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Golden-cheeked Warbler and Black-capped Vireo Habitat Assessment for the Leander Independent School District Vandegrift and Four Points Campus Proposed Access Road

Prepared for

Sedgwick LLP

Prepared by

SWCA Environmental Consultants

March 2015

SWCA Project Number 26651



GOLDEN-CHEEKED WARBLER AND BLACK-CAPPED VIREO HABITAT ASSESSMENT FOR THE LEANDER INDEPENDENT SCHOOL DISTRICT VANDEGRIFT AND FOUR POINTS CAMPUS PROPOSED ACCESS ROAD

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1.0 INTRODUCTION

Leander Independent School District (LISD) proposes to construct, use, and maintain a road to the existing LISD Vandegrift High School and Four Points Middle School campus (LISD campus) located within the City of Austin, Texas (Proposed Project). The purpose of the Proposed Project is to provide a crucial second access route to the LISD campus to help alleviate safety concerns related to traffic congestion and facilitate safe passage into and out of the LISD campus. The Proposed Project would be constructed within an approximately 100-foot-wide right-of-way that would be partially routed through a 420-foot-wide infrastructure corridor that traverses preserve lands of the Balcones Canyonlands Conservation Plan (BCCP) and partially through private lands. Approximately 13.9 acres or 65% of the Proposed Project route would occur within this BCCP Infrastructure Corridor; the remainder of the Proposed Project would be routed through private property (Figure 1). This BCCP Infrastructure Corridor currently contains four electric transmission lines owned and operated by the City of Austin or the Lower Colorado River Authority, a buried water line, an electric substation, direct access roads, and other disturbances within the immediate vicinity. The private lands crossed by the Proposed Project route are part of the 3M Campus.

Two permitted biologists from SWCA Environmental Consultants (SWCA) examined the BCCP Infrastructure Corridor in the vicinity of the Proposed Project route (Study Area) on February 10, 2015, to determine the extent and quality of golden-cheeked warbler (GCWA; *Setophaga chrysoparia*) and black-capped vireo (BCVI; *Vireo atricapilla*) habitat. The 3M Campus property was not surveyed because the physical disturbance associated with the Proposed Project will not include vegetation removal. This report summarizes the results of the habitat assessment.

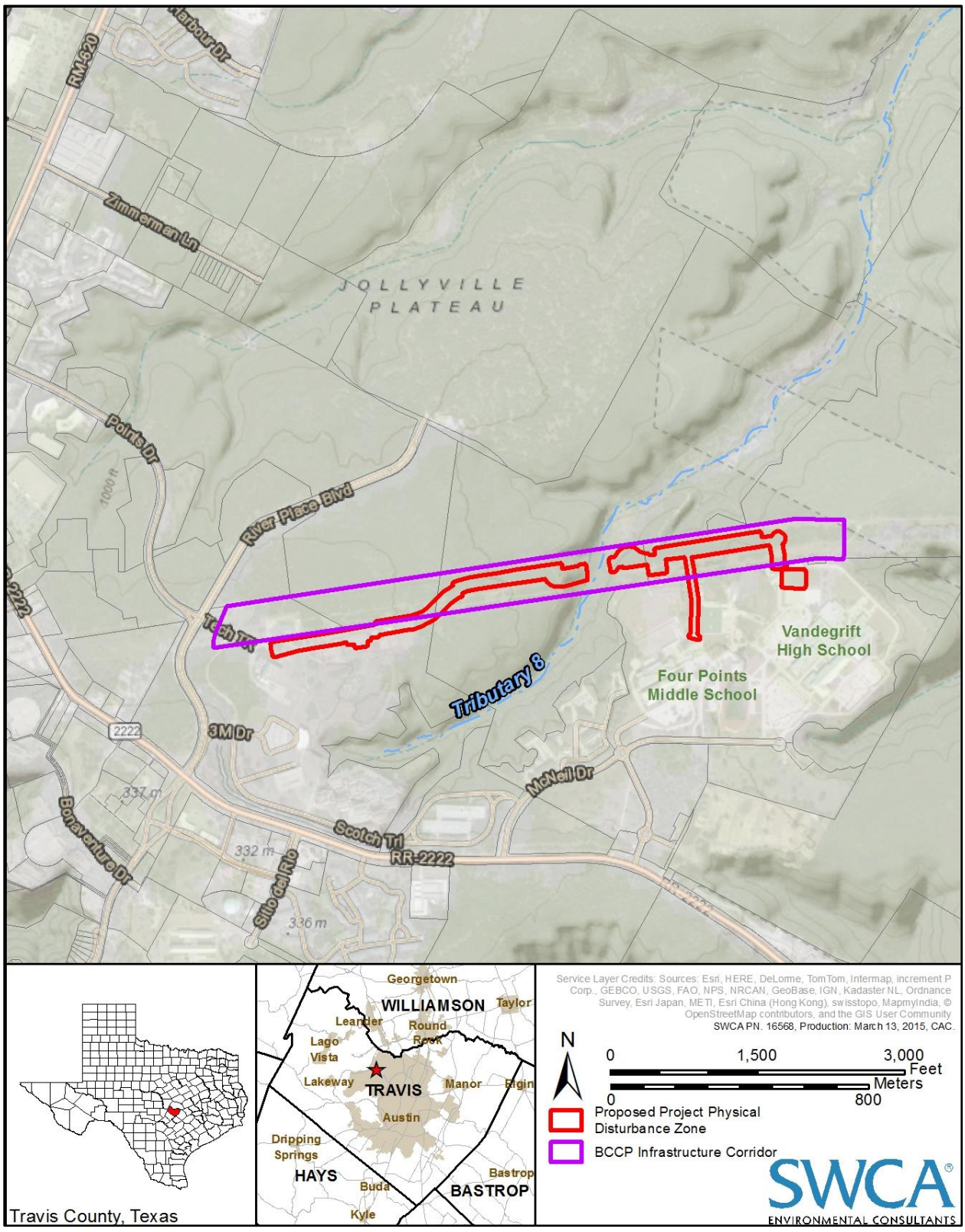

Figure 1. Location map of Study Area relative to proposed LISD access road.

2.0 SITE DESCRIPTION

The Study Area is within the Level III Edwards Plateau ecoregion and the Level IV Balcones Canyonlands ecoregion, which supports a relative abundance of running water due to the Trinity and Edwards Aquifers discharging through highly erodible Edwards Formation. The Balcones Canyonlands also supports a higher representation of deciduous woodland than anywhere else on the Edwards Plateau (Griffith et al. 2007). A headwater tributary of Bull Creek flows through the Study Area. General surface drainage is to the northeast, with topography ranging from approximately 1,060 feet above mean sea level (AMSL) in the western portion and sloping to 880 feet AMSL at the base of the Bull Creek drainage.

2.1 VEGETATION

Vegetation within the Study Area is mainly classified as Live Oak-Ashe Juniper Woods (Texas Parks and Wildlife Department 1984). This vegetation type consists primarily of mixed juniper-oak woodlands with smaller sections of broadleaf evergreen woodlands, grassland, and evergreen shrublands.

Vegetation communities observed within the Study Area include dense juniper-oak woodland, grassland and shrubland fragmented by sections of bare or disturbed ground associated with maintenance of the existing utility lines. Dominant species associated with the upland woodlands includes Ashe juniper (*Juniperus ashei*), plateau live oak (*Quercus fusiformis*), Texas oak (*Q. buckleyi*), Texas persimmon (*Diospyros texana*), yaupon (*Ilex vomitoria*), cedar elm (*Ulmus crassifolia*), and occasional blackjack oak (*Quercus marilandica*) (Appendix A, Photographs 1 and 2). Within the riparian woodland, deciduous tree species are more abundant and include escarpment black cherry (*Prunus serotina* var. *eximia*), American elm (*Ulmus americana*), and occasional hackberry (*Celtis* spp.) (Appendix A, Photograph 3), among others. Species within the shrubland habitat includes many of the same species observed within the woodlands with additional deciduous shrub species such as agarita (*Mahonia trifoliolata*) and sumac (*Rhus* sp.) (Appendix A, Photograph 4).

Overall, the vegetation communities within the Study Area are highly disturbed due to past and current land uses. Sections of the upland woodland and shrubland habitats have been cleared for the existing utility lines and associated access roads (Appendix A, Photograph 5). In addition, SWCA documented a portion of dead Ashe juniper trees on the west end of the Study Area, likely due to recent drought conditions (Appendix A, Photograph 6).

3.0 RESULTS

3.1 GOLDEN-CHEEKED WARBLER HABITAT

Portions of both the upland woodland and riparian woodland within the Study Area represent GCWA habitat due to appropriate species composition, tree height, and canopy cover (Figure 2). The upland woodland consists of a mix of Ashe juniper trees ranging in height from 20 to 30 feet and deciduous trees, including plateau live oak and cedar elm, ranging in height from 25 to 30 feet with canopy coverage averaging 50% to 80%. The riparian woodland also consists of a mix of Ashe juniper trees ranging in height from 15 to 20 feet with a diversity of deciduous tree species ranging in height from 30 to 40 feet with canopy coverage averaging 60% to 70%. Ashe juniper trees within both woodlands had a diameter at breast height (dbh) of approximately 5 to 8 inches. The eastern end of the Study Area does not represent habitat due to low Ashe juniper/live oak heights and lack of an extensive canopy (i.e., <35% cover). The western end also does not represent habitat, as much of the Ashe juniper trees are dead and would not represent GCWA habitat. Additionally, the pockets of shrubland vegetation that exist within the center of the BCCP Infrastructure Corridor do not represent GCWA habitat but will be further discussed in Section 3.2 below.

3.2 BLACK-CAPPED VIREO HABITAT

A small portion (11.7 acres or approximately 19%) of the Study Area is currently designated as a BCVI habitat management area (HMA), which Travis County describes as having the potential to be restored to BCVI habitat (Travis County 2012) (see Figure 2). Although past habitat restoration activities (2010–2012) have occurred within HMAs in the Study Area, follow-up presence/absence surveys of the restored areas have not detected the presence of BCVIs within the BCCP Infrastructure Corridor (Travis County 2011, 2012). These habitat restoration activities may have included "selectively removing undesirable monoculture woody species such as Ashe juniper" to promote the growth of other deciduous shrubs (Travis County 2012).

The shrubland vegetation community within the Study Area consists of moderately dense deciduous shrubs with shrub foliage cover down to ground level. The amount of potential habitat within the Study Area is small but these pockets of shrubland habitat include a mix of mostly deciduous shrubs with occasional Ashe juniper shrubs, ranging from 5 to 6 feet in height and separated by open grassland. Although the current condition of the shrubland habitat within the Study Area does not represent suitable BCVI habitat, the species composition, height, and spacing reflects potential for this vegetation community to be used by BCVI in the future if habitat restoration activities were to continue.

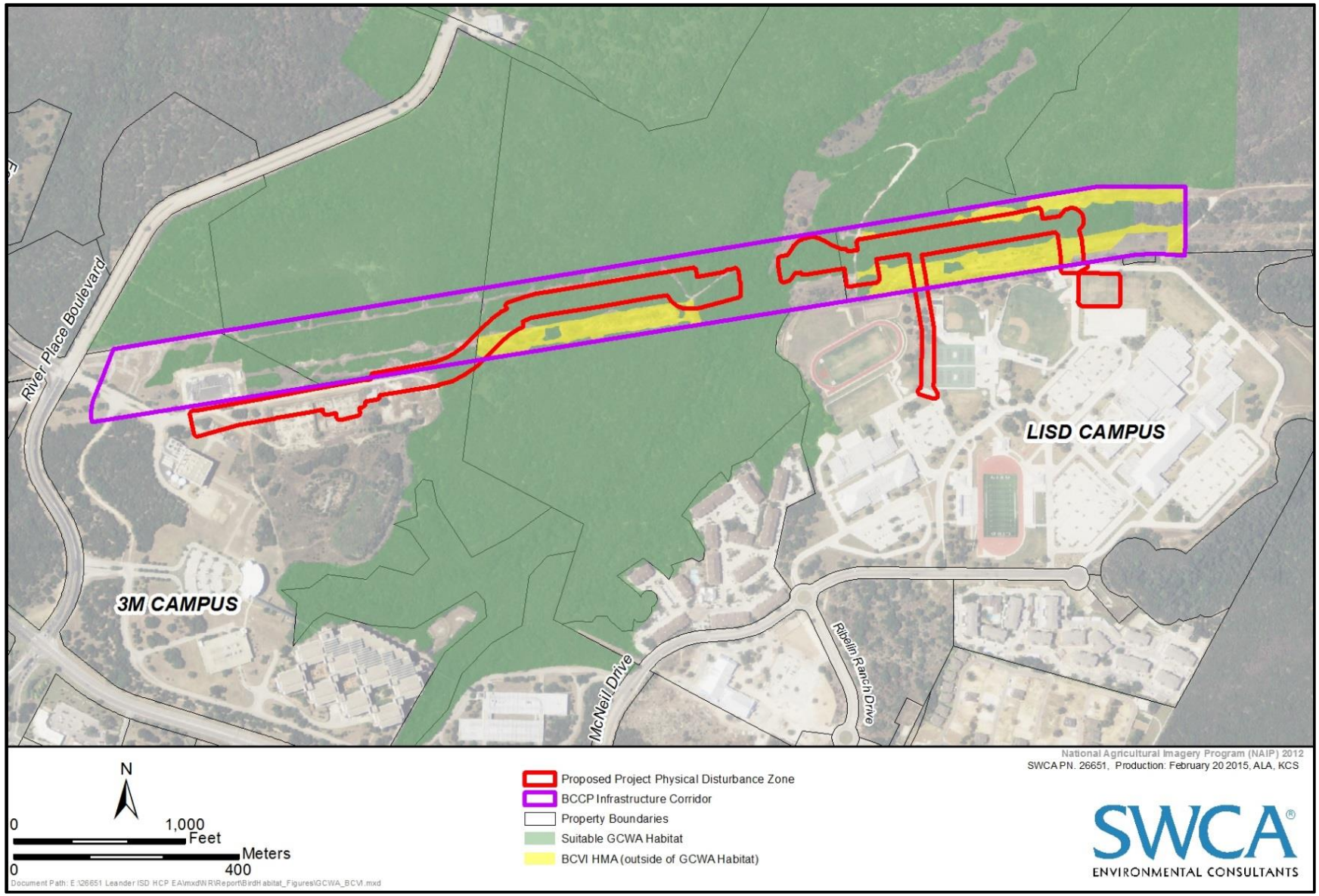

Figure 2. Potential golden-cheeked warbler (GCWA) and black-capped vireo (BCVI) habitat within the Survey Area.

4.0 SUMMARY

Based on U.S. Fish and Wildlife Service (USFWS) guidelines, vegetation communities within the Study Area reflect potentially suitable habitat for both the GCWA and BCVI (Campbell 2003; USFWS 2007, 2010), although much of this habitat is not of high quality. The Study Area is heavily disturbed by the direct presence and ongoing maintenance of electric transmission lines and indirectly by human activity in adjacent developments.

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APPENDIX A

PHOTOGRAPHIC LOG

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Photograph 1. Representative photograph of upland woodland within the Study Area and potential golden-cheeked warbler (GCWA) habitat.



Photograph 2. Representative photograph of upland woodland present along the slopes of Tributary 8 and potential GCWA habitat.



Photograph 3. Representative photograph of the riparian woodland along the perennial tributary and potential GCWA habitat.



Photograph 4. Representative photograph of shrubland habitat which may become potential black-capped vireo habitat if it continues to be managed for such purposes.



Photograph 5. Photograph of some of the disturbances within the BCCP Infrastructure Corridor including vegetation clearing, soil disturbance, and stormwater protection structures associated with the existing utility lines and poles.



Photograph 6. Photograph of dead Ashe junipers located within the upland woodland on the west end of the Study Area.

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MEMORANDUM

To: Alan Glen, Sedgwick LLP
Jimmy Disler, Sr., Executive Director of Facilities and Operations, Leander Independent School District

From: Amanda Aurora, Senior Scientist/Project Manager, SWCA Environmental Consultants

Date: March 23, 2015

Re: Delineation of Potential Waters of the U.S. for the Proposed Access Road to the Leander Independent School District Vandegrift and Four Points Campus

---

Leander Independent School District (LISD) proposes to construct, use, and maintain an access road (Proposed Project) to LISD Vandegrift High School and Four Points Middle School Campus (LISD campus) located in the northwest section of Austin, Texas, in Travis County. The Proposed Project would partially occur within an approximately 420-foot-wide Balcones Canyonlands Conservation Plan (BCCP) Infrastructure Corridor that traverses a portion of the Balcones Canyonlands Preserve. The purpose of the field investigation was to delineate the boundaries of all potential waters of the U.S. within the BCCP Infrastructure Corridor associated with the Proposed Project.

METHODS

SWCA Environmental Consultants (SWCA) conducted a desktop review of the Proposed Project to determine the location and boundaries of potential waters of the U.S. within the BCCP Infrastructure Corridor. Following the desktop review, SWCA biologists conducted a field investigation of the site on February 10, 2015, to delineate the extent of the ordinary high water marks (OHWMs) of a headwater tributary of Bull Creek (referred to as Tributary 8 in O'Donnell et al. 2008) within the limits of the BCCP Infrastructure Corridor. Tributary 8flows south to north and the Proposed Project would intersect the waterway.

SWCA conducted the delineation in accordance with current guidance from the U.S. Army Corps of Engineers (USACE 2005, 2010). At no time did the SWCA biologists enter the water when delineating Tributary 8.

SWCA recorded the extent of the OHWMs using a Trimble Geo 6000 real-time differentially corrected Global Positioning System (GPS) unit with sub-meter accuracy to map data points and the boundaries or centerlines of aquatic features. SWCA used geographic information system (GIS) software to analyze collected features, calculate areas, and generate figures. All point and line data collected

using the GPS receiver and displayed in figures are for review purposes only and do not represent a professional civil survey or an approved jurisdictional determination by the USACE.

FINDINGS

The Proposed Project lies within the Bull Creek watershed and the Federal Emergency Management Agency (FEMA) maps the BCCP Infrastructure Corridor as outside of the 100-year floodplain (Flood Zone X) (FEMA 2008). During the field survey, SWCA biologists mapped Tributary 8. Tributary 8 is intermittent and derives at least some of its flow from Edwards Aquifer spring discharge. Tributary 8 runs perpendicular to the BCCP Infrastructure Corridor and is intersected by the Proposed Project (Figures 1 and 2; Photographs 1 and 2). The width of Tributary 8 varies from approximately 3 to 5 feet and the depth of the channel between the OHWMs is approximately 3 to 6 inches deep. The Top of Bank (TOB) is approximately 7 to 11 feet wide and is approximately 2 to 5 feet deep. The area of likely USACE jurisdiction within the BCCP Infrastructure Corridor equals 0.11 acre. SWCA observed aquatic invertebrates, including water striders (*Gerris sp.*), and this stream is known to be inhabited by federally threatened Jollyville Plateau salamander (*Eurycea tonkawae*).

Tributary 8 is at the bottom of a steeply incised canyon. The soil within the canyon is thin and the surrounding vegetation is comprised of species including, Ashe juniper (*Juniperus ashei*), live oak (*Quercus fusiformis*), Texas oak (*Quercus texana*), cedar elm (*Ulmus crassifolia*), Texas persimmon (*Diospyros texana*), yaupon (*Ilex vomitoria*), Japanese privet (*Ligustrum japonicum*) and greenbriar (*Smilax bona-nox*).

CONCLUSION

The Proposed Project intersects Tributary 8, an intermittent stream that likely meets the definition of a water of the U.S. The total area of likely waters of the U.S. that would be under the regulatory jurisdiction of the USACE within the limits of the BCCP Infrastructure Corridor associated with the Proposed Project is approximately 0.11 acre.

These conclusions represent SWCA's professional opinion based on prior knowledge and experience with the USACE; including their regulatory guidance documents and manuals. Only the USACE and the U.S. Environmental Protection Agency have final authority in determining the presence of jurisdictional waters of the U.S. and the extent of their boundaries.

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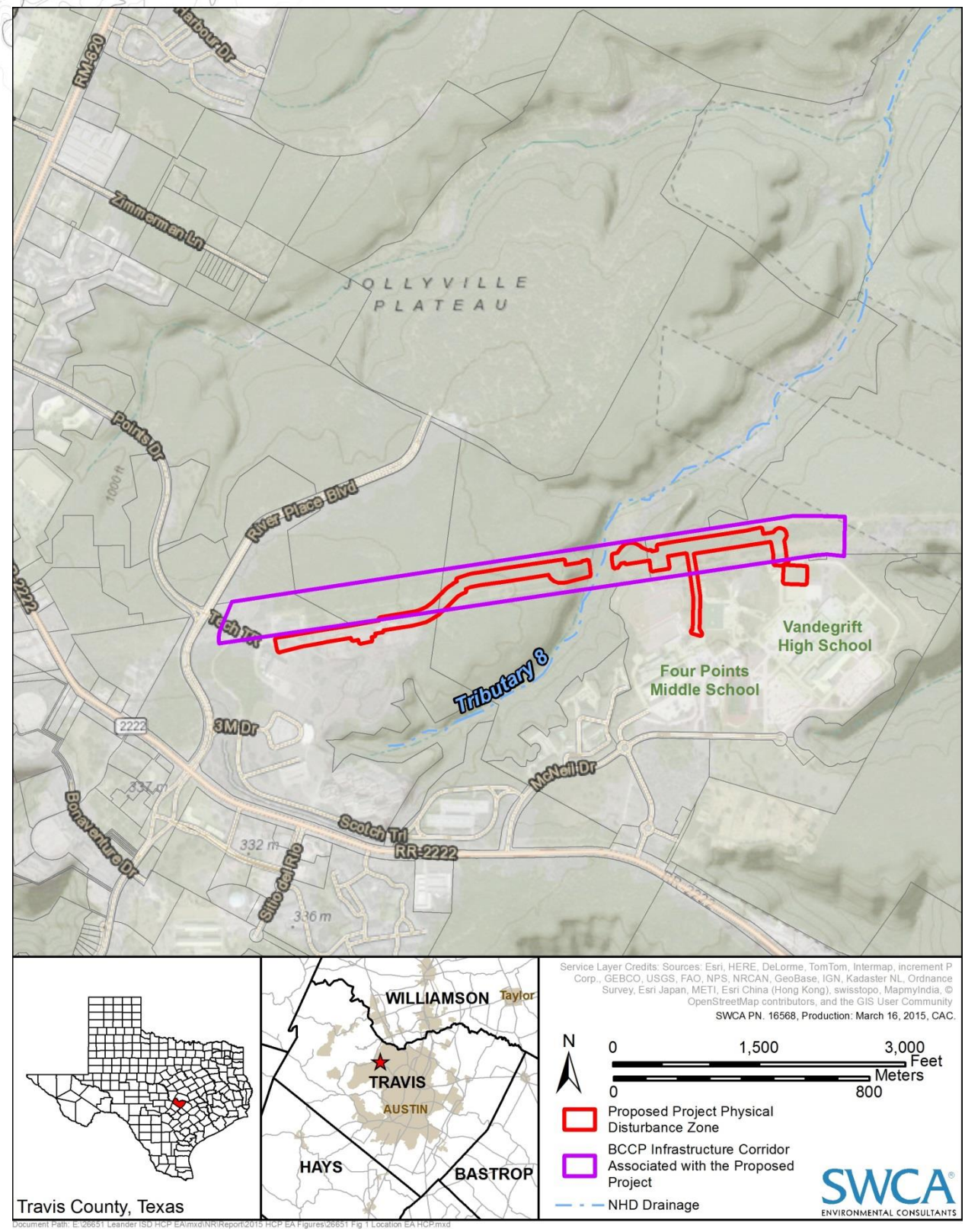

Figure 1. Location map of the Proposed Project.

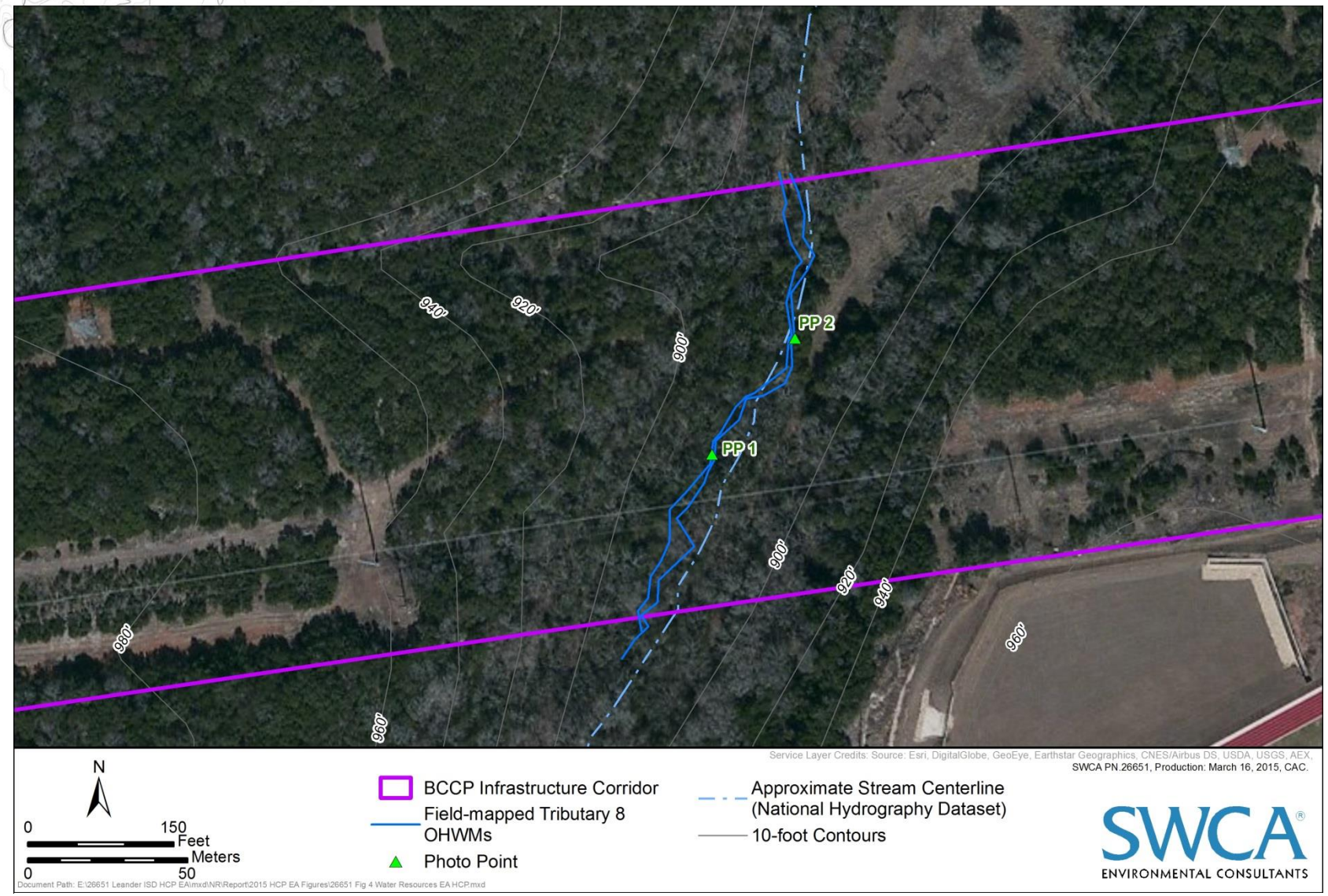

Figure 2. Aquatic resources map.



Photograph 1. Representative photograph of Tributary 8; facing northeast at Photo Point 1.



Photograph 2. Representative photograph of Tributary 8; facing north at Photo Point 2.

Attorney-Client Privilege / Attorney Work Project

Jollyville Plateau Salamander Habitat Assessment for the Proposed Access Road to the Leander Independent School District Vandegrift and Four Points Campus

Prepared for

Sedgwick, LLP
and
Leander Independent School District

Prepared by

SWCA Environmental Consultants

March 23, 2015

Attorney-Client Privilege / Attorney Work Project

JOLLYVILLE PLATEAU SALAMANDER HABITAT ASSESSMENT FOR THE PROPOSED ACCESS ROAD TO THE LEANDER INDEPENDENT SCHOOL DISTRICT VANDEGRIFT AND FOUR POINTS CAMPUS

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Appendix A Modified Wentworth Scale Characterization

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1. INTRODUCTION

Leander Independent School District (LISD) proposes to construct, use, and maintain a road to the existing LISD Vandegrift High School and Four Points Middle School campus (LISD campus) located in the northwest area of the City of Austin, Texas (Proposed Project; Figure 1). The LISD campus currently serves approximately 1,800 high school students and 700 middle school students. The LISD campus is currently accessible only from the heavily traveled Ranch-to-Market Road (RM) 2222 via McNeil Drive, which also provides access to more than 600 residential units in adjacent multi-family housing developments. This intersection is heavily congested and is the scene of numerous accidents, many involving students. The purpose of the Proposed Project is to provide a crucial second access route to the LISD campus that currently serves more than 2,400 students, faculty, and support staff, with daily commuting of more than 6,000 vehicle trips per day. The proposed road is needed to help alleviate safety concerns related to traffic congestion in the vicinity of the LISD campus and facilitate safe passage into and out of the LISD campus.

The purpose of this habitat assessment is to document existing habitat conditions for the Jollyville Plateau salamander (JPS) within and adjacent to the Proposed Project. SWCA Environmental Consultants (SWCA) biologists examined the entirety of the bed and banks of an intermittent drainage named Tributary 8 (which is a tributary to the main channel of Bull Creek; O'Donnell et al. 2008) within the limits of an existing 420-foot-wide primary infrastructure corridor (Study Area) within the Balcones Canyonland Preserve Plan (BCCP) preserve that would contain the Proposed Project.

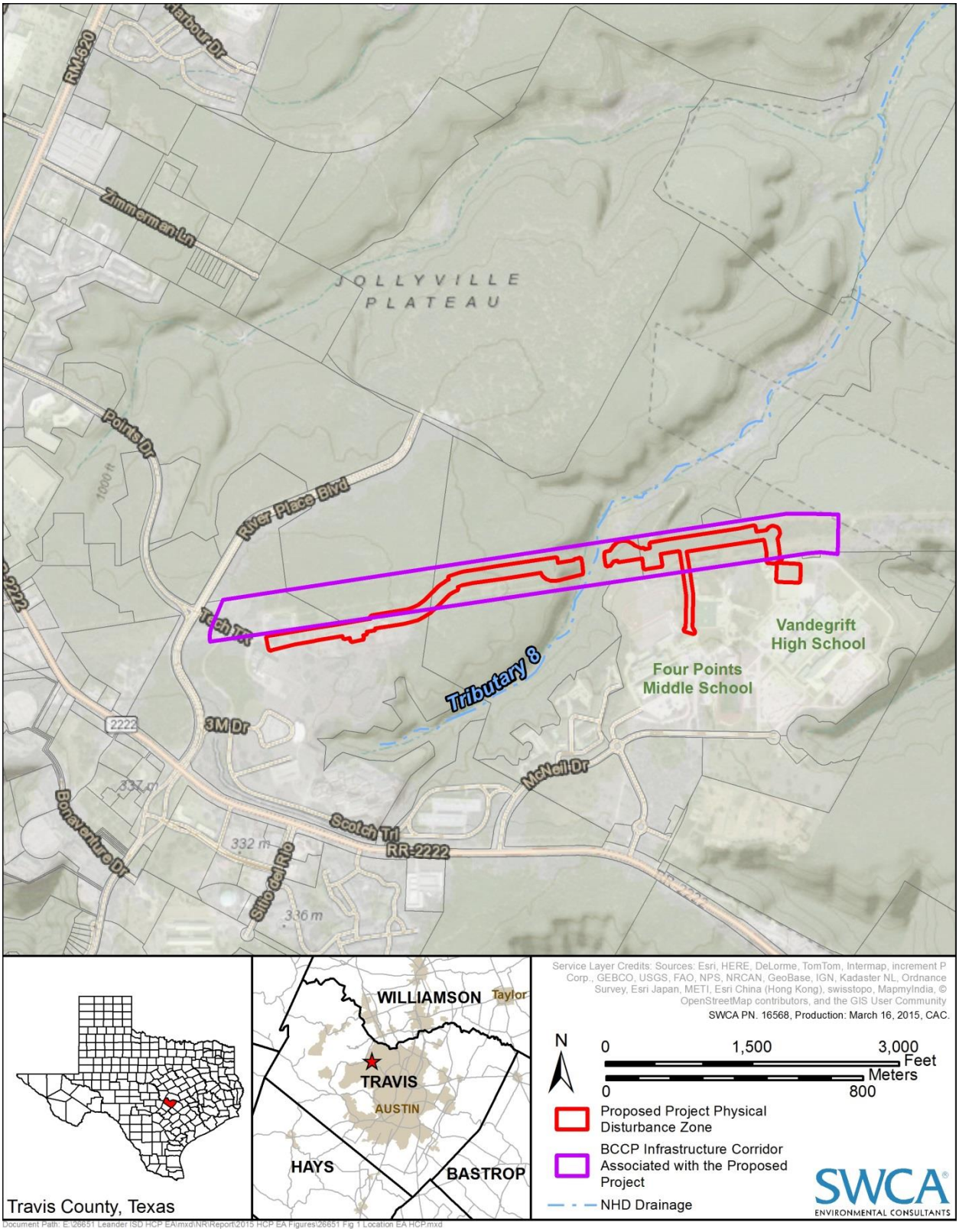

Figure 1. Location map of the Proposed Project .

2. HABITAT CHARACTERIZATION

On February 10, 2015, two SWCA biologists conducted a visual examination of the creek bed and banks within the Study Area. Tributary 8 flows at the bottom of a steeply incised canyon that drops approximately 110 feet from surrounding areas and is approximately 1,000 feet across. The soil within the canyon is thin and the surrounding vegetation is comprised of species including, Ashe juniper (*Juniperus ashei*), live oak (*Quercus fusiformis*), Texas oak (*Quercus texana*), cedar elm (*Ulmus crassifolia*), Texas persimmon (*Diospyros texana*), yaupon (*Ilex vomitoria*), Japanese privet (*Ligustrum japonicum*) and greenbriar (*Smilax bona-nox*). Overall, mature trees mixed with greenbriar dominated the Study Area with canopy cover at approximately 80%–90%.

SWCA biologists located a single spring approximately 195 feet south of the northern limit of the Study Area. A Trimble Geo-XH real-time differentially corrected Global Positioning System (GPS) unit with sub-meter accuracy geographically referenced the feature location. Additionally, the characteristics of four randomly chosen sampling points within the Study Area (labeled TE001–TE004) delineated the overall characteristics of the Study Area (Figure 2).

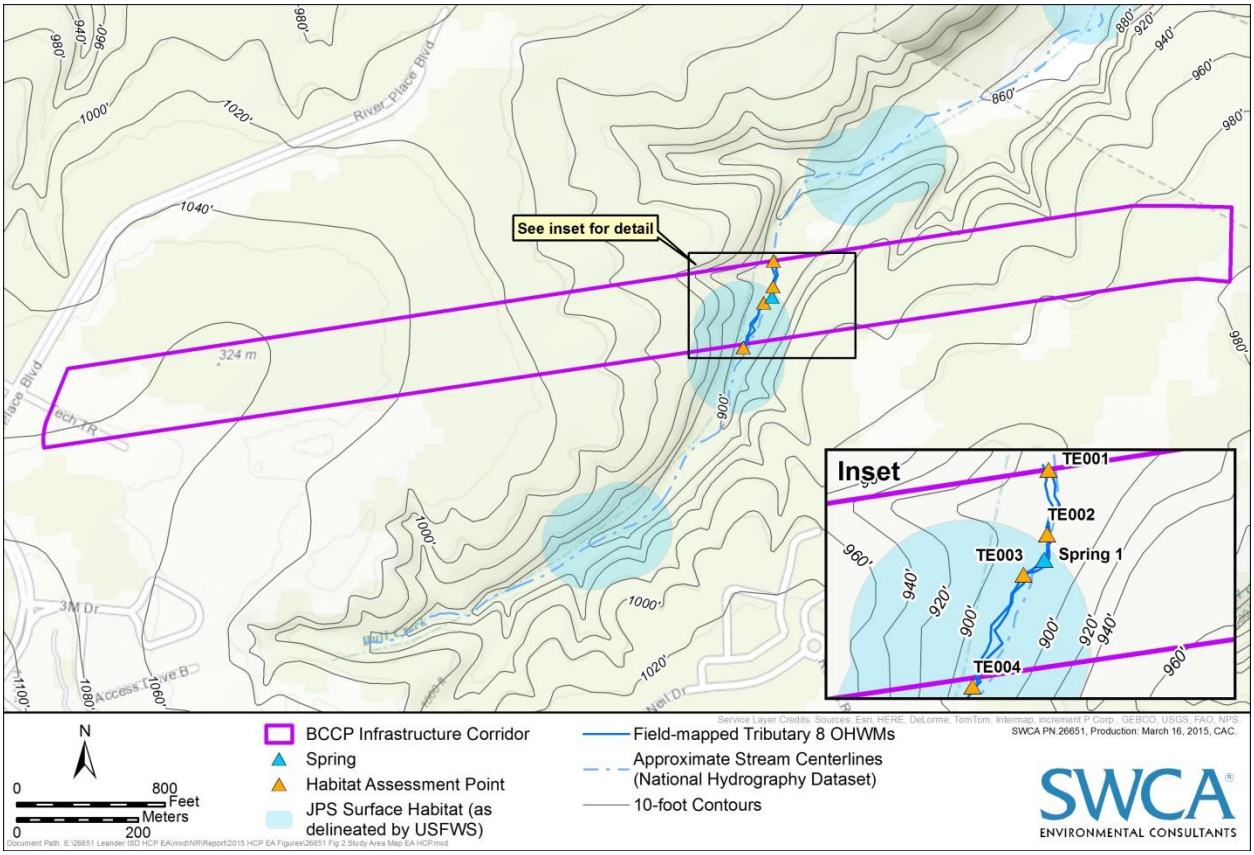

Figure 2. Study Area map, including habitat assessment points.

Habitat assessments for JPS per the U.S. Fish and Wildlife Service (USFWS 2014) sampling protocol require that a set of basic water chemistry values be collected at each spring outlet. SWCA biologists also took water chemistry readings at four habitat assessment points (TE001–TE004) within the Study Area (see Figure 2) in order to get a wider view of the potential habitat within the Study Area. USFWS (2013) reports that JPS require water that, "…should be flowing and unchanged in chemistry, temperature, and volume from natural conditions." Table 1 provides a summary of temperature, pH, dissolved oxygen (DO) and total dissolved solids (TDS) readings for each spring.

Compared to other salamanders, the Edwards Aquifer *Eurycea* species (including JPS) are well adapted to low oxygen levels (Turner 2009); however, Woods et al. (2010) notes that negative physiological effects begin when DO drops below 4.5 milligrams of oxygen per liter (mg/L) and that DO below 3.4 mg/L poses a grave threat to the closely related San Marcos salamander (*E. nana*). Barton Springs salamander (*E. sosorum*) abundance is highest when DO levels range between 5 to 7 mg/L, therefore it is assumed that similar levels are required for JPS. Mean DO levels of JPS sites with little or no surrounding development range from 5.6 to 7.1 mg/L, which coincides with DO required for other species of *Eurycea* (Bendik 2011). Table 1 shows that Spring 1 had DO readings of 6.19 mg/L, which is within the acceptable threshold for JPS inhabitation. All of the habitat assessment points had DO readings that range between 6.96 and 8.97, which indicates dissolved oxygen within this stream segment that is well above the minimum threshold for JPS.

Conductivity of water is important to JPS physiology because high conductivity is associated with increased water contamination and lower JPS abundance (Wilson and Dorcas 2003; Bowles et al. 2006). Mean conductance readings at JPS sites with little to no surrounding development range from 550 to 625 micro-Siemens per centimeter (µS/cm) and likely represent the ideal levels of TDS for JPS habitat (Bendik 2011; Bowles et al. 2006). One laboratory experiment showed adult San Marcos salamanders surviving in waters with no negative physiological effects where conductivity readings spiked up to 2,738 µS/cm. However, elevated TDS levels in urban streams are shown to correlate to lower densities of the invertebrate species which *Eurycea* salamanders prey upon (Woods and Poteet 2006). While adult *Eurycea* are likely able to survive in waters containing high amounts of TDS, their prey base is likely unable to do so (Coles et al. 2012). Table 1 shows that all measured conductivity readings within the Study Area are well below the typical documented mean values at undeveloped JPS sites. A relatively wet winter season is the likely cause of lowered TDS values within the Study Area as rainwater infiltration increases the amount of water relative to the amount of dissolved solids contained within the runoff.

Preferred temperature within recorded JPS habitats remains fairly stable throughout the year. Bowles et al. (2006) report that mean temperature within sites of undeveloped watersheds ranges from 65.3 degrees Fahrenheit (°F) to 73.4°F. Table 1 shows that only TE001 falls within the preferred range of JPS, however these temperatures were taken during the first half of February, which is winter in Central Texas. Cool temperatures in local watersheds during winter are not unexpected.

Bowles et al. (2006) reported that pH in nine occupied JPS sites (at both developed and undeveloped locations) ranged from 6.1 to 9.3 over the course of two years. These measurements were taken as often as every month, depending on the site. Table 1 shows that the pH values of all surveyed locations fall within the measured range of sites visited by Bowles et al. (2006).

Table 1. Water Chemistry, Embeddedness and Water Quantity of Survey Locations within Study Area

	Water Chemistry				Water Quantity		EPA EMAP* Embeddedness Measurements				
Location	**pH**	**Temp (°F)**	**Dissolved Oxygen (mg/L)**	**Total Dissolved Solids (ppm)**	**Wetted Depth (inches)**	**Approx. Width (feet)**	**0**	**25**	**50**	**75**	**100**
TE001	7.8	70.2	8.97	315	3	10	0	0	0	10	0
TE002	7.6	62.4	7.08	355	9	7	50	10	100	100	10
TE003	7.3	61.3	6.96	325	6	4	0	0	0	0	0
TE004	7.5	61.5	7.77	320	6	5.5	100	25	75	0	0
Spring 1-Transect 1	7.5	60.8	6.19	329	24	5	100	20	0	0	50
Spring 1-Transect 2					9	6	100	100	0	0	0
Spring 1-Transect 3					6	6	40	10	30	0	0
Spring 1-Transect 4					6	5	100	100	100	100	0

*EPA EMAP: U.S. Environmental Protection Agency Environmental Monitoring and Assessment Program

Proper cover and shelter are important factors when investigating potential JPS habitat. Much like other central Texas *Eurycea* salamanders, this species spends a great deal of time moving among the interstitial spaces (empty voids between rocks) within the substrate (Bowles et al. 2006). These spaces are utilized by the JPS as resting spaces and by JPS prey as habitat, therefore sedimentation in JPS habitat needs to be low (USFWS 2013). JPS are often found under rocks, leaf litter and other vegetation (Bowles et al. 2006). Every habitat assessment point and the single located spring had pictures taken and were scored using the U.S. Environmental Protection Agency (EPA) Environmental Monitoring and Assessment Program (EMAP) method as described in Sennatt et al. (2006). Typically, this method is used to determine embeddedness of particles within a stream bed. Embeddedness of each particle is defined as the fraction of a particle's upper surface surrounded by fine sediment (< 2 millimeter [mm]). Sand and finer sediments are considered 100% embedded. Each habitat assessment point had one transect for visual surveys, while Spring 1 had four transects for visual surveys. The first transect at Spring 1 was located at the outlet of the spring, while all subsequent transects were spaced 6 feet downstream of the previous transect; providing habitat evaluation of approximately 24 feet of streambed. Along each transect, sampling is conducted at five points within 10-cm diameter circles along 0, 25, 50, 75, and 100 percent of the wetted channel width. Sampling entails visually estimating substrate composition as viewed from the bank of the stream. SWCA biologists did not enter the stream at any point during the survey effort. Table 1 shows the results of the embeddedness survey. Overall, the stream reach within the Study Area contains embeddedness levels that are conducive for JPS habitation. While some locations had portions of the transect that were either fully embedded or comprised solely of bedrock (considered poor JPS habitat), most transects had a mixture of sedimentation rates with enough interstitial space to be considered good JPS habitat.

A strong positive relationship is shown to exist between the abundance and amount of rocky substrate greater than 2.5 inches in diameter (Bowles et al. 2006). Current survey protocol (USFWS 2014) also requires use of a modified Wentworth scale to estimate the percentage of substrate particles that fall into size each category. This scale is used to classify the mean quantity and size of the substrate within JPS

habitat and is a visual estimate conducted from the stream bank within the same 10-cm diameter sample points used for the embeddedness survey. Table 2 shows the particle size classification and Appendix A contains the survey results at each spring. For reference, 2.5 inches is roughly 63 mm; therefore appropriately sized cover for JPS ranges from small cobble to large boulder. Appendix A shows the full range of results at each transect. Overall, the entire stream reach within the Study Area is a mosaic of sand, bedrock, stones over 2.5 inches and leaf litter. However, TE001 was covered with thick mats of green-hair algae and therefore represents poor JPS habitat due to the lack of interstitial voids required by this species.

Table 2. Modified Wentworth Scale Used to Characterize Habitat Substrate

Code	Classification	Size (mm)
0	Organics	Misc. Organic Debris
1	Clay	<0.004
2	Silt	0.004 to <0.062
3	Sand	0.062 - 1
4	Coarse Sand	1 to 2
5	Granule	2 to 4
6	Small Gravel	4 to 8
7	Medium Gravel	8 to 16
8	Large Gravel	16-32
9	Rubble	32-64
10	Small Cobble	64-128
11	Large Cobble	128-256
12	Small Boulder	256-512
13	Medium Boulder	512-1024
14	Large Boulder	>1024
15	Bedrock	Solid Substrate

USFWS (2014) protocol also requires at least one measure of water quantity, including spring discharge, stream/pool depth, stream/pool width, and/or flow rate. Stream depth was collected as the sole measure of water quantity and is summarized in Table 1. All survey transects had enough water to keep a potential salamander fully submerged.

Table 3 summarizes the habitat conditions relative to ideal JPS requirements for inhabitation. Most of the examined sites within the Study Area can be considered potential surface habitat for this species. Every transect location where water chemistry sampling was conducted had values that fall within the range of values reported for occupied JPS habitat. Extensive green-hair algae at TE001 minimizes the apparent suitability of the habitat at this location as adequate for JPS inhabitation. Additionally, Spring 1- Transect 3 and Transect 4 may be considered poor habitat because the substrate composition is a mixture of dead leaf litter, sand and bedrock with few interstitial voids for JPS foraging.

Table 3. Habitat Suitability Summary of Each Transect.

	Water Chemistry				Substrate	
	DO	**Conductivity**	**pH**	**Temperature**	**Embeddedness**	**Wentworth**
TE001	√	√	√	√	√	
TE002	√	√	√	√	√	√
TE003	√	√	√	√	√	√
TE004	√	√	√	√	√	√
Spring1- Transect 1	√	√	√	√	√	√
Spring1- Transect 2	N/A	N/A	N/A	N/A	√	√
Spring1- Transect 3	N/A	N/A	N/A	N/A	√	
Spring1- Transect 4	N/A	N/A	N/A	N/A		√

3. TRANSECT DESCRIPTIONS AND PHOTOGRAPHS

TE001

The TE001 transect is at the northern boundary of the Study Area and is a low water crossing—as evidenced by an old ranch road and a sign blocking the road with a "Salamander Crossing" sign. TE001 is approximately 10 feet wide by approximately 3 inches deep and is characterized by large quantities of green-hair algae forming a thick mat across the entire transect (Photograph 1).



Photograph 1. Representative photograph of TE001.

TE002

The TE002 transect is approximately 140 feet south of TE001 and has orange flagging tape on a tree branch overhanging the water with the words "Site 76" written on it (Photograph 2). SWCA biologists were unable to find a spring associated with this flag. The stream is approximately 7 feet wide and approximately 9 inches deep at this location and much of the substrate was covered with dead tree leaves.



Photograph 2. Representative photograph of TE002.

TE003

The TE003 transect was placed approximately mid-way along the Study Area. The west bank is elevated approximately 4 feet above the streambed, which measures approximately 4 feet wide by approximately 6 inches deep (Photograph 3). Exposed bedrock is the primary substrate on either side of the streambed; however, the three samples in the middle show varying levels of gravel and small boulders with low embeddedness.



Photograph 3. Representative photograph of TE003.

TE004

The TE004 transect is approximately 20 feet south the southern boundary of the Study Area and measures approximately 5.5 feet wide by 6 inches deep (Photograph 4). SWCA biologists had a difficult time getting a GPS signal at this location because of the dense tree cover and were unable to get a satellite signal at the exact location of the Study Area boundary. The substrate along the west bank has high level of coverage by dead tree leaves, however the rest of the streambed has low levels of embeddedness and contains many rubble-sized rocks.



Photograph 4. Representative photograph of TE004.

Spring 1

Spring 1 is located between TE002 and TE003 (Photograph 5). Several large boulders obscure the outlet, which lies approximately 4 feet behind the boulder and is located on the stream bank, just above the current water level (Photograph 6). The outlet itself appears to be circular and approximately 4 inches in diameter. The stream at this location is approximately 5 feet wide by approximately 2 feet deep; though it appears that water might be contained further behind the boulders than is currently visible. Further access behind the boulders was not possible at the time of the survey. Four transects spaced 6 feet apart characterized approximately 24 feet of streambed. Embeddedness along the west bank of the stream was high and much of the substrate on the east bank was bare bedrock. Only transects 1 and 2 contained substrate with low embeddedness and enough cover to be considered good JPS habitat. As discussed previously, transects 3 and 4 can be characterized as a combination of leaf litter, sand, and bare bedrock—which is not considered suitable habitat for JPS.

This was the only spring SWCA biologists were able to locate within the Study Area. When the stream level is high, locating submerged groundwater outlets is very difficult as they become obscured by rocks and leaf litter. Finding such features becomes increasingly easier as the water level recedes and the groundwater outlets generate visible flow that moves towards the center of the drainage. Austin has experienced a relatively wet winter, therefore local drainages contained significant flow at the time of the survey.



Photograph 5. Overview of Spring 1.



Photograph 6. Close-up of Spring 1.

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APPENDIX A

MODIFIED WENTWORTH SCALE CHARACTERIZATION

Survey Location- TE001			West Bank				East Bank
Code	**Classification**	**Size (mm)**	**% Coverage-0**	**% Coverage-25**	**% Coverage- 50**	**% Coverage-75**	**% Coverage-100**
0	Organics	Misc. Organic Debris	100	100	100	100	100
1	Clay	<0.004					
2	Silt	0.004 to <0.062					
3	Sand	0.062 - 1					
4	Coarse Sand	1 to 2					
5	Granule	2 to 4					
6	Small Gravel	4 to 8					
7	Medium Gravel	8 to 16					
8	Large Gravel	16-32					
9	Rubble	32-64					
10	Small Cobble	64-128					
11	Large Cobble	128-256					
12	Small Boulder	256-512					
13	Medium Boulder	512-1024					
14	Large Boulder	>1024					
15	Bedrock	Solid Substrate					

Survey Location- TE002			West Bank				East Bank
Code	**Classification**	**Size (mm)**	**% Coverage-0**	**% Coverage-25**	**% Coverage-50**	**% Coverage-75**	**% Coverage-100**
0	Organics	Misc. Organic Debris			100	100	50
1	Clay	<0.004					
2	Silt	0.004 to <0.062					
3	Sand	0.062 - 1		10			
4	Coarse Sand	1 to 2	30				20
5	Granule	2 to 4	20	30			30
6	Small Gravel	4 to 8					
7	Medium Gravel	8 to 16					
8	Large Gravel	16-32		30			
9	Rubble	32-64					
10	Small Cobble	64-128		30			
11	Large Cobble	128-256					
12	Small Boulder	256-512					
13	Medium Boulder	512-1024	50				
14	Large Boulder	>1024					
15	Bedrock	Solid Substrate					

Survey Location- TE003			West Bank				East Bank
Code	**Classification**	**Size (mm)**	**% Coverage-0**	**% Coverage-25**	**% Coverage-50**	**% Coverage-75**	**% Coverage-100**
0	Organics	Misc. Organic Debris					
1	Clay	<0.004					
2	Silt	0.004 to <0.062					
3	Sand	0.062 - 1					
4	Coarse Sand	1 to 2					
5	Granule	2 to 4		10	40		
6	Small Gravel	4 to 8					
7	Medium Gravel	8 to 16		40	50		
8	Large Gravel	16-32					
9	Rubble	32-64					
10	Small Cobble	64-128				50	
11	Large Cobble	128-256					
12	Small Boulder	256-512		50	10		
13	Medium Boulder	512-1024					
14	Large Boulder	>1024					
15	Bedrock	Solid Substrate	100			50	100

Survey Location- TE004			West Bank				East Bank
Code	**Classification**	**Size (mm)**	**% Coverage-0**	**% Coverage-25**	**% Coverage-50**	**% Coverage-75**	**% Coverage-100**
0	Organics	Misc. Organic Debris	100	50	75		
1	Clay	<0.004					
2	Silt	0.004 to <0.062					
3	Sand	0.062 - 1					
4	Coarse Sand	1 to 2					
5	Granule	2 to 4					
6	Small Gravel	4 to 8					
7	Medium Gravel	8 to 16					
8	Large Gravel	16-32					
9	Rubble	32-64		50	25	100	100
10	Small Cobble	64-128					
11	Large Cobble	128-256					
12	Small Boulder	256-512					
13	Medium Boulder	512-1024					
14	Large Boulder	>1024					
15	Bedrock	Solid Substrate					

Survey Location- Spring 1- Transect 1			West Bank				East Bank
Code	**Classification**	**Size (mm)**	**% Coverage-0**	**% Coverage-25**	**% Coverage-50**	**% Coverage-75**	**% Coverage-100**
0	Organics	Misc. Organic Debris					
1	Clay	<0.004					
2	Silt	0.004 to <0.062					
3	Sand	0.062 - 1	90	25	10	10	50
4	Coarse Sand	1 to 2					40
5	Granule	2 to 4			40		
6	Small Gravel	4 to 8					
7	Medium Gravel	8 to 16	10				
8	Large Gravel	16-32			50		10
9	Rubble	32-64					
10	Small Cobble	64-128		75			
11	Large Cobble	128-256					
12	Small Boulder	256-512					
13	Medium Boulder	512-1024					
14	Large Boulder	>1024					
15	Bedrock	Solid Substrate				90	

Survey Location- Spring 1- Transect 2			West Bank				East Bank
Code	**Classification**	**Size (mm)**	**% Coverage-0**	**% Coverage-25**	**% Coverage-50**	**% Coverage-75**	**% Coverage-100**
0	Organics	Misc. Organic Debris					
1	Clay	<0.004					
2	Silt	0.004 to <0.062					
3	Sand	0.062 - 1	25	20			
4	Coarse Sand	1 to 2		20			
5	Granule	2 to 4					
6	Small Gravel	4 to 8					
7	Medium Gravel	8 to 16	75	50			
8	Large Gravel	16-32			50		
9	Rubble	32-64					
10	Small Cobble	64-128					
11	Large Cobble	128-256					
12	Small Boulder	256-512					
13	Medium Boulder	512-1024					
14	Large Boulder	>1024					
15	Bedrock	Solid Substrate			50		100

Survey Location- Spring 1- Transect 3			West Bank				East Bank
Code	**Classification**	**Size (mm)**	**% Coverage-0**	**% Coverage-25**	**% Coverage-50**	**% Coverage-75**	**% Coverage-100**
0	Organics	Misc. Organic Debris		50		100	
1	Clay	<0.004					
2	Silt	0.004 to <0.062					
3	Sand	0.062 - 1	100	50	100		
4	Coarse Sand	1 to 2					
5	Granule	2 to 4					
6	Small Gravel	4 to 8					
7	Medium Gravel	8 to 16					
8	Large Gravel	16-32					
9	Rubble	32-64					
10	Small Cobble	64-128					
11	Large Cobble	128-256					
12	Small Boulder	256-512					
13	Medium Boulder	512-1024					
14	Large Boulder	>1024					
15	Bedrock	Solid Substrate					100

Survey Location- Spring 1- Transect 4			West Bank				East Bank
Code	**Classification**	**Size (mm)**	**% Coverage-0**	**% Coverage-25**	**% Coverage-50**	**% Coverage-75**	**% Coverage-100**
0	Organics	Misc. Organic Debris					
1	Clay	<0.004					
2	Silt	0.004 to <0.062					
3	Sand	0.062 - 1	20	100	100		
4	Coarse Sand	1 to 2					
5	Granule	2 to 4					
6	Small Gravel	4 to 8					
7	Medium Gravel	8 to 16	30				
8	Large Gravel	16-32					
9	Rubble	32-64					
10	Small Cobble	64-128	50				
11	Large Cobble	128-256					
12	Small Boulder	256-512					
13	Medium Boulder	512-1024					
14	Large Boulder	>1024					
15	Bedrock	Solid Substrate				100	100