VALDINA FARMS SINKHOLE: HYDROGEOLOGIC & BIOLOGIC EVALUATION

prepared by

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Statement of Purpose and Methodology

The intent of the 5 December, 1987, investigation in Valdina Farms Sinkhole was to evaluate the impact of the first severe flooding of the cave since the construction of the Seco Creek recharge dam and diversion channel. The evaluation assessed physical changes within the cave, their hydrogeologic implications, and the impact of the flood on the cave ecosystem.

The investigative group was comprised of the following nine people who worked as three different teams:

<u>Biology team:</u>

- Allan Cobb -- aquatic biologist, cave biologist, photographer
- Andy Grubbs -- cave biologist
- Scott Harden -- geologist, cave biologist

All of the above had biologically examined the cave prior to its flooding.

<u>Survey team:</u>

- Joe Ivy -- cave surveyor, geology student
- Linda Palit -- cave surveyor
- Jack Ralph -- cave surveyor, aquatic biologist

<u>Hydrogeology team:</u>

- James Bowden -- cave diver
- Karen Hohle -- cave diver, photographer
- George Veni -- hydrogeologist, cave diver, photographer

This report is presented in a loose-leaf folder format for easy expansion through the addition of subsequent or supplemental studies, photographs, relevant correspondence, or other pertinent information.

Executive Summary

On 5 December, 1987, Valdina Farms Sinkhole was investigated to determine the impact of the first massive flooding since the construction of the Seco Creek Recharge Dam and Diversion Channel. The cave was observed for physical changes, including the exploration and survey of new passages, as well as observations of the cave's ecosystem and hydrogeology.

The only major physical changes in the cave were the entrenchment of the floor and the washing-out of large mud and guano deposits deeper into the aquifer. No evidence of siltation was encountered. A new small stream passage was opened by the flood, located off the main passage upstream of the entrance, but was not fully explored. Domes downstream were explored and surveyed in hopes of finding a bypass to nearby Sump 1, but only a large upper room was discovered. Sump 1 was dove, using SCUBA, and was found to be approximately 100 m long. On the sump's far side the air-filled passage was explored for 340 m to Sump 2. In total, the cave's explored length was increased by more than 50%.

Biologically, the cave's diverse and extensive fauna was decimated. The terrestrial fauna had drown and catfish, washed in by the flood, had eaten the cave's aquatic fauna. No bat colonies were observed, although two stray bats were present. Whether or not the cave is repopulated by species migrating from other caves will require further observation.

Hydrologically, the cave transmitted a very significant volume of recharge into the Edwards Aquifer. It shows no indication that it cannot continue to do so, although further downstream exploration is required. Estimated peak recharge rates for the cave, prior to flooding, may have been beyond the cave's capacity, however, discharge rates for the cave prior to its overflowing are not available. Nonetheless, the recharge event created a tremendous groundwater mound as water levels in area wells continued to rise for up to 4 months after the flood.

The recommendations include that the survey and exploration of the cave should continue to better facilitate, and increase the comprehension, of studies that will and are being done. The primary area of exploration would be downstream, although the upstream areas are also of significance. The cave should also be visited once each winter, spring and late summer, up through 1989, to determine the full impact of flooding on the ecosystem and its recovery. Lastly, a series of dye tracing should be

run to delineate the cave's upstream drainage area and downstream flow paths, and the number of local groundwater monitoring wells should be increased, including the placement of two into the cave.

Historical Background

The first known published description of Valdina Farms Sinkhole was given by W.B. Phillips, in a 1901 article on Texas bat guano caves. Although not extensively mined for guano, most subsequent trips to the cave, up through 1959, were made to study its three varieties of bat. In 1964, members of the Texas Speleological Association, led by James Reddell, surveyed the cave. Reddell led several more trips to study the invertebrate, as well as the cave's vertebrate, fauna, and in 1967 he published his findings in the Texas Speleological Survey's "Caves of Medina County" (see Appendix A).

In 1977, the Edwards Underground Water District (EUWD) announced plans to build a recharge dam along Seco Creek. This dam, like most others, would prevent streamflow from discharging off the Edwards Aquifer recharge zone and would thus enhance recharge into the aquifer. Unlike most such dams, however, this dam would be used to specifically recharge a large volume of water through a single large cave -- Valdina Farms Sinkhole.

Valdina Farms Sinkhole is located high on the Seco Creek floodplain. Only on rare occasions does the creek rise high enough to naturally flow into the cave via its shaft entrance. The proposed Seco Creek Dam project would include the excavation of a floodwater diversion channel to significantly increase the frequency and magnitude of floodwater recharge into the cave. The cave itself is essentially a 44 m deep shaft into a large passage that had been explored for about 600 m. In the downstream direction, into the Edwards Aquifer, the cave "ends" in a deep sump (the passage actually continues, but a "sump" is where it has completely filled with water). A more detailed description of the cave is provided by Reddell in Appendix A.

Following the announcement of the EUWD's plans, considerable controvery arose as to the feasibility and impact of the recharge structures. The hydrologic questions raised included: could the cave accept and transmit the projected amounts of recharge or would it fill up? and, would the cave silt-up with subsequent flooding, thus diminishing its recharge capacity? The most heated issues, however, concerned the cave's biology. The cave housed a very rich, varied and unique cave fauna. Would the flooding harm the cave's ecosystem?

Two investigations were made, in 1977, to address these concerns. Weldon W. Hammond made a hydrogeologic assessment of the cave and concluded, based on the physical character of the cave, past observations of flooding, and regional and local hydrogeology, that the cave could sustain and transmit large magnitude recharge (Appendix B). The second investigation was made by Glenn Longley on the cave's biology. Longley concluded that the cave life would not only suffer minimal adverse affects by the flooding, but would actually benefit from the additional organic material (food) washed into the cave (Appendix C). In a series of letters to the EUWD, Samuel Sweet, whose Ph.D dissertation examined the Texas cave salamanders -- including those in Valdina Farms Sinkhole -- hotly contested Longley's conclusions.

After considerable deliberations the EUWD decided to proceed with the Seco Creek project. The plans were finalized in 1981, and the dam and channel were completed in late 1982 (Appendix D, photo #1-11). Since that time several small recharge events occurred, but none were of adequate magnitude to challenge the conclusions of Hammond, Longley or Sweet, until May of 1987. During that flood more than 6.5 cubic meter/second (19 acre-feet/hour) of recharge was recorded by the EUWD and peak recharge was believed to be much higher. The flooding lasted from 28 May to 16 July. On 5 December, 1987, George Veni and Associates, under contract with the EUWD, entered Valdina Farms Sinkhole to evaluate the impact of the flood on the cave and its ecosystem.

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Hydrogeology

Regional

Valdina Farms Sinkhole is located in western Medina County, Texas, within the Balcones Fault Zone and the recharge zone of the Edwards Aquifer. The Edwards recharge zone is defined as that area within the fault zone where the Edwards Limestone (or equivalent units) outcrop on the surface and allow infiltration of surface water into the groundwater system. The Edwards is a highly productive and transmissive artesian karst aquifer. Groundwater flow within the Edwards is generally west to east, paralleling the Balcones Fault Zone, extending from as far west as Brackettville, Texas, and discharging at various springs to the east in San Antonio, New Braunfels and San Marcos, Texas.

Flow within the Edwards Aquifer is complex due to its nature as a karstic aquifer, but also due to stratigraphic and structural factors. East of the Valdina area, in Bexar County, the Edwards Limestone Group is divided into 8 subdivisions based on lithology and the effects of lithology on groundwater movement (Maclay and Small, 1984). The nature of groundwater movement in a particular area depends upon which unit the water is flowing in or around. The extensive Balcones faulting often juxtaposes units of different flow characters thus resulting in extremely nonheterogeous and anisotropic flow patterns.

The Miocene-age Balcones faulting is predominantly en echelon with the downthrown side towards the Gulf Coastal Plain. In Medina County, individual fault displacement ranges to more than 200 m. Beds within the fault blocks are relatively horizontal and otherwise undeformed. With the successive faulting the Edwards Limestone is moved into the subsurface and is overlain by younger, Tertiary-age, sediments. These deposits occlude upward groundwater movement, thus defining the artesian zone of the Edwards Aquifer. Artesian springflow is along faults that breach these overlaying units.

Karst features in the Edwards recharge zone can be described, relative to most other karst regions, as submature, and somewhat atypical and anomalous. While not quite as well developed as some of the classic karst areas, such as that in Central Kentucky around Mammoth Cave National Park, the Edwards karst is submature because it is well developed hydrologically, but not to the point of allowing extensive human physical access for study. Of the studies that have been done, based on physical access (e.g. Veni, 1986), it has been demonstrated that significant groundwater movement and recharge occurs through atypical features not generally present in many karst regions (although the majority of recharge occurs via the more common features like sinkholes, swallets, etc.). Ongoing studies also indicate that groundwater movement may be anomalous, in places, as conduit flow possibly converts to honeycomb flow and then back to conduit flow.

In spite of these variances from the general concept of karst, the Edwards Aquifer still adheres to the basic karstic principles of complex flow networks, and of rapid and unfiltered transmission of surface water into and through the groundwater system. One particular portion of the Edwards system that has been poorly studied is the paraphreatic, or water table, zone of the aquifer, including the shallow phreatic zone. Valdina Farms Sinkhole offers an excellent opportunity to examine this zone, which is seldom easily accessible through other Edwards caves.

Valdina Farms Sinkhole

The entrance to Valdina Farms Sinkhole is a 10 m diameter by 44 m deep vertical shaft, situated 3 m above the bed of Seco Creek in the 100-year floodplain (Appendix D, photo #13-15). This area is within a narrow band of the Edwards Aquifer recharge zone, within a fault block bounded by the Woodward Cave (old name for Valdina Farms Sinkhole) Fault, 420 m upstream, north, of the cave, and a major parallel fault 1.7 km downstream, south, of the cave. Displacement along the faults is 60 and 90 m, respectively.

The Woodward Cave Fault juxtaposes the upper member of the Glen Rose Formation with the Devils River Limestone (westward Edwards Limestone facies equivalent). The upper Glen Rose is generally noncavernous and impermeable, comprised of interbedded marls, limestones, shales and dolomites. In normal stratigraphic sequence, the upper Glen Rose underlies the Devils River/Edwards Limestone and forms the lower occlusive boundary of the Edwards Aquifer. It has been observed throughout Bexar, Comal and Medina Counties, however, that the upper portion of the upper Glen Rose has a marly limestone facies that can develop extensive cavernous permeability. Natural Bridge Caverns, in Comal County, is probably the best example.

This investigator has found several locations where surface water enters the upper member of the Glen Rose and crosses the interformational boundary into the Edwards. This phenomenon is probably also occurring along the Woodward Cave Fault near Valdina Farms Sinkhole. Personnel from the EUWD have identified significant cave and sinkhole recharge sites in the upper Glen Rose near the Woodward Cave Fault (however, these have not yet been located on a topographic map; Figure 4-1 illustrates the location of the fault relative to other karst features). These sites have often absorbed all of the flow of Seco Creek and prevented flow further downstream towards the cave. Scott Harden, a member of the investigative team, has observed the main passage of Valdina Farms Sinkhole to be flooded at such times, thus supporting the thesis that some Edwards recharge originates in the upper Glen Rose.

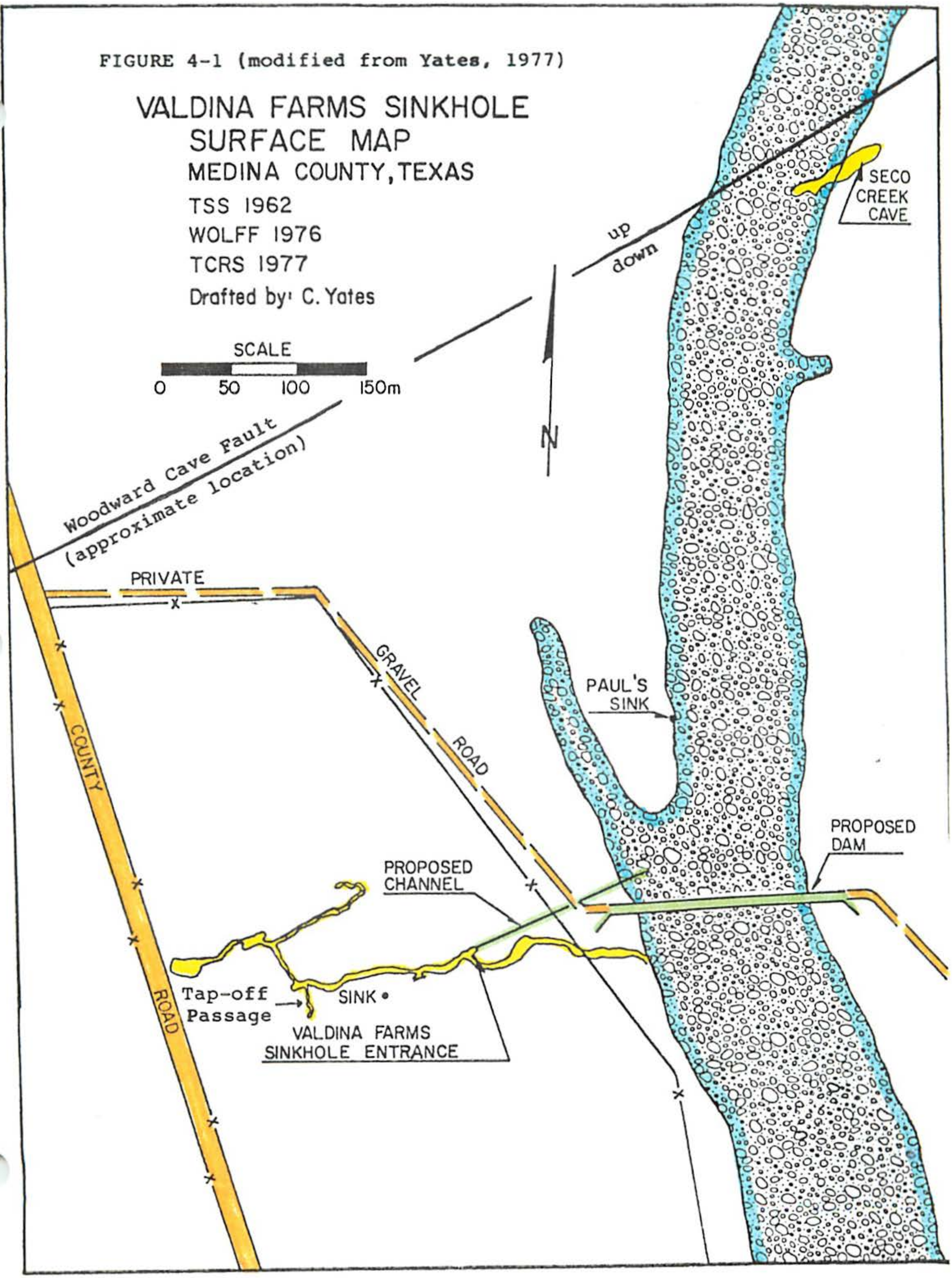
The main passage of Valdina Farms Sinkhole runs along regional strike at a N75E trending. The upstream portion of the cave, however, changes to a N50E trend at a passage junction. The main passage heads WSW from the junction and a side passage heads NE. The side passage is a muddy tube averaging 1.2 m in diameter (Appendix D, photo #21-22). It has been surveyed more than 100 m and explored approximately another 100 m without reaching an end. Given the trending of this passage, it probably drains a portion of Seco Creek, including the upper Glen Rose. On 5 December, 1987, the side passage was estimated to have a base flow of approximately 8 liters/minute (2 gallons/minute).

Upstream of the junction from the side passage, the main passage had an estimated base flow of 24 l/m (6 g/m), on 5 December, 1987, and averaged 2 m high by 3 m wide (Appendix D, photo #19). This passage has been surveyed and explored for 76 m to a large room. Collapse from the room blocks off most of the passage, and dams its water thus sumping its upstream continuation (Appendix D, photo #16). The drainage area for this passage is undetermined, but given its size and trending, it may pirate water from as far as the upper Glen Rose along Little Seco Creek 2.8 km to the west (Figure 4-2). Well-rounded stream gravel, found throughout this passage, support the hypothesis for a distant source area of recharge (Appendix D, photo #18).

Conduit groundwater flow from the upstream portion of the cave converges at the juncture of the main and side passage, flows into a 30 m long pool (Appendix D, photo #23), then down a small crawlway passage (cave map, Appendix A). Figure 4-1 shows 25 m of survey into the crawl, which is trending down-dip -- perpendicular to the trend of the main passage. The crawl is probably what is known as a "tap-off" passage, meaning a small passage that "taps-off" water from one large conduit into another. The purpose of this flow diversion is to adjust the gradient of the underground stream for more efficient transmission. The location and proximity of the other large conduit can only be speculated upon without further investigation, but its existance is quite probable because it is very unlikely the crawl would have formed without it.

In the downstream direction of Valdina Farms Sinkhole,

FIGURE 4-1 (modified from Yates, 1977)



exploration generally stops at the sump (Appendix D, photo #38-46). The elevation of the sump is 314.5 m (1Ø32 ft). Based on water well records for that area, Holt (1959) and Maclay and Small (1984) find the water table to vary between 292.6 and 277.4 m (96Ø and 91Ø ft) above mean sea level. The sump, therefore, is perched water and does not reflect the true water table which is 12 to 37 m deeper. The average cave-stream gradient, as mapped thus far, is 1:7.6. This figure is probably anomalously high due to debris from the entrance which helps dam and raise upstream water levels. If the gradient is correct and remains constant, the cave should reach the water table after 91 to 281 m further downstream in the main passage.

The potentiometric map of Maclay and Small (1984) show a gentle groundwater trough, trending to the southwest, in the vicinity of the cave. Present groundwater circulation in northern Medina County flows southwest, to bypass a major fault barrier in the east-central part of the county, before turning to flow east. This flow pattern is not reflected in the known portion of Valdina Farms Sinkhole. Maclay (1987) postulates that the fault barrier is a relatively recent change within the aquifer. It is probable that the diffuse flow portion of the aquifer, upon which most water well and potentiometric data are based, reflect this recent change but the major conduits, like Valdina Farms Sinkhole, continue to transmit water along their well established flow paths. The tapoff passage in the cave could reflect an early conduit expression of this diversion of flow.

Valdina Farms Sinkhole is formed in the lower half of the Devils River Limestone. It developed as part of an integrated network of phreatic conduits for the transmission of water into and through the Edwards Aquifer. The cave reflects a period in the earlier history of the aquifer when groundwater in that area traveled along strike, east-west, through high transmissivity conduits. The decline in the water table resulted in ceiling collapse in certain areas (Appendix D, photo #16 & 24), subsequent damming of conduit groundwaters (photo #16 & 24), and some deposition of calcite speleothems (photo #31). The cave's entrance developed along a joint intersection, where some upper level chambers had formed and extended to the surface. When the cave breached the surface, its entrance was rapidly enlarged by flooding along Seco Creek. The flooding also deposited large amounts of sediment, gravel and cobbles throughout the cave. Some water in the cave has recently been pirated to more effecient flow paths, possibly related to recently developed fault barriers in the Edwards Aquifer.

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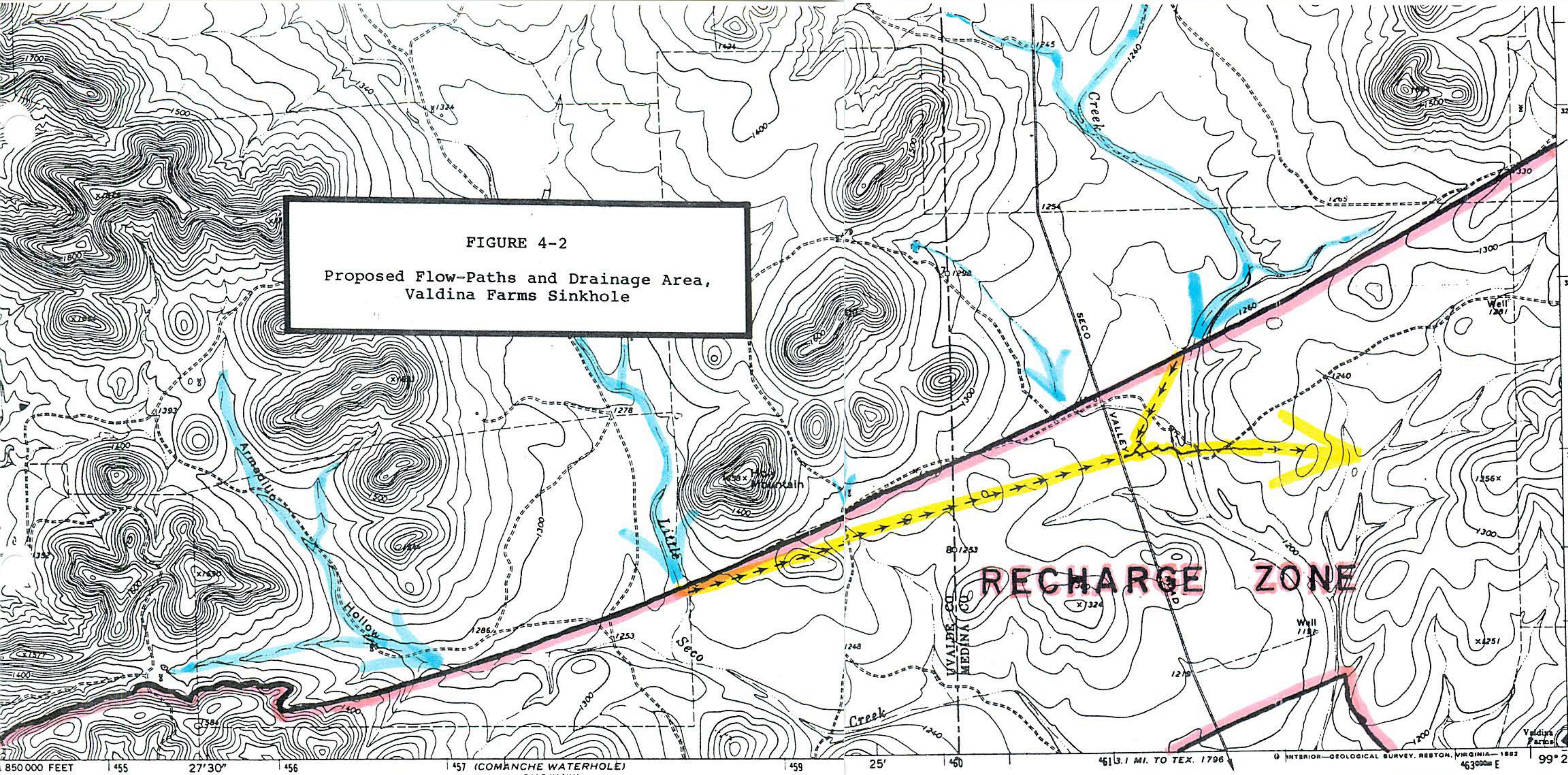

FIGURE 4-2

Proposed Flow-Paths and Drainage Area, Valdina Farms Sinkhole

(SABINAL NE)
6142 IV NE

SCALE 1:24 000

1 ½ 0 1 MILE

1000 0 1000 2000 3000 4000 5000 6000 7000 FEET

1 .5 0 1 KILOMETER

CONTOUR INTERVAL 20 FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1929

GN MN
0°13' 4 MILS
9¼° 169 MILS

...D AND 1969 MAGNETIC NORTH
...ATION AT CENTER OF SHEET

THIS MAP COMPLIES WITH NATIONAL MAP ACCURACY STANDARDS
FOR SALE BY U. S. GEOLOGICAL SURVEY, DENVER, COLORADO 80225, OR RESTON, VIRGINIA 22092
A FOLDER DESCRIBING TOPOGRAPHIC MAPS AND SYMBOLS IS AVAILABLE ON REQUEST

ROAD CLASSIFICATION

Secondary highway, all weather, hard surface

Light-duty road, all weather, improved surface

Unimproved road, fair or dry weather

State Route

Flatrock Crossing '82 RZB
TX MAP NO.: 69-29 COUNTY: YP-TD

THE REPRESENTATION OF THE EDWARDS UNDERGROUND WATER DISTRICT AND EDWARDS AQUIFER RECHARGE ZONE, WHILE COMPLILED FROM THE BEST AVAILABLE SOURCES, IS NOT NECESSARILY AUTHORITATIVE FOR ALL PURPOSES. FOR MORE INFORMATION CONTACT THE EUWD AT 1615 N. ST. MARYS, SAN ANTONIO, TX 78212 OR 1(800)292-1047.

FLATROCK CROSSING, TEX.

N2930—W9922.5/7.5

1969

DMA 6143 III SW—SERIES V882

Cave Ecology

Biologists hold a common fascination and desire to find varieties of flora or fauna that have never been previously found or described. The best places to find such varieties have been in restricted or isolated habitat where competition from foreign species is minimal. Islands have always been attractive as one such habitat, and, more recently, caves have been recognized as another.

Caves, or groups of caves, are virtual ecologic islands where species are isolated by geology, topography, and an inability to survive outside the cave environment, thus restricting travel from one cave to another. Evolution within a particular cave can therefore produce animals quite different from even neighboring caves in response to whatever unique conditions may exist there.

Due to the lack of sunlight for photosynthesis, most cave-life belongs to the animal kingdom, although some molds, bacteria and fungi have been identified. Yet sunlight poses the first and most significant impact on the evolution of the cave ecosystem. Sunlight, through photosynthesis, produces the greatest source of food energy on the planet. By lacking sunlight the cave ecosystem is thus very energy poor -- a condition well reflected by its fauna in adapting for survival.

Most cave fauna originate from species that have either: A) adapted to cave life after having been washed-in, or otherwise restricted to a cave; or B) adapted through gradual increasing use of a cave for food or shelter. Yet because of the lesser food energy available underground, these animals had to physically adapt to a less energy-consuming life cycle. The majority of cavernicoles (cave animals) are invertebrates, such as insects, which do not require the large amounts of food-energy consumed by most vertebrate animals. Although there are many differing views on how cavernicoles have adapted to the cave environment, most theorists agree that conservation of energy plays a major role. For example, eyes and pigment are not needed and therefore, neither is the energy to produce them. And although it is commonly said that the antennae of cavernicoles have elongated to feel around in the darkness, it can also be said that it is more energy efficient for an insect to move long antennae, and locate itself, rather than to move its entire body.

Cave fauna are classed into four basic types depending upon degree of adaption and on the importance of the cave relative to their life-cycle. The types are:

Accidentals: animals which have fallen, been washed into or otherwise entered the cave, but which cannot survive or reproduce there.

Trogloxenes: animals which habitually inhabit caves, but must regularly return to the surface for food or other necessities. Bats, cave crickets and harvestmen ("daddy-long-legs") are the most common.

Troglophiles: animals which can complete their entire life-cycles either on the surface or in a cave.

Troglobites: animals adapted to complete their entire life-cycles only in caves. Although some troglophiles may only be found in caves, they lack the obligate physical adaptations to restrict them there as is the case with troglobites. Troglobites are usually characterized by loss or reduction of eyes and pigment, and the elongation, reduction and development of certain appendages (or apparati) to better facilitate life and survival in a totally dark, energy-poor environment.

Valdina Farms Sinkhole

prepared by James R. Reddell*

Valdina Farms Sinkhole was first proven to be of biological interest by the discovery of a large population of bats, which included three species: the Mexican freetailed bat, *Tadarida brasiliensis mexicana* (Saussure), the Mexican brown bat, *Myotis velifer incautus* (Allen), and the leafchin bat, *Mormoops megalophylla megalophylla* Peters. The colony of the leafchin bat is of special interest in that the only other colonies in Texas are in Haby Bat Cave, Medina County; Frio Bat Cave, Uvalde County; and Webb Cave, Kinney County. The bats of Valdina Farms Sinkhole were first studied in 1957 (Raun and Baker, 1959). The discovery of a neotenic salamander, described in 1957 as *Eurycea troglodytes* (Baker, 1957), further increased interest in the cave.

The first study of invertebrates in the cave was made on 12 January, 1964, when an extensive collection was made by Keith Garrett, David McKenzie, John Porter and James Reddell. This collection included several species of interest, such as undescribed species of troglobitic asellid isopod, spider, harvestman, earwiglike entotroph, and pselaphid beetle. A second collection, on 20 March, 1971, by Tony Mollhagen, James Reddell and Suzanne Wiley, added a few more species to the cave's faunal list. The next study of the biology of Valdina Farms Sinkhole was made on 12-13 November 1977 by Dr. Glenn Longley, from San Marcos, to specifically address the impact of the proposed recharge dam at the cave. His study added a few species,

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*Texas Memorial Museum, 2400 Trinity, Austin, Texas 78705.

notably fish and frogs, to the known cave fauna, and concluded the dam would probably not have a significant adverse impact on the fauna. The most recent pre-flood study of the cave was made by Scott J. Harden on 9 December, 1984. At that time he found most of the species previously recorded and added records for the aquatic troglobitic isopod Cirolanides texensis Benedict, and the troglobitic amphipod Stygobromus russelli (Holsinger).

These previous collections have provided an excellent background for a study of the impact of massive artificial flooding on the cavernicole fauna. The only collection made in the cave since the major 1987 floods is that connected with this investigation. On 5 December, 1987, three highly competent collectors (Allan Cobb, Andy G. Grubbs and Scott J. Harden) made a lengthy study of the fauna. Their previous experiences in the cave, especially Harden's, add to the credibility of the results presented in Section 7 of this report.

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Post-Flood Exploration and Survey

The intense 1987 flooding of Valdina Farms Sinkhole raised the question, "had any new passages washed open?" The intent of the 5 December, 1987, investigation, in the exploration and survey of the cave, was to identify any such areas and explore/survey them as time and circumstances allowed. Because the most hydrologically interesting part of the cave is its downstream section, towards the Edwards Aquifer, most efforts were concentrated on this area to push the sump and/or find an air-filled bypass for it. The areas of new exploration and survey for the trip were: a new stream passage, domes downstream towards the sump, and the sump itself.

New Stream Passage

Noted at position 2 on Figure 6-1, a new passage was found to be washed open (Appendix D, photo #25). It headed south from the main passage and intersected an east-west trending passage. This E-W passage carried a small stream, and the rearrangement of the surrounding rock cobbles indicated a large volume of high velocity water had moved down it. The passage had been previously noted (Harden 1972) to extend only 3 m to cobble fill. Since the 1987 flood, however, the passage was open and it was explored more than 10 m without reaching an end. The passage is a cobble-floored stream crawlway that runs parallel to the main passage.

Downstream Domes

Longley's biologic report (Appendix C) noted two domes with unexplored passages at the top. These domes were located in the downstream section of the cave between the pool and the sump. The survey team, which concentrated on finding a bypass to the downstream sump, carried an aluminum extension ladder into the cave to explore the domes (Appendix D, photo #36). The results are illustrated in Figure 6-1, position 3.

Of the two domes, the eastmost was 6 m high and the passage at the top was accessible by the ladder. The passage led up another 5 m into a passage which extended 8.5 m west to the other dome. The passage continued west, off the far side of that dome, but could not be reached. However, extending off this passage, between the two domes, was another passage that continued upwards. After mapping 20 m of very muddy cave, averaging 1 m high by 1.5 m wide, the passage gained another 6 m in elevation and opened into a large (and also very muddy) room. The room was surveyed (measures 20 m x 10 m x 18 m high) and checked for offgoing passages, but everything that was accessible did not go far and was added to the map.

The two passages extending from the room that remain unexplored were unreachable by the survey team. One passage is 5 m up the eastmost wall of the room, and the other is a dome in the ceiling, 18 m directly above the floor. This dome contributes significant recharge to the cave, as indicated by a large plunge-pool and the washed-down organic debris underneath it.

Downstream Sumps 1 & 2

Harden (1972) described an attempt to SCUBA dive the downstream sump of Valdina Farms Sinkhole in 1970. The sump was penetrated for 50 m without reaching air. During the 5 December, 1987, investigation the sump was again dove (Appendix D, photo #38-46) and, after an estimated 100 m, the air-filled continuation of the stream passage was reached. This passage was followed for approximately 340 m to Sump 2, and increased the cave's total length by about 60%.

A rough sketch of the passage, beyond Sump 1, is included in Figure 6-1 (position 4). The passage averaged 3 m high by 5 m wide. A couple infeeding passages were found, but there was not enough time to determine if they were truely separate passages, or water from the main passage cutting through and around sediment banks to reappear downstream. Between Sump 1 and Sump 2 the cave gained only 1 to 1.5 m of additional depth. Sump 2 was probed to see if it could be passed without SCUBA, but no such option was discovered.

Conclusions

Early explorations in Valdina Farms Sinkhole were hampered by techniques and technologies which did not allow cavers to function for long periods of time in cold wet places. With the advent of more sophisticated and rugged lighting and vertical exploration systems, the use of wetsuits, and with tremendous advances in cave diving, much of the cave is more easily accessible for exploration, survey and study.

Prior to this investigation the cave had a surveyed length of 625 m and an explored length of 775 m. This investigation raised those figures to 677 and 1175 m, respectively. Having completed the broad-based reconnaisance of the cave, in December, 1987, further investigations should significantly increase its explored length, and rapidly match the surveyed length to it.

As for the areas examined, the new stream passage requires further exploration. The stream may be pirated flow from the tap-off passage (Figure 6-1, position 1) and may eventually feed into the downstream pools and sumps, but it could also turn south and tap-off water down-dip. The later choice seems most probable. The passage carries a large volume of water, during floods, and if it fed into one of the known downstream pools, its entry would probably be obvious. Although there are a couple of infeeders in the newly explored area between Sumps 1 and 2, they do not appear to be of appropriate magnitude for the new stream. Post-flood slumping of sediment banks, where these infeeders discharge into the main passage, however, could result in false impressions of their true flow capacities.

The exploration of the downstream domes is essentially complete. They showed no indication of bypassing Sump 1, or of leading to extensive, infeeding, passages. Instead, the domes led to short passages that extended upwards into other domes and fractures to the surface. Exploration of dome passages not reached by the December, 1987, survey team would probably not yield any significant new discoveries or understanding of the cave. The extensive dome development in that area is due to the proximity of Seco Creek. The domes were formed by water following solutionally enlarged fractures down to the main cave stream passage.

Preliminary estimates show that Sump 1 is located under the bed of Seco Creek. This is a curious phenomenon which this investigator has noted in other areas, and has proposed the following explanation. The relative high and low points within a cave passage are often the result of collapse. The passage extends upwards where collapse has occurred and remains relatively lower where it has not occurred. Collapse is a function of the rock's structural stability. Where the passage is water-filled, considerable buoyant support is lent to the cave ceiling, stability is increased, and collapse is uncommon. The area underneath a water-loosing streambed is a groundwater high. As the regional water table declines, the last place for a free-air surface to develop in a cave passage is under the streambed. Meanwhile, collapse could have occurred both upstream and downstream, in the cave passage, effectively damming the water in that location (under the streambed) to maintain the sump and thus prevent further collapse.

Exploration beyond Sump 1 indicated that the cave is lessening its gradient and may extend much further horizontally, before reaching the true water table, than was tentatively projected earlier in this report. If the new, or actual, gradient is about 1:300 as estimated, then the water table may not be reached for another 3,300 to 11,100 m. The infeeding passages require further exploration, as does Sump 2, to better understand and evaluate the cave. Due to the broad scope of work covered during the December, 1987, investigation, there was insufficient time to survey the passage beyond Sump 1. This needs to be accomplished in order to lessen estimates and speculations as to the cave's character.

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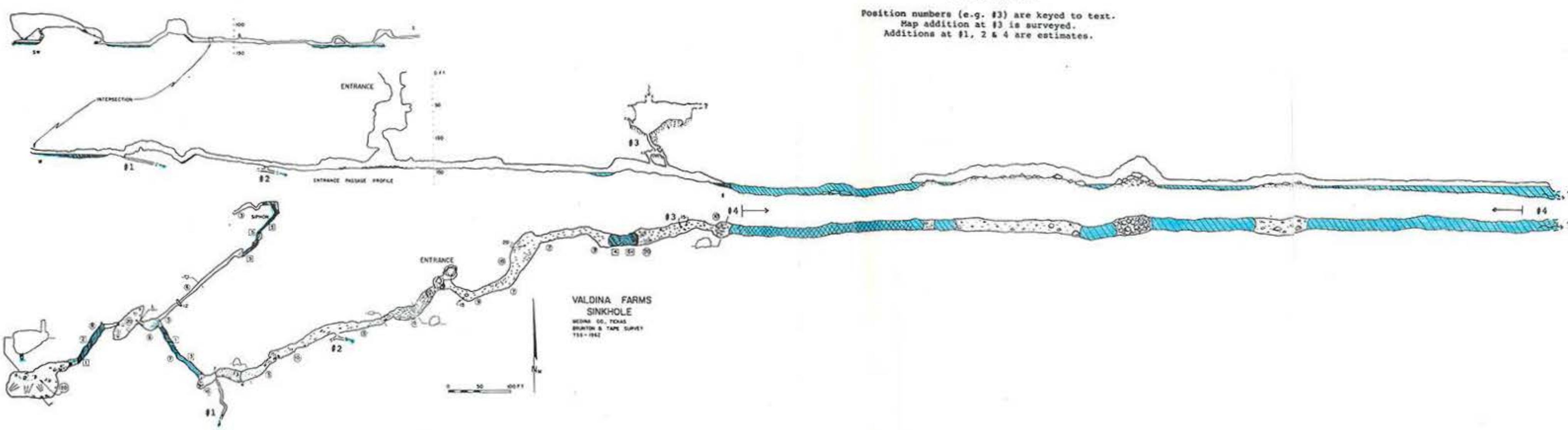

FIGURE 6-1

Nev Explorations and Survey in Valdina Farms Sinkhole,
5 December, 1987

Position numbers (e.g. #3) are keyed to text.
Map addition at #3 is surveyed.
Additions at #1, 2 & 4 are estimates.

Post-Flood Biologic Evaluation

prepared by James R. Reddell*

The Cave Fauna

Following is a complete list of the fauna which has been observed or collected from Valdina Farms Sinkhole. Whenever possible I have indicated the area in the cave from which the specimens were collected. These localities are coded by site as marked on Figure 7-1. The numbers for pools are identical with those used by Longley (1977). Elsewhere in this report and in the literature, Pools A, B and F are respectively referred to as the Guano Pool, Salamander Pool and Sump 1. Additionally, Areas 1-4 have been referred to as the downstream area, upstream area, upstream side passage, and the main upstream passage. A complete and concise listing of the cave's fauna is presented in Figure 7-2.

Earthworms

Undetermined material

Several earthworms were obtained in 1987 from the large upstream room (Area 4).

Snails

Undetermined material

Several as yet undetermined empty shells of terrestrial snails were found in 1987. They certainly washed in the cave.

Physa sp.

This is a common genus of aquatic snail. Its presence in 1964 and 1977 indicates that it is a troglophile. It was not found in 1987.

Copepods

Macrocyclops albidus (Jurine)

This copepod is an important member of the aquatic fauna of streams and pools on the surface. It has also been recorded from most caves examined for copepods. It was collected in several places in Valdina Farms Sinkhole in 1964. Although not found in 1987, a more extensive

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FIGURE 7-2

Systematic List of the Cave Fauna of Valdina Farms Sinkhole

Phylum Annelida
  Class Oligochaeta (earthworms) (troglophile?)
    Undetermined material
Phylum Mollusca
  Class Gastropoda
    Undetermined material
    Order Basommatophora
      Family Physidae
        Physa sp. (aquatic snails) (troglophile)
Phylum Arthropoda
  Class Crustacea
    Order Cyclopoida (copepods)
      Family Cyclopidae
        Macrocyclops albidus (Jurine) (troglophile)
        Paracyclops fimbriatus poppei (Rehberg) (troglophile)
    Order Podocopida (ostracods)
      Family Candoniidae
        Candona n.sp. nr. *stagnalis* Sars (troglobite)
    Order Amphipoda
      Family Crangonyctidae
        Stygobromus russelli (Holsinger) (troglobite)
    Order Isopoda (pillbugs and water slaters)
      Family Asellidae (water slaters)
        Lirceolus pilus (Steeves) (troglobite)
      Family Cirolanidae
        Cirolanides texensis Benedict (troglobite)
      Family Trichoniscidae
        Brackenridgia reddelli (Vandel) (troglobite)
    Order Decapoda
      Family Cambaridae (crayfish) (accidental)
  Class Arachnida
    Order Araneae (spiders)
      Family Agelenidae
        Cicurina n.sp. (troglobite)
        Cicurina varians Gertsch and Mulaik (troglophile)
      Family Nesticidae
        Eidmannella pallida (Emerton) (troglophile)
      Family Theridiidae
        Achaearanea porteri (Banks) (troglophile)
    Order Pseudoscorpionida (pseudoscorpions)
      Family Chernetidae
        Neoallochernes sp. (troglophile)
    Order Acarina (mites)
      Undetermined material (aquatic and terrestrial troglophiles)

FIGURE 7-2 continued

Order Opiliones (harvestmen)
Family Phalangodidae
Hoplobunus madlae Goodnight and Goodnight (troglobite)
Hoplobunus russelli Goodnight and Goodnight (troglobite)
Class Chilopoda (centipedes)
Order Lithobiomorpha
Undetermined material (troglophile)
Order Scutigeromorpha
Undetermined material (troglophile)
Class Diplopoda
Order Julida
Family Parajulidae
Gosiulus conformatus Chamberlin (accidental)
Class Insecta
Order Collembola (springtails)
Undetermined material (troglophile)
Order Entotrophi
Family Iapygidae (earwiglike entotrophs)
Undescribed genus and species (troglobite)
Order Thysanura
Family Nicoletiidae (cave silverfish)
Texoreddellia texensis (Ulrich) (troglobite)
Order Saltatoria
Family Rhaphidophoridae (cave crickets)
Ceuthophilus (Geotettix) cunicularis Hubbell (trogloxene)
Order Hemiptera
Family Gerridae (water strider bugs)
Undetermined genus and species (accidental)
Family Thyreocoridae (negro bugs)
Galgupha sp. (accidental)
Order Coleoptera
Family Carabidae (ground beetles)
Undetermined genus and species 1 (accidental)
Undetermined genus and species 2 (accidental)
Rhadine howdeni (Barr and Lawrence) (troglophile)
Tachys sp. (troglophile)
Family Histeridae (clown beetles)
Carcinops pumilio (Erichson) (troglophile)
Family Noteridae (burrowing water beetles)
Notomicrus sp. (accidental)
Family Pselaphidae
Hamotus n.sp. (troglophile)
Order Diptera
Undetermined material (gnats) (troglophile)
Family Streblidae (bat flies)
Trichobius major Coquillett (bat parasite)

FIGURE 7-2 continued

Phylum Chordata
  Class Teleostomi
    Order Cypriniformes
      Family Characidae
        Astyanax mexicanus (Filippi)
    Order Siluriformes
      Family Ictaluridae
        Undetermined genus and species (catfish) (accidental)
        Ictalurus furcatus (LeSueur) (blue catfish) (accidental)
        Ictalurus natalis (LeSueur) (yellow bullhead) (accidental)
    Order Perciformes
      Family Centrarchidae
        Chaenobryttus coronarius (Bartram) (warmouth sunfish) (accidental)
        Lepomis macrochirus Rafinesque (bluegill sunfish) (accidental)
  Class Amphibia
    Order Anura
      Family Bufonidae
        Bufo valliceps Wiegmann (Gulf Coast toad) (accidental?)
      Family Hylidae
        Hyla versicolor LeConte (accidental)
      Family Microhylidae
        Gastrophryne olivacea (Hallowell) (Great Plains narrow-mouthed toad) (accidental)
      Family Ranidae
        Rana berlandieri Baird (leopard frog) (accidental?)
  Class Mammalia
    Order Chiroptera
      Family Molossidae
        Tadarida brasiliensis mexicana (Saussure) (Mexican freetailed bat) (trogloxene)
      Family Mormoopidae
        Mormoops megalophylla megalophylla Peters (leafchin bat) (trogloxene)
      Family Vespertilionidae
        Myotis velifer incautus (Allen) (Mexican brown bat) (trogloxene)

search for it would probably find some specimens.

Paracyclops fimbriatus poppei (Rehberg)

This copepod is also an abundant member of both epigean and cavernicole waters. Although collected in 1964, it could not be found in 1987.

Ostracods

Candona n.sp. nr. stagnalis Sars

This eyeless ostracod has been found in a few caves in Central Texas. It was collected in 1964, but could not be found in 1987.

Amphipods

Stygobromus russelli (Holsinger)

This troglobitic amphipod has been found in Texas caves from Uvalde County east to San Antonio, and north to Bell and Coryell Counties. It was first discovered in the cave in 1984 by Scott J. Harden but could not be found in 1987.

Isopods

Lirceolus pilus (Steeves)

This species of troglobitic water slater was first discovered in Valdina Farms Sinkhole in 1964. It was also found in 1971 amd 1984, but was apparently not present in 1987. It has only been collected from the small stream feeding Pool B. This species is only known from Valdina Farms Sinkhole (Steeves, 1968).

Cirolanides texensis Benedict

This troglobitic aquatic isopod was first found in Valdina Farms Sinkhole in 1984, and was not found in 1987. The species is widespread in the caves of the Edwards Plateau.

Brackenridgia reddelli (Vandel)

This troglobitic terrestrial isopod was found in 1964, 1971 and 1984; it could be found in all parts of the cave, being particularly abundant in areas of organic debris. Its absence in 1987 is particularly notable. The species occurs in many caves in the central part of the Edwards Plateau.

Crayfish

Cambaridae genus and species
A single crayfish was seen in Pool F during the dive by SCUBA, but could not be captured. It certainly washed into the cave.

Spiders

Cicurina n.sp.
This blind species remains undescribed. It was found under rocks in Area 2 in 1964. It was not found in 1987.

Cicurina varians Gertsch and Mulaik
This troglophilic species occurs in caves throughout Texas. It was collected in Area 2 in 1964 and was also found in 1971. It was not found in 1987.

Eidmannella pallida (Emerton)
This spider is a troglophile found in many caves throughout North and Central America. It was found in Area 2 in 1964 but was not found in 1987.

Achaeranae porteri (Banks)
This is a widespread troglophilic spider first collected in Area 2 in 1964. It was not found in 1987.

Pseudoscorpions

Neoallochernes sp.
This pseudoscorpion genus has been collected in many Texas caves but specific determination must await a revision of the genus. It was collected in bat guano in Area 1 in 1964. It was not found in 1987.

Opilionids

Hoplobunus madlae Goodnight and Goodnight
This troglobitic harvestman was first collected in the cave in 1984. It is a widespread species throughout the Edwards Plateau. It was not found in 1987.

Hoplobunus russelli Goodnight and Goodnight
This troglobitic harvestman, collected in the cave in 1964, was first reported by Goodnight and Goodnight (1967). It was found on mud banks in Area 3. It is otherwise known only from two caves near Del Rio, Val Verde County, and the identity of this material is questionable since it was not found in 1984 when *H. madlae* was collected.

Mites

Undetermined material

A single aquatic mite was collected in 1987. It is certainly an accidental. Specimens collected in 1964 appeared to be troglobitic, but remain unstudied.

Centipedes

Order Lithobiomorpha

Undetermined troglophilic centipedes belonging to this order were found in 1964 in Area 1. No centipedes were found in 1987.

Order Scutigeromorpha

This undetermined troglophilic centipede was collected in 1984. It was not found in 1987.

Millipedes

Gosiulus conformatus Chamberlin

Millipedes belonging to this species were found in 1964 at the bottom of the first entrance drop and are certainly accidentals.

Springtails

Undetermined material

Springtails were abundant on all earlier trips into the cave but the identity of the material in not known. Few springtails were observed in 1987.

Entotrophs

Iapygidae genus and species

This primitive insect is a troglobitic species apparently belonging to an undescribed genus. It was found in 1971 in Area 3. The species may be endemic to Valdina Farms Sinkhole. It was not found in 1987.

Silverfish

Texoreddellia texensis (Ulrich)

This troglobitic silverfish was found in Area 3 in 1964. It was also collected in 1971, but could not be found in 1987. The species ranges widely across the Edwards Plateau.

Cave Crickets

Ceuthophilus (Geotettix) cunicularis Hubbell

This cave cricket is found in caves throughout the Edwards Plateau. It was found in all parts of the cave in 1964 and on later trips, but only two specimens could be found in 1987.

True bugs

Gerridae genus and species

Immature water strider bugs, not further identifiable, were found on the surface of the pool below the entrance drop. These are certainly accidentals.

Galgupha sp.

This genus of negro bug was represented by immature specimens, doubtless washed into the cave.

Beetles

Carabidae genus and species 1

An unidentified epigean ground beetle was apparently abundant in Areas 1 and 2. It has not been previously recorded from the cave and is presumably an accidental introduced to the cave by the 1987 flood.

Carabidae genus and species 2

A second unidentified ground beetle was collected in Area 2 in 1987. It is certainly an accidental and has not been previously found in the cave.

Rhadine howdeni (Barr and Lawrence)

This troglophilic beetle is widely distributed in caves of the Edwards Plateau; it has not been recorded from the surface. It was found in 1964 throughout the cave, but was particularly abundant in Area 2. It also was collected in 1971 and 1984 but could not be found in 1987.

Tachys sp.

This small troglophilic ground beetle has been found throughout the cave on all trips. In 1987 it was found in Area 4. The genus is widely distributed in caves throughout Texas.

Carcinops pumilio (Erichson)

This species of clown beetle was abundant in bat guano in Area 1 in 1964 and 1971. It is presumably a troglophile.

Notomicrus sp.

This burrowing water beetle was only collected in 1984 and is certainly an accidental.

Hamotus sp.

An undescribed species of antloving beetle, belonging to this rare genus, was found in Area 2 of the cave in 1964. It was not found in 1987.

Flies

Undetermined material

Gnats have been collected in the cave, but remain unstudied.

Trichobius major Coquillett

This batfly, usually a parasite of *Myotis velifer*, was collected during the course of earlier studies on the cave's bat fauna.

Fish

Ictaluridae genus and species

Undetermined catfish, all in good condition, were seen in Pools A, B, C and F in Valdina Farms Sinkhole in 1987.

Ictalurus furcatus (LeSueur)

Three large blue catfish (approximately 1500 gm, 500 gm and 125 gm) were seen in the cave in 1987, one of which was in Pool B. They all appeared to be well-fed.

Ictalurus natalis (LeSueur)

Yellow bullfish catfish were first observed in Valdina Farms Sinkhole by Glenn Longley in 1977. At that time he found a 5-cm long individual in Pool A, a 13-15 cm long individual in Pool B, and an 18 cm individual in Pool F. The absence of salamanders in the cave on that date may have been due to the presence of these fishes in the cave. A yellow bullhead was also observed in the cave in 1987. They appeared to be well-fed.

Gambusia sp.

Two undetermined fish of this genus were seen in the cave in 1987. They were thin.

Astyanax mexicanus (Filippi)

Three Mexican tetras were found in the cave in 1987. They were thin and apparently poorly nourished.

Chaenobryttus coronarius (Bartram)

What may have been a warmouth sunfish was seen in Pool F in the cave in 1987. It appeared to be in fair shape.

Lepomis macrochirus Rafinesque

Bluegills were seen in Pool F in the cave in 1987. They appeared to be in fair shape.

Salamanders

Eurycea troglodytes Baker

The Valdina Farms salamander was first described from the cave in 1957. It was collected on several occasions after that date, but could not be found by Longley in 1977 and was absent from the cave in 1987. On both of those occasions catfish were present in the cave and may have eaten the salamanders in the accessible pools. Sweet (1984) has demonstrated that the species described as Eurycea troglodytes is actually a hybrid swarm between Eurycea neotenes and Eurycea tridentifera Mitchell and Reddell.

Frogs

Bufo valliceps Wiegmann

The Gulf Coast toad is frequently found in cave entrance areas. It was found in 1964, 1971 and 1987.

Hyla versicolor LeConte

This frog is not usually found in caves. It was observed in the cave in 1977, but had certainly fallen or been washed in.

Gastrophryne olivacea (Hallowell)

The Great Plains narrow-mouthed toad is occasionally found in the entrance area of caves. It was found in 1964 and 1977.

Rana berlandieri Baird

This leopard frog was found in the cave in 1977. A 1964 record of Rana pipiens from the cave almost certainly refers to this species. Numerous frogs probably belonging to this species were found in 1987.

Bats

Tadarida brasiliensis mexicana (Saussure)

The Mexican freetail bat is usually present in caves in vast numbers. A population estimated in the tens of thousands has been reported for Valdina Farms Sinkhole. This is a migratory species and none were present when the cave was investigated in January 1957 or November 1977. On 9 February, 1957, several thousand Tadarida were present in the cave, indicating an unusually early return for their spring migration to Texas.

Mormoops megalophylla megalophylla Peters

The leafchin bat was first reported for Valdina Farms Sinkhole on 26 January, 1957, when several hundred individuals were noted. They have been noted to roost in the cave as late as May.

Myotis velifer incautus (Allen)

The Mexican brown bat has been observed in the cave throughout the year, with the largest concentration being in the spring when thousands are present. In May, 1957, large numbers were present, including young, indicating that this is a significant maternity colony. On 31 January, 1959, G.G. Raun and F.E. Potter, Jr., found thousands of dead Myotis in an inner room of the cave. They speculated that disease was the cause of the deaths, but considering that the cave was known to flood it is possible that this was caused by sudden flooding. Only a few Myotis were in the cave during Longley's, 1977, investigation, and only a couple were seen in 1987.

Conclusions

Valdina Farms Sinkhole possessed an unusual and distinctive cave fauna, containing as it did both significant populations of vertebrates and invertebrates, totaling more than 40 recorded species. Collections from 1964 to 1984 all contained significant numbers of both terrestrial and aquatic invertebrates. The 1987 collection included only a few earthworms, a few empty snail shells, one aquatic mite, two cave crickets, two epigean species of carabid beetle, and only a single troglophilic carabid beetle. This indicates that the fauna of the cave was completely decimated by the massive 1987 flood. No aquatic species, other than the fish and the mite, were observed in the cave.

The cave has certainly always been subject to flooding during heavy periods of rainfall, and at times as much as 12 m of water has been observed inside. At this time catfish and invertebrates doubtless wash into the cave. The presence of a few catfish in 1977 probably explains Longley's inability to find salamanders at that time, but it is unlikely that in the absence of considerable food input, via direct surface floods, catfish would survive. They were not seen in 1984 indicating they had died in the interim. The large numbers of fish washed into the cave in the 1987 flood almost certainly accounts for the total decimation of the endemic aquatic fauna.

It is somewhat harder to account for the total absence of native terrestrial troglobite and troglophile species. Most terrestrial troglobites can survive total immersion for days; in other cases they retreat into narrow crevices and upper levels to escape flooding. One cave used as a recharge site, Indian Creek Cave in Uvalde County, has retained its rich terrestrial fauna despite periodic catastrophic flooding. In the case of Indian Creek Cave, however, upper levels do not flood and thus there remains a fauna capable of repopulating the cave. Also Indian Creek Cave drains very rapidly and has never been known to stay immersed for more than a few days, probably not long enough to drown the terrestrial fauna. In the case of Valdina Farms Sinkhole, however, the hydrostatic pressure and complete immersion of the cave for weeks at a time doubtless eliminated all animals which might have inhabited or fled into crevices away from the large open passages, as well as drowned those which might have survived a short-term flood.

The effect of the 1987 floods on the bat population is unknown. There was essentially no evidence of recent habitation of the cave by bats. The absence of dead bats in the cave, unlike in 1959, cannot tell us whether the flooding killed bats or simply drove them away. Certainly the bats were present at the time of the flooding, but without knowing the time of day or the extent of the initial flooding it is not possible to speculate on the fate of the bats in the cave at that time. So prolonged was the flooding that any 1987 colonization may have been prevented entirely and only a few strays entered the cave since the flood receded. It will be important to examine the cave in 1988 to see if they again make use of the cave.

It will be of great interest to make periodic inspections of Valdina Farms Sinkhole to determine if the absence of the cave fauna is a permanent state or merely a temporary phenomenon. Certainly other caves in the area contain many, if not all, of these species and it will be of greatest interest to see if migration back into the cave system occurs. As tragic as the loss of this important cave is, it can still be of value to use the cave as a natural laboratory to determine the effects of such floods and to tell us much about the affects of such projects on the subterranean ecosystem.

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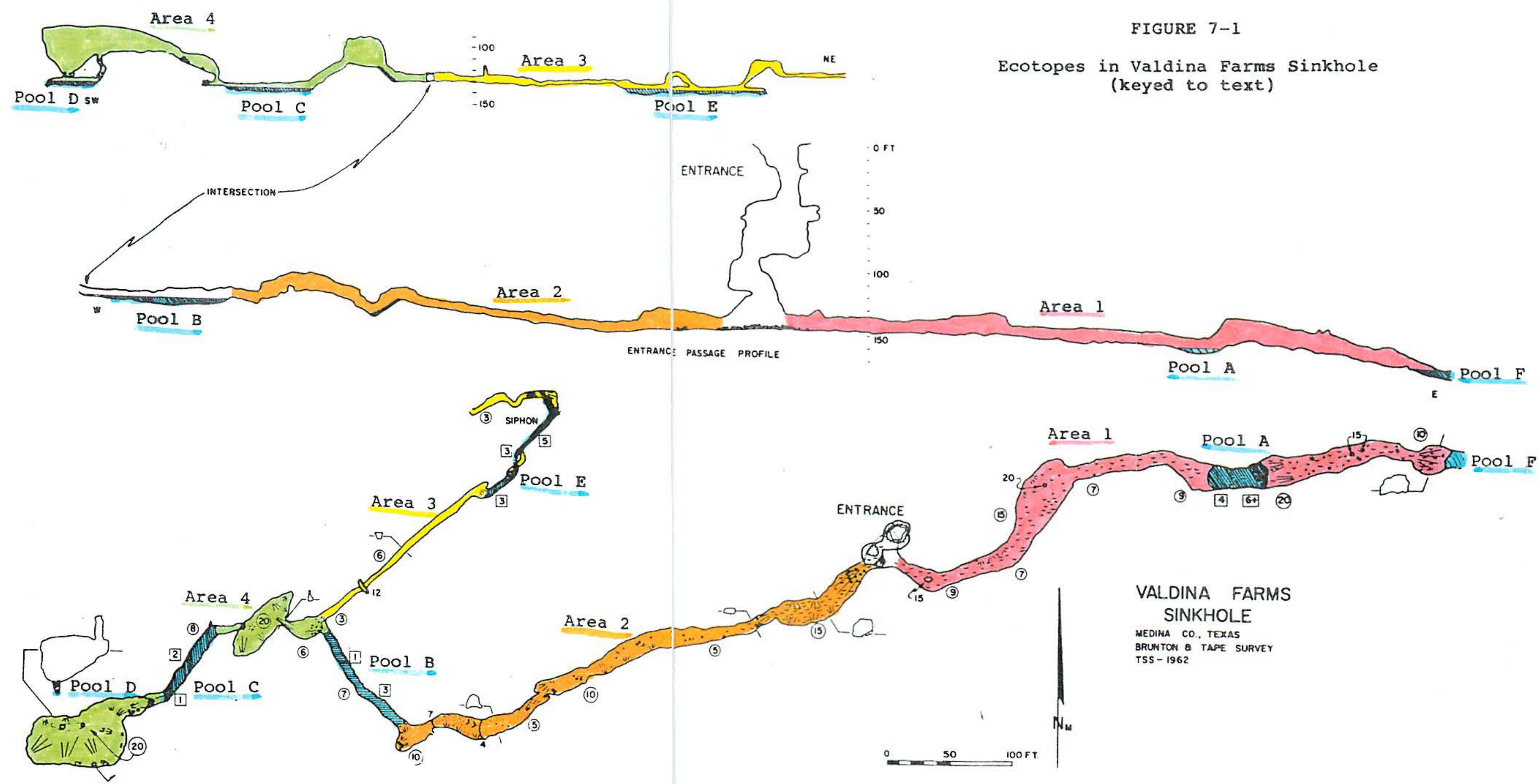
FIGURE 7-1

Ecotopes in Valdina Farms Sinkhole
(keyed to text)



Post-Flood Hydrogeologic Evaluation

The 5 December, 1987, hydrogeologic evaluation of Valdina Farms Sinkhole examined the pre- and postexisting, local and regional, hydrogeologic conditions, morphology, structure and stratigraphy of the cave network.

Bedrock Alterations

Changes in the bedrock morphology of the cave, due to the flooding, were found in the entrance pit. Prior to the flood the shaft walls were a rough, pitted, gray limestone. The high velocity and volume of water that swirled down the pit, however, smoothed the walls and stripped off the gray patina (Appendix D, photo #14). The most significant changes occurred along a ledge 5 m down the pit (1.5 m below the base of the diversion channel), and at the spillway from the channel into the pit. Prior to the flood the 5 m long ledge was less than a meter wide. Since the flood the ledge has widened to more than 2 m (Appendix D, photo #14-15). The change at the spillway is a rounding of the edge, from a sharp drop-off to a steep slope, into the pit (Appendix D, photo #12).

Sedimentology

Prior to the 1987 flood, the floor of Valdina Farms Sinkhole had a variable sediment cover. In the far upstream areas, flow velocity was low and ponding was common after natural flooding. Mud and silt coated the floors and walls of the upstream passages, sometimes exceeding thicknesses of more than 2 m. In contrast, the areas downstream of the entrance, due to occasional flooding through the shaft, the steeper passage gradient and the subsequent lack of ponding, lacked thick covers of mud or silt, although the guano was everpresent and constantly replenished. As far as could be determined, a gravel-cobble matrix was present throughout the cave under the mud, silt and guano deposits.

Upon entering the cave, after the 1987 flood, the first and most obvious change in the cave was the absense of the thick layers and piles of bat guano that once covered the floor (Appendix D, photo #27-28). All the guano had been flushed down the cave and into the Edwards Aquifer. In both the upstream and downstream directions of the cave, mud was scoured off the underlaying cobbles and gravel (Appendix D, photo #18, 20, 25, 27-32, 34, 35 & 37), and was replaced by a thin gray-brown layer of organic silt (photo #17, 22 & 37).

At the explored upstream end of the main passage, the only remaining pre-flood mud and silts were found high on passage walls (Appendix D, photo #19) and in the upper level room (photo #16). Mud on the floor was removed, and scoured gravel channels indicate high velocity flow existed (Appendix D, photo #18). No evidence of high velocity flow conditions were found in the upstream, NE trending, side passage.

Cut and slumped sediment banks, in the large upstream room, exposed well stratified sedimentary deposits of alternating clays and silts (Appendix D, photo #17-18). One such exposure was over 2 m high. A detailed study of these sediments would probably yield important data on the history and evolution of the cave and the Edwards Aquifer, ? as well producing important paleoclimatic data for the region. Caves are often the only places that valuable data of this type can be found.

Closer to the entrance, 30 m west or upstream, the main passage diminishes in size from over 7 m high to 1 m high. Prior to the flood this low ceiling height persisted for only 6 m before rising to at least 1.5 m high. Presently, the passage is 1 m high for about 60 m. A cone of rock scree, that used to be at the base of the entrance pit, has been leveled and the rocks have been pushed both upstream and downstream into the main passage.

Downstream from the entrance most of the mud deposits and all of the guano have been removed. Large banks of gravel and cobbles have been cut and channeled (Appendix D, photo #27-32, 34, 35, 37). Beyond Sump 1 a few large tree limbs were found, but there was no other evidence of either the severe flooding or the massive volumes of sediment and guano that were transported down it. The gray-brown layer of organic silt, which persisted throughout the rest of the cave and ranged in thickness from 1 mm to several centimeters, was largely absent beyond the sump. The passage had an orange-red hue from a clay coating. The clay can be found under the organic silt elsewhere in the cave, and is the weathering product of the limestone (Appendix D, photo #17-18).

Hydrology

No significant changes were observed in the hydrologic character of Valdina Farms Sinkhole as a result of the intense flooding of 1987. The downstream portion of the cave was washed clean, as expected, but the upstream portion of the cave was also highly transmissive as evidensed by organic and inorganic debris (branches, leaves, beer cans, etc.) jammed throughout the passage in the upstream direction of flow (Appendix D, photo #17).

The cave was able to sustain a recharge rate of more than 3.8 to 6.7 cubic meters/second (11.24 to 19.43 acre-feet/hour) for several weeks, its capacity being exceeded only briefly when its entrance overflowed, proving its capacity and competency as a significant point recharge site. Although the suspended sediment load of the recharge is higher than what naturally flowed into the cave, there was no indication that the cave is silting-up. However, the continued use of a grate at the cave, to prevent tree limbs and other debris from entering, will substantially help prevent it from becoming clogged.

Conclusions

The few changes in the cave's bedrock morphology occurred in the entrance shaft, where the floodwater's erosive powers were greatest. Portions of the shaft will continue to enlarge with time and the spillway will grade to a gentler angle, but these changes will not occur as rapidly as the initial alterations. During the first flood, the majority of the scoured and removed bedrock was weathered and was not as structurally sound as the bedrock currently exposed. Significant changes of the bedrock within the cave were not observed and are not expected.

Similarly, changes in the sedimentary deposits within the cave are in accord with such large scale flooding. Further changes, after subsequent floods, are expected but should not be as great in their individual magnitudes.

Based on the observed morphologic changes and other discussed indications, the following hydrologic scheme is hypothesized for Valdina Farms Sinkhole. Of the two upstream passages, the NE side passage contributes relatively little inflow to the cave. The inflow that does occur is obstructed by extensive clay/mud deposits. Although no significant changes were observed, it is possible that subsequent floods could remove more of the clay and increase that passage's permeability.

The upstream end of the main passage, in contrast to the side passage, has a tremendous groundwater capacity. Large volumes of water from the entrance flowed up this passage and were latter discharged from it at high rates. The portion of the discharge which was natural recharge through that passage cannot be determined without further data.

Most of the sediment-bank scouring occurred during the initial flood pulse at peak flow velocities. Water-filled and flood recessional conditions are not as likely to move large volumes of sediments, and, if they had, it is probable that some of those sediments would have been deposited in the passage beyond Sump 1. The depositional pattern of the buoyant organic silt also indicates lower flow velocities. The silt was deposited during flood recession. The fact that the silt was essentially not present past Sump 1 indicates that the flow velocities could not transport it there.

The observed portion of the Valdina Farms Sinkhole shows no indication that it cannot continue to transmit large volumes of recharge like the 1987 flood. However, it is important to stress that the explored portion of the cave may not be representitive of conditions elsewhere, where significant siltation may or may not be occurring. Additionally, the cave was originally projected to have an estimated maximum recharge rate of 73.6 cubic meters/second (214.9 acre-feet/hour) (Richardson, 1977), but peak recharge, prior to the cave's overflowing, could not be determined due to inadequate gauging equipment.

In spite of the above undetermined aspects of Valdina Farms Sinkhole's hydrologic performance, currently it has demonstrated a regional impact on recharging the Edwards Aquifer. Nearby water wells along Seco Creek (TD-69-38-6Ø1) and Highway 187 (YP-69-37-4Ø2), monitored by the EUWD, show a prolonged elevated recessional hydrograph due to the groundwater mound created by the cave. Compiled records up through October, 1987, 4 months after the flood, show water levels still rising in those wells. Another well, located 8 km to the WSW, was reported to pump turbid water for the first time in its history when the cave was in flood. Such information is useful, and is a first step, in delineating the cave's conduit and diffuse flow paths into the aquifer.

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Recommendations

Exploration and Survey

Hydrogeologic assessments are traditionally accomplished by use of "remote sensing" methods. The term "remote semsing" is usually reserved for techniques like aerial photography, but is applicable here because data and conditions are gathered and interpreted from a distance, and not by direct observation. In karst areas, especially where large and extensive caves like Valdina Farms Sinkhole are accessible, direct observations of hydrogeologic conditions are possible.

The continued exploration and survey of Valdina Farms Sinkhole is vital to the cave's continued study and flood-impact evaluation. The work-effort to benefit ratio greatly supports this assertion. Exploration eliminates the speculation of remote sensing methods on things like: precise delineation of conduit flow paths, assessment of conduit morphology, biologic and hydrologic evaluation of flood/man-made impacts, determination of aquifer development from morphologic and sedimentologic indicators, etc. Direct observations through exploration and survey can yield otherwise unobtainable information -- information which transcends an understanding of the cave into a better understanding of the aquifer. Where possible, it is often more efficient for exploration to preceed remote sensing methods.

Based on the above premises and the results of this evaluation, the following recommendations are made (in order of importance) for the continued exploration and survey of Valdina Farms Sinkhole:

1) Continued exploration and survey of the downstream sumps.

2) Exploration and survey of the main upstream passage. This can be accomplished by either finding an air-filled bypass to the upstream sump, excavating to lower the dam causing the sump, or by use of SCUBA to dive through it.

3) Continued exploration and survey of the upstream side passage.

4) Continued exploration and survey of the new stream passage.

5) Exploration and survey of Seco Creek Cave, a probable infeeder to Valdina Farms Sinkhole.

6) Assess and survey nearby sinkholes and the cave under a grate just upstream of the recharge dam.

Biology

The biologic evaluation of the impact of increased flooding of Valdina Farms Sinkhole cannot be solely made on the comparison of prior studies to the findings of one post-flood investigation. Although the cave life has apparently been decimated, the cave may be repopulated by the migration of species from other caves in the surrounding area. The study of any such migrations would not only fully answer the questions of the flood impacts and yield very interesting information about cave ecosystems throughout the aquifer region, but it could also provide useful data on the hydrogeology of the aquifer in that area. The returning species and their rates of migration may provide new insight on how the aquifer functions and was affected by the flooding of the cave.

In order to adequately address the initial question of how was the cave ecosystem affected by the 1987 flood, the following recommendations are made:

1) Schedule one trip for April, 1988, to observe the fauna for:
   a) die-off of the catfish;
   b) repopulation of terrestrial and aquatic cavernicoles;
   c) return of the *Myotis* bat maternity colony; and
   d) for base-line data, for comparison, in case the cave floods in May or June.

2) Schedule a trip circa September, 1988, with the same objectives as #1, regardless if the cave has flooded or not, to monitor any changes.

3) Schedule a trip for the winter of 1988-89, as with #1 & 2, except to also see if the *Mormoops* bat colony returns.

4) Repeat the above three-trip per year schedule through 1989. Depending upon future flooding or migration data, the schedule may need to be extended, or altered for further or fewer observations.

Hydrogeology

As a recharge site of regional impact and importance to the Edwards Aquifer, the following recommendations are made to delineate Valdina Farms Sinkhole's upstream drainage area, its downstream range of influence, and the continued assessment of flooding on both.

1) **Dye tracing:** the injection of non-toxic substances into the groundwater to not only trace its flow, but to determine its velocity, volume, and capacity for dispersion and dilution, from one location to another. Recommended sites to be traced to Valdina Farms Sinkhole are:
   a) selected caves and sinkholes along Seco Creek;
   b) selected caves and sinkholes along Little Seco Creek;
   c) selected areas along the Woodward Cave Fault.

   Recommended traces to begin at Valdina Farms Sinkhole are to:
   a) water wells which yielded turbid water while the cave was in flood;
   b) water wells along strike, in the direction of flow for the cave's main passage;
   c) water wells down-dip from the cave which may be receiving water from the tap-off passage.

2) Increased and improved flow monitoring of the cave.
   a) The current equipment in place along the diversion channel only measures stage height and does not adequately measure channel discharge.
   b) There is no monitoring of how the cave is responding to the increased recharge. Two monitoring wells should be placed into the cave, one upstream and one downstream of the entrance to measure conduit flow conditions during non-flood, as well as flood, periods. The upstream well would also monitor the impact of floods that do not flow in through the cave's entrance.
   c) Increase the number of monitoring wells in the region of the cave from 2 to 4 to better define and increase understanding of cave and aquifer hydrology in that area.

3) The time is probably past for this, but water wells down-gradient of the cave should have been tested for increased nitrate levels. Increased levels would have been due to the bat guano flushed into the aquifer by the flooding. Should a substantially large bat population take residence again in the cave, however, and deposit a considerable amount of guano before the next flood, the EUWD should be prepared to test for nitrates ASAP after the flood. Several tests should be run per well to diminish the possiblity of having tested too early or too late. Results from any dye tracings would be useful in selecting which specific wells would be best to monitor.

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VALDINA FARMS SINKHOLE (DONAHOE CAVE) (WOODARD CAVE) (VALDINA SINK) (VAL VERDE FARMS SINK HOLE) Medina County (#19)

Tarpley 15' Quadrangle

Owner: Robert Woodward

Description: The entrance to the cave lies along the gently sloping side of a hill a short distance from and above Seco Creek. During heavy rains some water runs into the cave. The entrance at the top is about 50 feet in diameter and drops in stair-step fashion to a point where it is 30 feet in diameter. Here a drop of 90 feet occurs. About 50 feet down the drop enlarges to form a room about 40 feet in diameter. A pool up to 4 feet deep lies at the bottom of the drop. About 20 feet from the entrance drop a second drop occurs. This is 60 feet deep and drops to one side of a southeast-northwest trending passage floored with guano and breakdown. To the east the passage extends as a 7 to 20 foot high passage for about 325 feet where a guano slope leads down into a 4 to 6+ deep pool of guano and water. During the summer when the bats are present this part of the cave is extremely unpleasant with flies present by the thousands and a high concentration of ammonia. It is possible to cross this pool by clinging to small formations and projections along the wall. On the opposite side of the pool a 20 foot high dome room is found in which a colony of bats reside. About 200 feet beyond the room a second deep pool occurs. This pool, however, is over six feet deep and clearance is so low along the sides as to force the explorer to remain in the middle of the passage where a ceiling slot provides a small breathing space. Lack of flotation gear on the mapping and subsequent trips to the cave has prevented exploration of this promising passage. From the entrance a guano-floored passage extends upstream for about 400 feet to a 4 foot high ledge. On the opposite side of this ledge vertical drops of 5 and 7 feet occur. Shortly beyond the 7 foot drop a pool of 1 to 3 foot deep water is encountered. This water is beyond the bat colony and is, therefore, comparatively clear. It is inhabited by blind salamanders. The pool is about 100 feet long and is fed by two small streams which emerge from two passages encountered at the end of the pool. To the left a tiny stream is followed up a small slope where it emerges from gravel. Beyond this point a steep slope leads up into an oval-shaped room about 70 feet long, 20 feet wide, and 20 feet high. On the opposite side from the entrance to the room a pit drops steeply down into a low stream passage with 1 to 2 feet of water and much mud. This passage ends in breakdown, from which the stream emerges, but immediately before its end a dome rises through unstable breakdown into one end of the largest room in the cave. This room is about 100 feet long, 40 feet wide, and 20 feet high. Pits in the floor of the room drop to stream level but the stream here siphons. No other passages leave the room. To the right at the junction a 3 foot in diameter muddy crawl leads for about 50 feet to a 12 foot high dome and from here along an alternating walking and crawling passage for about 250 feet to a slope down into the stream. The floor here is of deep sticky mud which rapidly covers everything completely. About 50 feet of stream passage lead to a point where it is necessary to climb from the stream and up a steep mud slope for about 10 feet. After a few feet a drop leads back down into the stream. After 60 additional feet of of mud-and-water passage another siphon at stream level occurs and it is again necessary to climb a steep difficult slope coated with soupy mud. There is about two feet of mud at the bottom of this slope. On the opposite side of this slope a shallower drop leads to a muddy crawl which extends about 50 feet before a third difficult mud slope is encountered. It is not possible to climb back up the other side of this slope so a rope is required. Almost immediately on the other side of this 20 foot drop a higher, steeper slope rises as an all but impossible slope. Here mud pitons or step-cutting equipment is badly needed. On the other side of this slope a 40 to 60 foot deep drop occurs which requires equipment and has not been entered. A long tie-off or expansion bolt will be necessary. (See map, page 46)

History: The earliest history of Valdina Farms Sinkhole is not known, but an early description and account of exploration in the cave is given by Phillips (1901) who writes, "The opening into the cave is on a slight rise about 30 feet above Secos Creek 200 yards from it. A huge funnel-shaped depression, 100 feet in diameter at the surface, leads down into the cave proper. The first bench is at a depth of 100 feet from the rim of the funnel, the floor then slopes 6 feet in 25 feet and at this point there is another vertical descent for 54 feet making the total depth from the rim of the funnel to the permanent floor 160 feet... The general shape of the shaft, hewn out of limestone by the action of water and air, is that of an enormous funnel set in the mouth of a bottle of very irregular shape. At its narrowest part, the neck of the bottle, the diameter is 12 feet, and so numerous are the bats in this cave that it requires three hours for them to emerge through it. One of my companions, who attempted to enumerate the number of bats, finally gave it up and threw his paper and pencil down, saying his arithmetic had 'gin out.' The cave has been entered by several different persons, but no guano has ever been removed from it, and it is now leased by Messrs. Maxwell & Thaxton, Austin, who propose to work it, hauling the material to D'Hanis, 16 miles, and shipping over the Southern Pacific Railway. The cave is now difficult of access. The only means of getting down into it is by rope, and when one swings clear of the projecting ledges and begins to spin around like a top, with the blue sky above and the brown rocks beneath, he realizes the uncertainty of life. I made two trips down, first on a rope, to see what arrangements could be made for a comfortable descent, and then on a ladder, which we constructed of 3/4-inch manila rope and mesquit-rungs. A great poet has said that a certain descent was easy but the return trip was laborious. He referred to an unmentionable place but might have had this cave in his mind. On the first trip I spun around at the end of the rope until I was glad to land even upon a skunk whose defunct body was in perfect harmony with his malodorous life. It was a large place into which he had fallen, but he filled it completely and could have filled several acres. There was another one 60 feet lower, and together they made a pair hard to beat. What they left to be desired in the way of odor was more than supplied by the bats... It is difficult to estimate the amount of guano in a place such as this. The floor is of irregular shape, and many large fragments of stone that have dropped from the roof are to be met with, besides smaller pieces that have become imbedded in the mass. What appears to be a bed of guano of considerable thickness is found, on investigation, to be a layer of from 1 to 6 inches in thickness covering the rock. A few feet from this point the guano may be 4 or 5 feet deep, completely filling the depressions in the floor. In some places it is banked up in mounds, or spread out evenly on the floor, where it is comparatively level. One can walk for 1,000 feet without stepping off from the guano, and can wade in it up to his knees. Most of the material in this cave is dry, but towards the northeast end it becomes soft and is evidently of more recent origin. When the bats become tired of one roosting place they go to another. Some of the smaller chambers opening out from the main cavern do not seem to have been used by the bats at all, for there is no guano in them nor any indication that they were ever used by the bats." A careful cross section and rough plan of the cave are included in this same report. The cave was next investigated by Dr. Lytle Adams during Project X-Ray. In November and agin on December 5, 1943, one of his assistants, Jack C. Couffer, entered the cave and made a collection of the old man bat, Mormoops megalophylla megalophylla. Patrick J. White next visited the cave at some time prior to 1948, but was unable to negotiate the last 20 feet of the entrance drop because of lack of equipment. A water sample was taken on June 1, 1952, and was analyzed by the Texas Board of Water Engineers. Unfortunately nothing is known of the history of guano mining in the cave, but it is doubted that any extensive mining was ever conducted. The remains of cables, ladders, and an elevator are scattered in and about the cave entrance. The first recent trip to the cave was made on January 25, 1957, when a group from the University of Texas Grotto visited it. This group was made up of James K. Baker, Dr. Richard Davis, Dave Hannah, Charles Whiteman, and Bill Helmer. A second trip, consisting of Baker, Helmer, Davis, Larry Littlefield, Fred Berner, Dave Kyser, and Kip Herreid, was made to the cave on February 9, 1957. Helmer's account of these trips is not generally available and so is partially reprinted here. "Only about 1000 feet of the cave was explored on the first trip to the cave by Baker, Davis, Hannah, Whiteman and Helmer, due to lack of time. At that time it was found to consist primarily of two oppositely directed passages averaging about 10 x 10, both of which developed into water tunnels. This part of the cave was wet and muddy, with a great deal of guano. Some crawling and climbing between muddy breakdown was necessary. A second trip returned to completely explore the cave during the first week of February. Baker, Helmer, Dr. Davis, Larry Littlefield, Fred Berner, Dave Kyser and Kip Herreid made the trip. Herreid is a graduate student from Johns Hopkins University working with Dr. Davis in his bat studies. The exploration began after the exhausting 150 foot climb into the cave was completed, but soon bogged down. After wading through waist deep water, the spelunkers found themselves in a series of small-diameter tunnels, some half-filled with water, and all deep in thick red rubber cement resembling red clay. Several hours were spent in covering around 600 feet and the exploration was finally abandoned, again due to lack of time, without finding any sign of an end to either the cave or the mud." (Helmer, 1957) A third trip to the cave was made in May 1957. Floyd E. Potter, Jr., visited the cave early in January 1959, and agin with Gerald G. Raun on January 31, 1959. On this last trip observations on a mass die-off of bats were made. Probably in 1960 Dr. Bassett Maguire of the University of Texas visited the cave and collected ostracods for use in physiological experiments. The cave was mapped by James Reddell, David McKenzie, and Terry Raines in 1964. On January 12, 1964, James Reddell, Keith Garrett, John Porter, and David McKenzie visited the cave and made a series of biological collections. In 1966 and 1967 a few additional trips have been made to the cave by various members of the University of Texas Grotto and by the staff of Texas Technological College. These trips have included ones by Bill Russell, Keith Garrett, James P. Bogart, and Robert W. Mitchell. It should be pointed out here that permission to enter the cave is restricted to people known by the owner to be interested in conducted scientific research and must be obtained in advance.

Hydrology: An analysis of water taken from the cave has been made and is as follows:

Silica	13	B	0.18
Iron	--	Total dissolved solids	610
Calcium	152	Hardness as $CaCO_3$	408
Magnesium	7.0	F	---
K + Na	14	NO_3	212
HCO_3	269	%Na	7
SO_4	33	pH	7.5
Cl	8.0		

The cave water is double calcium, a little low in Mg, about triple K + Na, average in HCO_3, 2 to 3 times SO_4, average Cl, 40 times NO_3, 2½ times total dissolved solids, double hardness of average "Edwards" water in the vicinity of the cave. This indicates that the sample was taken from the guano pool.

Biology: Valdina Farms Sinkhole contains an exceptionally rich and varied fauna. Its possession of a large bat colony and a complex of bat-free stream passages provides a diversity of habitat not to be found in any of the other large bat caves. The fauna associated with the bat colony is essentially unstudied and careful summer collections will double the faunal list. The invertebrate fauna includes several troglobites of interest, including new species of spider and opilionid. The troglophilic pselaphid beetle, Hamotus sp., is of interest in that there are only two described species in the United States and this appears to represent a new species. What may be troglobitic aquatic mites have also been taken in the guano pool, but these remain unstudied. Dr. Bassett Maguire (1960, 1961) has studied the ostracod, Candona sp., and has found that it will die within a few days if exposed to a flux of visible light of an intensity of about 1/20th of normal daylight. This is one of the few physiological experiments which have ever been conducted on a Texas cave animal. The only other invertebrate study in the cave is the collection by Reddell, McKenzie, Garrett, and Porter. There are, on the other hand, rather careful observations available on the bat colony. Three species of bat have been found in the cave: Myotis velifer incautus, Mormoops megalophylla megalophylla, and Tadarida brasiliensis mexicana. The following observations have been made by Raun and Baker (1958). "At Valdina Farms Mormoops is found in close association with Tadarida mexicana and Myotis velifer. The Mormoops colony is the smallest of the three. The colony of Mexican free-tails numbers in the tens of thousands, Myotis in the thousands and Mormoops only in the hundreds. On January 26, 1957 Mormoops was the only colony present except for a few scattered individuals of Myotis. A few days later however, on February 9, several hundred Myotis and several thousand Tadarida were present. This shows an early return of Tadarida and Myotis on their spring migration back into Texas... The three colonies of bats in Valdina Farms Sinkhole do not appear to intermingle. They all utilize the one and only entrance and of necessity pass through each others roosting chambers in their flights. However, the roosting chambers are seemingly quite distinct. Tadarida inhabits a large, high-vaulted chamber just interior to the twilight zone. Mormoops inhabits a smaller, domed, inner chamber of some 30 to 40 yards in length, 10 yards in width and 4 yards in height. This is separated from the outer Tadarida chamber by a narrow passageway. Myotis inhbbits a third chamber still deeper in the cave, and is again separated from the Mormoops chamber. This inner chamber is somewhat wider and longer but little higher than the chamber occupied by Mormoops." Raun (1960) reports on a mass die-off of the little brown bat in the cave. "On January 31, 1959, the author, accompanied by Mr. Floyd E. Potter, Jr., made a descent into the Valdina Farms Sinkhole in northwestern Medina County, Texas. Mr. Potter had been in the cave some three weeks before and had noticed the presence of large numbers of dead bats... There were no live bats present on this occasion. In an inner chamber of the cave, where there had been an active nursery colony of Myotis in 1957, we found a large number of mummified remains hanging on the walls in the natural position of roosting bats. The remains were recognizable as Myotis velifer but were not in condition for laboratory analysis. A count of the number of remains found hanging on 25 square feet of the wall and a rough extrapolation of the area where remains were visible indicated the presence of more than 500 dead bats. Additional remains, mostly skeletal fragments, were found in profusion on the floor and piled in crevices. Water flows through the cave on occasion, and in each place where there would be an eddy, there were piles of bones. The number of dead bats must have been several times the above estimate, perhaps reaching several thousand. There is no way of knowing what caused the mass die-off. The remains probably have been in the cave since the preceding summer. Disease seems to be the most reasonable answer." Davis, Herreid, and Short (1962) estimated that the population in 1957 totalled four million individuals. The most interesting member of the fauna of Valdina Farms Sinkhole is the blind neotenic salamander, Eurycea troglodytes Baker. This species was discovered in the cave in 1957 by James K. Baker, who subsequently described it as new. It is especially significant in representing an intermediate form between E. latitans and E. rathbuni. Of its habitat, Baker (1957) writes, "Most of the salamanders observed in the sinkhole inhabited a crystal clear pool of water approximately three feet deep, five feet wide, and 90 feet long; the holotype and most of the paratypes came from this pool. Although the pool is clear, the bottom is covered by several inches of silt and guano, and dead bats are sparsely scattered throughout the water. The food source for the salamanders could not be determined, as no other living organisms on which they could feed were visible in the water. (Stomach contents could not be used as captured specimens were not preserved for several days after capture.) It was noted, however, that the salamanders inhabited only those pools containing guano. Enormous flights of bats pass over some of the pools in the sinkhole, and their droppings and/or decaying dead are evidently utilized as food material by the salamanders, either directly or indirectly." This species has been more recently studied by Wake (1967) and by Bogart (1967). A faunal list of all species taken in the cave follows:

Snails
- *Physa* sp. -- troglophile; from pool at bottom of entrance drop

Ostracods
- *Candona* sp., nr. *stagnalis* Sars -- troglobite; abundant in guano pool

Copepods
- *Macrocyclops albidus* (Jurine) -- troglophile; abundant in guano pool
- *Paracyclops fimbriatus poppei* (Rehberg) -- troglophile; abundant in guano pool

Isopods
- *Asellus* sp. -- troglobite; probably undescribed; found in stream beyond pool
- *Protrichoniscus reddelli* Vandel -- troglobite; found on organic debris

Millipeds
- *Gosiulus conformatus* Chamberlin -- accidental; found at bottom of entrance drop

Centipedes
- Unidentified

Spiders
- *Achaearanea porteri* (Banks) -- troglophile; found hanging from walls
- *Cicurina* sp. -- troglobite; probably undescribed; found under rocks
- *Cicurina varians* Gertsch and Mulaik -- troglophile; found under rocks
- *Nesticus pallidus* Emerton -- troglophile; found under rocks

Opilionids
- *Hoplobunus* sp. -- troglobite; undescribed; found on clay banks

Pseudoscorpions
- *Tejachernes* sp. -- troglophile; found in guano

Mites
- Unidentified -- found in guano pool

Thysanura
- *Nicoletia texensis* Ulrich -- troglobite; found on clay banks

Crickets
- *Ceuthophilus (Geotettix) cunicularis* Hubbell -- trogloxene

Hemiptera
- *Galgupha* sp. -- troglophile; taken from guano
- Unidentified -- taken from pool at bottom of entrance drop

Gnats
- Unidentified -- troglophile; abundant in bat passages

Beetles
Carabidae
Rhadine howdeni (Barr and Lawrence) -- troglophile
Histeridae
Unidentified -- troglophile; taken from guano
Noteridae
Notomicrus sp. -- taken from guano; may be a troglophile
Pselaphidae
Hamotus sp. -- troglophile; probably undescribed; found under rocks
Salamanders
Eurycea troglodytes Baker -- troglobite
Frogs
Gastrophryne olivacea (Hallowell) -- accidental; found near guano pool
Rana pipiens Schreber -- trogloxene; found in and near guano pool
Bats
Mormoops megalophylla megalophylla Peters -- trogloxene
Myotis velifer incautus (Allen) -- trogloxene
Tadarida brasiliensis mexicana (Saussure) -- trogloxene

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Ref: TSS files

WANANT'S CAVE — Medina County (#5)

Medina Lake 15' Quadrangle

Owner: Wanant

Description: A small vertical entrance leads to a horizontal passage which, after a few feet, drops 25 feet to a lower level. There is 15 feet of free fall. The lower level consists of a room about 10 by 10 by 25 feet high, towards one end of which a small fissure leads back into the limestone for several feet. There are present in the cave a couple of large stalactites, one of which is partially broken off. Cave crickets and harvestmen have been observed.

History: The cave had been previously explored by the owner and a friend back only as far as the vertical drop. The only other recorded exploration is one by Jim Manning, Alan Siebenaler, Preston Knodell, and Pete Prossen of the St. Mary's University Speleological Society on May 4, 1957.

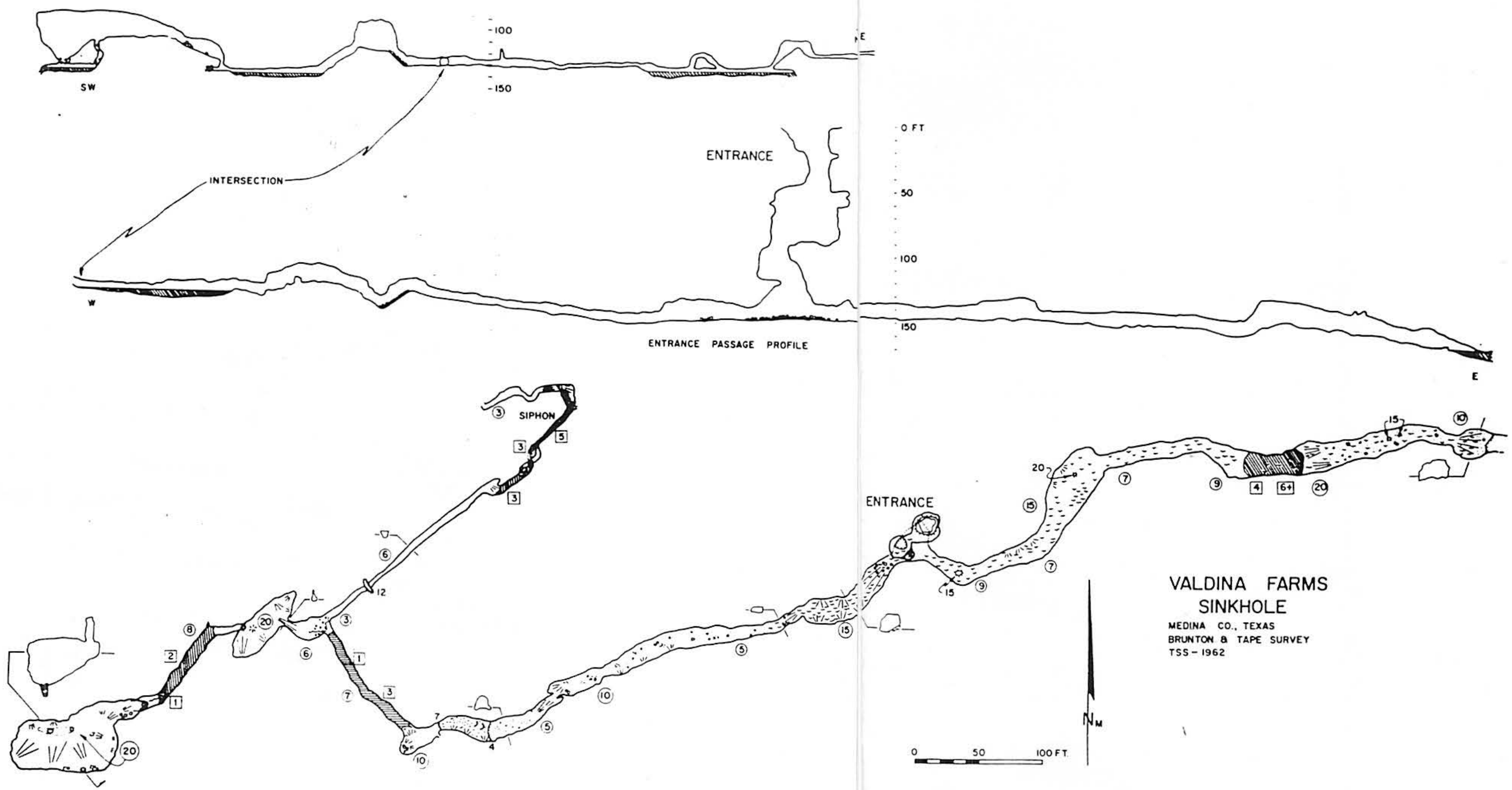
Ref: Jim Manning

WEYNAND'S CAVE — Medina County (#20)

Sabinal 15' Quadrangle

Owner: Louis Weynand

Description: The entrance to the cave is a 2½ foot in diameter hole dropping vertically 12 feet into a small room about 15 feet long, 10 feet wide, and 4 feet high. To the south and west small filled passages extend short distances before becoming impassible. The main passage extends to the north or northeast as a 2 to 3 foot high, 3 to 4 foot wide crawl. After about 20 feet it lowers to 1 foot high and narrows to 2 to 3 feet. After 10 feet it again returns to the 3 to 4 foot wide, 2 to 3 foot high passage. This continues for 40 to 50 feet before it encounters a 10 foot high, 5 foot wide place. This is formed by the collapse of the floor into an apparent lower level, which can be seen but which is blocked by breakdown. Beyond here the passage continues for about 20 feet where a junction is encountered. Straight ahead the passage fills with silt after about 10 feet. To the right it extends about 15 feet where a 20 foot high, 10 foot long, 5 foot wide dome is encountered. This passage continues beyond the dome as a 2 to 3 foot high, 4 foot wide passage for 50 to 60 feet before ending in breakdown apparently associated with a surface sink. The entire floor of the cave is covered with cricket guano to an undetermined depth.



100
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SW
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INTERSECTION
ENTRANCE
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W
ENTRANCE PASSAGE PROFILE
E
SIPHON
ENTRANCE
VALDINA FARMS
SINKHOLE
MEDINA CO., TEXAS
BRUNTON & TAPE SURVEY
TSS - 1962
0
50
100 FT

MEMORANDUM REPORT TO THE
EDWARDS UNDERGROUND WATER DISTRICT
ON THE VALDINA FARMS CAVE

By

WELDON W. HAMMOND, JR.
Consulting Geologist

INTRODUCTION

The Valdina Farms cave was entered January 25, 1977, for the purpose of conducting geologic and hydrologic investigations and to collect water samples for analysis.

GENERAL DESCRIPTION

The entrance to the Valdina Farms cave is located approximately 760' in a northwesterly direction from Seco Creek. The cave entrance is located on a low hillside approximately 20' above the Seco Creek channel. The entrance is approximately 50' in diameter with vertical walls. The vertical walls extend downward 90' to a small horizonal surface, then downward again to the base or floor of the main cavern which is 160' below the land surface.

GEOLOGY

No active stalactites or stalagmites were observed in the cave. Numerous bedding planes in the rock of the walls and roof of the cave exhibited evidence of ground water seeping into the cave.

The floor of the cave is littered with numerous limestone fragments ranging in size from pebbles to large boulders (2' - 6'). The cave floor and many of the limestone fragments are covered by guano deposits. The guano deposits range in thickness from a thin veneer to over six feet.

Guano had been swept from the channel, leaving only relatively clean, large limestone fragments. Guano deposits farther down the cave passage show evidence of water erosion with steep cut-bank surfaces facing the present pools of water.

HYDROLOGY

The Valdina Farms cave is located in the recharge zone or unconfined portion of the Edwards and associated limestones aqifer.

The present water level in the cave near the entrance tube is approximately 165' below land surface. This water level correlates very closely with the water level in a nearby well. Well number TD 69-29-901 (USGS well number C-7-27, Holt, 1956) is located approximately 0.9 mile southeast of the cave and had a water level of 163.33' below land surface on March 2, 1977. The elevation of the cave entrance is approximately 1190' and the elevation of well TD 69-29-901 is 1191.8'. In comparison, the water level in this well on February 2, 1957 was 239.3' below land surface (USGS records). During this same time period (1957) several teams of investigators entered the cave and were able to explore at least 1,000' of the cavern system (see attachment C).

Surface waters from Seco Creek have entered the Valdina Farms cave during extremely high runoff episodes. In 1958, Mr. Trigg Twichell of the USGS observed Seco Creek flood waters pouring into the Valdina Farms cave entrance (R. D. Reeves, personal communication). Flood probability curves would indicate that flooding of this magnitude has probably occured many times in the past and will occur again in the future.

The presence of driftwood, especially the larger fragments carried a substantial distance into the cavern system, the presence of a channel with scoured limestone fragments and the eroded guano deposits indicates that flowing water has entered the cavern system in the past and that during periods of high water in the cavern system there has been a substantial flow between the present pools.

WATER QUALITY

Samples of water were collected from the two pools in the cave (see attachment D). Analysis of these samples indicates that the water presently in the cave is typical of an "average" ground water from this portion of the Edwards Aquifer with high bicarbonate content (354-356 ppm) and high hardness (370 ppm). The nitrogen content as NO_3 was surprisingly low, 17 - 18 ppm, when considering that the pools which were sampled were adjacent to large guano deposits.

The infrequent flooding of the Valdina farms cave by Seco Creek has undoubtedly swept guano and guano decay products into the ground water system. In addition, the normal flow of ground water intercepted by the cavern system has and is carrying guano and guano decay products into the ground water system on a more or less continuous basis. The nitrate concentration in the water in the cavern system and in the ground water in nearby wells is higher than the nitrate concentrations in the average Edwards aquifer water. Nitrate concentrations in wells further removed from the Valdina Farms cave do not exhibit abnormal nitrate concentrations. It is highly probable that dilution by the immense amounts of ground water in the Edwards aquifer flowing past this area effectively lowers the nitrate concentrations to very low levels (4 - 7 ppm).

Bats have utilized caves in the recharge zone of the Edwards aquifer for roosting for perhaps thousands of years. Guano and guano decay products have entered the ground water system throughout this time.

CONCLUSION

The Valdina Farms cave has in the past functioned as a recharge point for the Edwards aquifer.

ATTACHMENT B

Measured Section

5. Limestone: light-grey, weathered surface white, thin bedded..3'+

4. Limestone: highly altered, grainy texture, thin bedded, red-orange stained, some dark grey beds, resistant.......6"

3. Limestone: light-grey, nodular, burrowed, mollusc fragments..2'

2. Limestone and marl: thin bedded, 1-3" beds, some red staining.. 1'

1. Limestone and marl: light-grey, white weathered surface, scattered mollusc fragments, nodular, lumpy surface, massive...4'

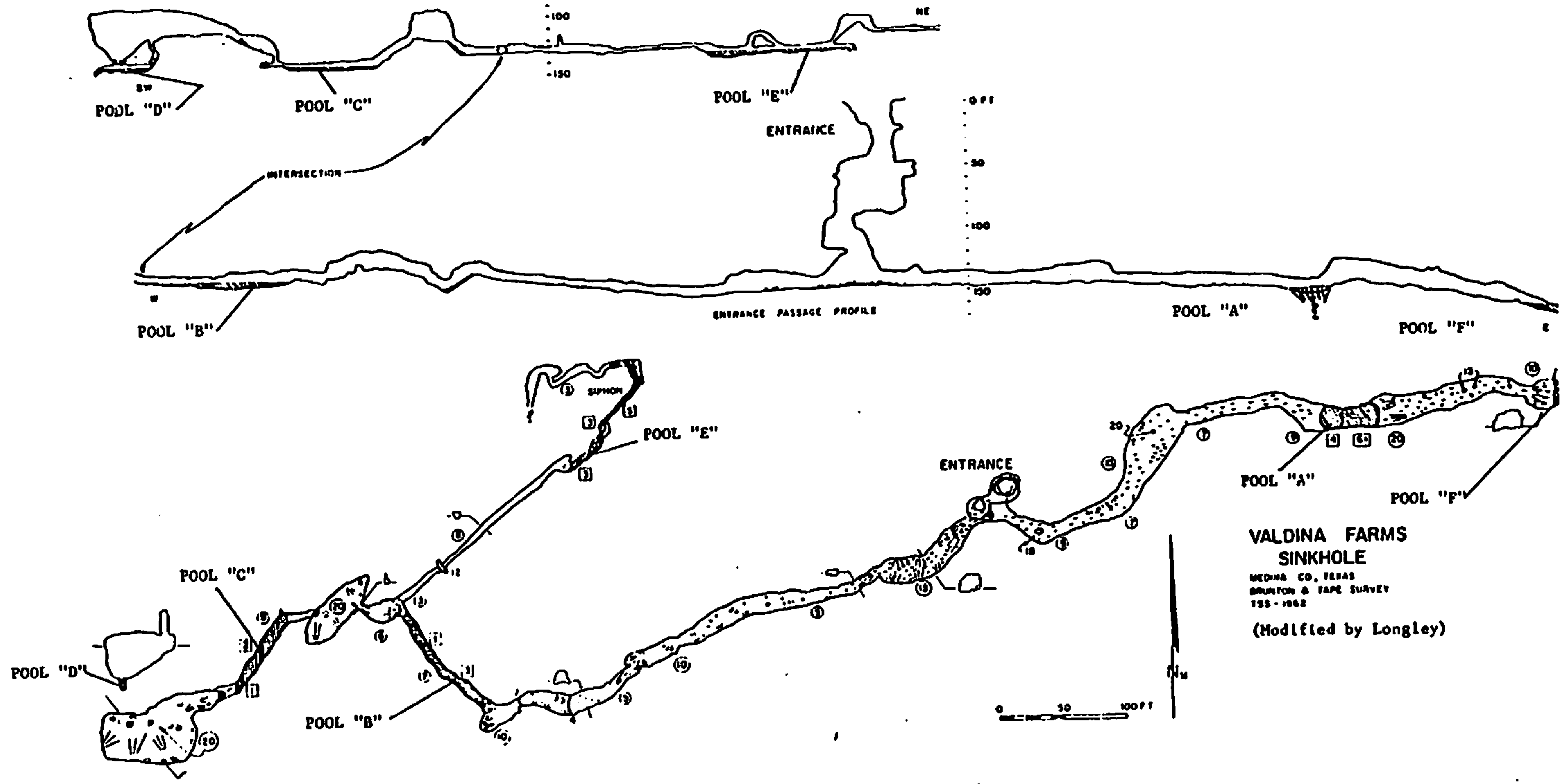
POOL "D"
POOL "C"
POOL "E"
ENTRANCE
INTERSECTION
POOL "B"
ENTRANCE PASSAGE PROFILE
POOL "A"
POOL "F"
SIPHON
ENTRANCE
VALDINA FARMS
SINKHOLE
MEDINA CO, TEXAS
BRUNTON & TAPE SURVEY
TSS - 1962
(Modified by Longley)
0 50 100 FT

Figure 1.

CENTRAL LABORATORY, ATLANTA, GEORGIA — *Attachment D*

Upstream

WATER QUALITY ANALYSIS
LAB ID # 34042 RECORD # 45472

SAMPLE LOCATION: WOODARD CAVE
STATION ID: 293058099235801 LAT.LONG.SEQ.: 293058 0992358 01
DATE OF COLLECTION: BEGIN--770129 END-- TIME--1525
STATE CODE: 48 COUNTY CODE: 325 PROJECT IDENTIFICATION: 464801303
DATA TYPE: 2 SOURCE: GROUND WATER GEOLOGIC UNIT: 218EDRDA
COMMENTS:
COUNTY: MEDINA, OWNER: VALDINA FARMS, COLL: WELDON HAMMOND,
FIELD HCO3 USE IN THIS ANALYSIS

ARSENIC DISSOLVED	UG/L	1	MANGANESE DISSOLVED	UG/L	10
BARIUM DISSOLVED	UG/L	0	MERCURY DISSOLVED	UG/L	0.2
BICARBONATE	MG/L	354	PH FIELD		7.1
CADMIUM DISSOLVED	UG/L	0	POTASSIUM DISS	MG/L	1.2
CALCIUM DISS	MG/L	130	RESIDUE DIS CALC SUM	MG/L	413
CARBONATE	MG/L	0	RESIDUE DIS TON/AFT		0.56
CHLORIDE DISS	MG/L	23	SAR		0.2
CHROMIUM DISSOLVED	UG/L	0	SELENIUM DISSOLVED	UG/L	1
COPPER DISSOLVED	UG/L	0	SILICA DISSOLVED	MG/L	16
FLUORIDE DISS	MG/L	0.1	SILVER DISSOLVED	UG/L	0
HARDNESS NONCARB	MG/L	84	SODIUM DISS	MG/L	11
HARDNESS TOTAL	MG/L	370	SODIUM PERCENT		6
IRON DISSOLVED	UG/L	10	SP. CONDUCTANCE FLD		706
LEAD DISSOLVED	UG/L	3	SULFATE DISS	MG/L	45
MAGNESIUM DISS	MG/L	12	WATER TEMP (DEG C)		22.0
			ZINC DISSOLVED	UG/L	20

CATIONS	(MG/L)	(MEQ/L)	ANIONS	(MG/L)	(MEQ/L)
CALCIUM DISS	130	6.487	BICARBONATE	354	5.803
MAGNESIUM DISS	12	0.988	CARBONATE	0	0.000
POTASSIUM DISS	1.2	0.031	CHLORIDE DISS	23	0.649
SODIUM DISS	11	0.479	FLUORIDE DISS	0.1	0.006
			SULFATE DISS	45	0.937
	TOTAL	7.983		TOTAL	7.393

PERCENT DIFFERENCE = 3.84

PRELIMINARY REPORT OF BIOLOGICAL INVESTIGATION

VALDINA FARMS SINKHOLE - MEDINA CO., TEXAS

by

Glenn Longley

ENVIRONMENTAL SCIENCES
OF SAN MARCOS
SAN MARCOS, TEXAS 78666

November 21, 1977

For

EDWARDS UNDERGROUND WATER DISTRICT
2603 Tower Life Building
San Antonio, Texas 78205

ACKNOWLEDGMENTS

I wish to thank those members of my support team for their considerable effort in my behalf. They include Mr. Jack Ralph, Mr. John Chelf, Mr. Dale Patè and Miss Marcia Cossey. I would also like to thank Mr. Dick Reeves of the U.S.G.S. for his untiring support and assistance. Mr. Harlan Wolff of Hondo was also very kind in making arrangements with Mr. Woodward and helping at the site. The ranch foreman, Mr. Colvin and his assistants at Valdina Farms were especially kind about informing me that my wife had gone to the hospital for our first boy. Mr. Woodward is to be thanked for allowing us to enter the cave. This indicates his support of scientific studies. Finally, the Edwards Underground Water District should be commended for their efforts in behalf of the Edwards Aquifer.

of the Edwards Aquifer since 1973. During the last year I have published three papers that describe new species from the Edwards Aquifer. I am in the process of writing several other papers at the present time which will describe new species and discuss the ecology of the Edwards Aquifer in much detail. I have been requested to present papers at the Second International Groundwater Symposium to be held in Roanoke, Virginia, next September. I spent a week at the U.S. National Museum, Smithsonian Institution in Washington, D.C. consulting with researchers there on various groups of organisms that occur in the Edwards Aquifer. My overall goal is to eventually get a very good picture of the relationships of all the organisms inhabiting the aquifer and their population ecology. My studies have indicated that this aquifer has the greatest diversity of subterranean fauna of any aquifer in the world. This view was first proposed by scientists at the U.S. National Museum after seeing the diversity of organisms in my collections.

I feel that because of my experience working with the aquifer continuously I can speak with some authority about what effect a proposal such as the one by the EUWD would have on the aquifer in the area of Valdina Sinkhole.

In February of this year I submitted a report to the U.S. Fish and Wildlife Service, Office of Endangered Species on the status of Eurycea rathbuni, the Texas Blind Salamander. This report is being published by the Fish and Wildlife Service in their Endangered Species Series (Longley, 1977). I also currently am under contract with the U.S. Fish and Wildlife Service to prepare a report for them on the two species of blind catfish occurring in the Edwards Aquifer in Bexar County.

On November 11, 1977, at the request of the Edwards Underground Water

BACKGROUND

An excellent description of the cave occurs in the publication, "The Caves of Medina County" prepared by the Texas Speleological Survey (Reddell, 1967). References to 80 publications that include discussions of cave biology in Medina County are included in a list taken from Reddell, 1968 (Appendix I). I have prepared a list of references to the genus Eurycea in Texas (Appendix II). These references are to the most important papers on the cave and spring dwelling salamanders in Texas. I have also obtained a list of references prepared by Samuel S. Sweet which include more references to Texas cave salamanders (Appendix III). I have reviewed a manuscript by Samuel S. Sweet that discusses the relationships between surface dwelling and cave dwelling populations of the salamanders of the genus Eurycea along the Balcones Escarpment in Texas. Mr. Sweet has concluded from his studies that Eurycea troglodytes Baker, 1957 (Valdina Farms Sinkhole Salamander) is a hybrid swarm and thus an invalid taxon which should be placed in synonymy with Eurycea neotenes Bishop and Wright, 1937 [part] (surface dwelling salamander found in many springs on Edwards Plateau) and Eurycea tridentifera Mitchell and Reddell, 1965 [Part] (a form found in Honey Creek Cave, Comal County, Texas) (Sweet, 1977).

I have reviewed many of the papers and reports that discuss Valdina Farms Sinkhole and have also read as many as possible that discuss the cave biota. I have been working directly with the subterranean aquatic fauna

INTRODUCTION

Valdina Farms Sinkhole occurs on the recharge zone of the Edwards Aquifer in Northwest Medina County. The cave is located 0.4 mile east of Seco Valley Road at a point 2 miles north of the entrance to Valdina Farms. Valdina Farms is owned by Mr. Robert Woodward. The Sinkhole is located near an un-named branch of Seco Creek where it enters the Seco Creek.

Geologists of the U.S. Geological Survey have observed large quantities of water entering the sinkhole during floods. The Edwards Underground Water District proposes to construct a dam on Seco Creek with a diversion channel that would direct additional water into Valdina Farms Sinkhole. The U.S. Geological Survey estimates that the proposed construction would add an average of 1400 acre feet of water to the aquifer each year. This flow would otherwise leave the recharge zone. The diversion channel is to be constructed in a manner such that boulders, large rocks and other large debris will not enter the cave. The entrance to the diversion canal will be several feet off the bottom of Seco Creek, and the channel will have a large bar screen on it. This arrangement will keep large rocks and trees out of the sinkhole. This will effectively prevent the cave from being clogged with debris.

District (EUWD) I travelled to Valdina Farms Sinkhole. At approximately 7:30 p.m. we met Mr. Harlan Wolff at his business in Hondo, Texas. Mr. Wolff and Mr. Richard D. Reeves, Hydrologist, U.S.G.S. directed us to the Valdina Farms. We met the ranch foreman, Mr. Colvin and proceeded to the cave entrance, arriving at approximately 9:30 p.m. where we examined the entrance and made camp. No activity by bats was noted.

As a support team I had the following persons: Mr. Jack Ralph, my graduate student in Aquatic Biology at Southwest Texas State University; Mr. John Chelf, experienced vertical caver and President of the SWTSU Caving Club; Mr. Dale Pate, experienced vertical caver and employee of the U.S.G.S. Water Resources Division in Austin, and Miss Maria Cossey, experienced vertical caver and biology student at SWTSU.

DISCUSSION

On Saturday, November 12, 1977, we entered the sinkhole. This was done after preparing two special caving ropes for the descent by rappel. At approximately 8:30 a.m. Mr. Floyd Potter, Texas Parks and Wildlife arrived with the following individuals: (name misplaced), Head-Non-Game (=Endangered Species Section), Texas Parks and Wildlife; Bruce A. Moulton, Environmental Division, Texas Department of Water Resources (formerly Texas Water Development Board) and Bob (last name missing), graduate student of Dr. Clark Hubbs at the University of Texas, Austin (representing the Sierra Club) - primary training Icthyology. Mr. Potter provided a truck with a winch having a steel cable for the descent of his group. Mr. Potter did not enter the sinkhole.

Everyone entered the entrance pits before 11 a.m. Equipment was lowered to the floor of the entrance pit. This included plankton nets, hand screen, and large curcular net, water sample jars, lighting, rubber 2-man raft, specimen jars, etc. When all equipment was at the bottom we proceeded down the east passage to the pool of water having some quano in it (Pool "A") shown in Figure 1. The first water samples were taken from this pool before it was disturbed. A small catfish, <u>Ictalurus natalis</u> (yellow bullhead) was observed in this pool. The fish was estimated to be 2 inches long and since eyes were present there was little doubt but that it was washed in from the surface during rains. Material for biological examination was collected from this pool. Since the water was apparently too deep to cross without swimming I decided to explore the remaining

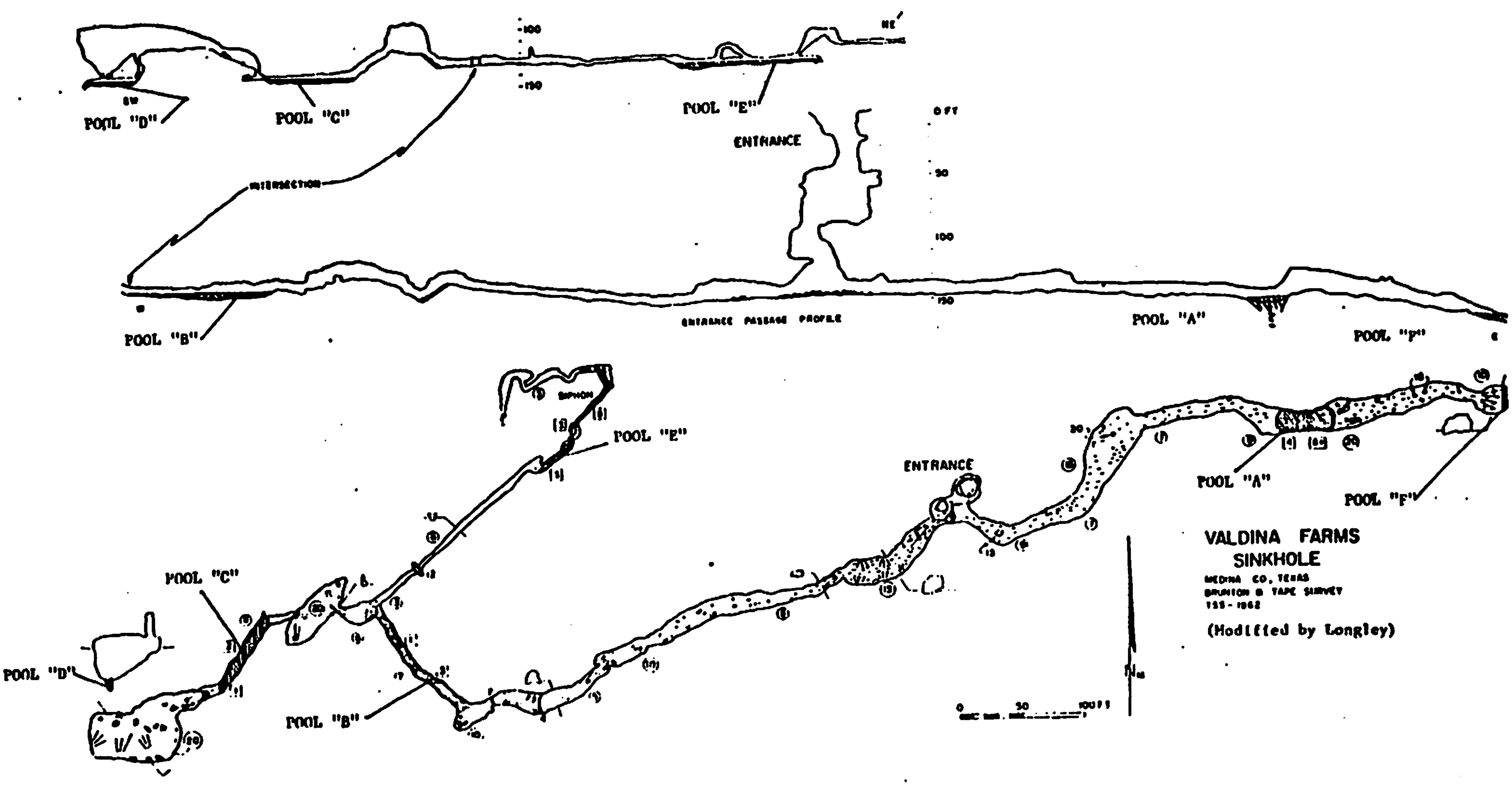
POOL "D"
POOL "C"
POOL "E"
ENTRANCE
INTERSECTION
POOL "B"
ENTRANCE PASSAGE PROFILE
POOL "A"
POOL "F"
SIPHON
VALDINA FARMS
SINKHOLE
MEDINA CO, TEXAS
BRUNTON & TAPE SURVEY
(Modified by Longley)

Figure 1.

western passages before attempting the crossing of the pool. When one stands at the brink of the pool, the end cannot be seen due to a curve in the passage.

We walked back toward the base of the entrance pit and numerous cave crickets (prob. Ceuthophilus cunicularis) were noticed on the walls and floor of the east passage. Small gnats were attracted to our lights. When we reached the base of the entrance pit, we entered the west passage. One rather slick descent occurs at approximately 360' to the west of the entrance pit. This was rigged with a nylon rope for use in lowering equipment and serving as a handline. We continued on until a long pool was encountered (Pool "B"). Before taking samples for water chemistry we observed another catfish (yellow bullhead) probably 5-6" long. I led the group down this water passage observing every portion in front of me before disturbing it. This pool was one that Samuel S. Sweet has been most successful in collecting the salamanders, Eurycea troglodytes. No salamanders were seen. The pool reached depths of approximately 5½ feet, and we had to hold gear above our heads to keep it from being completely soaked. In this passage there were some stalactites up to 3 feet long. As we waded through this passage we could hear running water and as we arrived at the end of the pool we were at the intersection of a passage running at approximately a 90° angle to the passage we had just left. A small gravel bar was present at the end of the pool in this area and a small stream of water runs from the gravel at this point forming a small riffle. This riffle area had been indicated as a particularly good collecting site by Mr. Potter. He had indicated that the salamanders could be found in the gravel. Some time was spent at this area searching through the gravel for organisms of any kind. None were found. From this point we continued down the passage which turned to the southwest. More water passage (Pool "C") was encountered, and no salamanders were seen. At the end of this water passage another riffle area was encountered. The gravel of this riffle was also carefully searched for organisms, and none were found. From this point we climbed up a narrow opening into a large room with sloping floors. One could observe water through the rubble on the floor at the base of a pit. One small member of my support team, Mr. John Chelf, crawled through a very narrow opening that led to this water (Pool "D"). He reported that the water apparently continued in passage to the southwest. No organisms were seen in this pool. We retraced our movements to the intersection where we continued to the northeast. The passage became very low and narrow (tubelike), and the bottom was covered with 5-6 inches of fine clay mud. After approximately 180 feet of crawling on hands and knees and stooping we reached more of this type passage at a slightly lower level. It contained water (Pool "E") with thick mud on the bottom of the pool. We crawled through this for about 80 feet reaching a room with space to stand up, but having very thick, deep mud on the floor. It was almost impossible to walk or crawl through this area. Passage continued in two directions from this point. One continued up and to the right into rooms with no apparent other exits. The other continued up a very slick, mud covered, steep incline to the left. At the top of this incline one had to drop down a steep slope at the base of which was a small tube with deep mud on the bottom. This tube continued downward to a small pit. From this pit a steep mud covered slope was encountered. When the crest of the slope was reached the other side was a very deep pit that would require ropes to traverse. Apparently this was as far as this cave has been penetrated. No evidence was present for activity beyond this point. In the last room before the deep pit there were numerous stalactite and soda straw formations. The chore of returning up the muddy incline from this room was difficult. At this point nothing in our packs was dry, and we were covered with thick mud from head to toe. We returned to the intersection where we sat in the pool (Pool "B") and made an attempt to remove enough mud from ourselves and our equipment so that we could continue. We returned through the west passage to the base of the entrance pit. Since night was near, we decided to leave the equipment in the cave and return the next day to cross the deep water in the east passage. We climbed out on ropes and the other group were pulled out using the winch and parachute harness. I would like to point out that this is not a recommended method for leaving the cave since the hook at the end of the cable tends to get caught at the rock lips. Several potential problems exist with the winch: 1) The cable may catch in crack and pull hook off end, 2) It may catch on a rock and pull the rock loose, and 3) there is too little control by person on the cable.

During the entire time in the cave few signs of recent activity by bats were noted. A few very small piles, <1 foot in diameter, of quano were noted that appeared to be of fairly recent origin. No very large accumulations of quano were noted. Most of the large deposits in the cave appeared to be mud. It is possible that below the mud were some older deposits of quano. No bats were noted in the cave. No sign of activity from the past summer was noted unless the very small piles of quano were from then. A few old bat skeletons were found but were in very poor condition. In the evening of November 12th no bats were seen leaving the cave. We camped a second night next to the entrance. Floyd Potter and his group left the sinkhole before dark Saturday evening.

The morning of November the 13th we entered the cave a second time. We spent much time at the base of the pit looking for biological specimens. A listing of the organisms found in the cave appears in Table 1. We pumped up the 2-man raft and carried it to Pool "A" in the east passage. I crossed the approximately 30 yards of water passage first, and the others pulled the raft back and Mr. Ralph and Miss Cossey also crossed the water in the raft. We then walked another approximately 135 feet and came to Pool "F" which filled the passageway as the passage sloped downward to the east. An approximately 7 inch yellow bullhead catfish (Ictalurus natalis) was noted in this pool. The pool did not have bat quano in it. No salamanders were seen in this pool. No other organisms were found in this pool. No bats were seen the second day of exploration. In the passage between the two pools there are two roof passages that appear on the map (Figure 1) as domes. These are not domes, but passages in which no end could be seen. Special climbing equipment would be necessary to enter these since they go almost straight up. It is very possible that these connect with the bed of Seco Creek which is located just east of the entrance to the cave. We returned to the base of the pit and removed the equipment and climbed out. By the time we had everyone and everything out of the cave it was late afternoon.

The cave was extremely muddy and most rooms had been flooded at least 3/4ths of the way to the ceiling. It appears that water has stood in most parts of the cave at much higher levels in the not too distant past due to the amount of silt accumulation on all walls and floors with any surface exposed upward.

We also were shown another fissure (pit entrance) near the bed of Seco Creek about 1/4 mile upstream by Mr. Harlan Wolff who had done the survey for the project. It is very possible that this cave connects with Valdina

Table 1. List of organisms reported from Valdina Sinkhole.

From Previous Reports	This Report
Mollusca (snails)	Mollusca (snails)
Physa sp.	*Physa* sp.
Arthropoda	Unidentified sp.
Ostracods	
Candona sp.	
Copepods	
Macrocyclops albidus	
Paracyclops fimbriatus poppei	
Isopods	
Asellus sp.	
Protichoniscus reddelli	
Millipeds	
Gosiulus conformatus	
Centipedes	
Unidentified	
Arachnida (spiders)	Arachnida (spiders)
Achaearanea porteri	3 or 4 species
Cicurina sp.	unidentified
Circurina varians	
Nesticus pallidus	
Opilionids	
Hoplobunus sp.	
Pseudoscorpions	
Tejachernes sp.	
Mites	
Unidentified	
Thysanura	
Nicoletia texensis	
Orthoptera	
Ceuthophilus cunicularis	
Hemiptera	
Galgupha sp.	
Diptera	
Gnats (unidentified)	
	Collembola (springtails)
	Two species unidentified
Coleoptera (Beetles)	Coleoptera (Beetles)
Rhadine howdeni	1 species unidentified
Histeridae - Unidentified	
Notomicrus sp.	Annelida
Hamotus sp.	1 species unidentified
Urodeles (salamanders)	
Eurycea troglodytes	
Anurans (frogs and toads)	Anurans (frogs and toads)
Gastrophryne olivacea	*Gastrophryne olivacea*
Rana pipiens (misidentified prob.)	*Rana berlandieri*
Mammals	*Hyla versicolor*
Chiroptera	*Bufo valliceps*
Mormoops megalophylla megalophylla	
Myotis velifer incautus	
Tadarida brasiliensis mexicana	

Farms Sinkhole.

Some figures which are useful in evaluating this project are placed in Appendix IV.

CONCLUSIONS

In general, it is my determination that the proposed project will not adversely effect the salamander in the cave. Terrestrial organisms in the cave will be effected more than any other group. The aquatic fauna, including salamanders, Eurycea troglodytes, isopods and other forms will probably benefit from the increased input of organic matter into the cave by flooding. It seems likely that most of the bat populations have been gone from the cave for some time, thereby eliminating their associated input of energy in the form of quano. I do not feel that the salamanders have left the system, but instead may have retreated into other areas where more organic matter exists. Organic matter in any form, so long as it is non-toxic, will actually stimulate the amount of life in a subterranean system. If the EUWD will control the entrance of large debris into the system, as they have indicated, the cave will not clog up. It is possible that some new passage will open when some of the mud is washed out of the system. Leaves and small drift will furnish more organic matter for the increase of energy flow in the system.

It has been my experience while studying other parts of the aquifer to find that organisms are generally not restricted to one cave, but instead are found in several caves in a particular area. The argument that certain of these forms are not found in other areas is based only on those known accessible caves in the general area. Many other caves may exist in the area that have not been discovered (example - the cave 1/4 mile upstream in Seco Creek discovered during surveying).

It is obvious to those of us that are familiar with the hydrology of the aquifer that recharge enhancement is a necessary procedure to help meet the ever increasing demands on the aquifer. Estimates of water use by the year 2020 show that the estimated use will exceed by greater than 30% the present average recharge (Longley, 1975). The loss of head in the aquifer to levels below spring openings at New Braunfels and San Marcos would have a far greater detrimental effect on biota than would the recharge into Valdina Farms Sinkhole. For example, in the San Marcos River there are two endangered species of fish, one salamander and several invertebrates. If the spring flow stops these forms will become extinct in all but man made refugiums. The main thing that would endanger these species is loss of spring flow.

Another argument that has been made is that the flooding will cause collapse of unstable parts of the cave. I did not note any particularly unstable appearing parts of the cave in the area near the entrance pit which would collapse under the effect of increased inflow. Any collapse that would occur should not plug the very large passages near the pit entrance. Areas away from the entrance will have the flow stabilized by the morphology of the cave. I do not foresee a torrent raging through the cave after the water level rises in response to the first water entering. There is very little chance of the cave completely flooding to the ceiling of all rooms due to the enormous size of many passages.

I would recommend that (if this project is allowed to proceed as it should be) a follow up study of this cave be made after flood waters from Seco Creek have entered the cave. This would allow biologists to view the effects of such a modification so that recommendations can be made for future projects of a similar type.

SUMMARY

In summary, the following main conclusions have been derived from this study:

1) The project will not cause the extinction of <u>Eurycea troglodytes</u> (Valdina Farms Salamander).
2) There is considerable doubt that the salamander is a distinct species, but instead is a form of <u>Eurycea neotenes</u> (Edwards Plateau Spring Salamander).
3) The cave will not plug up as a result of the proposed project.
4) The additional recharge that will include some non-toxic organic matter will stimulate the subterranean ecosystem.
5) The recharge will be of considerable benefit to the aquifer which is having ever increasing demands placed on it by pumping.
6) This will likely benefit organisms in springs fed by the aquifer due to prolonged flow.
7) This site is one of the best possible choices for additional recharge due to the low population density in the watershed above the site. Due to its location this area will not be heavily populated in the foreseeable future.
8) Any risk to terrestrial forms in the cave is far outweighed by the benefits to organisms in other areas (this includes man).
9) Pesticide use in the area above the watershed should be maintained at present levels which apparently are minimal.
10) Persons involved in the evaluation of this project should look at

the overall benefits and weigh them against the potential costs environmentally.

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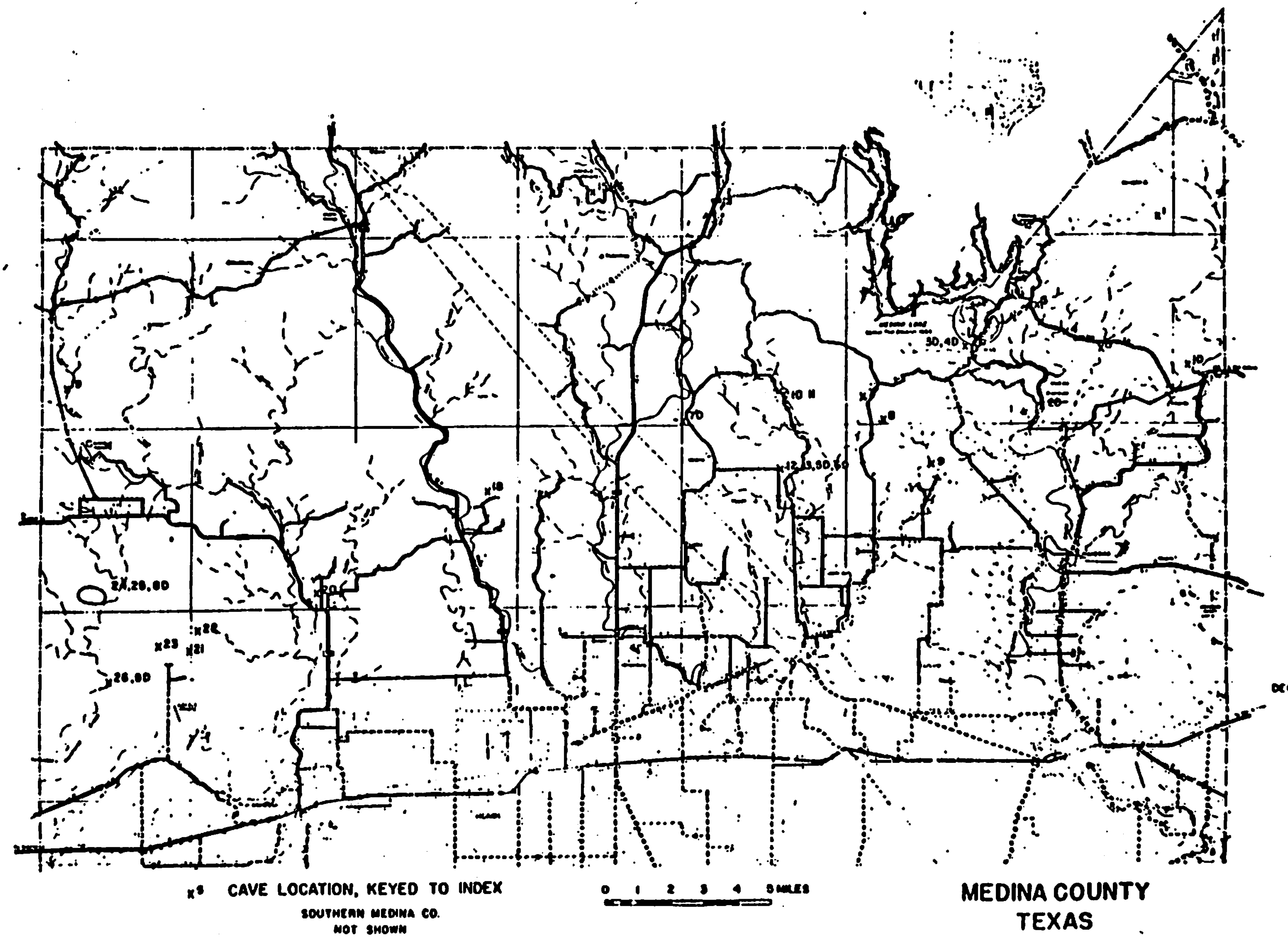
APPENDIX IV

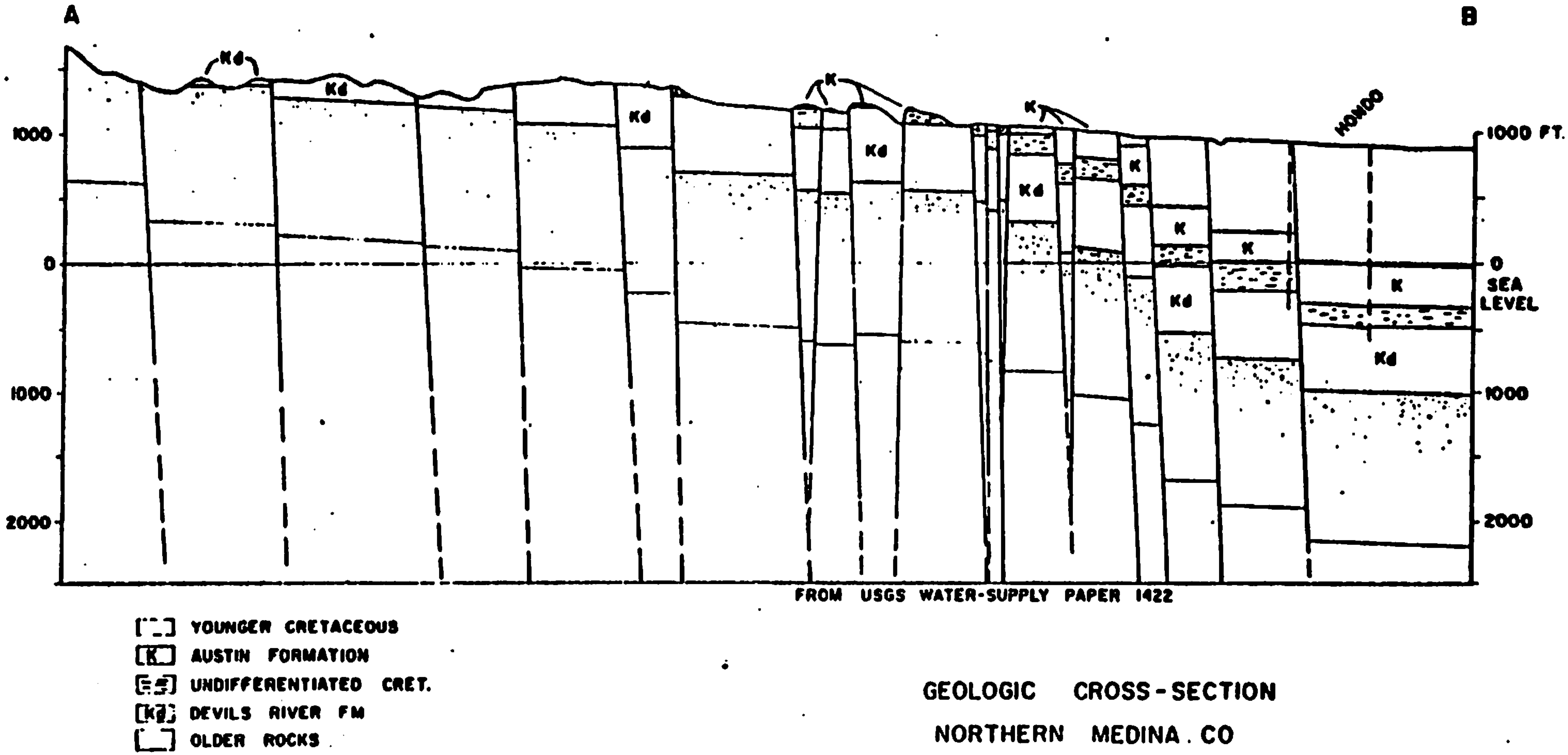
INDEX TO THE CAVES OF MEDINA COUNTY

DOUBTFUL CAVES AND SHELTERS:

(From Reddell, 1967)

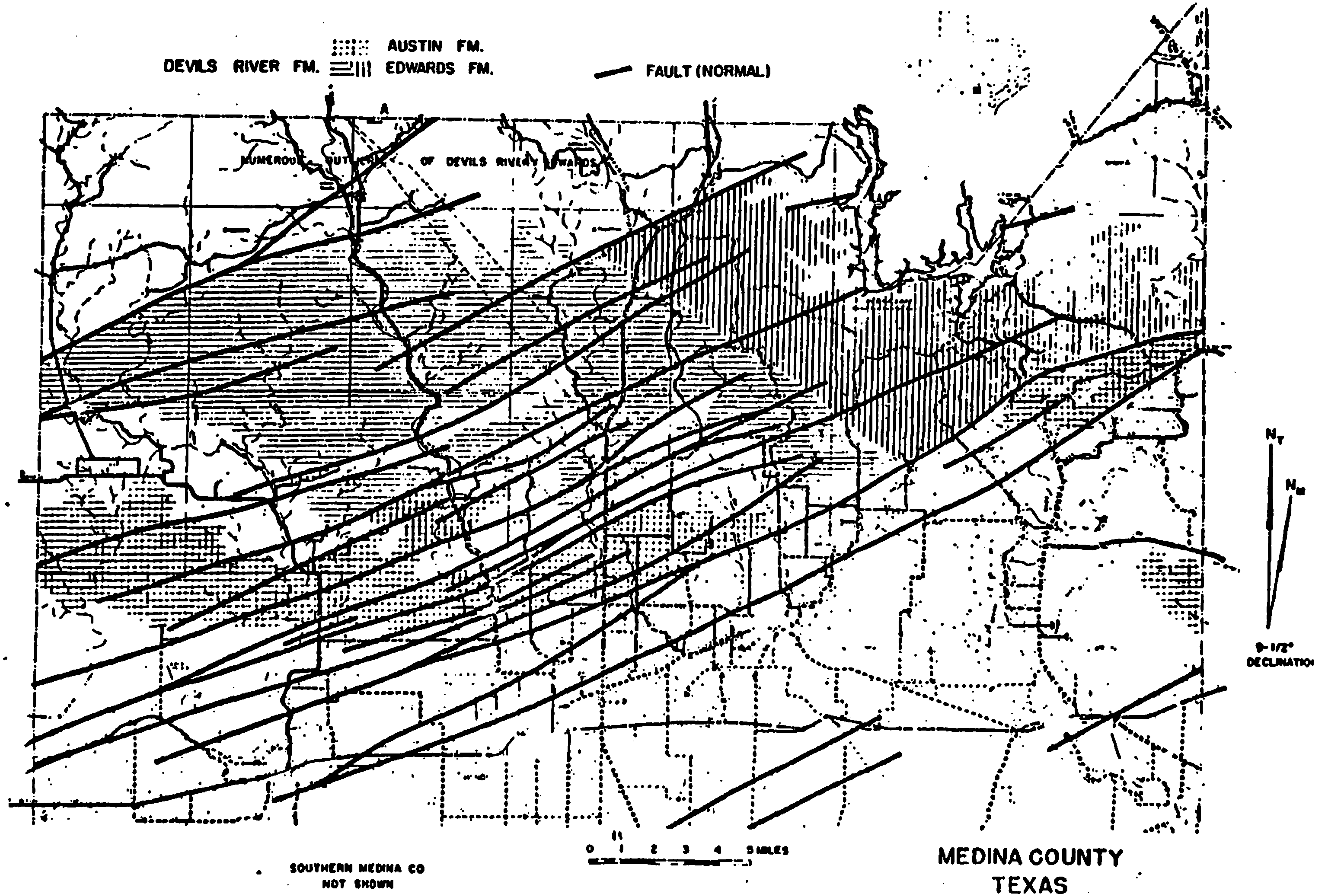


(From Reddell, 1967)



GEOLOGIC CROSS-SECTION
NORTHERN MEDINA . CO

(From Reddell, 1967)



MEDINA COUNTY
TEXAS

(right) rest after having transported the SCUBA gear to Sump 1. Allan Cobb.

#40 -- George Veni and James Bowden preparing to dive Sump 1. Allan Cobb.

#41 -- George Veni and James Bowden preparing to dive Sump 1. Andy Grubbs uses flash to light-up the sump. Allan Cobb.

#42 -- James Bowden entering sump and laying guideline. Allan Cobb.

#43 -- Andy Grubbs assisting George Veni with dive gear in preparation to dive the sump. Allan Cobb.

#44 -- George Veni diving sump, following guideline being placed by James Bowden. Allan Cobb.

#45 & 46 -- George Veni (#45) and James Bowden (#46) emerging from Sump 1 after exploring the sump for 100 m to 340 m of airfilled passage before discovering Sump 2. Allan Cobb.

the pool, facing upstream. George Veni.

#24 -- East-facing view of the minor collapse area, downstream of the Salamander Pool, which prevents flow from the pool from flowing directly down the main passage towards the downstream sections of the cave. Allan Cobb.

#25 -- Andy Grubbs crawling out of the newly washed-open stream passage and into the main passage. Note the stream cobbles have been cleansed of the thick mud which covered them prior to flooding. Allan Cobb.

#26 -- Joe Ivy at the base of the entrance shaft, beginning the 44 m climb to the surface while carrying a heavy load of equipment. Allan Cobb.

#27 -- The main cave passage looking downstream from the base of the entrance shaft. Note flood debris on the ceiling. George Veni.

#28 -- The main cave passage downstream from the entrance, facing east. Note that the thick deposits of bat guano are washed away. Allan Cobb.

#29 -- View to the northeast of a large cobble-gravel sediment bank stripped of bat guano, mud, and entrenched more than 2 m deep by floodwaters. Allan Cobb.

#30 -- View to the west of a large cobble-gravel sediment bank stripped of bat guano, mud, and entrenched more than 2 m deep by floodwaters. Allan Cobb.

#31 -- East-facing view of the flood-flushed, guano-free, "Guano Pool". Allan Cobb.

#32 -- Scott Harden straining sediments at the upstream end of the Guano Pool looking for cavernicoles. Allan Cobb.

#33 -- East-facing view of Andy Grubbs in the Guano Pool. Allan Cobb.

#34 -- East-facing view of passage beyond the Guano Pool. Jack Ralph (background) and Joe Ivy (foreground) tape-measure a distance in surveying the cave. Allan Cobb.

#35 -- Linda Palit getting a compass bearing in surveying the cave just downstream of the Guano Pool. View is to the north. Note the entrenched cobble-gravel bank, and the overlaying layer of organic silt. Allan Cobb.

#36 -- Andy Grubbs ascending extension ladder into a downstream dome that leads into a large upper level room. Allan Cobb.

#37 -- One of the few remaining mud banks in the main passage of the cave; near Sump 1. Slumping of the mud bank is due to structural instability, caused by 1.5 m deep entrenchment Andy Grubbs is standing in. Note dark organic silt layer atop the lighter colored mud. Allan Cobb.

#38 -- Andy Grubbs looking into Sump 1 (all Sump 1 photos face east). Allan Cobb.

#39 -- Cave divers James Bowden (left) and George Veni

Note the color and textural change in the bedrock due to flooding. Also the ledge he is at was initially less than a meter wide and has been widened to more than two meters. George Veni.

#15 -- Scott Harden, 10 m down the 44 m deep entrance shaft of Valdina Farms Sinkhole. George Veni.

#16 -- Large upstream upper level room. Collapse from this room (covered by thick deposits of mud) raises upstream water levels of the main stream passage, resulting in a sump and limiting exploration. The funnel in the floor drops 4 m down to the stream passage sump. George Veni.

#17 -- Stratified sediments in the large, upstream, upper level room of Valdina Farms Sinkhole. Pre-flood sediments are dominantly red clays and silts. The overlaying gray-brown organic silt, and beer can, were deposited during flood recession. This sediment bank is 7 m above stream level and is part of a floodwater trench cut through the upper room. George Veni.

#18 -- Lower portion of a spectacular 2 m high exposure of stratified and crossbedded sediments in the northwest corner of the large upstream room. This sediment bank is 3 m above stream level and is part of a floodwater trench cut through the room. Note the well-rounded stream gravel on the floor. George Veni.

#19 -- Main stream passage just downstream of the upper room, facing northeast. The passage is expected to continue similarly on the upstream side of the room if a way through or around the sump can be found. George Veni.

#20 -- Andy Grubbs examining the walls in a small room along the main passage, just upstream of the junction with the side passage. Note the gravel and cobble floor, which had been mud covered prior to the flooding. Photo taken from within the room, facing northeast. Allan Cobb.

#21 -- James Bowden crawling through muddy stream in side passage. Photo is taken in the first pool, facing upstream. Bowden is under the climb to the first upper level. George Veni.

#22 -- Typical cross section of the upstream side passage; an elliptical, joint guided, phreatic tube, with thick mud deposits which are entrenched by seasonal vadose streamflow. Note where Bowden has dug 1 cm through the recently deposited, dark, organic silt to the lighter colored clays below. Photo is taken from the downstream end of the first pool, facing southwest. George Veni.

#23 -- The "Salamander Pool". Pool just downstream of the confluence of the upstream main and side passages. The pool was a major salamander habitat prior to flooding. Photo is taken from the downstream end of

Photographs

The following descriptions are keyed to the accompanying slide photographs and Figure D-1. Nos. 1-12 are surface photos and are not located on the map. The photographs inside the cave are generally arranged in a west to east, or upstream to downstream, order. The photo numbers also correspond to references within the report. All photographs were taken during the 5 December, 1987, investigation by either George Veni or Allan Cobb, and are thus appropriately indicated for proper photo credit should any be published or similarly used.

#1 -- Seco Creek Recharge Dam. View from the northwest, overlooking the diversion channel. Grated box just upstream of the dam gates a small cave. George Veni.
#2 -- Seco Creek Recharge Dam. Longitudinal view from its east end. George Veni.
#3 -- View from Seco Creek west into the diversion channel. Note sedimentation in the creekbed due to the recharge dam. George Veni.
#4 -- Seco Creek Diversion Channel. View westward from atop the west bank of Seco Creek to the bridge and debris grate. George Veni.
#5 -- Bridge and debris grate for the Seco Creek Diversion Channel. George Veni.
#6 -- Seco Creek Diversion Channel. Westward view from atop bridge towards the entrance to Valdina Farms Sinkhole. George Veni.
#7 -- Seco Creek Diversion Channel. Westward view from within the channel towards the entrance to Valdina Farms Sinkhole. George Veni.
#8 -- Sediment filled paleo-sinkhole in south wall of the Seco Creek Diversion Channel, approximately 20 m west of the entrance to Valdina Farms Sinkhole. George Veni.
#9 -- Karen Hohle looking into a small conduit that was washed open and/or filled with cobbles during the 1987 flood. The hole is located in the base of the south wall of the Seco Creek Diversion Channel, approximately 15 m west of the entrance to Valdina Farms Sinkhole. George Veni.
#10 -- Westward view of the Seco Creek Diversion Channel spillway into Valdina Farms Sinkhole. George Veni.
#11 -- Eastward view of the Seco Creek Diversion Channel spillway into Valdina Farms Sinkhole. George Veni.
#12 -- Northeastward view of the Seco Creek Diversion Channel spillway into Valdina Farms Sinkhole. Note the scoured bedrock and the rounded edge of the spillway due to flooding. George Veni.
#13 -- Southwestward view of Joe Ivy rappeling into Valdina Farms Sinkhole. George Veni.
#14 -- Scott Harden rappeling into Valdina Farms Sinkhole.

FIGURE D-1

Location Index to 5 December, 1987, Slide Photographs

Numbers keyed to text and slide index.
Boxes and arrows indicate area and direction of photos.
#1-12 are on the surface and are not represented below.

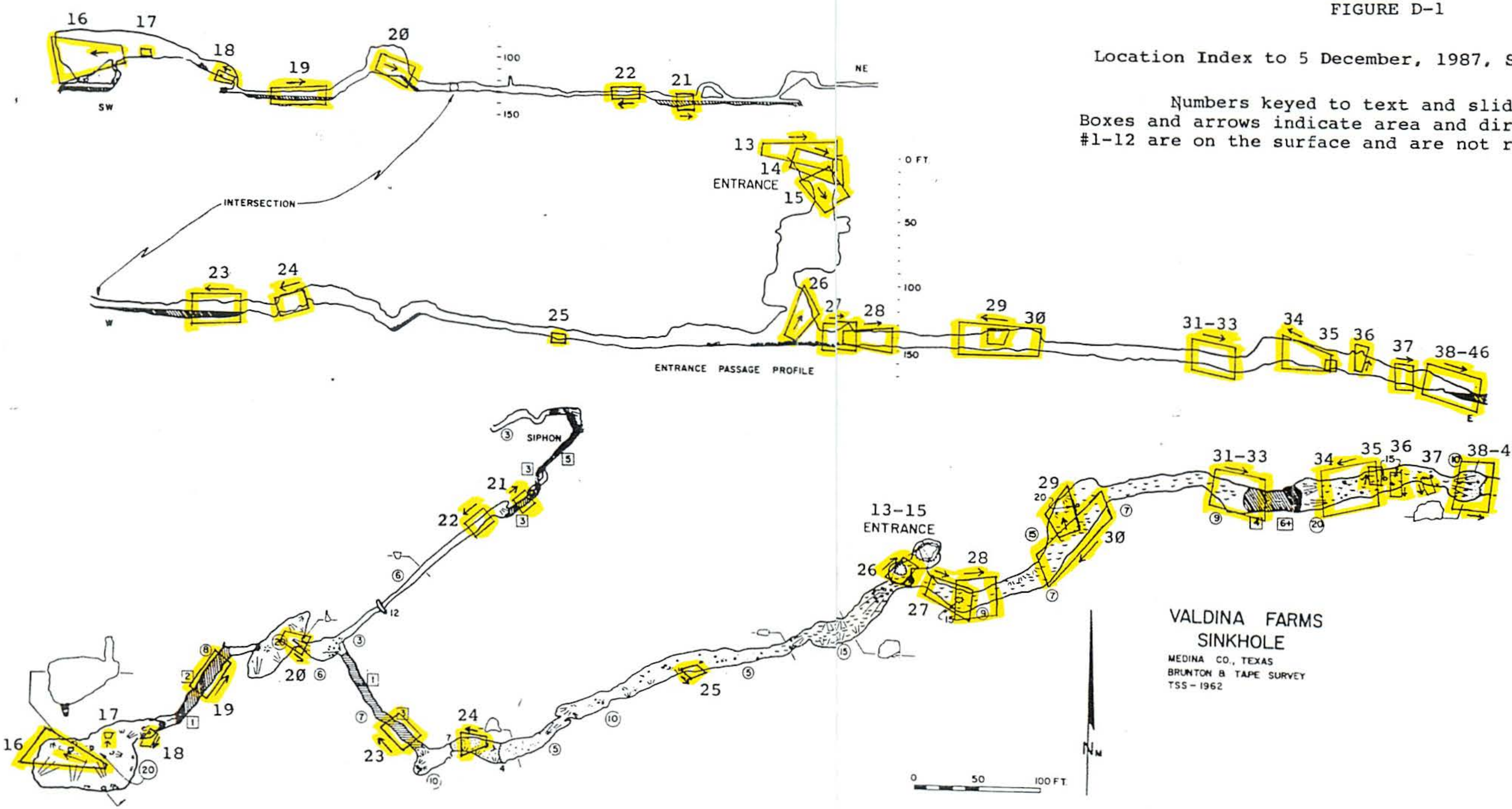


FIGURE 6-1

New Explorations and Survey in Valdina Farms Sinkhole,
5 December, 1987

Position numbers (e.g. #3) are keyed to text.
Map addition at #3 is surveyed.
Additions at #1, 2 & 4 are estimates.