Interim Core Map Documentation for Texas Wild-Rice

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Draft Interim Core Map Developer: Compliance Services International (CSI)

Species Summary

The Texas wild-rice (*Zizania texana*; Entity ID 870) is a monocotyledonous endangered plant found in Texas. The U.S. Fish and Wildlife Service (FWS) has assigned designated critical habitat for the Texas wild-rice. This species inhabits clear, cool, thermally constant flowing water. Its range is limited to a small number of localities, with little or no ability to disperse between or beyond these localities. Additional habitat information is provided in **Appendix 1**.

EPA Review Notes

The developers created this core map using the U.S. Environmental Protection Agency's (EPA) process available at: https://www.epa.gov/endangered-species/process-epa-uses-develop-core-maps-pesticide-use-limitation-areas. EPA reviewed the draft interim map and documentation and evaluated if: (1) the map and documentation are consistent with EPA's process; (2) areas included or excluded from the interim core map are consistent with the biology, habitat, and/or recovery needs of the species; (3) data sources are documented and appropriate; and (4) the GIS data and mapping process are consistent with the stated intention of the developer. EPA agrees that this map is a reasonable depiction of core areas for this species and was consistent with the agency's mapping process. This documentation was not prepared by EPA, but EPA may have edited this documentation for clarity or other purposes.

The core map developed for this species is considered interim and can be used to develop pesticide use limitation areas (PULAs). This core map incorporates information developed by FWS and made available to the public; however, the core map has not been formally reviewed by FWS. This interim core map may be revised in the future to incorporate expert feedback from FWS.

This core map does not replace or revise any range or designated critical habitat developed by FWS.

Description of Core Map

The core map for the Texas wild-rice is based on its designated critical habitat. The most recent Recovery Plan from FWS includes both textual description of habitats and a map of the *San Marcos Ecosystem Management Unit*, which is the same shape as the designated critical habitat and represents the currently inhabited range of the species (See **Appendix 1** for more information). Other available known location information from the Global Biodiversity Information Facility (GBIF), iNaturalist, and NatureServe databases were not used for core map development, as they did not improve on the dataset used for core map development.

The core map spans 85 acres (Figure 1). A summary of acreage by National Landcover Database (NLCD) land use type is provided in Table 1.

Based on EPA's "best professional judgment classification" system, CSI has graded this core map as "none" because the core map is developed from unaltered critical habitat. More information about this classification system and its definitions can be found in the core map process document (EPA 2024).

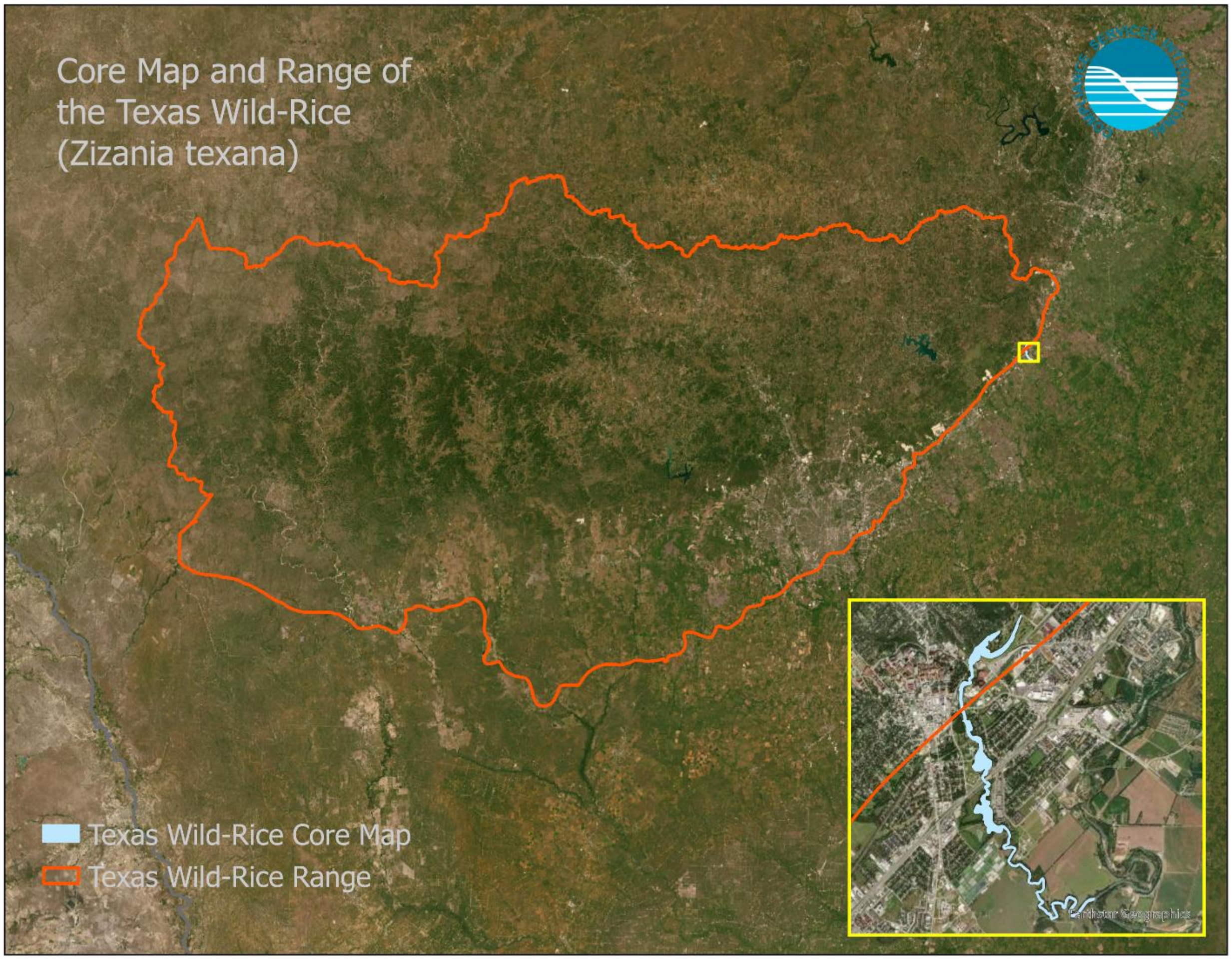

Figure 1. Interim core map for the Texas wild-rice.

NLCD_Land_Cover_Class	Acres
Woody Wetlands	32
Developed, Open Space	15
Emergent Herbaceous Wetlands	11
Evergreen Forest	8
Open Water	6
Developed, Low Intensity	4
Developed, Medium Intensity	3
Shrub/Scrub	2
Developed, High Intensity	1
Hay/Pasture	1
Deciduous Forest	-
Mixed Forest	-

Table 1. Acres by National Land Cover Database (NLCD) class within the core map of the Texas wild-rice. Total core map area (based on NLCD pixel count): 83 acres[1].

Evaluation of Known Location Information

There were three evaluated datasets with known location information:

- Occurrence locations in iNaturalist;
- Occurrence locations in GBIF; and
- Occurrence locations in NatureServe.

Compliance Services International evaluated these three datasets before developing the core map. Overall, there were 155 usable research-grade observations found in iNaturalist[2]. The GBIF dataset comprised 126 usable georeferenced observations, all from iNaturalist. Both datasets were useful as comparison against other datasets, but did not otherwise contribute to the core map development process. NatureServe public element occurrence (EO) data were also evaluated and are considered by CSI to be more conservative than the iNaturalist and GBIF datasets for this species, due to the clustered nature of iNaturalist observations and the relatively high level of obscuration (one 343 mi^2 hexagon) of the public data from NatureServe.

Approach Used to Create Core Map

The core map was developed using EPA's process for developing core maps for species listed by the FWS and their designated critical habitat[2] (referred to as "the process"). This core map was developed by CSI

[1] This acreage is slightly different from the core map acreage (85) due to the pixelation of NLCD land cover. The core map is not developed from raster data.

[2] According to iNaturalist, an observation is designated as "research grade" if it 1) is verifiable with date, coordinates, photos/sounds, and not captive; 2) achieves community agreement defined as "more than 2/3 of identifiers needs to agree on the species level ID or lower;" and 3) "must pass a data quality assessment, which includes checks for accurate date and location, evidence of a wild organism, and clear evidence of the organism itself" (https://help.inaturalist.org/en/support/solutions/articles/151000169936-what-is-the-data-quality-assessment-and-how-do-observations-qualify-to-become-research-grade-).

using the four steps described in the process document:

1. Compile available information for a species;
2. Identify core map type from among the following defined types: DCH, range, and biological information. From EPA, summaries of each core map type are provided below (EPA 2024).
3. Develop the core map for the species; and
4. Document the core map.

For step 1, CSI compiled available information for the Texas wild-rice from FWS, as well as observation information available from various publicly available sources including iNaturalist, GBIF, and NatureServe. The information compiled for the Texas wild-rice is included in **Appendix 1**. Influential information that impacted the development of the core map includes a description of the species habitat from the FWS Draft Species Biological Report (FWS 2024a) and descriptions of its extant populations.

For step 2, CSI used the compiled information including the species range, critical habitat, known locations, and habitat location information to determine the core map type. Compliance Services International compared the known location data to the range and found that known locations from larger databases (iNaturalist and GBIF) were consistent with designated critical habitat and did not add significant areas outside of critical habitat, so were only used for comparison with core map development. Known location information from FWS was limited to descriptions of the current area inhabited—the *San Marcos Ecosystem Management Unit*—which is also the species' critical habitat.

Although the Texas wild-rice would not be expected to be found on agricultural land (*i.e.*, it is an "off-field" species), there is relatively little agriculture in the area and CSI was not convinced that critical habitat required cultivated areas removed; therefore, no refinement was necessary to exclude cultivated land. Consequently, based on the weight of evidence, CSI selected a designated critical habitat core map type.

For step 3, CSI used the best-available data sources to generate the core map. Data sources are discussed in the EPA's core map process document. For this interim core map, CSI followed EPA's decision framework to arrive at a core map type of critical habitat. Designated critical habitat was identified as a core map type because the Texas wild-rice has critical habitat that more accurately identifies critical areas for core map development than its more widespread range. **Appendix 2** provides more details on the GIS analysis and data used to generate the core map.

Discussion of Approaches and Data that were Considered but Not Included in Core Map

Range

Range was considered for the core map type, but ultimate decided against because the species has difficulty dispersing from its existing area, which is much smaller in extent. If conservation efforts or other circumstances result in the species expanding further into its range, this may be considered as a viable alternative for use in core map development. If so, developers should consider supplementing the range with its critical habitat area, as the latter extends beyond the perimeter of the former (Figure 1).

Known Observation Datasets

Datasets such as iNaturalist, GBIF, and NatureServe were considered but not used. NatureServe public EOs are viewable in their mapper as hexagons corresponding to locations where the species may have been observed. All the occurrences can reasonably be inferred to be associated with critical habitat based on their position and respective uncertainty distances (discussed in Appendix 1). Unaltered DCH was selected for the core map.

Appendix 1. Information compiled for Texas Wild-Rice

1. **Recent FWS documents**
   - Designation of Critical Habitat (1980): https://www.govinfo.gov/content/pkg/FR-1980-07-14/pdf/FR-1980-07-14.pdf#page=253.
   - Draft Recovery Plan (2024b): https://ecos.fws.gov/docs/recovery_plan/RecoveryPlanSection08.15.2024_1.pdf.
   - Species Biological Report (2024a): https://iris.fws.gov/APPS/ServCat/DownloadFile/255055.

2. **Background information**
   - Status: Federally listed as endangered in 1978 (FWS 2025).
   - Resiliency, redundancy, and representation (the 3Rs) (FWS 2024a)
     - Resiliency: "To maintain population resiliency, these species rely upon (1) adequate water quantity, (2) adequate water quality, (3) intact undisturbed surface ecosystems, and (4) control of invasive competitors and predators. When each of these physical and biological needs is present and functioning, resilient populations are expected."
     - Redundancy: "The southern Edwards Aquifer species occupy a very restricted range. Texas wild-rice, San Marcos salamanders, and Texas blind salamanders consistent of a single extant population and effectively lack redundancy."
     - Representation: "All of these species are narrow endemics reliant on the spring systems of the southern Edwards Aquifer, thus reducing their ability to adapt to both near-term and long-term changes in their physical (e.g., climate and habitat structure, etc.) and biological (e.g., competitors, pathogens, and predators, etc.) environments."
   - Habitat, Life History, and Ecology (FWS 2024a)
     - Habitat: "Texas wild-rice forms large stands at depths from 0.23-1 m (0.76-3.3 ft) and requires clear, relatively cool, thermally constant (about 22.2°C [72°F]) flowing water (Poole and Bowles 1999, entire). Springflow and San Marcos River discharge are critically important for growth and survival of Texas wild-rice (Saunders et al. 2001, pp. 28, 30). Texas wild-rice relies on carbon dioxide as its carbon source for photosynthesis rather than the more commonly available bicarbonate used by most other aquatic plants (Rose and Power 2001, pp. 59-65).
     - Edwards Aquifer water contains relatively high levels of carbonic acid, formed by the combination of carbon dioxide and water through karstification of carbonate rocks and microbial processes (BIO-WEST, Inc. 2004a, p. 10; Birdwell and Engel 2009, p. 147; Gray and Engel 2013, p. 335). Carbon dioxide in the water is readily available near spring openings and in relatively fastmoving waters that transport the dissolved gas downstream. Low springflows can be carbon limiting for carbon dioxide-using obligates including Texas wild-rice. The Texas wild-rice occurs primarily on gravel and sand substrates overlaying Crawford black silt and clay (Poole and Bowles 1999, entire; Saunders et al. 2001, p. 24; Vaughan 1986, p. 17).
     - [The Texas wild-rice occurs] in a limited range at a small number of localities, with little or no ability to disperse between or beyond these localities. These characteristics make [it] susceptible to local extirpation and extinction due to stochastic events (McKinney 1997, p. 499; O'Grady et al. 2004, p. 514). Having a high number of individuals at a site provides no protection against extinction from these threats. Dispersal beyond their extant range is unlikely, given the isolated nature of the spring headwater system dynamics and

aquifer hydraulic connectivity that limit movement of individuals.
    - Pollinators: “Texas wild-rice is wind pollinated” (FWS 2024a).
    - Life History and Ecology:
        - Reproduction of the Texas wild-rice occurs either asexually (clonally) through stolons or sexually via seeds. Asexual reproduction occurs primarily by tillering at the base of the plant and from adventitious roots at the nodes of stolons. Clonal reproduction appears to be the primary mechanism for expansion of established stands (Emery 1967, p. 204; Emery 1977, p. 394; Power 2002, p. 573), but does not appear to be an efficient mechanism for dispersal and colonization of new areas. The Texas wild-rice segments have, however, been observed floating downstream and some of these may become established plants; but plants would only establish if they were lodged into suitable substrate and habitat.
        - During sexual reproduction, Texas wild-rice flowers above the water surface and wind pollinated florets produce seed (Power 1997, p. 435). This typically occurs from May to July, although it can occur year-round. The triggers for flowering are not well understood but are probably related to increased photoperiod and sufficient access to sunlight by individual plants in relatively shallow water.
- Taxonomy (FWS 2024a)
    - The Texas wild-rice is an aquatic, monoecious (pistillate and staminate flowers are on the same stem), perennial grass, which can grow to over 2 m long in the swift-flowing water of the San Marcos River (FWS 1996, p. 42; Poole and Bowles 1999, p. 292). The reproductive stems (culms) are erect and emergent. Asexual reproduction occurs by development of basal tillers and stolons. The leaves are linear, elongate, green, and 5-25 mm (0.2-1.0 in) wide. The female inflorescence is a narrow panicle, 16-31 cm (6.3-12.2 in) long, and 1-10 cm (0.4-3.9 in) wide. Although flowering and seed production occur year-round, peak flowering and production of viable seed occurs from May through July. The spreading staminate branches occur below the appressed pistillate branches. Spikelets consist of a single naked floret and lack glumes. The staminate spikelets are 6-11 mm (0.24-0.43 in) long, 1.2-2 mm (0.05-0.08 in.) wide, with white stamens, and hang down when mature. The pistillate spikelets are 8-12 mm (0.32-0.4 in) long by 1.2-1.8 mm (0.05-0.07 in) wide. Each spikelet has a 10 to 35-mm-long (0.39 to 1.38- inch) hair-like awn at its tip. The awns are scabrous with scattered prickle hairs, and 10-35mm (0.39- 1.38 in) long. The seeds (as obtained from cultivation) are cylindrical, 4.3-7.6 mm (0.17- 0.30 in) long, 1-1.5 mm (0.04 -0.06 in) wide, 1/2 to 3/4 as long as the lemma and palea, and black, brown, or greenish. The chromosome number is n= 15. (Silveus 1933, pp. 473-475; Hitchcock 1950, pp. 561-563; Correll and Correll 1975, pp. 277-279; Terrell et al. 1978, pp. 53- 55; FWS 1996, p. 42).
    - The plant was formally described and named as Z. texana by Hitchcock (1933, p. 454) after originally being incorrectly identified as Z. aquatica in 1892 (U.S. National Herbarium sheet 979361). It is one of three Zizania species in North America; phylogenetic analysis indicates that Z. texana is more closely related to *Z. palustris* than to *Z. aquatica* (Xu et al. 2010, entire).
- Relevant Potential Pesticide Use Sites (FWS 2024a)
    - Although water quality in the Edwards Aquifer is generally good, several studies have detected contaminants in groundwater from the southern segment including nitrates, herbicides, pesticides, polycyclic aromatic hydrocarbons, and many others.
- Downlisting Criteria (FWS 2024b)
    - All populations of [Texas wild-rice], in all management units where the species is present,

maintain sufficient resiliency for 18 consecutive years. For surface species (fountain darter, Comal Springs riffle beetle, and Texas wild-rice), sufficient resiliency will be achieved when:

- Populations do not trend toward a decline and do return to the cumulative mean after short-term fluctuations;
- Populations do not fluctuate below the cumulative mean of non-drought years (defined as the mean of previous years that Comal or San Marcos springs did not decrease below 100 cubic feet per second) by more than 10% in a given year;
- Populations do not decline from the cumulative mean of non-drought years more than 25% during drought years when Comal or San Marcos springs decreases below 100 cubic feet per second; and
- Populations do not decline from the cumulative mean of non-drought years more than 50% during a repeat of the drought of record (defined here as a three-year period when aquifer recharge was at its lowest recorded level of 397,800 acre-feet total for 1954-1956).

- Habitat is restored and maintained within each management unit in the areas described below (see the SBR for additional information on habitat within each management unit; FWS 2024a, Section 1.0). The habitat restoration should achieve a level that supports resilient populations as described in Downlisting Criterion 1. This initiative should include restoration of terrestrial riparian areas aimed at minimizing runoff into adjacent aquatic habitat for the benefit of all species, while also providing suitable habitat and food resources for the Comal Springs dryopid beetle, Peck's cave amphipod, and Comal Springs riffle beetle. The habitat restoration may occur with existing hydromorphological modifications. However, if there are any additional hydromorphological modifications, they should support a more natural ecosystem condition (e.g., impoundment removal, dechannelization, natural substrate) instead of leading to a more unnatural ecosystem. While it is expected that habitat may change during droughts and floods (e.g., siltation during low flows, loss of substrate or vegetation), the habitat management plan described in Downlisting Criterion 3 should restore habitat in the locations described here. After completion, the habitat restoration should be maintained for at least 18 years.
- At least 20,000 square meters (2 hectares [4.9 acres]) of Texas wild-rice is maintained in the upper San Marcos River, including areas that are shallow enough to allow for natural seeding. Texas wild-rice should be distributed through the Upper San Marcos River to the City of San Marcos wastewater treatment plant outfall.
- There is a habitat management plan that is fully implemented and focuses on habitat restoration and reducing habitat degradation for all waters and lands associated with management units to ensure that habitat continues to sustain resilient populations of each species. The habitat management plan should address how habitat will be managed when the needs of different listed species conflict, along with management of threats to habitat, including recreation, runoff, drought, floods, and harmful non-native species. The habitat management plan will be fully implemented in all management units for the species for at least 18 years.
- The daily average discharge during the 18-year period in the Comal River exceeds 6.4 m^3/s (225 cfs) including the drought of record, and the minimum daily average flow is not less than 0.9 m3 /s (30 cfs). In the San Marcos River, the daily average discharge during the 18-year period exceeds 140 cfs (4 m^3/s) including the drought of record, and the minimum daily average flow is not less than 1.3 m^3/s (45 cfs). The duration of minimum daily average flows in both rivers must not exceed six months and is followed by three

months of 2.3 m^3/s (80 cfs) or greater to ensure adequate habitat and water quality. Achievement of this criterion will be measured using continuous monitoring data from streamflow gages at Comal and San Marcos springs (USGS 08168710 and 08170000) for a minimum of 18 years.

  - Water quality consistently meets or exceeds established EPA numeric criteria for protection of aquatic life throughout the areas where the species are present (EPA 2022, unpaginated). Water temperature in surface habitat does not exceed 25°C (77°F) near springs (areas within spring runs, Spring Lake, the main spring outlets at Sessom, Landa Lake, Spring Island, Panther Canyon well, Hueco Springs, and Fern Bank Springs), other surface habitat does not exceed this temperature at least 50% of the days per year at the substrate, and downstream surface habitat at the substrate does not exceed 27°C (81°F). Conductivity is 560-650 microsiemens per centimeter in the San Marcos Management Unit and 560-610 microsiemens per centimeter in the Comal Management Unit during conditions that do not contain surface runoff from rainfall. Turbidity is generally less than 1.0 in spring water and habitat. Measurements should only be considered during baseflow conditions that do not contain surface runoff. Areas of very shallow habitat during drought conditions should not be considered for this criterion. This criterion will be achieved when these standards are met throughout the species habitat within each management unit, as described in Criterion 2, above, during quarterly sampling for 18 years. For Fern Bank and Hueco springs, more information will need to be gathered to evaluate the expected conductivity, turbidity, pH, and temperature at these springs. Research may also be needed to evaluate species-specific groundwater quality needs if there is a concern that the EPA numeric criteria for aquatic life may not adequately address water quality needs.
  - A self-sustaining refugia population in captivity is capable of maintaining at least 90% of the genetic diversity from the wild for 10 years without collections, as determined by population genetic modeling and a population with lambda of 0.95 or greater. This captive population may be used for population reintroduction and augmentations, or emergency refugia in case of catastrophic loss in the wild. This minimum target captive population size should be 500 individuals unless new science indicates that another number is more appropriate for these goals. If research compromises individuals for these goals, those individuals should not be included as part of the refugia population. There should be refugia populations for every species population in the San Marcos Ecosystem, and for every management unit for the three invertebrate species.

- Delisting Criteria (FWS 2024b)
  - All populations maintain resiliency for 45 consecutive years and are expected to maintain resiliency in the future. Populations will be considered resilient when they meet the definition described in Downlisting Criterion 1 above. For the San Marcos salamander, the criterion for surface species should be followed.
  - Habitat can sustain resilient populations and is restored as described above in Downlisting Criterion 2, maintained for at least 45 years, and anticipated to remain restored in perpetuity due to the actions of the habitat management plan described in Downlisting Criterion 3. Habitat for the San Marcos salamander is not included in Downlisting Criterion 2 and should meet the criteria provided for all species, as well the following for the San Marcos ecosystem: Approximately 6000 square meters (0.6 hectares [1.5 acres]) of unembedded cobble and gravel substrate with low macrophyte cover is maintained through Spring Lake and the upper 50 meters (164 feet) of the river when

flows are above 2.3 m^3 /s (80 cfs) and maintain at least 3000 square meters (0.3 hectare [0.7 acre]) of unembedded substrate when flows are below 2.3 m^3 /s (80 cfs). Surface habitat should connect to a groundwater source, such as a spring.

  - Future habitat degradation is prevented through a habitat management plan as described above in Downlisting Criterion 3. The habitat management plan will be fully implemented for at least 45 years and anticipated to continue in perpetuity.
  - The flows in Downlisting Criterion 4 are achieved for 45 years. Flows are expected to continue in perpetuity through actions of a fully implemented water management plan.
  - Groundwater quality in Downlisting Criterion 5 is achieved for 45 years and there is no indication that water quality is degrading over time, as determined by increasing trends in nutrients, conductivity, or contaminants.
  - Captive populations continue to be maintained as described in Downlisting Criterion 6. This will continue until the five years of post-delisting monitoring is completed.

- Recovery Actions (FWS 2024b)
  - Ensure Adequate Water Quantity and Quality within the Southern Edwards Aquifer and Management Units. Priority 1.
    - This action will include the protection of groundwater quantity and quality that would improve or protect habitat quality for each of the management units. Conservation water management agreements, groundwater management plans, or equivalent, will be developed, implemented, and fulfilled to ensure adequate surface and groundwater to maintain springflow and water quality at each of the management units. Evaluate if additional land in the recharge and contributing zone should be protected to maintain groundwater quality. Watershed protection plans that include stormwater treatment, wastewater discharges, and hazardous spill prevention and response.
  - Protect and Restore Habitat in Waters and on Lands Within and Adjacent to the Management Units. Priority 1.
    - Habitat within the management units, including springs, caves, subsurface habitat, streams, and riparian zones, should be restored and protected for each species. Adequate buffers of natural vegetation should be maintained around the aquatic habitats to support and maintain ecological integrity. Protections may include, but are not limited to, land management activities, ordinances, land acquisition from willing sellers, long-term conservation agreements, and habitat management plans. The plans should address and plan to resolve threats to habitat including local development, runoff, recreation, habitat modification and destruction, and non-native species.
  - Establish and Implement Captive Refugia Populations with a Captive Population Management Plan and Reintroduction Plan. Priority 1.
    - Until the threats to these species are ameliorated, extinction from the wild is possible due to stochastic or catastrophic events. Populations of these species should be maintained in captive refugia as a means of preventing extinction in case of such events. The captive management plan and reintroduction plan should account for situations in which species cannot be reintroduced immediately, and where several reintroduction attempts may be necessary. This will likely require genetic management and captive propagation of each species. Development of these plans will require determining the needs of the species in captivity, financial resources to support the efforts, plans for emergency

        - collections during catastrophic events, and the steps needed for reintroduction in case of extirpation from the wild. Research may also be needed to test techniques for captive population management and reintroduction.
    - Promote Edwards Aquifer Species Conservation and Recovery through Outreach, Education, and Cooperation. Priority 3.
        - Proactive outreach and education will be achieved by management agencies and partners to the local communities through events, workshops, and social media. Outreach efforts should use strategies to seek out broad participation, including by those who may not pursue conservation focused events. Incentives and education should be offered to private landowners, land managers, and businesses to encourage active cooperation needed to aid the recovery of these species. Working with landowners adjacent to habitat and near contributing streams should be prioritized.
    - Monitor Progress Toward Criteria within the Management Units: Priority 3.
        - This action would implement formal monitoring plans that provide information needed to evaluate species status and trends. Monitoring will further facilitate the assessment of climate change impacts on species and their habitats as well as efficacy of habitat restoration efforts. Specific associated activities will be described in the RIS. Monitoring should continue for five years after delisting, as required by the 1988 amendments to the ESA.

3. Description of Species Range

- The Texas wild-rice is endemic to the upper San Marcos River. The current distribution is from the Spring Lake to approximately 4.3 km (2.7 mi) downstream. The designated critical habitat extends to the confluence with the Blanco River (ca. 8.1 river-km [5 river-mi]). Low water velocity, water depth, turbidity, sediment, and shading may limit the establishment of Texas wild-rice in the lower San Marcos River (Poole et al. 2022, p. 7). However, depth may be limiting primarily due to effects of water clarity, since Texas wild-rice has been planted successfully in depths greater than 2 m (Crawford-Reynolds 2018, p. 10). Over 80 percent of the Texas wild-rice population is located from the Spring Lake dam to the Rio Vista railroad bridge, and less than 5 percent occurs downstream of I-35 (FWS 2019c, entire, BIO-WEST, Inc. 2023b, p. 27).

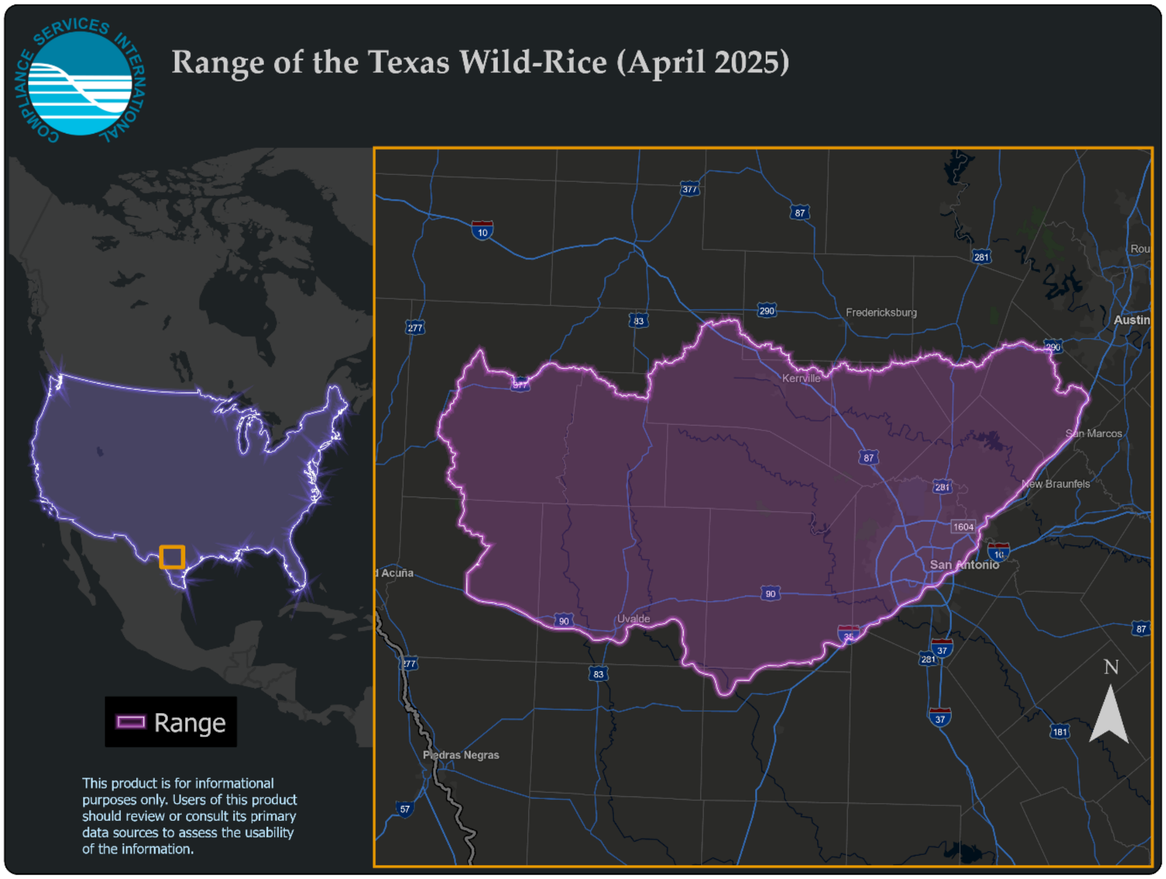

Figure 2. Range of the Texas Wild-Rice (FWS 2025).

4. Critical Habitat

- Critical habitat was designated for the Texas wild-rice on July 14, 1980, and consists of the Upper San Marcos River from Spring Lake downstream to the confluence with the Blanco River (45 FR 47355). This critical habitat designation is approximately 253,000 m^2 (about 25 ha or 62 acres).
- The critical habitat designation for the Texas wild-rice predates the rulemaking that identifies PBFs (81 FR 7414).
- The final rule designating critical habitat describes those actions that would adversely modify designated critical habitat, including any actions that would:
  - i. Significantly alter the flow or water quality in the San Marcos River;
  - ii. Physically alter Spring Lake or the San Marcos River, such as dredging, bulldozing, or bottom plowing; or
  - iii. Physically disturb the plants, such as harrowing, cutting, or intensive collecting. The Texas wild-rice habitat also may be adversely affected by invasive non-native plants and animals.
- Primary constituent elements (PCEs) are the physical and biological features of critical habitat essential to a species' conservation. The PCEs of *Zizania texana* critical habitat are not listed.

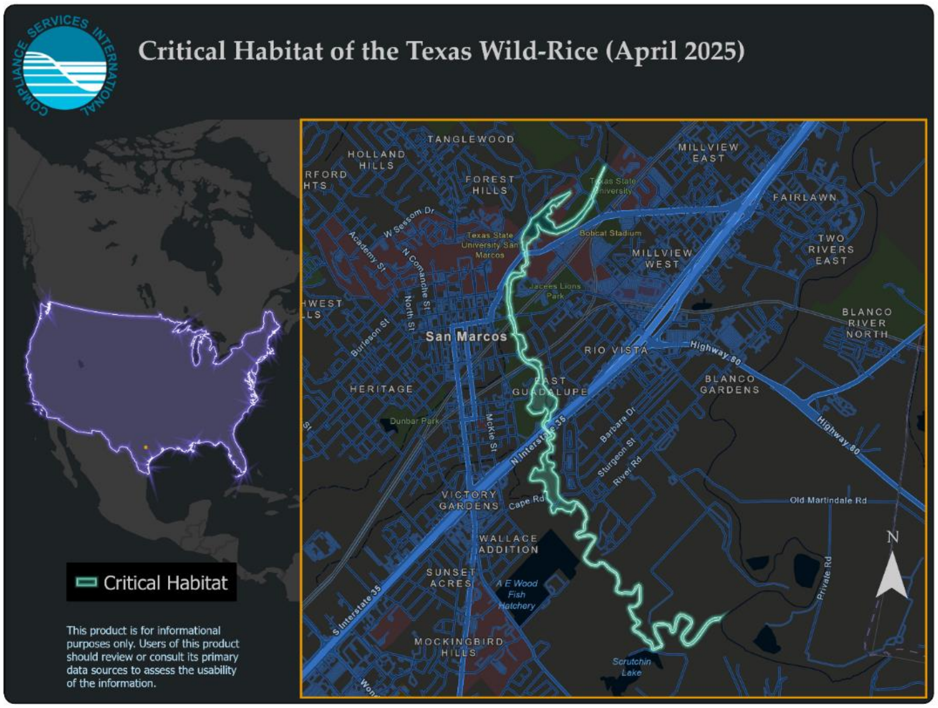

Figure 3. Critical Habitat of the Texas Wild-Rice (FWS 2025).

5. Known Locations

- iNaturalist: https://www.inaturalist.org/observations?taxon_id=170443
  - 202 verifiable observations, 155 of which are research-grade with usable public coordinate data. **Error! Reference source not found.**
  - These locations are concentrated near the eastern boundary of the species range and likely associated with the designated critical habitat. 154 of the 155 observations were within a "public positional accuracy" ("PPA") distance to the species' critical habitat.

- GBIF: https://www.gbif.org/species/2703229
  - GBIF includes 183 occurrence records; 126 of which are georeferenced with usable coordinate data based on latitude/longitude precision (3+ decimal places) and relative recency (2010-present). These observations are all in proximity to the range and critical habitat of the species. They are also entirely a subset of the iNaturalist observations described above.
  - The usable coordinates are consistent with the critical habitat. One-hundred twenty-five of the 126 usable coordinates are within a public positional accuracy (uncertainty) distance intersecting with critical habitat, which is along the eastern edge of the range.

- NatureServe Explorer: https://explorer.natureserve.org/
  - The lone location identified in the NatureServe Explorer database is consistent with the range and (even more so) the critical habitat of the species.
  - Public EO location information is not more refined than the critical habitat itself and does not add additional areas that are distinct from the critical habitat; therefore, the NatureServe data were not used for core map development. However, it is consistent with the critical habitat.

Appendix 2. GIS Data Review and Method to Develop Core Map

The core map for this species is based on the designated critical habitat. Although the species is considered to be "off-field," the core map extent does not include a significant amount of agricultural area (85 acres); therefore, the removal of cultivated areas > 25 acres was not necessary.

1. **References and Software**
   - Software used: ArcGIS Pro version 3.2.
   - FWS Species Critical Habitat: https://ecos.fws.gov/ecp/species/805.

2. **Datasets Used in Core Map Development**

   2.1. Critical Habitat

The critical habitat for this species was designated on July 14, 1980. A shapefile including species critical habitat for all critical habitat species was downloaded from the FWS ECOS website on January 24, 2025. The shapefile was converted to a feature class stored in a file geodatabase and reprojected to WKID #4269 ("North America Albers Equal Area Conic").

1. Using an ArcGIS Web Map the species was queried based on the ECOS listed "Entity ID" of 870 and exported as a feature class to a temporary file geodatabase as a standalone Entity ID-specific layer.
2. The area of the critical habitat was calculated automatically by loading it into the software (ArcGIS Pro version 3.2) and reading its area from the attribute table ("Shape_Area"), then converting its units (square meters) into acres with a conversion rate of 0.000247105.
3. This shapefile was added to an ArcGIS Pro map and compared against the available known location information from the GBIF, iNaturalist, and NatureServe databases.

Compliance Services International has determined that the shapefile for critical habitat functions well as the basis for the core map.

Figure 4. Designated Critical Habitat of the Texas Wild-Rice (FWS 2025).

3. **Creating the Core Map**

The Texas wild-rice core map is developed from critical habitat data as follows:

1. Import the species critical habitat as a feature class named “TWR_CH.”
2. (Optional) Export the previous layer “TWR_CH” as a new layer identifiable as the species core map (“TWR_CoreMap”).

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