SAMUEL T. BISCOE
COUNTY JUDGE

TRAVIS COUNTY ADMINISTRATION BUILDING
700 LAVACA ST.
P.O. BOX 1748
AUSTIN, TEXAS 78767
(512) 854-9555
(512) 854-9535 FAX

December 16, 2014

Adam Zerenner, Field Supervisor
US Fish and Wildlife Service
Austin Ecological Services Field Office
10711 Burnet Rd., Suite 200
Austin TX 78758

Re: Request for Guidance Regarding State Highway 45 Southwest & Flint Ridge Cave

Mr. Zerenner:

Travis County is requesting guidance from the United States Fish and Wildlife Service (USFWS) regarding the proposed State Highway 45 Southwest (SH 45 SW) project as it relates to nearby Flint Ridge Cave, a resource protected under the Balcones Canyonlands Conservation Plan (BCCP) permit.

On March 18, 2014, the Travis County Commissioners Court approved an Interlocal Cooperation Agreement between Hays County, Travis County, and the Central Texas Regional Mobility Authority (CTRMA) to develop and construct this project. Because Travis County is both a holder of the BCCP permit and partially funding the project, we recognized issues might arise regarding Flint Ridge Cave. Hence, the Interlocal Cooperation Agreement requires CTRMA to develop, construct, and maintain SH45 SW in a manner that does not result in Travis County's noncompliance with the BCCP permit. It also requires that there be consultation with the USFWS regarding any such issues.

A principal goal of the SH 45 SW project is to construct and maintain SH45 SW while preserving the environmental integrity of Flint Ridge Cave. To meet any mitigation requirements of the BCCP permit for the part of the project beyond 0.25 mile from the cave's entrance, we propose that the BCCP Infrastructure Participation Certificate process be followed. To meet any mitigation requirements within 0.25 miles of the entrance, TxDOT, in coordination with Travis County, has developed the enclosed report. Entitled "Potential Effects of the Construction and Operation of State Highway 45 Southwest on the Ecological Integrity of Flint Ridge Cave in Southern Travis County," it supplements information developed through TxDOT's Draft Environmental Impact Statement process for SH45 SW. The report concludes that the environmental integrity of Flint Ridge Cave will be maintained on the basis of site characteristics and impact avoidance and minimization through project design features and other measures. Additional technical reports are available at http://www.sh45sw.com/environmental/draft-eis.php

So that USFWS can receive any needed clarification of our proposal, and so that we can learn of any issues with the proposal that USFWS will require us to address based on the BCCP permit, we request that USFWS review the information we have provided and meet with representatives of Travis County, TxDOT, CTRMA, and the City of Austin. We request that this meeting be scheduled by January 23.

The Travis County contact for providing any additional information you might need and to arrange the scheduling of a meeting will be Jon White, Director of the Natural Resources & Environmental Quality Division for the Transportation and Natural Resources Department. You may contact him by e-mail at jon.white@traviscountytx.gov or by telephone at 512-854-7212.

We look forward to working with USFWS to develop a project that fully protects karst resources while meeting the transportation needs of the community.

Sincerely,

Samuel T. Biscoe

Samuel T. Biscoe
Travis County Judge

Enclosures: Final Draft: Potential Effects of the Construction and Operation of State Highway 45 Southwest on the Ecological Integrity of Flint Ridge Cave in Southern Travis County

cc: Darren LeBlanc, USFWS
Steven Manilla, TNR, County Executive
Jon White, TNR
Tom Nuckols, County Attorney
Commissioner Gerald Daugherty, BCCP Coordinating Committee
Mayor Lee Leffingwell, BCCP Coordinating Committee
Carlos Swonke, TxDOT
Douglas Booher, TxDOT
Mike Heiligenstein, Executive Director, CTRMA
Sean Beal, CTRMA
William Conrad, City of Austin, Secretary BCCP

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Final Draft: Potential Effects of the Construction and Operation of State Highway 45 Southwest on the Ecological Integrity of Flint Ridge Cave in Southern Travis County, Texas

Prepared for

Texas Department of Transportation

Prepared by

Cambrian Environmental

and

SWCA Environmental Consultants

SWCA Project No. 27070.02

December 2014

Final Draft

Final Draft: Potential Effects of the Construction and Operation of State Highway 45 Southwest on the Ecological Integrity of Flint Ridge Cave in Southern Travis County, Texas

CSJs 1200-06-004 and 1200-07-001

Prepared for

TEXAS DEPARTMENT OF TRANSPORTATION

Prepared by

SWCA ENVIRONMENTAL CONSULTANTS
4407 Monterey Oaks Boulevard
Building 1, Suite 110
Austin, Texas 78749
www.swca.com

and

Cambrian Environmental
4422 Pack Saddle Pass, Suite 204
Austin, Texas 78745
www.cambrianenvironmental.com
Geoscience Firm Registration No. 50484

SWCA Project Number 27070.02

STATE OF TEXAS
KEMBLE WHITE
GEOLOGY
No. 3863
LICENSED
PROFESSIONAL GEOSCIENTIST

As a licensed professional geoscientist I attest that the contents of this report are complete and accurate to the best of my knowledge.

Kemble White Ph.D., P.G.
Cambrian Environmental
Texas Geoscience Firm Registration Number 50484
kwhite@cambrianenvironmental.com
(512) 663-0156

Cambrian

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BACKGROUND

The Texas Department of Transportation (TxDOT) and the Central Texas Regional Mobility Authority are currently in the planning stages of the proposed State Highway 45 Southwest (SH 45SW) transportation project. The project would extend a current segment of SH 45 from the southern terminus of State Loop 1 (MoPac) to Farm-to-Market Road 1626 (FM 1626) through Travis and Hays Counties. The length of this extension is about 3.5 miles—all but the southern tip of which occurs within the recharge zone for the Barton Springs Segment of the Edwards Aquifer. The proposed project consists of construction of a four-lane roadway within state-owned right-of-way (ROW) that is generally 425 to 575 feet wide and totaling approximately 309 acres. The proposed project occurs within the Balcones Escarpment, a highly cavernous geographic region known to be occupied by a diverse community of rare and endangered karst invertebrates. Karst invertebrates are obligate cave-dwelling (troglobitic) organisms characterized by a number of anatomical and physiologic adaptations to cave life including loss of pigment and sclerotization (thickness of the exoskeleton), reduction or loss of eyes, elongation of appendages, lengthened life span, modified fecundity, and metabolic adaptation to nutrient-poor habitat conditions. The cave environment is relatively monotonous compared to surface invertebrate habitats and is characterized by stable temperatures close to the mean surface temperature, constant near-saturation humidity, low evaporation rates, and the absence of photosynthetic nutrient production.

Six karst invertebrate species from Travis County have been listed as endangered by the U.S. Fish and Wildlife Service (USFWS) under the Endangered Species Act (ESA). In an attempt to balance development impacts with conservation Regional Habitat Conservation Plans (RHCPs) have been developed in both Travis and Williamson counties. These plans, coordinated between local governments and the USFWS, have successfully protected dozens of known locations not only for the endangered taxa but for many of the other rare cave-adapted species who share the same habitat and who might otherwise become candidates for endangered status. In Travis County the Balcones Canyonlands Conservation Plan (BCCP) has implemented a habitat conservation plan which aims to provide protection for 62 specific caves known at the time the permit was drafted to contain both endangered karst invertebrates and a broader category of karst invertebrate species of concern (SOC). Protection of SOC caves provides "no surprises" protections for the BCCP permit holders under the ESA whereby no further resources will be required of the permit holders in the future should any of those SOC become listed. None of the BCCP SOC are currently proposed for listing.

Flint Ridge Cave (FRC) is one of the most notable caves in the Austin area both for its ecological and hydrological significance. Figure 2 presents the cave map for FRC. It is one of the 62 caves identified in the BCCP due to the presence of two SOC including a beetle (*Rhadine austinica*) and a spider (*Cicurina bandida*). See Figure 3 for the full list of BCCP caves. The entrance of FRC is located approximately 150 feet east of the ROW for SH 45SW on land owned and managed by the City of Austin for management of the Edwards Aquifer. The entrance of FRC is marked by a large sinkhole and, relative to most caves known from the Edwards Aquifer recharge zone, the cave has an anomalously large surface catchment area. It is known as one of the most significant upland recharge features in the Barton Springs zone.

IMPACTS ANALYSIS

This document summarizes the potential for adverse effects on the ecological integrity of Flint Ridge Cave (FRC) from the construction and operation of SH 45SW in southern Travis County. Troglobitic fauna are vulnerable to impacts from development activities due to their absolute dependence on environmental conditions present only in the caves. The USFWS most recently detailed the habitat requirements for endangered karst invertebrates in central Texas in the habitat module of the Bexar County Karst Invertebrate Recovery Plan[1] (Updated 28 July 2011). The USFWS identifies eight primary components of karst invertebrate habitat including:

1. Cave and Karst Habitat
2. Mesocaverns
3. Microhabitat
4. Drainage Basins
5. Humidity and Temperature
6. Nutrients
7. Surface Vegetation Community
8. Surface Animal Community

Most threats described below alter the stable physical environment of the cave, alter nutrient input, or introduce substances and/or organisms that have the potential to adversely affect karst invertebrate species.

- Entrances to caves can be filled-in or collapse during development activities or activities for agricultural purposes. Covering cave entrances can alter the physical cave environment, as well as impede or eliminate nutrient input.
- Chemical contamination from ground water and/or surface drainages, including pesticides, fertilizers, sewage, hazardous materials spills, various pipeline leaks, storage tanker leaks, landfills, and urban runoff, could adversely affect karst invertebrates. Trash dumping also may be a source of chemical contamination.
- Altering surface drainage via alterations in topography, impervious cover, etc. could lead to drying of karst features and changes in nutrient inputs.
- Loss or alteration of surface communities can potentially adversely affect karst invertebrates by altering nutrient inputs, altering the stable physical environment of the cave, and introducing potentially harmful organisms. When changes in surface community plant composition occur, there is the potential to alter the type and quality of nutrient input into the cave system from the alteration of vegetation. Moreover, changes in surface plant species composition can in turn alter the surface animal species composition. Alterations in animal species composition may lead to

[1] http://www.fws.gov/southwest/es/Documents/R2ES/Bexar_RP_Habitat_module.pdf

less nutrient input into caves via a decrease of troglophiles and trogloxenes. Troglophiles are species that are not cave-adapted but have affinities for caves. Trogloxenes are species that may or may not be cave adapted but regularly use caves for sheltering and forage on the surface contributing organic matter to the cave ecosystem. If the surface plant community is denuded (replaced with impervious cover, left as bare ground, etc.) this could lead to fluctuations in cave temperatures and moisture regimes that are outside the normal range of variability for the system. Lastly, disturbance of the soil may lead to increased density of red imported fire ants (*Solenopsis invicta*) and alter the physical environment of the cave through increased sedimentation.

- Materials excavation operations have the potential to alter the stable physical environment of the cave ecosystem by increasing the number of cave entrances, which could have a drying effect, increase sedimentation, and change water drainage patterns to the system. Furthermore, caves can be completely destroyed through this type of activity.

The BCCP HCP[2] states that in order for the permit holders to get "no surprises" assurances under the ESA the specifically named SOC caves must be protected as follows:

> To be considered "protected" a karst fauna area must contain a large enough expanse of continuous karst and surface area to maintain the integrity of the karst ecosystem on which each species depends. The size and configuration of each karst fauna area must be adequate to maintain moist, humid conditions, air flow, and stable temperatures in the air-filled voids; maintain an adequate nutrient supply; prevent contamination of the surface and groundwater entering the ecosystem; prevent or control the invasion of exotic species, such as fire ants; and allow for movement of the karst fauna and nutrients through the interstitium between karst features. In most instances, this will entail protecting the entire surface and sub-surface drainage area of each cave and enough of the surface vegetation community to support small animals and buffer against fire ant infestations that can eliminate native ant populations. In absence of detailed hydrological studies for use in delineating cave preserve boundaries, land delineated by the contour interval representing the bottom of the cave should be targeted for preservation. (BCCP EA/HCP p. 2-30)

The following discussion will consider the potential for impacts to the ecological integrity of FRC according to each of the USFWS's habitat components.

1. **Cave and Karst Habitat** The cave and karst habitat components refers to the physical architecture of the humanly accessible subsurface habitat. Current schematics for the SH 45SW project do not include any activities above the footprint of the cave (See attached schematics). The majority of the cave footprint occurs outside of the ROW with the exception of the terminal passage. In plan view, the footprint extends within approximately 60 feet of the proposed edge of pavement of the roadway. However, that portion of the cave occurs at depths up to 150 feet below the land surface. Accordingly, the cave and karst habitat component is unlikely to be effected by the project.

2. **Mesocaverns** This habitat component consists of the humanly inaccessible void spaces which provide important sheltering habitat for invertebrates and avenues for dispersal between caves. These voids extend for unknown distances from the cave footprint and may be integrated with the subsurface hydrology of the cave system. Because the project will not impact the cave footprint

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[2] http://www.co.travis.tx.us/tnr/bccp/pdfs/Habitat_Conservation_Plan_Final_Environment_Impact_Statement.pdf

and because the distance between the construction area and the footprint is generally several hundred feet (with the exception of the terminal passage) the mesocavern habitat component is unlikely to be effected by the project. In the vicinity of FRC the proposed roadway will be elevated and built on fill. Excavation activities will be limited to the minimal amount of grading required to install retaining walls and to create a compensating drainage area as necessary to replace drainage area being covered by the roadway. See page 4 of the attached EIS Drainage sheets and additional comments in drainage basin section below.

3. **Microhabitat** This habitat component consists of preferable breeding, feeding and sheltering sites within the cave itself. Because the project will not impact the cave footprint the microhabitat habitat component is unlikely to be effected by the project.

4. **Drainage Basins** FRC is one of the most notable caves in the Austin area both for its ecological and hydrological significance. The entrance of FRC is located approximately 150 feet east of the ROW for SH 45SW on land owned and managed by the City of Austin for management of the Edwards Aquifer. The entrance of FRC is marked by a large sinkhole and relative to most caves known from the Edwards Aquifer recharge zone the cave has an anomalously large surface catchment area. It is known as one of the most significant upland recharge features in the Barton Springs zone. Previous estimates of the drainage basins' size have ranged between 40 and 69 acres. The larger of these estimates, however, was based on topography data of lesser accuracy than what it currently available. Recent karst investigations (including the Draft Environmental Impact Statement for the project) have generated more accurate topographic models of the FRC surface drainage basin ranging between 43.7 and 55.4 acres based on LIDAR and aerial survey data. The drainage basin boundaries were also ground-truthed with on-site observations of flow patterns following heavy rains in late September 2014. The most important difference between the earlier and more recent drainage basin estimates is that it has now been demonstrated that the FRC drainage basin does not entirely cross the SH 45 ROW. Further, the most recent schematics show that the roadway can be constructed almost entirely outside of the FRC surface drainage basin. Current schematics for the roadway indicate that approximately 0.71 acres of the drainage basin will be covered by the roadway. Runoff from that area will be routed outside of the drainage basin and treated through a series of structural and non-structural Best Management Practices (BMPs). To compensate for the loss of drainage area an area of equivalent acreage east of the roadway and along the FRC drainage basin boundary will be graded upward so that it contributes runoff to the FRC drainage basin. The area will be constructed with clean soil taken from the site and it will be re-vegetated with native vegetation. The project will be completed with no net loss of surface drainage basin for FRC. The attached drainage schematic for the vicinity of FRC illustrates surface flow patterns affecting FRC and nearby features and identifies the area to be re-graded to contribute to the FRC surface drainage basin.

   In concept, the subsurface drainage basin is the area within which groundwater may flow into a cave or associated mesocavern habitat. Delineation of a subsurface drainage basin is complicated for a variety of reasons. First, the concept is inherently problematic when the cave in question occurs within a contiguous karst landscape containing multiple caves. Where does one drainage basin end and another begin? Fundamental aspects of karst invertebrate habitat remain unknown. To what extent does habitat extend beyond the limits of the cave map? Caves containing stable habitat for terrestrial species are generally perched above the modern water table where total inundation no longer occurs. These caves were generally formed at or near ancient water tables under paleohydrologic conditions, and their morphology reflects that origin. Modern hydrology, however, tends to be dominated by vertical infiltration of small amounts of water along fractures. Does the shape of the cave (as represented by the cave map) have anything to do with the direction from which modern drainage may originate? Because of these and many other uncertainties, in practice, most previous delineations of subsurface drainage basins for caves containing endangered karst invertebrates in Texas have relied on the professional opinions of karst consultants using buffers of various distances based on metrics derived from cave footprints or other sources. Few of their methods have involved actually tracing moisture through the vadose (above the water table) zone above the caves.

Due to the complexity of the underlying geology, the subsurface drainage basin for FRC is difficult to delineate. In 2000, Veni did a hydrogeologic assessment of FRC. He defined the subsurface drainage area as shown in Figure 1. Veni went on to state that these boundaries delineation the minimum areas through which recharge is likely to enter FRC and that recharge from beyond these areas may also reach the cave. Due to the proximity of the cave footprint to the proposed roadway alignment, the majority of methods used by previous researchers would put the roadway within the caves subsurface drainage basin. The City of Austin is commencing a study which will attempt to identify the specific surface locations of water entering FRC through various known drip locations in the cave ceiling. The completion date of that study is unknown. Data collection will be subject to the occurrence of large rain events and the study results may not be conclusive. The results of the study may indicate discrete points of surface connection but the scope of the study is not extensive enough to define the subsurface drainage area of FRC.

Because the proposed roadway would likely be within the subsurface drainage basin does not mean that there will be impacts to the subsurface hydrology of FRC, however. The roadway itself is impervious cover and all storm water will be channeled away through impermeable conveyances. All known sensitive recharge features within the right of way in the vicinity of FRC will be protected in accordance with TCEQ rules. At present only one such feature is considered sensitive. Feature F-55 is a fractured rock outcrop within a drainage channel whose drainage basin defines the western limit of the FRC surface drainage basin. In order to provide an enhanced buffer area for FRC, the roadway is currently proposed to cover F-55. However, the hydrologic function of F-55 will be maintained with the installation of a bottomless culvert which will allow unaltered runoff from its drainage basin to continue to flow across F-55. There will also be compensating drainage area directed to F-55. See page 7 of the EIS drainage sheets. Feature F-62a is considered a sensitive feature although it was not subjected to the exploratory excavation work that other potentially sensitive features were given because it is located just outside of the right of way. It will be included within the buffer area for FRC along with its surface drainage basin.

Based on the geologic structure that influenced the development of FRC the most likely area within the right of way to contribute to the subsurface drainage basin would be the fault plane along which the lower two-thirds of the cave is developed. This fault is identified as Fault 5 in the project geologic assessment. Appropriate BMPs will be implemented in this vicinity during construction and operation of the project according to the Water Pollution Abatement Plan. BMPs would be designed to mitigate impacts from storm water and accidental spills. The attached evaluation of spill data for the project area addresses the likelihood of spills.

Failing these BMPs the majority of the site itself contains soils that have natural buffering capabilities. The portion of the project area near FRC is located within a mapped deposit of terra rossa, a clay paleosol formed by in-situ weathering of limestone. Within this area the typical characteristics of the recharge zone do not occur. Whereas outcrops of the Edwards group typically exhibit thin to absent soils, abundant rock outcrops and scrubby live/oak-juniper vegetation, the terra rossa terrains have relatively deep heavy clay soils, few rock outcrops, and vegetation including mesquite trees which are typically found on the Del Rio Clay but are rare within the recharge zone.

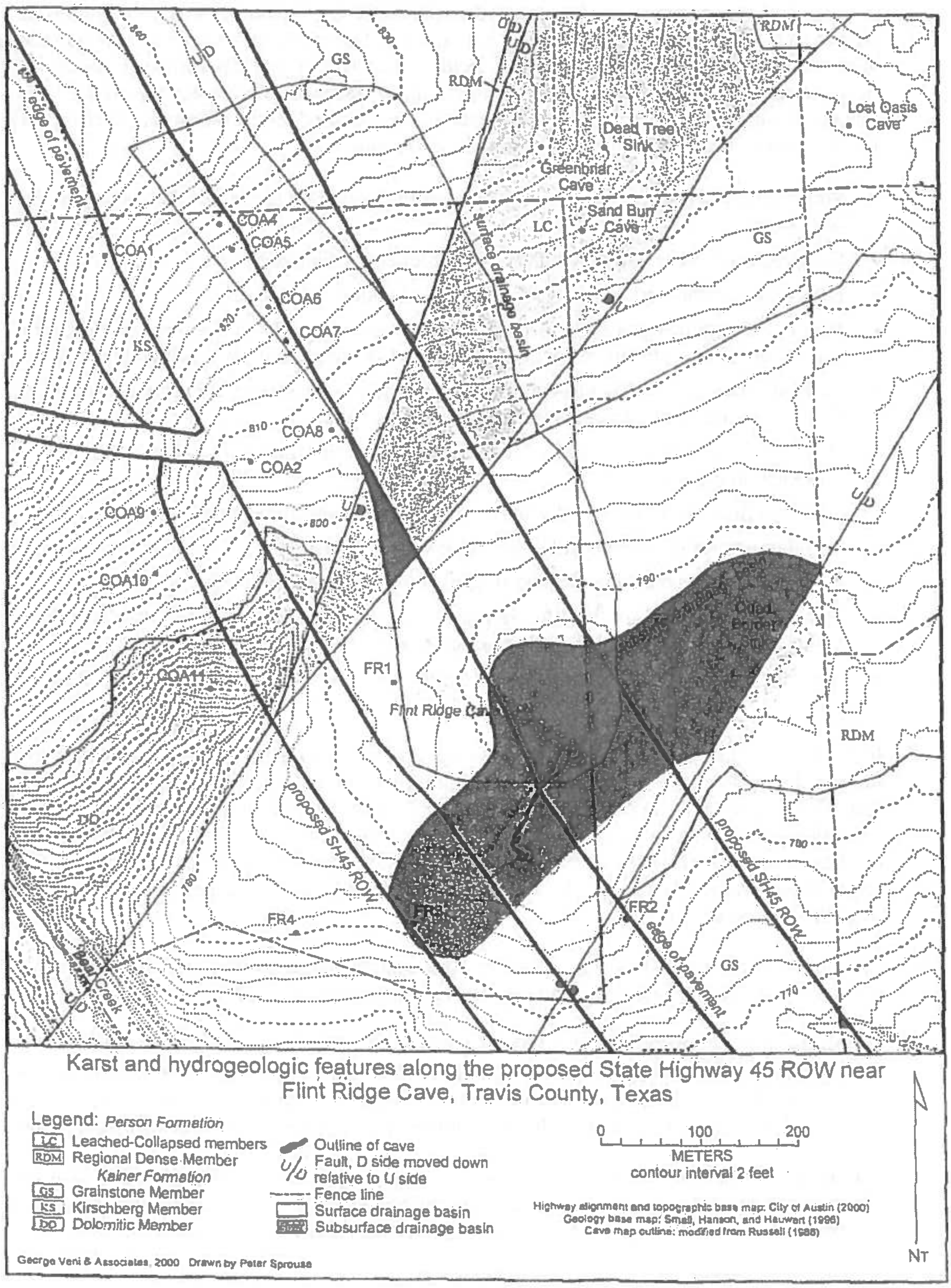


Figure 1. Veni: Flint Ridge Cave surface and subsurface drainage basins.

In 2005 TxDOT commissioned a detailed site-specific investigation of soil conditions in the project area[3]. Reports from those studies are attached. During the investigation, professional soil scientists and hydrogeologists conducted field studies within the FRC drainage basin and the Headquarter Flat Sink Cave (HFSC) site just to the northeast of the project area at the Ladybird Johnson Wildflower Center. Figure 4 presents the locations of soil test locations relative to FRC. The findings of those studies can be summarized as follows:

- Soil diversity is greater than illustrated on existing Natural Resources Conservation Service soil maps;
- Soil properties serve as strong buffers to aquifer contamination;
- High clay contents serve as a significant buffer to aquifer recharge;
- Major pathways of water movement exist along roots and rocks in the upper portion of the soil column, but preferential flow is less than earlier anticipated using brilliant blue dye;
- Limited water flow occurs through the lower portion of the soil column and the subjacent limestone because of clay-plugged macrovoids and fissures;
- Due to increased impervious cover, enhanced surface runoff is likely to be a major construction impact;
- Overland flow of surface water is most critical when soils are very moist to saturated;
- A higher percentage of soils at HFSC are shallower than at FRC;
- Soil texture, clay content, and stone content at the two sites are similar;
- Soil infiltration rates (not the same as aquifer recharge) and soil storage of water are expected to be higher at FRC than HFSC because soil depths are greater at FRC; and
- It is expected that water runoff from soils at the HFSC site would be greater than at the FRC site.

It should be noted that due to FRCs unusually large drainage basin water is not likely to be a limiting factor for the terrestrial karst invertebrate species of concern known from the cave. In fact, FRC is known to be completely inundated by storm water during flood events, a state that few other caves on the BCCP acquisition are ever subjected to. As a result it is likely that the troglobitic beetle and spider populations in FRC rely on upper-level mesocaverns as refugia during flood events. Those upper level refugia occur entirely within the portion of the cave that is outside of the project ROW.

Based on site characteristics and the above conservation measures it is unlikely that significant impacts to the FRC surface or subsurface drainage basins would occur.

5. **Humidity and Temperature** This habitat component refers to the capacity of the subsurface environment to maintain atmospheric conditions that are buffered from variations in surface conditions. Because the project will not impact the cave footprint and other items mentioned above the humidity and temperature habitat component is unlikely to be effected by the project.

6. **Nutrients** This habitat component refers to the cycling of organic matter within the cave system which relies upon input from the overlying surface ecology. The metric commonly used to determine the potential for these impacts is protection of the likely trogloxene foraging area.

[3] Wilding, L. 2005 Site Specific Soil Investigations for the Proposed State Highway 45 (South) Located in Travis and Hays Counties, Texas

Based on studies of common trogloxene species such as cave crickets (*Ceuthophilus* spp.), the USFWS had determined this area to extend up to 105 meters or 345 feet from the cave entrance. As can be seen in the attached figures the entire potential trogloxene foraging area will be avoided. Accordingly the nutrient habitat component is unlikely to be effected by the project.

7. **Surface Vegetative Community** This habitat component refers to the native grassland/woodland required to provide forage for trogloxene species. The USFWS has determined that the minimal area required to sustain a native grassland/woodland for a karst invertebrate preserve is between 40 and 100 acres. Surface vegetative community will not be a limiting factor for FRC following construction of the proposed project since FRC occurs on a very large section of the City of Austin Water Quality Protection Lands.

8. **Surface Animal Community** This habitat component refers to the fauna which provide carcasses, scat, and other forms of nutrient cycling for the trogloxene community. The surface animal community will not be a limiting factor for FRC following construction of the proposed project since FRC occurs on a very large section of the City of Austin Water Quality Protection Lands.

CONCLUSION

Based on site characteristics and proposed impacts avoidance and minimization measures the ecological integrity of Flint Ridge Cave is likely to be maintained. TxDOT along with its partners and consultants have extensive experience in constructing and operating roadways in sensitive karst areas. Recent projects such as US 183-A, SH 45 North, RM 1431, IH-35 over Inner Space Cavern, and the SH 195 improvement project have all been completed with similar, but less extensive karst due-diligence programs. Construction of the proposed project is not likely to impact the BCCP SOC found within FRC.

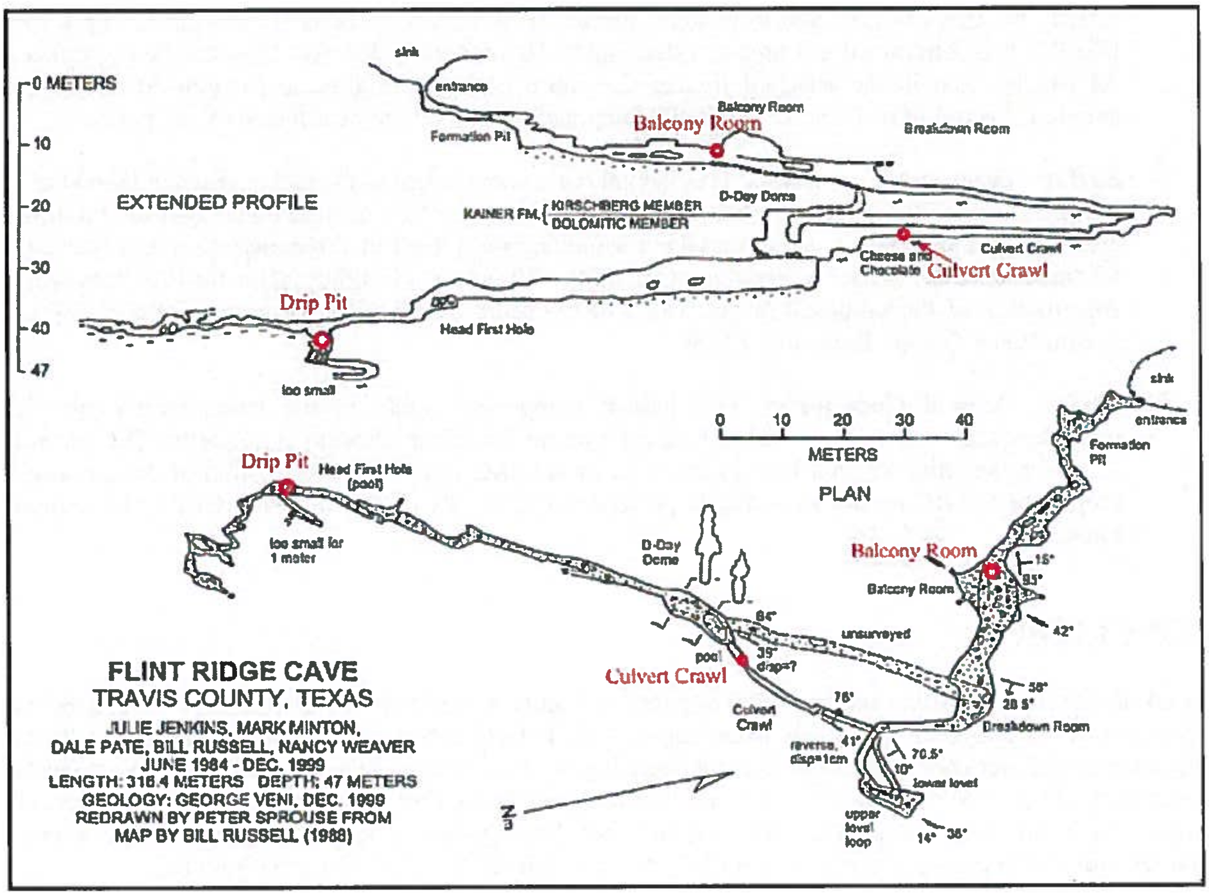


Figure 2. Map of Flint Ridge Cave.

TABLE 11

CAVES (CONTAINING LISTED AND NON-LISTED KARST INVERTEBRATES) PROPOSED FOR PROTECTION

Adobe Springs Cave	Fossil Garden Cave	Midnight Cave
Airman's Cave	Gallifer Cave	Moss Pit
Amber Cave	Get Down Cave	New Comanchee Trail
Armadillo Ranch Sink	Goat Cave	No Rent Cave
Arrow Cave	Hole-in-the-Road Cave	North Root Cave
Bandit Cave	Ireland's Cave	Pennie Cave
Beard Ranch Cave	Jack's Joint	Pickle Pit
Bee Creek Cave	Japygid Cave	Pipeline Cave
Blowing Sink	Jest John Cave	Rolling Rock Cave
Broken Arrow Cave	Jester Estates Cave	Root Cave
Buda Boulder Spring	Jollyville Plateau Cave	Slaughter Creek Cave
Cave X	Kretschmarr Cave	Spanish Wells Cave
Cave Y	Kretschmarr Double Pit	Spider Cave
Ceiling Slot Cave	Lamm Cave	Stark's North Mine
Cold Cave	Little Bee Creek Cave	Stovepipe Cave
Cotterell Cave	Lost Gold Cave	Talus Spring
Disbelievers Cave	Lost Oasis Cave	Tardus Hole
District Park Cave	M.W.A. Cave	Tooth Cave
Eluvial Cave	Maple Run Cave	Weldon Cave
Flint Ridge Cave	McDonald Cave	Whirlpool Cave
Fossil Cave	McNeil Bat Cave	

Figure 3. Excerpt from Balcones Canyonlands Conservation Plan.

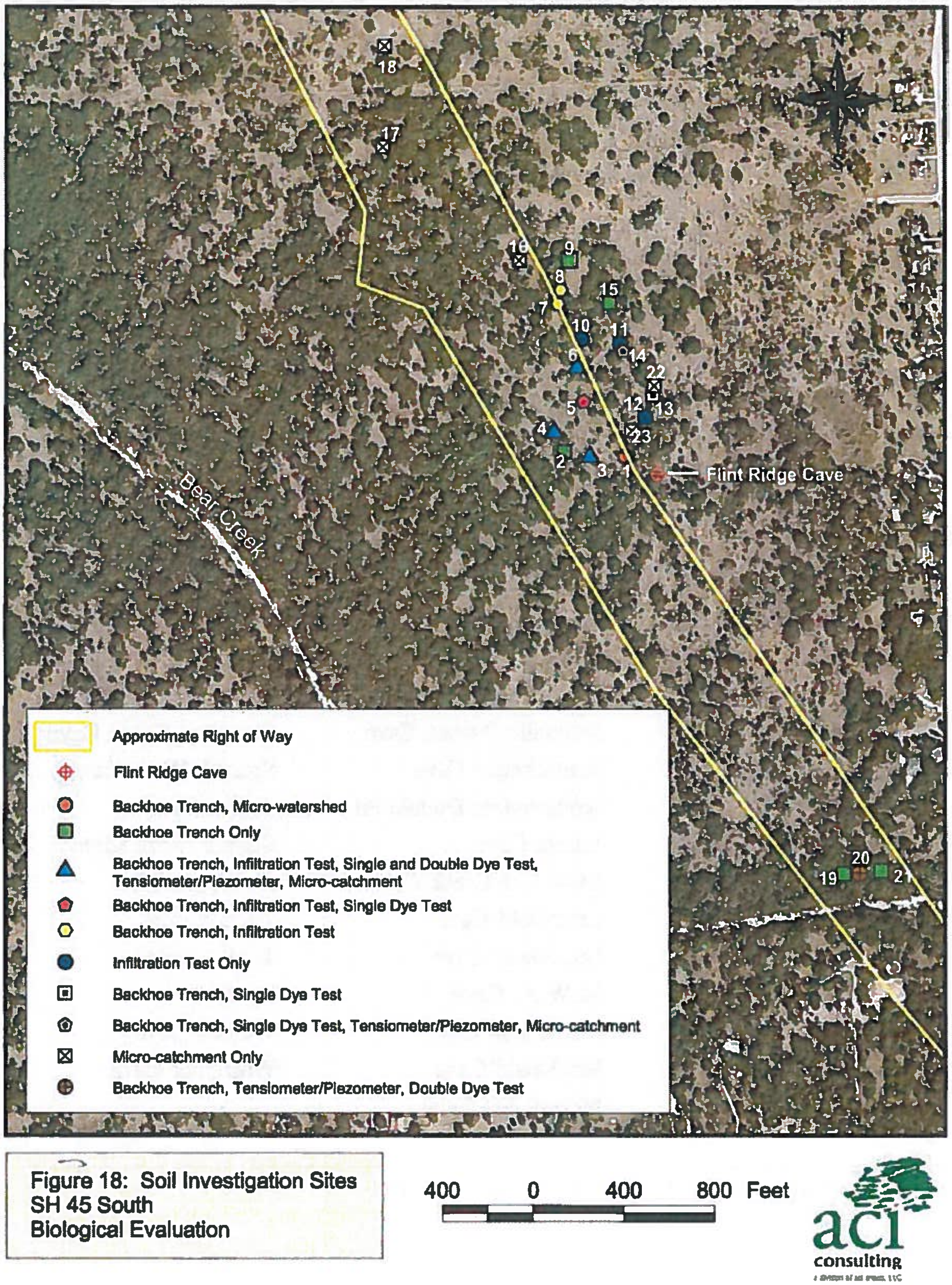


Figure 4. Soil test locations relative to Flint Ridge Cave.

MEMO

February 12, 2014
(Revised April 25, 2014)

To: Carlos Swonke, P.G.
Director of Environmental Affairs

Through: Rodney Concienne, P.G.
Branch Manager, ENV-HMM

From: David Morley, P.G.
Environmental Specialist, ENV-HMM

Subject: AUS SH45 SW (CSJ 1200-06-004) – Travis County Spill Data Evaluation

Summary

The Texas Department of Transportation (TxDOT) is in the advanced planning stages of the proposed 3.5-mile section of State Highway 45 Southwest (SH45 SW; CSJ 1200-06-004). When completed, the proposed project will connect MoPac South to FM1626 in Travis County. Previously proposed project development in this area generated concern among several groups regarding the potential impacts to the Edwards Aquifer. The City of Austin (COA) Watershed Protection Department completed a dye trace study in 2010 to simulate accidental spills in selected portions of the proposed SH45 SW project area. COA published the results of the dye trace study in a report dated October 2012, and they concluded that "an accidental spill from SH45 SW and MoPac South intersection area can be expected to recharge into the Edwards Aquifer and initially arrive at Barton Springs within two to four days under high aquifer discharge conditions. Slower initial arrival times of about three weeks can be expected under drought conditions, on the basis of previous studies..." In response to the community's sensitivity to potential future impacts to the Edwards Aquifer resulting from possible accidental spills from vehicles traveling along SH45 SW and a desire to plan for the implementation of appropriate measures during highway construction and operation to protect the aquifer, TxDOT compiled and analyzed roadway spill data from federal, state, county, and city databases for the time period of 2003 – 2012 to quantify the probability of an accidental spill of hazardous liquids from mobile sources (i.e., vehicles, tanker trucks, etc.) occurring within this proposed 3.5-mile section of highway. TxDOT calculated that a maximum of 5.6 hazardous liquids spills per billion vehicle miles traveled occurred on one of three existing parkways and highways in Travis County that are most similar to the proposed SH45 SW during 2003 – 2012. One spill occurred only on existing SH45 SE (IH35 to SH130) during its 3.7 operational history with approximately 0.18 billion vehicle miles traveled. No spills occurred on either of the other two analogous parkways or highways over a 10 year period with approximately 2.58 billion vehicle miles traveled.

1 Introduction

The Texas Department of Transportation (TxDOT) is in the advanced planning stages of the proposed 3.5-mile State Highway 45 Southwest (SH45 SW). When completed, the proposed project will connect MoPac South to FM1626. This is a new project that once was a part of the formerly proposed Austin Outer Loop project, which was proposed in the 1980s and consisted of five segments and the extension of MoPac South to intersect the southwest portion of SH45. Three of the segments were completed in the early 1990s, and MoPac South and a small west-to-east portion of SH45 joining MoPac South and FM 1826 were completed in 1995. The currently proposed SH45 SW project is situated on part of the recharge zone of the Barton Springs Segment of the Edwards Aquifer Recharge Zone. As such, the proposed roadway generated concern among several groups regarding the potential impacts to the Edwards Aquifer (a karst limestone aquifer), which is a sole-source water supply, habitat for karst invertebrates and aquatic life, and water supply for the recreational facility at Barton Springs. In 1989 in response to the former Austin Outer Loop project, a lawsuit was filed against TxDOT by Save Our Springs (SOS) and Save Barton Creek Association (SBCA). The Barton Springs/Edwards Aquifer Conservation District (BSEACD) intervened on the lawsuit. Through a 1990 settlement consent decree, TxDOT agreed to implement measures that mitigate the potential effects of the proposed highway. Those measures included constructing hazardous material traps and filtration ponds, placing signs to educate the public about the location of the recharge zone along the highways, limiting highway access points and their associated secondary impacts, and completing a study of roadway runoff contamination. In 2010, the City of Austin (COA) Watershed Protection Department completed a dye trace study to simulate accidental spills in selected portions of the area between MoPac South and FM 1626. COA published the results of the dye trace study in a report dated October 2012; and they concluded that "an accidental spill from the SH45 SW and MoPac South intersection area can be expected to recharge into the Edwards Aquifer and initially arrive at Barton Springs within two to four days under high aquifer discharge conditions. Slower initial arrival times of about three weeks can be expected under drought conditions, on the basis of previous studies" (Hauwert et al., 2004a).

In response to the community's sensitivity to potential future impacts to the Edwards Aquifer resulting from possible accidental spills from vehicles, tanker trucks, etc. traveling along the proposed SH45 SW and a desire to plan for the implementation of appropriate measures during highway construction and operation to protect the aquifer, TxDOT compiled and analyzed spill data for three analogous roadways in Travis County from federal, state, county, and city databases for the time period of 2003 – 2012 to attempt to quantify the probability of an accidental spill of hazardous liquids occurring on the proposed 3.5-mile highway and impacting karst habitat and the aquifer. This report summarizes these activities and the conclusions.

2 Spill Data Compilation and Analysis

TxDOT compiled roadway hazardous materials spill data for mobile sources for the period of record 2003 – 2012, a period spanning ten years, from the following federal, state, county, and city databases:

- U.S. Department of Homeland Security and U.S. Coast Guard, Nation Response Center (NRC) Emergency Response Notification System (ERNS) Database
- U.S. DOT - Hazardous Materials Incident Report Subsystem (HMIRS) of the Pipeline and Hazardous Materials Safety Administration (PHMSA) Hazardous Materials Information System https://hip.phmsa.dot.gov/analytics SOAP/
- U.S. DOT - Bureau of Transportation Statistics (BTS) http://www.rita.dot.gov/bts/data and statistics/databases
- National Transportation Safety Board (NTSB), http://www.ntsb.gov/investigations/reports hazmat.html

- TCEQ Spill Reports Database
- TxDOT Crash Records Information System (CRIS) database is managed by the Traffic Operations Division, Crash Records Section of TxDOT.
- City of Austin (COA) Fire Marshall and Travis County Fire Marshall (these data are stored in two databases); the National Fire Information Reporting System (NFIRS), http://www.nfirs.fema.gov/documentation/reference/; and the Austin Fire Department (AFD) Computer-Aided Dispatch (CAD).

These databases reflect reports from first responders to vehicular accidents where hazardous materials were spilled. Of these only the NRC-ERNS, USDOT-PHMSA, TCEQ Spill Report, and TxDOT's CRIS databases provided usable data that contained sufficient location and spill record information for the purposes of this study. The USDOT-BTS, NTSB and COA databases did not provide usable data, as they contained only statewide-level data, lacked data for Travis County, or lacked sufficient structure and detail to be electronically queried. Visiting governmental offices to conduct research was beyond the scope of this project. The assumption is that the historic data from the usable sources will represent potential future events, at least from a statistical perspective. The usable data were sorted according to the following attributes:

- Identification (ID) - internal identification of spill location
- Year – year spill occurred
- Location – location of spill
- Latitude and Longitude – latitude and longitude of spill location
- Type of Material Spilled – solid, liquid, gas, unknown
- Substance Spilled – fuel, gasoline, sewage, etc.
- Volume – gallons of spill material
- Source of Data – agency from which data was acquired

Data containing sufficient geospatial references, such as latitude/longitude, street address, road intersection, etc., were entered into data tables. The data tables were then used to create a shapefile for each of the four usable data sources in TxDOT's graphic information system (GIS) using ArcGIS 10. The four shapefiles were then consolidated into a single shapefile.

In order to conservatively estimate the number of spills per vehicle-mile traveled (VMT) on roadways in Travis County analogous to the proposed SH45 SW during 2003 - 2012, TxDOT included reported mobile source spills of hazardous liquids regardless of volume. Approximately 23 percent of the data (39 out of 172 records) did not include spill location data sufficient to locate it on a map. In these cases, the data, if of sufficient quality, were used to develop county-wide spill statistics. The details of the statistical analysis of the data are presented later in this report.

3 Traffic Volume Statistics/Vehicle Miles Traveled

In order to analyze potential traffic volumes on the proposed SH45 SW, TxDOT acquired and evaluated traffic volume data, specifically in the form of current annual average daily traffic (AADT) counts, for similar existing highways and parkways in Travis County for 2012. AADT is a measure of the total volume of vehicle traffic of a segment of highway or road for a year divided by 365 days. It is a useful and simple measurement of how busy the road is. AADT data are collected for multiple twenty-four hour periods. The counts are done during the non-summer weeks; excluding Fridays, Saturdays, Sundays, and holidays. The AADT typically includes both directions and frontage roads, if applicable; however, for this analysis only main lane data for year 2012 were used. A Weighted 2012 AADT was calculated by multiplying current AADT values by length of road segment, summing these weighted values, and then dividing this sum by the sum of road segment lengths. The Weighted 2012 AADT can be converted to daily vehicle miles traveled (2012 DVMT) and annual vehicle miles traveled (2012 AVMT). DVMT is calculated by multiplying the Weighted AADT by the length of the highway or parkway segment, and AVMT is the DVMT multiplied by 365 days per year.

In addition to the 2012 AADT count, TxDOT also queried and analyzed its roadway data management system to identify sections of existing highways and parkways in Travis County that have design characteristics and functional classifications most similar to the proposed SH45 SW. Once these were identified, then the traffic volume data for these analogous sections of highway and parkway were compiled and analyzed.

Based on the above listed criteria, the most analogous highways and parkways in Travis County to the proposed SH45 SW were identified and the traffic volume for each compiled. The three most analogous highways/parkways are existing SH45 (from RM 1826 to MoPac South), existing SH45 SE (from IH 35 to SH 130), and State Loop 360. A summary of the Weighted 2012 AADT, 2012 DVMT, and 2012 AVMT data for each analogous highway and parkway is presented in Table 1.

Table 1: Summary of Weighted 2012 AADT, DVMT and AVMT Data for Travis County Highways/Parkways Most Analogous to the proposed SH45 SW

Analogous Highway or Parkway	Length (miles)	Weighted 2012 AADT (vehicles per day)	2012 DVMT (vehicle-miles)	2012 AVMT (vehicle-miles)
Existing State Highway 45 SE (IH35 to SH130)	11.3	11,803	133,248	48,635,368
Existing State Highway 45 (RM1826 to MoPac South)	2.6	13,509	35,111	12,815,344
State Loop 360	14.0	47,937	671,118	244,958,200

AADT is Annual Average Daily Traffic, which is the total volume of vehicle traffic of a highway or road for a year divided by 365 days.

DVMT is Daily Vehicle Miles Traveled, which is the AADT for each segment highway or parkway multiplied by the length of the highway or parkway segment.

AVMT is Annual Vehicle Miles Traveled, which is DVMT multiplied by 365 days per year.

The 2012 DVMT for the analogous existing SH45 (RM1826 to MoPac South), existing SH45 SE (IH35 to SH130), and State Loop 360 were 35,111, 133,248, and 671,118 vehicle miles traveled, and the 2012 AVMT were approximately 12.8 million, 48.6 million, and 244.9 million vehicle miles traveled.

4 Statistics of Spills 2003-2012

A total of 172 mobile source (i.e., vehicles, tanker trucks, etc.) hazardous materials spill incidents in Travis County were identified for calendar years 2003 – 2012 (a ten-year period of record). A summary of the number of events in the dataset is presented in Table 2. Of the events, 14 spills were of unknown or unrecorded material, 1 comprised solid material, and 13 were gaseous and irrelevant for subsequent analysis. Of the 144 liquid spills, the records for 43 included an estimate of the volume of material spilled.

Table 2: Summary of Travis County hazardous material spill incidents for the period 2003 – 2012

Year	Count	Material			
		Unknown	Liquid (*)	Solid	Gas
2003	12		12 (3)		
2004	11		11 (2)		
2005	19	1	18 (5)		
2006	18		16 (5)		2
2007	14		14 (7)		
2008	13		12 (5)	1	
2009	4		4 (1)		
2010	22	2	18 (2)		2
2011	20	4	14 (6)		2
2012	39	7	25 (7)		7
Total	172	14	144 (43)	1	13

(*) The parenthetical data in the Liquid column gives the number of liquid spills for which spill volume was recorded.

The numbers of events presented in Table 2 were normalized by dividing the entries in each row by the number of spills reported in each year of the study period. In addition, the last row contains percentages for the entire sample. That is, the last row is based on the number of occurrences for each column over the entire period of record. The results of this computation are displayed in Table 3.

Table 3: Percentage of recorded spills by category

Year	Material			
	Unknown	Liquid (*)	Solid	Gas
2003		100.0 (25.0)		
2004		100.0 (18.2)		
2005	5.3	94.7 (26.3)		
2006		88.8 (27.7)		11.1
2007		100.0 (50.0)		
2008		92.3 (38.5)	7.7	
2009		100.0 (25.0)		
2010	9.0	81.8 (9.0)		9.0
2011	20.0	70.0 (30.0)		10.0

2012	17.9	64.1 (17.9)		17.9
Total	8.1	83.7 (25.0)	0.6	7.6

(*) The parenthetical data in the Liquid column gives the proportion of liquid spills for which spill volume was recorded.

For the majority of the years in the study period the number of unknown material spill events was zero or a relatively small fraction of the sample, with the number of events in years 2011 and 2012 being noticeably higher than the other years. The reasons for these increases were not investigated; such an effort is outside the scope of this project. The fraction of spills recorded that were liquid and that included an estimate of volume recorded as part of the reporting process was 25 percent or greater for the majority of years in the study period. Approximately 8 percent of recorded spills constituted solids or gases. Solids are relatively easy to confine to the spill site and gases cannot be confined to the spill site. This result reinforces TxDOT's decision to focus the study on only hazardous liquid spills.

In June 2011, Texas Tech University, under contract to TxDOT, published a report (David B. Thompson, et al, June 6, 2011) that analyzed the occurrence and statistics of hazardous material spill incidents for mobile sources along <u>all</u> Texas highways (not only those in Travis County) for the five-year period of 2002 – 2006, as compiled by TCEQ. The report examined the statistical distribution of hazardous liquid spill volumes. They found that hazardous liquid spills observed on roadways in the entire state during 2002-2006 were distributed according to the following percentiles:

- 50 percent – 60 gallons or less
- 67 percent – 100 gallons or less
- 83 percent – 300 gallons or less
- 90 percent – 820 gallons or less
- 95 percent - 2,500 gallons or less
- 99 percent - 20,000 gallons or less

Therefore, 95 percent of the hazardous liquid spills from mobile sources observed in Texas during 2002 – 2006 were 2,500 gallons or less, and 99 percent of spills were about 20,000 gallons or less.

This statistical distribution includes areas outside of Travis County that typically experience more frequent liquids transportation on roadways, especially associated with commerce occurring in and between large industrial complexes. As such, the percentiles likely represent a conservative (overstated) condition with respect to actual conditions in Travis County. In other words, the same percentiles for Travis County alone would likely reflect smaller spills.

Furthermore, the probability of the occurrence of a spill greater than 10,000 gallons (only half of the 20,000 gallon value mentioned above) is extremely low due in large part to the fact that the amount of hazardous material that may be legally shipped on public highways is regulated by 23CRF§658, and federal highway regulations limit the weight of a motorized cargo vehicle to 80,000 pounds gross weight. This means that a tanker truck is limited to approximately 10,000 gallons of liquid or less depending on the specific gravity of the material (John A. Marler, et al, September 2005). This indicates that a spill of greater than 10,000 gallons would be extremely rare and require, for example, two tanker trucks to be involved in an incident and simultaneously spill. Nonetheless, industry-leading hazardous material traps and filtration ponds will be engineered for the proposed SH45 SW project to more than adequately confine and contain the appropriate worst-case spill volume to ensure adequate protection of the environment.

For the three analogous highways/parkways identified in Section 3, TxDOT calculated hazardous liquid spill rates for the corresponding 2012 AVMT. Our analysis only included main lanes (i.e., no frontage roads, etc.). Because the 2012 DVMT only represented that year and the spill data covered a ten year period (2003 – 2012) for the existing SH45 (RM1826 to MoPac South) and State Loop 360 and a 3.7 year period (May 2009 – 2012) for SH45 SE (IH35 to SH130), the average annual number of spills was calculated by dividing the number of spills by ten and 3.7, respectively. For each analogous highway/parkway, the number of hazardous liquid spills for 2003 - 2012, average annual number of spills, and number of spills per AVMT are summarized in Table 4.

Table 4: Hazardous Liquid Spills for 2003 – 2012, Average Annual Number of Hazardous Liquid Spills, and Hazardous Liquid Spills per AVMT

Analogous Highway or Parkway	Number of Hazardous Liquid Spills 2003 – 2012(*)	Average Annual Number of Hazardous Liquid Spills	2012 AVMT (vehicle-miles)	Hazardous Liquid Spills per Billion VMT (spills/billion vehicle-miles)
Existing State Highway 45 SE (IH35 to SH130)	1	0.27(*)	48,635,368	5.6
Existing State Highway 45 (RM1826 to MoPac South)	0	0	12,815,344	0
State Loop 360	0	0	244,958,200	0

(*) For SH45 SE the time period is only 3.7 years of the 10-year period, as it was opened to traffic in May 2009.

For the ten year period, and accounting for the 3.7 year period for SH45 SE, the maximum frequency of recorded hazardous liquids spills on the three analogous highways/parkways was 5.6 spills per billion vehicle miles traveled. This equates to no spills on existing SH45 (RM1826 to MoPac South) and State Loop 360 over 10 years with approximately 2.58 billion vehicle miles traveled, and one spill on existing SH45 SE (IH35 to SH130) over 3.7 years with approximately 0.18 billion vehicle miles traveled.

5 Conclusions

1. The 2012 DVMT for the analogous existing SH45 (RM1826 to MoPac South), existing SH45 SE (IH35 to SH130), and State Loop 360 were 35,111, 133,248, and 671,118 vehicle miles traveled, and the 2012 AVMT for the same three roadways were approximately 12.8 million, 48.6 million, and 244.9 million vehicle miles traveled.

2. Records of hazardous material spill incidents for mobile sources on highways and parkways in Travis County for the period of 2003 – 2012 were obtained from four publically available databases. A total of 172 spill incidents were available for analysis. Materials comprising gases, solids, and unknown materials were eliminated from further analysis. The remaining 144 hazardous liquid spill incidents were examined.

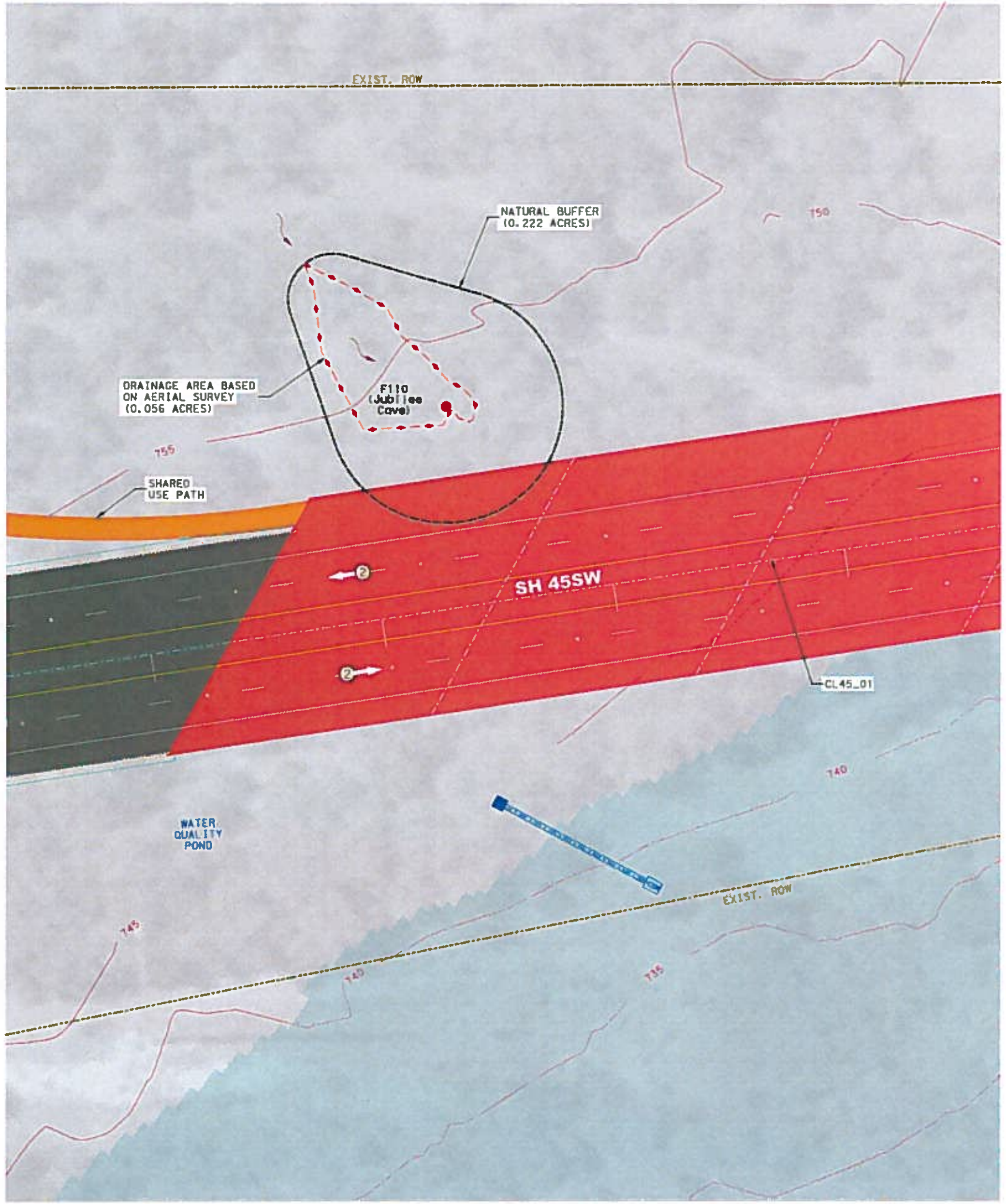
3. TxDOT calculated a maximum of 5.6 spills per billion vehicle miles traveled occurred on one of three parkways and highways in Travis County that are most similar to the proposed SH45 SW during 2003 - 2012. One spill occurred only on existing SH45 SE (IH35 to SH130) during its 3.7 operation history with approximately 0.18 billion vehicle miles traveled. No spills occurred on either of the other two analogous parkways or highways over a 10 year period with approximately 2.58 billion vehicle miles traveled.

4. Texas Tech University's June 2011 report indicated that over 90 percent of hazardous liquids spills from mobile sources in Texas for 2002 - 2006 were less than 820 gallons.

6 Additional References

- Marler, John A., Barrett, Michael E., and Malina, Joseph, September 2005, Hazardous Materials Traps Transport Spill Containment for Stormwater Pollution Prevention along Texas Highways. Center for Research in Water Resources, Bureau of Engineering Research, The University of Texas at Austin, J.J. Pickle Research Campus, Austin, TX 78712. Technical Report, CRWR 05-06.

- Thompson, David B., Morse, Audra, and Acker, Jenna, June 6, 2011, Analysis of the Occurrence and Statistics of Hazardous Materials Spill Incidents along Texas Highways and Suggestions for Mitigation of Transport-Related Spills to Receiving Waters. Center for Multidisciplinary Research in Transportation, Department of Civil and Environmental Engineering, Texas Tech University, P.O. Box 41023, Lubbock, Texas 79409-1023. Research Report Number 0-5200-1, Project Number 0-5200.



CAVE GATE CONSTRUCTION

THESE NOTES COME FROM TCEQ PUBLICATION RG-348 UNDER THE SECTION CALLED "GATE CONSTRUCTION".

1. PLACE WELDING MAT OVER CAVE ENTRANCE TO PROTECT IT FROM WELDING RESIDUALS.
2. DRILL ANCHOR POINTS TO SOLID BEDROCK, ANCHOR GRID WITH ¾IN. TO 1 IN. REBAR FROM 8 IN. TO 10 IN. LONG.
3. WELD ANCHORS TO SUPPORTIVE CROSS BEAMS, FLAT SIDE FACING UP.
4. CONSTRUCT LEVEL HORIZONTAL GRID OF 2 IN. BY 2 IN. BY 3/8 IN STEEL ANGLE, LEAVING ROOM FOR ACCESS DOOR.
5. PLACE STEEL ANGLE ON THEIR EDGE SIDE, WITH THE ANGLE PEAK POINTED IN THE SAME DIRECTION. CONSULT A CAVE SPECIALIST FOR BEST PLACEMENT. SPACE BARS 1.5 IN. APART THROUGHOUT.
6. ACCESS DOOR IS 30 IN. SQUARE WITH HINGED DOOR AND CONCEALED LOCK BOX.
7. PROVIDE 2 IN. WIDE LOCK WITH 3/8 IN. SHACKLE.
8. CONSTRUCT HORIZONTAL STIFFENERS ACROSS ANGLE EXPANSES WITH 1 TO 2 IN. WIDE BY 3/8 IN. THICK FLAT BAR STOCK. SPACE THEM 4 TO 5 FT. APART.
9. APPLY RUST INHIBITIVE PAINT WITH HAND BRUSH.
10. REMOVE PROTECTIVE BLANKET AND ALL FOREIGN MATERIALS GENERATED.

NATURAL BUFFERS

1. BRIDGE DRILL SHAFT CONSTRUCTION WITHIN THE NATURAL BUFFER SHALL BE AVOIDED TO THE MAXIMUM PRACTICAL EXTENT.
2. TEMPORARY SEDIMENT CONTROL MEASURES SHALL BE PLACED AS NEAR TO CONSTRUCTION AS POSSIBLE TO MINIMIZE DISTURBANCE WITHIN THE BUFFER ZONES AND THE DRAINAGE AREA.
3. NATURAL VEGETATION WITHIN THE BUFFER ZONES SHALL BE MAINTAINED AS MUCH AS POSSIBLE. NO ORNAMENTAL GRASSES OR LANDSCAPING SHALL BE INCORPORATED WITHIN THE BUFFER ZONES OR DRAINAGE AREAS.

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SCALE IN FEET

INTERIM REVIEW
THIS DOCUMENT IS RELEASED FOR THE PURPOSE OF INTERIM REVIEW UNDER THE AUTHORITY OF WADE E. STRONG, PE 61841 ON 10/27/2014
IT IS NOT TO BE USED FOR CONSTRUCTION PURPOSES.

SH 45 SW
ENVIRONMENTAL STUDY

RODRIGUEZ TRANSPORTATION GROUP
CONSULTING ENGINEERS
FIRM #587

Texas Department of Transportation®

DATE: 10/27/2014

SH 45SW
PRELIMINARY
SCHEMATIC DESIGN
SENSITIVE KARST FEATURE F110
JUBILEE CAVE
DRAINAGE DETAILS

10/27/2014
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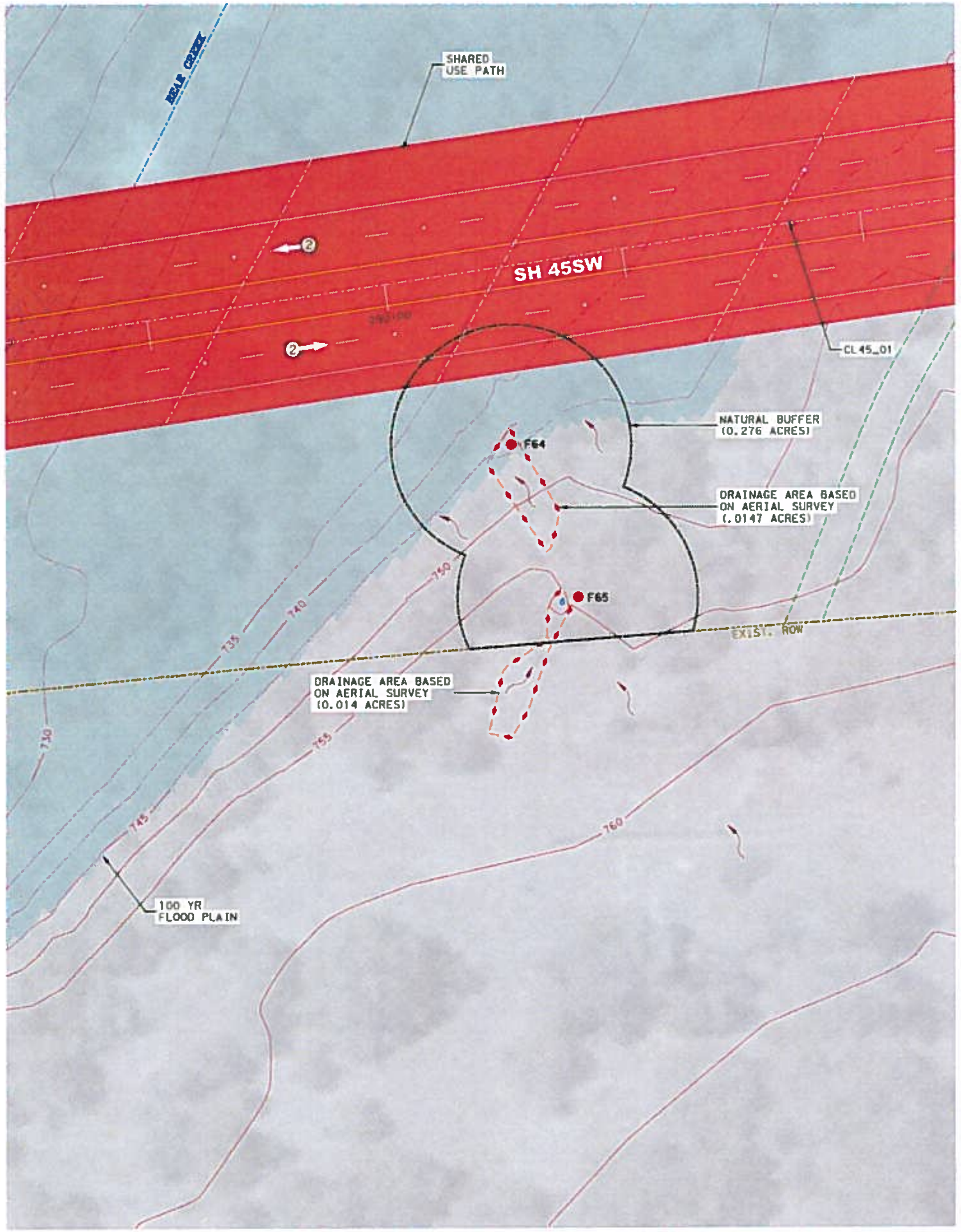

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3. WELD ANCHORS TO SUPPORTIVE CROSS BEAMS, FLAT SIDE FACING UP.
4. CONSTRUCT LEVEL HORIZONTAL GRID OF 2 IN. BY 2 IN. BY 3/8 IN STEEL ANGLE, LEAVING ROOM FOR ACCESS DOOR.
5. PLACE STEEL ANGLE ON THEIR EDGE SIDE, WITH THE ANGLE PEAK POINTED IN THE SAME DIRECTION. CONSULT A CAVE SPECIALIST FOR BEST PLACEMENT. SPACE BARS 1.5 IN. APART THROUGHOUT.
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8. CONSTRUCT HORIZONTAL STIFFENERS ACROSS ANGLE EXPANSES WITH 1 TO 2 IN. WIDE BY 3/8 IN. THICK FLAT BAR STOCK. SPACE THEM 4 TO 5 FT. APART.
9. APPLY RUST INHIBITIVE PAINT WITH HAND BRUSH.
10. REMOVE PROTECTIVE BLANKET AND ALL FOREIGN MATERIALS GENERATED.

NATURAL BUFFERS

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3. NATURAL VEGETATION WITHIN THE BUFFER ZONES SHALL BE MAINTAINED AS MUCH AS POSSIBLE. NO ORNAMENTAL GRASSES OR LANDSCAPING SHALL BE INCORPORATED WITHIN THE BUFFER ZONES OR DRAINAGE AREAS.

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SH 45 SW
ENVIRONMENTAL STUDY

RODRIGUEZ TRANSPORTATION GROUP
CONSULTING ENGINEERS
FIRM #587

Texas Department of Transportation

DATE: 10/27/2014

SH 45SW
PRELIMINARY
SCHEMATIC DESIGN

SENSITIVE KARST FEATURES F64 & F65
DRAINAGE DETAILS

10/27/2014
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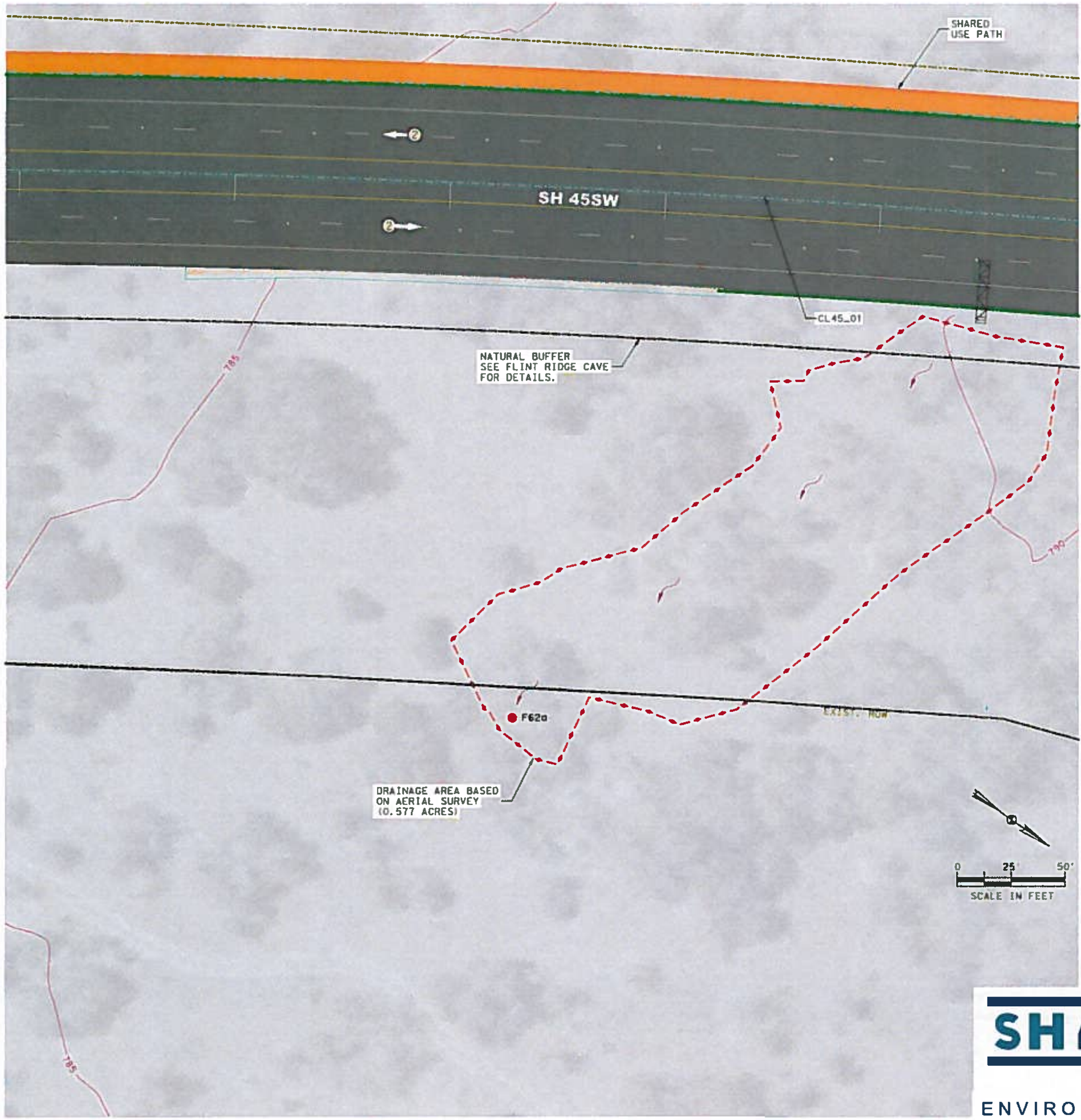

NATURAL BUFFERS

1. BUFFERS AROUND SENSITIVE FEATURES INDICATE A CONSTRUCTION-FREE ZONE TO THE MAXIMUM PRACTICAL EXTENT.
2. TEMPORARY SEDIMENT CONTROL MEASURES SHALL BE PLACED AS NEAR TO CONSTRUCTION AS POSSIBLE TO MINIMIZE DISTURBANCE WITHIN THE BUFFER ZONES AND THE DRAINAGE AREA.
3. NATURAL VEGETATION WITHIN THE BUFFER ZONES SHALL BE MAINTAINED AS MUCH AS POSSIBLE. NO ORNAMENTAL GRASSES OR LANDSCAPING SHALL BE INCORPORATED WITHIN THE BUFFER ZONES OR DRAINAGE AREAS.

INTERIM REVIEW

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SH 45 SW
ENVIRONMENTAL STUDY

RODRIGUEZ TRANSPORTATION GROUP
CONSULTING ENGINEERS
FIRM #587

Texas Department of Transportation®

DATE: 10/27/2014

SH 45SW
PRELIMINARY
SCHEMATIC DESIGN

SENSITIVE KARST FEATURE F62a
DRAINAGE DETAILS

10/27/2014
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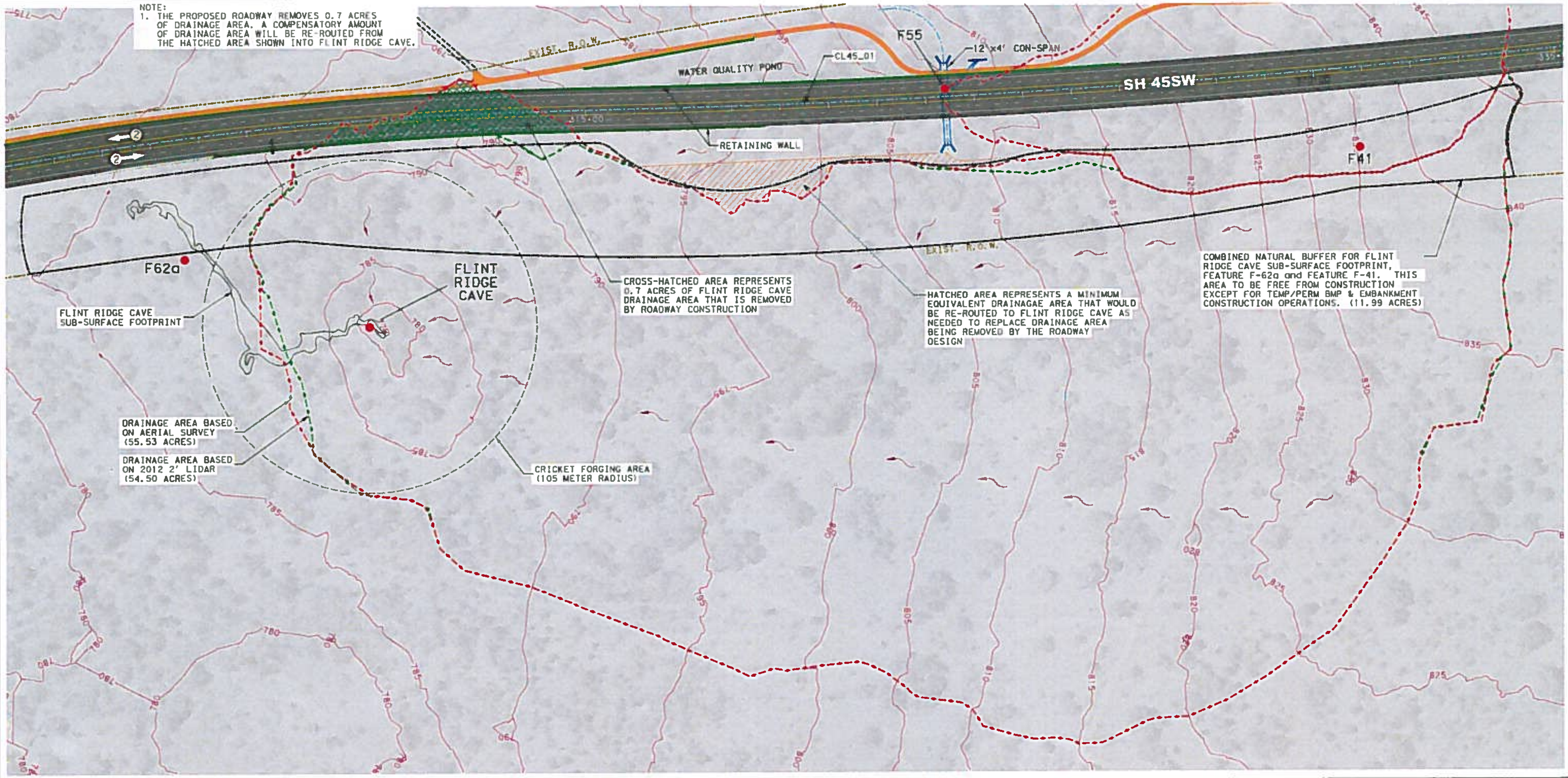

LEGEND

- F62a ● = SENSATIVE KARST FEATURE
- = DRAINAGE AREA BASED ON AERIAL SURVEY
- = DRAINAGE AREA BASED ON 2012 2' LIDAR
- = FLINT RIDGE CAVE DRAINAGE AREA (USED IN DRAFT EIS)
- = SHARED USE PATH
- = DRAINAGE FLOW DIRECTION
- = EXISTING RIGHT OF WAY
- = CRICKET FORGING AREA (105 METER RADIUS)
- = NATURAL BUFFER (CONSTRUCTION-FREE ZONE)

NATURAL BUFFERS

1. BUFFER ZONES AROUND SENSITIVE FEATURES INDICATE A CONSTRUCTION-FREE ZONE TO THE MAXIMUM PRACTICAL EXTENT.
2. TEMPORARY SEDIMENT CONTROL MEASURES SHALL BE PLACED AS NEAR TO CONSTRUCTION AS POSSIBLE TO MINIMIZE DISTURBANCE WITHIN THE BUFFER ZONES AND THE DRAINAGE AREA.
3. NATURAL VEGETATION WITHIN THE BUFFER ZONES SHALL BE MAINTAINED AS MUCH AS POSSIBLE. NO ORNAMENTAL GRASSES OR LANDSCAPING SHALL BE INCORPORATED WITHIN THE BUFFER ZONES OR DRAINAGE AREAS
4. HIGH SERVICE ROCK BERMS SHALL BE PLACED AROUND THE PERIMETER OF NATURAL BUFFERS AS NEEDED TO PROTECT THE FEATURES FROM CAPTURING SEDIMENT LADEN RUNOFF DURING CONSTRUCTION. INTERCEPTOR SWALES AND/OR DIVERSION DIKES WILL BE USED TO TEMPORARILY DIVERT SEDIMENT LADEN RUNOFF AWAY FROM FLINT RIDGE CAVE DURING CONSTRUCTION. REFER TO THE TEMPORARY EROSION AND SEDIMENT CONTROL PLANS FOR ADDITIONAL DETAILS.

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SCALE IN FEET

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SH 45 SW
ENVIRONMENTAL STUDY

RODRIGUEZ TRANSPORTATION GROUP
CONSULTING ENGINEERS
FIRM #587

Texas Department of Transportation®

DATE: 10/28/2014

SH 45SW RIGHT OF WAY WITHIN THE AREA OF POTENTIAL EFFECTS ON FLINT RIDGE CAVE

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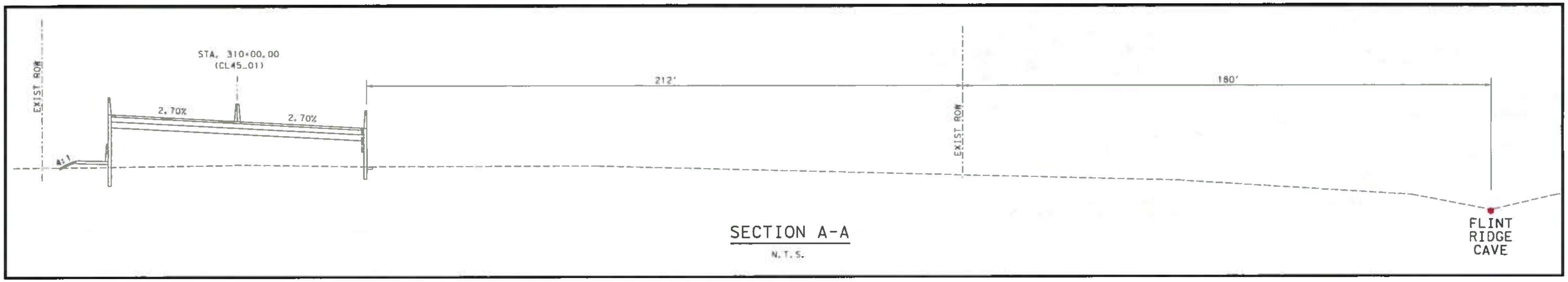

SECTION A-A

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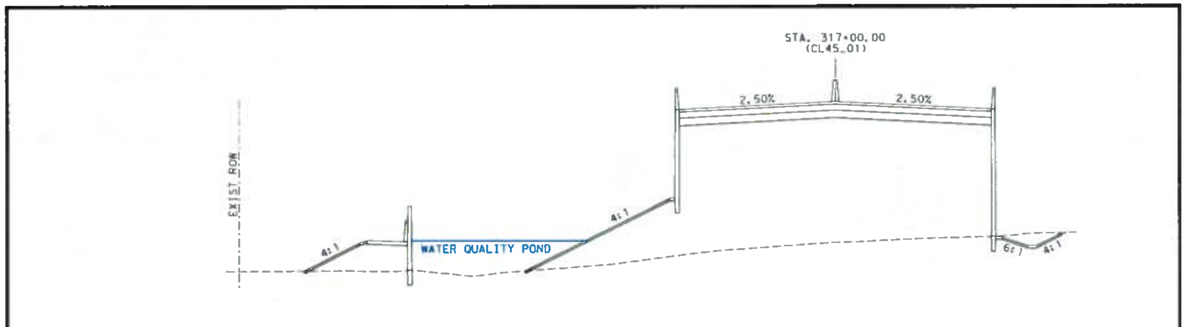
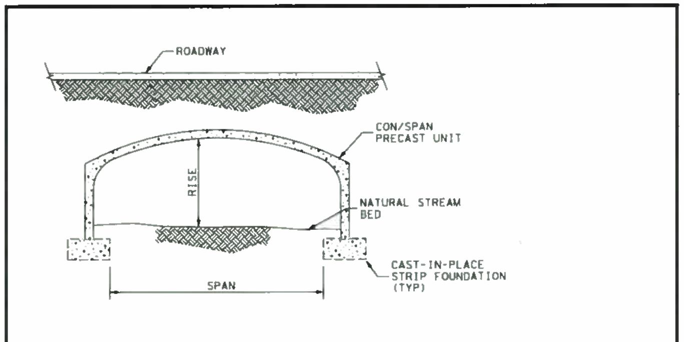


SECTION B-B

N.T.S.



SECTION C-C

N.T.S.

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SH 45 SW

ENVIRONMENTAL STUDY

RODRIGUEZ TRANSPORTATION GROUP

CONSULTING ENGINEERS

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Texas Department of Transportation®

DATE: 10/19/2014

SH 45SW RIGHT OF WAY WITHIN THE AREA OF POTENTIAL EFFECTS ON FLINT RIDGE CAVE

10/19/2014
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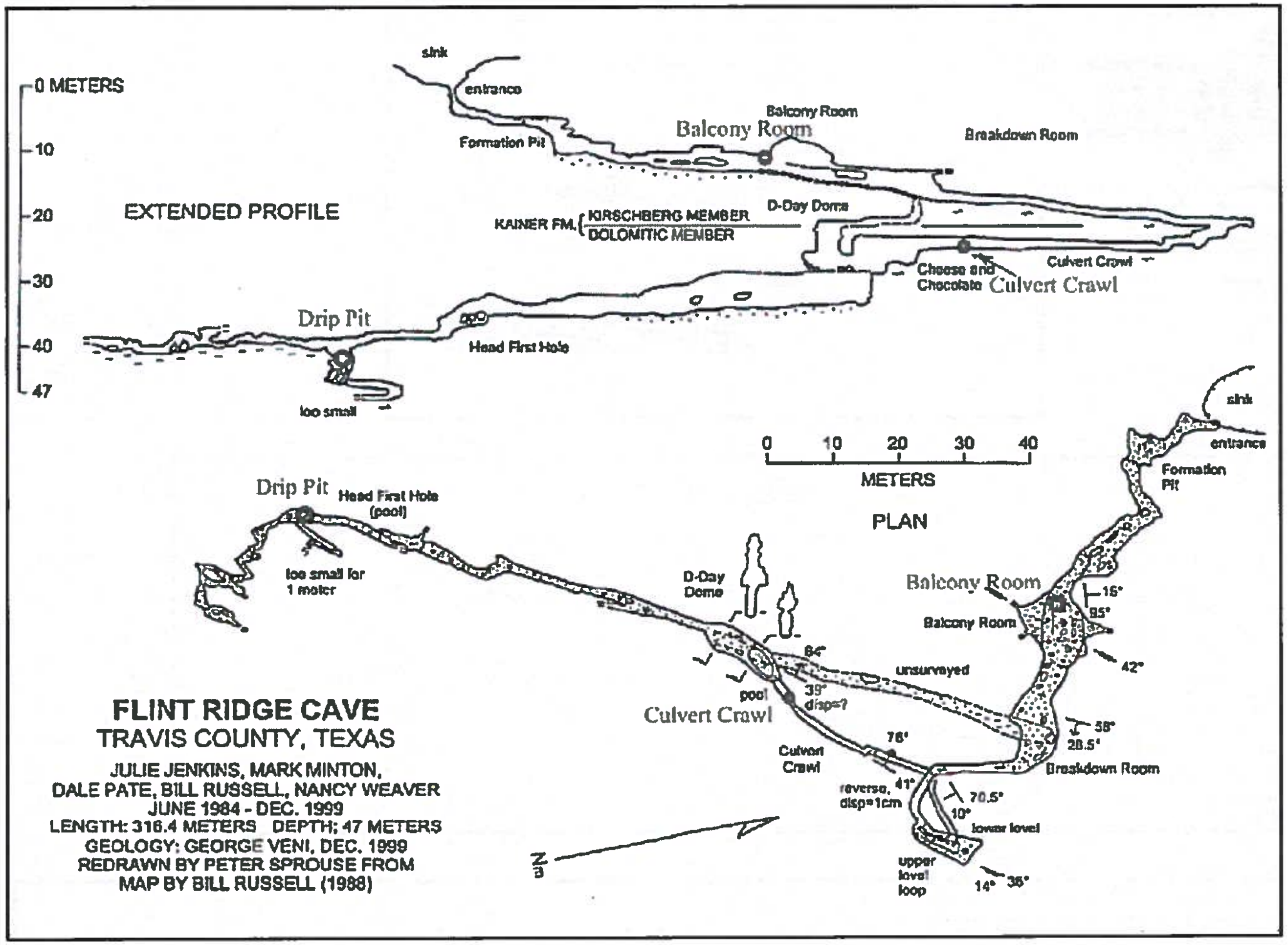


FLINT RIDGE CAVE
TRAVIS COUNTY, TEXAS

JULIE JENKINS, MARK MINTON,
DALE PATE, BILL RUSSELL, NANCY WEAVER
JUNE 1984 - DEC. 1999
LENGTH: 316.4 METERS DEPTH: 47 METERS
GEOLOGY: GEORGE VENI, DEC. 1999
REDRAWN BY PETER SPROUSE FROM
MAP BY BILL RUSSELL (1988)

INTERIM REVIEW
THIS DOCUMENT IS RELEASED FOR THE PURPOSE OF INTERIM REVIEW UNDER THE AUTHORITY OF WADE E. STRONG, PE 61841 ON 10/19/2014
IT IS NOT TO BE USED FOR CONSTRUCTION PURPOSES.

SH 45 SW
ENVIRONMENTAL STUDY

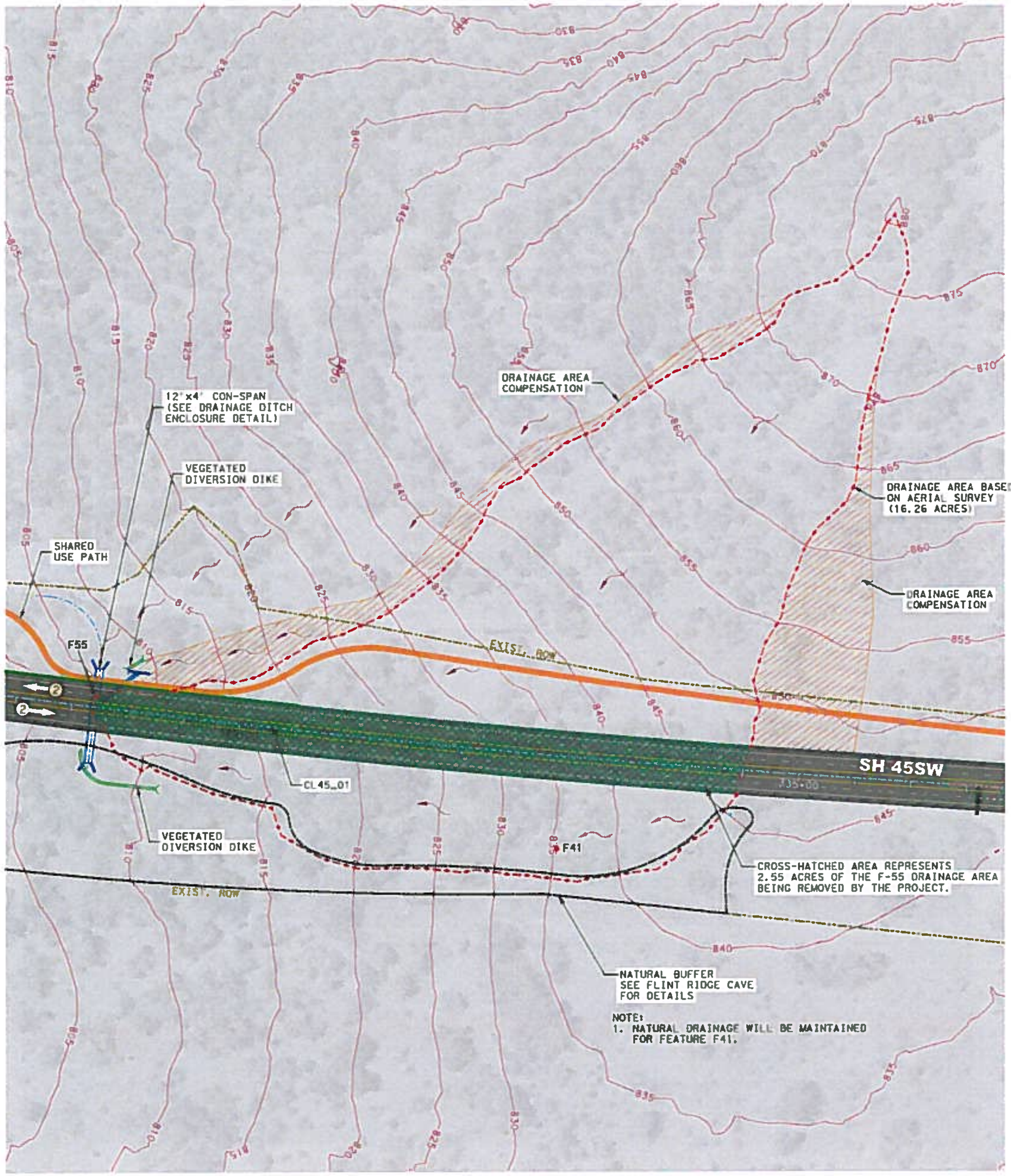
RODRIGUEZ TRANSPORTATION GROUP
CONSULTING ENGINEERS
FIRM #587

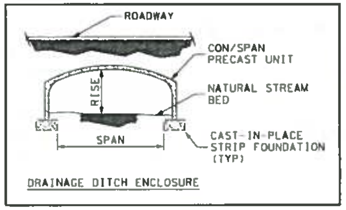
Texas Department of Transportation®

DATE: 10/19/2014

SH 45SW RIGHT OF WAY
WITHIN THE AREA OF
POTENTIAL EFFECTS ON
FLINT RIDGE CAVE

10/19/2014
C:\8140403\d\v\planShts\Schematics\DETAIL SHEET 4b.dgn





NATURAL BUFFERS

1. BUFFERS AROUND SENSITIVE FEATURES INDICATE A CONSTRUCTION FREE ZONE TO THE MAXIMUM PRACTICAL EXTENT.
2. TEMPORARY SEDIMENT CONTROL MEASURES SHALL BE PLACED AS NEAR TO CONSTRUCTION AS POSSIBLE TO MINIMIZE DISTURBANCE WITHIN THE BUFFER ZONES AND THE DRAINAGE AREA.
3. NATURAL VEGETATION WITHIN THE BUFFER ZONES SHALL BE MAINTAINED AS MUCH AS POSSIBLE. NO ORNAMENTAL GRASSES OR LANDSCAPING SHALL BE INCORPORATED WITHIN THE BUFFER ZONES OR DRAINAGE AREAS.
4. HIGH SERVICE ROCK BERMS SHALL BE PLACED AROUND THE PERIMETER OF THE BUFFER ZONES AS NEEDED TO PROTECT THE FEATURES FROM CAPTURING SEDIMENT LADEN RUNOFF DURING CONSTRUCTION. REFER TO THE TEMPORARY EROSION AND SEDIMENT CONTROL PLANS FOR ADDITIONAL DETAILS.

NOTE:
1. THE PROPOSED ROADWAY DESIGN REMOVES 2.55 ACRES FROM THE F55 DRAINAGE AREA. A COMPENSATORY AMOUNT OF AREA FROM OFFSITE TO WEST (CROSS-HATCHED AREA SHOWN) WILL BE RE-ROUTED BACK TO THIS FEATURE.

0 100' 200'
SCALE IN FEET

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SH 45 SW
ENVIRONMENTAL STUDY

RODRIGUEZ TRANSPORTATION GROUP
CONSULTING ENGINEERS
FIRM #587

Texas Department of Transportation

DATE: 10/27/2014

SH 45SW
PRELIMINARY
SCHEMATIC DESIGN

SENSITIVE KARST FEATURE F55
DRAINAGE DETAILS

10/27/2014
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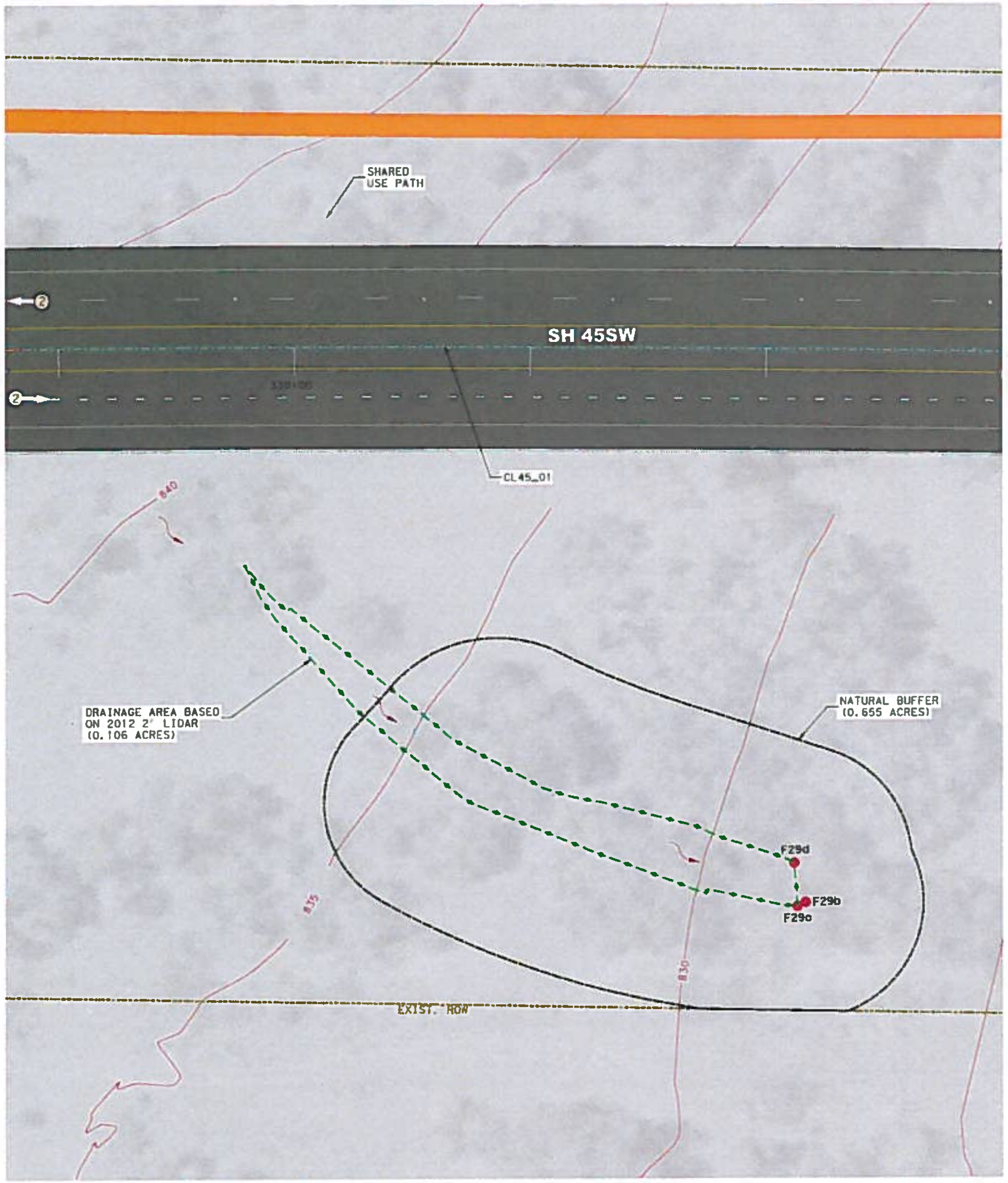

NATURAL BUFFERS

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SH 45 SW
ENVIRONMENTAL STUDY

RODRIGUEZ TRANSPORTATION GROUP
CONSULTING ENGINEERS
FIRM #587

Texas Department of Transportation®

DATE: 10/27/2014

SH 45SW
PRELIMINARY
SCHEMATIC DESIGN
SENSITIVE KARST FEATURES
F29b, F29c & F29d
DRAINAGE DETAILS

10/27/2014
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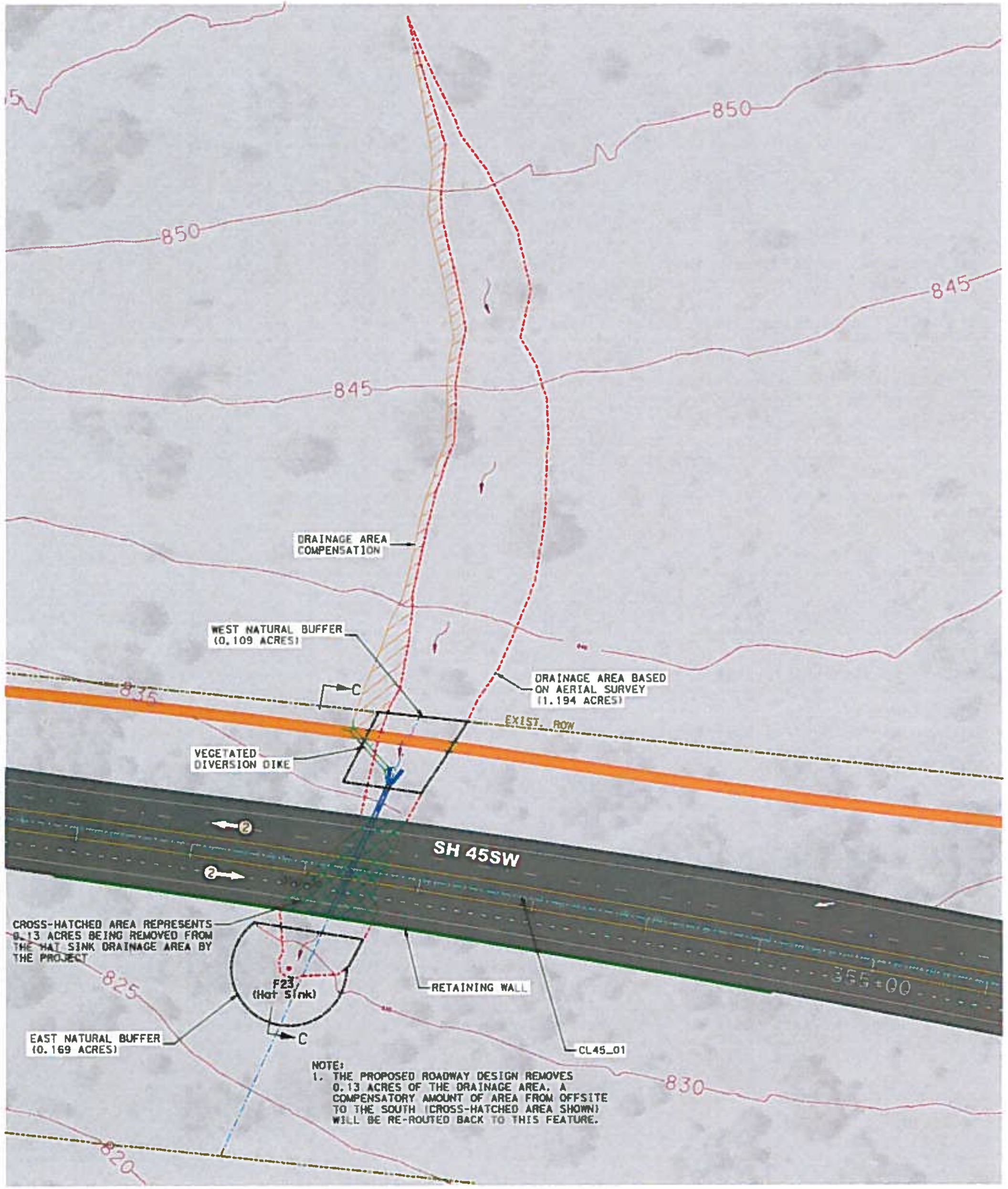

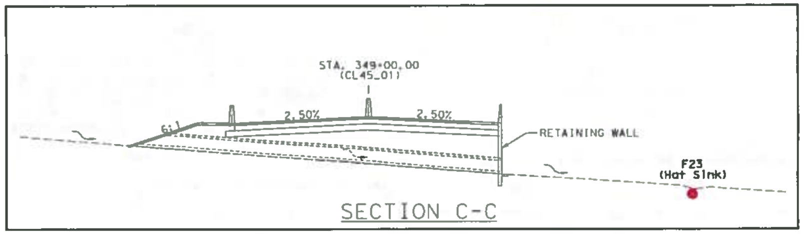

CAVE GATE CONSTRUCTION

THESE NOTES COME FROM TCEQ PUBLICATION RG-348 UNDER THE SECTION CALLED "GATE CONSTRUCTION".

1. PLACE WELDING MAT OVER CAVE ENTRANCE TO PROTECT IT FROM WELDING RESIDUALS.
2. DRILL ANCHOR POINTS TO SOLID BEDROCK, ANCHOR GRID WITH ¾IN. TO 1 IN. REBAR FROM 8 IN. TO 10 IN. LONG.
3. WELD ANCHORS TO SUPPORTIVE CROSS BEAMS, FLAT SIDE FACING UP.
4. CONSTRUCT LEVEL HORIZONTAL GRID OF 2 IN. BY 2 IN. BY 3/8 IN STEEL ANGLE, LEAVING ROOM FOR ACCESS DOOR.
5. PLACE STEEL ANGLE ON THEIR EDGE SIDE, WITH THE ANGLE PEAK POINTED IN THE SAME DIRECTION. CONSULT A CAVE SPECIALIST FOR BEST PLACEMENT. SPACE BARS 1.5 IN. APART THROUGHOUT.
6. ACCESS DOOR IS 30 IN. SQUARE WITH HINGED DOOR AND CONCEALED LOCK BOX.
7. PROVIDE 2 IN. WIDE LOCK WITH 3/8 IN. SHACKLE.
8. CONSTRUCT HORIZONTAL STIFFENERS ACROSS ANGLE EXPANSES WITH 1 TO 2 IN. WIDE BY 3/8 IN. THICK FLAT BAR STOCK. SPACE THEM 4 TO 5 FT. APART.
9. APPLY RUST INHIBITIVE PAINT WITH HAND BRUSH.
10. REMOVE PROTECTIVE BLANKET AND ALL FOREIGN MATERIALS GENERATED.

NATURAL BUFFERS

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0 50' 100'
SCALE IN FEET

INTERIM REVIEW
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SH 45 SW
ENVIRONMENTAL STUDY

RODRIGUEZ TRANSPORTATION GROUP
CONSULTING ENGINEERS
FIRM #587

Texas Department of Transportation

DATE: 10/27/2014

SH 45SW
PRELIMINARY
SCHEMATIC DESIGN
SENSITIVE KARST FEATURE F23
HAT SINK
DRAINAGE DETAILS

10/27/2014
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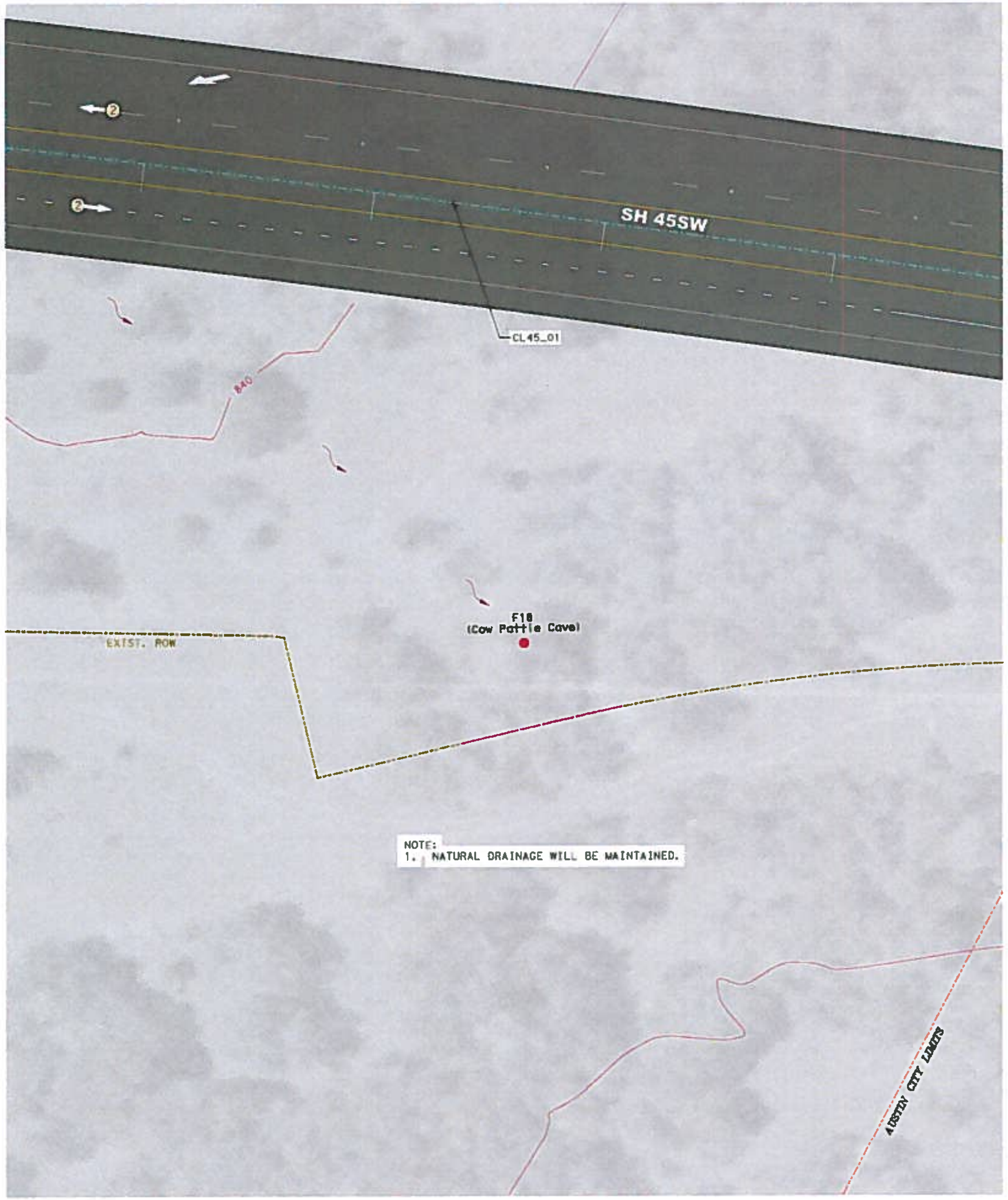

CAVE GATE CONSTRUCTION

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8. CONSTRUCT HORIZONTAL STIFFENERS ACROSS ANGLE EXPANSES WITH 1 TO 2 IN. WIDE BY 3/8 IN. THICK FLAT BAR STOCK. SPACE THEM 4 TO 5 FT. APART.
9. APPLY RUST INHIBITIVE PAINT WITH HAND BRUSH.
10. REMOVE PROTECTIVE BLANKET AND ALL FOREIGN MATERIALS GENERATED.

0 100' 200'
SCALE IN FEET

INTERIM REVIEW
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SH 45 SW
ENVIRONMENTAL STUDY

RODRIGUEZ TRANSPORTATION GROUP
CONSULTING ENGINEERS
FIRM #587

Texas Department of Transportation®

DATE: 10/22/2014

SH 45SW
PRELIMINARY
SCHEMATIC DESIGN
SENSITIVE KARST FEATURE F18
COW PATTIE CAVE
DRAINAGE DETAILS

10/22/2014
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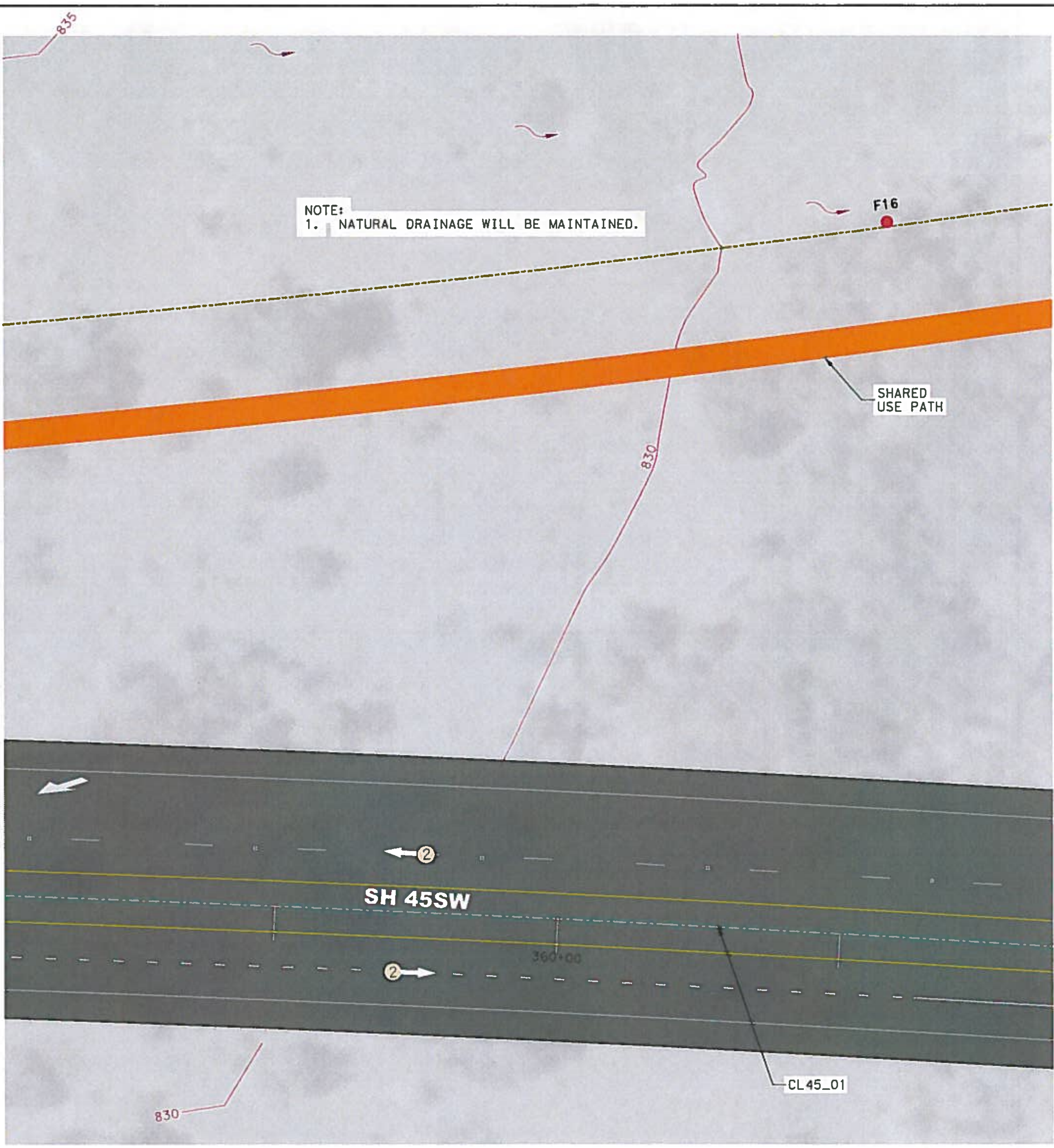

0 25' 50'
SCALE IN FEET

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SH 45 SW
ENVIRONMENTAL STUDY

RODRIGUEZ TRANSPORTATION GROUP
CONSULTING ENGINEERS
FIRM #587

Texas Department of Transportation®

DATE: 10/22/2014

SH 45SW
PRELIMINARY
SCHEMATIC DESIGN

SENSITIVE KARST FEATURE F16
DRAINAGE DETAILS

10/22/2014
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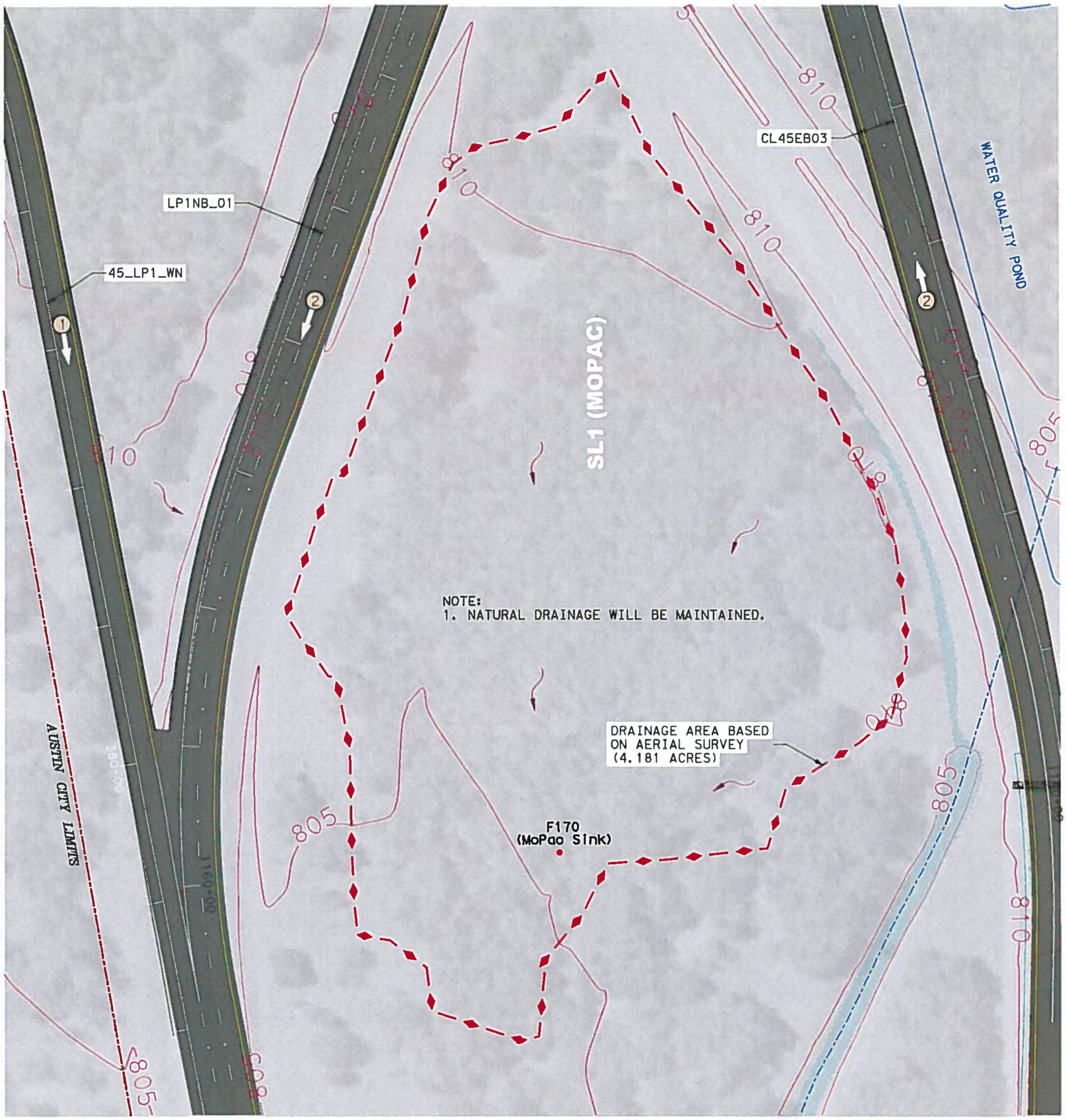

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SCALE IN FEET

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SH 45 SW

ENVIRONMENTAL STUDY

RODRIGUEZ TRANSPORTATION GROUP

CONSULTING ENGINEERS

FIRM #587

Texas Department of Transportation®

DATE: 10/22/2014

SH 45SW PRELIMINARY SCHEMATIC DESIGN

SENSITIVE KARST FEATURES F170 MOPAC SINK DRAINAGE DETAILS

10/22/2014
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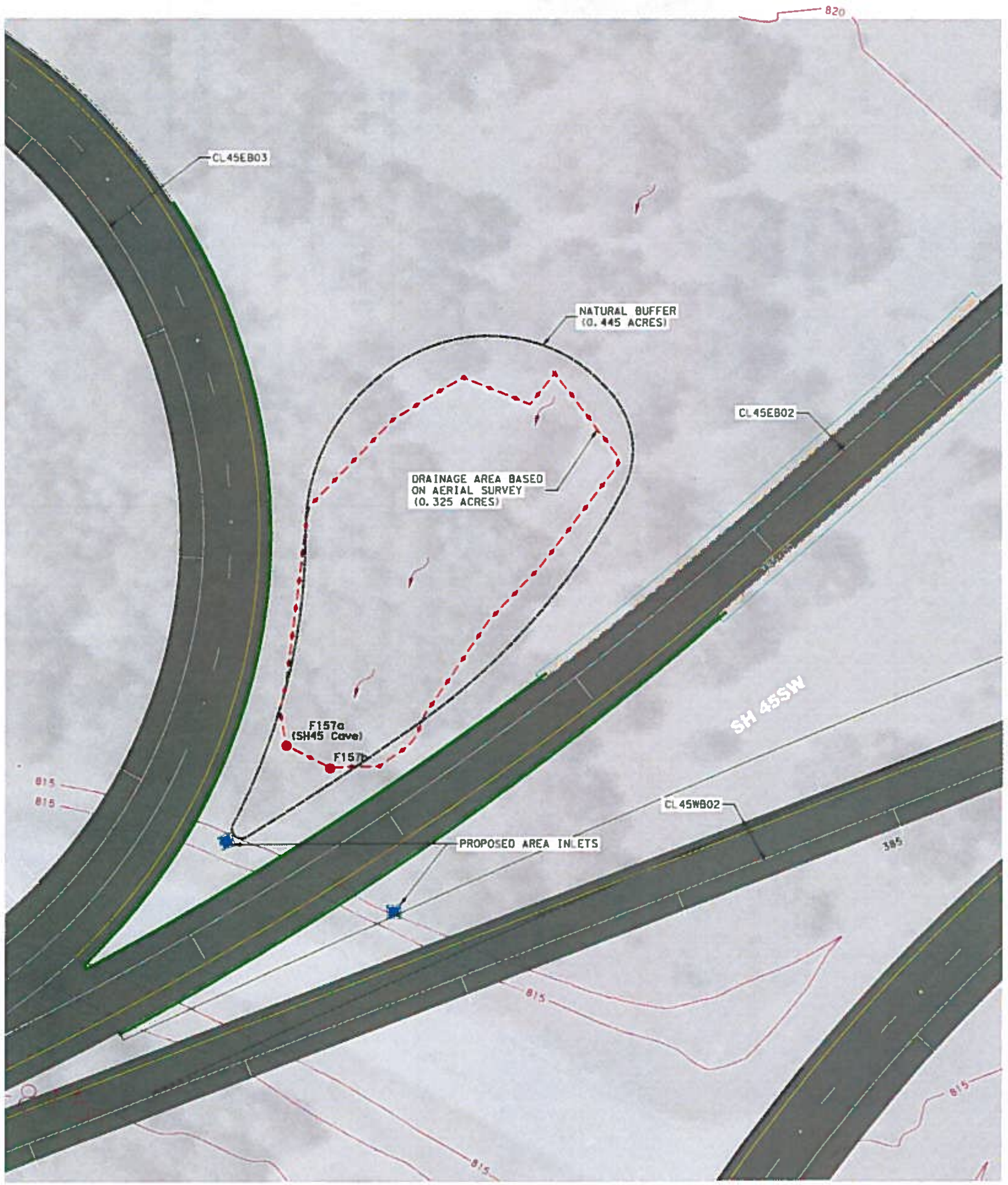

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NATURAL BUFFERS

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SH 45 SW
ENVIRONMENTAL STUDY

RODRIGUEZ TRANSPORTATION GROUP
CONSULTING ENGINEERS
FIRM #587

Texas Department of Transportation®

DATE: 10/27/2014

SH 45SW
PRELIMINARY
SCHEMATIC DESIGN

SENSITIVE KARST FEATURES
F157a (SH45 CAVE) & F157b
DRAINAGE DETAILS

10/27/2014
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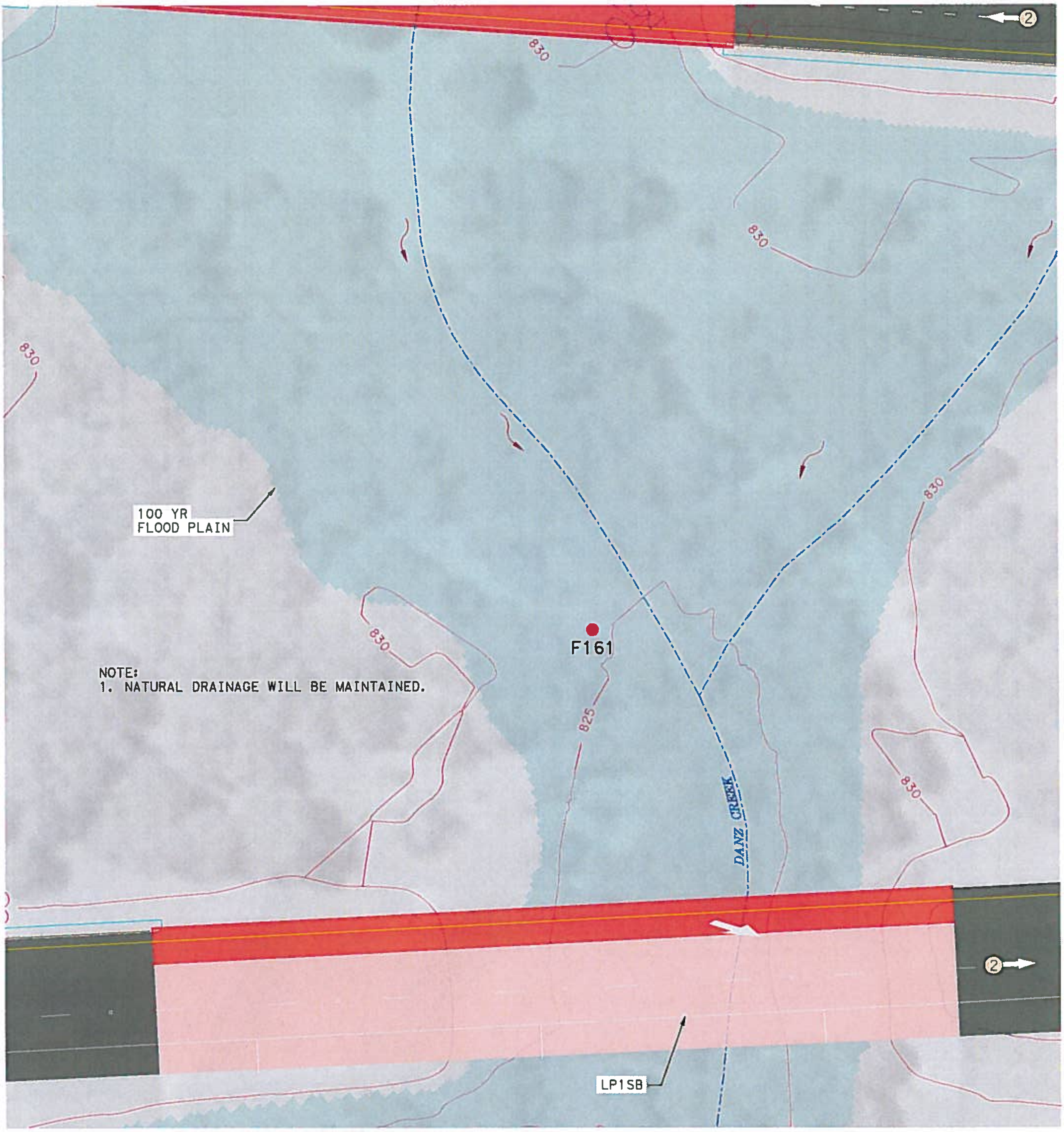

0 25' 50'
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SH 45 SW
ENVIRONMENTAL STUDY

RODRIGUEZ TRANSPORTATION GROUP
RTG
CONSULTING ENGINEERS
FIRM #587

Texas Department of Transportation®

DATE: 10/22/2014

SH 45SW
PRELIMINARY
SCHEMATIC DESIGN

SENSITIVE KARST FEATURE F161
DRAINAGE DETAILS

10/22/2014
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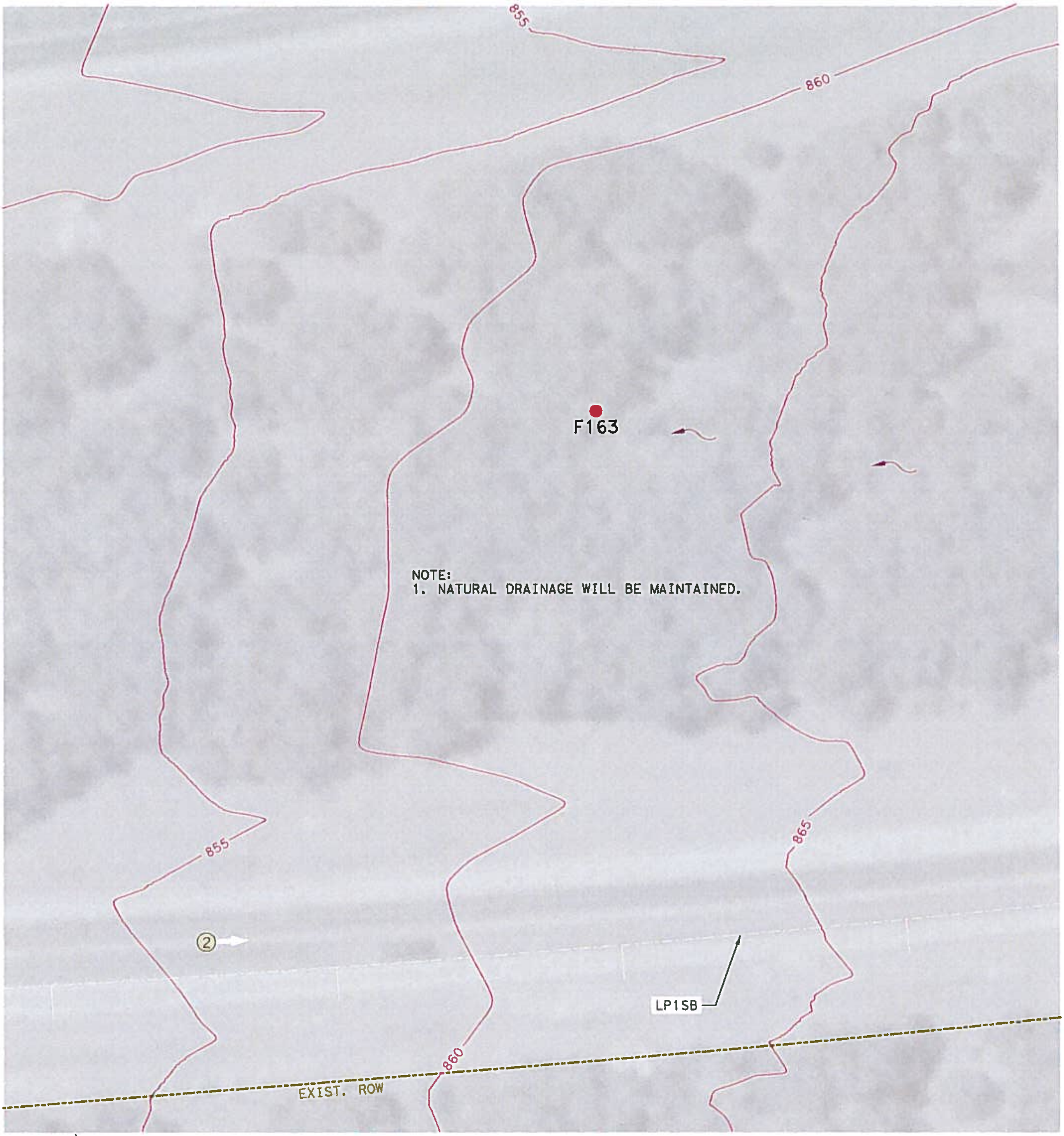

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SH 45 SW
ENVIRONMENTAL STUDY

RODRIGUEZ TRANSPORTATION GROUP
RTG
CONSULTING ENGINEERS
FIRM #587

Texas Department of Transportation®

DATE: 10/22/2014

SH 45SW PRELIMINARY SCHEMATIC DESIGN

SENSITIVE KARST FEATURE F163 DRAINAGE DETAILS

10/22/2014
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