threatened (USFWS 1991):

1. All existing populations are to protected and maintained;
2. At least one viable breeding population exists in each of the following six locations: Oklahoma, Mexico, four of the six Texas regions;
3. Sufficient and sustainable area and habitat on the winter range exists to support the breeding populations;
4. All of the above have been maintained for at least 5 consecutive years and available data indicate that they will continue to be maintained.

Subsequent population viability analyses conducted for the BCVI suggest 500–1,000 males as a minimum viable population size (USFWS 1996b). More recently, researchers assessed BCVI genetics and disagree about whether there is evidence for metapopulation structure or distinct populations (Barr et al. 2008, Zink et al. 2010, Barr et al. 2011, Zink et al. 2011). Thus, some revision of recovery criteria may be necessary, particularly for setting abundance and distribution targets (as specified in criteria 2) that more accurately represent the ecology and status of the species as it is now understood. Nevertheless, the underlying concepts of maintaining BCVI habitat and numbers throughout the range (i.e., limiting range contraction) and encouraging the protection and management of BCVI on public lands are used in the CTGCP conservation strategy in chapter 6.

4 Covered activities and impacts

The CTGCP provides a streamlined process for an applicant to acquire incidental take permits for the Covered Species and comply with the ESA. This chapter discusses the types of activities covered by the CTGCP, potential impacts of those activities on GCWA and BCVI, and broad-scale estimates of incidental take of the species.

4.1 Covered activities

Human population growth will continue in central Texas throughout the plan's duration, with the majority of growth occurring in urban-metro and suburban counties (Texas Department of Transportation 2011, TSDC 2012; see section 2.6). There will be corresponding increases in housing, commercial and municipal development, expansion and maintenance of roadways, power generation and transmission, and other land management activities, although precise projections of development are difficult to quantify given the spatial and temporal scale of the CTGCP Plan Area and economic uncertainties (Gaines 2008, Texas Comptroller of Public Accounts 2008).

Given the complexity and uncertainty of various development activities and the broad spatial scope of the CTGCP Plan Area (38 counties), the CTGCP Covered Activities will focus on residential and nonresidential construction projects for which estimates of take can be reasonably quantified (section 4.3). Thus, incidental take permits issued in conjunction with the CTGCP will authorize incidental take of the Covered Species associated with the Covered Activities and related sub-activities described below.

Residential and nonresidential building construction

Residential construction includes single-family homes and buildings containing two or more housing units, along with other structures and improvements related to the residential use of the building (e.g., garage, driveway, waterlines, other utilities). Nonresidential construction includes: amusement, social and recreational buildings; religious buildings; industrial buildings; parking garages; service stations and repair garages; hospitals and institutional buildings; office, bank, and professional buildings; public works and utilities buildings; schools and other educational buildings; stores and customer services; transient accommodations (e.g., hotel, motel, cabins); other similar buildings; along with other structures, utilities, and improvements related to the use of such buildings. Individual projects might include all or a subset of the sub-activities listed in Table 4.1.

Table 4.1. Description of Covered Activities and related sub-activities for which incidental take permits may be issued under the CTGCP.

Covered activity	**Description**
Residential and nonresidential construction	Construction and maintenance of building projects, including but not limited to residential (e.g., single- and multi-family homes, subdivisions), commercial, municipal (e.g., parks, schools, libraries), or industrial projects, facilities, and associated infrastructure.
Sub-activity	**Description**
Land surveys	Surveyor access to project area and activities related to assessing

	cultural, environmental and physical features
Construction of access roads	Provides temporary access into and through construction site; may also provide permanent access for ongoing use and maintenance activities. Includes clearing of vegetation, grading or surfacing as needed, and other similar activities and associated equipment.
Temporary facilities	Temporary facilities and utilities needed during construction process; e.g., safety and construction barriers, ramps/walkways for pedestrians, field offices, storage units, employee parking, sanitation facilities, utilities.
Site preparation	Preparing the site for construction. Includes clearing of vegetation, removal of surface soil layer, removal of other features or structures not part of the finished project, excavation, rough grading, and other similar activities and associated equipment.
Construction of buildings and utilities	Erection of building and associated infrastructure and utilities. Includes foundation, framing, internal and external features, utility installation and distribution lines, other related activities, and use of necessary materials and equipment.
Landscaping and restoration	Planting vegetation or restoring natural areas and use of associated equipment.
Cleanup	Daily removal of construction debris, waste materials, packaging material, etc.; also removal of temporary products and access roads from the site when project is completed.
Post-construction use of site and building	Use of residential sites is generally continual and permanent. Use of nonresidential sites is generally temporary and sporadic, with heavy use during the hours of operation and little to no use when closed.

4.2 Incidental take of Covered Species

Incidental take of the Covered Species resulting from the Covered Activities will be measured by the acreage of direct and indirect impacts to GCWA or BCVI potential habitat. Direct impacts are caused by the action (Covered Activity) and occur at the same time and place (e.g., project footprint), whereas indirect impacts are later in time or farther removed in distance, but are still reasonably foreseeable (40 CFR 1508.8). For example, direct impacts may include bird collisions with vehicles or structures while indirect impacts may result from changes in food availability, predator assemblage or abundance, noise levels, or human activity. Impacts to habitat will be used as a proxy for the incidental take of GCWA or BCVI individuals or territories because habitat acreage is a relatively stable metric of take and mitigation compared to determining number of individuals or territories that vary from year to year. This approach is consistent with previous incidental take permits and biological opinions approved for the species.

Land development activities discussed in section 4.1 have the potential to impact golden-cheeked warbler or black-capped vireo habitat, through the loss or degradation of habitat related to removing or substantially altering natural vegetation communities. This removal or degradation

of habitat reduces the amount of habitat available to the species and may reduce quality of the remaining nearby habitat. While direct impacts to the Covered Species are relatively easy to determine and quantify (e.g., removal of habitat within a project footprint), the extent to which indirect impacts affect the species is not well understood. In the context of the CTGCP, negative indirect impacts to the Covered Species should have a measureable or detectable change in environmental conditions from pre-project to post-project that are clearly caused by the project and can reasonably be expected to result in measureable or detectable negative outcomes for the Covered Species. Measurable or detectable negative outcomes include decreases in probability of occurrence, density, reproductive success, or survivorship.

Studies that explicitly or implicitly assessed indirect impacts of various activities on the GCWA, using appropriately-designed and reported methods, support the role of habitat patch size in occupancy, abundance, and reproductive success; research to date does not clearly support the assumption of negative effects due to noise, human activities, or other factors often considered deleterious for the species (see Appendix C for overview). As patch size decreases, the probability of GCWA occurrence decreases (Collier et al. 2012), and GCWA density decreases with a decrease in probability of occurrence (Mathewson et al. 2012). Research also indicates that GCWA commonly fail to reproduce successfully in patches below a size threshold of approximately 20 ha (50 ac; Butcher et al. 2010). Therefore, reduction in patch size can result in two primary changes in GCWA responses: (1) decrease in GCWA density (number of birds per ha) in the remaining patch area, and (2) rendering a patch unable or unlikely to support successful pairing and reproduction in patches below the reproductive threshold.

There is a limited amount of research that addresses impacts of anthropogenic disturbance on BCVI or provides indication of potential responses to such disturbances. However, it is likely that indirect effects of some kind may occur in areas adjacent to direct impact over space and time because of changes in the vegetation structure and ecological dynamics of the area. For example, it is plausible that brown-headed cowbird habitat use may change in response to the clearing of vegetation in an area in ways that affect nearby BCVI habitat (Wilkins et al. 2006). Fire suppression in habitat adjacent or near to developed areas may allow successional advancement of the vegetation and juniper encroachment and thus degrade the habitat (Wilkins et al. 2006). Although it is unknown at what distance(s) indirect impacts may extend from the project's footprint, it is likely that the extent of indirect effects increases with increasing area of direct impact to habitat.

Additionally, numerous studies on other bird species have examined impacts to those species connected with urbanization, exurban development, roads, and noise and generally show negative trends in diversity and abundance with increasing amount of these land uses, although often with the caveat of extensive heterogeneity among responses of different species (e.g., see reviews in Freisen et al. 1995, Chace and Walsh 2006, Mannan 2009, Benítez-López et al. 2010, Ortega 2012). Because these impacts are species- and situation-specific, only broad generalizations from these findings may apply to the Covered Species. Impact assessments (e.g., Before-After-Control-Impact (BACI) studies; Morrison et al. 2008) are a necessary approach to improve our understanding of potential indirect impacts to GCWA and BCVI resulting from the Covered Activities. Nevertheless, we recognize indirect impacts will likely occur from the Covered Activities. The method developed for quantifying direct and indirect impacts to the

Covered Species (chapter 5) encompasses some of these unknowns when determining the amount of appropriate mitigation for incidental take. As new information about impacts to the species becomes available, it will be incorporated into the quantification of direct and indirect impacts and calculations will be revised as needed (see chapter 5).

4.3 Estimates of take

This section provides broad-scale estimates of potential loss of GCWA and BCVI habitat resulting from the Covered Activities. Spatially-explicit data is available for future projections of residential development in Texas (section 4.3.1). Estimating potential loss of habitat related to nonresidential development assumes a linear relationship between residential and nonresidential development (section 4.3.2). Calculations for project-specific impacts to determine mitigation requirements are discussed in section 5.3.

4.3.1 Residential building construction

Potential loss of habitat for GCWA and BCVI due to residential construction and related impervious surfaces was estimated by using projections developed in the U.S. Environmental Protection Agency (EPA) Integrated Climate and Land Use Scenarios (ICLUS) project (USEPA 2009, Bierwagen et al. 2010). Specifically, we used the Base Case (BC) and A2 scenarios of impervious surface from 2010 to 2050 to encompass the CTGCP plan and permit durations (i.e., 15 year plan duration plus up to an additional 10-year permit duration; see section 1.3.2). These two spatially-explicit datasets represent the average and maximum projections, respectively, of changes in land use and corresponding increases in housing and impervious surface through 2050. The EPA model provides a value of percent increase in impervious surface for each 1-km^2 pixel (Figures 4.1 and 4.2). The two scenarios were based on different social, economic, and demographic storylines.

Golden-cheeked warbler

Texas A&M IRNR developed a spatially-explicit GCWA occupancy model in 2010 using 2007-2008 Landsat imagery and in-field GCWA survey data from across the breeding range. Incorporating characteristics of woodland patch size, landscape composition, and spatial location in the range, the model provides an estimated probability of occupancy for each of 1,000s of woodland patches (i.e., the probability that at least one GCWA occupies a given patch; details in Collier et al. 2012). For the CTGCP analysis, patch occupancy probability values were classified as <25%, >25-50%, >50-75%, >75-90%, and >90% while the EPA impervious surface estimates were classified as <5%, >5-25%, >25-50%, and >50%. The impervious surface classes were then intersected with the GCWA habitat patches, resulting in a matrix of acres lost in a given occupancy category by impervious surface category for each recovery region (Appendix D). All values are based on the CTGCP Permit Area, thus excluding those counties with existing or developing regional HCPs (Williamson, Travis, Hays, Comal, Bexar). To estimate loss of GCWA habitat due to residential development, we added the categories for GCWA patches with >25% predicted occupancy and impervious surface values of >5%. The overlay of the EPA model and Texas A&M model suggests 10,241–14,595 ha (25,306–36,065 ac) of GCWA habitat loss due to residential development in the CTGCP Permit Area through 2050 (Table 4.2). The average potential habitat loss between the two scenarios is 12,418 ha (30,686 ac).

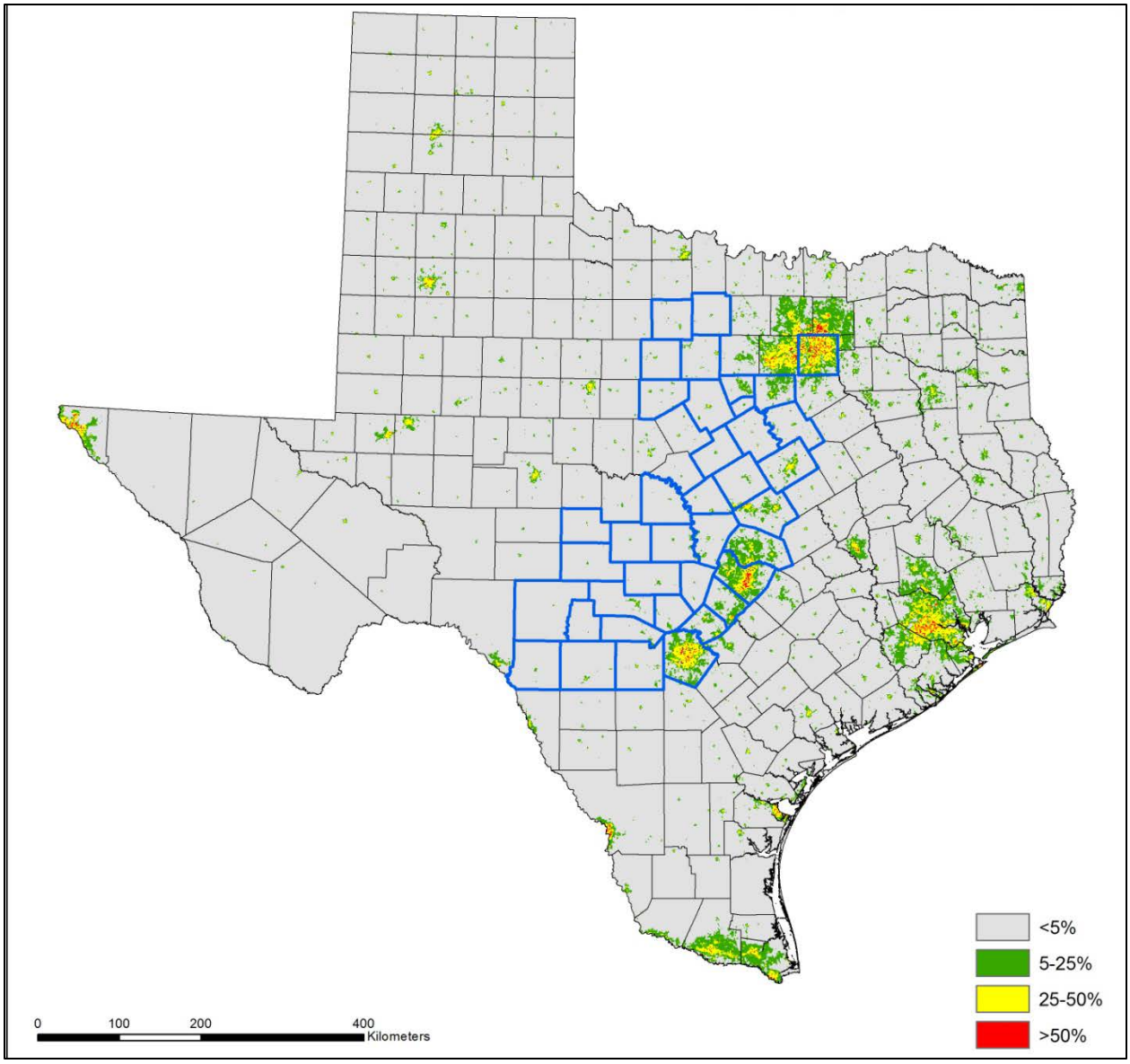

Figure 4.1. Percent increase in impervious surface cover throughout Texas using the EPA's ICLUS Base Case (BC) scenario through 2050. Counties in the CTGCP Plan Area are outlined in blue.

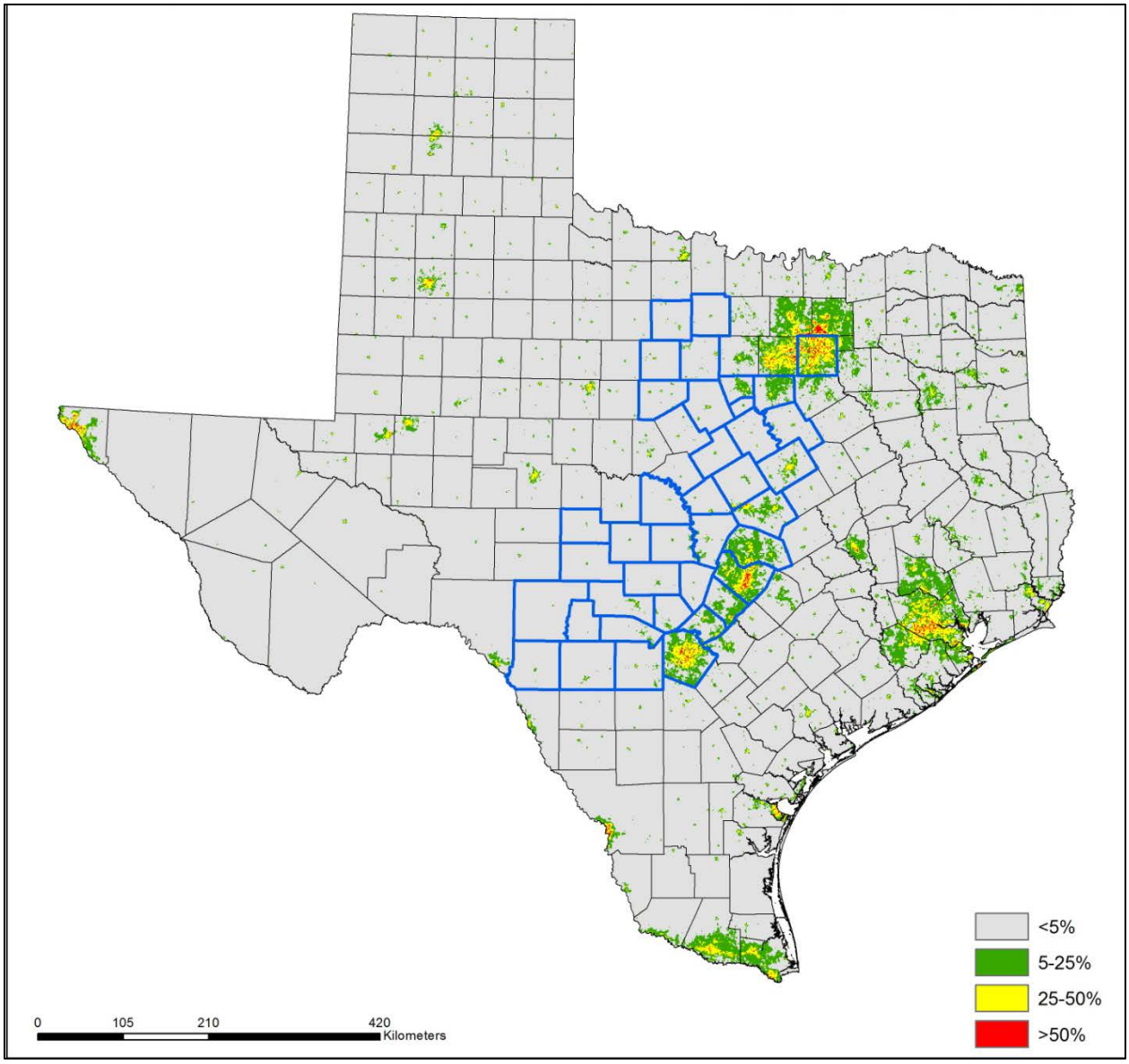

Figure 4.2. Percent increase in impervious surface cover throughout Texas using the EPA's ICLUS A2 scenario through 2050. Counties in the CTGCP Plan Area are outlined in blue. Although difficult to discern at this state-wide scale, there are finer-scale differences between this scenario and Figure 4.1.

Table 4.2. Estimates of GCWA habitat loss (ha) due to residential development in the CTGCP Permit Area through 2050 by recovery region, based on GCWA patches with >25% probability of occupancy and areas with EPA-estimated increases of >5% impervious surface. EPA scenarios of BC and A2 are explained in the text.

GCWA recovery region	BC	A2
1	277	277
2	560	850
3	4,842	6,446
4	191	221
5	1,120	2,263
6	639	1,170
7	1,126	1,202
8	1,486	2,166
Total (ha)	10,241	14,595

Black-capped vireo

BCVI habitat is difficult to assess at broad spatial scales from satellite imagery. This is in part due to the inability to determine vegetative structure occurring underneath the canopy cover (presence of vegetation <1 m above ground is an important nesting component) and their habitat is typically in an earlier successional stage throughout most of the CTGCP area, with different areas growing into or out of habitat in any given year. The Texas A&M BCVI habitat model (described in section 3.2.2; McFarland et al. 2012)—the only broad scale spatially explicit estimate of habitat—was used along with the EPA model described above to provide a general estimate of potential habitat loss resulting from residential development. For this analysis, pixel probability values were classified as <0.1, 0.1–0.2, 0.2–0.3, and >0.3 (there are no pixels with >0.6 probability). All areas with occupancy probabilities >0.1 were included to be as inclusive as possible regarding potential habitat, since this is a preliminary model and the majority of BCVIs detected during surveys were in areas with probabilities <0.2. These areas were then intersected with all EPA pixels having an impervious surface value of >25%. This value was used for BCVI (versus >5% as for GCWA) because pixels with <25% impervious surface could still encompass potential BCVI habitat (e.g., rural roadsides). This resulted in a matrix of hectares lost per occupancy probability category for each BCVI recovery region (Appendix D).

The overlay of the EPA model and Texas A&M BCVI model suggests 703–917 ha (1,737–2,266 ac) of BCVI habitat loss due to residential development in the CTGCP Permit Area through 2050 (Table 4.3), or an average of 810 ha (2,002 ac) between the two scenrios. As noted earlier, the BC and A2 scenarios in the EPA model represents the average and maximum projections of impervious surface, respectively. Although the higher values in Table 4.3 for BC in some of the recovery regions seems non-intuitive, it is likely related to the way in which the EPA models weighted growth in regions beyond suburban areas with the different scenarios.

Table 4.3. Estimates of potential loss (ha) in BCVI habitat based on projected increases in residential development. BCVI recovery regions include only those counties within the CTGCP Permit Area. EPA scenarios of BC and A2 are explained in the text.

BCVI recovery region	Estimated potential habitat	Estimated habitat loss	
		BC	A2
1	129,967	92	153
2	197,975	387	306
3	2,974,209	438	244
Total (ha)	3,302,151	917	703

4.3.2 Nonresidential building construction

The EPA land use model described in 4.3.1 includes only residential buildings (USEPA 2009). To estimate potential impacts to GCWA and BCVI due to nonresidential development, we first assume a broad-scale, linear relationship between residential and nonresidential structures. The U.S. Energy Information Administration (USEIA) estimates 26,739,000,000 sq ft of total floorspace of commercial buildings in the west-south-central region of the U.S. (including AR, LA, OK, and TX; USEIA 2006) and 21,900,000,000 sq ft of total floorspace of residential buildings (USEIA 2009) for a commercial-to-residential ratio of 1.22 : 1. Next, we assume new nonresidential construction will increase at the same rate as residential development and affect GCWA or BCVI habitat in proportion to the amount of habitat lost to residential development (section 4.3.1). Therefore:

GCWA = 12,418 ha (average habitat loss from BC and A2 scenarios, Table 4.2) x 1.22 = **15,150 ha** potential loss of GCWA habitat due to nonresidential development.

BCVI = 810 ha (average habitat loss from BC and A2 scenarios, Table 4.3) x 1.22 = **988 ha** potential loss of BCVI habitat due to nonresidential development.

4.4 Take covered under the CTGCP

A summary of the previous assessments of potential impacts to the Covered Species resulting from the Covered Activities is provided in Table 4.4 along with the amount of incidental take that will be covered under the CTGCP for the Permit Area.

Table 4.4. Hectares of potential impact to GCWA and BCVI resulting from each Covered Activity, summarized from section 3.3, and amount of incidental take covered by the CTGCP.

Activity category	Potential impact (ha)		Incidental take (ha) covered by CTGCP
	GCWA	BCVI	
Buildings: residential	12,418	810	?
nonresidential	15,150	988	
Total (ha)	27,568	1,798	?

4.5 Cumulative impacts

Cumulative impact is defined as the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such

other actions (50 CFR 1508.7). Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time. This analysis is used to help the Service determine whether the proposed action is likely to result in jeopardy for a federally listed species.

Impacts to GCWA and BCVI habitat may occur through the continuation of or future increase of various human activities and urbanization which are not covered under the CTGCP, including road construction and maintenance, new water and waste water infrastructure, new energy development and infrastructure (oil and gas development, wind farms, transmission lines, etc.), surface mining, and other land management activities. These activities are difficult to quantify without applying a wide array of assumptions, but some overlap of these activities with GCWA or BCVI habitat is likely. The summary below and Table 4.7 show estimated hectares of habitat that may be impacted or is under some form or protected status for both species.

GCWA		
Estimated amount of habitat:		
in Permit Area	1,413,131 ha	see Chapter 3
in Plan Area	1,678,695 ha	see Chapter 3
expected to be impacted in Permit Area by residential or nonresidential development	27,568 ha	see Chapter 4
expected to be impacted in the Plan Area through existing or developing HCPs	47,659 ha	see Table 4.7
impacted through other human activities (e.g., road/water/energy development)	unknown	
impacted through natural processes (e.g., drought, fire, disease, climate change)	unknown	
currently under some level of protected status in the Plan Area	94,000 ha + conservation banks	see Chapter 2
BCVI		
Estimated amount of habitat:		
in Permit Area	296,000–2.9 million ha	see Chapter 3
in Plan Area	329,000–3.1 million ha	see Chapter 3
expected to be impacted in Permit Area by residential or nonresidential development	1,798 ha	see Chapter 4
expected to be impacted in the Plan Area through existing or developing HCPs	10,446 ha	see Table 4.7
impacted through other human activities (e.g., road/water/energy development)	unknown	
impacted through natural processes (e.g., drought, fire, disease, climate change)	unknown; some impacts might create habitat	
currently under some level of protected status in the Plan Area	>10,300 ha + conservation banks	see Chapter 2

Table 4.7. Estimated loss (ha) and amount of take requested (ha) in existing or developing regional HCPs.

HCP	GCWA		BCVI	
	Estimated loss	requested take	Estimated loss	requested take
Balcones Canyonlands Conservation Plan	-	10,827	-	405
Williamson County Regional HCP	12,141	2,428	1,727	1,727
Hays County Regional HCP	8,903	3,642	1,335	526
Comal County Regional HCP	4,239	2,120	-	405
Southern Edwards Plateau HCP	20,700	3,683	4,081	1,068
LCRA Transmission Services Corporation	464	464	990	990
Oncor Electric Delivery Company LLC	1,213	1,213	2,312	2,312
Total (ha)	47,659	24,376	10,446	7,433

5 Conservation program

5.1 Goals and objectives

The conservation program for the CTGCP includes measures to minimize and mitigate impacts to the Covered Species to the maximum extent practicable. Biological goals for the CTGCP are listed below and each one is discussed in subsequent sections.

- Minimize impacts to the Covered Species.
- Mitigate unavoidable impacts to the Covered Species through the protection and management of biologically relevant areas.
- Incentivize the implementation of mitigation and conservation activities in priority regions of the Plan Area that have the greatest conservation need.
- Avoid take and contribute to the conservation of other listed species occurring in the Plan Area.
- Update the mitigation priorities and impact analyses as new information on the species ecology, status, and threats becomes available.

5.2 Goal: Minimize impacts to the covered species

Applicants should consider options for avoiding impacts to the Covered Species and their habitat, for example, by relocating the project facilities. If avoidance is not possible, applicants must comply with the following measures to minimize the impacts of their activities on the Covered Species.

To minimize possible direct impacts to GCWA or BCVI within the project footprint, applicants must conduct the initial clearing of habitat (i.e., removal of woody vegetation resulting in the loss or degradation of GCWA or BCVI habitat) during the non-breeding season, which is August 1 through February 29 for GCWA and September 1 through March 15 for BCVI.

To minimize possible indirect impacts to GCWA and BCVI beyond the project footprint, construction activities will be limited or avoided within 100 m of habitat adjacent to the footprint during the respective species' breeding season. Although this buffer distance is not well corroborated in the literature (e.g., Appendix C), 100 m has become accepted and used in previous management and conservation plans for the species. In addition, applicants will implement oak wilt prevention measures as recommended by the Texas A&M Forest Service and Natural Resources Conservation Service. Oak wilt is a fungal disease that disables water conduction in infected oaks and causes death of the tree within weeks or months. Damage to trees from construction or pruning can lead to new infection centers. Prevention measures include: avoid pruning or wounding oaks during late winter, spring, or early summer (February 1 through June 30); treat fresh wounds on oaks immediately with would dressing or commercial tree paint; immediately chip, burn, or bury debris from diseased red oaks; proper handling of trees that may be used for firewood. See sources in Appendix E for additional detail.

Applicants will also implement best management practices (BMP) to avoid or minimize impacts to Covered Species habitat, other species not covered in the plan, and the surrounding environment. A variety of information and guidelines exist for avoiding or minimizing impacts to certain habitats, such as those provided by TPWD's Habitat Assessment Program, Texas

Commission on Environmental Quality, Texas State Soil and Water Conservation Board, and Texas Water Development Board. Sources of information pertaining to BMPs for Covered Activities are found in Appendix E. BMPs are updated periodically and the most recent versions should be referenced.

In general, BMPs include but are not limited to:

- Conduct appropriate cultural, biological, and geological surveys prior to construction activities;
- Know the state and local laws, ordinances, and regulations and acquire specific permits and licenses prior to any construction activities;
- Minimize the area of land to be cleared or otherwise impacted, for example, by using existing access roads or right-of-ways;
- Use construction techniques that minimize disturbance to flora and fauna and confine it within defined working areas
- Implement relevant erosion and sediment control measures;
- Avoid working in areas adjacent to surface water features to the maximum extent practicable;
- Implement fire protection and prevention measures where applicable, for example, when using welding equipment on the construction site, and allow smoking only in designated areas;
- Check vehicles for seeds and plants when entering/leaving the site to limit the spread of exotic and/or invasive plant species;
- Prevent the spread of oak wilt, as noted above;
- For areas impacted during construction activities but not used post-construction, restore them to the original or better condition, for example, laying topsoil and seeding areas used as temporary access roads.

See section 6.5 below for additional information if a project is to be located in a county in which a non-covered listed or candidate species may occur. A list of species by county is in Appendix A.

5.3 Goal: Mitigate unavoidable impacts to the covered species through the protection and management of biologically relevant areas.

5.3.1 Mitigation measures

When impacts to GCWA or BCVI habitat cannot be avoided, the applicant must determine the amount of required mitigation using the project-specific impact calculations (section 5.3.2) and mitigation ratios (section 5.4). Mitigation requirements must be met before the corresponding incidental take occurs (e.g., credits purchased, land acquired). As GCP administrator, the Service will be responsible for maintaining records of ITPs and the name/location of mitigation secured for the related take.

Mitigation options available under the CTGCP for either Covered Species include purchasing credits from approved conservation banks, establishing conservation easements, or other options approved by the Service. Although incidental take can occur only in the CTGCP Permit Area,

mitigation can occur within the entire Plan Area if options are available and certain conditions are met (see section 6.4).

Approved banks and conservation easements will have separate agreements with the Service or qualified third party in which are defined the roles and responsibilities of the banker or easement holder and land manager along with a plan for habitat management, monitoring, and funding of related activities. Appropriate mitigation for both Covered Species must include sufficient funding for habitat management, as land acquisition alone is often not sufficient. Standards for monitoring, management, and reporting, regardless of the mitigation option use, are discussed in chapter 7. If the applicant opts to purchase credits from an approved conservation bank or establish an easement—or any process by which the obligation is transferred to a third party—the applicant's responsibility for mitigation ends with the purchase of the credits or easement.

Although conservation banks and easements are the only available mitigation option as of this writing, other processes and options for acquiring mitigation credits may become available throughout the life of the CTGCP and can be used by the applicant once approved by the Service.

5.3.2 Quantifying project-specific mitigation requirements

5.3.2.1 Golden-cheeked warbler

Incidental take of GCWA under the CTGCP is measured as area of potential GCWA habitat that is directly or indirectly impacted by the Covered Activities described in chapter 4, and is quantified based on the Texas A&M GCWA occupancy model (Collier et al. 2012) and related density estimates (Mathewson et al. 2012). The A&M occupancy model, derived from field data and remote-sensing metrics, links the underlying map of potential habitat with GCWA presence/absence data and provides a predicted response in probability of occupancy and abundance. This information is used to estimate expected changes in GCWA occurrence and density in an area if the habitat is removed or degraded. Degradation of the habitat will be treated as complete removal of habitat.

To streamline and standardize the process of quantifying impacts under the CTGCP, direct and indirect impacts will be calculated remotely using ArcMAP, rather than conducting in-field surveys to determine GCWA presence. All areas identified as potential habitat in the Texas A&M GCWA habitat map will be considered when calculating impacts for covered activities. The A&M model does not include any woodland patches smaller than a single average GCWA territory, which is approximately ≥2 ha (≥5 ac). In-field surveys to assess the extent of potential habitat in and around a project area may be needed for situations in which unexpected or unrecorded changes to habitat are known to have occurred (e.g., recent wildfires). If multiple patches of potential habitat are intersected by the project footprint, direct and indirect impacts will be calculated for each patch as described below.

General steps to calculate mitigation requirements for GCWA:

1. Calculate direct impacts for each patch intersected by the project footprint;
2. Calculate indirect impacts for each patch;
3. Sum direct and indirect impacts; and
4. Multiply the summed impacts by the appropriate mitigation ratio (section 5.4).

Direct impacts

Direct impacts include habitat that is cleared or degraded within the project footprint; any alterations that do not result in total clearing of habitat will still be treated as complete clearing of habitat. The amount of acreage within the project footprint that overlaps with mapped GCWA habitat will be considered directly impacted (e.g., Figure 5.1). In addition, quantification of direct impacts will be scaled in accordance with the pre-project occupancy probability of the impacted habitat patch, by multiplying the amount of directly impacted habitat by the occupancy probability value. In this manner, direct impacts to habitat patches that are more likely to support GCWAs, and likely to support higher densities of GCWAs, will be weighted more heavily than direct impacts in patches with lower initial occupancy probabilities. This approach incorporates patch size and surrounding landscape composition in the calculation of impacts, such that direct impacts to larger patches in landscapes with more woodland cover will be weighted as greater than direct impacts occurring in smaller patches or more fragmented landscapes.

Steps to calculate direct impacts:

1. Delineate the project area.
2. Overlay polygon of project area on GCWA habitat map.
3. Note the original size of the overlapped habitat patch(es) and the corresponding occupancy probability value in Table 5.1.
4. Calculate the area of habitat intersected by the project footprint, rounded up to the nearest hectare (i.e., 12.8 ha rounds to 13 ha, 16.2 ha rounds to 17 ha).
5. Multiply the area of habitat that intersects the project footprint by the direct impact multiplier (= 1+ occupancy probability); round up the resulting value to the nearest hectare.

Table 5.1. Range-wide average of GCWA occupancy probabilities by patch size, based on the Texas A&M GCWA habitat map and occupancy model (Collier et al. 2012).

	Occupancy probability	
Patch size (ha)	Approximate range of values	Value used to calculate direct impacts[1]
2-5	0.0-0.1	0.05
>5-10	0.1-0.2	0.15
>10-20	0.2-0.3	0.25
>20-40	0.3-0.4	0.35
>40-60	0.4-0.5	0.45
>60-100	0.5-0.6	0.55
>100-150	0.6-0.7	0.65
>150-300	0.7-0.8	0.75
>300-800	0.8-0.9	0.85
>800	0.9-1.0	0.95

[1] Value in this column + 1 = direct impact multiplier.

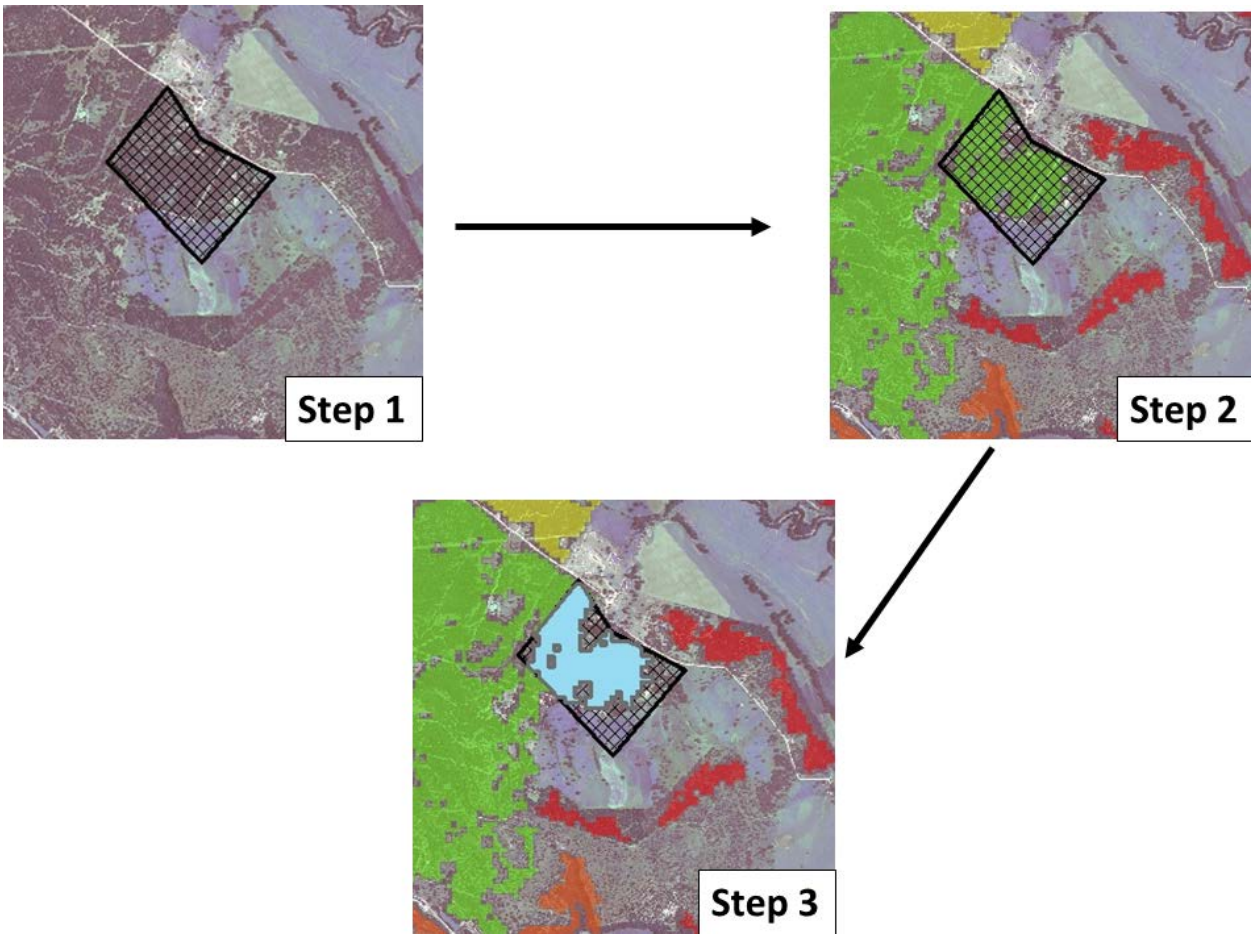

Figure 5.1. This diagram illustrates GCWA habitat directly impacted by a project footprint. The project is delineated in step 1, the polygon is overlaid on the map of GCWA habitat (green, red, and yellow patches) in step 2, and the area of habitat intersected by the project (light blue) is determined in step 3.

Indirect impacts

Current knowledge of indirect impacts to GCWA is discussed in chapter 4. Since a reduction in patch size can result in corresponding reductions in predicted occupancy and density in the remaining patch area, indirect impacts will be assessed with regard to changes in patch size and density as a result of habitat cleared or degraded resulting from a Covered Activity. The process to quantify indirect impacts is outlined below, with patches that are reduced to <20 ha post-project dealt with somewhat differently than patches that remain >20 ha post-project due to the aforementioned reproductive threshold (Butcher et al. 2010). Addressing these indirect impacts through acquiring the appropriate amount of mitigation is expected to adequately offset impacts that extend beyond the project footprint in space and time.

Habitat patches >20 ha post-project

Relationships between patch size, GCWA occupancy probabilities, and GCWA density estimates (# male/ha; Collier et al. 2012, Mathewson et al. 2012) are used to assess indirect impacts, by essentially calculating the difference in estimated GCWA density when a project results in a reduction in patch size sufficient to shift down from one size category to another. The values in Table 5.2 are multipliers that represent changes in average GCWA density relative to changes in patch size and are used to calculate indirect impact (details of how numbers in Table 5.2 were derived are provided in Appendix F).

Steps to calculate indirect impacts for patches >20 ha post-project using Table 5.2:

1. Find the hectare category of the initial patch size (in the "From" rows).
2. Find the hectare category of the patch size after the project footprint is subtracted. This is the remaining patch size (in the "To" columns).
3. Multiply the number in the corresponding cell (the indirect impact multiplier) with the remaining patch size.

For example, a project that resulted in a 200-ha patch being reduced to 140 ha would need 21 ha of mitigation for the indirect impacts (140 ha x 0.15 = 21 ha). See Figure 5.2 for additional examples.

Table 5.2. Indirect impact multipliers used to calculate indirect impacts. Numbers in bold are categories of patch size in hectares. Shaded cells correspond to examples in the text.

		To									
	Patch size	**>800**	**>300-800**	**>150-300**	**>100-150**	**>60-100**	**>40-60**	**>20-40**	**>10-20**	**>5-10**	**2-5**
From	**>800**	0.00	0.23	0.40	0.55	0.67	0.77	0.85	0.92	0.97	1.03
	>300-800	--	0.00	0.17	0.32	0.44	0.54	0.62	0.69	0.75	0.80
	>150-300	--	--	0.00	0.15	0.27	0.37	0.45	0.52	0.57	0.63
	>100-150	--	--	--	0.00	0.12	0.22	0.30	0.37	0.43	0.48
	>60-100	--	--	--	--	0.00	0.10	0.18	0.25	0.30	0.36
	>40-60	--	--	--	--	--	0.00	0.08	0.15	0.21	0.26
	>20-40	--	--	--	--	--	--	0.00	0.07	0.13	0.18
	>10-20	--	--	--	--	--	--	--	0.00	0.06	0.11
	>5-10	--	--	--	--	--	--	--	--	0.00	0.05
	2-5	--	--	--	--	--	--	--	--	--	0.00

Example 1: original patch = 35 ha, project footprint overlaps 19 ha, resulting patch size = 16 ha

Direct impacts

Footprint of direct impact		Direct impact multiplier (= occup. prob. + 1)		**Direct (ha)**	Rounded values	
19	X	1.35*	=	25.65	26 ha	*based on average value in Table 5.1 for patch size of 35 ha

Indirect impacts

Remaining patch < 20 ha?
Y: enter remaining ha as indirect impact in #1
N: skip to #2

1	Remaining ha			**Indirect (ha)**		
	16		=	16	16 ha	
2	Indirect impact multiplier	Remaining patch size (ha)		**Indirect (ha)**		
	NA	X NA	=	NA		
			TOTAL =		42 ha	equals the number of hectares of mitigation

Example 2: original patch = 70 ha, project footprint overlaps 10 ha, resulting patch size = 60 ha

Direct impacts

Footprint of direct impact		Direct impact multiplier (= occup. prob. + 1)		**Direct (ha)**	Rounded values	
10	X	1.55*	=	15.5	16 ha	*based on average value in Table 5.1 for patch size of 70 ha

Indirect impacts

Remaining patch < 20 ha?
Y: enter remaining ha as indirect impact in #1
N: skip to #2

1	Remaining ha			**Indirect (ha)**		
	NA		=	NA		
2	Indirect impact multiplier	Remaining patch size (ha)		**Indirect (ha)**		
	0*	X 60	=	0	0 ha	*based on value in Table 5.2: From >60-100 ha category To >60-100 ha category
			TOTAL =		16 ha	equals the number of hectares of mitigation

Figure 5.2. Examples of GCWA direct and indirect impact calculations for 4 scenarios of varying patch sizes pre- and post-project (continues on next page).

Example 3: original patch = 200 ha, project footprint overlaps 60 ha, resulting patch size = 140 ha

Direct impacts					Rounded values	
Footprint of direct impact		Direct impact multiplier (= occup. prob. + 1)		**Direct (ha)**		
60	X	1.75*	=	105.0	105 ha	*based on average value in Table 5.1 for patch size of 200 ha

Indirect impacts

Remaining patch < 20 ha?
Y: enter remaining ha as indirect impact in #1
N: skip to #2

1	Remaining ha			**Indirect (ha)**		
	NA		=	NA		
2	Indirect impact multiplier	Remaining patch size (ha)		**Indirect (ha)**		
	0.15*	X 140	=	21.0	21 ha	*based on value in Table 5.2: From >150-300 ha category To >100-150 ha category
			TOTAL =		126 ha	equals the number of hectares of mitigation

Example 4: original patch = 400 ha, project footprint overlaps 50 ha, resulting patch size = 350 ha

Direct impacts					Rounded values	
Footprint of direct impact		Direct impact multiplier (= occup. prob. + 1)		**Direct (ha)**		
50	X	1.85*	=	92.5	93 ha	*based on average value in Table 5.1 for patch size of 400 ha

Indirect impacts

Reproductive threshold - Remaining patch < 20 ha?
Y: enter remaining ha as indirect impact in #1
N: skip to #2

1	Remaining ha			**Indirect (ha)**		
	NA		=	NA		
2	Indirect impact multiplier	Remaining patch size (ha)		**Indirect (ha)**		
	0*	X 350	=	0	0 ha	*based on value in Table 5.2: From >300-800 ha category To >300-800 ha category
			TOTAL =		93 ha	equals the number of hectares of mitigation

Figure 5.2. Examples of GCWA direct and indirect impact calculations for 4 scenarios of varying patch sizes pre- and post-project (continues from previous page).

Habitat patches <20 ha post-project
For habitat patches that are >20 ha before the project action and reduced to <20 ha post-project, this change in patch size caused by the project results in the remaining patch becoming unlikely to serve as habitat within which reproduction can successfully occur (Butcher et al. 2010). Thus, the full area of the remaining patch post-project will be considered subject to this indirect impact. Direct impacts will be calculated as above. Indirect impacts will equal the number of habitat hectares remaining in the patch, rounded up to the nearest hectare (see Figure 5.2 for examples).

Steps to calculate indirect impacts for patches <20 ha post-project

1. Indirect impacts equal the number of habitat hectares remaining in the patch post-project.

Habitat patches <20 ha pre-project
For patches that are <20 ha before the project action, and thus remain <20 ha post-project, only direct impacts will be calculated (as above), since these areas provide a low probability of pairing and fledging success.

Steps to calculate indirect impacts for patches <20 ha

1. Use zero for indirect impacts.

5.3.2.2 Black-capped vireo

Direct impacts
Direct impacts for BCVI will be determined by calculating the acreage of BCVI habitat removed or degraded within the project footprint. Because it is difficult to identify BCVI habitat remotely with a high degree of certainty, assessing the amount of habitat impacted requires several steps. The Texas A&M BCVI habitat map (see chapter 3 for description) will be used to make an initial coarse determination of whether a project overlaps with potential BCVI habitat as delineated by the map. Aerial imagery of the project area may also be assessed visually to determine whether the appropriate conditions occur on the ground to support potential BCVI habitat in the project area. Finally, ground-based evaluation of vegetation conditions that cannot be assessed remotely will be used to confirm that an area does or does not support suitable BCVI habitat and to identify the area of suitable BCVI habitat that will be directly impacted by a project. While it may be necessary to conduct ground-based evaluations for many projects, the initial steps of using the BCVI habitat map and aerial imagery will eliminate the need for ground-based surveys in some cases.

The following steps will be completed for any project in the BCVI breeding range of the CTGCP Permit Area. Direct impacts will be quantified in this method and multiplied by the appropriate mitigation ratio (section 5.4). Figure 5.3 summarizes the steps below.

1. Digitize the proposed project perimeter or the outline of the area where vegetation will be directly impacted.
2. Overlay the project polygon on the BCVI habitat map layer:
    a. If the project polygon does not overlap with potential habitat as designated by the BCVI habitat layer, no further steps are needed. The project will be assessed no impacts to BCVI.
    b. If the project polygon does overlap with potential habitat as designated by the

BCVI habitat layer, further steps are needed. Proceed to step 3.

3. Use aerial imagery to assess whether the area meets woody cover criteria: area has at least some (>0% woody cover assessed over a ≈ 30m^2 area). Examples of aerial imagery where BCVIs are known to occur are in Appendix G.
    a. If visual assessment of the aerial imagery indicates the project area does not have at least some woody cover (>0% assessed over a ≈ 30m^2 area), no further steps are needed. The project will be assessed no impacts to BCVI.
    b. If visual assessment of the aerial imagery indicates the project area does have at least some woody cover (>0% assessed over a ≈ 30m^2 area) further steps are needed. Proceed to step 4.
4. Use ground-based information to determine whether conditions on the ground suggest the project area has suitable BCVI habitat. Habitat criteria include (1) presence of woody vegetation >0.5 m in height, (2) woody vegetation covers >5% of the area, (3) presence of structural heterogeneity beneath the canopy, and (4) cover provided by woody vegetation (leaves, branches) within 0–1 m of the ground.
    a. If assessment of on-the-ground conditions indicates the project area does not meet the criteria for potential BCVI habitat, no further steps are needed. The project will be assessed no impacts to BCVI.
    b. If assessment of on-the-ground conditions indicates the project area does meet the criteria for potential BCVI habitat, proceed to step 5.
5. Calculate the area of probable BCVI habitat that overlaps with the project polygon. This is the area of direct take.

Indirect impacts

Current knowledge of indirect impacts to BCVI is discussed in chapter 4. Lack of research-based evidence for identifying and quantifying indirect impacts precludes the ability to develop and implement a specific process for calculating indirect impacts for a given project. Rather, the mitigation ratios established in section 5.4 will be applied to the direct impacts calculated above and be sufficient to encompass these unknowns about indirect impacts. As new information about impacts to the species becomes available, it will be incorporated into the quantification of direct and indirect impacts and calculations will be added or revised as needed (section 5.6).

5.3.3 Biologically relevant areas

Baseline conditions for GCWA or BCVI habitat in which mitigation occurs should meet the following minimum requirements:

1. GCWA
    a. GCWAs are known to occur in the area during the breeding season.
    b. Protect ≥20 ha (≥50 ac) of habitat that is part of a ≥100-ha (≥247 ac) habitat patch (see below for detail).
2. BCVI
    a. BVCIs ideally occur in or near the habitat during the breeding season (see section 5.4.2 for detail).
    b. Protect ≥20 ha (≥50 ac) of habitat that is part of a larger habitat extent of ≥40 ha (≥100 ac) (see below for detail).

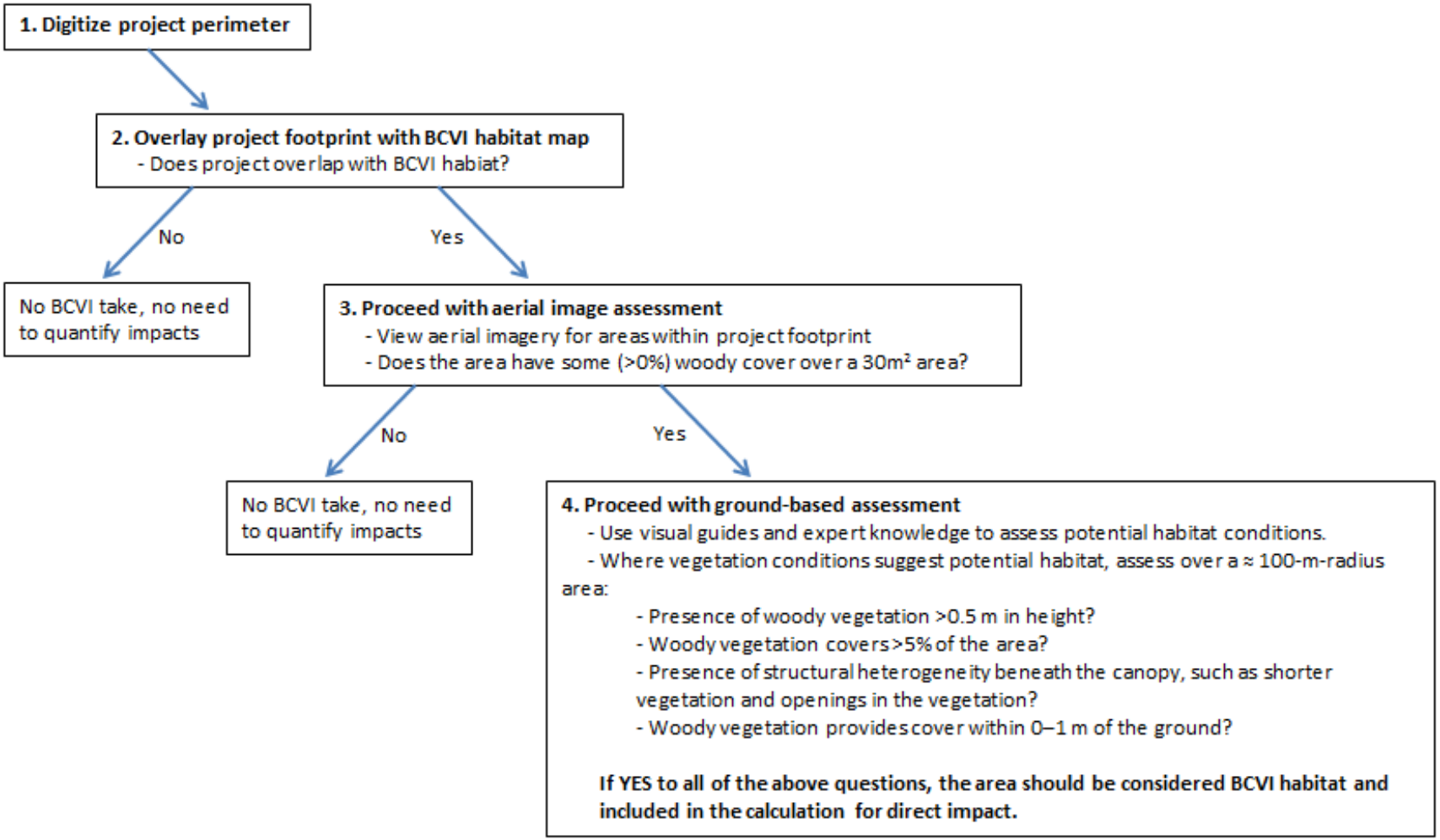

Figure 5.3. Process flow diagram for determining presence of potential BCVI habitat.

The known presence of the Covered Species provides some assurance that the existing habitat may be able to support individuals of the species, although future monitoring will be needed to verify continued occupancy of the area (see chapter 6).

Minimum acreage thresholds for each Covered Species help to ensure the protected habitat is biologically relevant. Protecting a small amount of habitat (e.g., to mitigate for a few hectares of incidental take) may provide little or no conservation benefit to the species (see section 5.4). Recent standards developed by the Service for the minimum acreage of protected area in conservation banks for GCWA and BCVI are 202 ha (500 ac) and 100 ha (~250 ac), respectively (USFWS 2013). As there are no minimum standards for conservation easements in general, the minimum requirements discussed here may be particularly relevant to individual conservation easements.

GCWA can occupy and reproduce successfully in habitat patches as small as 20 ha (50 ac; Butcher et al. 2010), although they are more likely to occur in large patches (Collier et al. 2012). Across the breeding range, woodland patches of ~75 ha have an average probability of 0.5 that it will be occupied by GCWA, with increasing probabilities as patch size increases (Collier et al. 2010, Collier et al. 2012). This suggests conservation dollars and effort are better spent in patches greater than 75 ha where GCWA are more likely to occur. Therefore, we recommend for mitigation properties a minimum of 20 contiguous ha (≥50 ac) of protected habitat that is part of a larger patch of ≥100 ha (≥247 ac). Preference should be given to increasing the amount of protected land within the same patch in which habitat is already under protected status, if such options are available. Some flexibility for minimum patch sizes may be granted in the northern regions of the GCP plan area, at the Service's discretion, due to there being fewer large patches of GCWA habitat in the north than in the south.

Research suggests BCVI may be more apt to settle, pair, and breed when in areas with other BCVI (Ward and Schlossberg 2004). Although similar patch size data does not yet exist for BCVI as for GCWA, they are known to occur in and breed successfully in areas of habitat large enough to contain at least 4–6 territories (Texas A&M unpublished data), or about 20 ha (50 ac) based on an average territory size of about 4 ha (Grzybowski 1995, Texas A&M unpublished data). Furthermore, data from studies in Oklahoma provide some insight into the long-term persistence of clustered groups of BCVI territories and their distribution. The raw data, based on 20 years of surveys, suggests that the clusters of BCVI territories that consistently persist among years are those that have about ≥10 territories (thus ≥40 ha [≥100 ac]) and are within 1 km of other extant clusters of BCVI territories (J. Grzybowski, unpublished data). Since BCVI habitat is often ephemeral, particularly in the eastern portion of its range, it is likely that more than this minimum amount is necessary long-term to allow for rotating management practices. Therefore, we recommend for mitigation properties a minimum of 20 contiguous ha (≥50 ac) of protected habitat that is part of a larger habitat extent of ≥40 ha (≥100 ac). Preference is strongly given to properties in which areas adjacent to the protected habitat are already actively managed for and are known to have breeding BCVI (see section 5.4.2).

If required mitigation for incidental take of the Covered Species, as derived from the methods in section 5.3.2, equates to less than the minimum habitat thresholds discussed above (<20 ha for GCWA, <20 ha for BCVI), applicants can

1. Work in concert with other applicant(s) to acquire sufficient acreage;
2. Purchase a conservation easement of their required acreage adjacent to existing protected habitat—where opportunities are provided by willing landowners—such that the total area protected is at or above the minimum size threshold; or
3. Acquire credits from a conservation bank or other Service-approved mitigation approach.

Any applicant who is unable or unwilling to meet these minimum requirements will need to seek a different mitigation option discussed in section 5.3.1 or pursue development of a separate HCP.

Minimum requirements for either species may change, if needed, based on the results of future research (section 5.6).

5.4 Goal: Incentivize the implementation of mitigation and conservation activities in priority regions of the Plan Area that have the greatest conservation need.

The CTGCP allows for take and mitigation within a broad expanse of central Texas, providing the opportunity to ensure that mitigation efforts can be directed in ways that best support each species' recovery goals given their status across the Plan Area. A framework was developed for prioritizing the location of mitigation actions and other conservation activities where they are most needed to benefit the Covered Species. Regardless of where take occurs, the mitigation ratios established here will encourage the placement of mitigation in high priority regions.

To determine the general status of the species and the priorities among regions, three primary pieces of information were compiled for the Covered Species relative to each species' Service-defined recovery regions (Figures 3.1 and 3.9): (1) species status using the best available information on estimated relative abundance in each recovery region, (2) threats to the species' habitat, and (3) estimated area of protected land that is managed for the species. For each of the three criteria, recovery regions were categorized as low, medium, or high relative to other regions and assigned a priority value (Table 5.3). Regions with the greatest conservation need (Priority 1) are those with the following traits: the number of individuals (known or estimated) is relatively low; threats to the habitat due to human development or other factors are relatively high; and/or the amount of protected land managed for the covered species is relatively low. Regions in which conservation actions are least needed at this time (Priority 3) include those with relatively high numbers of individuals and/or high amount of protected and managed habitat, and relatively low threats to habitat. Specific regional prioritization and mitigation ratios for GCWA and BCVI are discussed in sections 5.4.1 and 5.4.2.

Table 5.3. Criteria for ranking recovery regions for the GCWA and BCVI conservation strategies based on estimated abundance, threats, and amount of protected land in each recovery region.

Priority	Relative abundance	Threats	Protected land
1	Low	Moderate to high	Low
2	Moderate to high	Low, moderate, or high	Low
3	Moderate to high	Low	Moderate to high

This process is inherently qualitative and subjective to some degree, in part because not all the factors can be clearly quantified. Even when the information can be quantified more precisely, the numbers alone cannot provide an empirical right answer to setting conservation priorities, as this also requires an assessment of values, tradeoffs, needs, and goals. In this case, species recovery goals were used as a primary focus for the strategy. Regional priorities may shift over time based on changes to the species status and threats, incorporation of new scientific information, and modification of recovery goals, which will ensure mitigation and conservation actions are applied where they are most needed. Appropriate implementation of this prioritization strategy requires that the Service stay appraised of threats and conservation activities occurring throughout the CTGCP Plan Area even if those threats and activities are not directly related to or covered by the CTGCP. This broader scope is required to ensure that biological benefit is being provided and understand where conservation actions are most needed.

5.4.1 Golden-cheeked warbler

The GCWA recovery plan (USFWS 1992) is 20 years old and requires updating. However, the overall intention of the recovery goals focused on maintaining the spatial distribution of the species throughout its breeding range in Texas by protecting a sufficient amount of habitat in each recovery region. The CTGCP can contribute broadly to these goals by prioritizing mitigation in regions with the fewest individuals, greatest threats, and least area of protected land.

The current prioritization for GCWA recovery regions (Table 5.4) is based on information discussed in chapter 3 and the process described above. Regions 1, 2, and 4 were assigned Priority 1 primarily because they contain relatively low to moderate estimates of GCWA abundance, relatively small amounts of protected lands, and moderate to high existing or probable future threats to habitat. Regardless of where incidental take occurs, the applicant responsible for the take should pursue mitigation options in the first priority regions before second and third priority regions. If mitigation options are unavailable in Priority 1 regions (e.g., lack of willing sellers for easements), then the applicant should pursue mitigation options in Priority 2 and 3 regions sequentially. It is up to the Service's discretion at what point the applicant can pursue mitigation options in lower priority regions.

Table 5.4. GCWA recovery region prioritization, to determine where conservation of the species is most needed given current circumstances. Prioritization includes consideration of all counties in the GCP plan area. See chapter 3 for details of abundance, threats, and protected lands.

Recovery region	Relative abundance[1]	Overall threats	Protected land	Priority value
1	Low	Med-high	Low	1
2	Low	Med-high	Low	1
3	Med	Med	High	3
4	Med	Med	Low	1
5	High	High	High	3
6	Med	Med	High	3
7	High	Low	Low	2
8	High	Low	Low	2

[1] Based on abundance estimates from Mathewson et al. 2012.

Mitigation ratios
Mitigating the incidental take of GCWA will require first calculating the acreage of mitigation necessary to compensate for the loss, followed by determining where mitigation can occur. Mitigation ratios (mitigation : take) will be applied to the acreage determined in section 5.3.2 in the following manner, regardless of where take occurs:

- 1 : 1 if mitigation occurs in a Priority 1 region
- 1.5 : 1 if mitigation occurs in a Priority 2 region
- 2 : 1 if mitigation occurs in a Priority 3 region

For example, 20 ha of impact will equate to 20 ha of required mitigation if mitigation occurs in a Priority 1 region, 30 ha in a Priority 2 region, or 40 ha in a Priority 3 region. The lower ratio in Priority 1 regions should incentivize the pursuit of mitigation options in those areas.

The mitigation ratios apply to the physical location of the property used for mitigation. For example, if the service area of a conservation bank is in Priority 1 region but the bank itself is located in Priority 2 region, then the applicant who opts to purchase credits from the bank would be eligible for the Priority 2 mitigation ratio—i.e., where the protected property is physically located.

5.4.2 Black-capped vireo

The BCVI recovery plan (USFWS 1991) is over 20 years old and requires updating, although a 5-year review was published in 2007 (USFWS 2007). The general intention of the recovery goals is to protect and stabilize known BCVI occurrences and focus protection and conservation efforts in 4 of the 6 Texas recovery regions. The CTGCP can contribute broadly to these goals by prioritizing mitigation and management in regions with the fewest individuals, greatest threats, and least area of protected and managed land, and in localities with the highest likelihood of successfully increasing vireo occupancy, abundance, and reproductive success.

Although the CTGCP Plan Area encompasses about one-half of the BCVI's Texas breeding range, the BCVI's status, amount of protected land, and threats to the vireo is considered throughout all the Service-defined recovery regions in Texas to keep the CTGCP area in perspective. The current prioritization for BCVI recovery regions (Table 5.5) is based on the information discussed in chapter 3 and the process described above. Within the CTGCP Plan Area, BCVI region 1 was assigned Priority 1 primarily because it contains relatively few known BCVI, has moderate to high perceived threats to the habitat, and a relatively limited amount of protected land actively managed for the species. Regardless of where take occurs, the applicant responsible for the take should pursue mitigation options in Priority 1 region; if mitigation options are unavailable in Priority 1 region (e.g., lack of willing sellers for easements), then the applicant should pursue mitigation options in Priority 2 and 3 regions sequentially. It is up to the Service's discretion at what point the applicant can pursue mitigation options in lower priority regions.

Table 5.5. BCVI recovery region prioritization, to determine where conservation of the species is most needed given current circumstances. Prioritization includes consideration of all counties in

the BCVI Texas range; regions with an asterisk overlap the CTGCP Plan Area. See chapter 3 for details of abundance, threats, and protected lands.

Recovery region	Relative abundance[1]	Overall threats	Protected land, actively managed	Priority value
1*	Low	Med-high	Low	1
2*	High	Med	High	3
3*	High	Med	Med	2
4	Low	Med	Low	1
5	Med	Low-med	High	3
6	Low	Low-med	Med	2

[1] based on known BCVI numbers from in-field surveys

Mitigation ratios

Mitigating the incidental take of BCVI will require first calculating the acreage of mitigation necessary to compensate for the loss (chapter 5), followed by determining where mitigation can occur. Mitigation ratios will be applied to the acreage determined in section 5.3.2 in the following manner, regardless of where take occurs. Mitigation ratios are higher than for GCWA so as to encompass potential indirect impacts that cannot otherwise be calculated for BCVI given the current knowledge of the species (see section 5.3.2).

	Distance to nearest known group:		
Priority	Adjacent (within 1km)	Near (within 5km)	All other distances
1	2 : 1	2.8 : 1	3.6 : 1
2	2.4 : 1	3.2 : 1	4 : 1
3	2.8 : 1	3.6 : 1	4 : 1

For example, 20 ha of impact will equate to: 40 ha of required mitigation if mitigation occurs adjacent to a known group of birds in Priority 1 region, 48 ha if mitigation occurs adjacent to a known group of birds in Priority 2 region, or 56 ha if mitigation occurs adjacent to a known group of birds in Priority 3 region. The lower ratios in the Priority 1 region and for protecting habitat closer to existing groups should incentivize the pursuit of mitigation options in those areas.

Incorporating distance to nearest known groups (≥10 territories) is intended to provide additional conservation benefit to the species. As discussed in section 5.3.3, research suggests BCVI persist longer in areas when in clustered groups and within 1 km of other extant clusters of BCVI territories (J. Grzybowski unpublished data). In addition, previous research indicates that land management and restoration activities to create or improve BCVI habitat may be unsuccessful if implemented in areas where BCVI are not present in the area; such restored and managed areas may not become occupied despite cost and effort implemented to manage the habitat (Knipps 2011). Whereas, management activities in areas that were occupied by BCVI at low abundance and with low reproductive success pre-management have been successful in increasing BCVI abundance in those areas (Kostecke et al. 2005, J. Grzybowski unpublished data). Therefore, protecting areas within 1 km of a group of BCVI territories may be more valuable to the long-

term persistence of BCVI in the area, and make management efforts more effective, than protecting habitat that is isolated from known occurrences. An additional perimeter of 5 km was established as a reasonable limit within which there could still be some benefit to the species. These distance categories may shift if future research shows other distances are more appropriate.

As with GCWA, these mitigation ratios apply to the physical location of the property used for mitigation. For example, if the service area of a conservation bank is in Priority 1 region but the bank itself is located in Priority 2 region, then the applicant who opts to purchase credits from the bank would be eligible for the Priority 2 mitigation ratio—i.e., where the protected property is located.

In addition, we stress that protecting BCVI habitat alone is not sufficient to provide conservation benefit to the species. Active management is needed because BCVI habitat often needs periodic manipulation to maintain the appropriate vegetation characteristics, and BCVI can be severely impacted by brown-headed cowbird parasitism. Whether management is needed, what management is needed, when, and how often, should be determined by the monitoring and adaptive management program conducted as part of any mitigation implementation.

5.5 Goal: Avoid take and contribute to the conservation of other listed species occurring in the Plan Area.

As of February 2013, there are 82 species in the CTGCP Plan Area (50 in the Permit Area) that are listed as federal- or state-threatened or endangered species and/or candidates for federal listing and whose breeding, wintering, or migratory ranges potentially overlap GCWA or BCVI breeding habitat. Many of these species are unlikely to occur throughout large portions of GCWA or BCVI habitat because of restricted ranges or different habitat use (Appendix A). Incidental take of these species is not covered under the CTGCP, therefore impacts to these species must be avoided or, if avoidance is not possible for a particular project, the applicant must seek additional permits with the appropriate agency (i.e., the Service for federally-listed species and TPWD for state-listed species). Areas designated as critical habitat for any of the listed species will be excluded from incidental take authorization under this CTGCP.

A summary of the species, their ranges, habitat associations, and threats is in Appendix A, including lists of species by counties and website links for expanded species descriptions (primarily referencing summaries or reviews by the Service, TPWD, or NatureServe). Limited information exists for some of these species.

The applicant will need to consult with the Service on appropriate actions if the range of a listed or candidate species overlaps the county in which a project will occur, and if the project footprint or adjacent areas contain potential habitat for that species. In-field surveys may be required to determine whether one or more listed or candidate species occurs in or adjacent to the project footprint. Detection of karst features during actions associated with covered activities must be reported to the Service immediately and may require separate authorization before activities can continue.

Entities providing mitigation properties and managing for GCWA or BCVI will also need to be aware of the occurrence of other listed species and critical habitat areas and must include

discussion of impact avoidance in their management plans as needed. In most cases, however, managing woodland or shrubland habitats for GCWA or BCVI will also benefit other species that use similar habitats (e.g., tobush fishhook cactus).

5.6 Goal: Update the mitigation priorities and impact analyses as new information on the species ecology, status, and threats becomes available.

Inclusion of an adaptive management component in an HCP is encouraged (65 FR 35242). Traditional HCPs that address one or several projects in a particular area develop biological goals specific to impacts and the mitigation applied. In such cases, an adaptive management component can provide a structure to enable necessary modification of the plan implementation so that the mitigation continues to comply with the HCP by ensuring that the biological goal of benefit to the species is continued. For example, the required monitoring information may indicate changes in habitat use or occupancy by the species of interest and modifications to the plan implementation, such as changes to management of a mitigation area, may be necessary to ensure that the biological goals continue to me met (e.g., the mitigation unit continues to be occupied by the species of interest).

The CTGCP will also potentially require modification over time and as new information becomes available, to ensure that the biological goals continue to be met. However, this plan differs from a traditional HCP in several ways that require application of adaptive management at a different scale. The biological goals of this plan pertain to minimizing impacts and maximizing benefits to the covered species at a much broader scale, applying to the entire breeding range of the GCWA and a large portion of the BCVI breeding range. Making adjustments to specific on-the-ground management practices to ensure their compliance with mitigation obligations is the responsibility of the various parties implementing mitigation action for each individual permitted project (conservation banks, land trusts holding easements, etc). However, making adjustments to the broader framework within which mitigation is applied to optimize benefits to the species (e.g., prioritizing regions) must occur at the plan scale.

Thus, an adaptive framework is necessary at the plan scale, to make adjustments to several components including:

- Calculations for assessing direct and indirect impacts for GCWA and BCVI
- Minimum requirements for mitigation (e.g., patch size, vegetation condition)
- Priority regions for mitigation
- Mitigation ratios

These items are currently based on the best available information on the species ecology, status, threats, and recovery goals. As new research and information become available, changes to these specifications may be warranted to ensure that the impact assessment is accurate, the mitigation is appropriate and provides adequate benefits to the species, and the regional priorities reflect current conditions for the species status and threats. Specifically this may involve:

- Periodic (e.g., every 5 years) review and update of species status in each region (i.e., estimated abundance and distribution, and habitat availability), extent and distribution of threats, and amount of protected habitat to reassess priority regions for mitigation.

- Periodic review of research findings regarding what activities may cause impacts and how the Covered Species may be affected by those activities.
- Periodic review of research on species habitat use, selection, and quality as it pertains to determining minimum requirements for mitigation areas.
- Periodic review of land costs and availability of mitigation areas, for assessment of appropriate and practicable mitigation ratios.
- Given frequent advances in remote sensing data and analyses, along with the high rate of land use or habitat changes in certain areas (e.g., human development, natural succession of BCVI habitat), GCWA and BCVI habitat maps and related occupancy models should be updated at least every 5 years throughout the plan's duration for assessing take.
- In addition, if any major change occurs on the landscape (e.g., wildfire), habitat maps and related occupancy models should be updated as soon as data is available.

For all updating needs, preference will be given to information generated from well-designed studies, analyses, and peer-reviewed literature rather than anecdotal information. To assist with achieving the aforementioned review of new information and updating of conservation and mitigating strategies, the Service may solicit input from the respective Recovery Teams and Species Recovery Leads to assess species status, threats, conservation efforts, etc., both range-wide and relative to the CTGCP. The Service will meet with each Recovery Team at least once within the first year of the CTGCP's implementation and at least once every other year thereafter. Meetings can occur more often if deemed necessary. However, at the time of this writing, there is no established Recovery Team for the black-capped vireo and the Recovery Team for golden-cheeked warbler has not met in several years, although an updated GCWA recovery plan is in the works. If Recovery Teams are not established or active by the time the CTGCP is finalized, the Service may work internally or align information needs with 5-year reviews required for federally listed threatened and endangered species (Section 4(c)(2)(A) of the ESA). The Service may also at any time request opinions and recommendations from species' experts not included in the Recovery Teams.

6 Monitoring and reporting

A monitoring program is a mandatory element of HCPs (and therefore GCPs) and should be designed to provide information to evaluate compliance by the applicant and determine if the biological goals and objectives of the plan are being met (65 FR 35242). For HCPs, compliance monitoring verifies that the permittee is carrying out the terms of the HCP while effectiveness monitoring evaluates the biological effects of the permitted action and determines whether the effectiveness of the operating conservation program of the HCP is consistent with the assumptions and predictions made when the HCP was developed and approved. The Service is responsible for ensuring that the CTGCP is working as planned and monitoring whether the permittees are complying with permit requirements (65 FR 35246).

Compliance monitoring and reporting

The primary monitoring responsibility of the Service is ensuring compliance by the permittee with the permit's terms and conditions and, by extension, that property holders who offer habitat as mitigation for incidental take to the covered species continue to manage the habitat for the covered species. The latter is stipulated in separate conservation agreements with the Service.

[Example text from Florida scrub-jay umbrella HCP:
The Service Field Office designated to oversee the CTGCP will maintain a database of applicants and issued permits and will compile annual reports that track the total amount of funds received for mitigation purposes related to the CTGCP, location information and acreage of the mitigation property and acreage of Covered Species habitat within the property. Each ITP holder will submit annual reports to the Service for the duration of their Covered Activity, describing all activities carried out on the site, amount of habitat impacts, and implementation of the mitigation and minimization measures discussed in chapter 5. The Service will ensure that incidental take of the Covered Species does not exceed the level authorized in each ITP. Each ITP holder will allow designated Service personnel to access the property at any time for the purpose of conducting compliance inspections and verify the accuracy of reports. Any violations of permit conditions will be reported to the ITP holder and Service law enforcement. Failure to bring the property into compliance could result in enforcement actions by the Service.]

Effects and effectiveness monitoring and reporting

Inclusion of an effects and effectiveness monitoring component in an HCP is required to ensure that mitigation areas and actions meet and continue to meet biological goals (65 FR 35242). Traditional HCPs that address one or a few projects in a particular area develop and implement monitoring to ensure compliance with the biological goals of their plan; this can also provide information that feeds into the adaptive management framework. Monitoring to ensure that the mitigation continues to comply with the HCP goals can be fairly simple for most HCPs. For example, monitoring to ensure continued occupancy of a mitigation site by the covered species can indicate changes in habitat use or occupancy and trigger modifications to the management of a mitigation area that may be necessary to ensure that the biological goals continue to me met (e.g., the mitigation unit continues to be occupied by the species of interest).

For the CTGCP—in which the mitigation options include use of conservation banks, easements, or other Service-approved means—the owners or managers of the conservation banks or easements are responsible for monitoring species status, reporting on actions and results, and

developing and implementing an overall management plan for the mitigation properties. Management plan outlines for both GCWA and BCVI have been recently developed by the Service and are available at www.fws.gov/southwest/es/austintexas/Cons_Banking.html and provide guidance for monitoring, management, and reporting.

In addition, the Service is responsible for determining whether biological goals of the CTGCP are being met and whether changes to the conservation and mitigation strategies are needed. Monitoring for these purposes should use a broad-scale approach appropriate to the scale of the CTGCP, which requires assessing status and impacts to the Covered Species across a large geographic area. The species' 5-year reviews and additional work by Recovery Teams provide an avenue for periodically compiling and updating information about the species biology, habitat conditions, conservation measures, and threats, which can be a form of monitoring for the CTGCP. However, there is currently no mechanism in place to actively monitor the status and trends of GCWA and BCVI across their breeding range, which could provide additional information for updates to and future application of the CTGCP. Guidance for a broad-scale monitoring program that would meet these information needs is provided in Appendix H should opportunity and funding become available.

7 Changed and unforeseen circumstances

The Service provides regulatory assurances under the No Surprises policy to incidental take permittees that no additional land use restrictions or financial compensation will be required of the permit holder with respect to species covered by the permit, even if unforeseen circumstances arise after the permit is issued indicating that additional mitigation is needed for a given species covered by a permit (63 FR 8859). The No Surprises assurances apply only to incidental take permits issued in accordance with the requirements of the Services' regulations where the conservation plan is being properly implemented, and apply only to species covered by the conservation plan (63 FR 8867).

Changed circumstances means changes in circumstances affecting a species or geographic area covered by a conservation plan that can reasonably be anticipated by the permittees and the Service and that can be planned for (e.g., the listing of new species, or a fire or other natural catastrophic event in areas prone to such events). Unforeseen circumstances means changes in circumstances affecting a species or geographic area covered by a conservation plan that could not reasonably have been anticipated by plan developers and the Service at the time of the conservation plan's negotiation and development, and that result in a substantial and adverse change in the status of the covered species (63 FR 8870).

[Example text from Florida scrub-jay umbrella HCP:
Applicants who receive incidental take authorization under the CTGCP will receive "No Surprises" assurances as would any other incidental take permittee. Permittees who purchase credits from a conservation bank or other Service-approved option have no long-term obligations after they fulfill their mitigation requirements. Permittees who establish a conservation easement to mitigate their incidental take have no long-term obligations after they fulfill their mitigation requirements beyond their Service approved management plan which includes adaptive management. Therefore, we do not anticipate that any changed circumstances would require additional discussions with any permit holder who has met their mitigation requirements.]

However, changed and unforeseen circumstances may affect how (or if) the Service continues to administer the CTGCP. Possible changed circumstances might include:

- The covered species become downlisted or delisted;
- The covered species become extinct;
- The Service publishes a revised recovery plan for a covered species;
- Significant modifications (via research) to our understanding of direct and indirect impacts to the covered species;
- The covered species are adversely affected by a catastrophic event, either in their ranges or in areas of protected habitat;
- There are no available conservation credits or land for acquisition;
- Optional use of mitigation funds for management actions;
- Potential impacts to newly listed non-covered species.

[Example text from Florida scrub-jay umbrella HCP:
There may be unforeseen circumstances that may have widespread, negative effects on the covered species. Unforeseen circumstances could also include legislative, executive, or judicially-directed changes in the Service's legal authority to implement the CTGCP.

If any changed or unforeseen circumstances are discovered or identified by the administering Field Office or the Regional Office, that office will convene joint discussions with the other to evaluate effects of the changed or unforeseen circumstance and to plan an appropriate response. Based on the conclusions of these discussions, possible responses would be to continue implementation as provided in the CTGCP, to amend the CTGCP, or to terminate use of the CTGCP. We anticipate that it would be appropriate to suspend issuance of individual permits while such an amendment is considered. All amendments will be evaluated in accordance with 50 CFR 13.23 and 17.32. Decisions to suspend or terminate implementation of the CTGCP will be made by Service Field Office designated to oversee the CTGCP. Changed circumstances will also be considered in deciding whether the CTGCP should be renewed after expiration.

If amendments are made to the CTGCP as a result of changed or unforeseen circumstances, the amendments would apply only to those applicants seeking ITPs after the changes were made. Amendments would not apply to Permittees who already received ITPs under the CTGCP.]

8 Alternatives to the taking

To be determined

8.1 No action

[e.g., continue to develop individual-project or county-level plans]

8.2 Other…

[Could include any number of other alternatives (e.g., include additional species, limit Covered Activities, encompass all BCVI range in TX), need to discuss what's appropriate with FWS]

9 Program implementation

Program administration
Participation process
Financial considerations
Etc.

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