GUADALUPE RIVER HABITAT CONSERVATION PLAN

TECHNICAL MEMORANDUM: ASSESSMENT OF WASTEWATER TREATMENT FACILITY DISCHARGES AND THEIR POTENTIAL TO IMPACT *EURYCEA* SALAMANDER HABITAT

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1.0 Introduction

The Guadalupe River Habitat Conservation Plan (GRHCP) considers covering the operation and maintenance (including effluent discharge) of GBRA owned and/or operated wastewater treatment facilities (WWTFs) in the GRHCP Plan area. Discharges from WWTFs are being examined for potential impacts to Eurycea salamander habitat. Wastewater treatment facilities with the potential to impact Eurycea salamanders are located in Kendall and Comal counties, Texas and include Cordillera Ranch, Boerne Independent School District, Park Village, Singing Hills, 4S Ranch, Johnson Ranch and Canyon Park Estates (**Figure 1**). These two counties are at the margins of the Edwards Plateau, which is characterized by karst limestone topography conducive to groundwater and surface water interactions, including gaining/losing streams and springs. Both counties contain numerous karst features and cave systems, with over 400 karst features (sinks, caves, springs, and others) documented in Comal County and over 900 karst features documented in Kendall County ([Texas County Karst Totals | Texas Speleological Survey | TSS | Cave | Records | Publications | NSS | National Speleological Society Study Group]). These karst features include sinks that provide recharge pathways to underlying aquifers as well as springs where groundwater emerges to the surface.

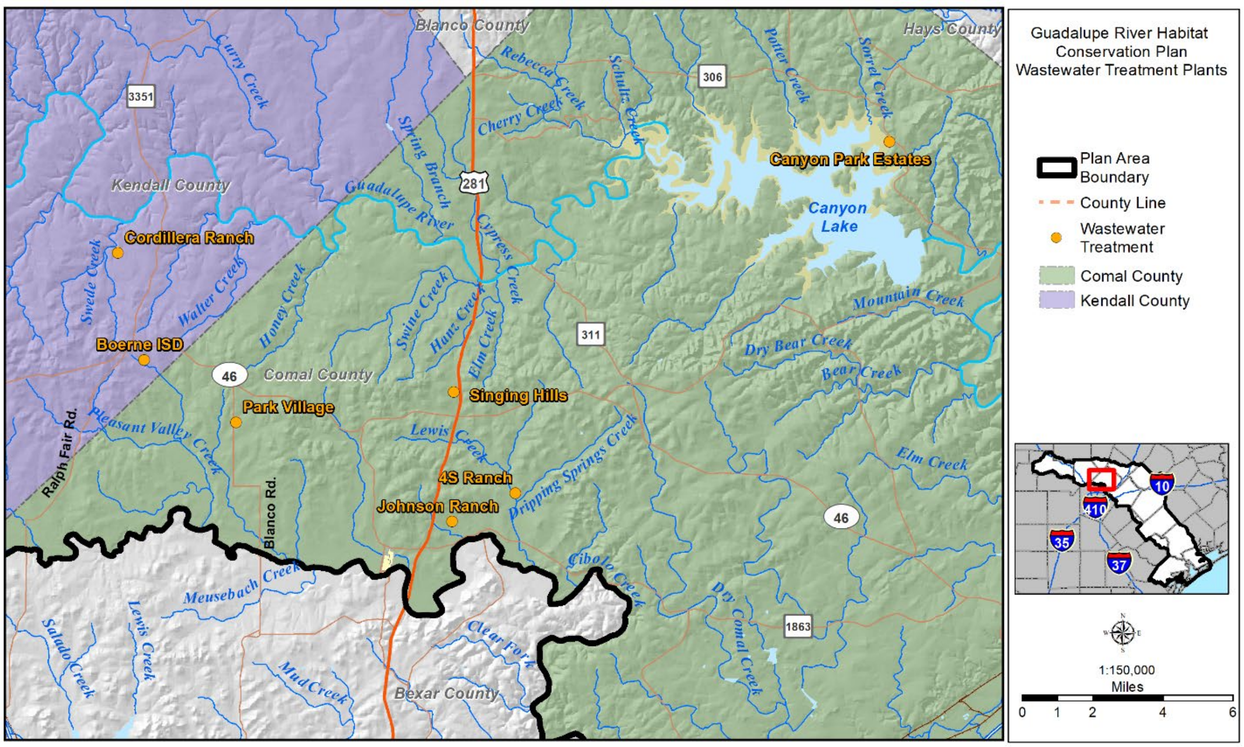

Figure 1. Analyzed WWTFs in Kendell and Comal Counties

These seven WWTFs have small capacities with daily average discharges ranging from 0.0485 to 0.48 millions of gallons per day (MGD). The daily average and peak 2-hour discharge limits for each facility are presented in Table 1. None of these facilities have planned expansions at this time.

Table 1. Permitted discharge requirements for seven focal WWTFs.

Wastewater Treatment Facility	Daily Average Discharge (MGD)	Peak 2-Hour Discharge (GPM)
4S Ranch	≤ 0.48	≤ 1,000
Boerne ISD Voss Middle School[1]	≤ 0.0485 (4.5 AFY/acre)	N/A
Canyon Park Estates	≤ 0.26	≤ 451
Cordillera Ranch[1]	≤ 0.192 (2.1 AFY/acre)	N/A
Johnson Ranch	≤ 0.350	≤ 972
Park Village	≤ 0.195	≤ 542
Singing Hills	≤ 0.48	≤ 1,333

AFY/acre = acre feet per year per acre; ISD = Independent School District; GPM = gallons per minute; MGD = millions of gallons per day; N/A = Not Applicable

[1] Transferred to holding ponds or tanks and land applied.

Kendall and Comal counties contain karst features that create pockets of aquatic habitat in springs and caves with the potential to support salamanders. The majority of springs in these counties are gravity-fed that issue at the head of incised areas. The aquatic habitats created by these springs are generally isolated, and they often support a unique aquatic biota that is restricted to the area near the springs because of specific habitat requirements, namely a narrow range of water temperature. A unique and interesting biotic component of the spring and cave biota in Central Texas are the salamanders of the Genus *Eurycea*. Three of these species have been identified as potentially impacted by GRHCP activities including the Cascade Caverns salamander (*Eurycea latitans*), Fern Bank salamander (*E. pterophila*), and undescribed *Eurycea* species 2 (Devitt et al. 2019). The Texas Salamander (*E. neotenes*) is a common Texas Hill Country salamander but is not considered for GRHCP coverage as it is not proposed or petitioned for listing.

Other *Eurycea* species in the GRHCP plan area but not included in this analysis include the Barton Springs salamander (*E. sosorum*) and Austin blind salamander (*E. waterlooensis*) located in the Barton Springs Segment of the Edwards Aquifer; and the San Marcos salamander (*E. nana*) and Texas blind salamander (*E.* [*Typhlomolge*] *rathbuni*), which inhabit the southern segment of the Edwards Aquifer primarily in Hays County. The distance removed from WWTFs analyzed eliminated these four federally listed *Eurycea* species from further evaluation.

Therefore, this memorandum focuses on potential impacts that GBRA WWTF effluent discharges may have on listed or potentially listed *Eurycea* salamanders in Kendall and western Comal counties.

2.0 Evaluation

For this assessment, a desktop analysis of GBRA WWTF and salamander locations, flow paths, water quantity and water quality was performed. The intent of this analysis was to assess the likelihood of these discharges impacting salamanders and subsequently, whether any potential were reasonably certain to constitute take. The first step was to analyze the receiving streams for each WWTF discharge to their confluence with Cibolo Creek or the Guadalupe River. This was accomplished using University of Texas - Bureau of Economic Geology (UTBEG) topographic quadrangle maps (Collins 1992-1994b) and Google Earth imagery. The analysis was intended to identify potential karst features along the path of the effluent discharge. Apparent and inferred faults were identified using UTBEG geologic quadrangle maps in Kendall County. Google Earth was used to estimate the length of the tributary, identify features suggesting a connection between surface water and groundwater, and to compare the reach of the WWTF effluent during different seasons. If water disappeared underground, it was assumed that the effluent had the potential to contribute to a flow path feeding a spring system. Limited access to privately owned land did not allow for field verification of this desktop exercise.

The second step was to identify springs and caves in Kendall and western Comal counties that are known to contain *Eurycea* salamanders. Given the complexity of karst habitats, it is difficult to assess the direction of underground water flow from surface observations. However, it stands to reason that springs or caves located downslope and in the same drainage as a WWTF discharge could potentially be impacted by effluent. The third step in the assessment was to evaluate if any water quality concerns exist relative to salamander habitat in these unique, spring head environments.

2.1 WWTF Effluent Path Analysis and Karst Feature Assessment

After tracing the effluent discharge of WWTFs in Kendall and western Comal counties (**Figure 1**), three WWTFs, Johnson Ranch, 4S Ranch, and Park Village, were identified as discharging into intermittent streams that cross inferred faults, and there is evidence to suggest recharge occurs at the fault lines. The Johnson Ranch WWTF has a permitted discharge up to 0.35 MGD (Table 1) and is approximately 0.75 mile from Cibolo Creek. The U.S. Geological Survey (USGS) topographic quadrangles for Anhalt and Bulverde along with Google Earth were used for the more detailed examination. The effluent from Johnson Ranch WWTF discharges into an unnamed tributary (Figure 2) and then combines with the runoff from a retention pond of a small subdivision to the Northeast. The tributary flows by an inferred fault line (Figure 2), but the fault does not appear to be expressed at the surface from the Google Earth view. After approximately 0.75 miles, the tributary joins Cibolo Creek. A sediment deposit at the confluence of the unnamed tributary and Cibolo Creek prevents connectivity except during high flows following a major rainfall event (Figure 2).

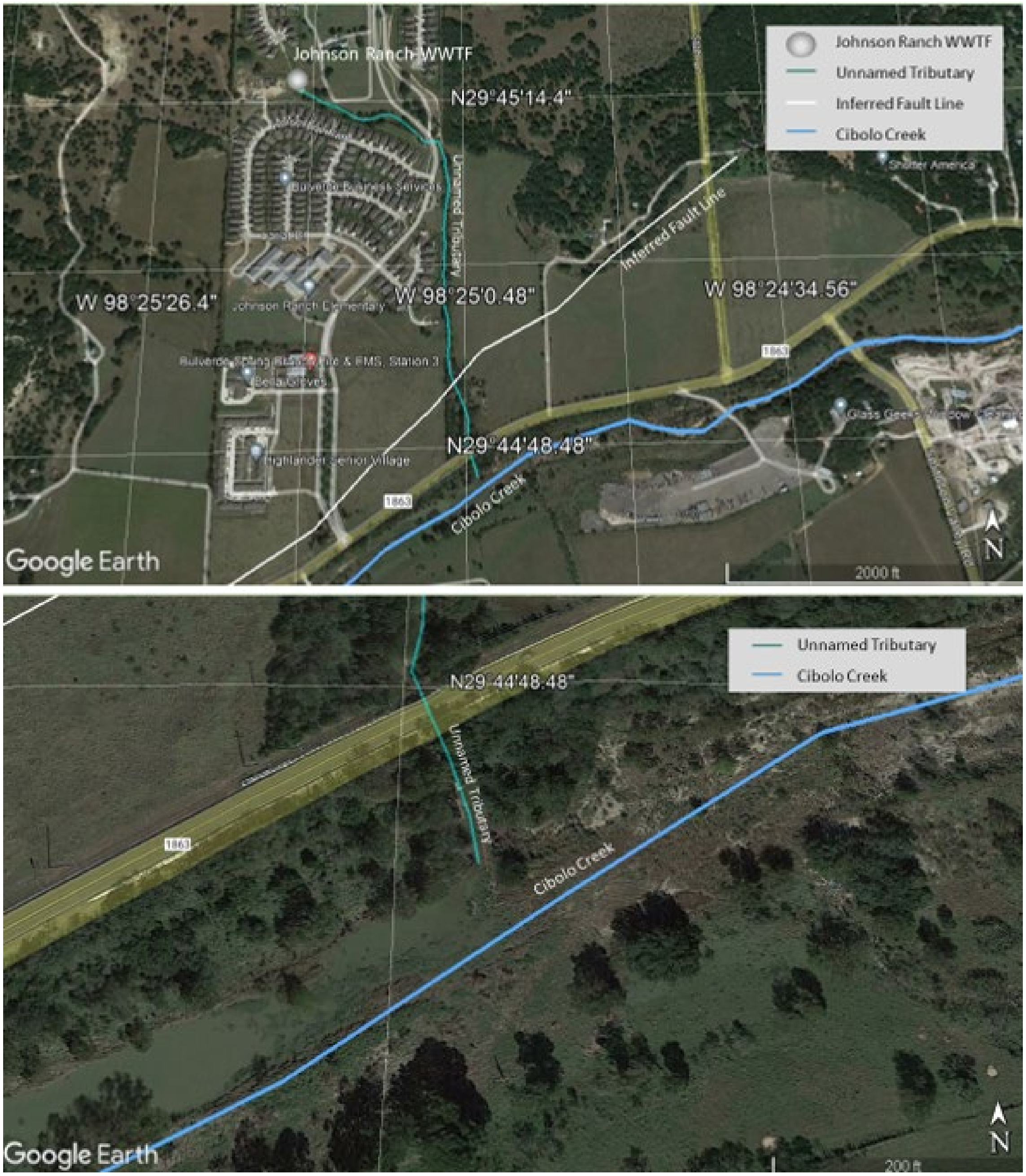

Figure 2. Johnson Ranch WWTF effluent path and fault line intersection (top); confluence with Cibolo Creek (bottom).

The 4S Ranch WWTF has a permitted discharge up to 0.48 MGD (Table 1). The USGS topographic quadrangles for Anhalt and Bulverde along with Google Earth were used for a more detailed examination. The effluent from 4S Ranch is discharged through a pipeline into a holding pond and used primarily for irrigation in the surrounding housing development. However, when the pond fills up, it overflows into Lewis Creek which is approximately 3 miles downstream to Cibolo Creek (Figure 3). Lewis Creek is intermittent in nature with aquatic habitat typically limited to isolated pools. The Lewis Creek drainage intersects one mapped fault line that may receive water (Figure 3, Collins 1992 and 1993). Upon imagery review, small pools of water were only observed in the Lewis Creek bed on occasion in the fall. Lewis Creek was generally observed as intermittently dry and does not flow to Cibolo Creek under normal weather conditions.

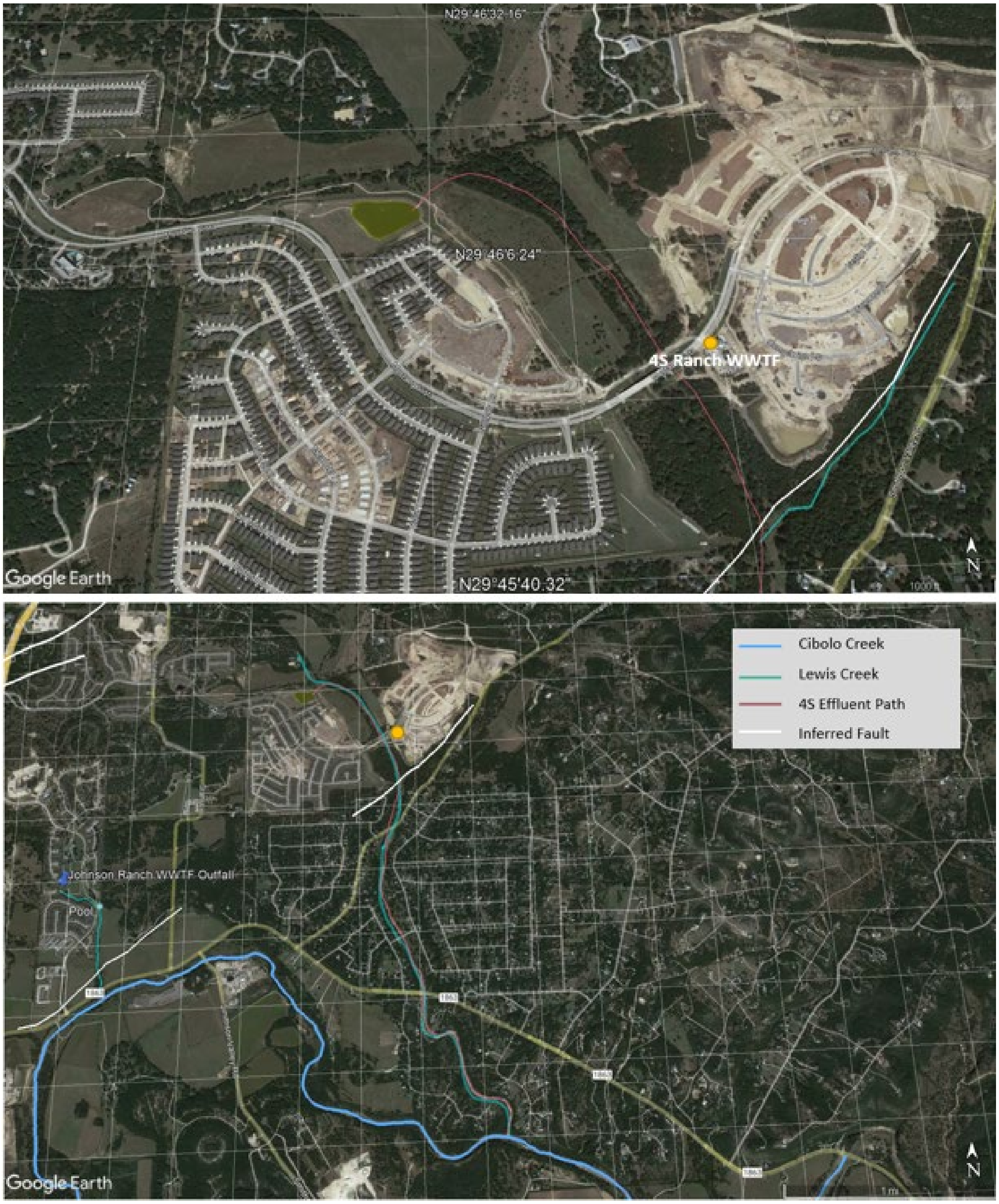

Figure 3. 4S Ranch WWTF discharge outfall into pond (top); Effluent path and fault line intersection towards confluence with Cibolo Creek (bottom).

In addition to Johnson Ranch and 4S Ranch, Park Village WWTF effluent flows over two separate inferred faults that had ponded water present in imagery where the stream crosses the fault with no flow downstream. The Park Village WWTF has a permitted discharge up to 0.195 MGD (Table 1). The USGS topographic quadrangles for Bergheim, Camp Bullis, and Bulverde along with Google Earth were used for the more detailed examination. Park Village WWTF discharges into an unnamed tributary that joins with Kelly Creek after approximately 0.25 miles (Figure 4). The origin of Kelly Creek is over an inferred fault where there is a pool (Collins 1993, 1994a, 1994b). After another 0.2 miles, Kelly Creek flows over another fault where a pool forms (Figure 4, Collins 1993, 1994a, 1994b). After this pool, Kelly Creek is dry to the confluence with Cibolo Creek, suggestive of potential recharge.

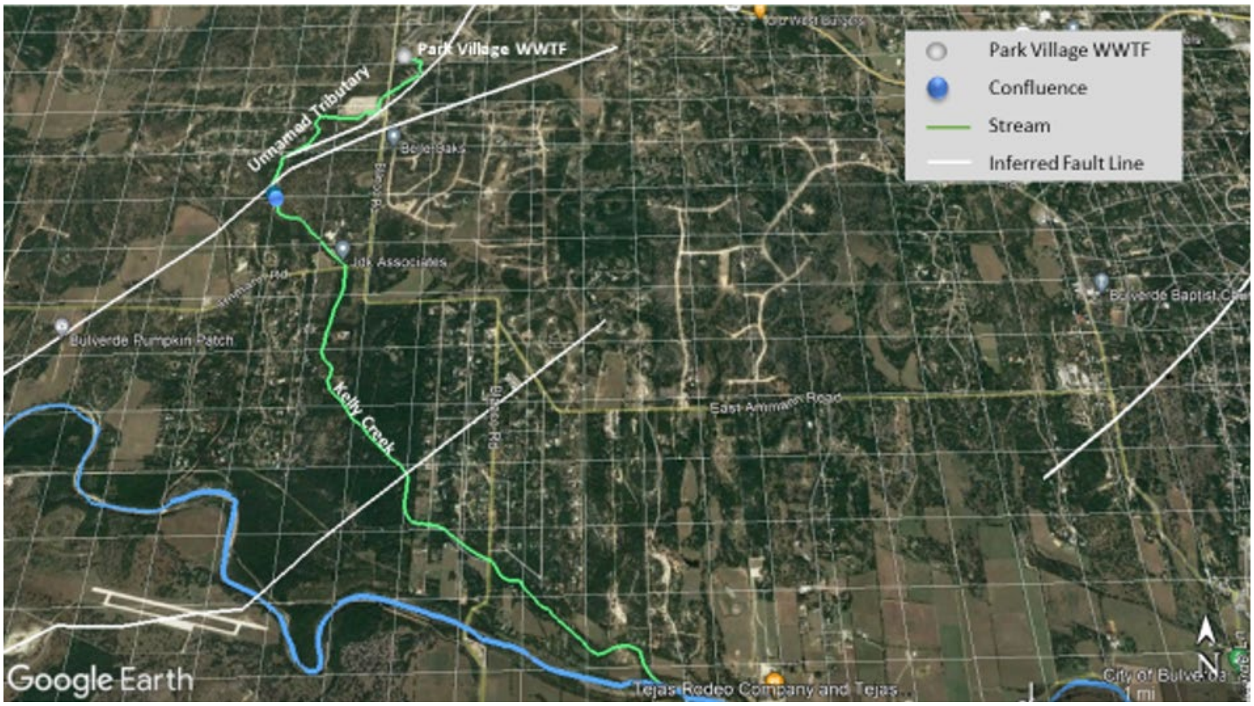

Figure 4. Park Village WWTF discharge into unnamed tributary and effluent path and fault line intersections towards confluence with Cibolo Creek.

The presence of potential karst features is not solely indicative of direct impacts to aquatic karst environments as the volume and quality of discharge are also important factors to be considered. Given the relatively limited volume of discharges occurring from these facilities (Table 1) and the seasonal variation in water occurrence, impacts to karst *Eurycea* habitats from water quantity specific to these WWTF discharges appear unlikley.

2.2 Occupied Salamander Habitat

Figure 5 depicts known *Eurycea* localities, including springs and caves, in Kendall and western Comal counties in the vicinity of the WWTFs. Sources used for identifying these salamander localities were the University of Texas Natural History Collection database, Texas Parks and Wildlife Department's Natural Diversity Database, and *Eurycea* literature (Sweet 1978, Chippindale et al. 2000, Bendik 2006, Devitt et al. 2019, Diaz, personal communication 2022). From these sources, a total of 22 springs and caves containing *Eurycea* salamanders are in the vicinity of GBRA WWTFs (Kendall and western Comal counties) (**Figure 5**).

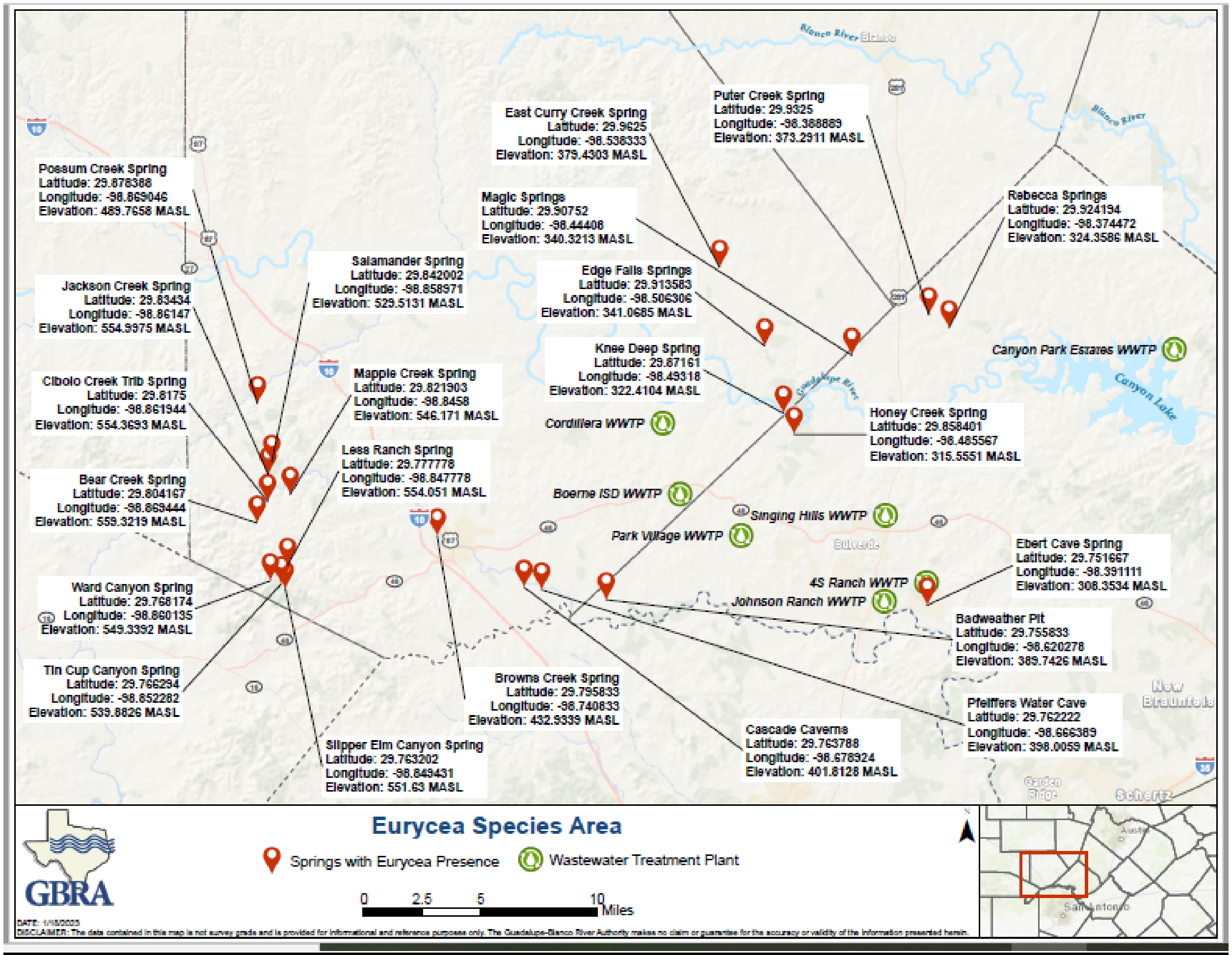

Figure 5. Habitats with *Eurycea* presence and GBRA WWTFs in Kendall and western Comal counties

Numerous springs that have documented occurrences of *Eurycea* salamanders are eliminated from consideration for potential impact based solely on location and topography. Knee Deep, Edge Falls, Magic, Rebecca, Puter Creek, and East Curry Creek springs are all on the north side of the Guadalupe River. The GBRA WWTFs are all located on the south side of the Guadalupe River, with the exception of Canyon Park Estates, which is downstream and adjacent to Canyon Lake. The Guadalupe River serves as a significant low-lying barrier to movement of groundwater that provides habitat for salamanders, therefore, the springs north of the river are highly unlikely to be impacted by GBRA WWTF activities. Similarly, the relatively small volume of discharge, distance from salamander-occupied springs, and location of discharges from Canyon Park Estates WWTF into Canyon Lake makes it highly unlikely discharges from this facility impact salamander habitat.

Another group of springs appear highly unlikely to be impacted by GBRA WWTF effluent based on location and elevation of the spring outlet. Possum Creek, Jackson Creek, Cibolo Creek Tributary, Bear Creek, Ward Canyon, Tin Cup Canyon, Slippery Elm Canyon, Browns Creek, Salamander, Maple Creek, and Less Ranch springs are all located upslope and west of GBRA WWTFs (**Figure 5**). All of these springs sit at an elevation of 432 meters above sea level (msl) or greater, while all of GBRA WWTF outfalls sit at an elevation of less than 400 msl. Because the springs are located at a higher elevation than the WWTF discharge points, these springs are unlikely to be impacted by GBRA WWTF discharges.

The remaining locations where salamanders have been collected in Kendall and western Comal counties are all caves: Ebert Cave, Cascade Caverns Cave, Honey Creek Cave, Pfeiffer's Water Cave, and Badweather Pit Cave. Because caves can extend some distance beneath the surface and the elevations provided for these features represent entrance elevations at the surface, elevation data are not appropriate for assessing the potential impact from GBRA WWTF discharges. However, the location, distance, and operational considerations of GBRA WWTFs are informative. Cascade Caverns, Badweather Pit, and Pfeiffer's Water Cave are about 5 miles from Boerne Independent School District WWTF and 10 miles from Cordillera Ranch WWTF. These two facilities do not discharge into a receiving water body, but rather apply their effluent to landscaping and golf course grounds. Given that land application occurs and both Cascade Caverns and Pfeiffer's Water Cave are on the south side of Cibolo Creek, while the WWTFs are on the north side and miles removed from Cibolo Creek, GBRA activities appear highly unlikely to impact these habitats. Park Village WWTF is located about 4 miles downslope from Badweather Pit Cave and both are on the north side of Cibolo Creek. Minimal discharges from the Park Village WWTF (Table 1) and the distance to Badweather Pit Cave make impacts to salamanders highly unlikely.

Ebert Cave is the only remaining location in this specific analysis where *Eurycea* have been documented. The 4S Ranch WWTF discharges into the same drainage that contains Ebert Cave (Figure 3). Ebert Cave appears to be located on private property within 0.75 miles of the 4S Ranch WWTF and about 1.75 miles from the discharge point. A search of the Texas Speleological Survey website identified a description of Ebert Cave by James Jasek from 1975 (The Texas Caver (usf.edu), Jasek 1975). Jasek described the entrance to the cave as "located in a dry stream bed near a pasture road." Water was identified in the cave about 60-100 feet below the surface, which required rappelling in two stages and crawling through a tight passage for 30-40 feet to reach. Ebert Cave was identified as a locality for salamanders in the taxonomic and systematic revision of central Texas Eurycea offered by Chippindale et al. (2000). The date the salamander specimen was collected or who collected it from Ebert Cave is unclear. According to the Texas Speleological Survey, the coordinates for the cave opening were never verified with a GPS. The ranch that once contained Ebert Cave was subdivided and has been largely developed or is currently being developed into smaller lots. The 4S Ranch WWTF effluent is used primarily for landscape irrigation so discharges to Lewis Creek are relatively limited and occur about 1.75 miles upstream of the approximate cave location. The unknown cave entrance was described as "a dry creek bed" prior to subdivision development and analysis of aerial images over time showed aquatic habitat in Lewis Creek was generally limited to isolated pools. Therefore, it is unlikely that 4S Ranch WWTF effluent routinely reaches where this cave entrance may have historically been.

2.3 Water Quality

In addition to elevation, distance to springs and/or caves, water quantity, and application mechanism, an important consideration is water quality. Each GBRA WWTF adheres to the Texas Commission on Environmental Quality regulations for discharge of wastewater into or adjacent to water in the state. It is acknowledged that those regulations alone, may or may not protect aquatic species in unique habitats. However, relative to the GRHCP, the distance to salamander habitat, relatively small volume of discharge, and intermittent nature of the receiving water bodies limits the concern for direct water quality impacts from permitted discharge activities. There is always a slight risk from flash flooding events over land applications or flushing stagnant intermittent effluent pools into karst openings. These flash events could deposit debris and other organic matter that could impose temporary biological oxygen demands on these intermittent streams, springs and/or cave environments. The increased amount of water during said flooding events would likely contribute to a higher dilution factor which could potentially alleviate these concerns. Although possible, these impacts, if observed, should be temporary and flash flooding is outside of GBRA's control.

3.0 Conclusions

Considering the location of WWTFs, topography, effluent discharge volumes, limited risk from water quality perturbations, and flow paths in relation to documented salamander localities, the GRHCP project team concludes that the potential for effluent from these seven WWTFs in Kendall and western Comal counties to result in take of *Eurycea* salamanders is not reasonably certain. In many cases, potential impacts to salamander habitat are negated by land application or reuse of effluent for landscaping, while in other cases the discharge occurs in locations downslope or removed from documented salamander localities. Future built facilities that have the potential for impact or future discoveries of currently unknown populations would need to demonstrate avoidance of impacts or be subject to a separate ESA compliance process or an amendment to the proposed GRHCP.

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