



Appendix J | **2024 Item M Net Disturbance and
Incidental Take Assessment for EARIP ITP
Annual Report**



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MEMORANDUM

TO: Scott Storment, Chad Furl, Kristina Tolman, Olivia Ybarra
FROM: BIO-WEST
DATE: December 30, 2024
SUBJECT: **ITEM M NET DISTURBANCE AND INCIDENTAL TAKE
ASSESSMENT FOR 2024 EARIP ITP ANNUAL REPORT**

EXECUTIVE SUMMARY

The Edwards Aquifer Habitat Conservation Plan (HCP) Incidental Take Permit (ITP) requires a Net Disturbance and Incidental Take assessment to be conducted at the conclusion of each year for incorporation into the ITP Annual Report. Requirement M (1a and 2a) of the ITP specifically addresses minimization and mitigation activities associated with the HCP. This requirement stipulates that over the course of any given year no more than 10% of a covered species occupied habitat can be affected by HCP mitigation and restoration activities. Following quantification of net disturbance specific to these activities, incidental take was calculated for the disturbed areas. However, that is only part of the overall incidental take assessment. Incidental take associated with implementation of all other applicable HCP covered activities was then characterized and quantified to the degree practical. For a more detailed description of methodologies and species-specific results please refer to the Item M Net Disturbance (**SECTION 1**) and Incidental Take (**SECTION 2**) assessments of this technical memorandum. As in previous years, all 2024 assessments were performed in accordance with ITP requirements.

Table ES provides an overview of net disturbance percentages and a summary of incidental take for 2024. As shown in Table ES, only the Fountain Darter had a net disturbance when considering the project footprint for HCP mitigation and restoration activities overlaid on occupied habitat. The net disturbance was < 0.5% of the total occupied habitat for the Fountain Darter in the Comal system and San Marcos system, respectively. In summary, the ITP 10% disturbance rule (Item M [a]) was in compliance for 2024.

With the prolonged, extreme drought conditions experienced in 2024, incidental take was calculated for all four monitored species in the Comal system. Incidental take calculations for the Comal system exceeded those observed in previous drought years, excepting 2023. The primary cause for this increase was low total system discharge which resulted in additionally expanded amounts of exposed surface habitat characterized as Comal invertebrate occupied habitat. Over half of the incidental take calculated for the Fountain Darter was due to elevated water temperatures documented in the Upper Spring Run section. For the San Marcos system, incidental take calculations were also elevated above average conditions in 2024, but not as severe as 2023. It is important to emphasize that the San Marcos River in 2023 experienced the lowest total system discharge since the biological monitoring plan implementation in 2000, and remained lower than average in 2024. As such, the 2024 spring to fall reductions in aquatic vegetation in the San Marcos system were greater than most other “drought” years characterized over the past two decades, excepting 2023. The resulting loss of aquatic vegetation / habitat and slightly elevated water temperatures recorded in the City Park section in 2024 led to these calculated conditions.

Table ES. Summary of Impacted Habitat (m²) and Net Disturbance and Incidental Take for HCP Covered Species compared against ITP Maximum Permit Amounts.

COVERED SPECIES PER SYSTEM	HCP Mitigation / Restoration		HCP Measures / Drought	Combined Impacted Habitat 2024 TOTAL (m ²)	INCIDENTAL TAKE		2024 INCIDENTAL TAKE TOTAL	ITP Maximum Permit Amount	ITP Permit Maximum minus (combined first twelve years)
	IMPACTED HABITAT (m ²)	NET Disturbance % OF TOTAL Occupied Habitat	IMPACTED HABITAT (m ²)		HCP Mitigation / Restoration	HCP Measures / Drought			
COMAL SYSTEM									
Fountain Darter	380.0	<0.5%	540.0	920.0	570	40,627	41,197	797,000	611,518
Comal Springs Riffle Beetle	0	0%	227.3	227.3	0	1,500	1,500	11,179	4,143
Comal Springs Dryopid Beetle	0	0%	76.6	76.6	0	8	8	1,543	1,502
Peck's Cave Amphipod	0	0%	30.9	30.9	0	32	32	18,224	16,986
SAN MARCOS SYSTEM									
Fountain Darter	830.0	<0.5%	5,307.6	6,137.6	2,698.5	18,553.2	21,252	549,129	293,554
San Marcos Salamander	0.0	0%	12.0	12.0	0.0	36.0	36	263,857	256,097
Texas Blind Salamander	0	0%	0	0	0	0	0	10	10
Comal Springs Riffle Beetle	0	0%	0	0	0	0	0	n/a	n/a
Comal Springs Dryopid Beetle	0	0%	0	0	0	0	0	n/a	n/a

Finally, when examining 2024 results, habitat conditions in both systems were definitely impacted which was reflected by the larger than typical incidental take calculations. However, these larger numbers remain considerably below those characterized in the Biological Opinion Drought of Record (DOR)-like scenario. As such, we are confident the incidental take numbers summarized above and documented in this memorandum continue to justify the data sets used and methodologies employed relative to performing an incidental take assessment within the context of the Biological Opinion. It is understood that adjustments to data sets and/or methodologies may be employed based on feedback from the USFWS, HCP Science Committee, HCP participants, or others as deemed appropriate by the EARIP.

SECTION 1: ITEM M NET DISTURBANCE ASSESSMENT

Requirement M (1a and 2a) of EAA’s USFWS threatened and endangered species permit (#TE63663A-1) addresses minimization and mitigation activities associated with the HCP. The requirements for Item M (1a and 2a) are stated below directly from the permit:

- 1 Comal Springs, Landa Lake, and the Comal River
 - a. The Permittees will limit disturbance of the (a) substrate, (b) water quality, (c) plants, and (d) animals of the Comal Springs, Landa Lake, and Comal River to no more than 10% of the occupied habitat on an annual basis when implementing HCP measures such as habitat and riparian restoration efforts that may directly or indirectly affect species considered here;
- 2 San Marcos Springs, Spring Lake, and the San Marcos River
 - a. The Permittees will limit disturbance of the (a) substrate, (b) water quality, (c) plants, and (d) animals of the San Marcos Springs, Spring Lake, and the San Marcos River to no more than 10% of the occupied habitat on an annual basis when implementing HCP measures such as habitat and riparian restoration efforts that may directly or indirectly affect species considered here;

All activities described in this memorandum pertain to the HCP covered species that are actively authorized (Item H: 1-6) in 2024 for incidental take via EAA’s ITP permit.

Documentation of baseline habitat conditions: For the actively covered HCP species, maps of occupied habitat for the Comal and San Marcos Springs/River systems were prepared in GIS, based on EAA biological monitoring data (BIO-WEST 2002 – 2013a, b; BIO-WEST 2014 - 2025a, b) and other existing sources for the HCP covered species. Table 1 summarizes the occupied habitat in meters squared (m²) for each of the covered species pertinent to the Item M assessment with associated figures presented in Appendix A. As per the ITP and USFWS Austin Ecological Services (ES) guidance, the 2024 assessment is representative of conditions for calendar year 2024 including any mitigation / restoration measures that resulted in a change in occupied habitat for any of the covered species.

Documentation of HCP mitigation areal extent per project: Descriptions of the HCP minimization and mitigation measures for the City of New Braunfels, City of San Marcos, and Texas State University are presented in the ITP Annual Report and will not be duplicated in this memorandum. For 2024 activities, pertinent to these projects, the areal extent of the project footprint has been quantified in Table 2 and depicted in subsequent figures per project. The project footprints were then overlaid on the occupied habitat maps in GIS and calculations of “Impact” area were performed. The results for each project and covered species are presented in Table 2.

TABLE 1. COVERED SPECIES OCCUPIED HABITAT (Figures depicting occupied habitat included in Appendix A)

ITEM M - SPECIES	OCCUPIED HABITAT (m ²)	NOTES AND ASSUMPTIONS
COMAL SPRINGS / RIVER		
Fountain Darter	109,209	Based on collections and known occurrence in aquatic vegetation types sampled over the course of the HCP biological monitoring. Sampling included drop netting, dip netting, snorkel, SCUBA, and seining throughout the Comal system. Although Fountain Darters have been collected on bare substrate on occasion, no bare areas were included in this assessment.
Comal Springs Riffle Beetle	2,678	Based on collection of individuals via cotton lure, drift net, or quadrat sampling over the years. An area of 1 m ² around each collection point was included but did not include any overlap between collection points.
Peck's Cave Amphipod	2,838	This species is considered subterranean and thus subsurface habitat is the more appropriate calculation. The total area of subsurface habitat for this species is presently unknown. Surface habitat was based on collection of individuals via cotton lure and drift net sampling. An area of 0.5 m ² around each collection point was included but did not include any overlap between collection points.
Comal Springs Dryopid Beetle	827	This species is considered subterranean and thus subsurface habitat is the more appropriate calculation. The total area of subsurface habitat for this species is presently unknown. Surface habitat was based on collection of individuals via cotton lure and drift net sampling. An area of 0.5 m ² around each collection point was included but did not include any overlap between collection points.
SAN MARCOS SPRINGS / RIVER		
Fountain Darter	94,596	Based on collections and known occurrence in aquatic vegetation types (including Texas wild-rice) sampled over the course of HCP biological monitoring. Sampling included drop netting, dip netting, snorkel, SCUBA, and seining throughout the San Marcos system. Although Fountain Darters have been collected on bare substrate in the river on occasion, no bare river areas were included in this baseline assessment. In contrast, bare substrate areas in Spring Lake were included for this assessment as Fountain Darters have frequently been observed inhabiting these areas within Spring Lake. Finally, although Fountain Darters have been collected further upstream in the slough arm of Spring Lake, those collections are considered seasonal at this time and thus were not included in the overall area calculated.
San Marcos Salamander	2,520	Based on observation or collection of individuals via snorkel / SCUBA over the course of HCP biological monitoring. Also, based on collections conducted by the USFWS San Marcos Aquatic Resources Center.
Texas Blind Salamander	n/a	This species is considered subterranean and thus subsurface habitat is the appropriate calculation. As such, no surface habitat was calculated as "occupied habitat" for this species.
Comal Springs Riffle Beetle	11	Based on collection of individuals via cotton lure and drift net sampling. An area of 1 m ² around each collection point was included but did not include any overlap between collection points.
Comal Springs Dryopid Beetle	0.5	This species is considered subterranean and thus subsurface habitat is the more appropriate calculation. The total area of subsurface habitat for this species is presently unknown. Surface habitat was based on collection of individuals via drift net sampling. An area of 0.5 m ² around each collection point was included but did not include any overlap between collection points.

TABLE 2. Mitigation and Restoration Project Areas and Calculated Impact Area per Covered Species in 2024

HCP ACTIVITY	Project Footprint Area (m ²)	“Impact Area” Overlap with Occupied Habitat for Covered Species (m ²)						
		Fountain Darter	Comal Springs riffle beetle	Comal Springs dryopid beetle	Peck’s cave amphipod	San Marcos salamander	Texas blind salamander	
CITY OF NEW BRAUNFELS								
Flow-split management	--	--	--	--	--			
Restoration and maintenance of native aquatic vegetation	865	380	0	0	0			
Decaying vegetation removal	A	--	--	--	--			
Aeration program	Discontinued in 2018							
Gill parasite	0	0	0	0	0			
Riparian restoration	9,130	--	--	--	--			
Bank Stabilization	Completed in 2016							
Riffle beetle restoration	1,725	--	0	0	0			
Non-native animal species removal	A	--	--	--	--			
Sediment Island removal	Completed in 2013							
TOTAL	11,720	380	0	0	0			
CITY OF SAN MARCOS / TEXAS STATE UNIVERSITY								
Enhancement and restoration of Texas wild-rice	B	--	--	--		--	--	
Management of recreation specific to Protection zones (only)	6,000	39	--	--		--	--	
Non-native animal species removal	A	--	--	--		--	--	
Restoration and maintenance of native aquatic vegetation	1,855	830	0	0		0	0	
Texas State Pump Intake Project	Completed in 2022							
Sediment removal	C	--	--	--		--	--	
Access Points and Bank Stabilization	C	--	--	--		0	0	
Riparian restoration	4,367	0	0	0		0	0	
TOTAL	12,222	869	0	0		0	0	

- A** Throughout system – described in qualitative impacts discussion
- B** Project footprint is accounted for in Native Aquatic Vegetation restoration project
- C** No EAHCP activities conducted in 2024.

Comal System

The **Old Channel bank stabilization** project construction was completed during 2016 and thus no calculations were included in the 2024 evaluation for that finished project. Similarly, the **Flow-split management** project was completed in spring 2014 and involved portions of Landa Lake and the Old Channel. Activities conducted in 2024 involved routine operation and maintenance that did not extend out beyond the existing renovated structure. As such, there was no additional footprint for this project in 2024.

The **restoration and maintenance of native aquatic vegetation** project involved restoration activities in the Comal system as shown in Figure 1. These activities included routine aquatic gardening and restoration plantings of native aquatic vegetation for portions of the start and finish of the year. However, only essential gardening and maintenance activities were conducted when the Comal system fell below 130 cfs (Provision M). The 2024 project footprint for native vegetation restoration activities are quantified in Table 2. As noted in Table 2, the project footprint of the Native Aquatic Vegetation restoration effort in the Comal system encompassed 865 m² of which 380 m² overlaps with occupied Fountain Darter habitat. There was not any overlap with occupied habitat for the endangered Comal invertebrates. Although not quantified for this assessment, disturbance from foot traffic to and from these locations and from slightly elevated turbidity during non-native vegetation removal did temporarily occur.

The **Sediment Island removal** project in the Old Channel was completed in 2013 and thus no calculations were included in the 2024 evaluation for that finished project. Activities associated with supplemental planting of native aquatic vegetation in that section of the Old Channel were covered under the native aquatic restoration project. As presented in previous years, there is no project footprint map for the **Decaying Vegetation Removal** project as it was conducted throughout the main portion of Landa Lake and the New Channel on an as needed basis when floating mats of aquatic vegetation had built up. As such, no quantified area of impact was designated in 2024 for this activity. Temporary disturbance resulting from occasional foot traffic within Fountain Darter occupied habitat did occur as well as slightly elevated turbidity downstream from immediate work zone. The **Aeration** project in Landa Lake was discontinued in 2018 and thus no calculations were included in the 2024 evaluation.

The **Gill parasite** project involved one-time water sampling at designated cross sections in 2024 via kayak and thus no impacts were noted for this activity. As in previous years, the **Riffle beetle restoration** project only involved on shore activities (Figure 2). The **Non-native animal species removal** project had no project footprint map as methodologies are conducted throughout Landa Lake and the Comal River without permanent or temporary installation of equipment. Most all work was conducted via snorkel or SCUBA in areas of high fish density with non-native fish being speared. **Riparian restoration** was continued in 2024 and involved a project footprint of 9,130 m². The riparian treatment areas are depicted on Figure 3 and quantified in Table 2. All activities were conducted on the banks and water's edge and did not overlap with any occupied habitat for the covered species.

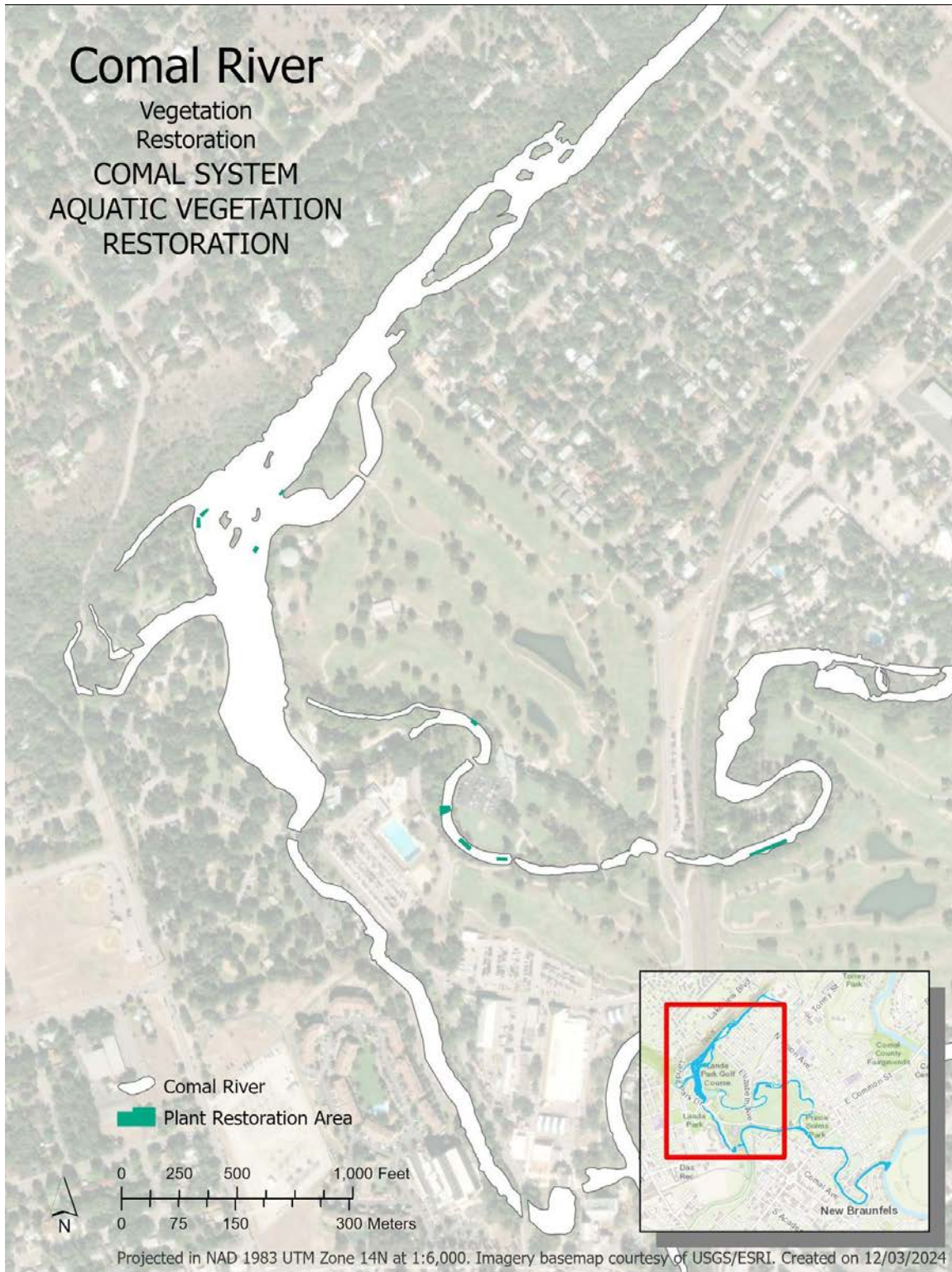


Figure 1. Restoration and Maintenance of Native Aquatic Vegetation project in the Comal system.

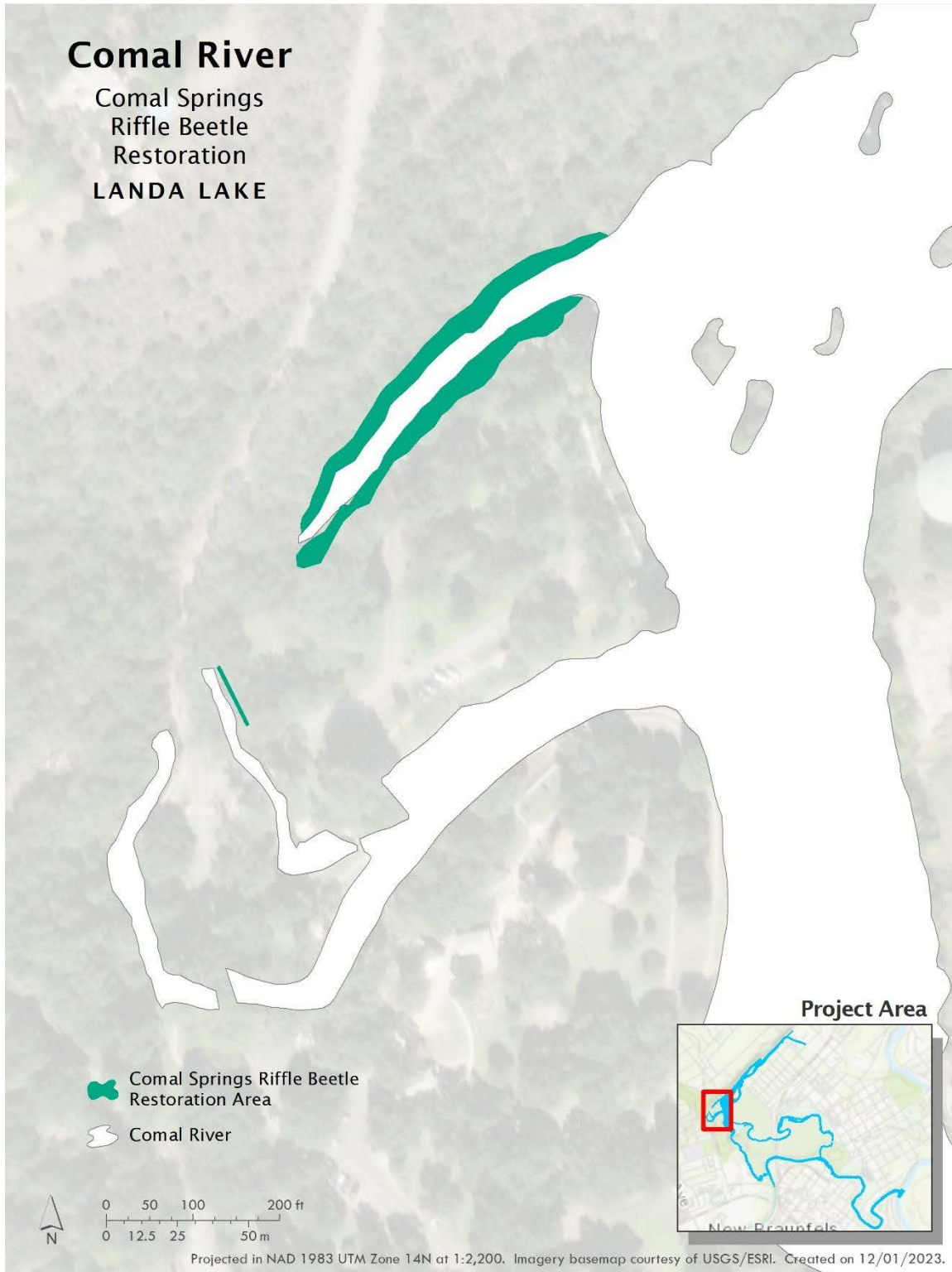


Figure 2. Comal Springs Riffle Beetle Restoration project – Comal System.

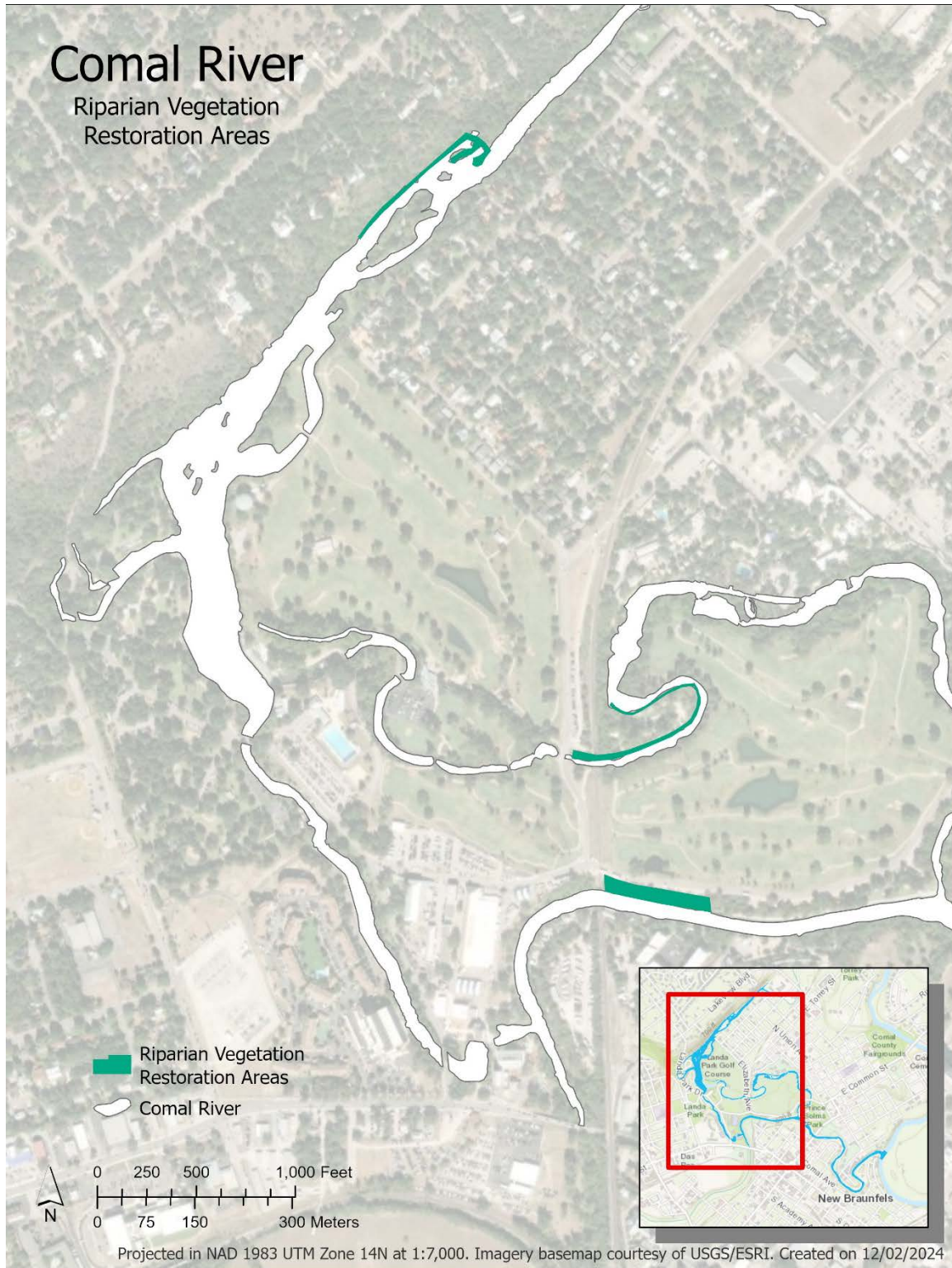


Figure 3. 2024 Riparian Vegetation Restoration Areas – Comal System.

San Marcos System

The **Enhancement and restoration of Texas wild-rice** and **Restoration and maintenance of native aquatic vegetation** project areas are depicted in Figure 4. As described in the ITP Annual Report, select non-native aquatic vegetation was removed from these areas allowing native vegetation (including Texas wild-rice) to expand over 2024. Native aquatic vegetation was also planted in cleared areas within these sections to promote restoration activities where practical and appropriate. These activities included routine aquatic gardening and restoration plantings of native aquatic vegetation for the start of the year. However, only essential gardening and maintenance activities were conducted after the San Marcos system fell below 120 cfs (Provision M). As evident in Table 2, the working project area supports a footprint of 1,855 m² of which 830 m² overlaps with Fountain Darter occupied habitat. Although not quantified for this assessment, disturbance from foot traffic to and from these locations and from slightly elevated turbidity during non-native vegetation and sediment island removal did temporarily occur.

Total system discharge in the San Marcos River declined below 120 cfs during the spring and thus, four Texas wild-rice **Protection Zones** were maintained in 2024 (Figure 5). These areas included Clear Springs, river left; immediately below Sewell Park, river right; directly across from the Veramendi access point, river left; and Bicentennial Park, river right. The total footprint of these areas resulted in the protection of approximately 6,000 m². The upstream protection zone in the eastern spillway below Spring Lake Dam was strategically placed over Fountain Darter and San Marcos salamander occupied habitat as well as Texas wild-rice. Although this area overlaps each of these covered species occupied habitats, the majority of the project footprint is a net benefit from the protection of recreation in these areas. The impact areas listed in Table 2 represent a 0.5 m swath across the floating buoy installation path of the protection zones to account for the placement of the floating buoys (78.68 total linear feet) used to deter recreators. As such, the total disturbance area for the four protection zones was 39.3 m² for the Fountain Darter.

As in years past, there is no project footprint map for the **Non-native animal species removal** project as it was conducted throughout Spring Lake and the San Marcos River without permanent or temporary installation of equipment. Most work was conducted via snorkel or SCUBA in areas of high fish density with non-native fish being speared.

There was no new EAHCP work in 2024 with respect to **Access Points** or **Bank Stabilization** in the San Marcos system and thus, no calculations were included in the 2024 evaluation. The **Riparian restoration** project along the San Marcos River in 2024 involved a project footprint of approximately 4,367 m². The active riparian treatment areas are depicted on Figure 6 and quantified in Table 2. As in years past, the riparian restoration project took place on the banks and water's edge and did not overlap with any occupied habitat for the covered species.

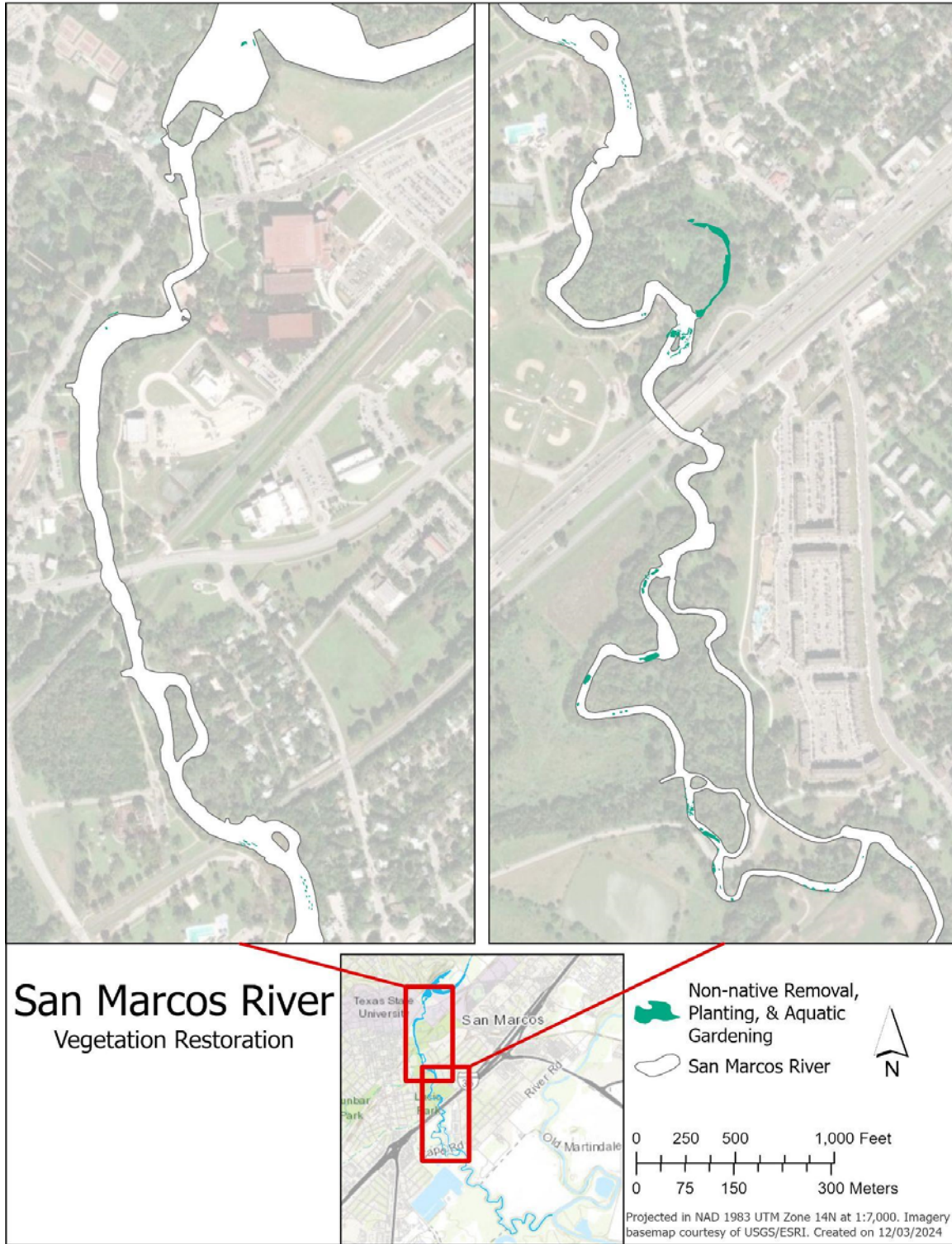


Figure 4. Restoration and Maintenance of Native Aquatic Vegetation and Enhancement of Texas wild-rice projects – San Marcos River.

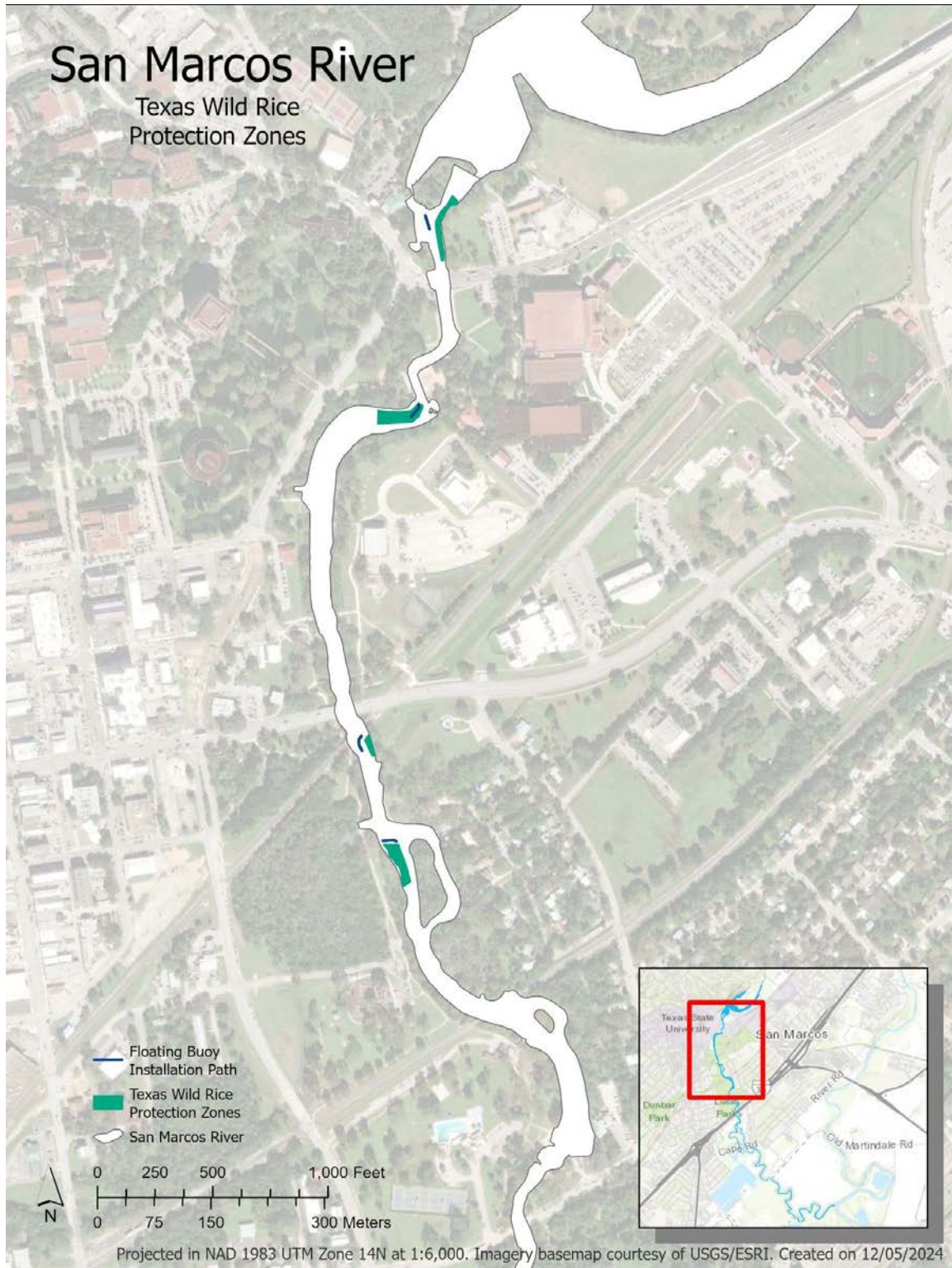


Figure 5. Four Texas wild-rice Protection Zones maintained during 2024 – San Marcos River.

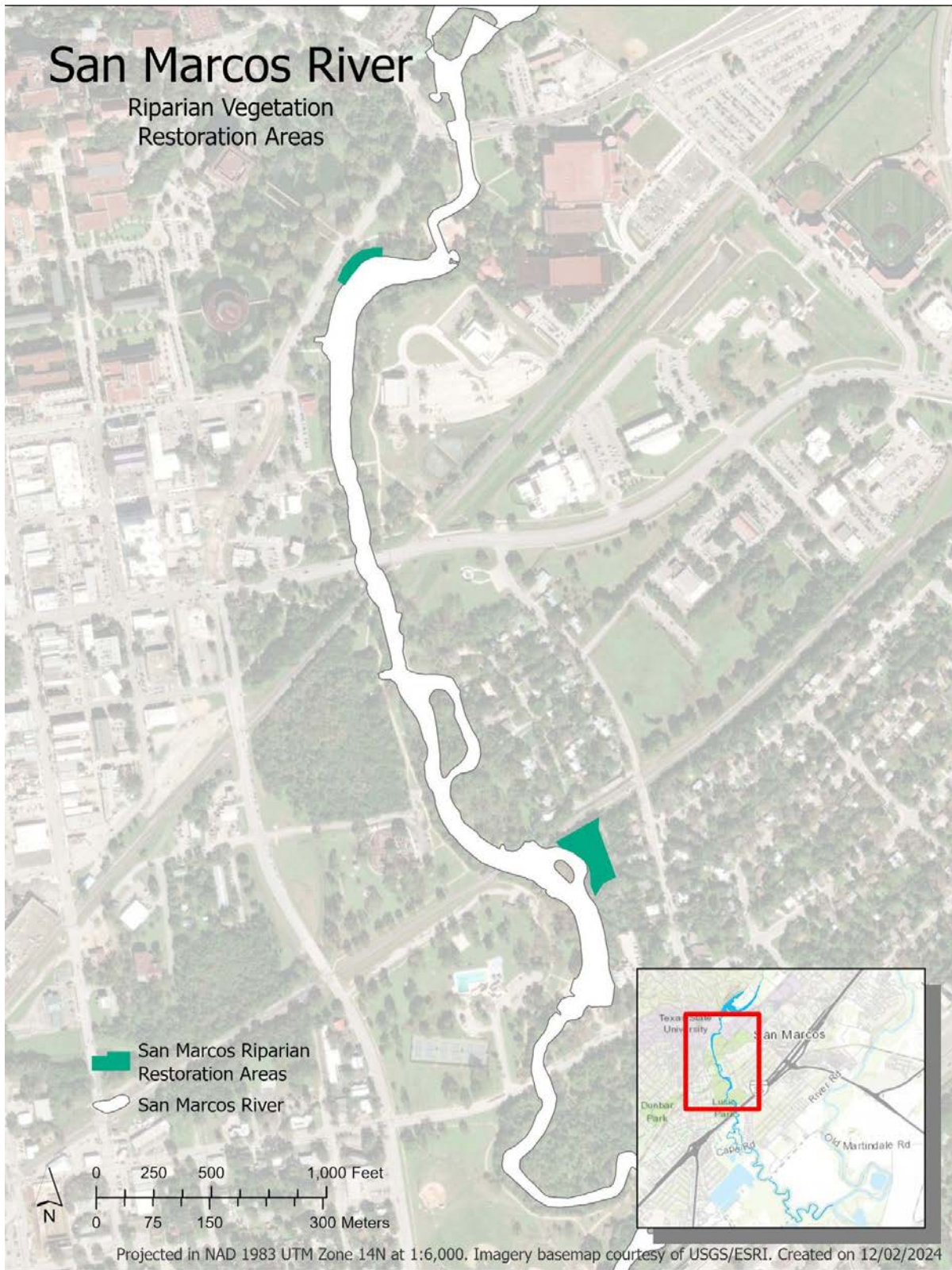


Figure 6. 2024 Riparian Restoration areas – San Marcos River.

Net Disturbance Assessment:

As described above, the baseline maps of occupied habitat versus the HCP project footprint maps were examined to quantify the area of potential effects from mitigation and restoration activities as required in Item M (1a and 2a). This included a system-wide assessment of net disturbance. The focus was on quantifying the direct impacts via areal coverage of activity, but temporary disturbance from slightly elevated turbidity and increased foot traffic were also described. Table 3 shows the Net Disturbance calculation which is simply the sum of all project impact area that is overlaying baseline occupied habitat for a given covered species per system. As shown in Table 3, only the Fountain Darter had < 0.5% net disturbance when considering the project footprints overlaid on occupied habitat in both systems.

TABLE 3. Net Disturbance Area and Percentage of Total per Species per System

COVERED SPECIES	Total Occupied Habitat (m ²)	Net Disturbance	
		Impact Area (m ²)	% of Total
CITY OF NEW BRAUNFELS			
Fountain Darter	109,209	380	< 0.5%
Comal Springs riffle beetle	2,678	0	--
Comal Springs dryopid beetle	827	0	--
Peck’s cave amphipod	2,838	0	--
CITY OF SAN MARCOS / TEXAS STATE UNIVERSITY			
Fountain Darter	94,596	869	< 0.5%
San Marcos salamander	2,520	0	--
Texas blind salamander	^A		
Comal Springs riffle beetle	11	0	--
Comal Springs dryopid beetle	0.5	0	--

^A No surface habitat documented for this species.

For the San Marcos salamander, Texas blind salamander, Comal Springs riffle beetle, Comal Springs dryopid beetle or Peck’s cave amphipod, there were no activities conducted in 2024 that directly impacted any of the locations or orifices where collections have routinely been made over the years. As such, no direct impacts to subterranean or aquifer habitat was experienced from 2024 HCP mitigation and restoration measures in the San Marcos system.

In summary, the ITP 10% disturbance rule (Item M [a]) was in compliance for 2024.

SECTION 2 - INCIDENTAL TAKE

All discussions presented in this section relate back to the USFWS Biological and Conference Opinions for the Edwards Aquifer Recovery Implementation Program Habitat Conservation Plan – Permit TE-63663A-1 (Consultation No. 21450-2010-F-0110), hereafter, Biological Opinion. The 2024 incidental take assessment described in this section was conducted in the same manner as previous years by first being broken down into two distinct categories to be carried forward in the assessment. The first category involves HCP mitigation and restoration activities specifically accomplished within the two springs ecosystems. These projects were the focus of the SECTION 1 - Item M net disturbance assessment. The second category pertains to covered activities that are foundational components (flow protection and springflow management measures) and on-going activities (water borne recreation, water diversions, existing water management infrastructure and operation, etc.). Each category is assessed independently below and then summed to represent the total amount of incidental take observed in 2024. Although calculated independently, a foundational first step to both assessments was the documentation of “occupied” habitat for the covered species as described in SECTION 1 (Table 1, Appendix A).

As described in SECTION 1, the baseline maps of occupied habitat versus the HCP project footprint maps were examined to quantify the area of potential effects from mitigation and restoration activities in Item M (1a and 2a) (Table 2). The focus was on quantifying the direct impacts (removal of non-native vegetation, removal of sediment, permanent placement of equipment, etc.) via areal coverage of activity, but temporary disturbance from slightly elevated turbidity and increased foot traffic were also qualitatively described. Table 3 in SECTION 1 shows the net disturbance calculation which is the sum of all project impact area that is overlaying baseline occupied habitat for a given covered species per system.

HCP MEASURES and DROUGHT: Documentation of impacted habitat for all other applicable HCP Covered Activities

In addition to characterizing the impacted habitat from direct HCP mitigation measures and restoration activities as described SECTION 1, this assessment also addresses impacted habitat from all other applicable HCP Covered activities. As previously referenced, these other activities will be referred to as “HCP measures and drought” throughout the remainder of this assessment. As with the net disturbance assessment and Biological Opinion, this evaluation uses impacted habitat as the foundation for subsequent analysis. A discussion for each covered species is presented below.

Fountain Darter:

A wealth of aquatic vegetation data over time is available per the long-term biological monitoring that has been conducted by EAA since 2000. The health and abundance of the Fountain Darter is strongly tied to the quantity and quality of aquatic vegetation present in both the San Marcos and Comal systems. As such, the determination was made to use the current aquatic vegetation data to characterize and quantify the amount of impacted habitat that occurred in 2024 relative to HCP measures and drought. Spring and fall sampling efforts for aquatic vegetation have been conducted in seven sample reaches (4 in Comal and 3 in San Marcos) since 2002. The sample reaches for the Comal System are shown in Figure 7 and include the Upper Spring Run sample reach, Landa Lake sample reach, New Channel sample reach, and Old Channel sample reach. The sample reaches for the San Marcos system are shown in Figure 8 and include the Spring Lake Dam sample reach, City Park sample reach, and the I35 sample reach. For both systems (Figures 7 and 8), the corresponding river section that corresponds to each sample reach is also shown.

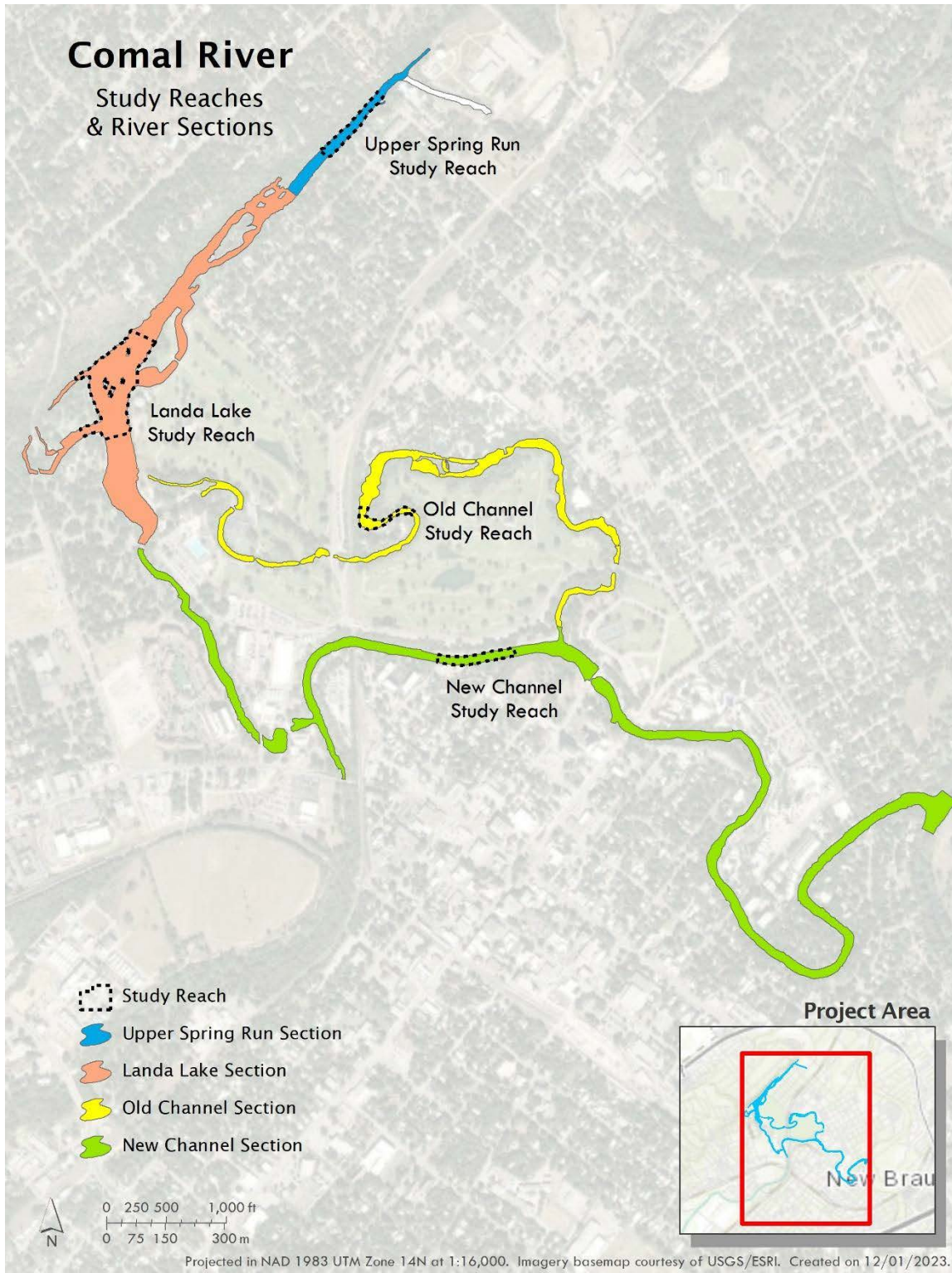


Figure 7. Study Reaches (4) for the Comal System and Corresponding River Section.

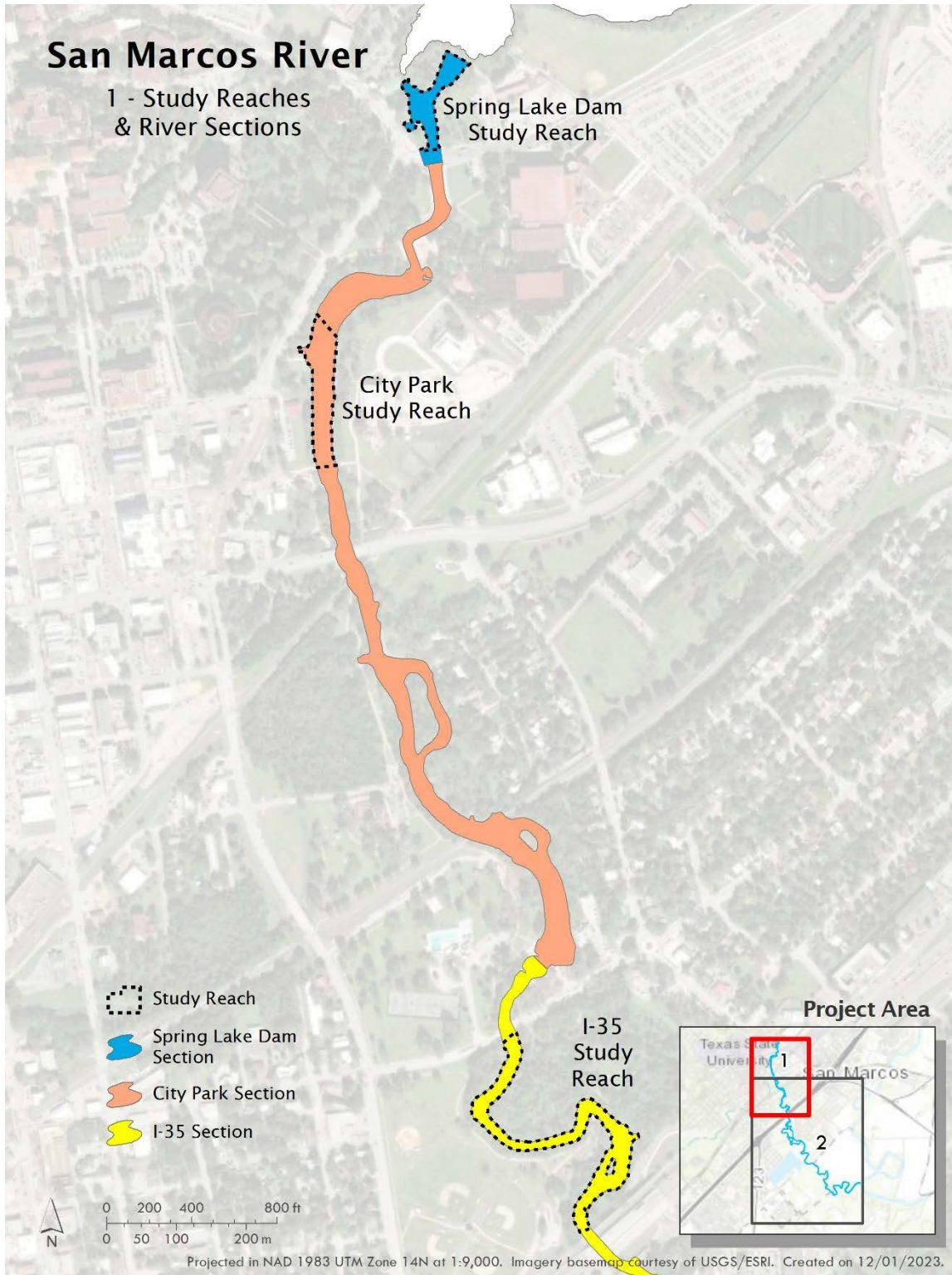


Figure 8. Study Reaches (3) for the San Marcos System and Corresponding River Section.

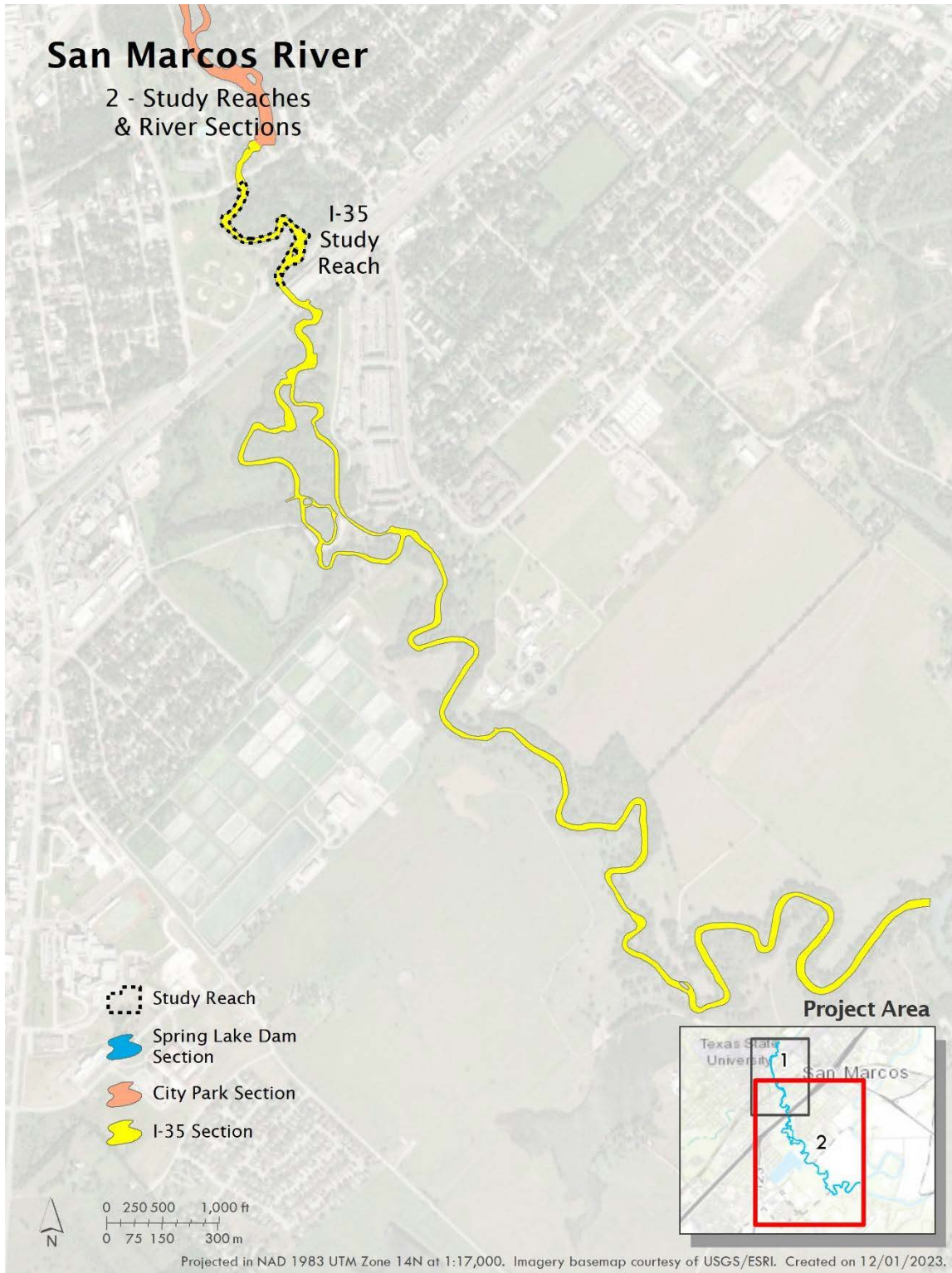


Figure 8 cont. I35 Study Reach and Corresponding Lower River Section in the San Marcos System.

The first step in this analysis was to compile all the spring and fall coverage of individual aquatic vegetation species from each of the seven sample reaches over time. All rooted aquatic vegetation per reach per event was combined into a total aquatic vegetation amount. Green algae were not included in the assessment because it is not rooted, is poor quality Fountain Darter habitat, and has a high level of variability from year to year. Although bryophytes are not rooted, they were included in the assessment for the slow-moving sample reaches of Landa Lake and the Upper Spring Run in the Comal system only. The main river sections that support a defined channel and greater velocities result in highly variable conditions for the non-rooted bryophytes in the New and Old Channels of the Comal River and all three reaches in the San Marcos River. However, in the Landa Lake and Upper Spring Run sample reaches, relationships between bryophytes and total system discharge are apparent, and bryophytes provide high quality Fountain Darter habitat in these reaches.

Table 4 shows the percentage retention in aquatic vegetation observed from spring to fall for average years as well as individually for 2024. As evident in Table 4, all study reaches in the Comal system, except the Old Channel, experienced a decline relative to average conditions in overall aquatic vegetation in 2024 from spring to fall. In the San Marcos system, both the Spring Lake Dam and City Park study reaches experienced declines (relative to average conditions) in aquatic vegetation from spring to fall in 2024 (Table 4).

Table 4. Percentage Retention of aquatic vegetation from Spring to Fall per sample reach per system.

Scenario	Percentage Retention in Aquatic Vegetation from Spring to Fall						
	Comal System Sample Reaches				San Marcos System Sample Reaches		
	Upper Spring Run	Landa Lake	Old Channel	New Channel	Spring Lake Dam	City Park	I35
Average Flow Condition Years	83.34%	95.98%	102.58%	122.40%	89.22%	91.74%	97.76%
Spring 2024 coverage (m ²)	3,121.88	16,058.71	384.04	2,860.80	1,616.46	3,766.31	2,020.40
Fall 2024 coverage (m ²)	2,652.02	15,996.26	384.25	2,814.79	1,427.53	2,737.52	2,085.14
2024 Spring to Fall Retention	84.95%	99.61%	100.05%	98.39%	88.31%	72.68%	103.20%

Table 5 shows the conversion process from percentage retention between spring and fall aquatic vegetation during average years when compared directly to 2024. Using the City Park sample reach as an example, there is approximately an 92% retention during average years. This implies that under average conditions in the City Park reach there is an approximate 8% decline in aquatic vegetation observed from spring to fall each year. This amount is considered a pre-HCP condition because 1) it is calculated based on routine conditions prior to the HCP, and 2) during average years, a lot of HCP measures would not be actively engaged. As such, the difference in retention (91.74 [average] – 72.68% [2024] = 19.06%) is the value used to assess the overall loss of Fountain Darter occupied habitat within this river section. As shown in Table 5, only the New Channel reach in the Comal system showed a 2024 decline greater than average conditions resulting in 540 m² of impacted habitat. As previously noted, both the Spring Lake Dam and City Park study reaches in the San Marcos River experienced declines greater than average conditions during 2024. The percent difference from these reaches multiplied by the total m² from the entire section results in 12 m² for the Spring Lake Dam section and 5,296 m² for the City Park section (Table 4). For this

incidental take assessment, those values are considered the amount of habitat that was impacted by the HCP Measures and Drought category for those particular river sections.

Table 5. Total Impacted Area (m²) for the Fountain Darter based on percentage retention of aquatic vegetation from Spring to Fall per sample reach per system.

Scenario	Percentage Retention in Aquatic Vegetation from Spring to Fall						
	Comal System Sample Reaches				San Marcos System Sample Reaches		
	Upper Spring Run	Landa Lake	Old Channel	New Channel	Spring Lake Dam	City Park	I35
Average Flow Condition Years	83.34%	95.98%	100%	100%	89.22%	91.74%	97.76%
2024 Actual	84.95%	99.61%	100.05%	98.39%	88.31%	72.68%	103.20%
HABITAT CALCULATIONS applied to river sections							
Difference between Average and 2024 (%)	0%	0%	0%	1.61%	0.91%	19.06%	0%
Total Fountain Darter Occupied Habitat (m ²) per entire river section	3,294	47,653	24,686	33,576	1,294	27,788	12,323
2024 Total Impacted Area (m ²)	0	0	0	540	12	5,296	0

Comal Springs Invertebrates:

To calculate the impacted habitat area for the Comal Springs riffle beetle, Comal Springs dryopid beetle, and Peck’s cave amphipod, areas of disturbance in 2024 (not including the HCP mitigation and restoration measures assessed separately) were assessed and area of impact quantified by overlapping area of disturbance and occupied habitat. The occupied habitat maps for each of the Comal invertebrates are described in SECTION 1 and displayed in Appendix A. In 2024, disturbances pertaining to HCP measures and drought to the Comal invertebrate species were the drying of surface area in the spring runs, western shoreline, and Spring Island area in late summer/fall.

With HCP measures in place, the 2024 drought resulted specifically in the drying of surface habitat in Spring Run 1, Spring Run 2, Spring Run 4, Spring Run 5, along the fringe of the western shoreline of Landa Lake, and within the Spring Island area. This disturbance resulted in the total 2024 amount of calculated impacted invertebrate habitat area displayed in Table 6. Please note that the overall area of exposed substrate in the system in 2024 was greater than quantified in Table 6, as that value represents only the exposed surface substrate overlapping with occupied habitat for each covered species. This approach was used to stay consistent with the occupied habitat approach used for each covered species. Additionally, any impacted area calculated in 2023 (Table 6) that was not consistently re-wetted during 2024 was subtracted from the 2024 total for the annual take assessment per USFWS guidance. This was done to avoid duplicative counting of incidental take for areas that were already impacted and counted, but not yet recovered from an on-going drought.

For the Comal invertebrates, no attempt was made to characterize subsurface habitat in this assessment. If a documented occupied habitat point had exposed substrate, it was included regardless of potential downward migration. When comparing against the occupied habitat maps, the greatest area of disturbance for the Comal Springs riffle beetles and Peck’s cave amphipods were in the Spring Runs and around the

Western Shoreline, while the main area of disturbance for the Comal Springs dryopid beetle was Spring Runs 1 and 2.

Table 6. Total Impacted Area (m²) for the Comal Springs Invertebrates.

Covered Species	2024 Impacted Occupied Habitat Area (m ²)			
	Main Spring Runs	Western Shoreline	Spring Island	TOTAL 2024 (2023)
Comal Springs riffle beetle	269.9	257.3	79.1	606.4 (379.1)
Comal Springs dryopid beetle	166.3	0.5	29.4	196.3 (119.7)
Peck’s cave amphipod	254.2	255.7	74.6	584.5 (553.6)

San Marcos salamander:

As San Marcos salamander habitat below Spring Lake Dam and in Spring Lake remains fairly consistent from spring to fall, there was no attempt to quantify direct habitat changes. Additionally, there was not any notable drying of surface habitat in the Spring Lake Dam section in 2024. As such, there was no quantification of disturbance using exposed surface area overlapping with occupied habitat. Therefore, the only known disturbance of occupied San Marcos salamander habitat in 2024 was from recreational activities below Spring Lake dam. As there is not a quantification of recreation in this sample reach, the percentage of retention of aquatic vegetation in the Spring Lake dam reach calculated for the Fountain Darter was used (as in each previous year) for the San Marcos salamander as a surrogate for disturbance. As shown in Table 5, there was a 12 m² impacted area calculated for the Spring Lake Dam reach.

Texas blind salamander:

There is no surface habitat documented in the Item M assessment (SECTION 1) for the Texas blind salamander. There were no aquifer impacts noted via HCP measures or drought in 2024, and thus, no impacted habitat is reported for the Texas blind salamander in this assessment.

INCIDENTAL TAKE CALCULATIONS

The next step in the analysis is converting the impacted habitat area to incidental take of individuals so that a comparison can be made to the ITP permit. As in all previous years, incidental take was again scaled in accordance with the condition of the system at that particular time. For instance, incidental take caused by a reduction of 10% of the occupied habitat in the system is not the same proportionally to a condition where 40%, 70%, or 90% of the occupied habitat is removed from the system. The rationale is that when only a small amount of habitat is removed, a large portion of quality habitat remains for the covered species to utilize. However, when larger portions of occupied habitat are reduced, the situation inherently becomes more stressful for the individuals. As in previous years, the densities of the covered species recorded over time via EAA biological monitoring in both systems prior to HCP implementation were used (Table 7).

Table 7. Descriptive statistics of Covered Species density by System

Covered Species	Density (individuals per m ²) Descriptive Statistics (Percentiles and Mean)				
	25	Median	Mean	75	90
Fountain Darter					
Comal system	1.50	6.00	11.35	15.50	29.30
San Marcos system	1.50	3.50	5.90	7.00	13.00
Comal Springs riffle beetle	6.60	9.10	10.71	12.40	19.38
Comal Springs dryopid beetle^A	-	-	0.10	-	-
Peck’s cave amphipod	1.04	1.67	2.05	2.33	4.33
San Marcos salamander					
San Marcos River	3.00	6.00	6.08	8.50	10.5
Spring Lake	10.00	12.00	13.17	16.25	19.00

^A Too few collected to use full set of descriptive statistics

To account for a scaled approach for calculating incidental take (increased impacts with increased levels of habitat loss); the following schedule (Table 8) was used to determine which density statistic to multiply by impacted habitat area to generate the incidental take estimate. The schedule is based on remaining occupied habitat per covered species per system. For example, if 30% of the total occupied habitat was impacted for the Fountain Darter in the San Marcos system that would leave 70% of the occupied habitat for the Fountain Darter. For the incidental take calculation, the median density for the Fountain Darter (3.5 darters per m², Table 7) would be used to multiply against the total impacted area.

Table 8. Density assignment schedule based on remaining occupied habitat

Remaining Occupied Habitat Percentage	Corresponding Density Statistic
100 to 75	25%
74 to 50	Median
49-25	Mean
24-10	75%
9-0	90%

In 2024, water temperature conditions within several reaches were elevated above the potential for impacts to Fountain Darter life stages and reproductive success based on literature (Brandt et al. 1993, Bonner et al. 1998, McDonald et al. 2007). Although spawning success and larval growth show declines in a laboratory setting at temperatures over 27 °C, it is a conservative temperature trigger; the lethal limit (50% mortality) for larval fountain darters is 31.9° C and approximately 3.0° C higher for adults (Brandt et al. 1993, Bonner et al. 1998, McDonald et al. 2007). Figures 9 and 10 show water temperature ranges observed in each system over the course of 2024, the past five years, and over the long-term. To account for potential additional impacts from elevated water temperatures, a density assignment scale was developed for water

temperature specific to the Fountain Darter. This scale is presented in Table 9 with the corresponding density statistic increasing per elevated temperature ranges. This scale is to be used in combination with the density assignment schedule for remaining occupied habitat percentage (Table 8), with the higher of the two applied to that specific reach when making final calculations of incidental take. In the Comal System, the Upper Spring Run Reach (Heidelberg and Booneville Far) exceeded 30 °C resulting in an adjustment to the Mean density statistic; while the New Channel reach exhibited temperatures between 27 to 29 (Figure 9) requiring an adjustment to the Median density statistic for this reach. In the San Marcos system, the City Park reach exhibited temperatures between 27 to 29 °C (Figure 10) and thus an adjustment to the Median density statistic was applied.

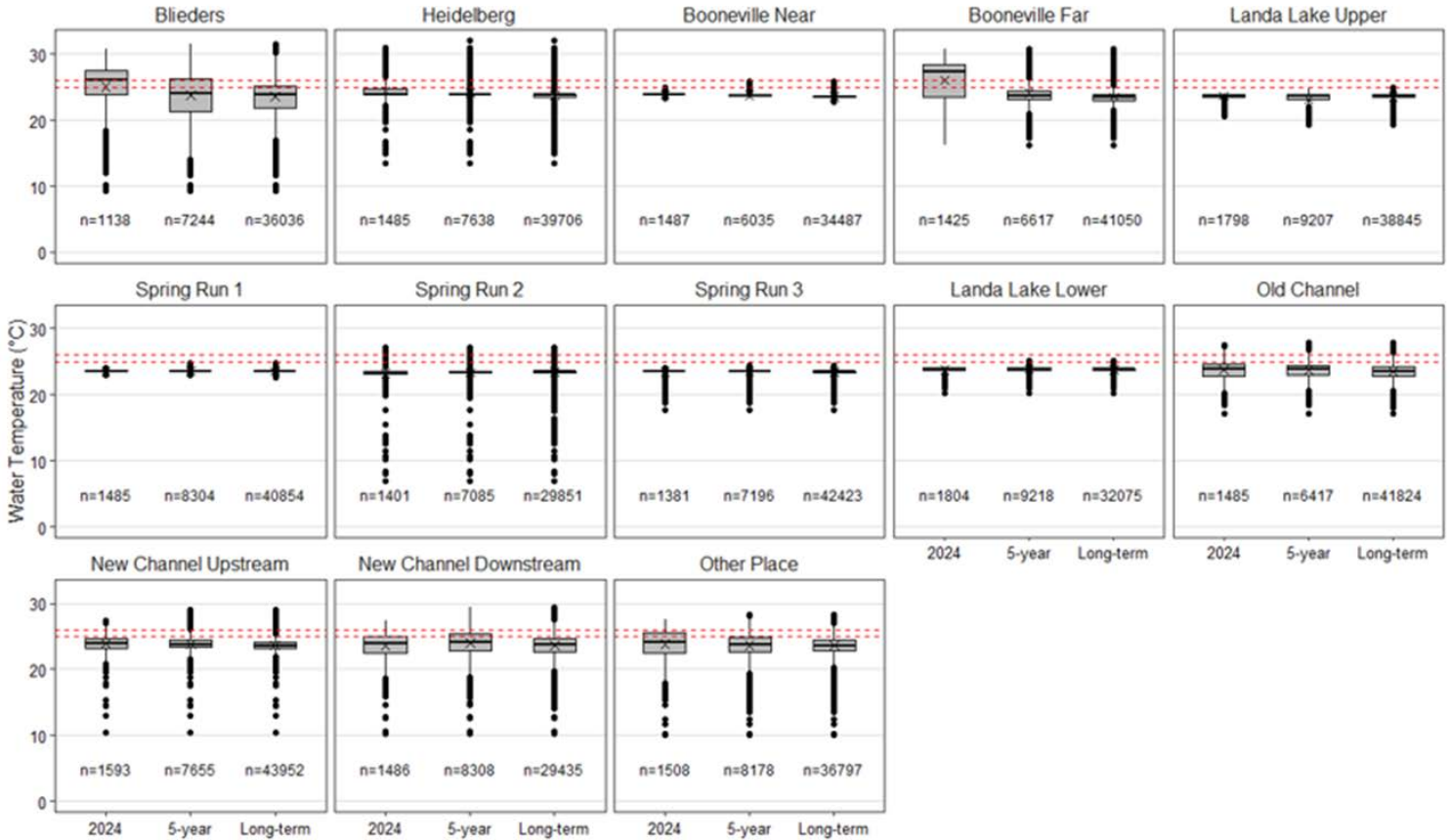


Figure 9. Boxplots displaying 2024, 5-year (2020–2024), and long-term (2020–2024) water temperature trends in the Comal Springs/River. The thick horizontal line in each box is the median, x represents the mean, and the upper/lower bounds of each box represents the interquartile range. Whiskers represent minimum/maximum values up to 1.5 times the interquartile range, and outliers beyond this are designated with solid black circles. The “n” values along the x-axis represent the number of individual temperature measurements in each category. The lower and upper red dashed lines indicate maximum optimal temperatures for Fountain Darter larval (≥ 25 °C) and egg (≥ 26 °C) production (McDonald et al. 2007), respectively.

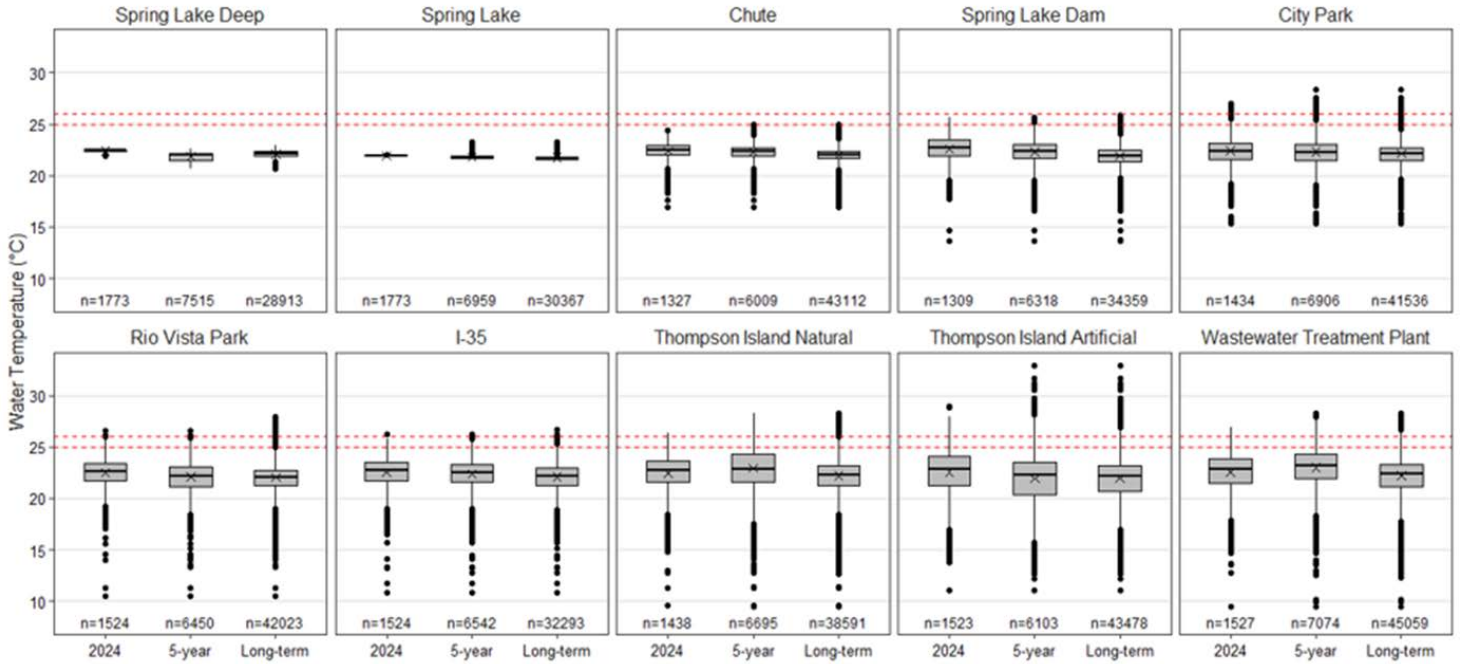


Figure 10. Boxplots displaying 2024, 5-year (2020–2024), and long-term (2020–2024) water temperature trends in the San Marcos Springs/River. The thick horizontal line in each box is the median, x represents the mean, and the upper/lower bounds of each box represents the interquartile range. Whiskers represent minimum/maximum values up to 1.5 times the interquartile range, and outliers beyond this are designated with solid black circles. The “n” values along the x-axis represent the number of individual temperature measurements in each category. The lower and upper red dashed lines indicate maximum optimal temperatures for Fountain Darter larval (≥ 25 °C) and egg (≥ 26 °C) production (McDonald et al. 2007), respectively.

Table 9. Density assignment schedule based on water temperature range within reach

Water Temperature range (°C)	Corresponding Density Statistic
< 27	25%
27 to 29	Median
29 to 31	Mean
31 to 33	75%
> 33	90%

Using the density schedules in Tables 8 and 9, impacted habitat areas calculated in Tables 3, 4, and 5, incidental take calculations were made for each covered species.

Fountain Darter:

Table 10 shows the incidental take calculated for the Fountain Darter in the Comal system and San Marcos system (San Marcos River and Spring Lake) relative to HCP mitigation and restoration activities as well as the HCP measures and drought. It is important to keep the two categories (HCP mitigation / restoration and HCP measures / drought) separate in the analysis. The rationale is that HCP mitigation and restoration activities have a mandate to stay under 10% of the total occupied habitat or cease. Additionally, there is another clause in Provision M of the ITP that these activities should cease under certain low-flow triggers if undesirable impacts are encountered. As such, any impacts from the HCP measures or drought should be calculated independently for an accurate comparison in future drought years.

Table 10. Calculated Incidental Take for the Fountain Darter per system based on impacted habitat and water temperature.

FOUNTAIN DARTER PARAMETERS	COMAL SYSTEM					SAN MARCOS SYSTEM					
	HCP Mitigation / Restoration	HCP Measures / Drought				San Marcos River			Spring Lake		
		Landa Lake	Upper Spring Run*	Landa Lake	Old Channel	New Channel	HCP Mitigation / Restoration	HCP Measures / Drought		HCP Mitigation / Restoration	HCP Measures / Drought
								All reaches	City Park		
2024 Impacted Area (m ²)	380	0	0	0	540	771	5,296	12	59	0	
Total Occupied Habitat (m ²)	109,209	3,294	47,653	24,686	33,576	41,405	27,788	13,617	53,191	53,191	
% of Occupied Habitat Impacted	0.35%	0.00%	0.00%	0.00%	1.61%	1.86%	19.06%	0.09%	0.11%	0.00%	
Corresponding Habitat Percentile Density (individual/m ²)	1.50	1.50	1.50	1.50	1.50	1.50	3.50	1.50	1.50	--	
Water Temperature Percentile Density adjustment	1.50	11.35	1.50	1.50	6.00	3.50	3.50	1.50	1.50	--	
2024 Incidental Take Estimate	570	37,387	0.00	0.00	3,240	2,699	18,536	18	89	0	
2024 TOTAL INCIDENTAL TAKE PER SYSTEM	41,197					21,340					

* Although no spring to fall decrease in submerged aquatic vegetation was documented in the Upper Spring Run study reach, the extreme water temperatures resulted in the application of the Mean Fountain Darter Density to the full amount of occupied habitat in the Upper Spring Run Section.

Comal Springs invertebrates:

Table 11 shows the incidental take calculated for the Comal Springs riffle beetle, Comal Springs dryopid beetle, and Peck’s cave amphipod relative to the HCP mitigation and restoration activities as well as the HCP measures and drought. For the Comal Springs riffle beetle and Peck’s cave amphipod, the percentage of impacted area was less than 25% so the 25th percentile density was applied (Table 7). As previously stated, only the mean is presently available for use in calculating incidental take for the Comal Springs dryopid beetle.

Table 11. Calculated Incidental Take for the endangered Comal Springs invertebrates based on impacted habitat.

COMAL INVERTEBRATES PARAMETERS	Comal Springs Riffle Beetle		Comal Springs Dryopid Beetle		Peck's Cave Amphipod	
	HCP Mitigation / Restoration	HCP Measures / Drought	HCP Mitigation / Restoration	HCP Measures / Drought	HCP Mitigation / Restoration	HCP Measures / Drought
2024 Impacted Area (m ²)	0	227.3	0.0	76.6	0.0	30.9
Total Occupied Habitat (m ²)	2,678	2,678	827	827	2,838	2,838
% of Occupied Habitat Impacted	0.00%	8.49%	0.00%	9.26%	0.00%	1.09%
Corresponding Percentile Density (individual/m ²)	6.60	6.60	0.10	0.10	1.04	1.04
2024 Incidental Take Estimate	0	1,500	0	8	0	32
2024 TOTAL INCIDENTAL TAKE	1,500		8		32	

San Marcos salamander: Table 12 shows the incidental take calculated for the San Marcos salamander in the San Marcos system (San Marcos River and Spring Lake) relative to the HCP mitigation and restoration activities as well as the HCP measures and drought. In 2024, all calculated impacted area was below Spring Lake Dam so only the San Marcos River total occupied habitat area compared against. The percentage of impacted areas for HCP Measures / Drought was 0.8% of total occupied habitat and thus the 25th percentile density was applied for the San Marcos River (Table 9).

Table 12. Calculated Incidental Take for the San Marcos salamander based on impacted habitat.

SAN MARCOS SALAMANDER PARAMETERS	SAN MARCOS SYSTEM			
	San Marcos River		Spring Lake	
	HCP	HCP	HCP Mitigation	HCP
2024 Impacted Area (m ²)	0	12	0	0
Total Occupied Habitat (m ²)	1,530	1,530	990	990
% of Occupied Habitat Impacted	0.0%	0.8%	0.0%	0.0%
Corresponding Percentile Density (individual/m ²)	3.00	3.00	--	--
2024 Incidental Take Estimate	0	36	0	0
2024 TOTAL INCIDENTAL TAKE	36			

Texas blind salamander: There was no impacted habitat reported for the Texas blind salamander in 2024, thus no incidental take was calculated for the Texas blind salamander this year.

COMPILATION OF RESULTS AND SUMMARY

Table 13 summarizes the 2024 impacted habitat area and incidental take attributed to the HCP relative to the ITP permit amount. Per the established methodologies, the Fountain Darter, San Marcos Salamander and Comal Invertebrates experienced incidental take during 2024.

Table 13. Summary of Impacted Habitat (m²) and Incidental Take for HCP Covered Species compared against ITP Permit Amounts.

COVERED SPECIES PER SYSTEM	IMPACTED HABITAT (m ²)		HABITAT 2024 TOTAL (m ²)	INCIDENTAL TAKE		2024 INCIDENTAL TAKE TOTAL	ITP Maximum Permit Amount	ITP Permit Maximum minus (combined first 12 years)
	HCP Mitigation / Restoration	HCP Measures / Drought		HCP Mitigation / Restoration	HCP Measures / Drought			
COMAL SYSTEM								
Fountain Darter	380.0	540.0	920.0	570.0	40,626.9	41,197	797,000	611,518
Comal Springs Riffle Beetle	0	227.3	227.3	0	1,500	1,500	11,179	4,143
Comal Springs Dryopid Beetle	0	76.6	76.6	0	8	8	1,543	1,502
Peck's Cave Amphipod	0	30.9	30.9	0	32	32	18,224	16,986
SAN MARCOS SYSTEM								
Fountain Darter	830.0	5,307.6	6,137.6	2,698.5	18,553.2	21,252	549,129	293,554
San Marcos Salamander	0.0	12.0	12.0	0.0	36.0	36	263,857	256,097
Texas Blind Salamander	0	0	0	0	0	0	10	10
Comal Springs Riffle Beetle	0	0	0	0	0	0	n/a	n/a
Comal Springs Dryopid Beetle	0	0	0	0	0	0	n/a	n/a

As shown in Table 13, only the Fountain Darter in the Comal and San Marcos systems had net disturbance when considering the project footprint for HCP mitigation and restoration activities overlaid on occupied habitat in 2024. In both systems, the ITP 10% disturbance rule (Item M [a]) was in compliance for 2024.

With the prolonged, extreme drought conditions experienced in 2024, incidental take was calculated for all four monitored species in the Comal system. Incidental take calculations for the Comal system exceeded those observed in previous drought years, excepting 2023. The primary cause for this increase was low total system discharge which resulted in additionally expanded amounts of exposed surface habitat characterized as Comal invertebrate occupied habitat. Over half of the incidental take calculated for the Fountain Darter was due to elevated water temperatures documented in the Upper Spring Run section. For the San Marcos system, incidental take calculations were also elevated above average conditions in 2024, but not as severe as 2023. It is important to emphasize that the San Marcos River in 2023 experienced the lowest total system discharge since the biological monitoring plan implementation in 2000, and remained lower than average in 2024.

As such, the 2024 spring to fall reductions in aquatic vegetation were greater than most other “drought” years characterized over the past two decades, excepting 2023. The resulting loss of aquatic vegetation / habitat and slightly elevated water temperatures recorded in the City Park section in 2024 led to these calculated conditions.

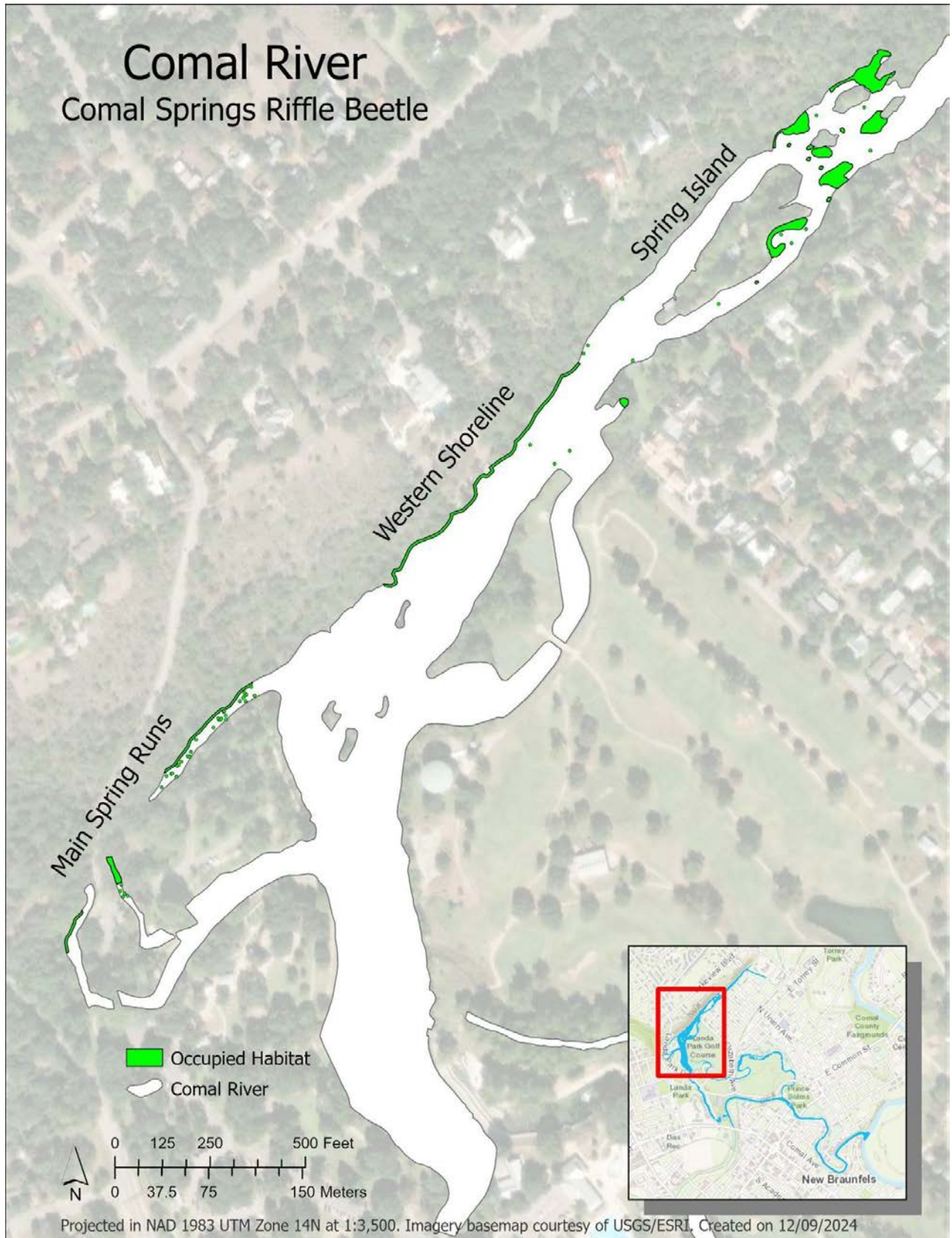
Finally, when examining 2024 results, habitat conditions in both systems were definitely impacted which was reflected by the larger than usual incidental take calculations. However, these larger numbers remain considerably below those characterized in the Biological Opinion Drought of Record (DOR)-like scenario. As such, we are confident the incidental take numbers summarized in Table 13 and documented in this memorandum continue to justify the data sets used and methodologies employed relative to performing an incidental take assessment within the context of the Biological Opinion. It is understood that adjustments to data sets and/or methodologies may be employed based on feedback from the USFWS, HCP Science Committee, HCP participants, or others as deemed appropriate by the EARIP.

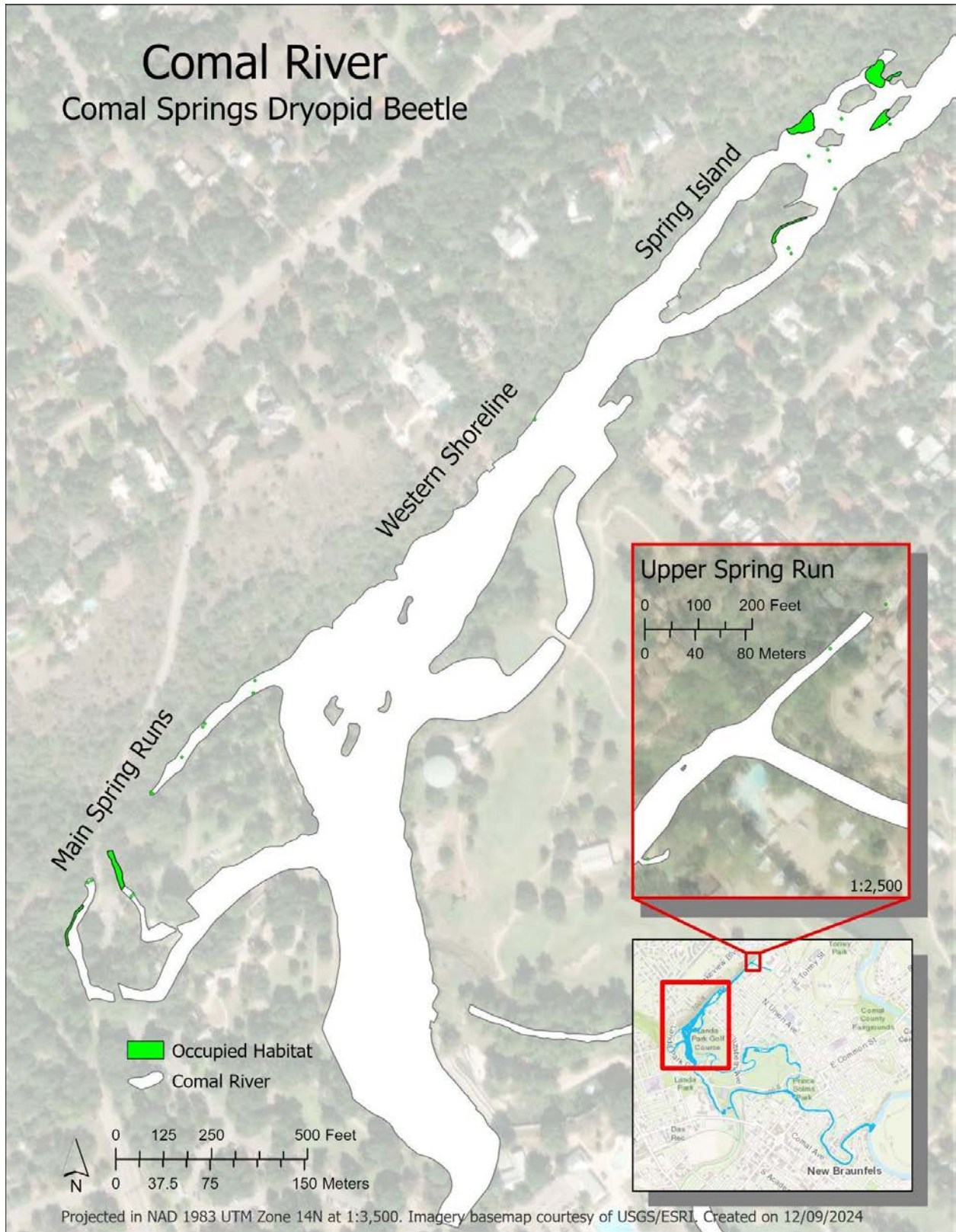
REFERENCES

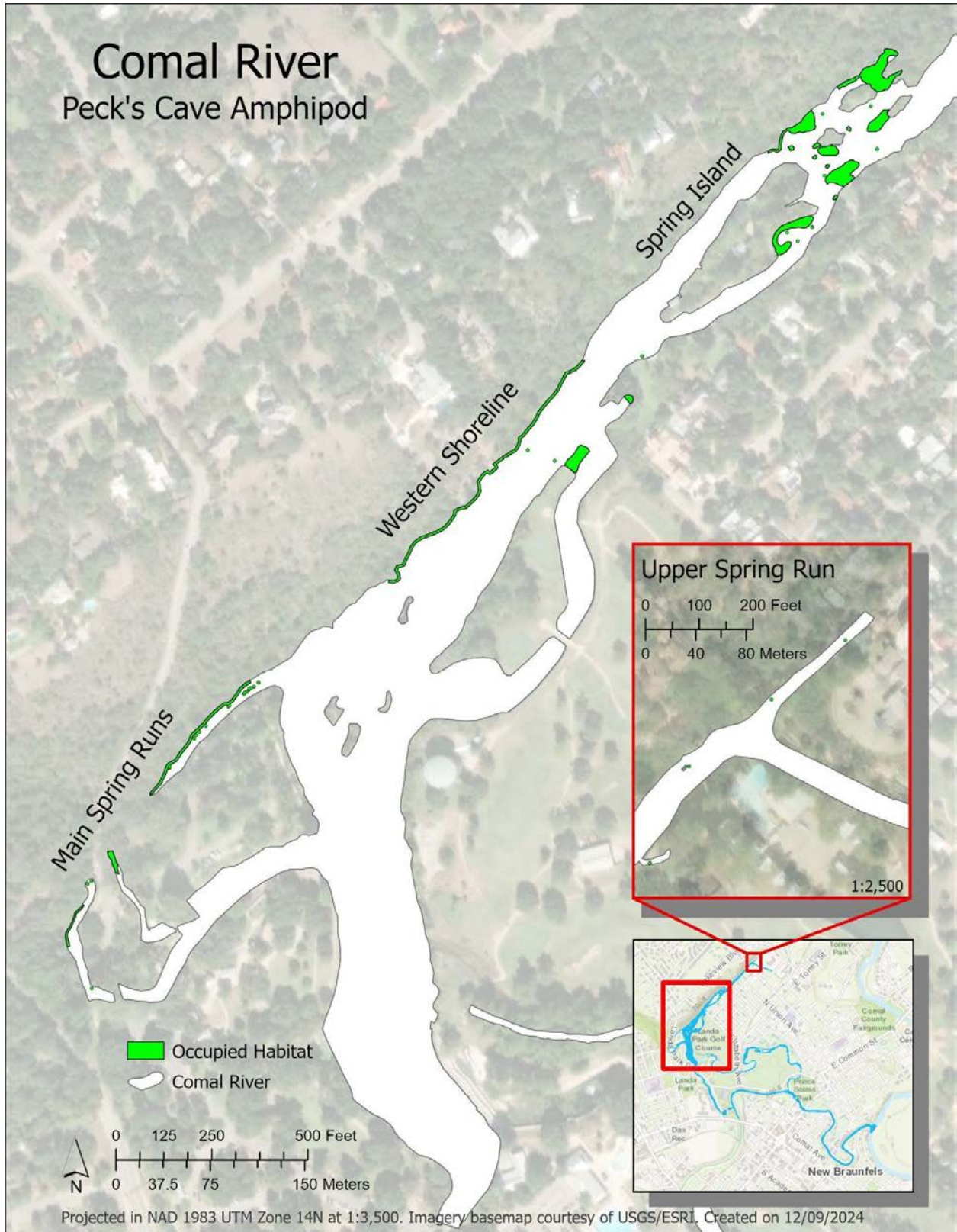
- BIO-WEST, Inc., 2002-2013a, Comprehensive and critical period monitoring program to evaluate the effects of variable flow on biological resources in the Comal Springs/River aquatic ecosystem: Final Annual Reports (2002 through 2012) submitted to the Edwards Aquifer Authority, San Antonio, Texas, variously paginated.
- BIO-WEST, Inc., 2002 - 2013b, Comprehensive and critical period monitoring program to evaluate the effects of variable flow on biological resources in the San Marcos Springs/River aquatic ecosystem: Final Annual Reports (2002 through 2012) submitted to the Edwards Aquifer Authority, San Antonio, Texas, variously paginated.
- BIO-WEST 2014a - 2025a. Habitat Conservation Plan Biological Monitoring Program. San Marcos Springs/River Ecosystem. 2013 to 2024 Annual Reports. Edwards Aquifer Authority.
- BIO-WEST 2014b - 2025b. Habitat Conservation Plan Biological Monitoring Program. Comal Springs/River Ecosystem. 2013 to 2024 Annual Reports. Edwards Aquifer Authority.
- Bonner, T. H., Brandt, T. M., Fries, J. N., and Whiteside, B. G. 1998. Effects of temperature on egg production and early life stages of the Fountain Darter. *Transactions of the American Fisheries Society* 127: 971-978.
- Brandt T.M., K.G. Graves, C.S. Berkhouse, T.P. Simon, and B.G. Whiteside. 1993. Laboratory spawning and rearing of the endangered Fountain Darter. *Progressive Fish-Culturist* 55:149-156.
- [EARIP] Edwards Aquifer Recovery Implementation Program. 2011. Habitat Conservation Plan and Appendices. December 2011.
- McDonald, D. L., T. H. Bonner, E. L. Oborny Jr., and T. M. Brandt. 2007. Effects of fluctuating temperatures and gill parasites on reproduction of the Fountain Darter, *Etheostoma fonticola*. *Journal of Freshwater Ecology* 22: 311-318.
- (USFWS) United States Fish and Wildlife Service, 2010, Biological and Conference Opinions of the Edwards Aquifer Recovery Implementation Program Habitat Conservation Plan Permit TE-63663A-O[Memorandum]. Albuquerque, NM: Department of the Interior 145-146.

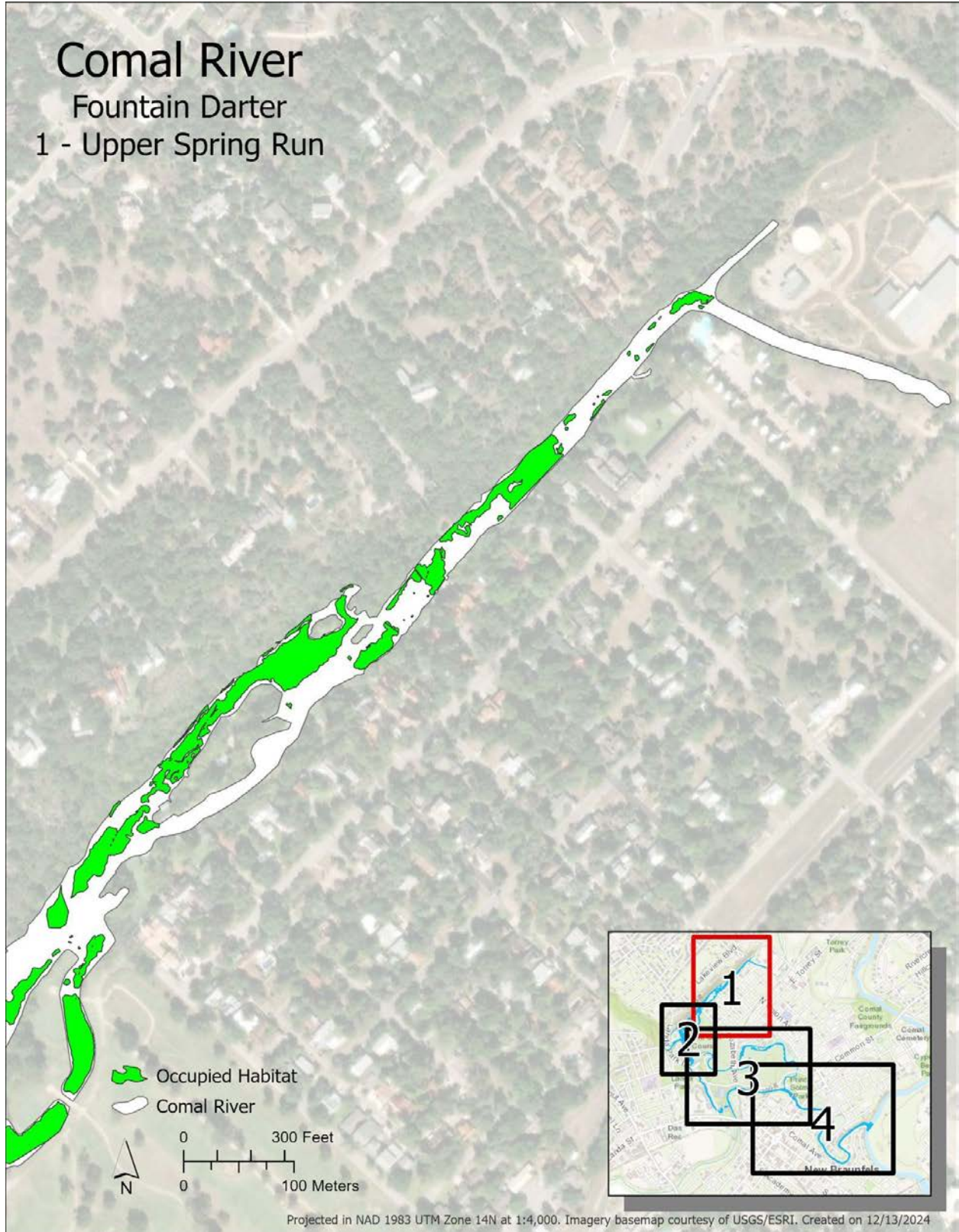
APPENDIX A Covered Species 2024 Occupied Habitat Maps

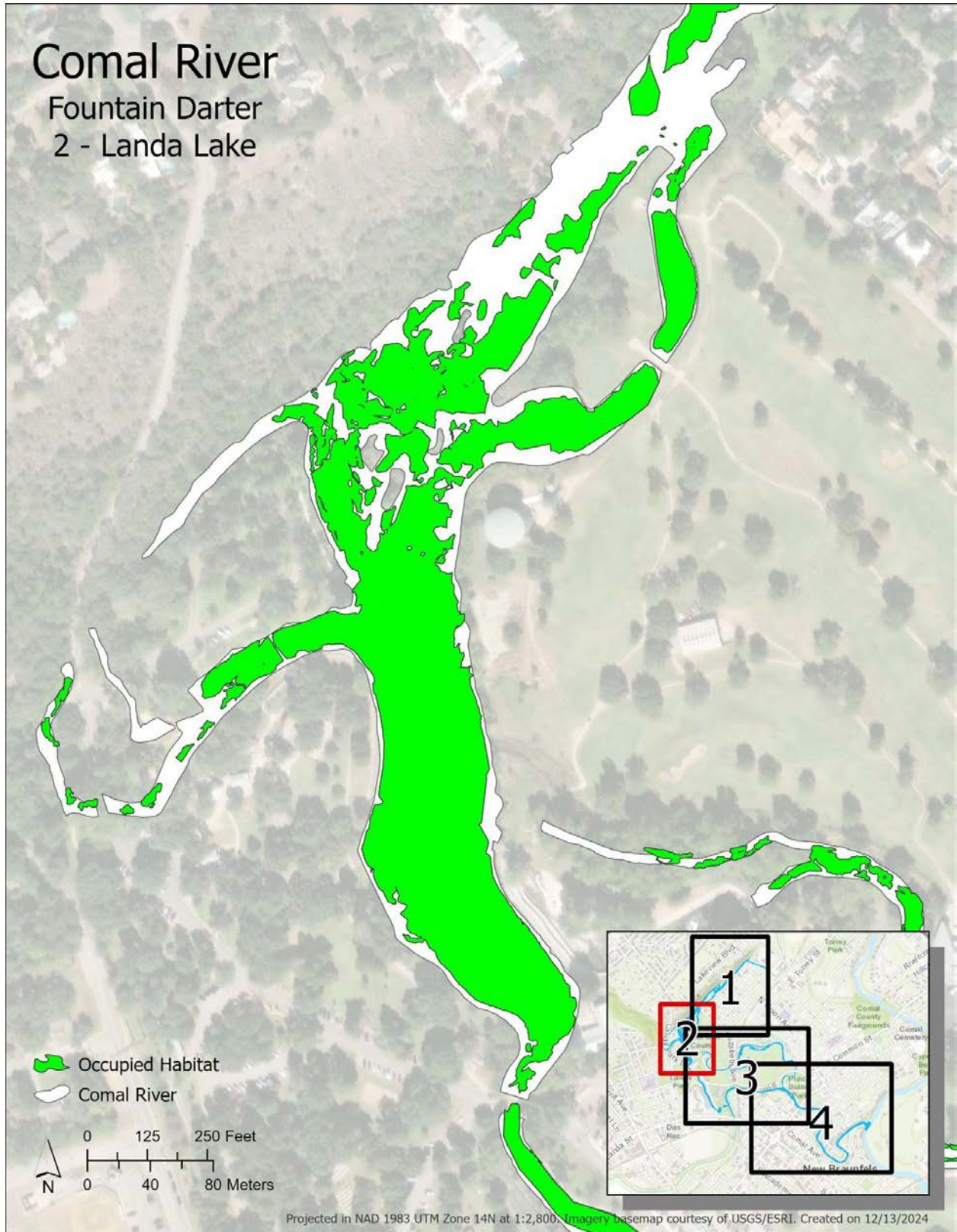
Comal Springs / River

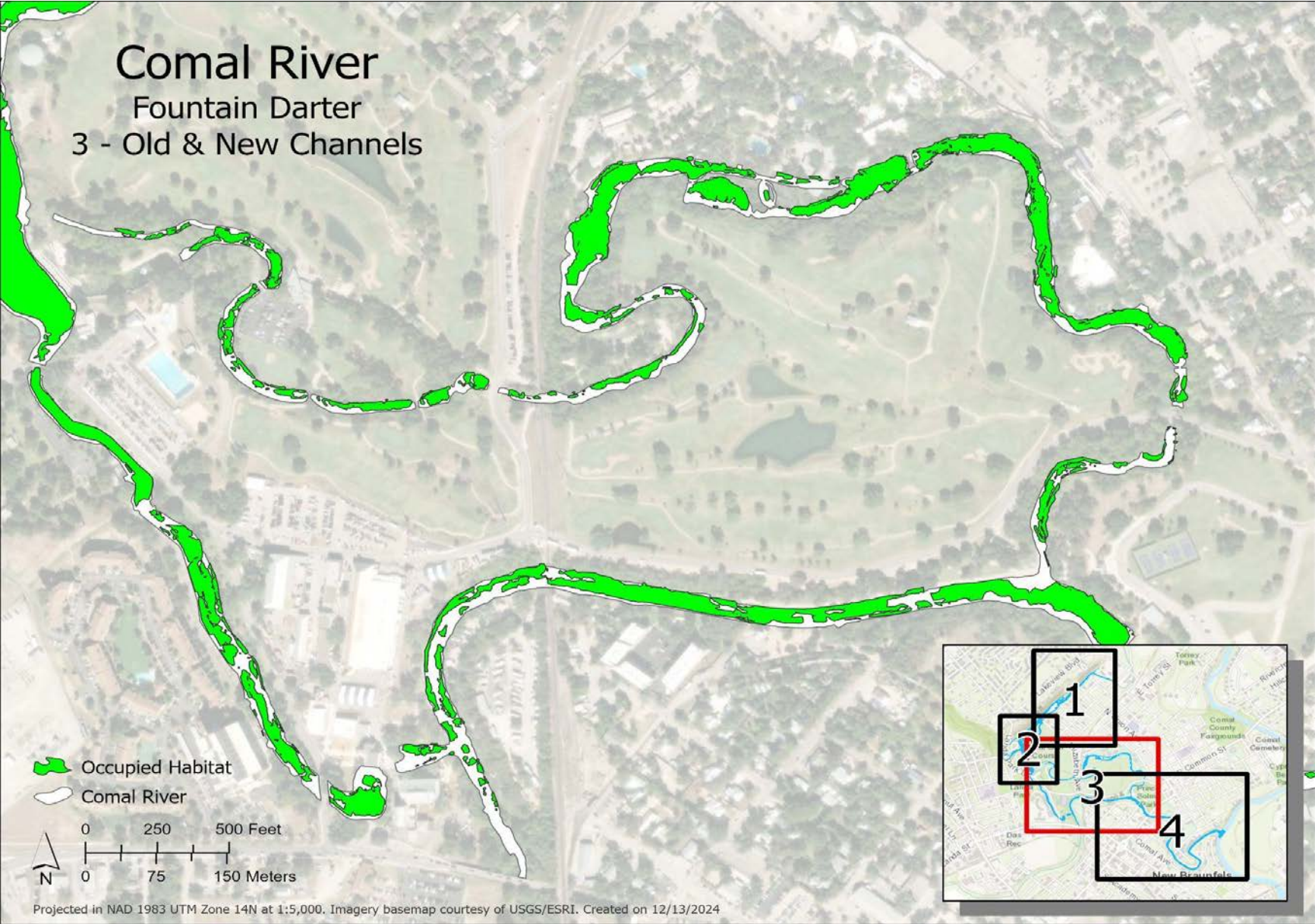


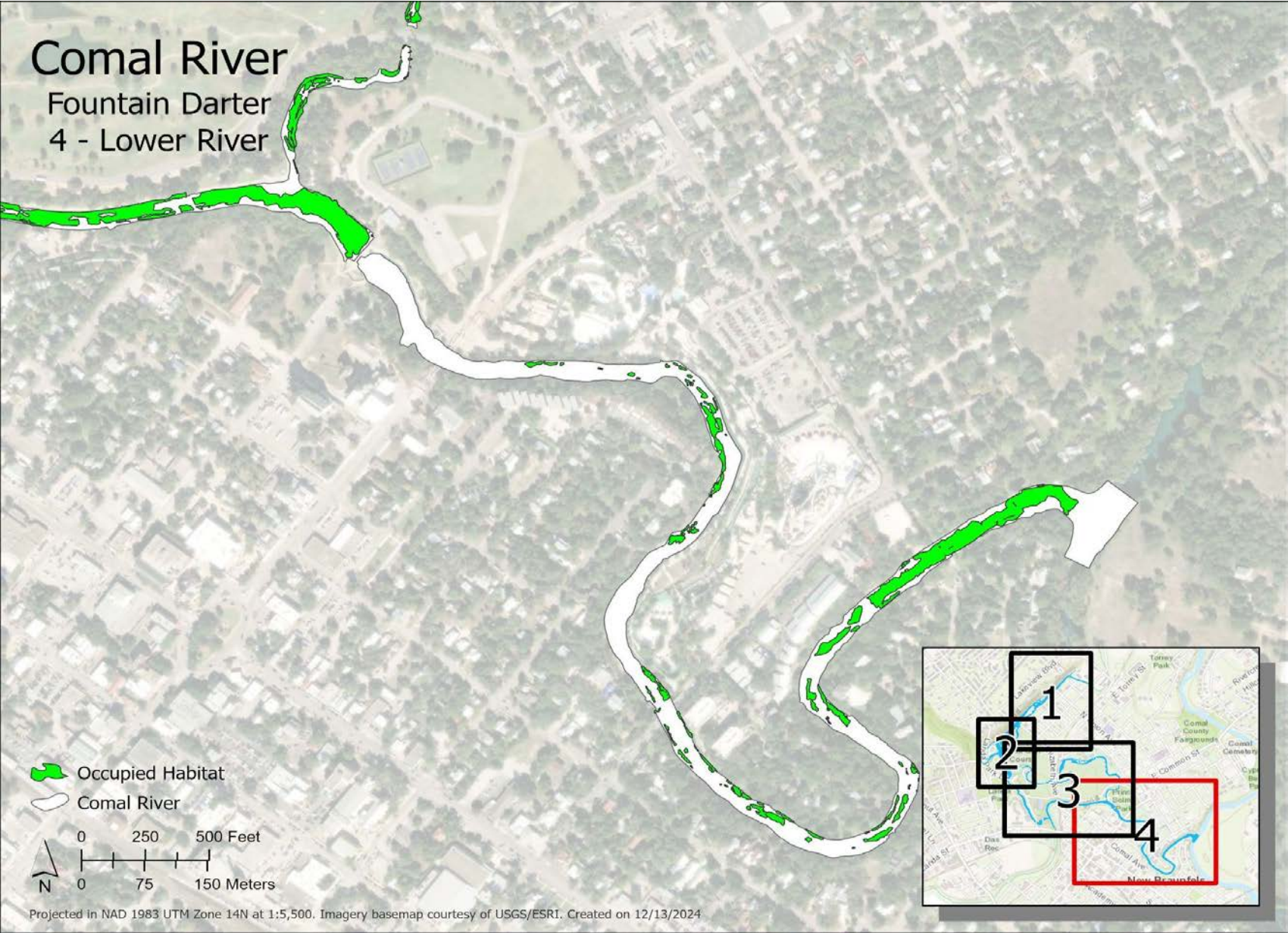




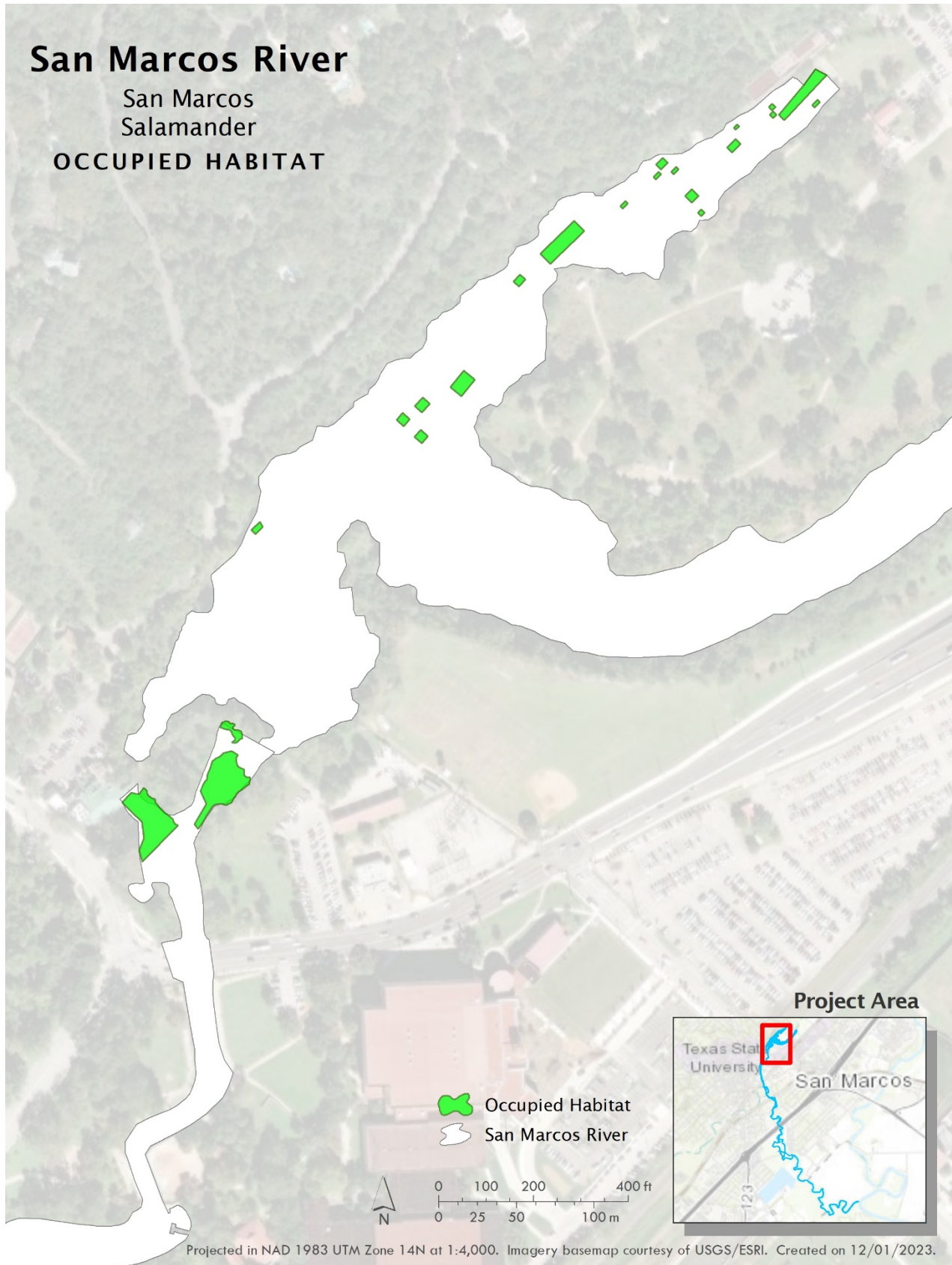








San Marcos Springs/River



San Marcos River

Comal Springs
Riffle Beetle
SPRING LAKE





