Cave Stream Habitat for Jollyville Plateau Salamander across Buttercup Creek Area Interpreted from Cave Mapping and Verified with Groundwater Traces

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Austin Water, Wildlands Conservation Division, Balcones Canyonlands Preserve

Final Draft January 21, 2020



Cover Photograph Credits

Left Side:

Jollyville Plateau Salamander and Millipede in Testudo Tube Cave Stream
Rachael Barlow in Testudo Tube Cave stream
Photographs by Mark Sanders on June 5, 2002

Right Side:

Jollyville Plateau Salamander in Treehouse Cave Stream (Photo: Piers Hendrie on May 20, 2017)
Leslie Bell in Marigold Cave Stream (Photo: Christopher E. Francke on June 12, 2011)

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Abstract

While aquatic salamanders like the listed threatened Jollyville Plateau Salamander (*Eurycea tonkawae*) are most commonly observed in springs and spring-fed creeks, most of their habitat is actually contained in subsurface cave streams. Using a combination of cave maps, cave stream elevations, Jollyville Plateau Salamander observations, and existing dye trace tests, a continuous cave stream is mapped based on existing data and hypothesized to discharge from Blizzard Springs in a Travis County preserve that feeds Cypress creek tributary of the Colorado River. This cave stream is called Buttercup Creek Cave Stream and is hypothesized to have several tributaries contributing flow from the west as far as Anderson Mill Road.

Introduction

Because springs are most readily accessible for observation of aquatic salamanders, such as the threatened Jollyville Plateau Salamander (*Eurycea tonkawae*), there is a tendency to see aquatic aquifer life as surface phenomena. Hill and Vaughn (1898) described the presence of "peculiar cave-inhabiting animals" including "eyeless salamanders" in the groundwater across the Austin, San Marcos and San Antonio area. Yet, until recently, it was accepted that the Barton Springs Salamander (*Eurycea sosorum* or eyeless *Eurycea waterlooensis*) was only found in Barton Springs. Zara Environmental LLC in Manchaca, Texas was able to recover Barton Springs Salamanders from their water well after making 212 trap recoveries from the well (Herpetological Review 2015). Bendik et al. (2016) used mark recapture methods to delineate surface critical habitat for the Jollyville Plateau Salamander (*Eurycea tonakawae*). Devitt et al. (2019) mapped the distribution of aquatic salamanders using DNA sequence data.

The purpose of this report is to provide a description of a primary habitat of the Jollyville Plateau Salamander within underground cave streams, that are delineated from both from cave mapping by volunteer cavers, as well as verification provided by historical groundwater traces.

Geology

The cave streams from Lime Creek/Anderson Mill Road to Buttercup Creek extending southward are developed within the Cedar Park Limestone, Whitestone Member, Bee Cave Member, and Bull Creek Member of the Walnut Formation, based on interpretations by William Russell (1993) and Mike Warton. Blizzard or R-Bar-B Ranch Spring was estimated to discharge about 15 feet below the top of the Upper Glen Rose Formation, based on a 1997 measured section taken at the spring by Nico Hauwert. A more detailed description of the stratigraphy in relation to local caves is provided by Hauwert and Warton (1997). Moore (1964), Rogers (1969), Rose (1972), Senger et al. (1990), Kirkland et al. (1996), Small et al. (1996), Housch (2007), and Hauwert (2010) also provides descriptions of local stratigraphy.

In general the cave streams in this report are developed within the Comanche Peak and Walnut Formations, and discharge from the Upper Glen Rose Formation at Blizzard Springs. Cave development within the relatively lower permeability units are typically restricted to fault and fractures, which are typically aligned northeast to southwest in the study area Hauwert (2009). In

unconfined portions of the Edwards Aquifer, groundwater can also be directed east or southeast through permeable beds descending along down-stepped fault blocks.

Cave Exploration

The vast majority of caves were historically filled by pioneers, ranchers, and developers for a variety of reasons including keeping water at the surface for livestock and mill operation, eliminating fall hazards to people and livestock, disposing of trash, and improving marketability of land investment for future development (Veni and Hauwert, 2015). Reopening the filled caves generally was performed to a limited extent by volunteers of the Underground Texas Grotto and other cave clubs (San Marcos, Dallas-Fort Worth, Texas A&M University, San Antonio, Greater Houston, etc.) since the 1950's. Cave restoration work is extremely challenging. Cave exploration reported by the Texas Speleological Survey began in 1963. By 1990, the caver community had excavated, explored, and mapped about 163 caves across the Austin area, and 20% of those had already been refilled or destroyed. One of the only caves to be extended over 240 feet down to the water table was Blowing Sink Cave. While weekend excavation of Blowing Sink cave began by volunteers in 1984, the water table wasn't reached until five years later in 1989. Even then, it took years of observation to discover the presence of Barton Springs Salamanders in the cave stream.

Russell (1993) hypothesized

> *"…Buttercup Creek in the Cedar Park karst faunal region in Williamson County, overlies an important karst network composed of several caves such as Buttercup River Cave, Ilex Cave, Boulevard Cave, Whitewater Cave, and a large number of small sinkholes and caves that may contribute to an underground stream. Testudo Tube is a more distant infeeder to the system. Available information indicates that the stream exits either at a spring in Bull Creek to the south, which contributes to Austin's water supply, or feeds into the northern pool of the Edwards Aquifer."*

Dye Tracing

Prior to groundwater tracing, large scale water-level (potentiometric-surface) maps suggested that groundwater within the Northern Segment of the Edwards Aquifer across the study area was restricted by low permeability faults that created hydraulic barriers that caused generally east flow toward springs along Interstate 35 (Senger et al. 1990). Dye tracing was initially conducted in the Buttercup Creek area by Nico Hauwert and Mike Warton in 1997 (Hauwert and Warton 1997; Hauwert and Cowan, 2015) which demonstrated that southward rather than eastward flow was occurring. The 1997 tracing study included fairly comprehensive monitoring of any possible destinations including Blizzard (R-Bar-B Ranch) Spring and downstream Cypress Creek, Bull Creek at the junction of two northernmost tributaries and Spicewood Springs Road Crossing north of Oak Grove Church, Long Hollow at the FM2769 Bridge near its mouth at Lake Travis, South Brushy Creek at Palmer Lane Bridge crossing, Lime Creek at its juncture with Fisher Hollow near its mouth of Lake Travis, and a single visual observation and water sample in the Hideaway Cave stream on August 16, 1997. Dye samples in the form of charcoal packets and water samples were analyzed by Ozark Underground Labs in Protem, Missouri.

On August 9, 1997 at 14:45 three pounds of sodium fluorescein dye were poured in a cave stream within Whitewater Cave about 22 feet below the surface. Water and charcoal samples were recovered from Blizzard Springs on August 15, 1997 at 20:30. The tracer also flowed through Hideaway Cave as green color was observed on August 16, 1997 18:35 and verified by 60.8 parts per billion concentration measured in a corresponding water sample.

On August 9, 1997 at 16:10 three pounds of rhodamine wt were poured in a cave stream in Marigold Cave about 71 feet below the surface. The dye was observed discharging from Blizzard Springs on August 12, 1997 at 20:30. The dye traveled 2.9 miles south within about 3 days.

The 1997 tracing results indicated that groundwater from the Buttercup Creek portion of the Northern Segment of the Edwards Aquifer flowed generally southwest along general fault and fractures trends to the Cypress Creek tributary of the Colorado River.

In August 2007, three tracers were injected on the Wheless BCP Preserve (Shade et al., 2007), Figure 2). On August 23, 2007 five pounds of rhodamine wt were injected in cave WF27. The tracer was first measured 1,570 feet northeast at initial samples collected from Audubon Spring on August 28, 2007, five days after injection.

On August 25, 2007 three pounds of eosin were injected in sinkhole WF94. It was detected in a small spring 430 feet east of the injection site, among the first samples collected after an injection on August 28, 2007.

On August 27, 2007, two pounds of sodium fluorescein (uranine) were poured in stream sink WF68. It was detected in Wheless Spring about 3,610 feet southeast by September 7, 2007.

Cave Stream Interpretation

The cave stream habitats for Jollyville Plateau Salamanders were interpreted in Figures 1 and 2 based on mapped subsurface cave streams that were georeferenced. The 1997 and shorter 2007 trace data were incorporated.

Figure 3 shows the calculated elevation of cave streams, pools, or base of caves to verify the interpretation, since cave streams flow from higher elevations to lower elevations. The interpretation assumed the fewest density of cave streams that are suggested by the data.

On a west branch of the cave stream, the cave stream containing Jollyville Plateau Salamanders in Testudo Tube trends east toward Godzilla Cave which similarly has water with Jollyville Plateau Salamanders roughly 1,000 feet away (Figure 1). This “Testudo Branch” Cave Stream tributary has elevations from 980 feet mean sea level (msl) descending to about 920 feet msl. We interpret that this branch is also observed in Buttercup Drain Cave.

We also interpret that Discovery Well, Hunters Lane, Nelson Ranch, Ilex and Convoluted Canyon caves make up a separate western branch of the cave stream, with elevations of about 990 descending to about 920 feet msl.

The main branch of the Buttercup Creek Cave Stream is interpreted to pass near Forest Trail Cave (which doesn’t quite reach the cave stream, through Marigold Cave at elevations of about 882 feet msl, through Tree House Cave).

Conclusion

The combination of cave mapping, cave stream elevations, Jollyville Plateau Salamander observations, and groundwater tracing is used to define a Buttercup Creek Cave Stream that is hypothesized to be continuous subsurface critical habitat for the Jollyville Plateau Salamander. The Buttercup Creek Cave Stream is hypothesized to extend over three miles northeast of its discharge at Blizzard Springs, which feeds a tributary of Cypress Creek tributary to the Colorado River. The main portion of the Buttercup Creek Cave Stream parallels fault and fracture trends. Extensive caves are developed within the Comanche Peak and Walnut Formations, which are generally considered lower solubility than the underlying Edwards Group. Several branches extend west and northwest of the main tributary of the cave stream. The cave stream descends at least 200 feet in elevation, from about 1,000 feet mean sea level near Lime Creek/Anderson Mill Road to about 800 feet mean sea level at Blizzard Springs. Additional cave exploration, cave mapping, faunal surveys, and groundwater tracing are recommended to refine sources of the Buttercup Creek Cave Stream.

Figure 1

North Buttercup Creek Area Cave Stream Interpretation

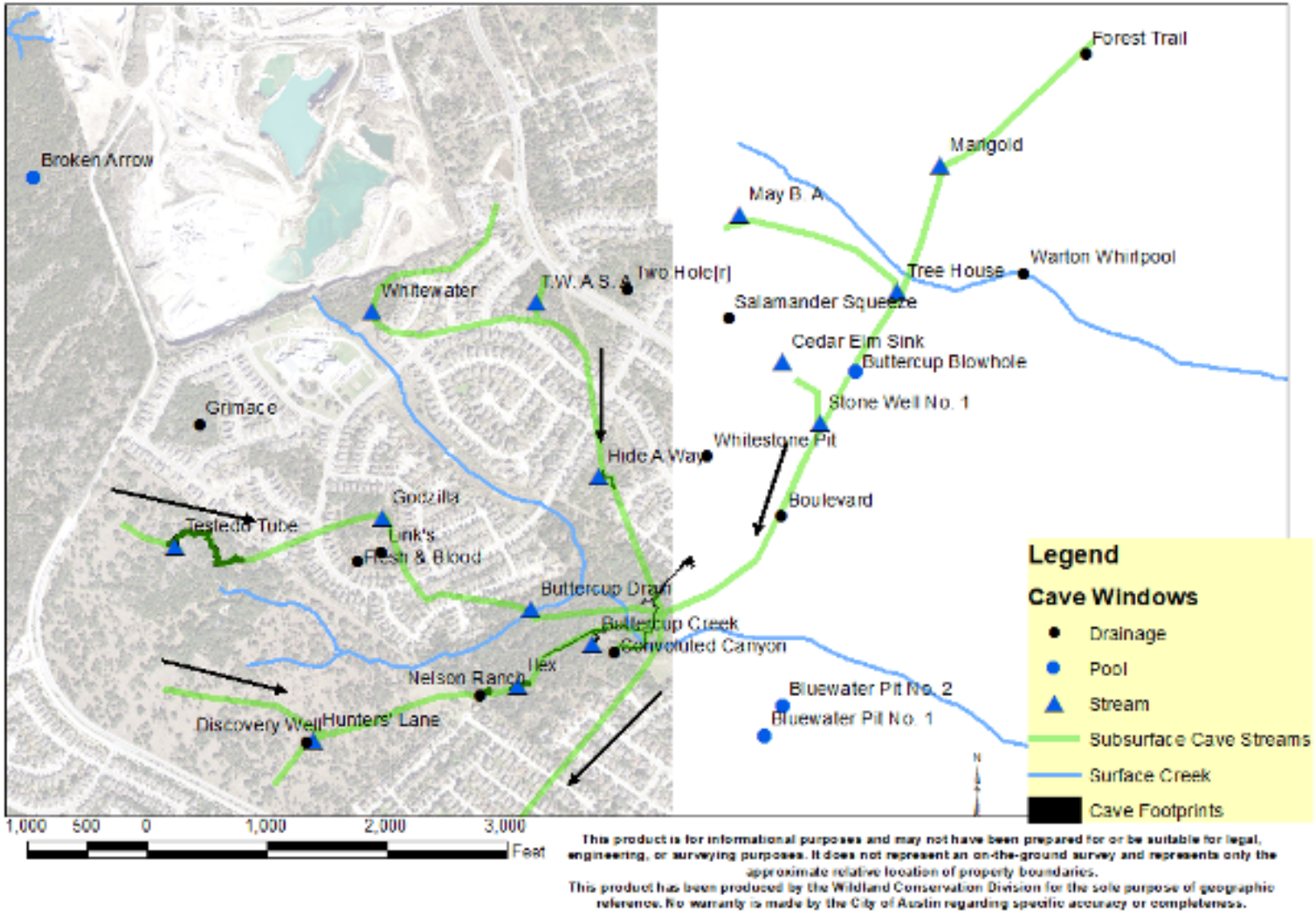
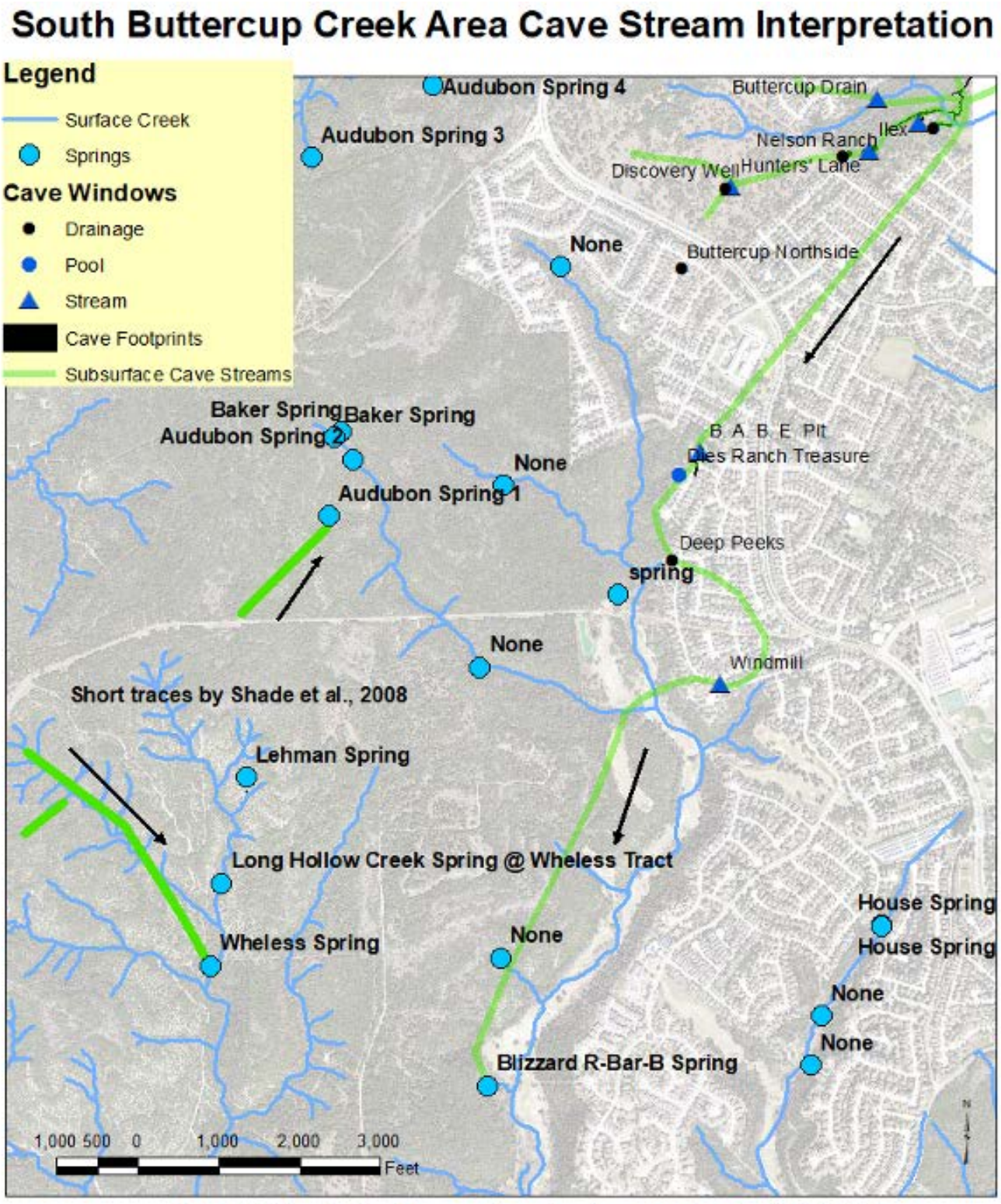


Figure 2



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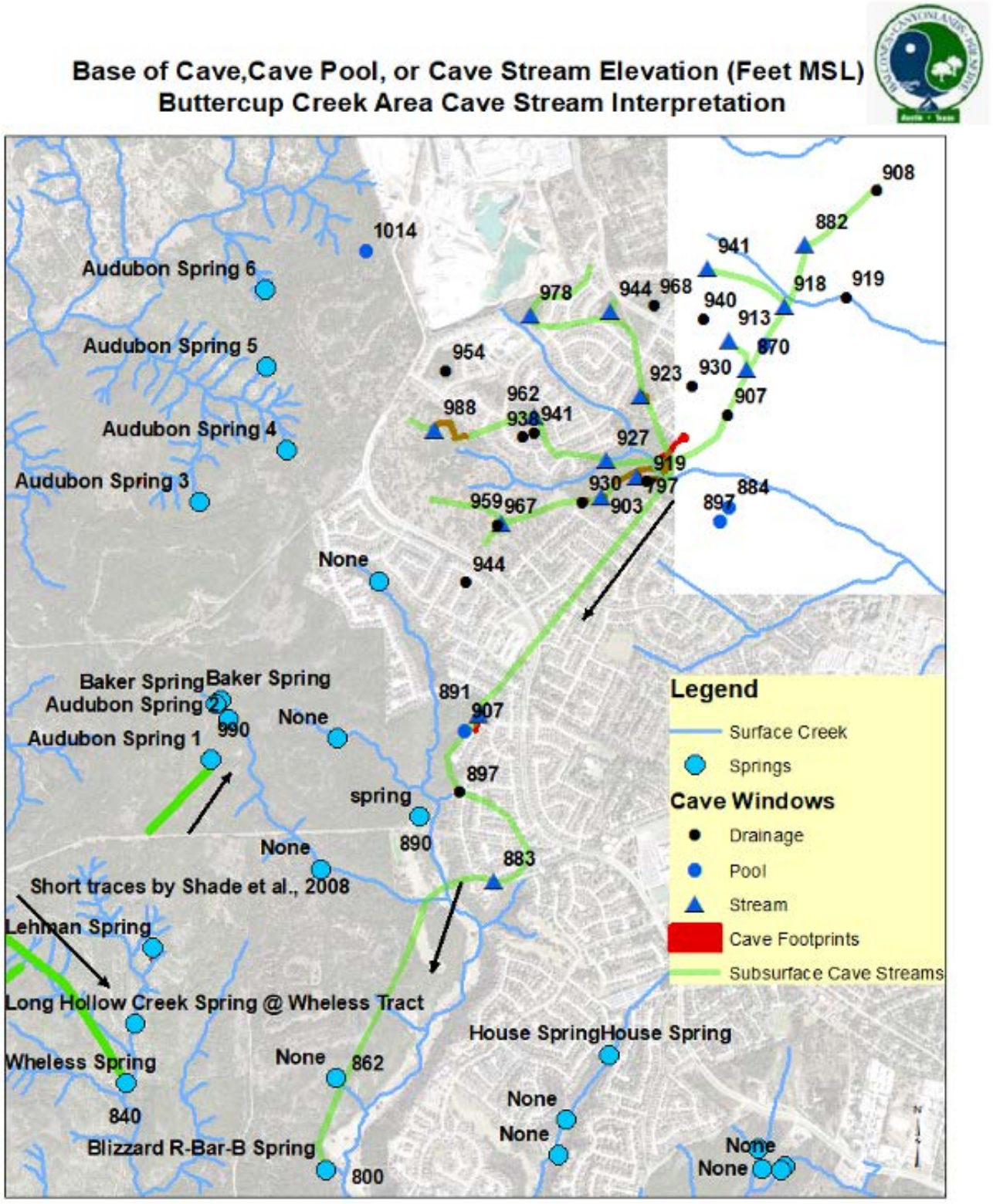
This product has been produced by the Wildland Conservation Division for the sole purpose of geographic reference. No warranty is made by the City of Austin regarding specific accuracy or completeness.

Figure 3


Base of Cave,Cave Pool, or Cave Stream Elevation (Feet MSL)
Buttercup Creek Area Cave Stream Interpretation
1014
Audubon Spring 6
Audubon Spring 5
Audubon Spring 4
Audubon Spring 3
908
882
941
978
944
968
940
918
919
913
954
923
930
907
962
988
938
941
927
919
930
797
884
959
967
903
897
None
944
Baker Spring
Baker Spring
Audubon Spring 2
990
Audubon Spring 1
None
891
907
897
spring
890
None
883
Short traces by Shade et al., 2008
Lehman Spring
Long Hollow Creek Spring @ Wheless Tract
Wheless Spring
840
None
862
Blizzard R-Bar-B Spring
800
House Spring
House Spring
None
None
None
None
Legend
Surface Creek
Springs
Cave Windows
Drainage
Pool
Stream
Cave Footprints
Subsurface Cave Streams
1,000 500 0 1,000 2,000 3,000
Feet
This product is for informational purposes and may not have been prepared for or be suitable for legal, engineering, or surveying purposes. It does not represent an on-the-ground survey and represents only the approximate relative location of property boundaries.
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Appendix A - Water Flow and Direction Data of Selected Caves

B. A. B. E. Pit	Stream, Flow Rate: ~1 gal/m, Direction: NNE to SSW
Bluewater Pit No. 1	Drainage Pool, Flow Direction: SSW to NNE
Bluewater Pit No. 2	Drainage Pool, Flow Direction: NNE to SSW
Boulevard	Drainage, Flow Direction: NE to SW
Buttercup Creek	Stream, Flow Rate: >20 gal/m, Flow: SSW to NNE
Buttercup Drain	Stream, Flow Rate: >5 gal/m, Flow: NW to SE
Cedar Elm	Stream, Flow Rate: >5 gal/m , Flow: SW to NE to SW
Dies Ranch Treasure	Drainage Pool, Flow Direction: NNE to SSW
Godzilla	Stream, Flow Rate: ~1 gal/m, Direction: W to E
Hideaway	Stream, Flow Rate: >2 gal/m, Direction: NW to SE
Hunters Lane	Stream, Flow Rate: <2 gal/m, Direction: SW to NE
Ilex	Stream, Flow Rate: >20 gal/m, Direction: SW to NE
Marigold	Stream, Flow Rate: >30 gal/m, Direction: SW to NE, NE to SW
May B. A.	Stream, Flow Rate: >1 gal/m, Flow Direction: W to E
Nelson Ranch	Drainage, Flow Direction: SW to NE
Salamander Squeeze	Drainage, Flow Direction: W to E
Stonewell No. 1	Stream, Flow Rate: <1 gal/m, Direction: NE to SW
T. W. A S. A	Stream, Flow Rate: <1 gal/m, Direction: W to NE
Testudo Tube	Stream, Flow Rate: >10 gal/m, Direction: W to E
Tree House	Stream, Flow Rate: >5 gal/m, Split Flow Direction: W to E splits to NE to SW and SE to NW
Two Hole	Drainage, Flow Direction: W to E
Whitewater	Stream, Flow Rate: >5 gal/m, Direction: NW to SE
Windmill	Stream, Flow Rate: >1 gal/m, Direction: E to W

Appendix B – Buttercup Creek Area Salamander Sites

Site	Date – Source*	Type
B. A. B. E. Pit	2003-01-13 - MWA	Stream
Bluewater Pit No. 1	1997-06-01 - MWA	Pool
Bluewater Pit No. 2	1997-06-01 - MWA	Pool
Buttercup Creek	1997-04-16 - MWA	Stream
Buttercup Drain	Reddell TexBio	Stream
Godzilla	2017-05-21 - FNB	Stream
Hide A Way	Reddell TexBio	Stream
Hunters' Lane	2018-11-23 -FNB	Stream
Ilex	2014-12-18 - TMMC	Stream
Marigold	2011-10-01 - FNB	Stream
Salamander Squeeze	1995-03-15 - MWA	Drainage
T.W. A S. A	2015-12-02 - FNB	Stream
Testudo Tube	Reddell TexBio	Stream
Tree House	2018-12-02 - FNB	Stream
Two Hole	1995-03-17 - MWA	Drainage
Whitewater	2018-04-15 - FNB	Stream
Windmill	Reddell TexBio	Stream

***Source**

MWA - Mike Warton Reports
TexBio - James Reddell - Fauna Catalogue
FNB - Francke and Bell - Buttercup Creek Fauna Survey Reports

Appendix C - Cave Maps (23)

Dies Ranch Treasure, Gholson, and B.A.B.E. Pit

Bluewater Pit No. 1

Bluewater Pit No. 2

Boulevard

Buttercup Creek

Buttercup Drain

Cedar Elm

Cypress Creek No. 1 (Dies Ranch Treasure)

Godzilla

Hideaway

Hunters Lane

Ilex

Marigold

May B. A.

Nelson Ranch

Salamander Squeeze

Stone Well No. 1

T. W. A S. A

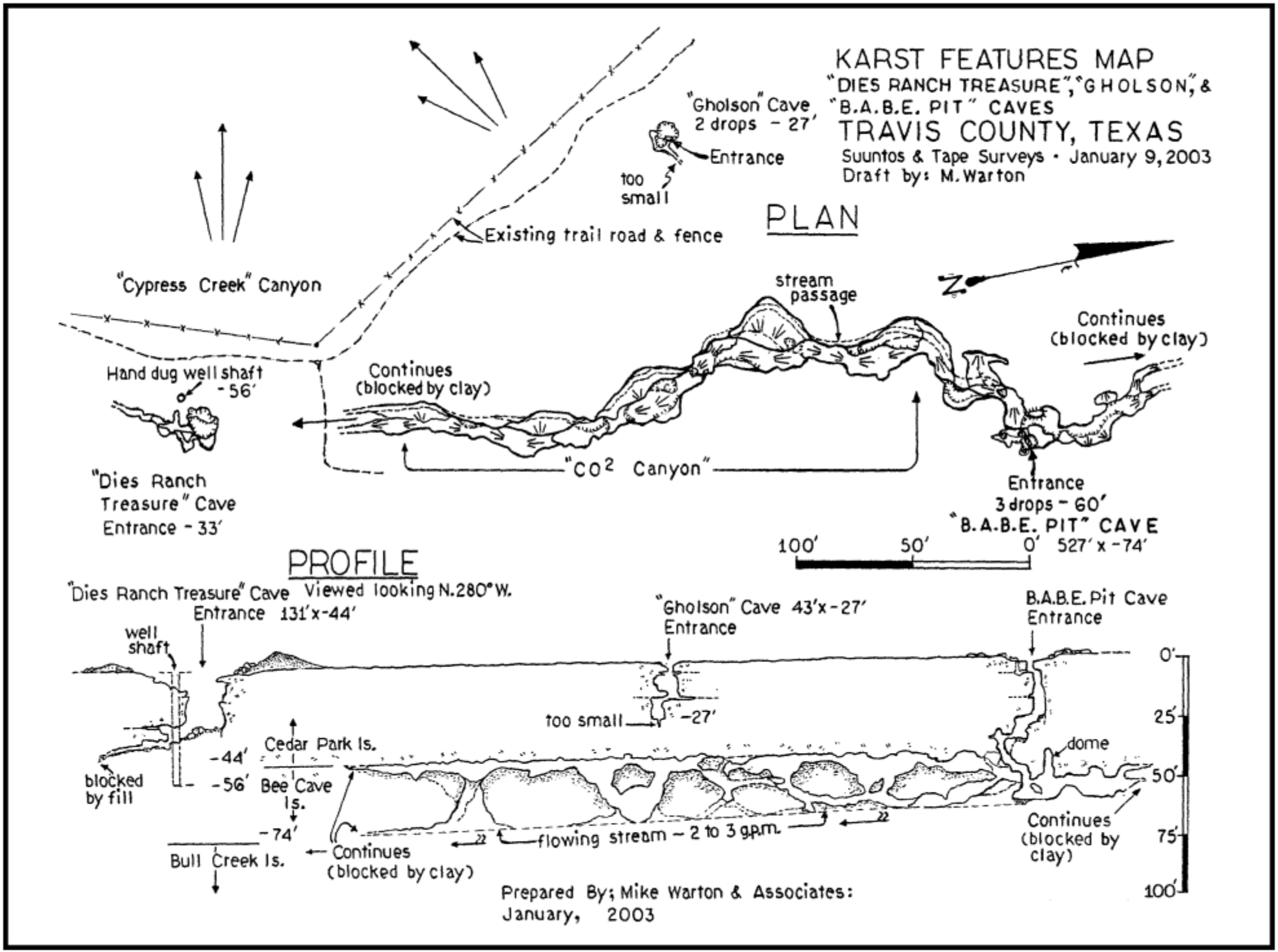
Testudo Tube

Tree House

Two Hole

Whitewater

Windmill



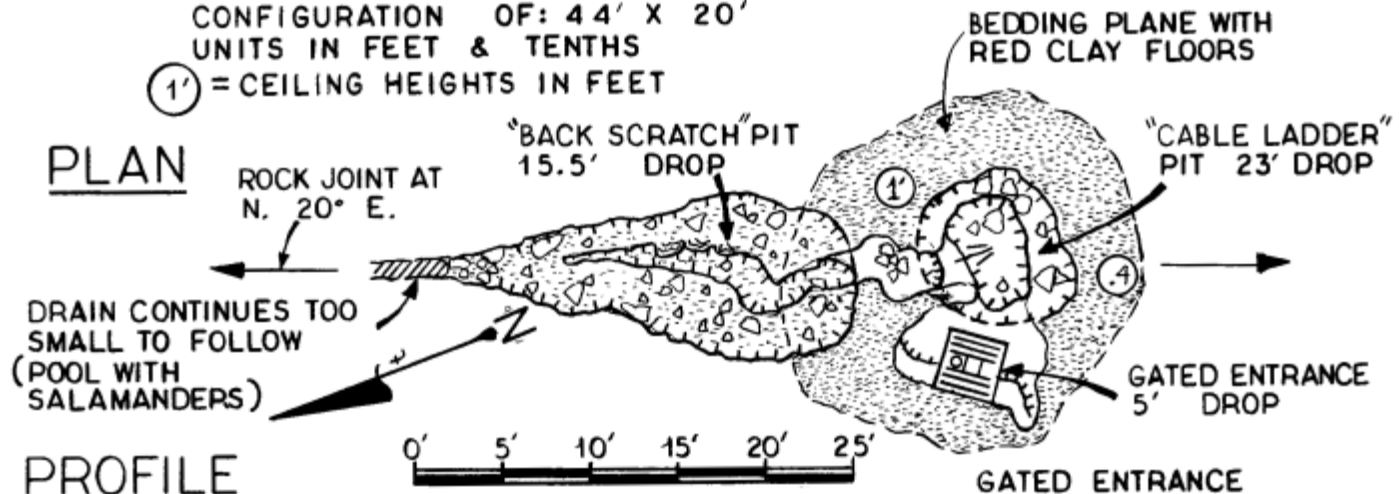
Source: 2003-01-13 - Warton - Final Report of Findings - Gholson Tract - Addendum Site Cave Maps

BLUEWATER PIT CAVE NO. 1

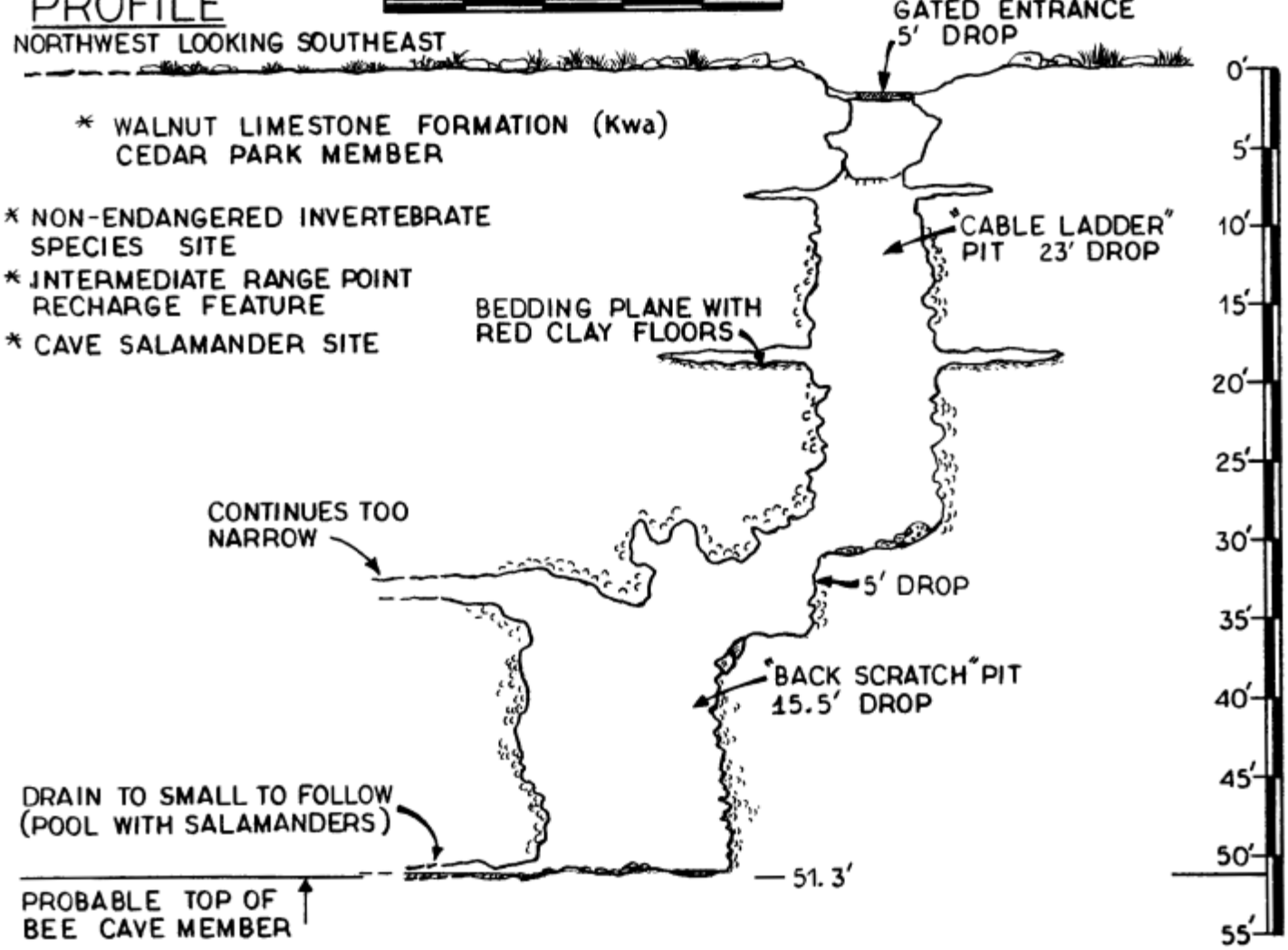
WILLIAMSON COUNTY, TEXAS

SUUNTOS & TAPE SURVEY- JUNE 1, 1997
PERSONNEL; MIKE WARTON & ASSOCIATES: B WETUSKI
L. GREEN · M. GUERRA · M. WARTON
DRAFT BY: MIKE WARTON
LENGTH: 82.4' X DEPTH: 51.3'
CONFIGURATION OF: 44' X 20'
UNITS IN FEET & TENTHS
(1') = CEILING HEIGHTS IN FEET

PLAN



PROFILE
NORTHWEST LOOKING SOUTHEAST



PREPARED BY: MIKE WARTON & ASSOCIATES T.S.S. 1997

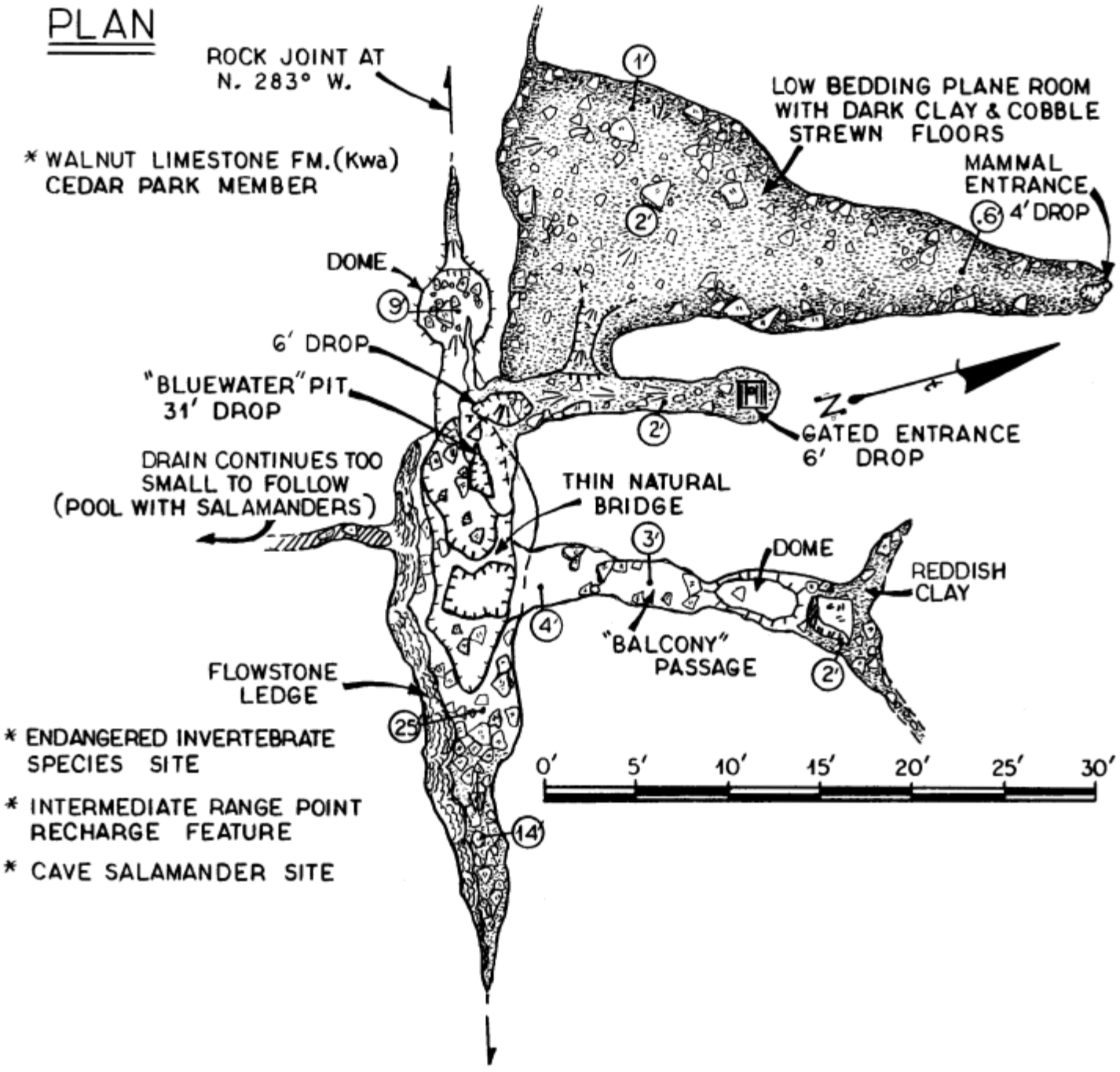
Source: 1997-10-18 - Warton - Final Report of Findings - Buttercup Creek Section 4 & Phase V - Appendix A

BLUEWATER PIT CAVE NO. 2

WILLIAMSON COUNTY, TEXAS

SUUNTOS & TAPE SURVEY • JUNE 1, 1997
PERSONNEL ; MIKE WARTON & ASSOCIATES : B WETUSKI
L. GREEN • M. GUERRA • M. WARTON
DRAFT BY: MIKE WARTON
LENGTH: 151.7′ DEPTH: 47.5′
CONFIGURATION OF: 53′ X 46′
UNITS IN FEET & TENTHS
(2′) = CEILING HEIGHTS IN FEET

PLAN



PREPARED BY: MIKE WARTON & ASSOCIATES T.S.S. 1997

Source: 1997-10-18 - Warton - Final Report of Findings - Buttercup Creek Section 4 & Phase V - Appendix A

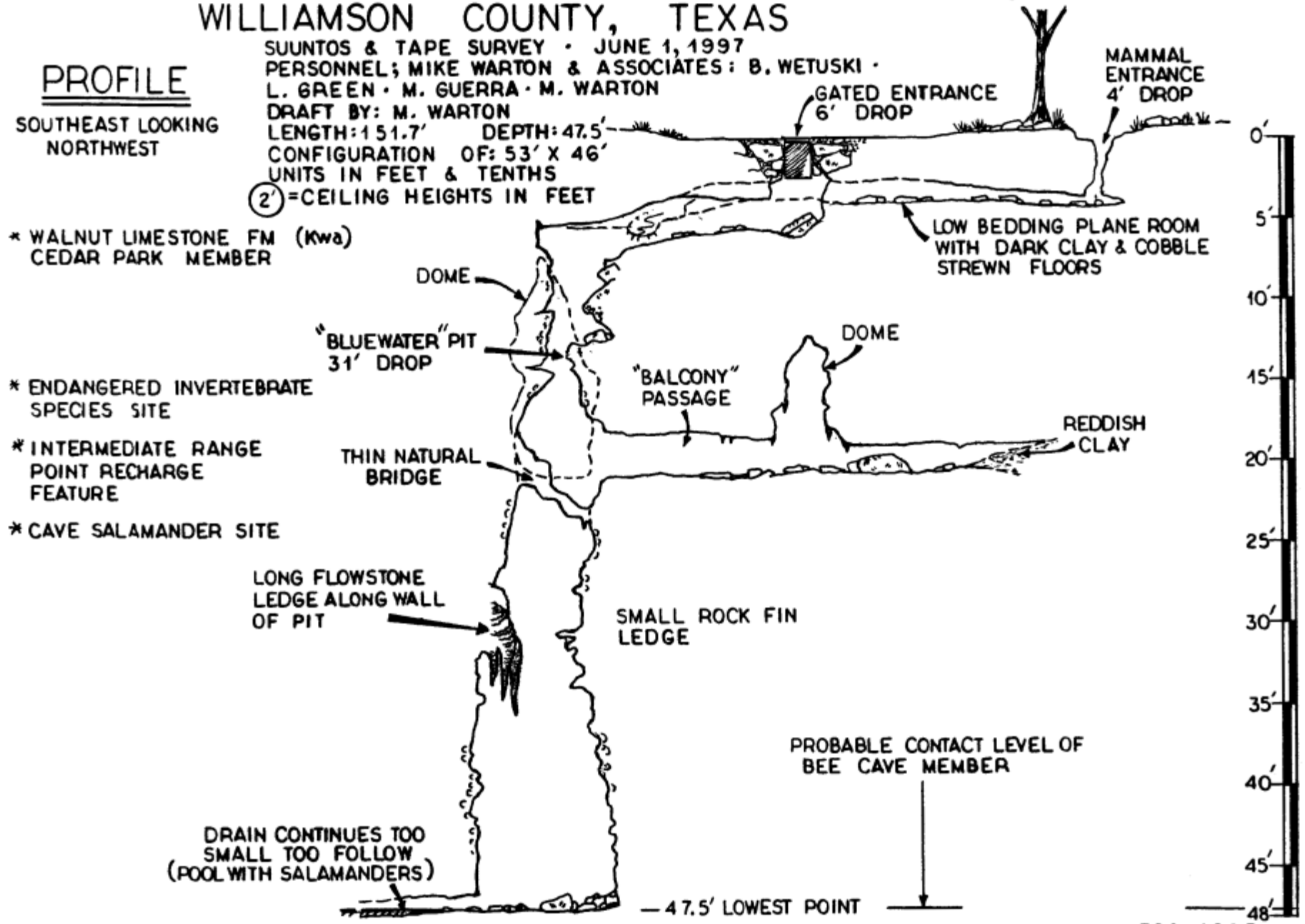
BLUEWATER PIT CAVE NO. 2

WILLIAMSON COUNTY, TEXAS

SUUNTOS & TAPE SURVEY · JUNE 1, 1997
PERSONNEL; MIKE WARTON & ASSOCIATES: B. WETUSKI · L. GREEN · M. GUERRA · M. WARTON
DRAFT BY: M. WARTON
LENGTH: 151.7′ DEPTH: 47.5′
CONFIGURATION OF: 53′ X 46′
UNITS IN FEET & TENTHS
(2′) = CEILING HEIGHTS IN FEET

PROFILE

SOUTHEAST LOOKING NORTHWEST



* WALNUT LIMESTONE FM (Kwa)
CEDAR PARK MEMBER

* ENDANGERED INVERTEBRATE SPECIES SITE

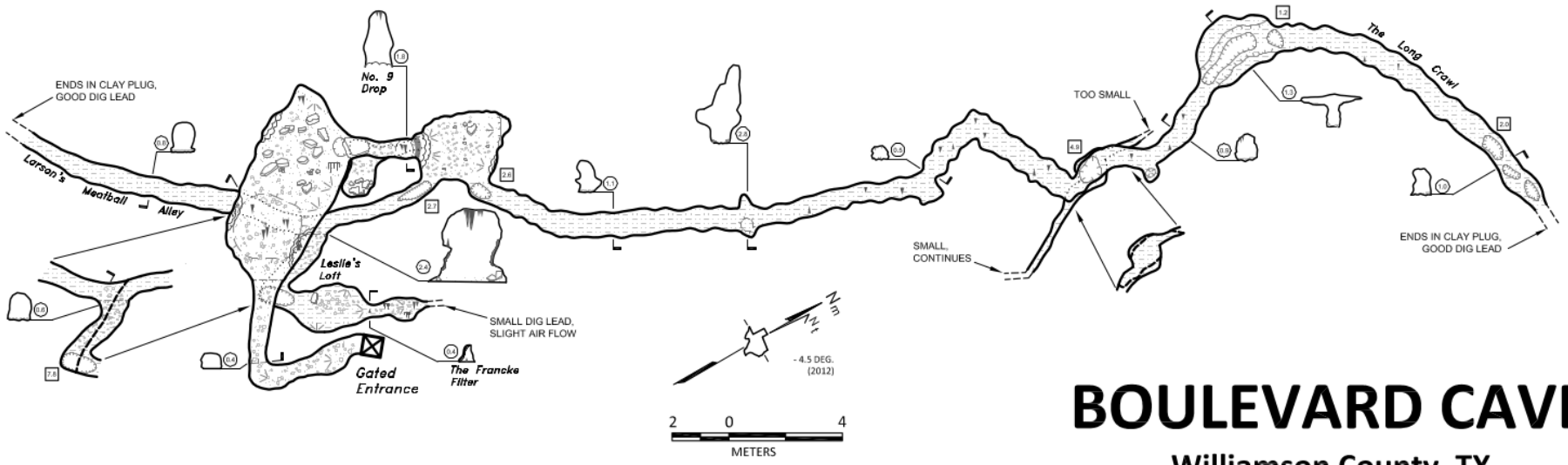
* INTERMEDIATE RANGE POINT RECHARGE FEATURE

* CAVE SALAMANDER SITE

PREPARED BY: MIKE WARTON & ASSOCIATES

T.S.S. 1997

Source: 1997-10-18 - Warton - Final Report of Findings - Buttercup Creek Section 4 & Phase V - Appendix A

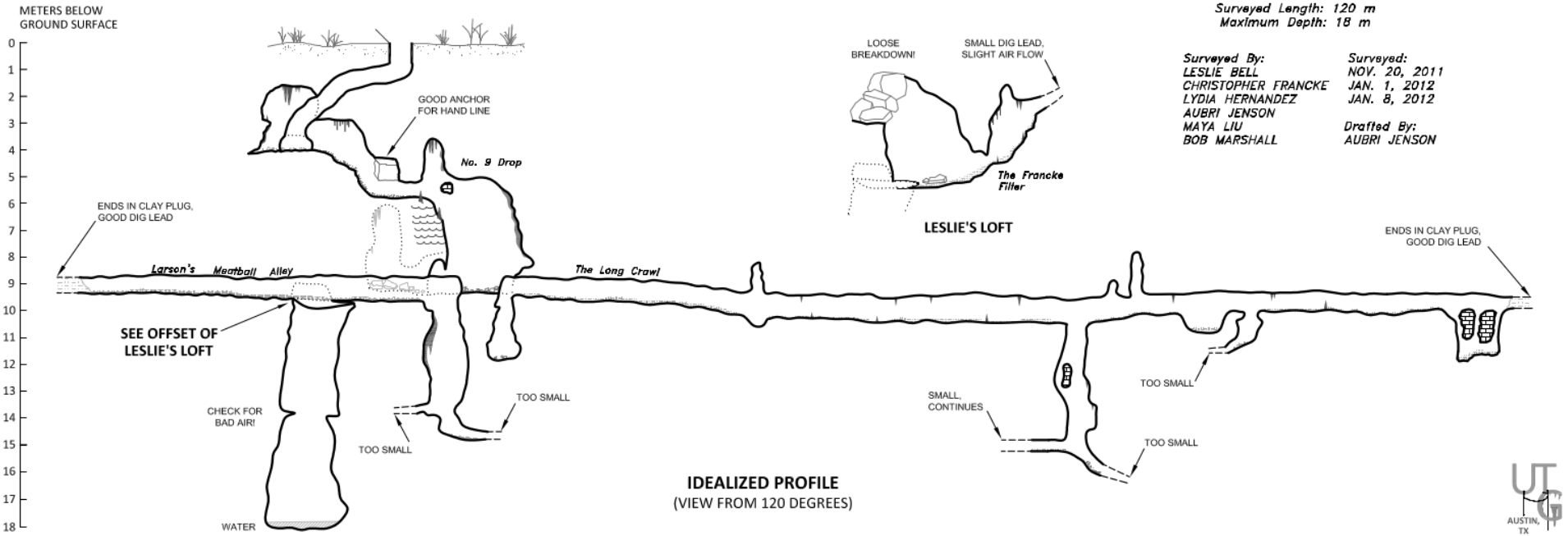


BOULEVARD CAVE

Williamson County, TX

Surveyed Length: 120 m
Maximum Depth: 18 m

Surveyed By:	*Surveyed:*
LESLIE BELL	*NOV. 20, 2011*
CHRISTOPHER FRANCKE	*JAN. 1, 2012*
LYDIA HERNANDEZ	*JAN. 8, 2012*
AUBRI JENSON	
MAYA LIU	*Drafted By:*
BOB MARSHALL	*AUBRI JENSON*



IDEALIZED PROFILE
(VIEW FROM 120 DEGREES)

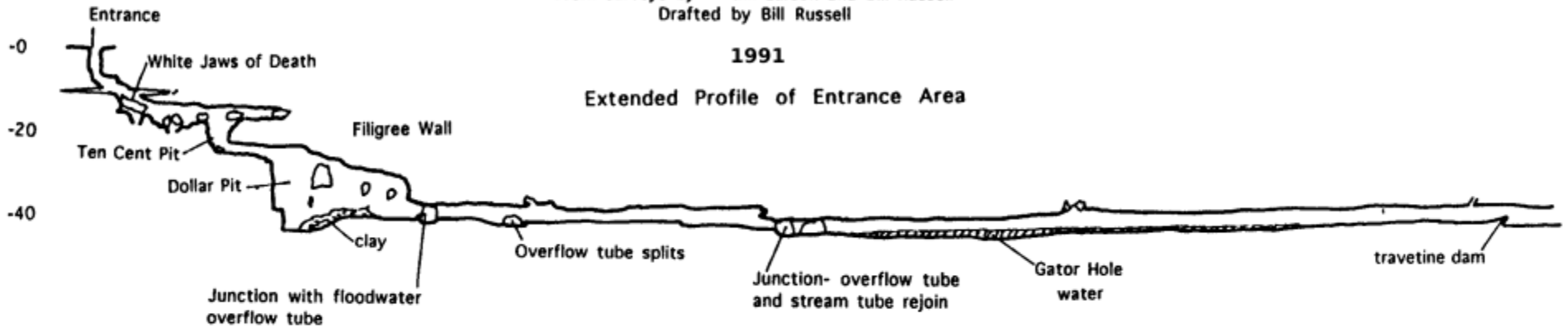
AUSTIN, TX

Buttercup Creek Cave Profiles

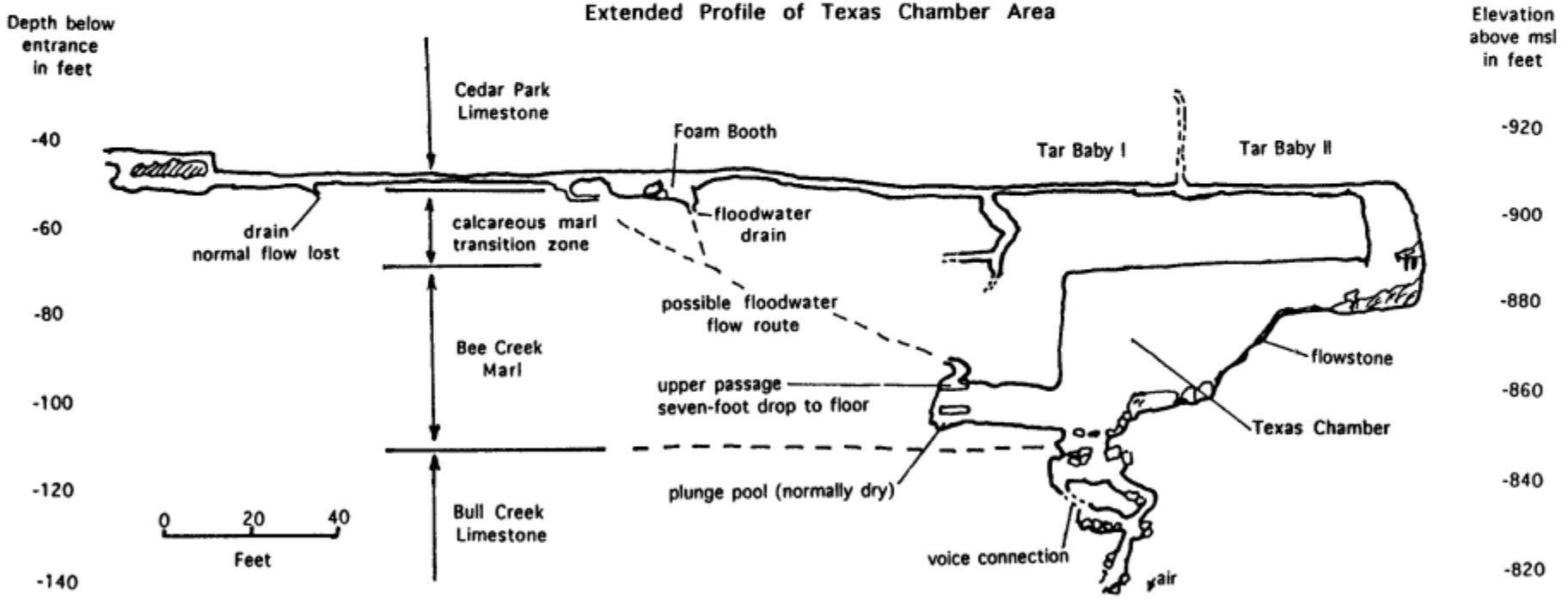
From surveys by Bill Larson and Bill Russell
Drafted by Bill Russell

1991

Extended Profile of Entrance Area



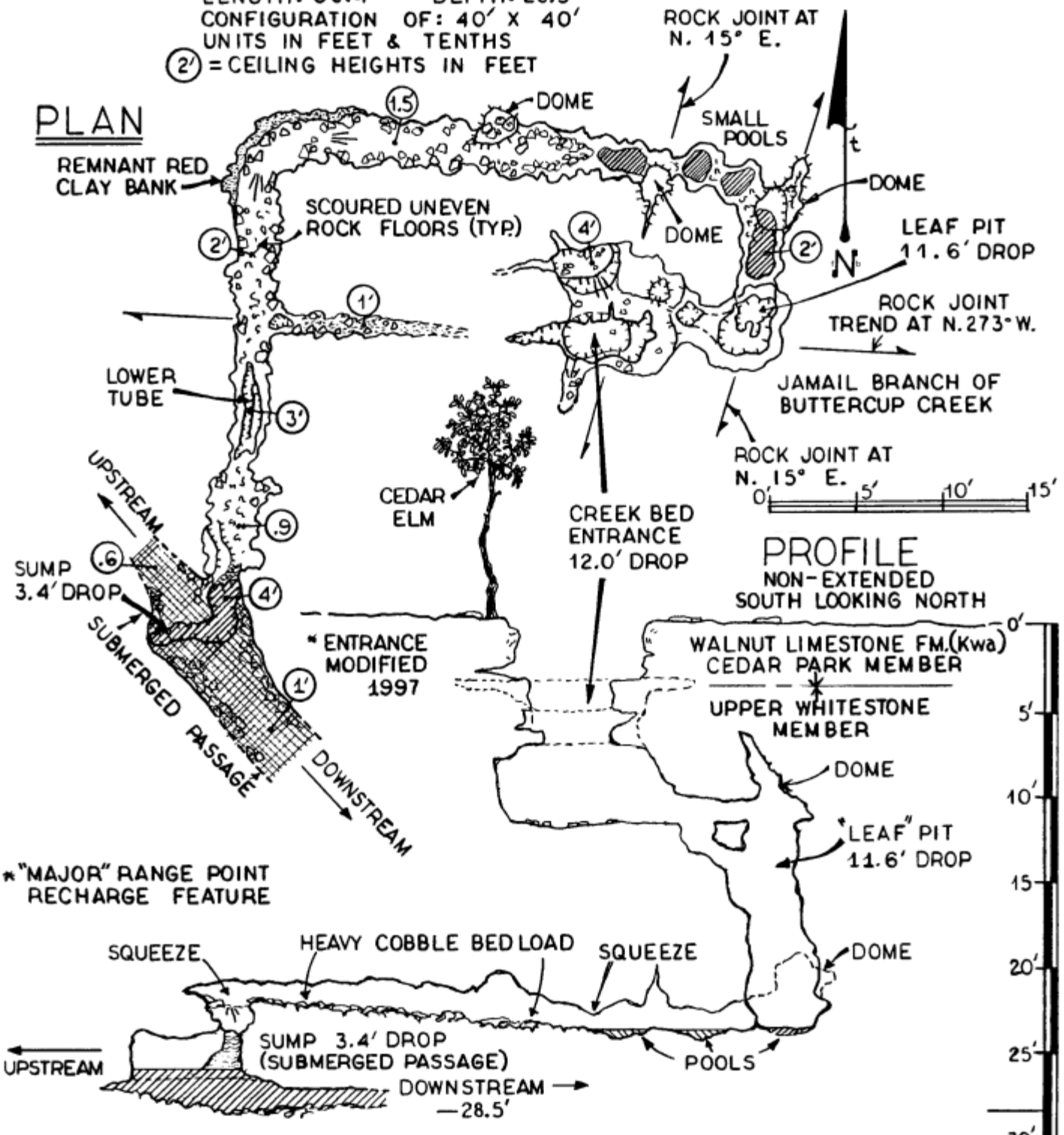
Extended Profile of Texas Chamber Area



BUTTERCUP DRAIN CAVE

WILLIAMSON COUNTY, TEXAS

SUUNTOS & TAPE SURVEY • APRIL 16, 1997
PERSONNEL; MIKE WARTON & ASSOCIATES: B. WETUSKI • C. MOORE • L. GREEN • M. WARTON
DRAFT BY: M. WARTON
LENGTH: 98.4′ DEPTH: 28.5′
CONFIGURATION OF: 40′ X 40′
UNITS IN FEET & TENTHS
(2′) = CEILING HEIGHTS IN FEET



PREPARED BY: MIKE WARTON & ASSOCIATES T.S.S. 1997

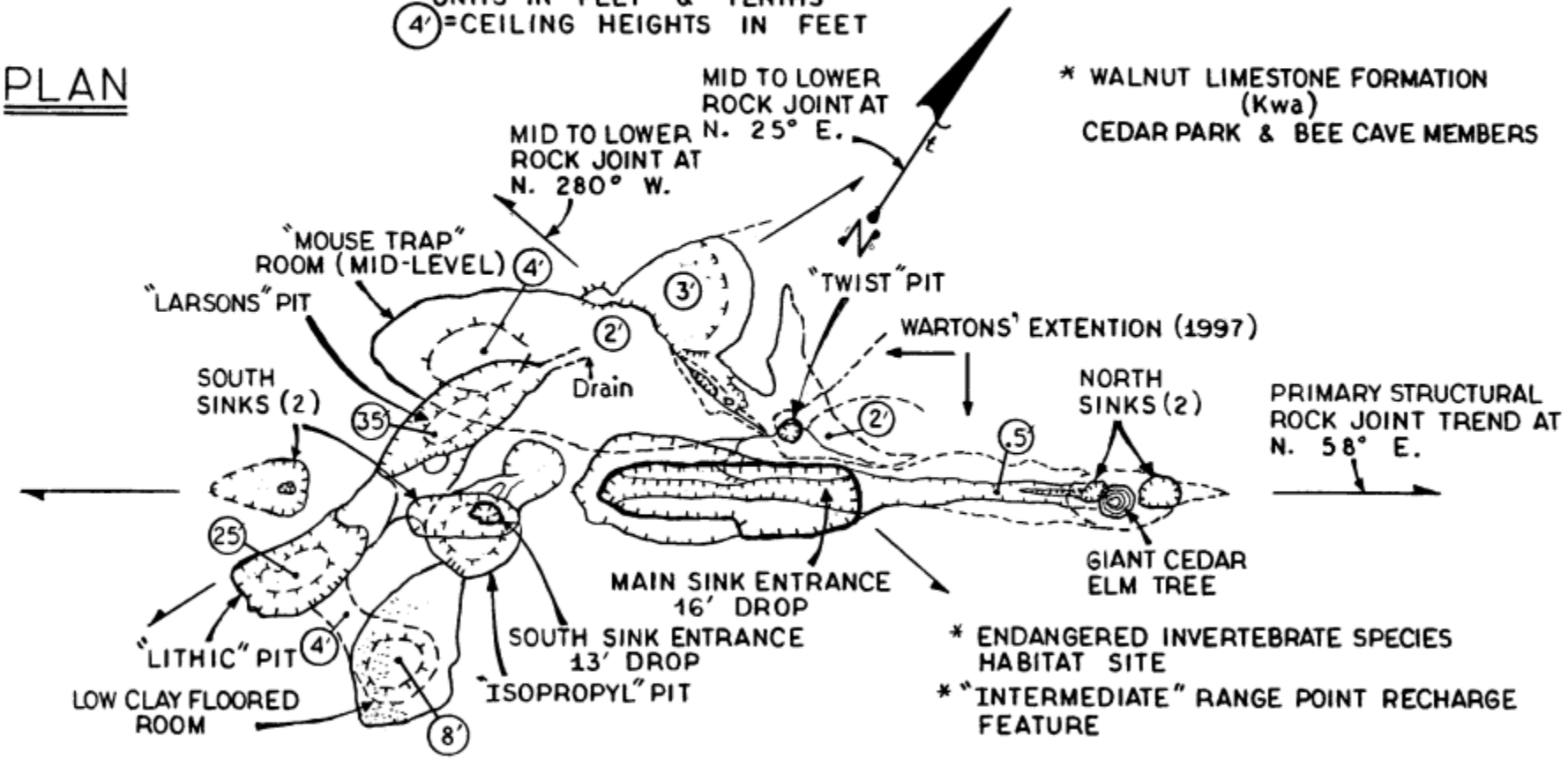
Source: 1997-10-18 - Warton - Final Report of Findings - Buttercup Creek Section 4 & Phase V - Appendix A

CEDAR ELM CAVE

WILLIAMSON COUNTY, TEXAS

SUUNTOS & TAPE SURVEY · MAY 2, 1997
PERSONNEL; MIKE WARTON & ASSOCIATES: B. WETUSKI · C. MOORE · L. GREEN · M. WARTON
DRAFT BY: M. WARTON
LENGTH: 292.8′ DEPTH: 59.2′
CONFIGURATION OF: 70′ X 33′
UNITS IN FEET & TENTHS
(4′)=CEILING HEIGHTS IN FEET

PLAN



* WALNUT LIMESTONE FORMATION (Kwa) CEDAR PARK & BEE CAVE MEMBERS

* ENDANGERED INVERTEBRATE SPECIES HABITAT SITE

* "INTERMEDIATE" RANGE POINT RECHARGE FEATURE

PREPARED BY: MIKE WARTON & ASSOCIATES

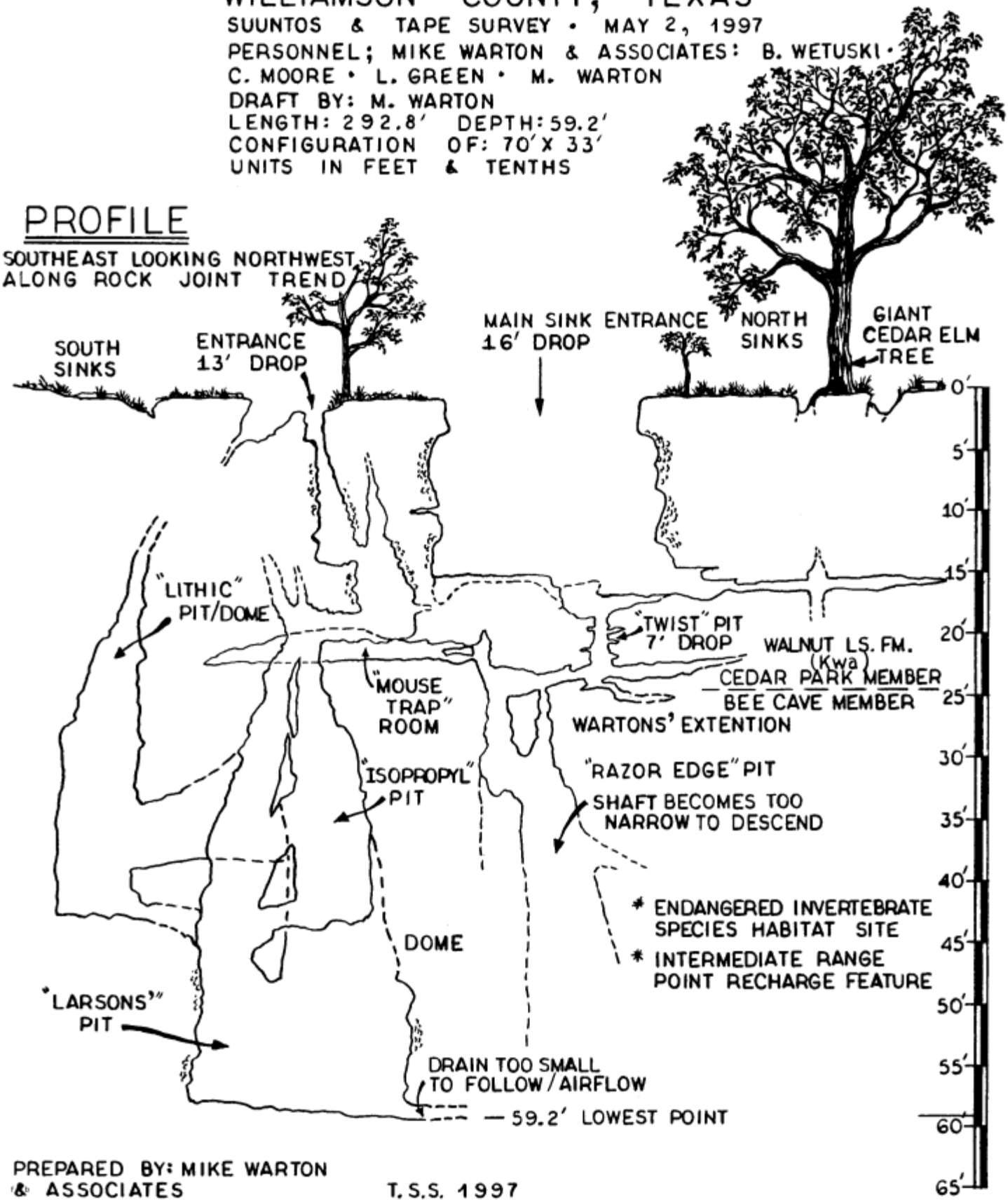
T.S.S. 1997

Source: 1997-10-18 - Warton - Final Report of Findings - Buttercup Creek Section 4 & Phase V - Appendix A

CEDAR ELM CAVE

WILLIAMSON COUNTY, TEXAS

SUUNTOS & TAPE SURVEY • MAY 2, 1997
PERSONNEL; MIKE WARTON & ASSOCIATES: B. WETUSKI • C. MOORE • L. GREEN • M. WARTON
DRAFT BY: M. WARTON
LENGTH: 292.8′ DEPTH: 59.2′
CONFIGURATION OF: 70′ X 33′
UNITS IN FEET & TENTHS



PREPARED BY: MIKE WARTON & ASSOCIATES

T.S.S. 1997

Source: 1997-10-18 - Warton - Final Report of Findings - Buttercup Creek Section 4 & Phase V - Appendix A

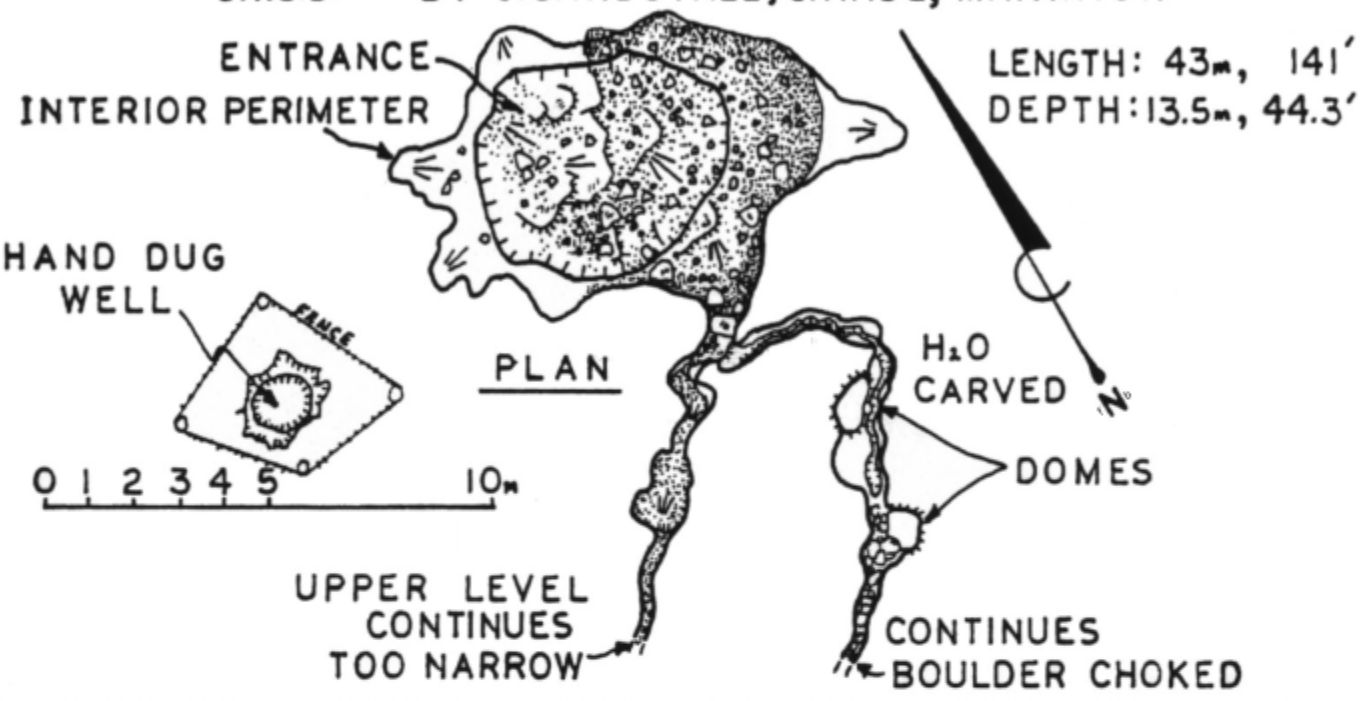
CYPRESS CREEK CAVE NO.1

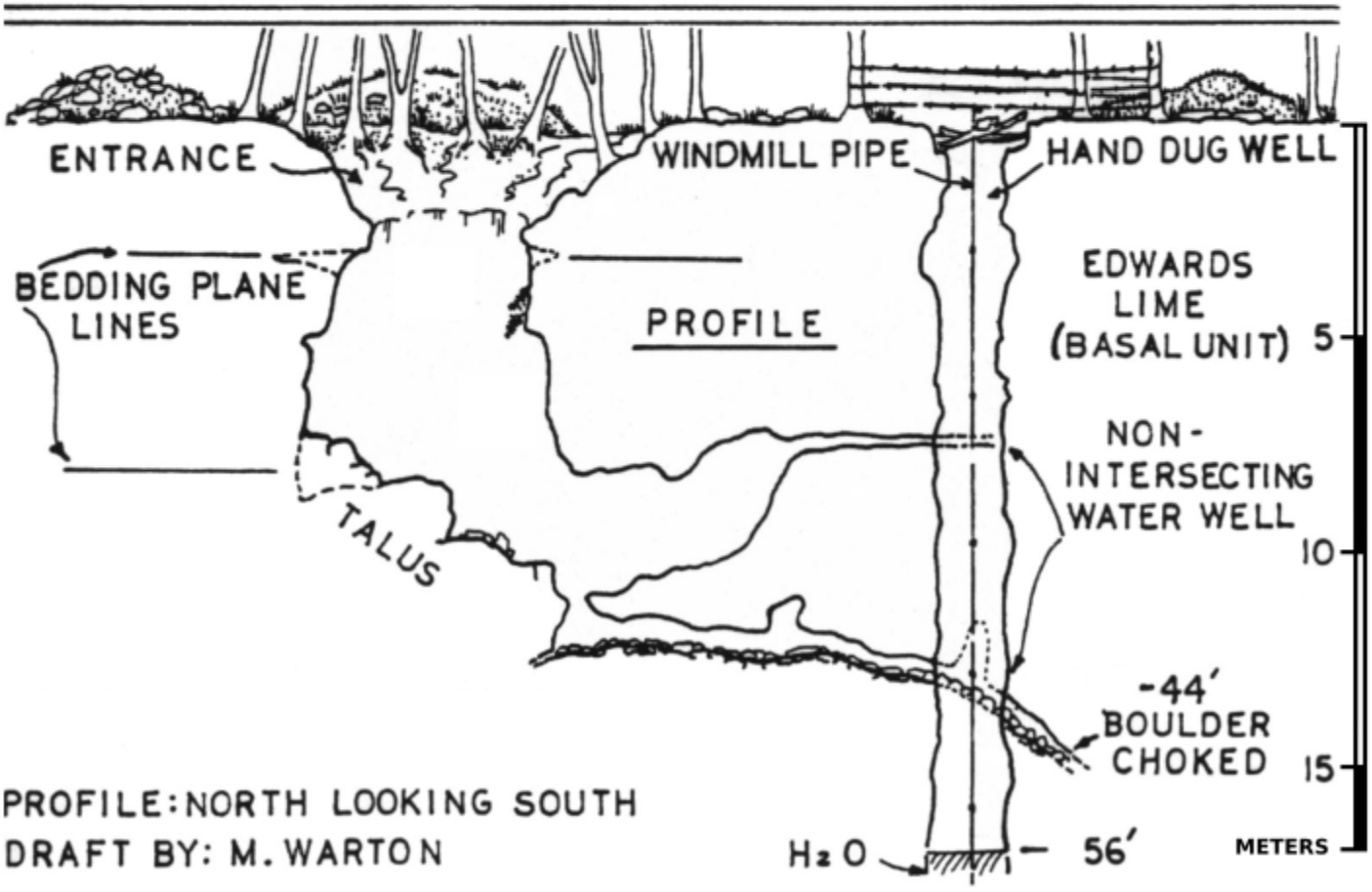
(DIES RANCH TREASURE CAVE)

TRAVIS COUNTY, TEXAS

SUUNTO & TAPE SURVEY OCTOBER 28, 1986

U.T.S.S. BY: J. SANDOVALL, C. AASE, M. WARTON



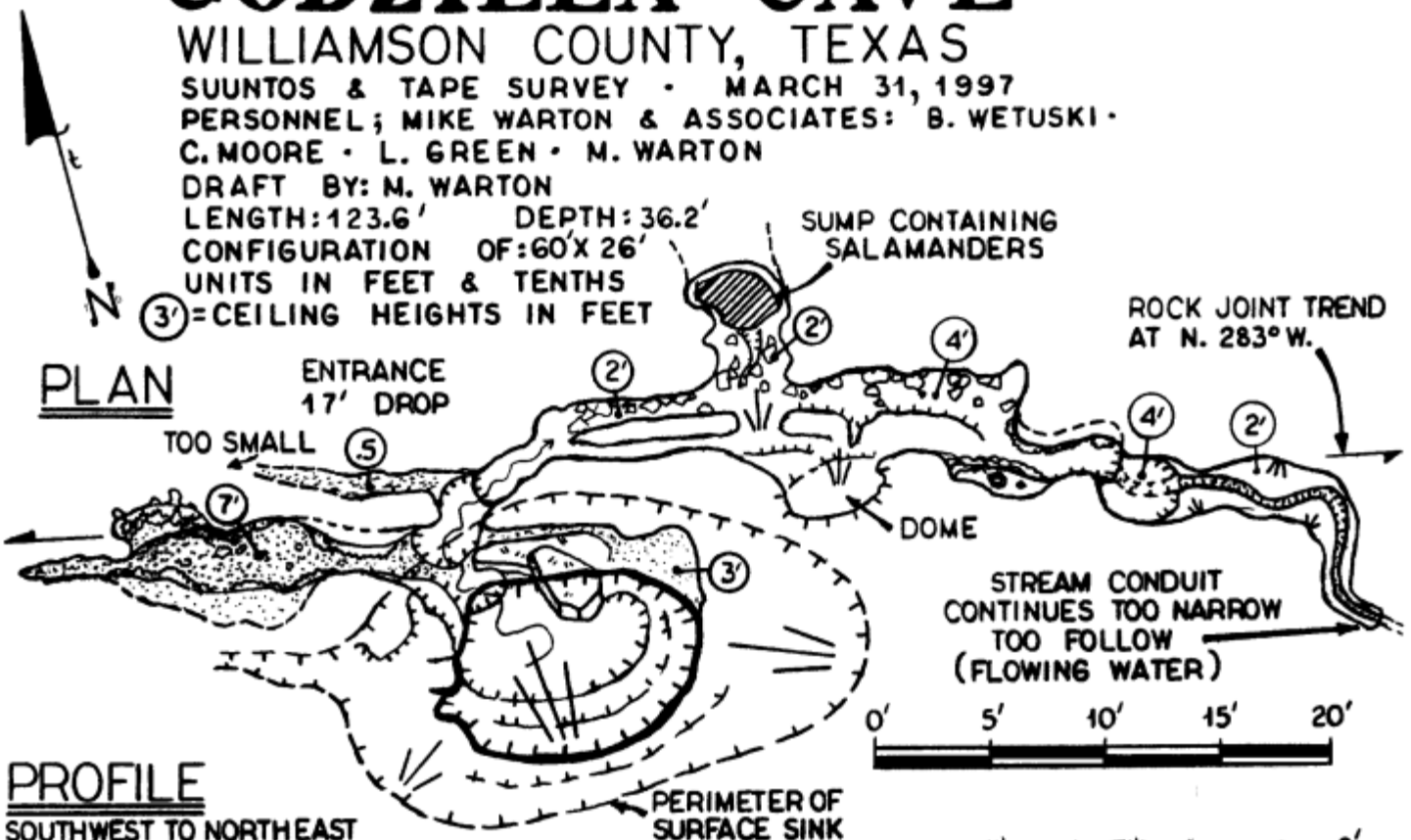


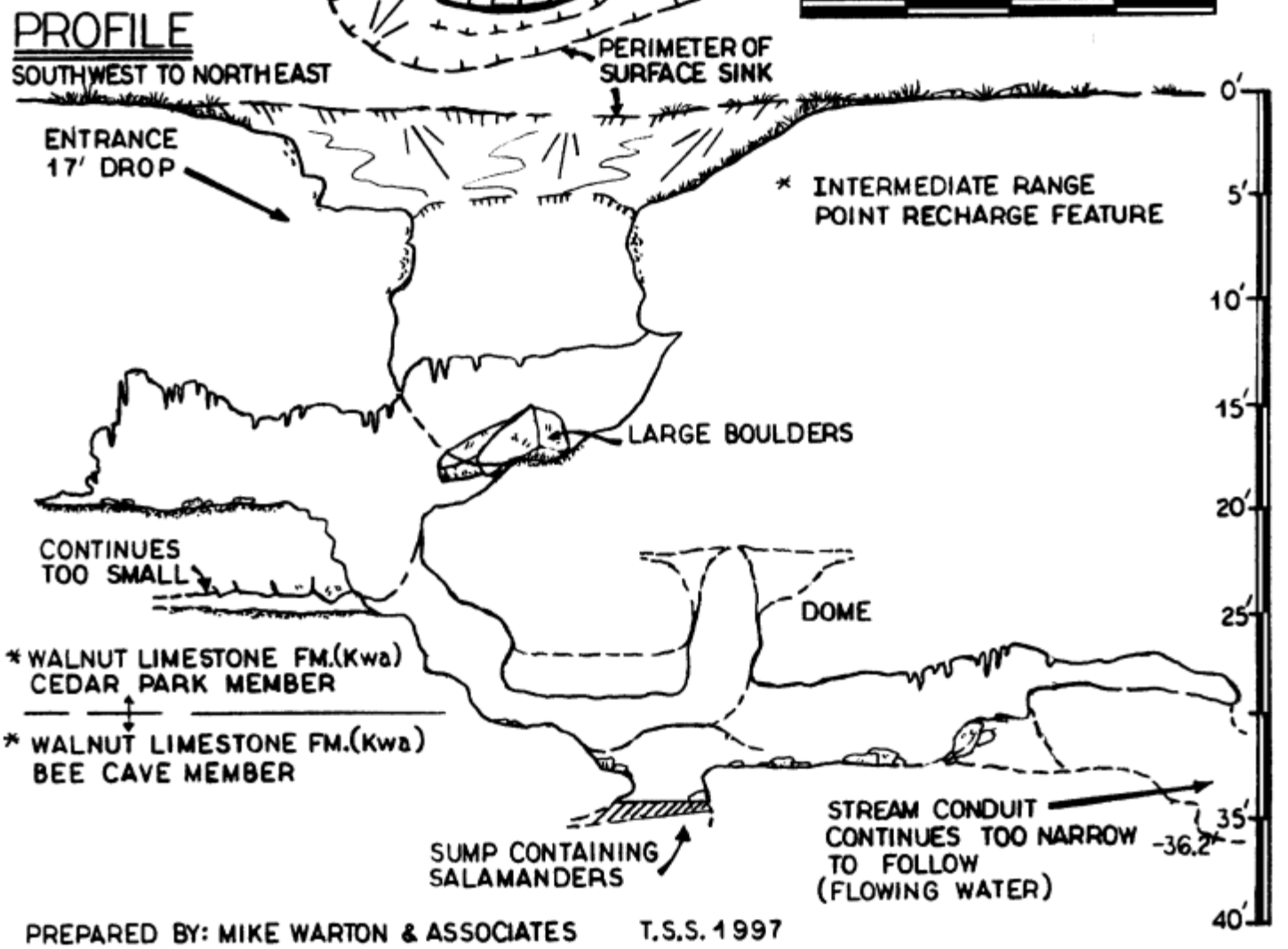
Source: 1986-10-28 - Warton - Speleological Investigation of the Milburn Ranch - Appendix

GODZILLA CAVE

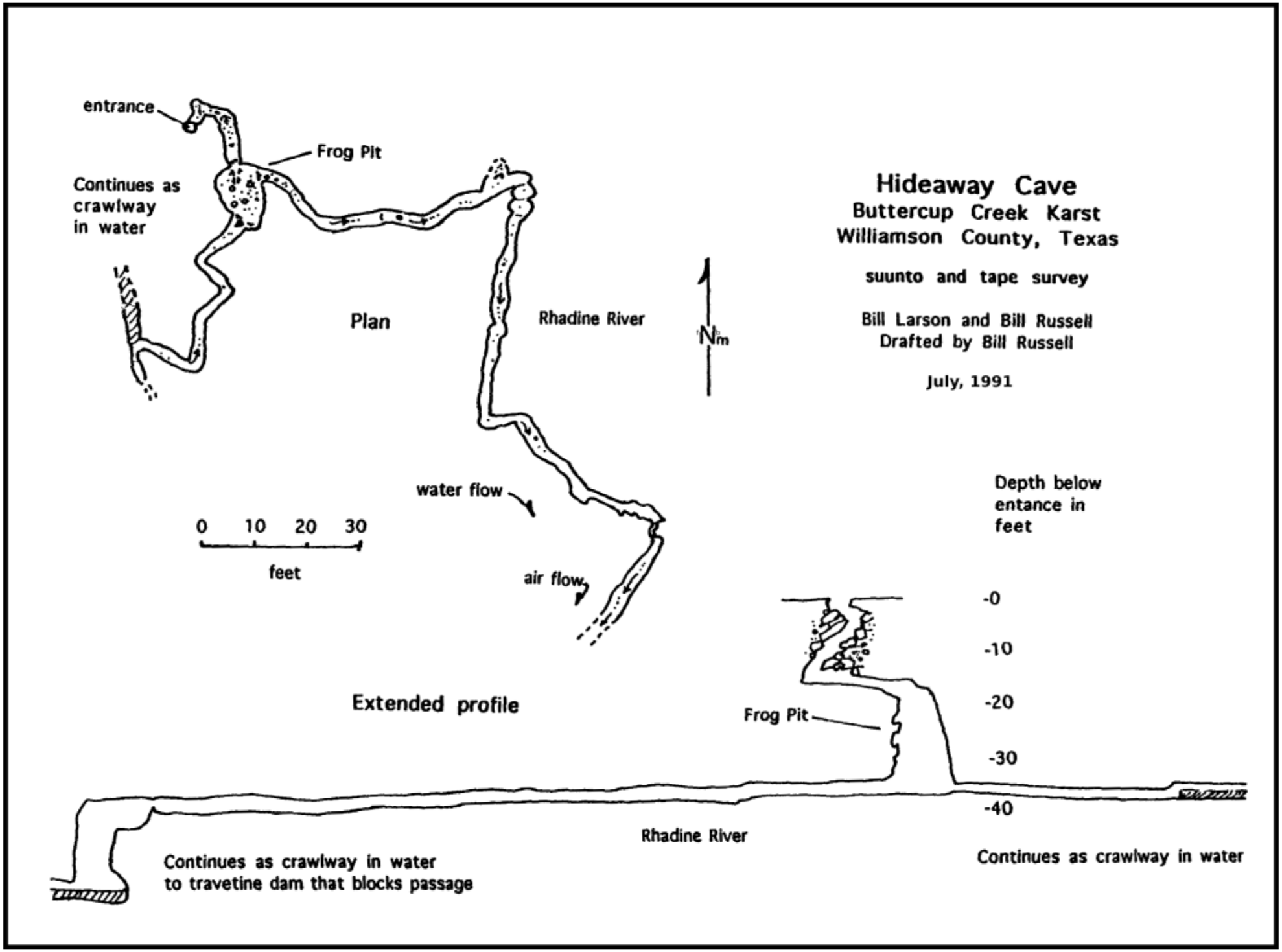
WILLIAMSON COUNTY, TEXAS

SUUNTOS & TAPE SURVEY · MARCH 31, 1997
PERSONNEL; MIKE WARTON & ASSOCIATES: B. WETUSKI · C. MOORE · L. GREEN · M. WARTON
DRAFT BY: M. WARTON
LENGTH: 123.6′ DEPTH: 36.2′
CONFIGURATION OF: 60′ X 26′
UNITS IN FEET & TENTHS
(3′) = CEILING HEIGHTS IN FEET





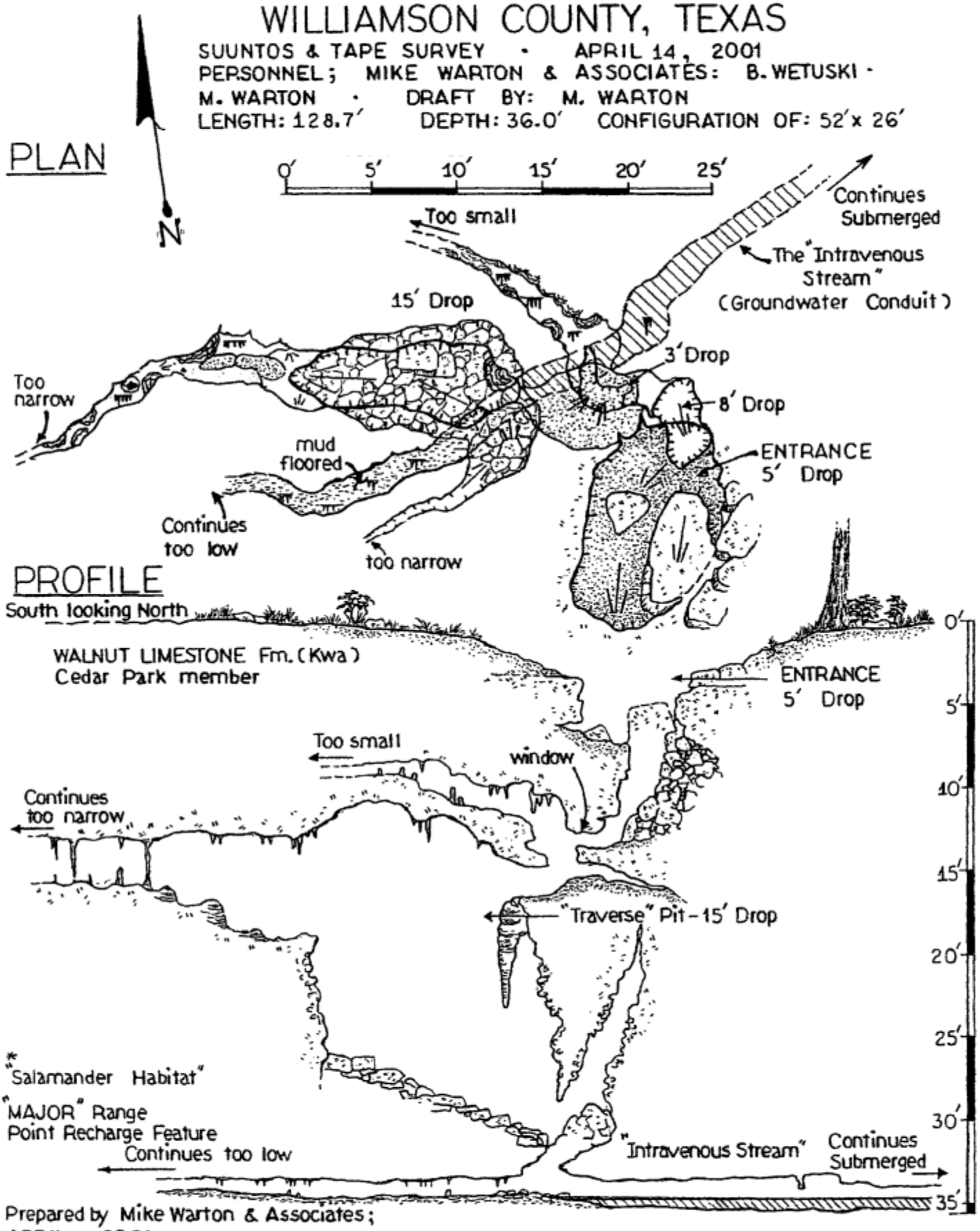
PREPARED BY: MIKE WARTON & ASSOCIATES T.S.S. 1997


entrance
Frog Pit
Continues as crawlway in water
Plan
Rhadine River
Nm
water flow
air flow
0 10 20 30
feet
Hideaway Cave
Buttercup Creek Karst
Williamson County, Texas
suunto and tape survey
Bill Larson and Bill Russell
Drafted by Bill Russell
July, 1991
Depth below entance in feet
-0
-10
-20
-30
-40
Extended profile
Frog Pit
Rhadine River
Continues as crawlway in water to travetine dam that blocks passage
Continues as crawlway in water

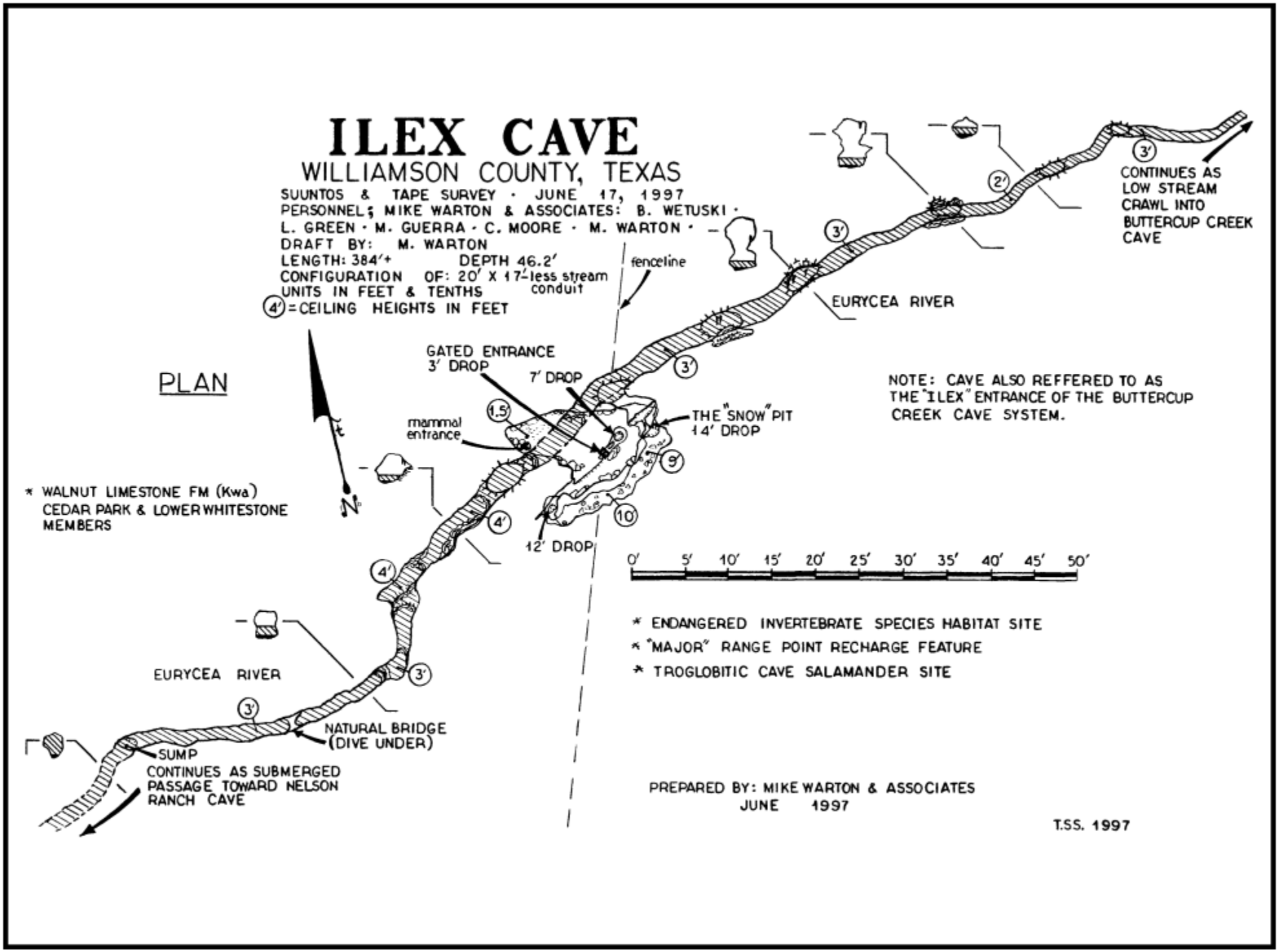
HUNTERS LANE CAVE

WILLIAMSON COUNTY, TEXAS

SUUNTOS & TAPE SURVEY · APRIL 14, 2001
PERSONNEL; MIKE WARTON & ASSOCIATES: B. WETUSKI - M. WARTON · DRAFT BY: M. WARTON
LENGTH: 128.7′ DEPTH: 36.0′ CONFIGURATION OF: 52′ x 26′



Prepared by Mike Warton & Associates;
APRIL, 2001



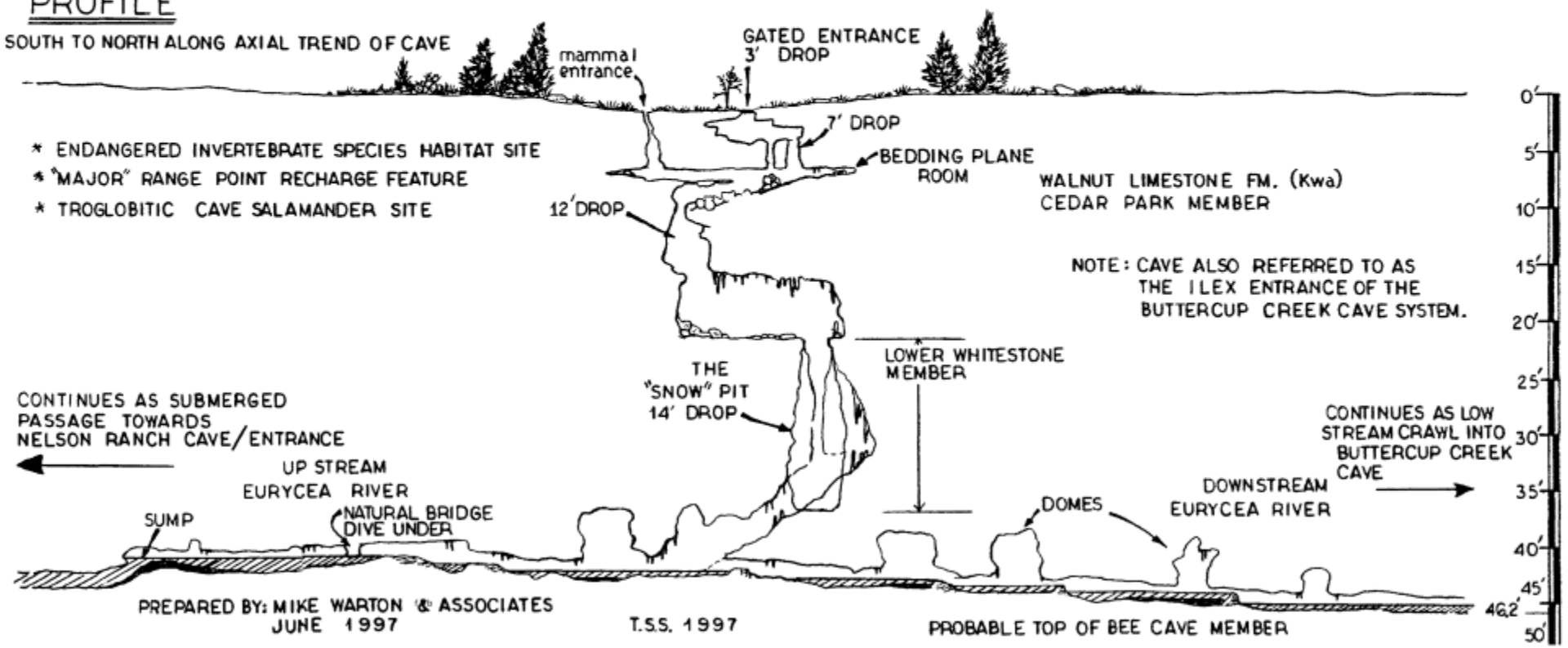
Source: 1997-10-18 - Warton - Final Report of Findings - Buttercup Creek Section 4 & Phase V - Appendix A

ILEX CAVE

WILLIAMSON COUNTY, TEXAS

SUUNTOS & TAPE SURVEY · JUNE 17, 1997
PERSONNEL MIKE WARTON & ASSOCIATES B WETUSKI · L. GREEN · M. GUERRA · C. MOORE · M. WARTON ·
DRAFT BY: M. WARTON
LENGTH: 384'+ DEPTH: 46.2'
CONFIGURATION OF: 20' X 17' less stream conduit
UNITS IN FEET & TENTHS
(4') = CEILING HEIGHTS IN FEET

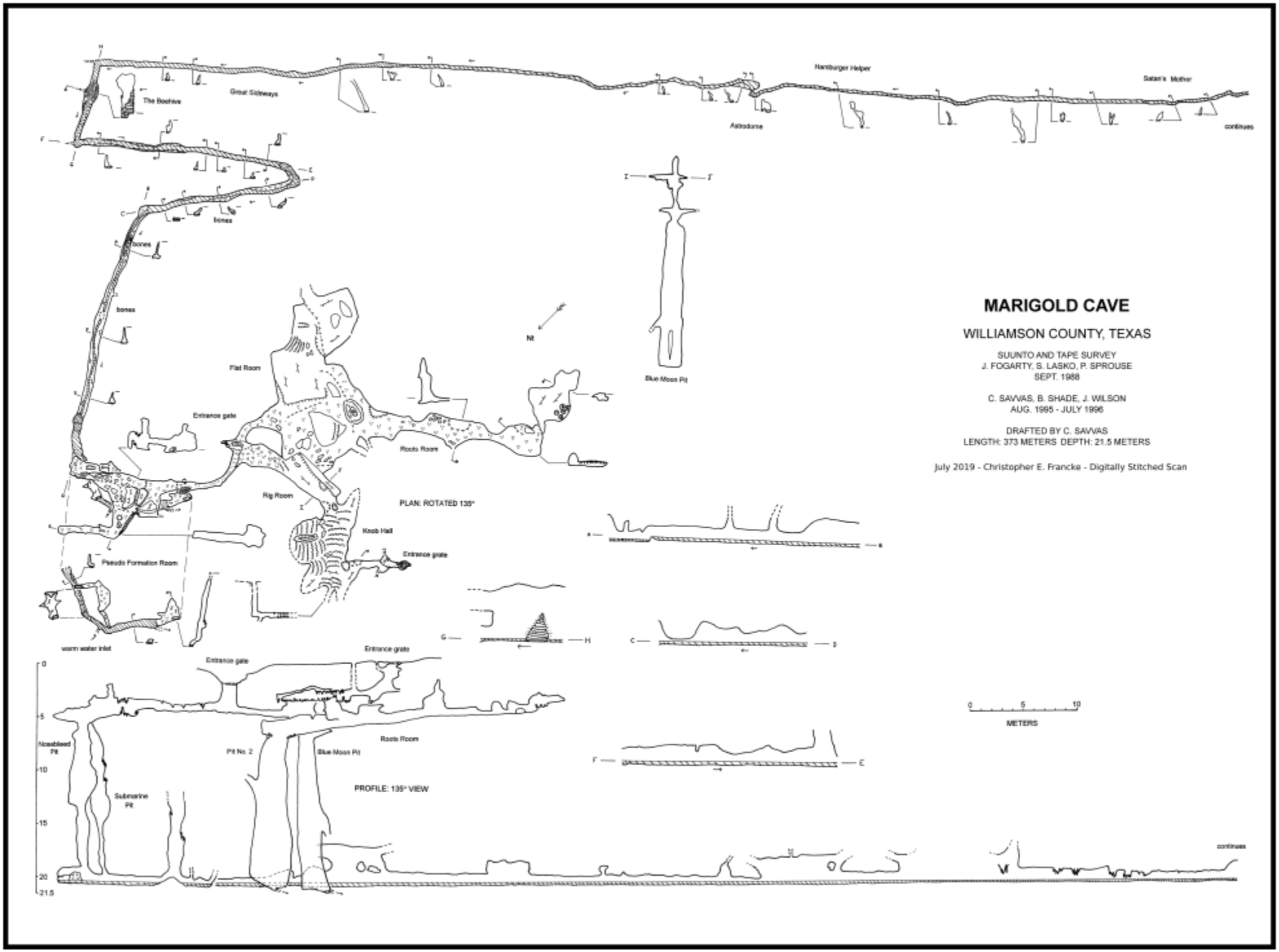
PROFILE



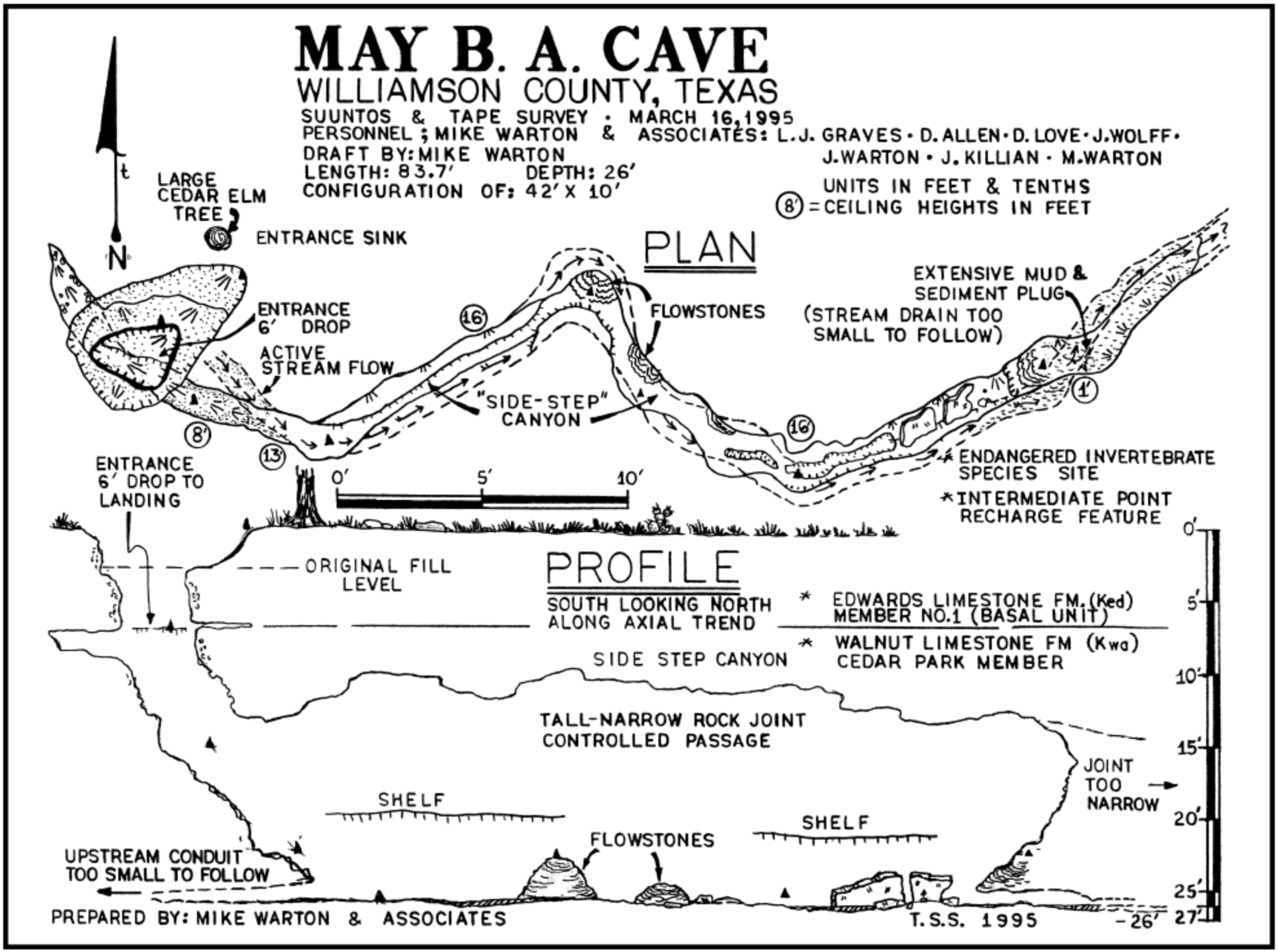
PREPARED BY: MIKE WARTON & ASSOCIATES
JUNE 1997

T.S.S. 1997

PROBABLE TOP OF BEE CAVE MEMBER



Source: 1996-07-xx - Savvas - Suunto and Tape Survey

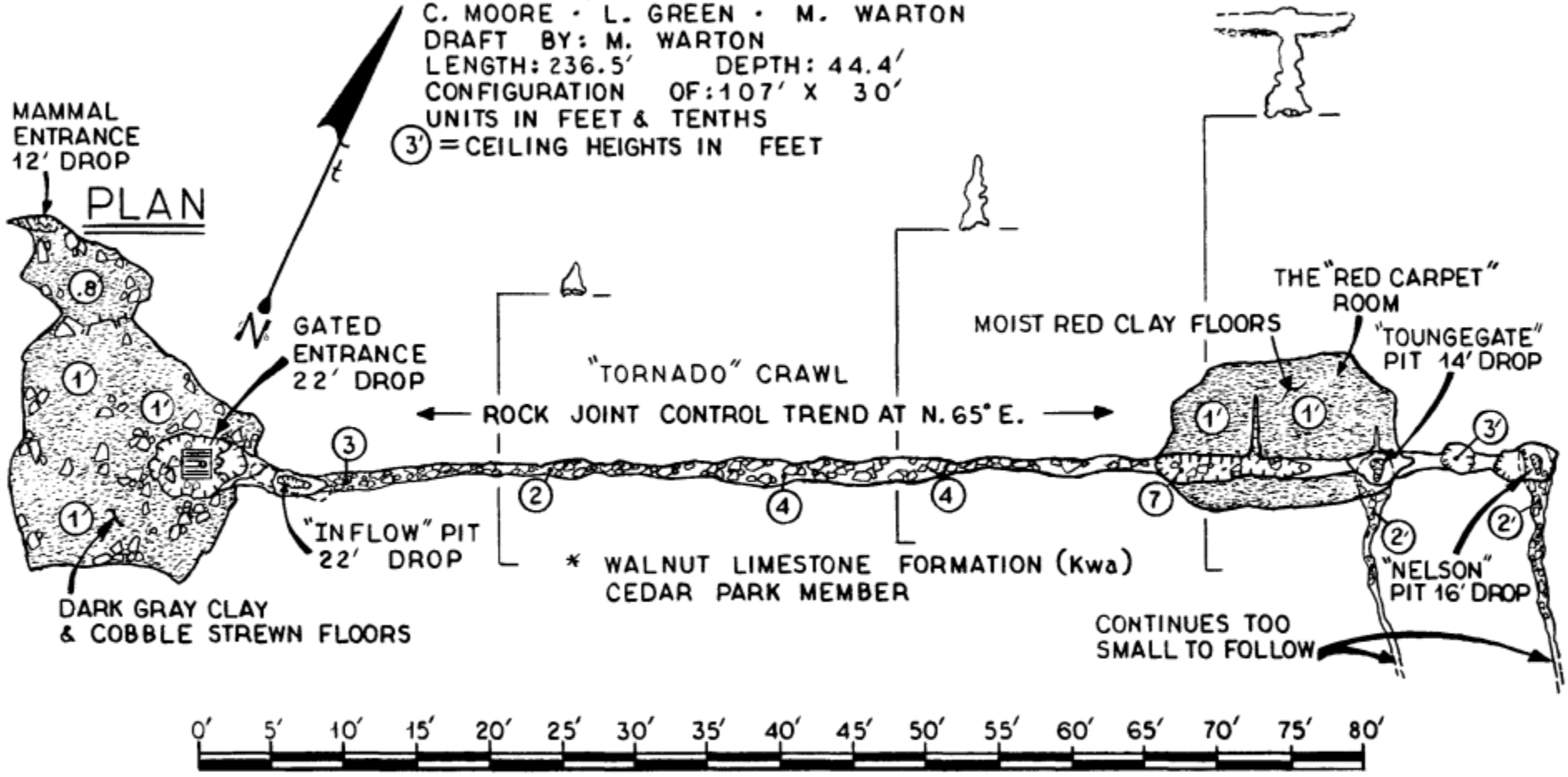


Source: 1997-10-18 - Warton - Final Report of Findings - Buttercup Creek Section 4 & Phase V - Appendix A

NELSON RANCH CAVE

WILLIAMSON COUNTY, TEXAS

SUUNTOS & TAPE SURVEY · MAY 27, 1997
PERSONNEL ; MIKE WARTON & ASSOCIATES: B. WETUSKI · C. MOORE · L. GREEN · M. WARTON
DRAFT BY: M. WARTON
LENGTH: 236.5′ DEPTH: 44.4′
CONFIGURATION OF: 107′ X 30′
UNITS IN FEET & TENTHS
(3′) = CEILING HEIGHTS IN FEET



* ENDANGERED INVERTEBRATE SPECIES HABITAT SITE
*"MAJOR" RANGE POINT RECHARGE FEATURE
* SEASONAL OXYGEN REDUCED ENVIRONMENT

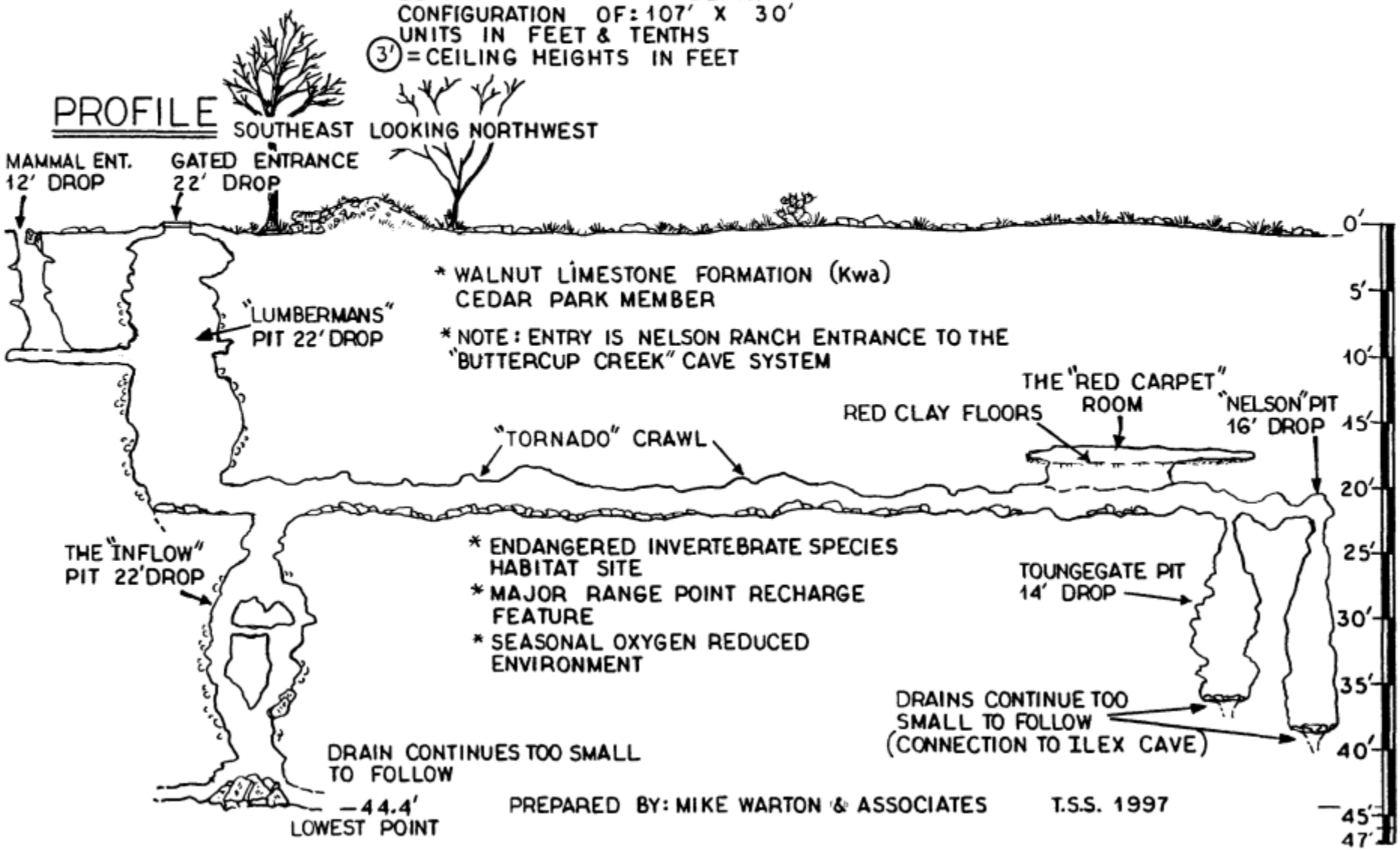
PREPARED BY: MIKE WARTON & ASSOCIATES T.S.S. 1997

Source: 1997-10-18 - Warton - Final Report of Findings - Buttercup Creek Section 4 & Phase V - Appendix A

NELSON RANCH CAVE

WILLIAMSON COUNTY, TEXAS

SUUNTOS & TAPE SURVEY · MAY 27, 1997
PERSONNEL; MIKE WARTON & ASSOCIATES: B. WETUSKI · C. MOORE · L. GREEN · M. WARTON
DRAFT BY: MIKE WARTON
LENGTH: 236.5' DEPTH: 44.4'
CONFIGURATION OF: 107' X 30'
UNITS IN FEET & TENTHS
(3') = CEILING HEIGHTS IN FEET



PREPARED BY: MIKE WARTON & ASSOCIATES T.S.S. 1997

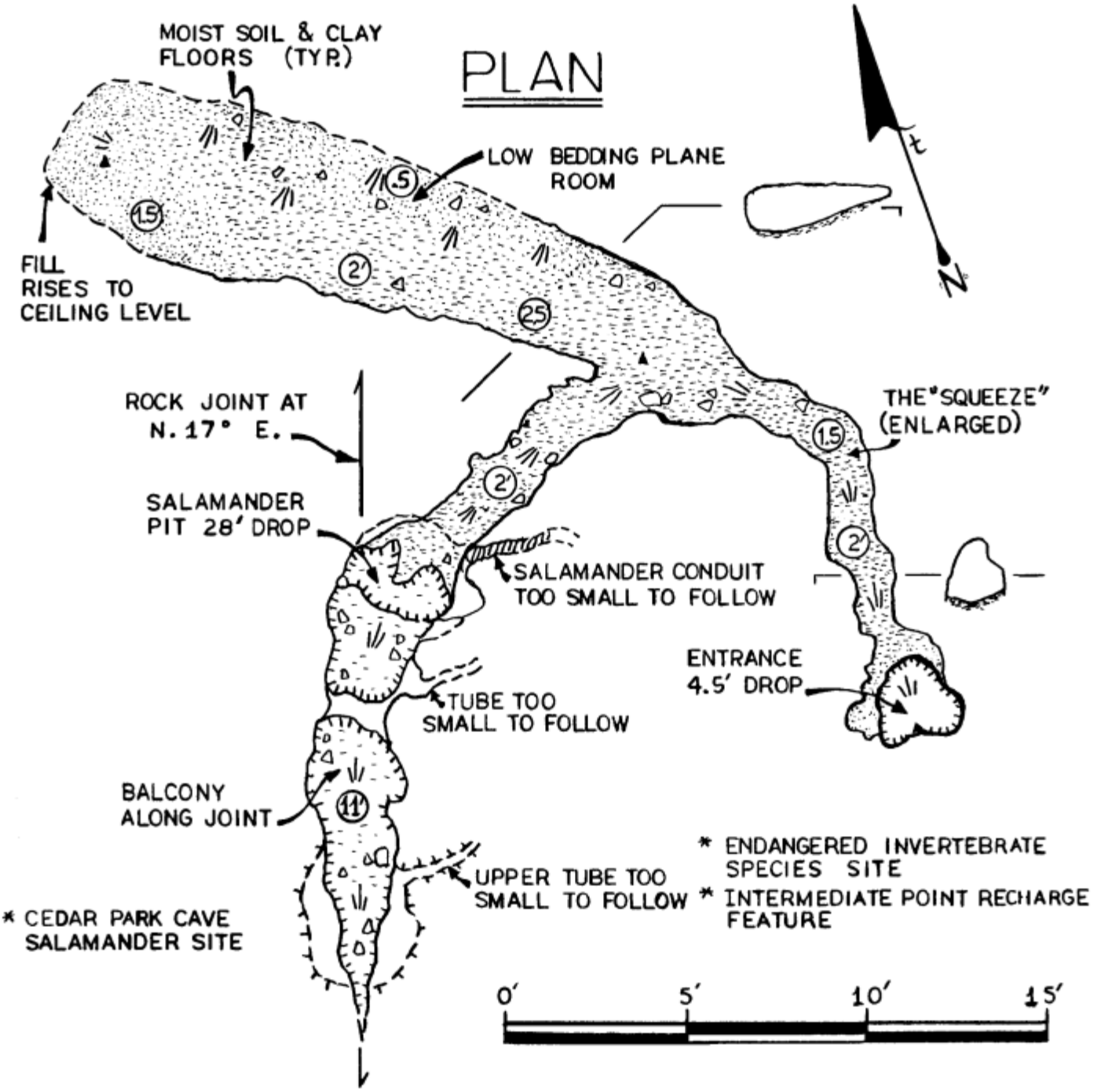
Source: 1997-10-18 - Warton - Final Report of Findings - Buttercup Creek Section 4 & Phase V - Appendix A

SALAMANDER SQUEEZE CAVE

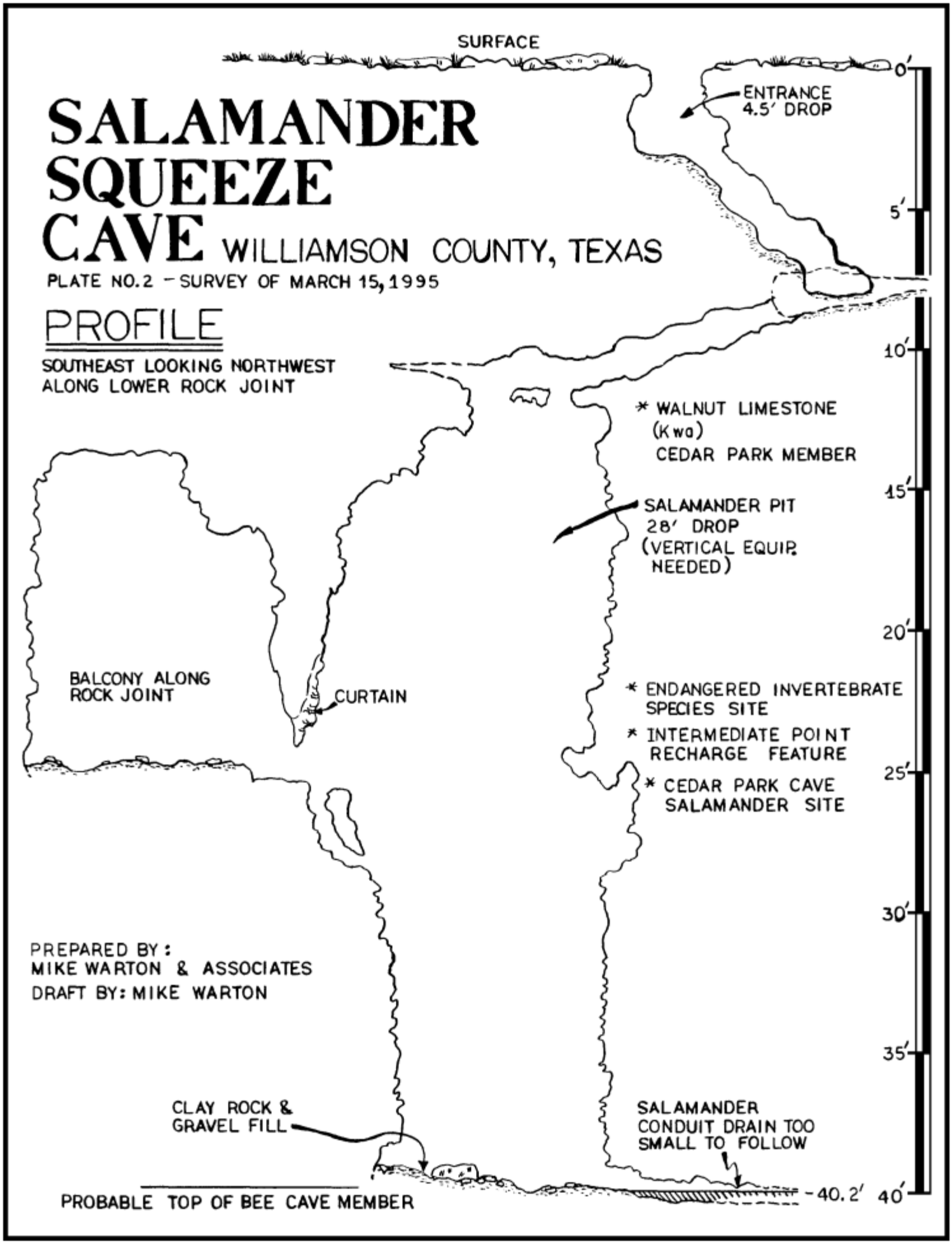
WILLIAMSON COUNTY, TEXAS

SUUNTOS & TAPE SURVEY • MARCH 15, 1995
PERSONNEL; MIKE WARTON & ASSOCIATES: L.J.GRAVES • D. ALLEN • D. LOVE • J.WOLFF • J. WARTON • J. KILLIAN • M. WARTON
DRAFT BY: MIKE WARTON
LENGTH: 90.3′ DEPTH: 40.2′
CONFIGURATION OF: 30′X 24′

UNITS IN FEET & TENTHS
(2′) = CEILING HEIGHTS IN FEET



PREPARED BY: MIKE WARTON & ASSOCIATES T.S.S. 1995



Source: 1997-10-18 - Warton - Final Report of Findings - Buttercup Creek Section 4 & Phase V - Appendix A

STONE WELL CAVE NO. 1

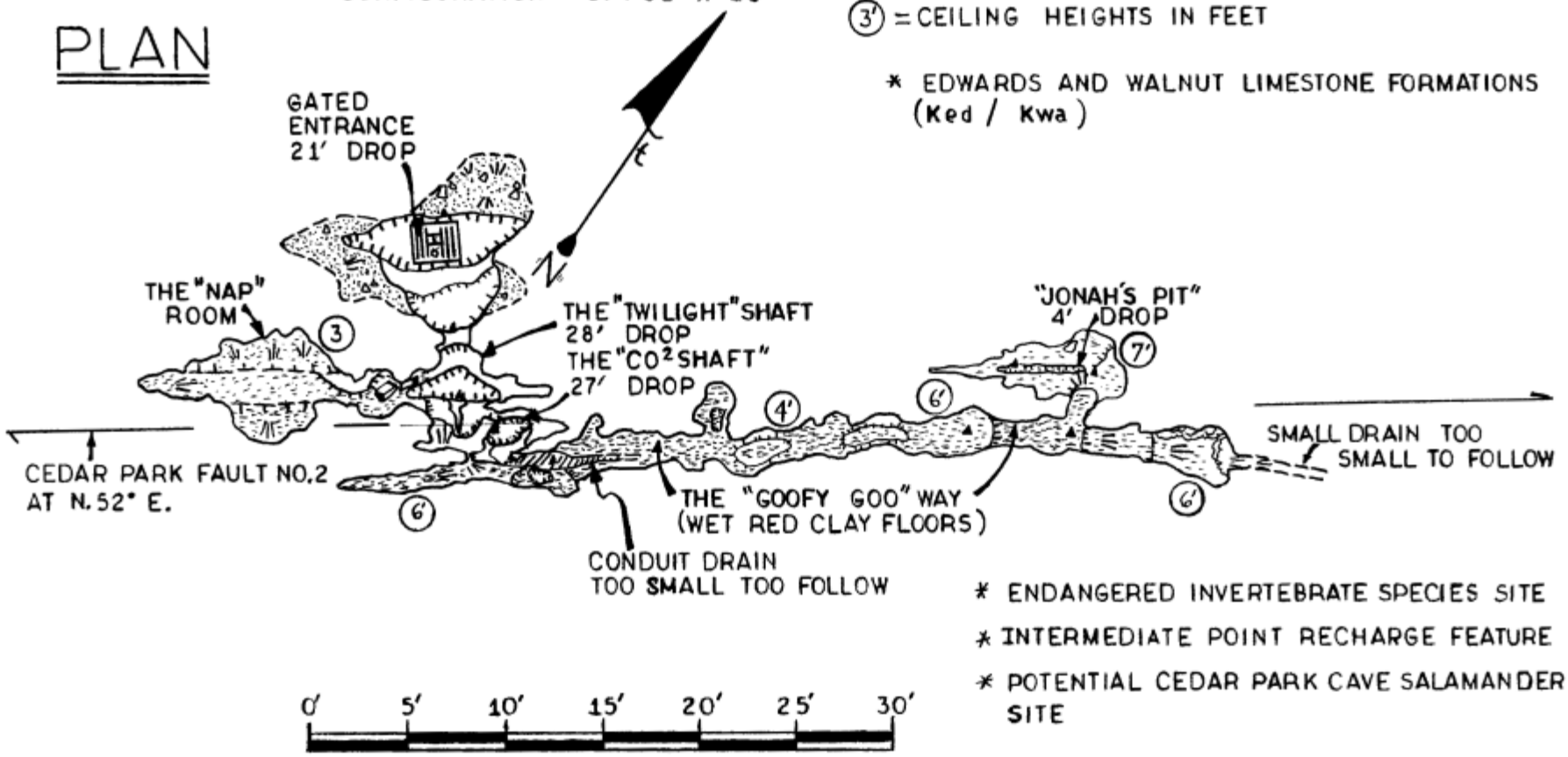
WILLIAMSON COUNTY, TEXAS

SUUNTOS & TAPE SURVEY · MARCH 21, 1995
PERSONNEL ; MIKE WARTON & ASSOCIATES: L.J. GRAVES · D. ALLEN · D. LOVE · J. WOLFF · J. WARTON · J. KILLIAN · M. WARTON
DRAFT BY: MIKE WARTON
LENGTH: 152.2' DEPTH: 77.6'
CONFIGURATION OF: 62' X 18'

UNITS IN FEET & TENTHS
(3') = CEILING HEIGHTS IN FEET

* EDWARDS AND WALNUT LIMESTONE FORMATIONS (Ked / Kwa)

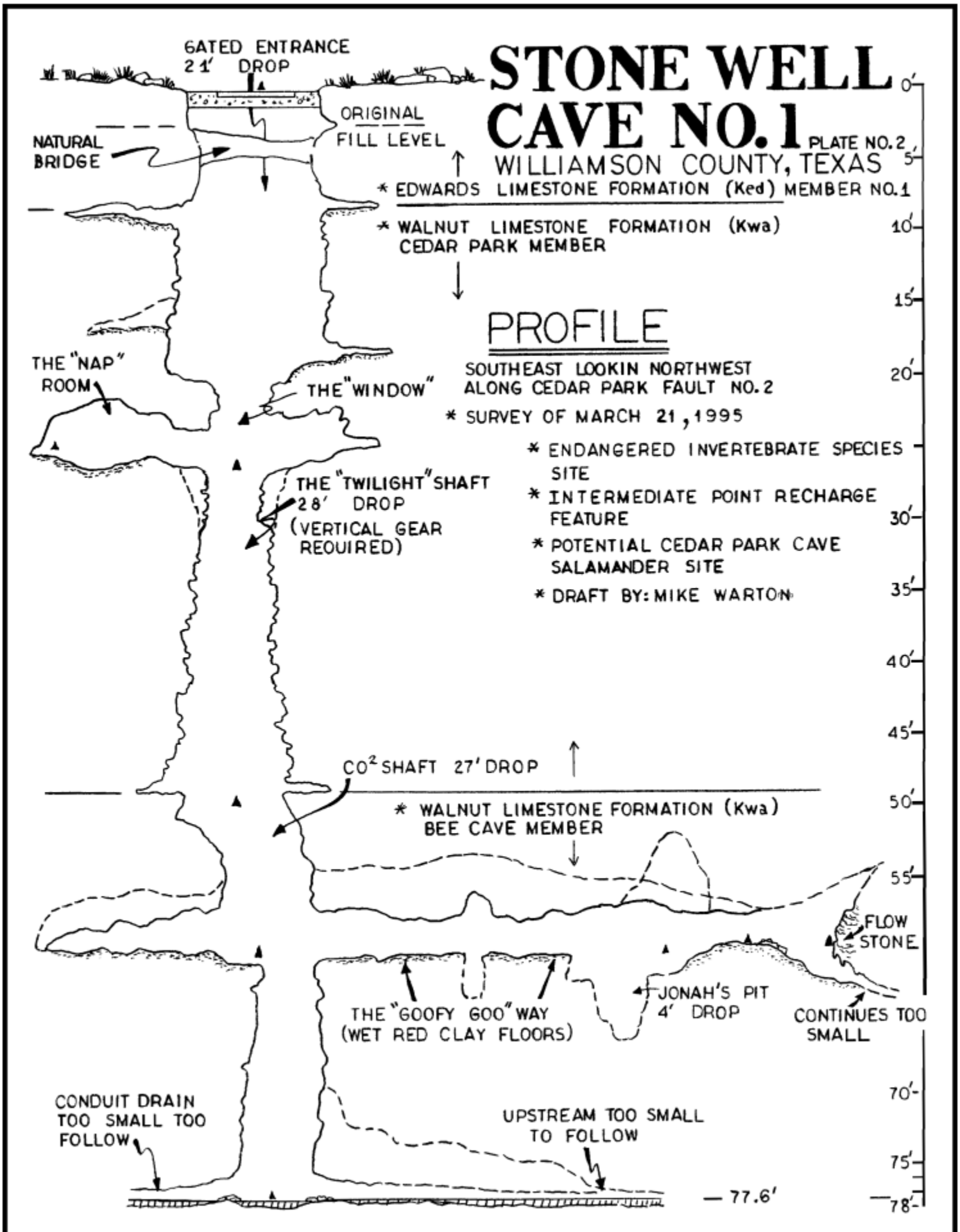
PLAN



* ENDANGERED INVERTEBRATE SPECIES SITE
* INTERMEDIATE POINT RECHARGE FEATURE
* POTENTIAL CEDAR PARK CAVE SALAMANDER SITE

PREPARED BY; MIKE WARTON & ASSOCIATES: PLATE NO. 1 T.S.S. 1995

Source: 1997-10-18 - Warton - Final Report of Findings - Buttercup Creek Section 4 & Phase V - Appendix A



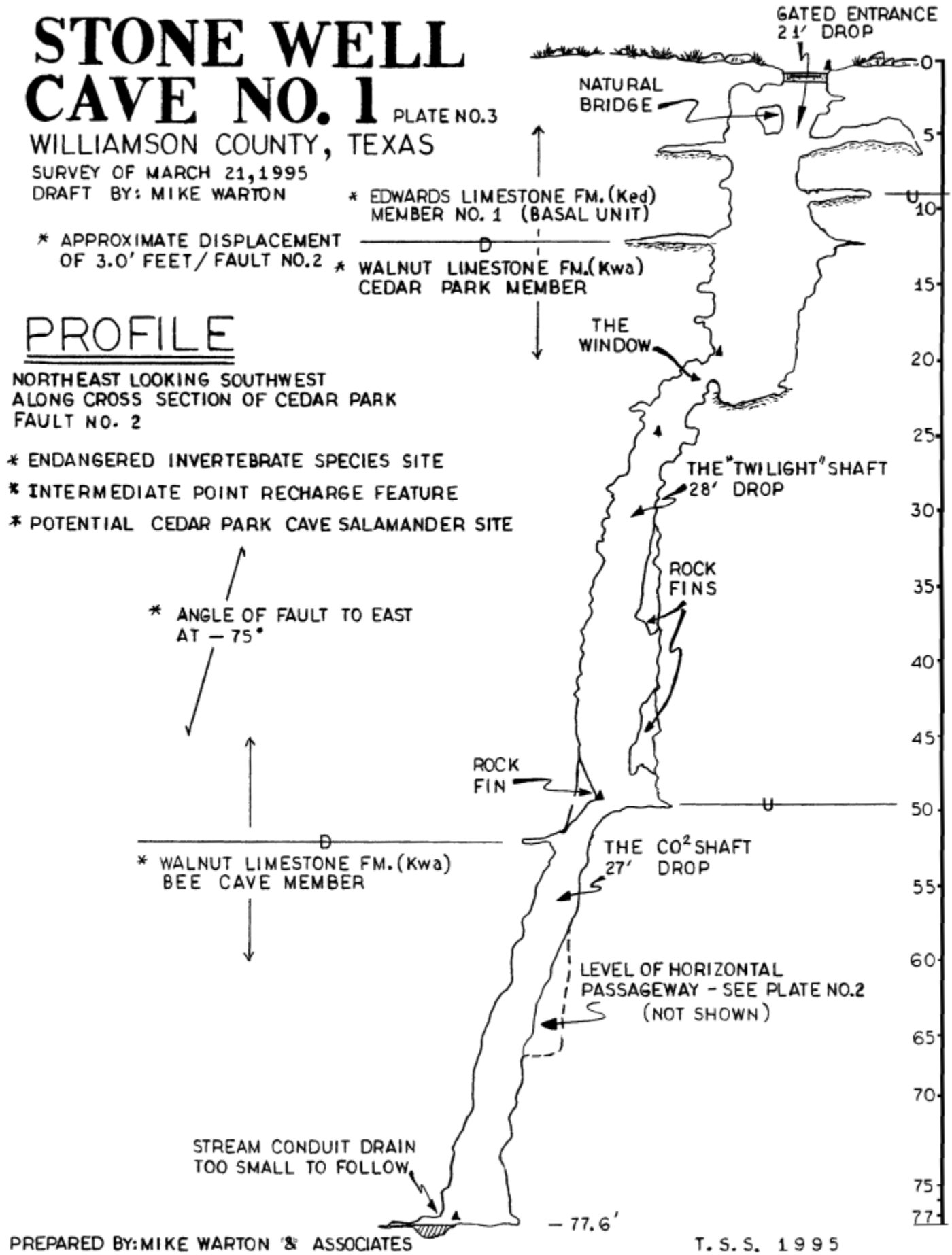
Source: 1997-10-18 - Warton - Final Report of Findings - Buttercup Creek Section 4 & Phase V - Appendix A

STONE WELL CAVE NO. 1

PLATE NO.3

WILLIAMSON COUNTY, TEXAS

SURVEY OF MARCH 21, 1995
DRAFT BY: MIKE WARTON



PREPARED BY: MIKE WARTON & ASSOCIATES

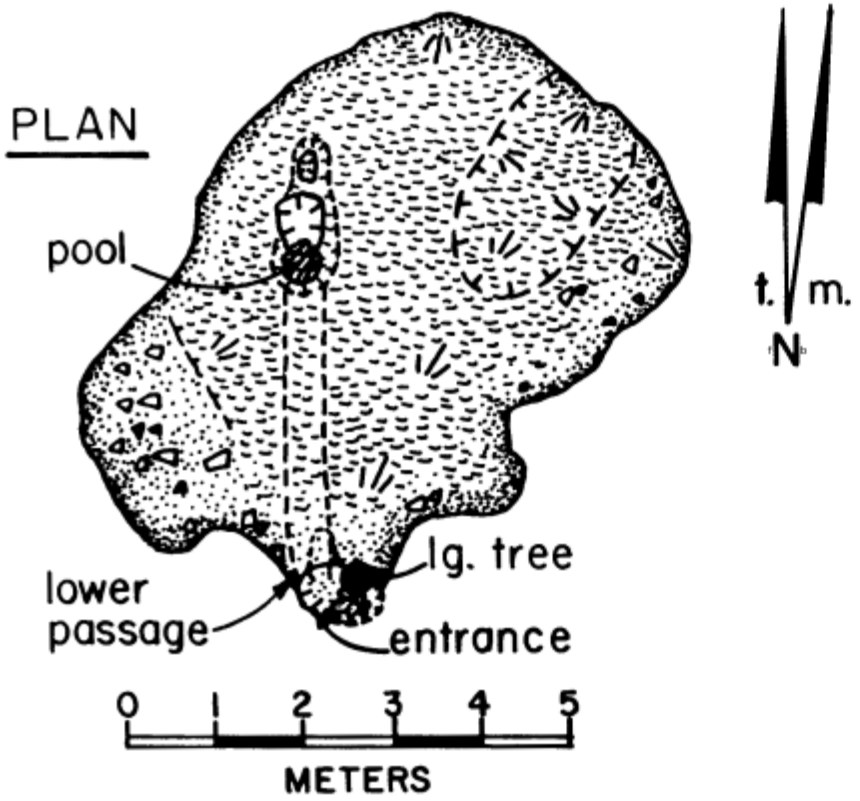
T. S. S. 1995

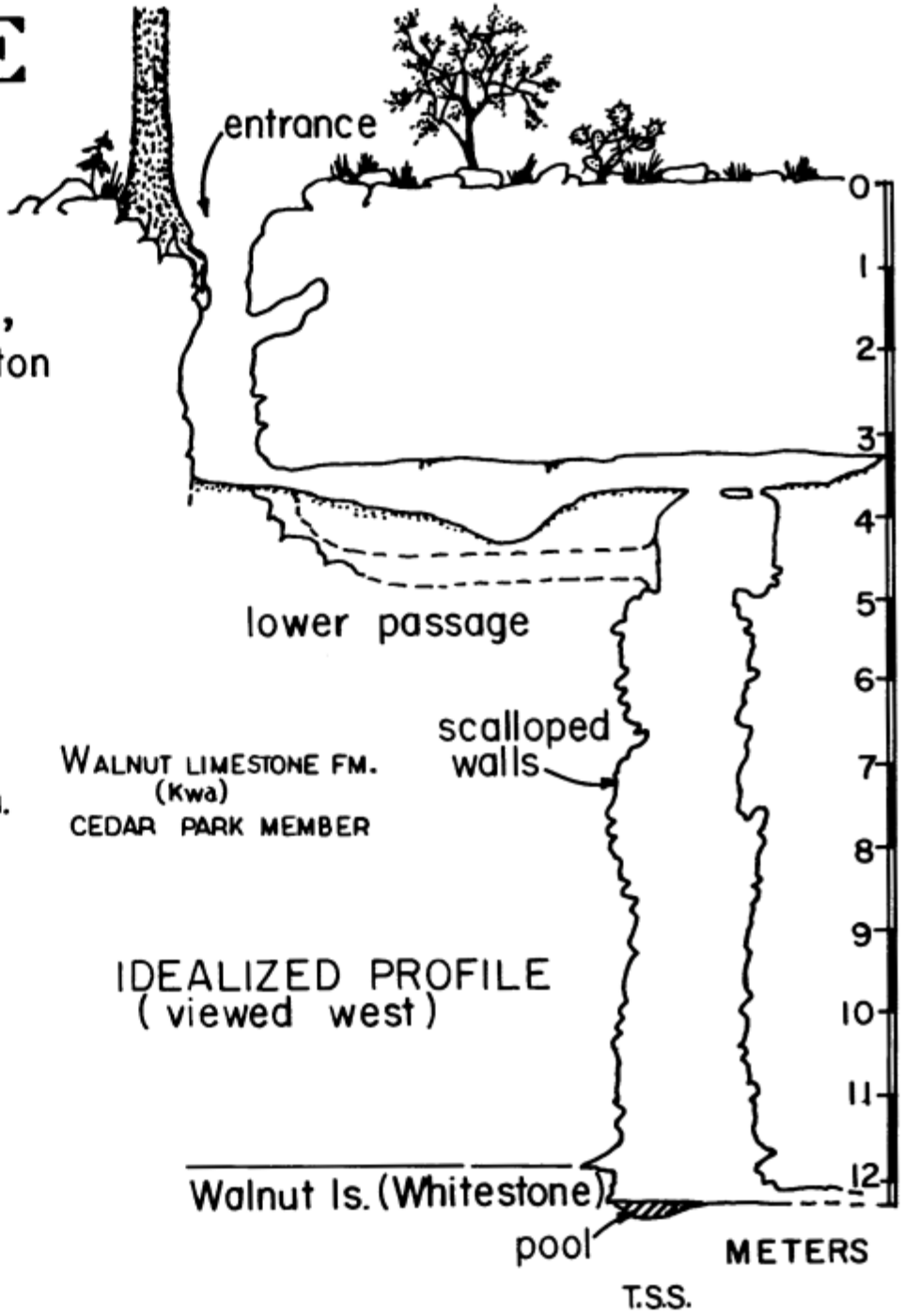
Source: 1997-10-18 - Warton - Final Report of Findings - Buttercup Creek Section 4 & Phase V - Appendix A

T.W.A.S. A CAVE

(Thornhill Warton & Schnieder Cave)

WILLIAMSON COUNTY, TEXAS
SUUNTOS & TAPE SURVEY
FEB. 7, 1987 excavated JAN. 11, 1987
PERSONNEL: Tom Thornhill, Mike Warton,
& Glenn Schnieder. DRAFT BY: M. Warton
LENGTH: 11.8m. or 38.7ft.
DEPTH: 12.4m. or 40.6 ft.



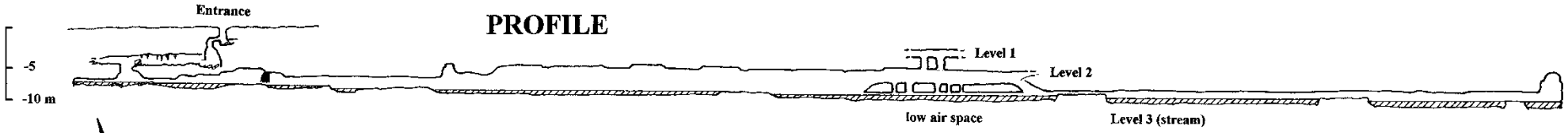


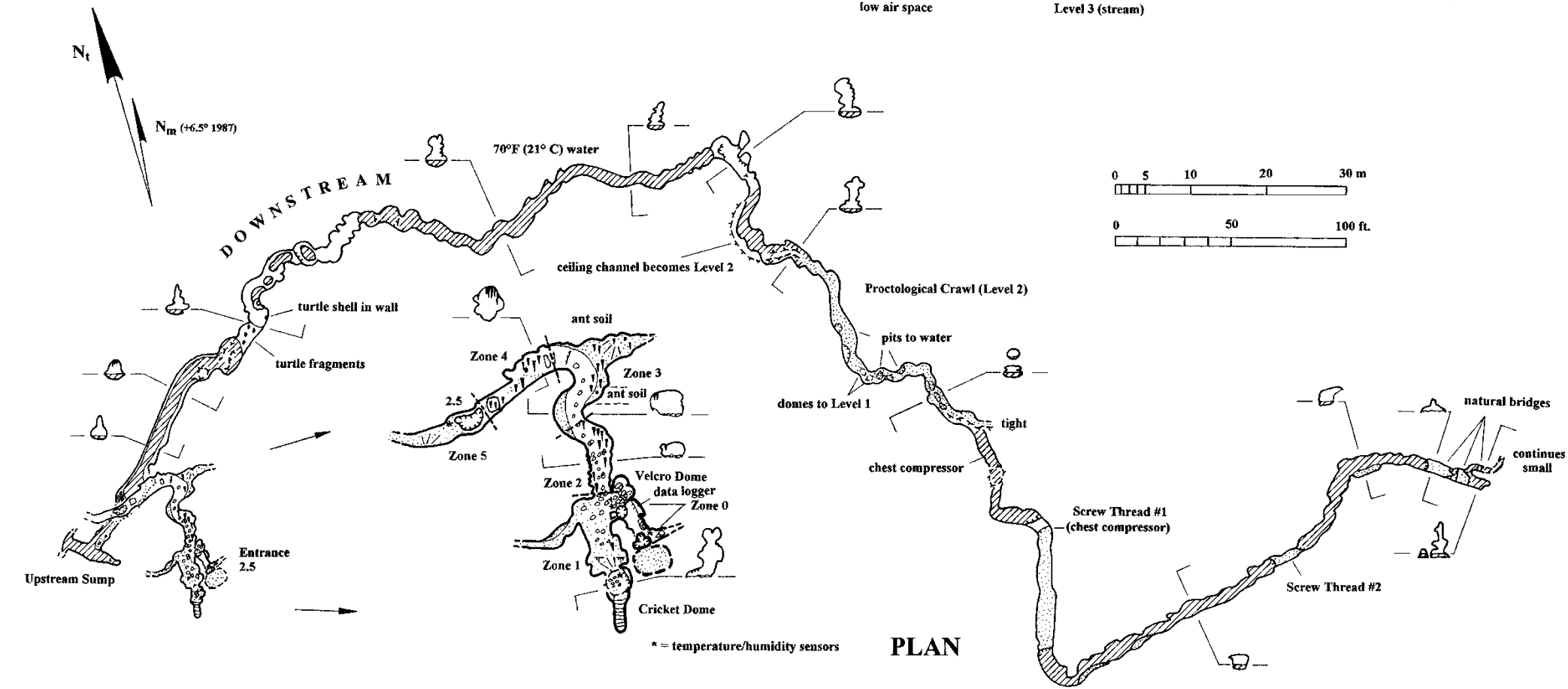
Source: 1997-10-18 - Warton - Final Report of Findings - Buttercup Creek Section 4 & Phase V - Appendix A

TESTUDO TUBE

Williamson County, Texas

Surveyed by William R. Elliott & Peter S. Sprouse
with Suunto instruments & fiberglass tape:
1992 — August 8, August 21
1993 — April 12, June 2, August 29
Drafted by William R. Elliott, February 24, 1994





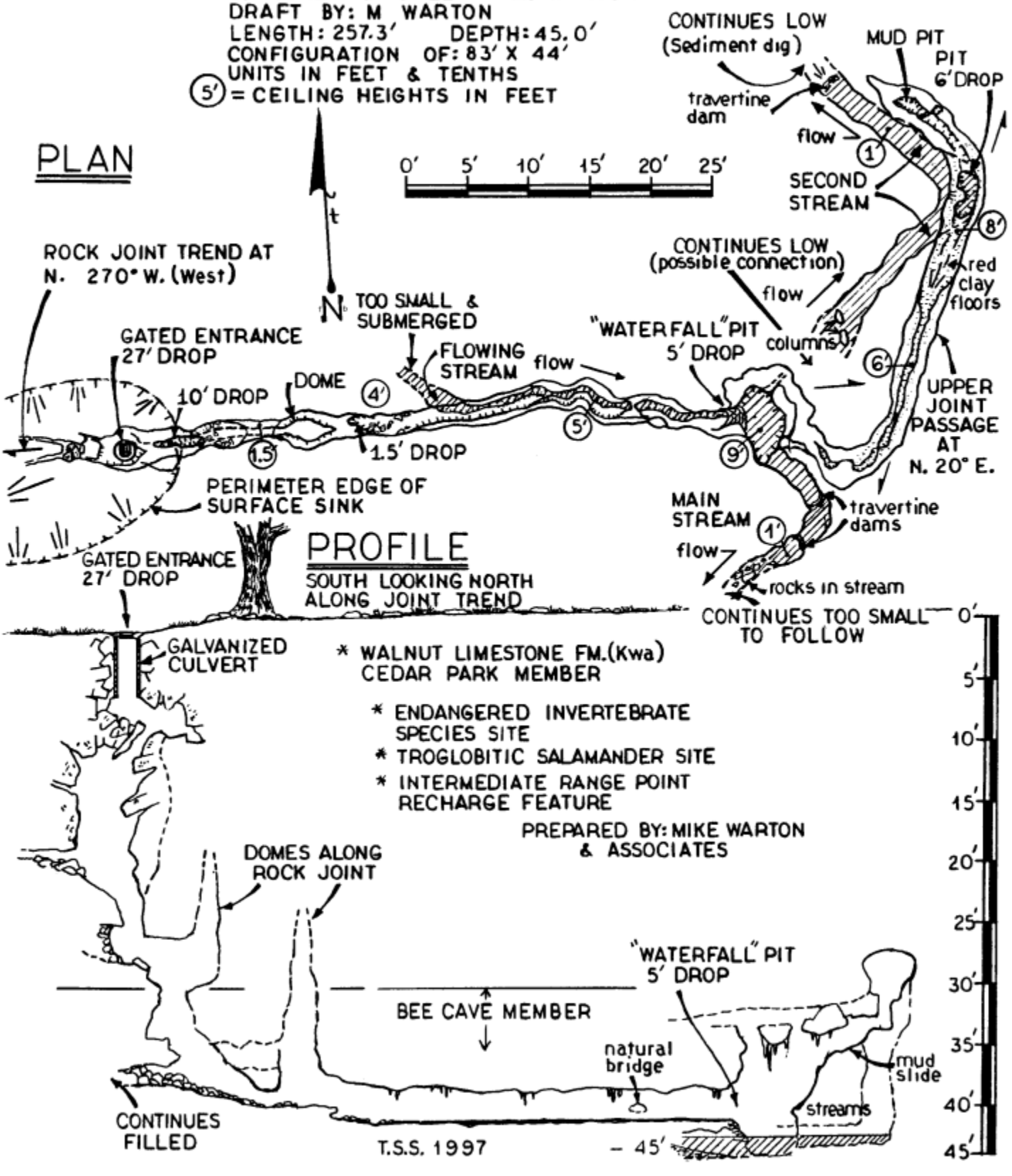
Detail of Ecology Study Area (2X)

Traverse Length: 327 m (1,073 ft.)
Depth: 8.8 m (28.8 ft.)
Measurements in meters

TREE HOUSE CAVE

WILLIAMSON COUNTY, TEXAS

SUUNTOS & TAPE SURVEY · MAY 6, 1997
PERSONNEL; MIKE WARTON & ASSOCIATES: B. WETUSKI · C. MOORE · L. GREEN · M. WARTON
DRAFT BY: M WARTON
LENGTH: 257.3′ DEPTH: 45.0′
CONFIGURATION OF: 83′ X 44′
UNITS IN FEET & TENTHS
(5′) = CEILING HEIGHTS IN FEET



Source: 1997-10-18 - Warton - Final Report of Findings - Buttercup Creek Section 4 & Phase V - Appendix A

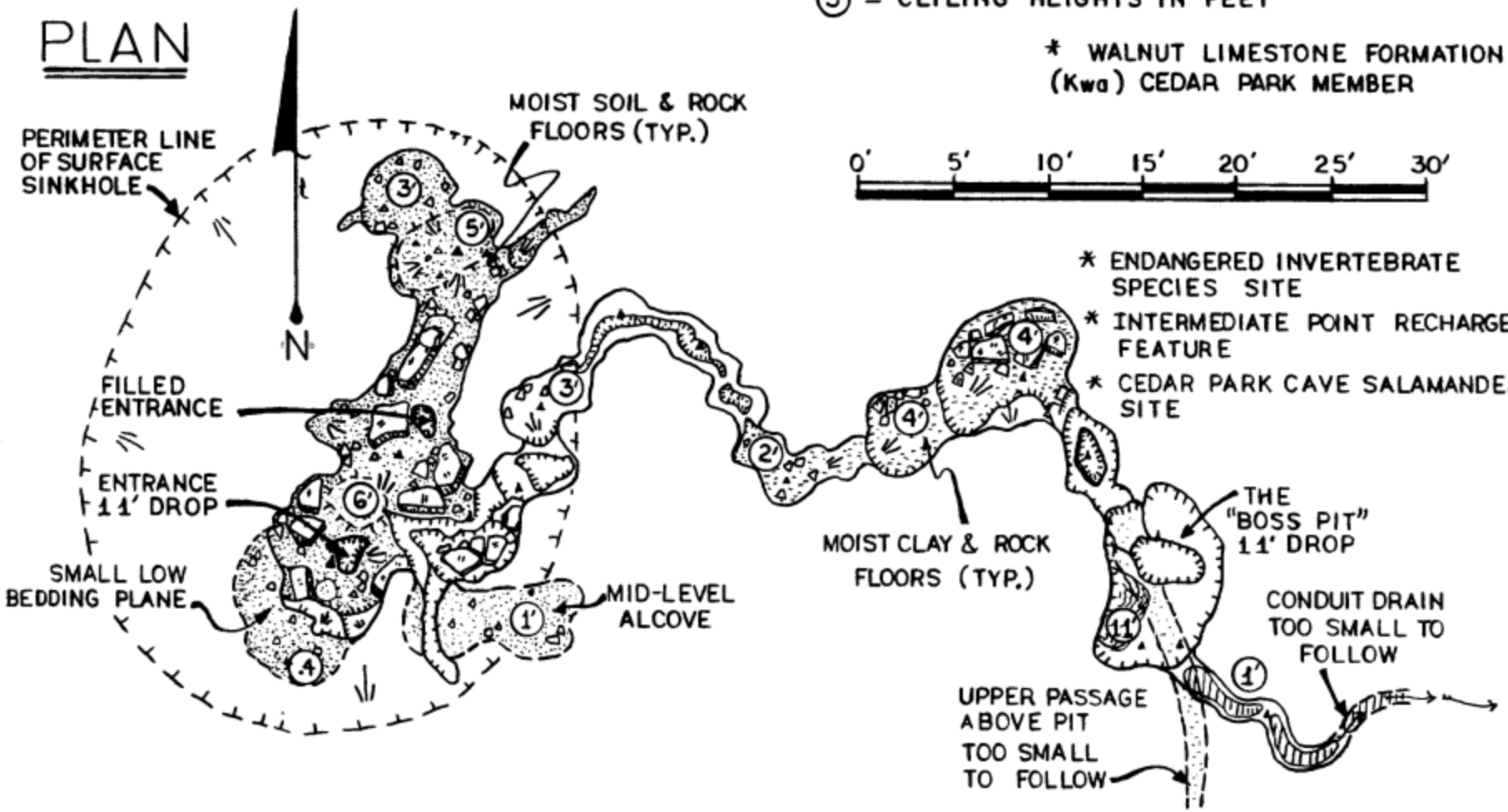
TWO HOLE CAVE

WILLIAMSON COUNTY, TEXAS

SUUNTOS & TAPE SURVEY · MARCH 17, 1995
PERSONNEL ; MIKE WARTON & ASSOCIATES: L. J. GRAVES · D. ALLEN · D. LOVE · J. WOLFF · J. KILLIAN · M. WARTON
DRAFT BY: MIKE WARTON
LENGTH: 138.2' DEPTH: 38.2'
CONFIGURATION OF: 72' X 33'

UNITS IN FEET & TENTHS
(3') = CEILING HEIGHTS IN FEET

PLAN



PREPARED BY: MIKE WARTON & ASSOCIATES

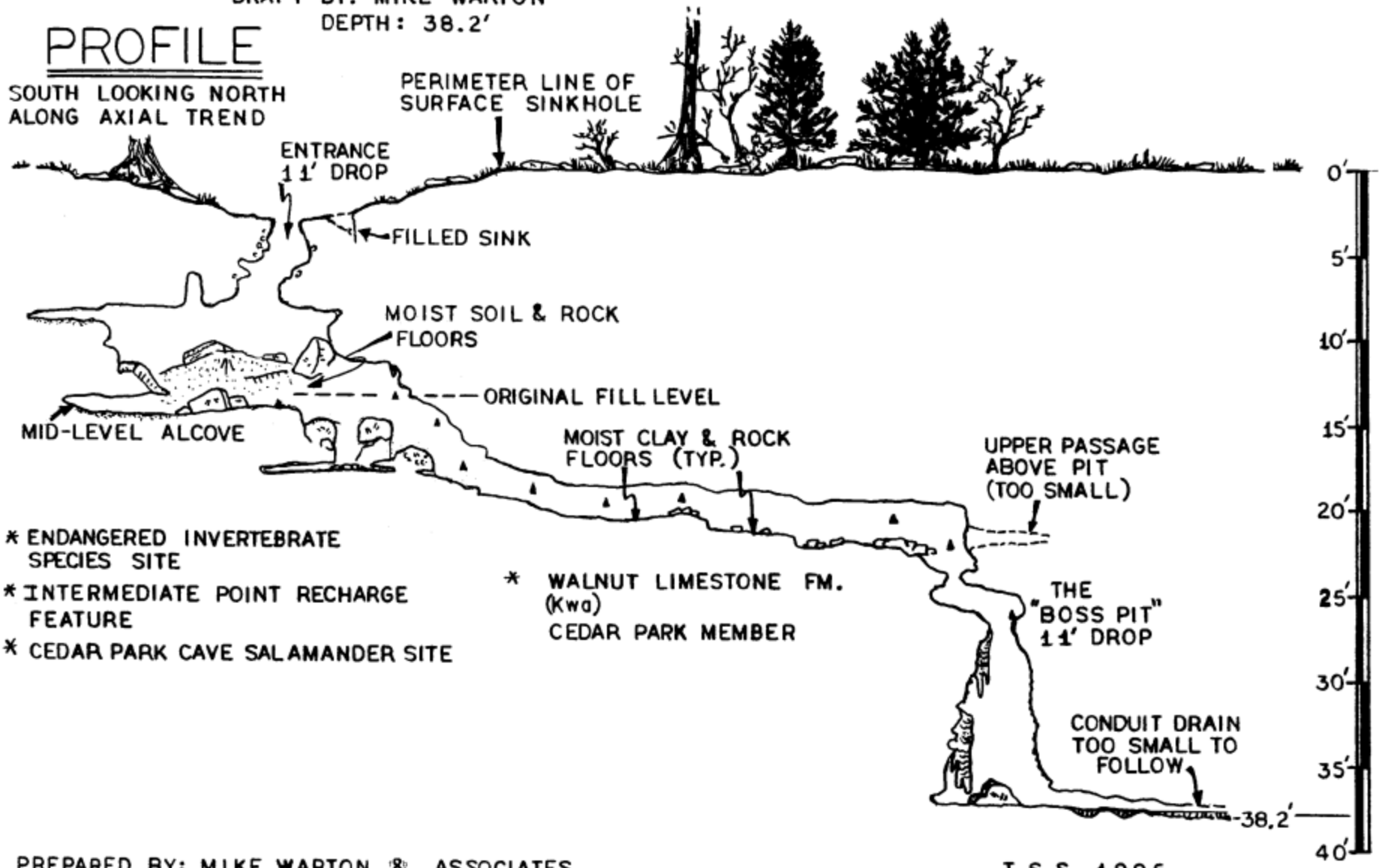
T.S.S. 1995

Source: 1997-10-18 - Warton - Final Report of Findings - Buttercup Creek Section 4 & Phase V - Appendix A

TWO HOLE CAVE

WILLIAMSON COUNTY, TEXAS

PLATE NO.2 · SURVEY OF MARCH 17, 1995
PERSONNEL: MIKE WARTON & ASSOCIATES
DRAFT BY: MIKE WARTON
DEPTH: 38.2'



PREPARED BY: MIKE WARTON & ASSOCIATES

T. S. S. 1995

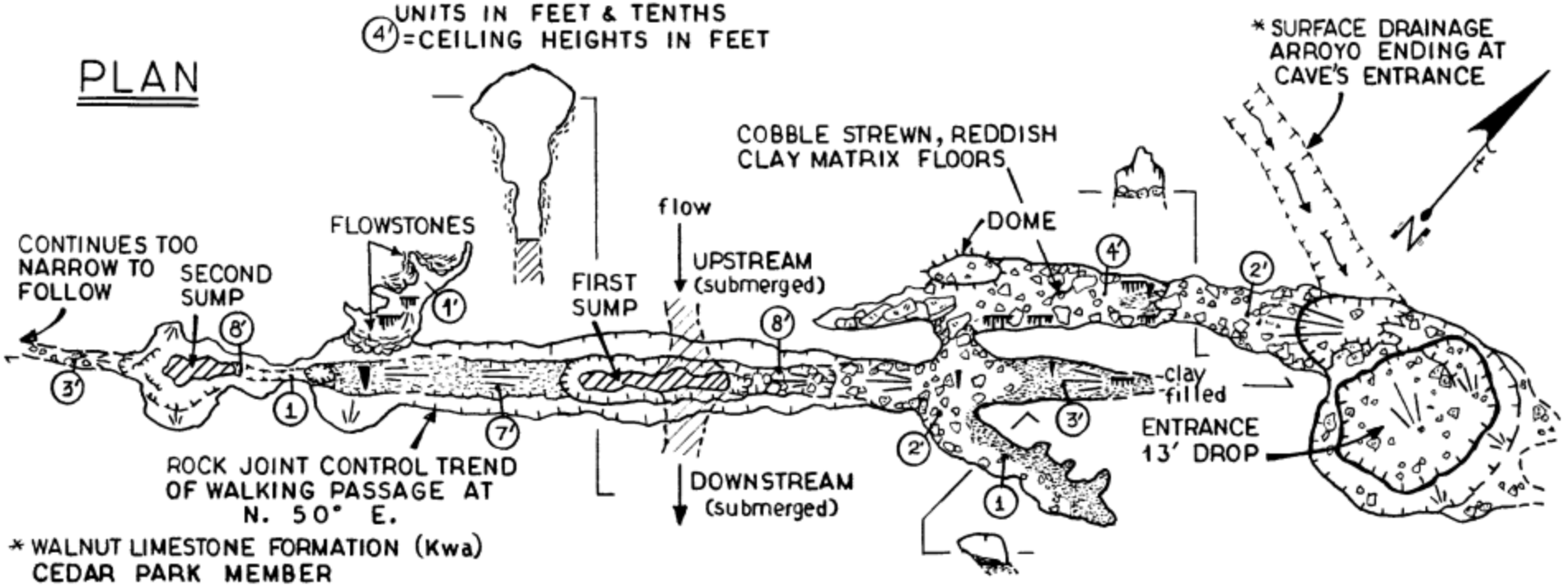
Source: 1997-10-18 - Warton - Final Report of Findings - Buttercup Creek Section 4 & Phase V - Appendix A

WHITEWATER CAVE

WILLIAMSON COUNTY, TEXAS

SUUNTOS & TAPE SURVEY · MAY 13, 1997
PERSONNEL; MIKE WARTON & ASSOCIATES: B. WETUSKI · C. MOORE · L. GREEN · M. WARTON
DRAFT BY: M. WARTON
LENGTH: 101.6′ DEPTH: 22.0′
CONFIGURATION OF: 81′ X 15′
UNITS IN FEET & TENTHS
(4′) = CEILING HEIGHTS IN FEET

PLAN



* WALNUT LIMESTONE FORMATION (Kwa) CEDAR PARK MEMBER
* ENDANGERED INVERTEBRATE SPECIES HABITAT SITE
* MAJOR RANGE POINT RECHARGE FEATURE

PREPARED BY: MIKE WARTON & ASSOCIATES · 1997

T.S.S. 1997

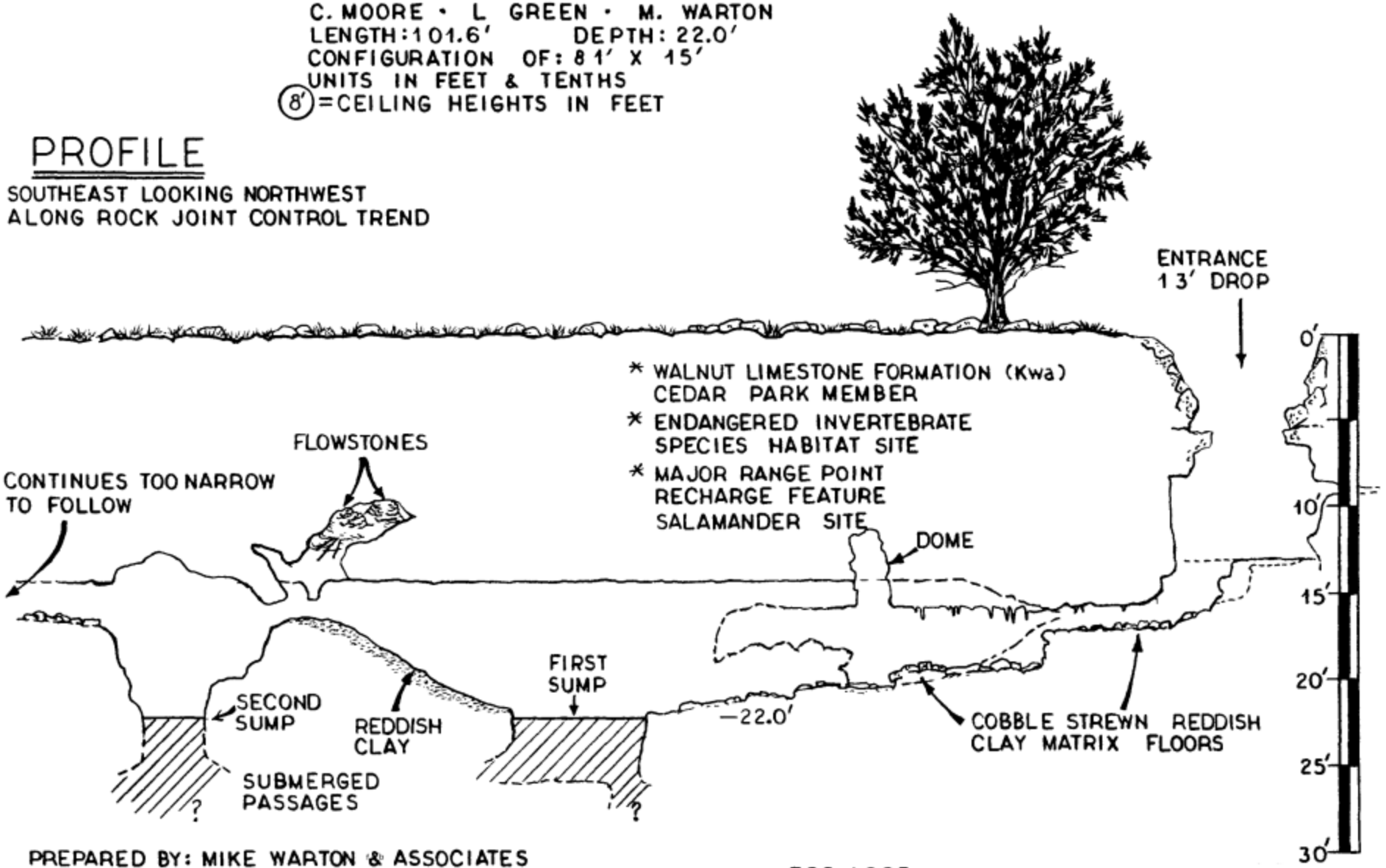
WHITEWATER CAVE

WILLIAMSON COUNTY, TEXAS

SUUNTOS & TAPE SURVEY • MAY 13, 1997
PERSONNEL; MIKE WARTON & ASSOCIATES: B. WETUSKI · C. MOORE · L GREEN · M. WARTON
LENGTH: 101.6′ DEPTH: 22.0′
CONFIGURATION OF: 81′ X 15′
UNITS IN FEET & TENTHS
(8′) = CEILING HEIGHTS IN FEET

PROFILE

SOUTHEAST LOOKING NORTHWEST
ALONG ROCK JOINT CONTROL TREND



PREPARED BY: MIKE WARTON & ASSOCIATES

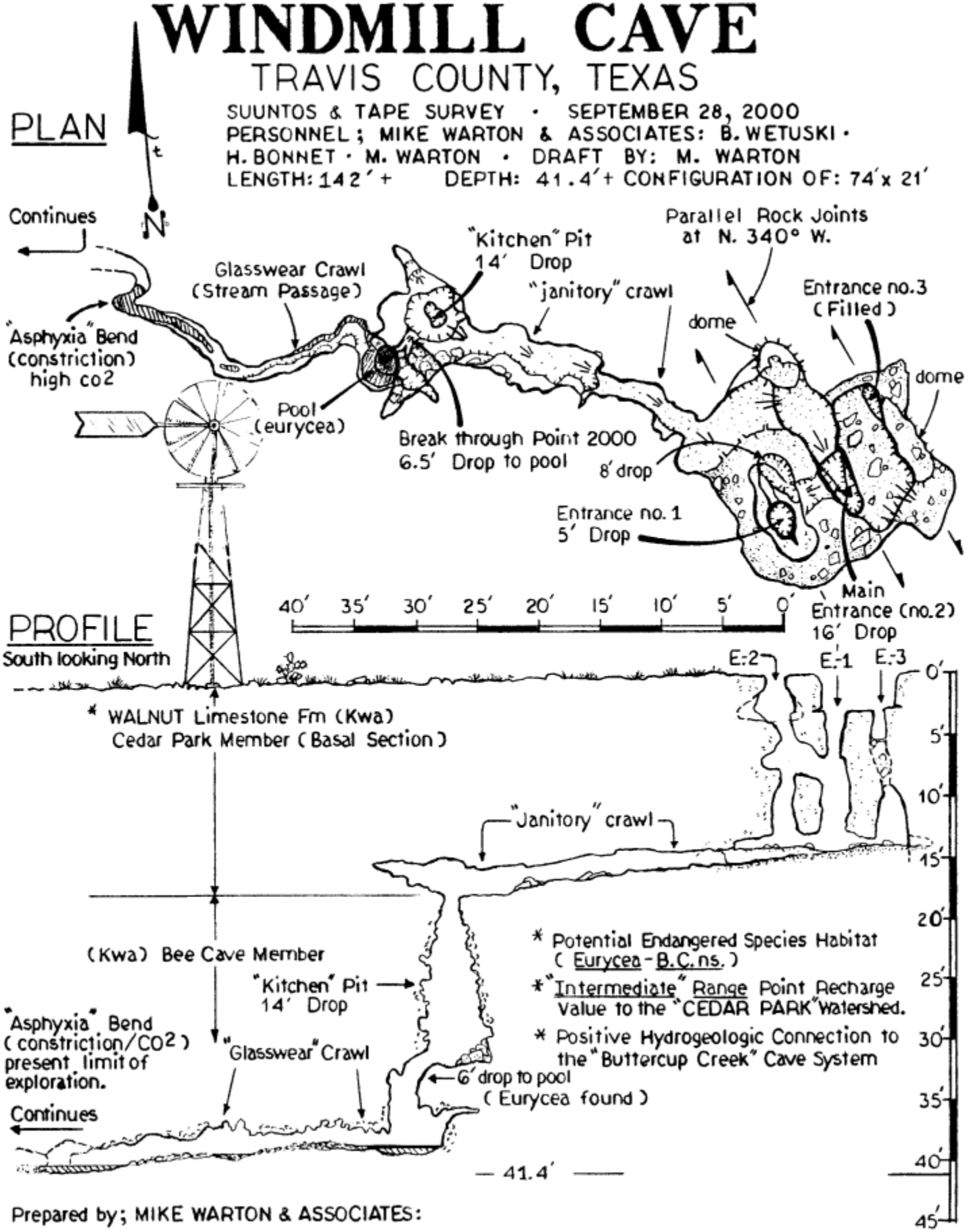
T.S.S. 1997

Source: 1997-10-18 - Warton - Final Report of Findings - Buttercup Creek Section 4 & Phase V - Appendix A

WINDMILL CAVE

TRAVIS COUNTY, TEXAS

SUUNTOS & TAPE SURVEY · SEPTEMBER 28, 2000
PERSONNEL; MIKE WARTON & ASSOCIATES: B. WETUSKI · H. BONNET · M. WARTON · DRAFT BY: M. WARTON
LENGTH: 142′+ DEPTH: 41.4′+ CONFIGURATION OF: 74′x 21′



Prepared by; MIKE WARTON & ASSOCIATES:
SEPT. - OCT., 2000