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HTGCD Well Evaluation: Dripping Springs Water Supply Co. Test Well 1 & Stratigraphic Evaluation of the Trinity Aquifer Units in Wester Hays County and Implications for Hydrological Variations

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HTGCD WELL EVALUATION: DRIPPING SPRINGS WATER SUPPLY CO. TEST WELL 1
&
STRATIGRAPHIC EVALUATION OF THE TRINITY AQUIFER UNITS IN WESTERN HAYS COUNTY AND IMPLICATIONS FOR HYDROLOGICAL VARIATIONS

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HAYS TRINITY GROUNDWATER CONSERVATION DISTRICT
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ABSTRACT:

The Trinity Aquifer is a very important groundwater resource for the Dripping Springs area and Central Texas as a whole. Evidence in recent studies show increased levels of aquifer stress and pumping due to higher influx of population and demand for potable water in the area.

In addition to high levels of pumping, groundwater appears to be influenced by facies change. There is little information on how certain geological units affect the presence of groundwater in the Trinity Aquifer – this study is purposed to bring a better understanding of how groundwater resources are stored and moved through the subsurface of the Onion Creek watershed.

This study presents data from an extensive evaluation of stratigraphical, hydrological, and geophysical data across the Onion Creek watershed, in the vicinity of Dripping Springs. Analysis of these data, and correlation across stratigraphic units will help Hays Trinity Groundwater Conservation District to better visualize and understand the relationship between surface water of Onion Creek and recharge to the Middle Trinity aquifer units, and thus conserve water more efficiently.

INTRODUCTION:

The Dripping Springs Water Supply Corporation has a new prospective well field just 1.66 miles northeast of the DSISD monitor well field. This study is purposed to understand and evaluate the change in stratigraphy between these two wells, and analyze how that plays a role in the hydrology. Results from detailed stratigraphic evaluation suggest that there are key stratigraphic variations in Middle Trinity geological units that may influence groundwater availability

This report compares data from DSISD Well No. 1 evaluation (Watson 2018) to a detailed lithological evaluation of Dripping Springs Water Supply Test Well 1. Data for DSWSTW1-RB is less abundant as it is a newly developed Test Well from the water supply company that has yet to be completed to a public water supply well. The Dripping Springs Water Supply Corporation has a new prospective well field just 1.66 miles northeast of the DSISD monitor well field, across the Onion Creek watershed.

METHODS:

A formation evaluation program was run on DSISD No. 1 (Watson 2018) including: geochemical sampling and analysis, geophysical logging, down-hole camera recording, cutting samples description, conventional core description, and a pumping test.

Data collected for DSWSTW1-RB is less abundant as it is a newly developed Test Well well from the water supply company that has yet to be completed to a public water supply well. A less extensive evaluation was run on DSWTW1, including: geophysical logging, down-hole camera recording, and cutting sample descriptions.

Onion Creek has played a large role in the development of the surrounding community and preservation of clean drinking water. Recent studies by HTGCD staff and partners has demonstrated a close association between Onion Creek surface water and subsurface Middle Trinity aquifer (Hunt 2016; Watson 2018).

An extensive stratigraphic evaluation was designed and run between the two wells, DSISD No. 1 and DSWS Test Well 1 with data from geophysical logging, sample cuttings description, downhole video recording, and a conventional core of Middle Trinity productive intervals at DSISD. The study is intended to help increase the understanding of stratigraphic, and resultant hydrological variability in certain Middle Trinity units.

In addition to high levels of pumping, groundwater appears to be influenced by facies change. There is little information on how certain geological units affect the presence of groundwater in the Trinity Aquifer – and this study is purposed to bring a better understanding of how groundwater resources are stored and moved through the subsurface of the Onion Creek watershed. Evaluations of stratigraphical, hydrological, and geophysical data across the watershed of Onion Creek will help understand the relationship between surface water of Onion Creek and recharge from the Middle Trinity aquifer units.

IMPORTANCE:

This report presents data from the DSISD well evaluation (Watson 2018) and from recent logging of a Test Well from the Dripping Springs Water Supply. Data for DSWSTW1-RB is less abundant as it is a newly developed Test Well from the water supply company that has yet to be completed to a public water supply well. The Dripping Springs Water Supply Corporation has a new prospective well field just 1.66 miles northeast of the DSISD monitor well field, across the Onion Creek watershed.

The Hays Trinity Groundwater Conservation District (HTGCD) has a number of tasks in the conservation of groundwater resources. The monitoring of water levels and water quality within the Trinity Aquifer allows HTGCD to observe changes in aquifer conditions over time, and

Onion Creek has played a large role in the development of the surrounding community and preservation of clean drinking water. Recent studies by HTGCD staff and partners has demonstrated a close association between Onion Creek surface water and subsurface Middle Trinity aquifer (Hunt 2016; Watson 2018).

In addition to high levels of pumping, groundwater appears to be influenced by facies change. There is little information on how certain geological units affect the presence of groundwater in the Trinity Aquifer – and this study is purposed to bring a better understanding of how groundwater resources are stored and moved through the subsurface of the Onion Creek watershed. Evaluations of stratigraphical, hydrological, and geophysical data across the watershed of Onion Creek will help understand the relationship between surface water of Onion Creek and recharge from the Middle Trinity aquifer units.

STUDY SITE:

The DSISD wellsite was chosen because of its proximity to the DSWSC well field, Onion Creek and the rapidly developing city of Dripping Springs. The well is located on school property approximately 3 miles south of the city of Dripping Springs and 1.66 miles southwest of the DSWSC Test Well 1 (figure 1). It is accessed from Ranch Road 12 and lies just north of South Onion Creek, a tributary of Onion Creek. It is a rural area of mixed ranchland and farming, although new development is rapidly changing land use.

The DSWS Test Well 1 is located nearby just 1.66 miles northeast of the DSISD well field. It is located north of Onion Creek, and just west of the FM150 Highway. It is rural ranchland, but there are new prospective developments popping up all along FM150 to the east.

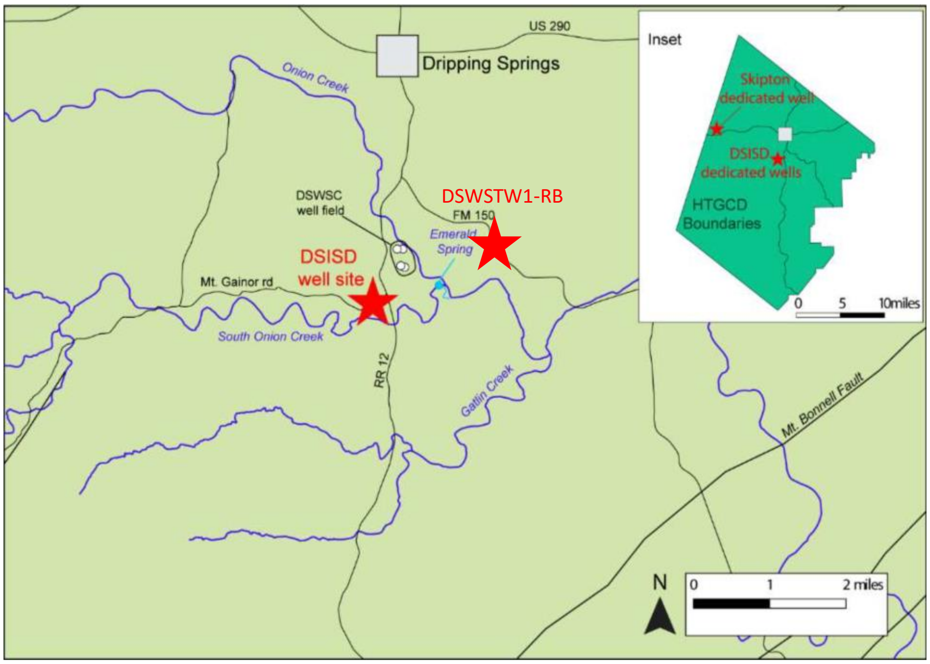


FIGURE 1: STUDY SITE

DSWSC: Dripping Springs Water Supply Corporation's well field, just ¾ miles NE of DSISD has been supplying groundwater to local residents for over 40 years. The corporation is HTGCD's largest groundwater permit holder. DSWSC well field produced 336 acre feet in 2017 and has a production permit of 1025 acre-feet/year as of 2018. Increased production over the next 5 to 10 years will likely be required to meet the growing needs of developing subdivisions and businesses.

A cross section running from the Dripping Springs Independent School District Well No. 1, across Onion Creek, over to a new test well that was spudded by Dripping Springs Water Supply Corporation was created using data from the two wells on stratigraphical, hydrological, and geophysical data.

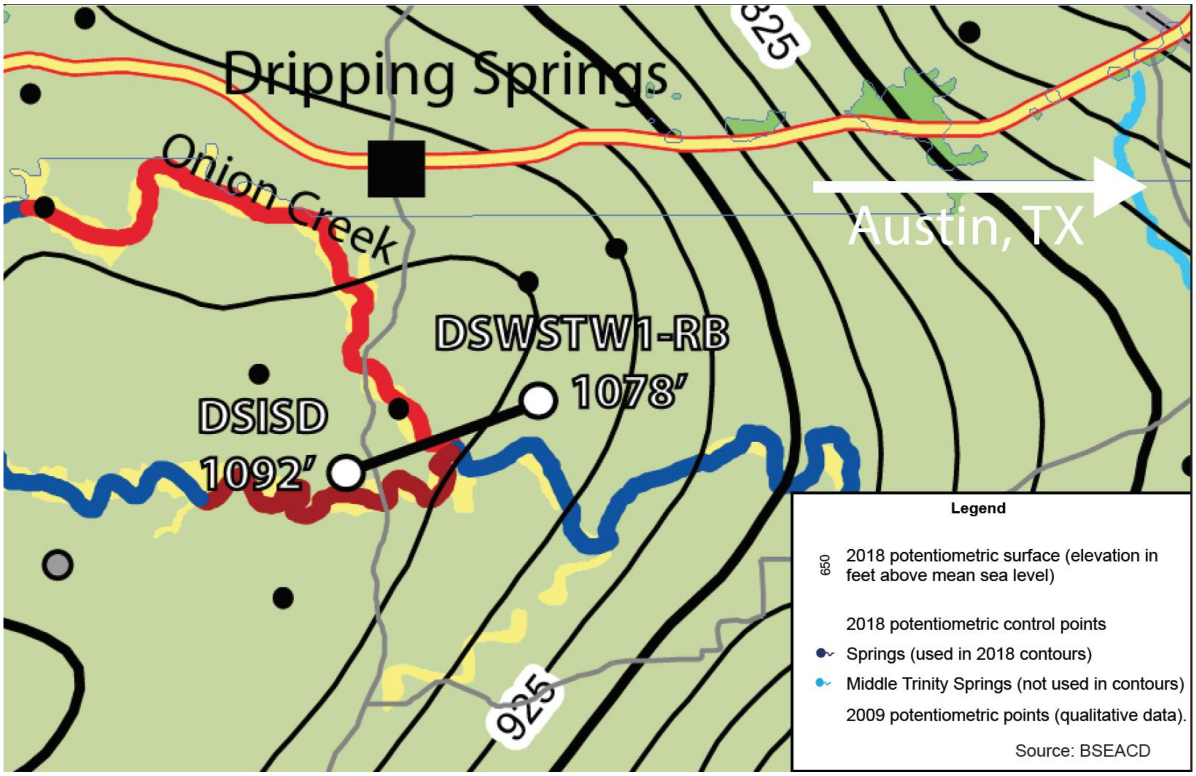


FIGURE 2: Cross section (DSISD to DSWSTW1-RB).

Onion Creek has played a large role in the development of the surrounding community and preservation of clean drinking water. Recent studies by HTGCD staff and partners has demonstrated a close association between Onion Creek surface water and subsurface Middle Trinity aquifer (Hunt 2016; Watson 2018). Evaluations of stratigraphical, hydrological, and geophysical data across the watershed of Onion Creek will help understand the relationship between surface water of Onion Creek and recharge from the Middle Trinity aquifer units. Groundwater management is key for the conservation and evaluation of potable water for Dripping Springs. The Dripping Springs area and land development along US Highway 290 west of Austin, is one of the fastest growing regions in Texas. Increased residential use and commercial use will continue to stress the water resources of Dripping Springs. That resource is provided by surface water from the West Travis County Pipeline and from Trinity Aquifer groundwater. With stratigraphic data limited for the Middle Trinity aquifer, this evaluation will provide a source of reliable data to evaluate the relationship between water level trends and geological trends.

CUTTINGS ANALYSIS:

DSWSTW1:

The following section presents a geologic description of surface samples, cuttings and core collected during DSWSTW1-RB drilling operations. Selected number of photographs and photomicrographs of cuttings photos taken using a Zeiss Stemi 305 microscope with digital camera are available in Appendix A. Additional content including a link to the full downhole camera video, will be made available on the HTGCD website.

SURFACE GEOLOGY:

The Upper Trinity, Upper Glen Rose Member crops out throughout the upper Onion Creek basin. In the fields and low hills to the west and north of the wellsite, Upper Glen Rose, Unit 3 is exposed at the surface. Unit 3 has been described in the literature (Muller, 1990) as a shallow aquitard. When Unit 3 is eroded, by Onion Creek or one of its tributaries, the fractured (jointed) limestone and dolomitic limestone beds of the basal units (solution zone) are directly exposed to surface water. Recent studies have suggested that surface water under these conditions, may move vertically through shallow karst features and enter the Middle Trinity aquifer (Hunt 2016, Watson 2018).

UPPER GLEN ROSE (0-110'):

The Upper Glen Rose is a regionally consistent carbonate interval that is made up of interbedded calcareous mudstones and skeletal wackestone-grainstones. Unit 3 was encountered from 0 to 40 feet, and was made up of interbedded calcareous mudstones-siltstones. This thickness of Unit 3 may contribute to a more confined Upper Glen Rose. Unit 2 consisted of interbedded grainstone-wackestone and was picked from 40 to 85 feet. Unit 1 was from 85 to 110 feet, and consisted of micritic wackestone-mudstones (see Appendix).

LOWER GLEN ROSE (110-306'):

The Lower Glen Rose of Dripping Springs Water Supply Corporation's Test Well 1 is 196 feet thick. This is only 4 feet thicker than the stratigraphic thickness of the Lower Glen Rose to the south east along the cross section. However, there are some key stratigraphic differences, and subsequent hydrological differences that separate the units.

(110-160') The upper 50 feet of the Lower Glen Rose consists of interbedded dolomitic and calcaerous mudstones-claystones that are clumpy/argillaceous. There are orbitolina throughout the upper 30 feet and traces of lignite and pyrite in the bottom 20 feet. This unit acts as a semi-confining unit for the upper carbonate interval.

(160-200') There is a patch reef interval that occurs in the Lower Glen Rose. The upper 10 feet of the carbonate reef consists of a skeletal "hash" grainstone, with fine grain skeletal fragments of mollusks and gastropods. The lower 30 feet is a "framebuilder", with fine-crse skeletal fragments, and a recrystallized caprinid rudist framework. There is excellent moldic and vuggy porosity. There is pyrite in the section and there are also rudist, oyster, bivalve, and gastropod fragments.

Figure 3 (160-170') skeletal "hash" grainstone

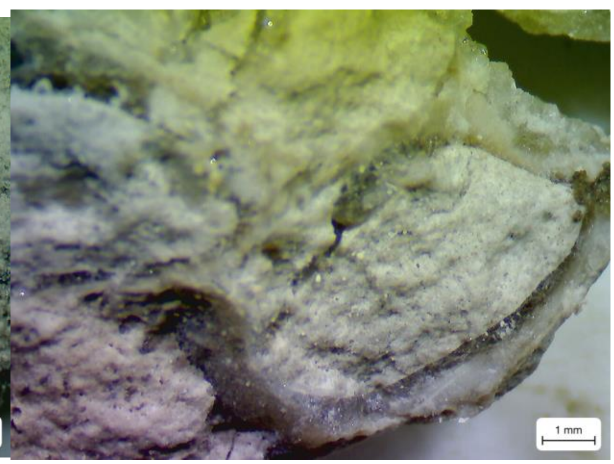


Figure 4: (180-190') Caprinid rudist framework

(200-220) From 200 to 220 feet is a skeletal micritic dolomite wackestone with a fine to very fine grain matrix of recrystalline dolomite along with a dolomitic wackestone.

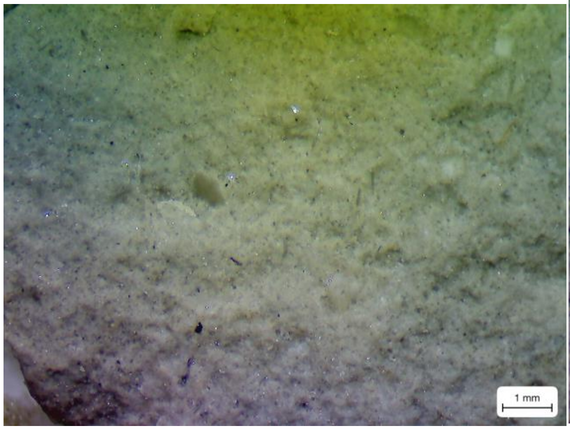
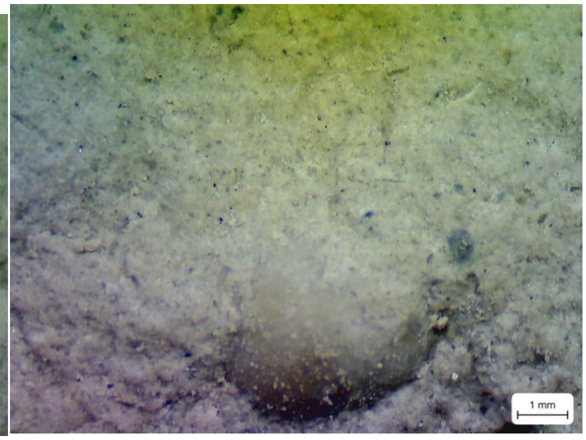



FIGURE 5: (210-220’) LEFT: Dolomitic wackestone, orbitolina, frags. FIGURE 6 (220-230’): Dolomitic wackestone with orbitolina

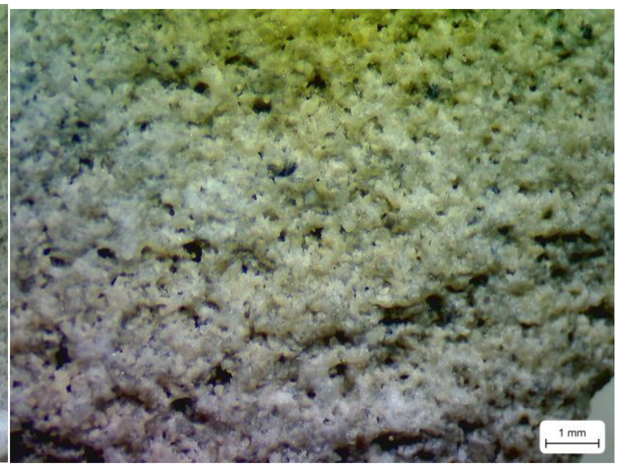



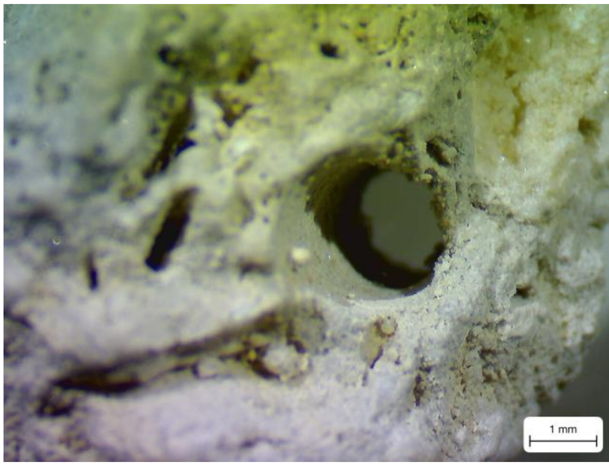
FIGURE 7 (230-240’): Part dolomitic matrix with fossil fragments. FIGURE 8 (250-260’)L Calcarenite shoal, fg skeletal fragments.

(220-240’) The section is a peletal skeletal dolomitic wackestone-grainstone with moldic porosity. There are orbitiolina, oyster, and peloidal fragments.

(250-260’) Well sorted calcarenite shoal interval. This showed a kick on the four-point resistivity log, and may be contributing to water availability in surrounding units. Fine grain skeletal fragments, well sorted. Good porosity – high water reading.

(260-270’) Very fine grained dolomite, with a recrystallized dolomite matrix.

(270-300’) Lower carbonate interval in the Lower Glen Rose. This contains a skeletal “framebuilder” reef. The upper 30 feet are a packstone-“Framebuilder” with very fine to coarrse skeletal fragments, coralline polips and caprinid rudist framework. The basal 8 feet are a coated-skeletal grainstone with good moldic porosity.



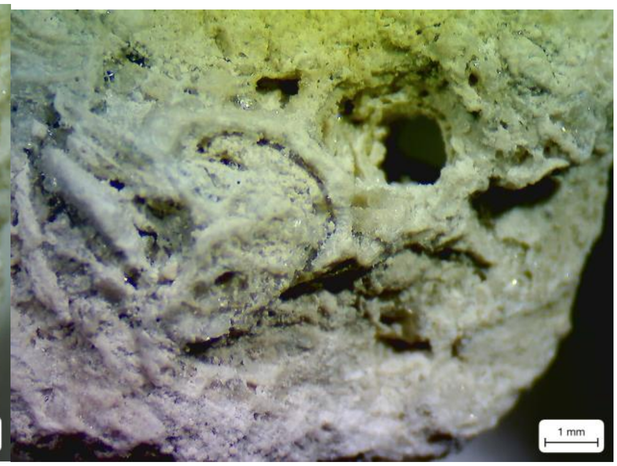


FIGURE 9: (290-300’) “framebuilder” vf-crse skeletal frags with moldic/vuggy porosity.
FIGURE 10: (270-280’) same, “framebuilder”

HENSEL (308-334’):

The Hensel is composed of interbedded skeletal-dolomitic-calcareous wackestones and very fine grain dolomitic siltstones/dolomites. There are abundant serpula tubes as well as medium grain orbitolina and mollusk frags. This acts as a semi-confining unit for the lower Cow Creek interval.

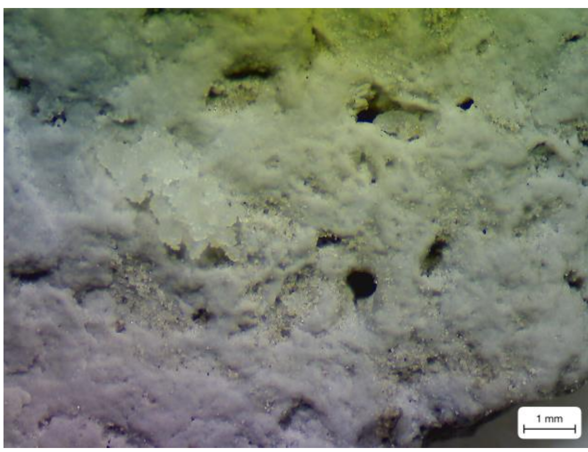
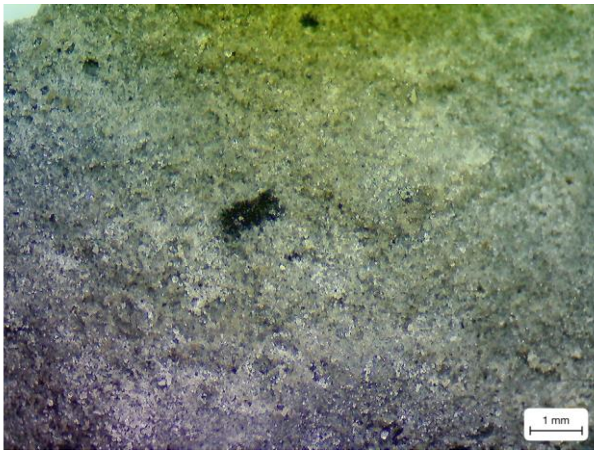


FIGURE 11: (340-350’) Part dolomitic wackestone

FIGURE 12: (330-340’) Dolomitic wkst with serpula tubes

PALEOSOL (334-348')

The paleosol is a skeletal-micritic dolomite with a very fine recrystallized matrix.



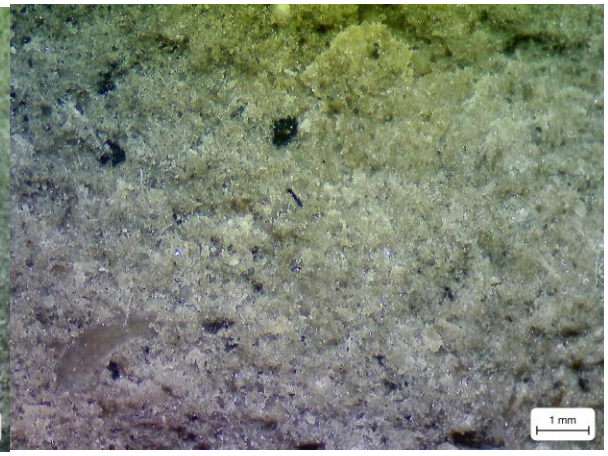
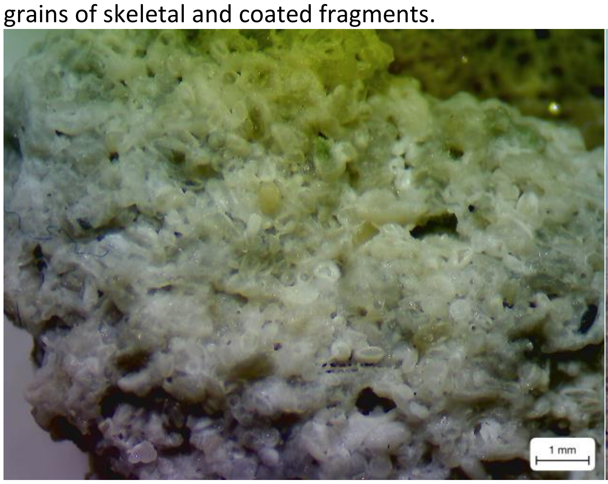


FIGURE 13 (340-350'): Dolomitic wackestone-dolomite, FIGURE 14 (330-340'): Dolomite paleosol

COW CREEK (348-421'):

(348-370') The upper section is a coated-skeletal grainstone packstone with fine to medium grain skeletal fragments and coated grains; there are interbedded dolomitic bryzoan. There is excellent moldic porosity between grains of skeletal and coated fragments.



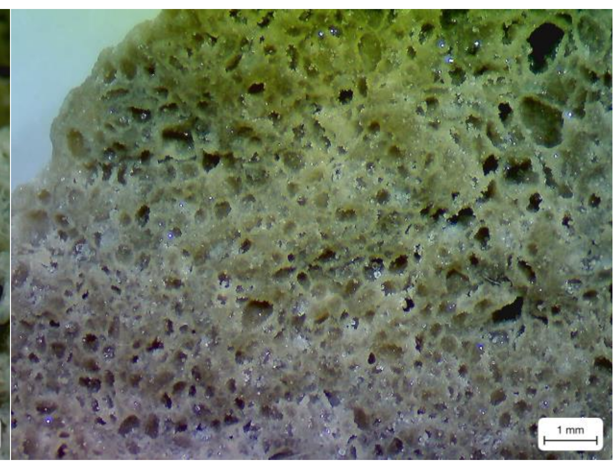


FIGURE 15 (350-360'): skeletal-coated grainstone; FIGURE 16 (350'-360'): Bryzoan/coral frag., fg, dolomitized

FIGURE 17 (390-400’): Dolomite, vf, recystalline relic fossil texture,

(370-421’) The lower 51 feet of the Cow Creek is a recrystallized dolomite with relic fossil cavities. There is moldic and vuggy porosity in the dolomite, with the most relic fossils (and thus, porosity) occurring at around 390’.

HAMMET (421-?):

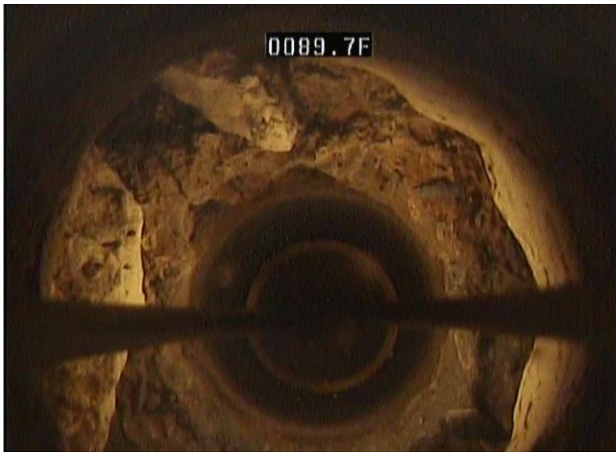
(421-445’) The Hammet at Dripping Springs Water Supply Test Well 1 consists of muddy, silty (vfg) dolomite with some calcareous mudstone interbedded between.

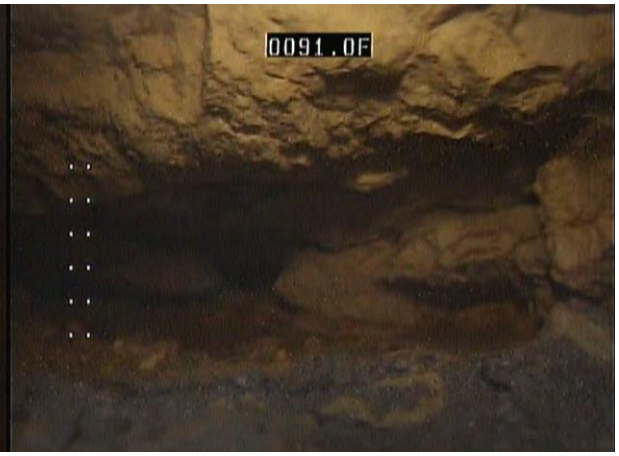
DOWNHOLE CAMERA VIDEO:

DSWS Test Well 1: On the morning of May 3, 2019 a downhole camera/video was lowered into the borehole by Joe Vickers. The formation water in the well had settled and the picture quality was quite good in most of the well. The downhole camera is an important tool in both formation identification and borehole condition. Selected screen captures from the downhole video can be found in Appendix B.

UPPER GLEN ROSE (0-110’):

Downhole video of the Upper Glen Rose had minimal view of the side wall of the unit from the camera, so general geology was difficult to interpret via downhole camera video. From 53’ to 58’can be seen to be a “vuggy” interval with and several small bedding plane voids and vugs, with water leaking out of them. The water table was encountered at 67.4 feet down the well hole. There is an exceptional image of a “cavernous” interval from 89 to 91 feet which seems to be a conduit for water movement in the Upper Glen Rose. There are a series of two solution cavities or caves developed along a bedding plane with abundant solution features. This “cave” was recorded on the gamma ray curve, and in the downhole video in DSWSTW1. There are small vugs located around 104.5 feet, along with some styolites.

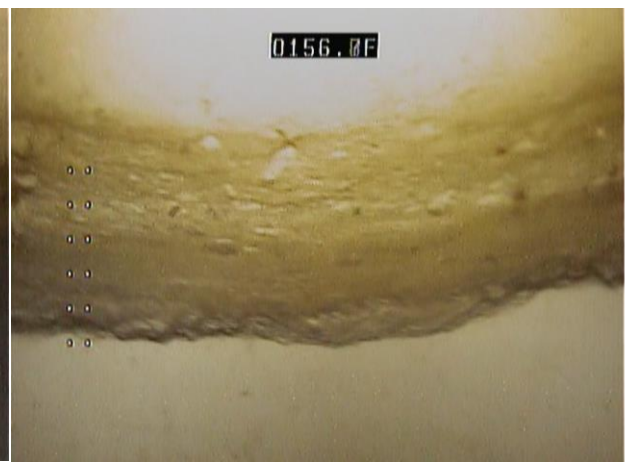


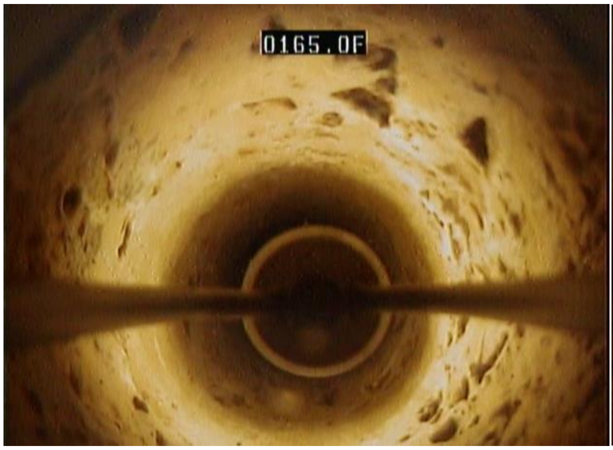


LOWER GLEN ROSE (110-306'):

In the Lower Glen Rose from 110-128 feet are a nodular units of light grey limestone with bedding planes and solution features. At 130 feet, there is a wackestone with wavy irregular laminae and abundant styolites and solution features.

After about 132 feet, the unit transitions into a more massive limestone with few visible bedding features. At 153 – 153.7 feet there is a beautiful transition that occurs from a fossiliferous, white-grey limestone wackestone to a thin (~0.5 foot) section of a dark brown dolomite mudstone-siltstone that has a fracture. Below the dark brown unit there is a dolomitic fossiliferous unit that gradationally transitions into the upper carbonate.





At 156 feet there is a carbonaceous black styolite that transitions into a fine grain limestone-wackestone that continues down to about 160 feet, where voids and cavities begin forming in the unit. At about 160 feet, larger skeletal fragments begin to appear, and a “patch reef” is encountered in the unit. From 160 to 180 feet there abundant skeletal “voids” or holes in the wall of the unit, which indicate very good porosity and water storage. This can be seen on the gamma ray readings in the geophysical log of DSWSTW1-RB.

From about 190 to 220 feet there are several large “drop voids” or caves. At 194.1 feet there is a “drop void” that appears to be a conduit with evidence of water flow. Smaller, but similar voids occur at 199.3, 202.0, and 216.0 feet, which are formed with solution features along bedding planes.

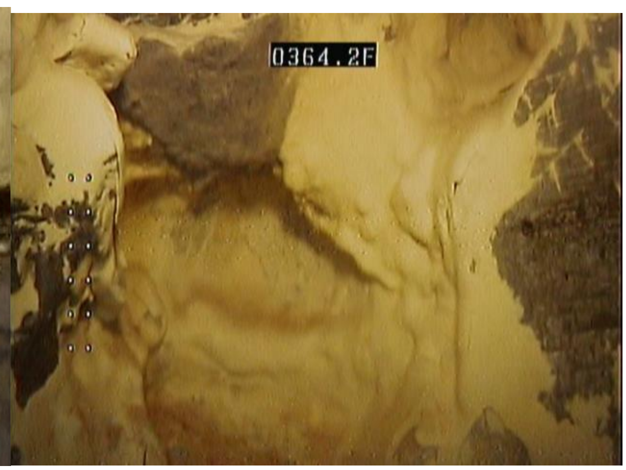
From 220-236’ feet is a homogenous light grey limestone. At the base of the Lower Glen Rose, the “reef/mound” facies occurs from 265 to 300 feet. It is a coarse skeletal hash “framebuilder” with abundant small vugs and caprinid rudists; 277.0 feet, Lower Glen Rose “framebuilder”A. At the bottom of the Lower Glen Rose, there is a wavy irregular bedding and styolites at 309 feet down the hole, transitioning into the Hensel.

HENSEL (306-334’)

The Hensel is difficult to describe geologically from downhole camera as the operator did not stop to look at the wall of the unit. The unit appears to be a nodular/wavy bedded limestone. At 325.3 and about 327 feet there are a few small voids along the surface of a bedding plane/styolite.

PALEOSOL (334-348’):

The paleosol is encountered at 334.8 feet, where the section hits the unconformity, and transitions from a fossiliferous, thin bedded limestone in the Hensel to an irregular wackestone with caliche, followed by a massive, brecciated, fractured “cave” with caliche. After the brecciated cave interval, there is a grey, caliche limestone-dolomite all the way down to 348 feet, where it transitions into the Cow Creek.

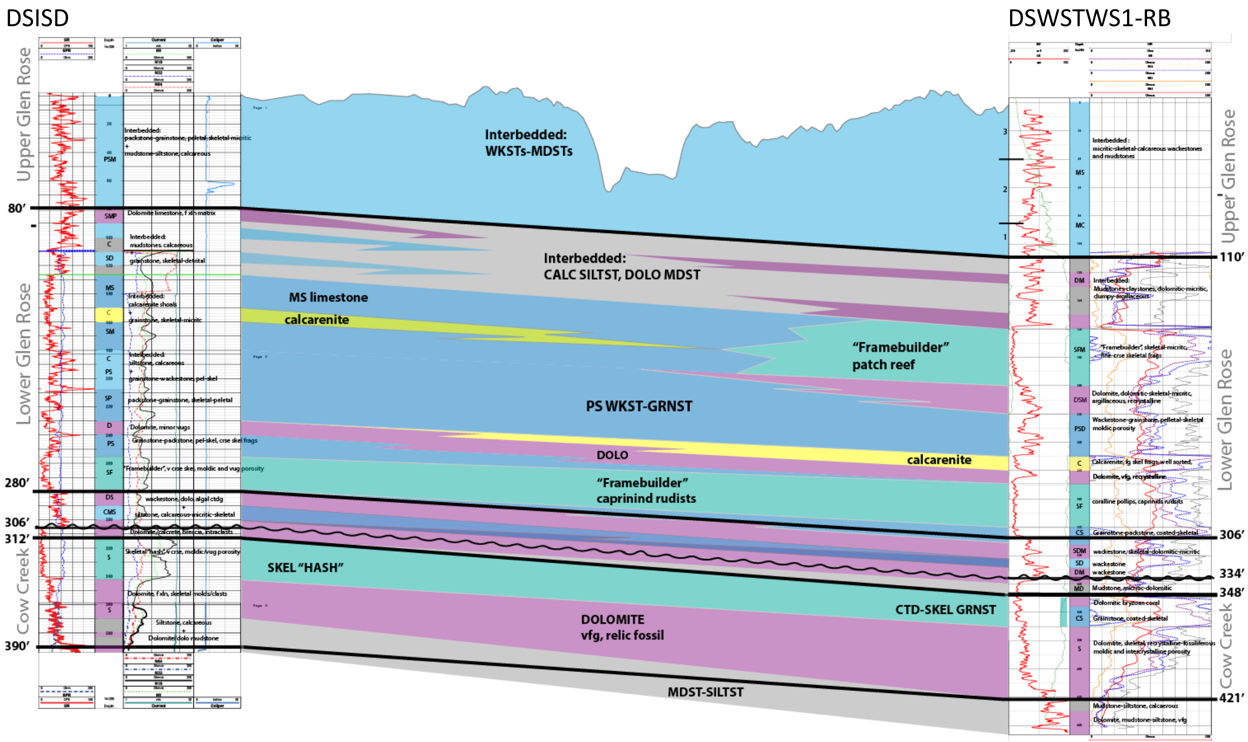


The top of the Cow Creek, from 348 to about 363 feet is a fairly uniform unit of a coated-skeletal grainstone. There are black, thin carbonaceous bedding planes or solution features that occur at 360 and 363.3 feet. At 363.3 feet, there is a black carbonaceous bedding plane/solution feature that is underlain by brecciated, fractured, dolomite that with caliche fill. There is a massive “cave” after the transition into dolomite at 363.3, followed by another “cave” at 368.8 feet.

At 404.2 there is another “cave” in the dolomite. After this cave, the caliche fill becomes less prominent, and the unit consists of thinly bedded dolomite. There is a drop void fill with sediment fill in the well at the bottom, 418 feet, which prevents further downhole movement of the camera.

STRATIGRAPHIC CROSS SECTION:

The detailed data from the Dripping Springs Water Supply Test Well 1 including lithological description, geophysical log annotations, and downhole camera video notes were used, in conjunction with data from Dripping Springs Independent School District Well No. 1 to southwest, to create a structural cross section across the Onion Creek watershed. This cross section was drafter with the intent to help evaluate the relationship between surface water and groundwater within the Onion Creek watershed. This stratigraphic correlation, in sequence with water monitoring will provide a source of reliable data to evaluate water level trends and possible water quality variation in the nearby aquifer.



To the West at DSISD No. 1, the Lower Glen Rose contains a unit (of interbedded calcarenite shoals and wackestones and grainstones, that transition in the West at DSWSTW1, to a "Framebuilder" caprinid rudist patch reef. There is low water production in the upper shoal unit of the DSISD well, so drilling in this area is often down to the Cow Creek. To the West, the DSWSTW1 is in a reefal mound that shows signs of higher water production. The ability to stratigraphically correlate the upper reef unit will help better understand the areal extent of patch reefs and how they affect the water availability in the Dripping Springs area.

The Hensel formation is 26 feet thick at DSISD No. 1 and 26 feet at the DSWS Test Well 1. Across the section the Hensel is a regionally consistent dolomitic interval. During the pump test, water levels in DSISD No. 2 showed a muted drawdown response to pumping from Cow Creek pumping in No. 1. This suggests that the Hensel may be acting as a semi confining unit.

A thin paleosol interval was identified in both wells separating the Hensel from the Cow Creek, and may be an important lithologic control on vertical connectivity in the Middle Trinity aquifer. Further investigation of wells 1 and 2 will help determine to what extent the Hensel acts as a confining unit.

To the West, at DSISD the top of the Cow Creek limestone aquifer was encountered at 312 feet. The upper porous carbonate is 30 feet thick and consists of coarse grained, skeletal hash- coquina in a fine skeletal grainstone matrix. The lower interval is fine crystalline dolomite with layers of moldic porosity developed in relic texture.

To the East, at the DSWSTW1 the top of the Cow Creek was encountered at 348 feet. The upper porous carbonate is 22 feet thick and consists of coralliferous dolomite (bryzoan) and a coated skeletal grainstone. The lower interval is also fine crystalline (brown sand) dolomite with moldic and vug porosity from relic skeletal fragments. This is expected to be a high-producing interval as well.

SUMMARY:

Results from detailed cross section analysis between DSISD and DSWSTW1 suggest that there are stratigraphic variations in the Middle and Lower Trinity units that may influence groundwater availability in the area.

From stratigraphic top to bottom, the Upper Glen Rose is a regionally consistent carbonate interval that is made up of interbedded calcareous mudstones and skeletal wackestone-grainstones. The main difference, however, is that as you move to the northeast at DSWSTW1 there is a thicker Unit 3. This may contribute to a more confined Upper Glen Rose, and different properties of recharge and flow that may contribute to a higher groundwater presence at DSWSTW1.

The Middle Trinity Aquifer is composed of the Lower Glen Rose, Hensel and Cow Creek limestone. Most stratigraphical variations occurred in these intervals, with the key difference being the presence of a patch reef interval in the upper carbonate of the Lower Glen Rose. As you move from SW to NE across the cross section, the upper carbonate transitions from an interbedded grainstone/calcarenite shoal to a developed “framework” reef/mound with abundant caprinid rudists. This discontinuous nature of the reef interval in the upper carbonate appears to play a large role in groundwater availability, as the unit to the NE has a much higher production than the calcarenite shoal to SW at DSISD No. 1. The lower carbonate of the Lower Glen Rose can be correlated across the cross section, and appears to have water production in both wells.

The Hensel acts as a regionally consistent silty, dolomitic aquitard interval across the section. The underlying Cow Creek has water production on both sides of the cross section, however the basal dolomite interval indicates a facies transition from a thinner, siltier dolomite section at DSISD to a more porous dolomite with relic fossil texture. This is often referred to as the “brown sand” because of its high water yields, and this appears to be true when observing readings on the four-point resistivity log. The underlying Hammett is a regionally consistent siltstone-dolomite aquitard unit for the Middle Trinity in this area.

CONCLUSION AND FUTURE WORK:

The Dripping Springs area, and Central Texas in general, rely on the Trinity Aquifer as an important source of potable groundwater. Evidence of recent studies show increased levels of stress on the aquifers due to an influx of population and demand for growth into the area. Proper conservation of groundwater is key to maintain and protect the aquifer against future pumping and impacts from developments in Dripping Springs.

In addition to high levels of pumping, groundwater appears to be influenced by facies change. Results from cross section analysis indicate that the developed upper “reef” interval in the Lower Glen Rose correlates to better water yield compared to the interbedded calcarenite/grainstone shoal to the west at DSISD. The Cow Creek also appears to become more porous and dolomite as you move NE towards DSWSTW1, and may contribute to greater water production.

Understanding and characterizing the geology of Trinity Aquifer is one of the most important tasks in learning how hydrological variations occur. Geology and hydrology are almost always interconnected in some way in karstic systems such as the Middle Trinity Aquifer. Detailed evaluations of stratigraphy of the geological units in Trinity Aquifer is necessary in order to understand and monitor the hydrological state of the aquifer units.

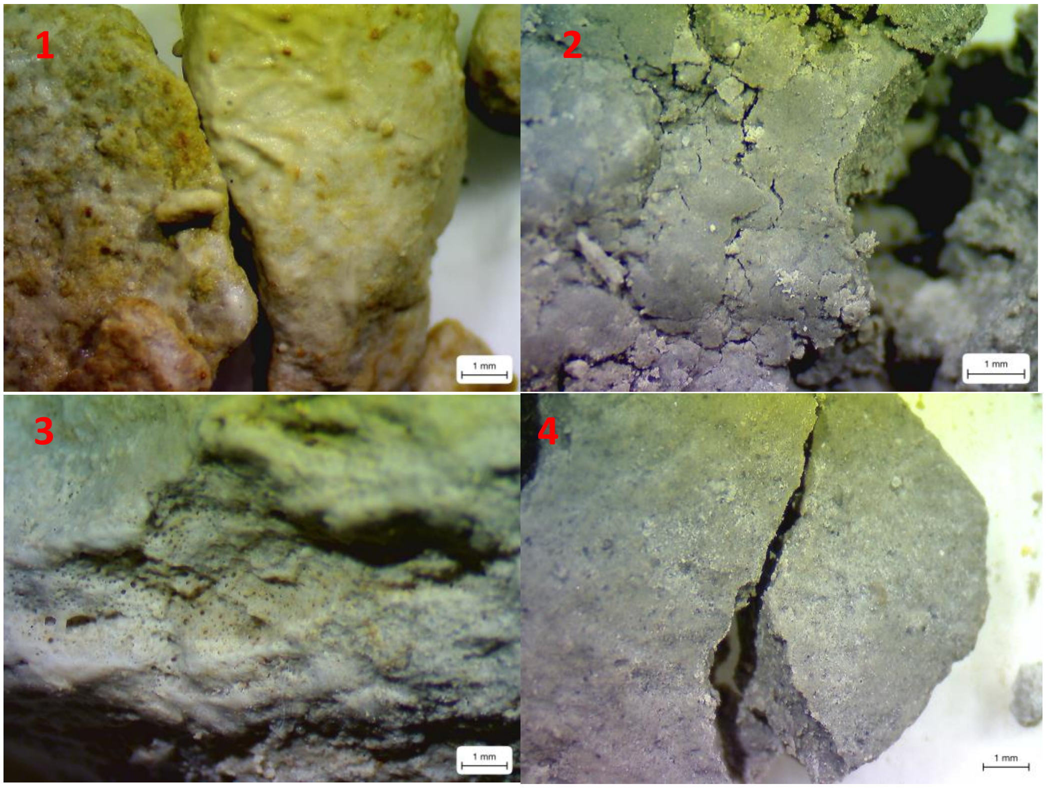
Future evaluations, including more detailed hydrological, geochemical, and stratigraphical analyses will help further understand how geological units influence the hydrology of aquifer units in Dripping Springs and the surrounding Hays County area.

WORKS CITED:

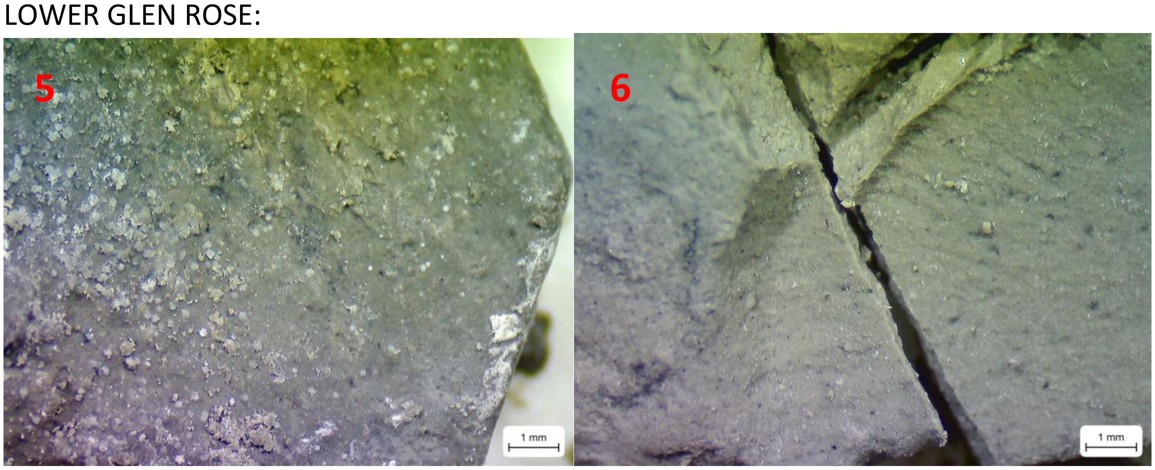
Watson, Jeff. 2018. HTGCD DSISD Dedicated Monitoring Wells: Summary of Drilling Operations and Well Evaluation. Hays Trinity Groundwater Conservation District.

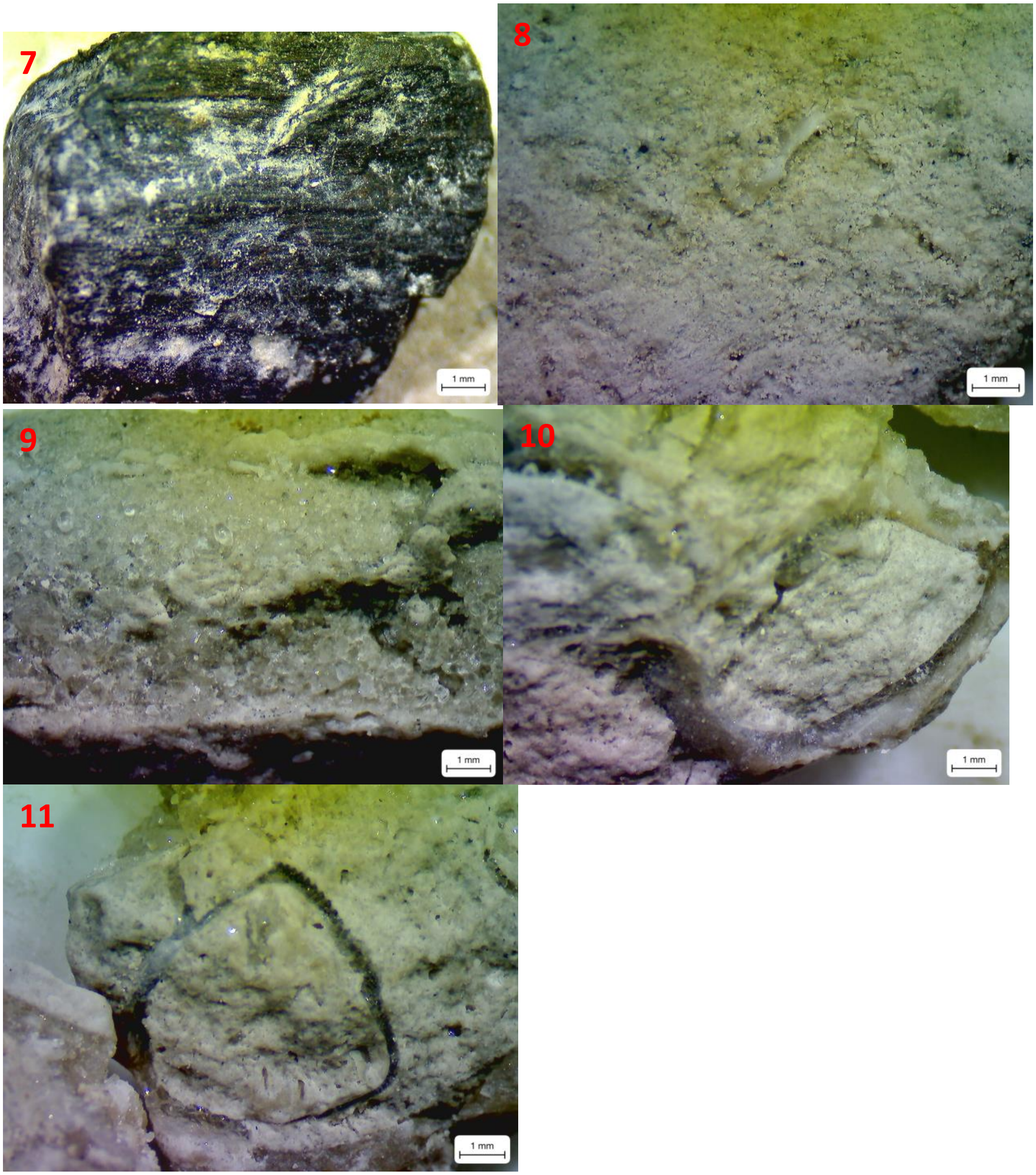
Appendix A

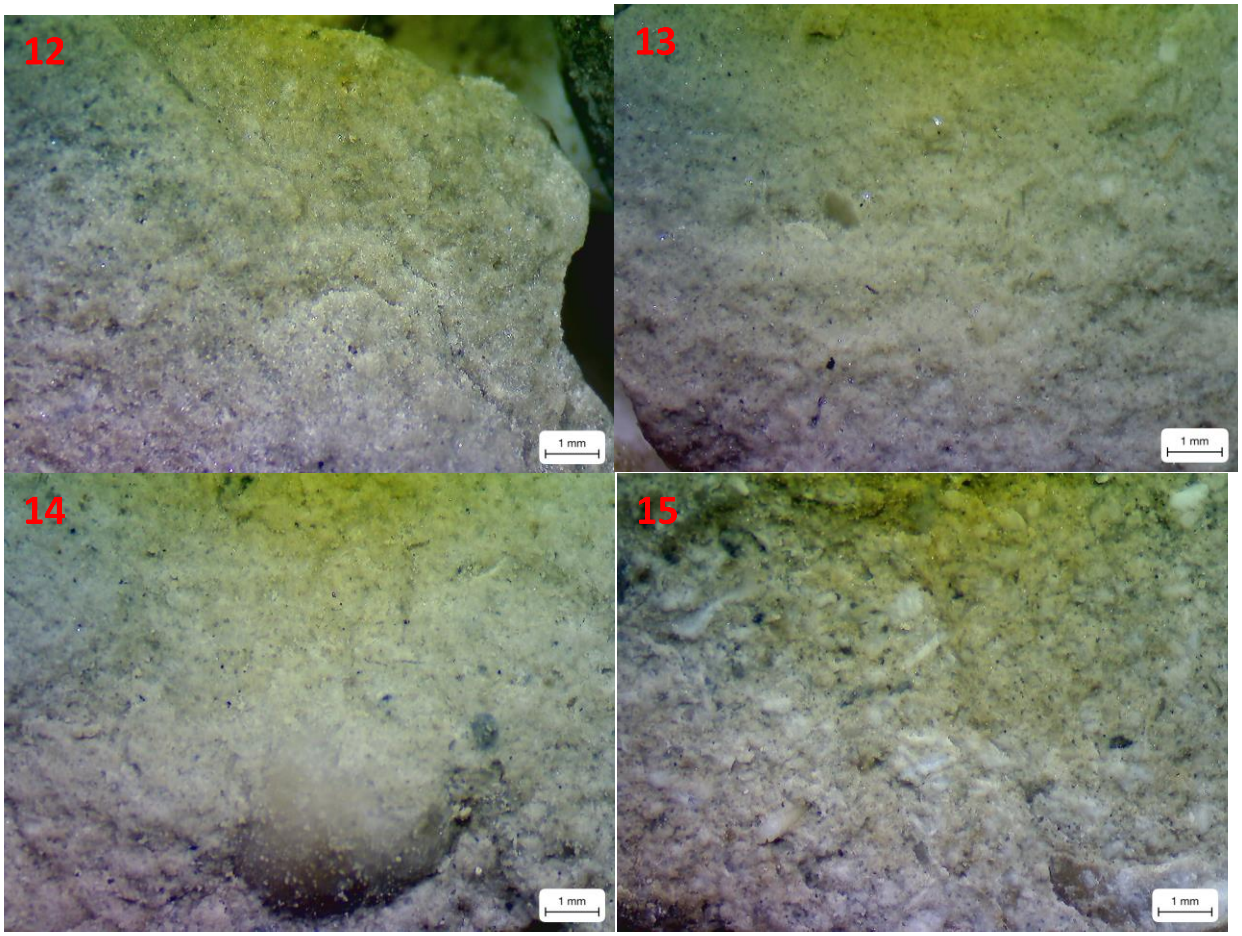
UPPER GLEN ROSE:

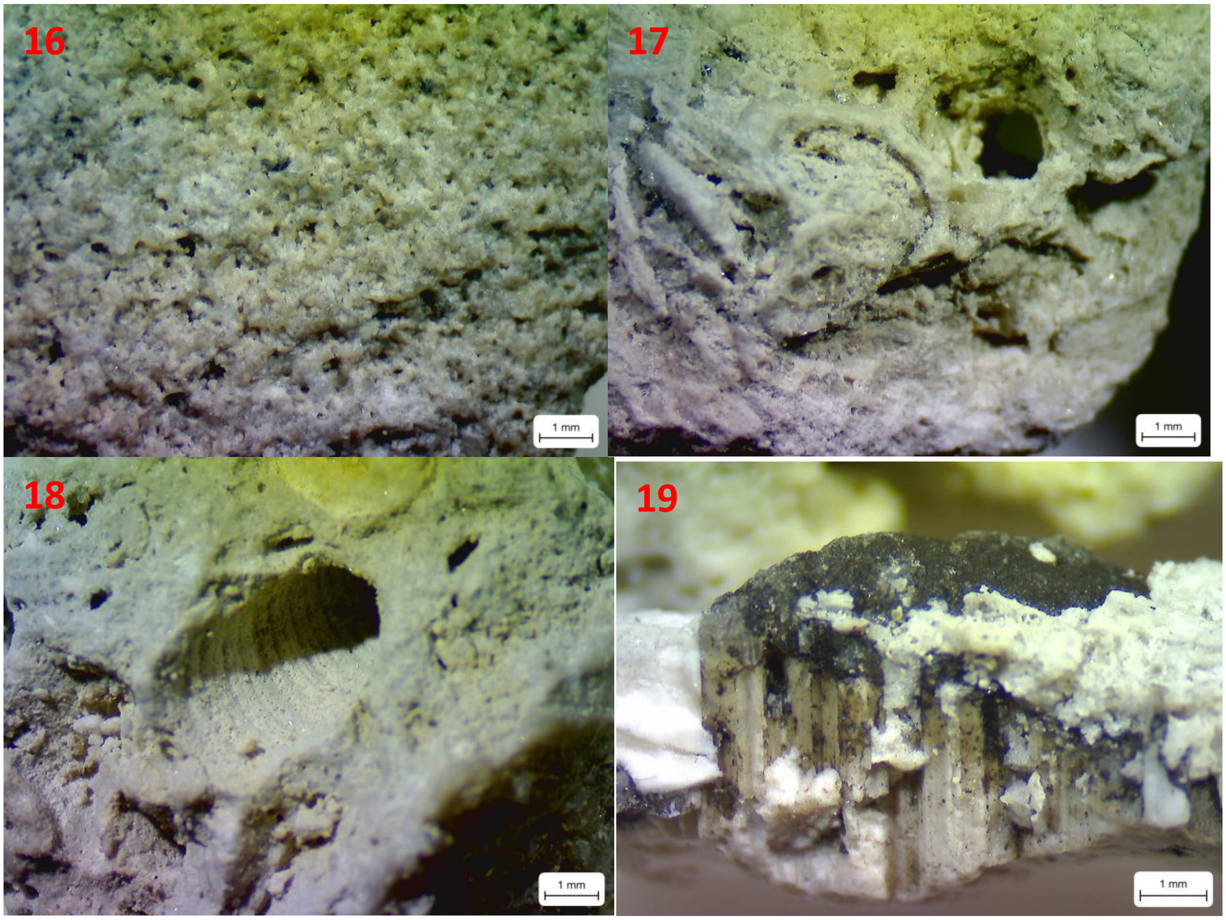


LOWER GLEN ROSE:

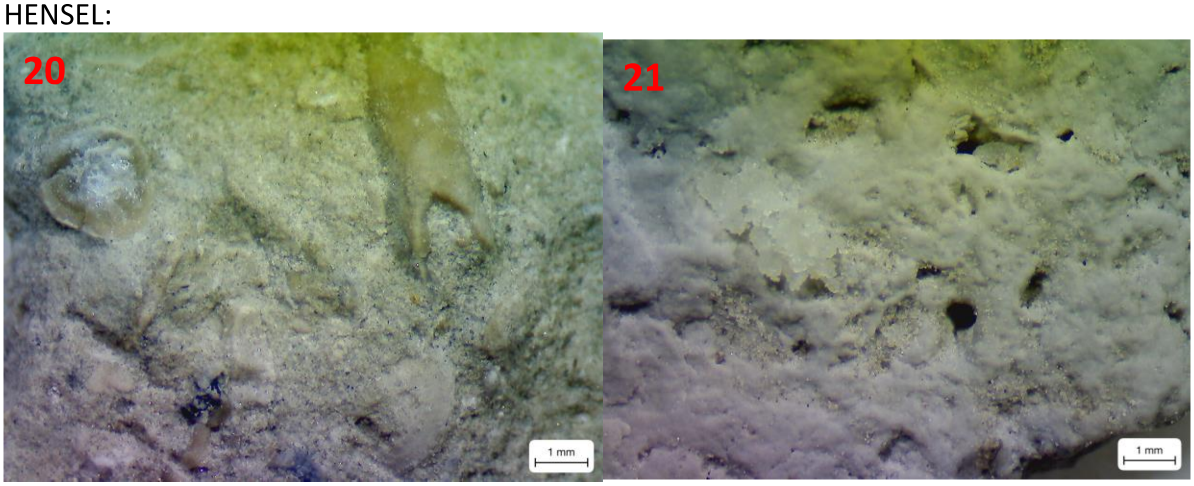



7
1 mm
8
1 mm
9
1 mm
10
1 mm
11
1 mm

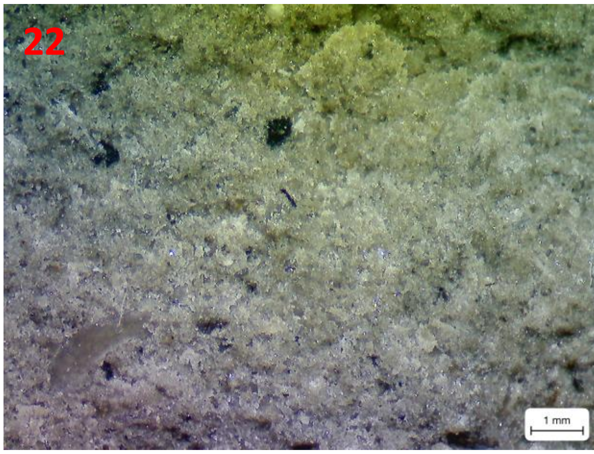

12
1 mm
13
1 mm
14
1 mm
15
1 mm

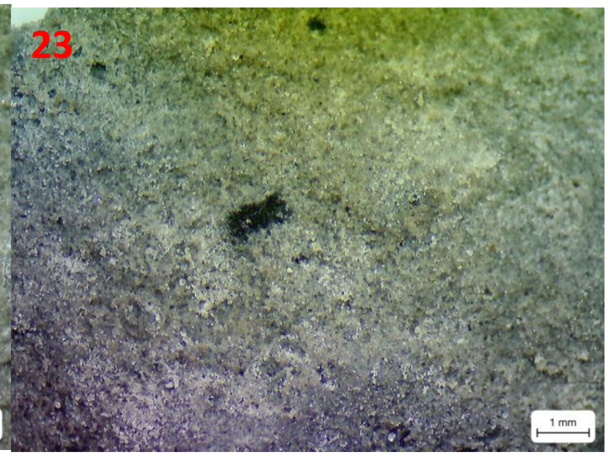


HENSEL:

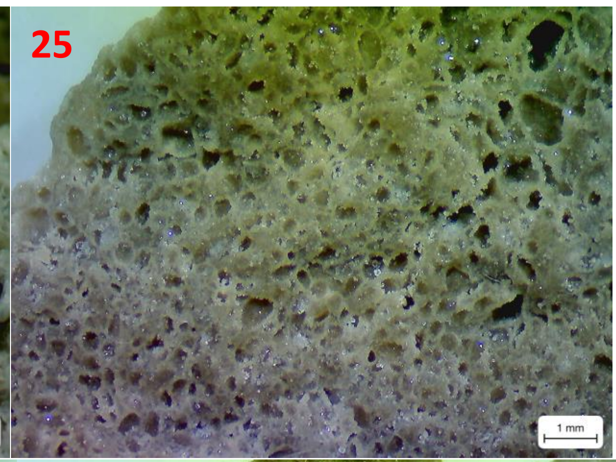


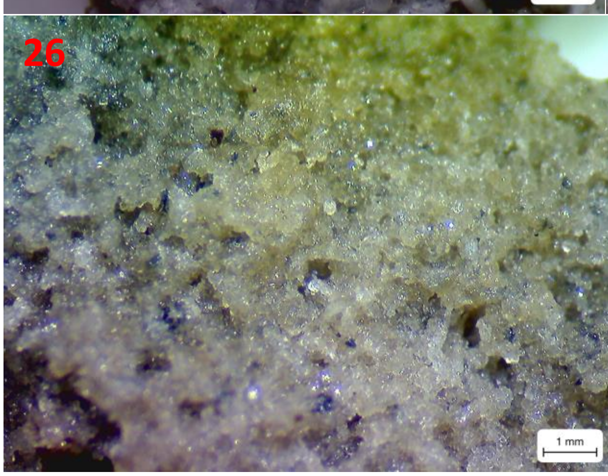
PALEOSOL:





COW CREEK:





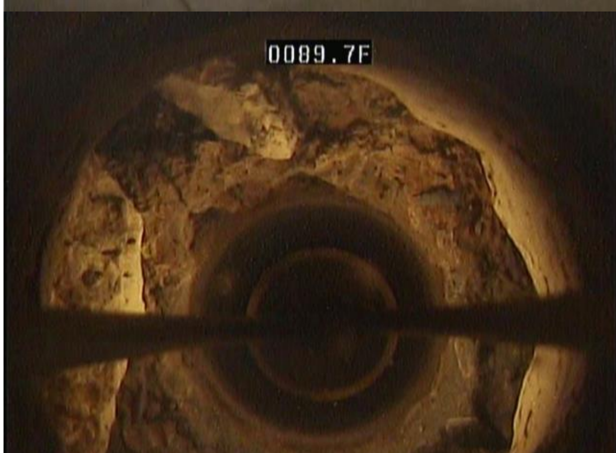
Appendix A:

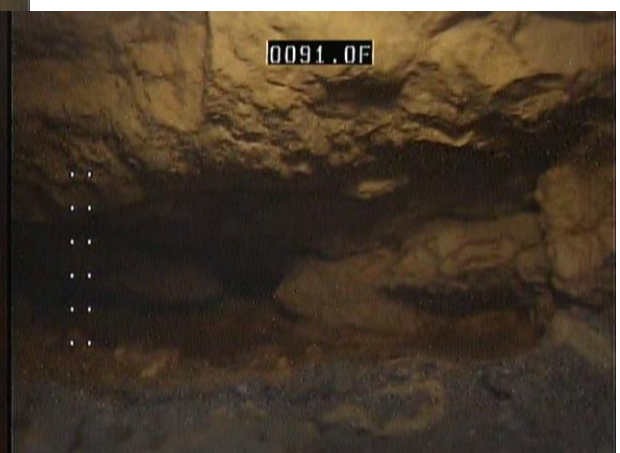
1. (Kgru, 50-60') Micritic wackestone
2. (Kgru, 80-90') Clumpy-argillaceous, calcaerous mudstone
3. (Kgru, 90-100') Vfg tan dolomitic mudstone
4. (Kgru, 100-110') Vfg grey siltstone

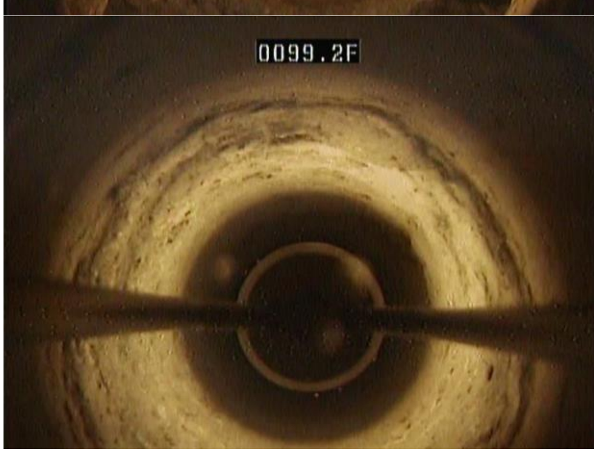
5. (Kgrl, 130-140’) Vfg grey calcareous mudstone
6. (Kgrl, 140-150’) Vfg grey claystone
7. (Kgrl, 150-160’) Lignite
8. (Kgrl, 160-170’) Calcareous, skeletal grainstone
9. (Kgrl, 180-190’) Recrystallized fossil cavity
10. (Kgrl, 180-190’) “framebuilder”, caprinid rudist
11. (Kgrl, 180-190’) “framebuilder”, caprinid rudist
12. (Kgrl, 200-210’) Vfg dolomite grnst
13. (Kgrl, 210-220’) Dolomitic wackestone
14. (Kgrl, 210-220’) Dolomite wackestone with orbitolina
15. (Kgrl, 230-240’) fg skeletal pckst-grainstone
16. (Kgrl, 250-260’) Calcarenite shoal
17. (Kgrl, 270-280’) “framebuilder” caprinid rudist packstone
18. (Kgrl, 280-290’) borehole
19. (Kgrl, 290-300’) Pyrite growth on calcite crystal
20. (Khe, 320-330’) Skeletal dolomitic wackestone
21. (Khe, 330-340’) Part dolomitic wackestone
22. (Paleosol, 330-340’) Dolomite, fg skel frags
23. (Paleosol, 340-350’) Dolomite, vfg
24. (Kcc, 350-360’) Coated skeletal grainstone
25. (Kcc, 350-360’) Dolomitic bryzoan coral
26. (Kcc, 370-380’) “Brown sand” dolomite
27. (Kcc, 400-410’) Dolomite, relic fossil texture

APPENDIX B: DOWNHOLE CAMERA VIDEO

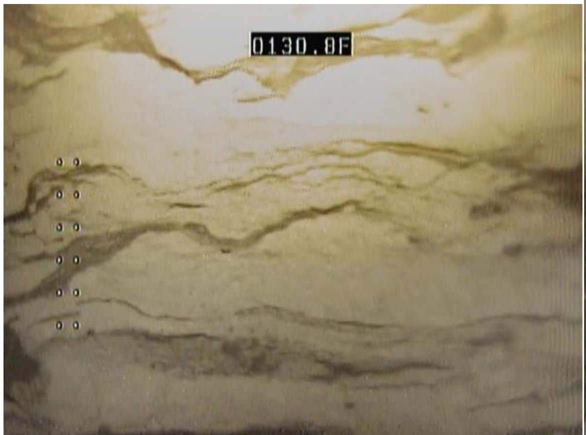
UPPER GLEN ROSE:

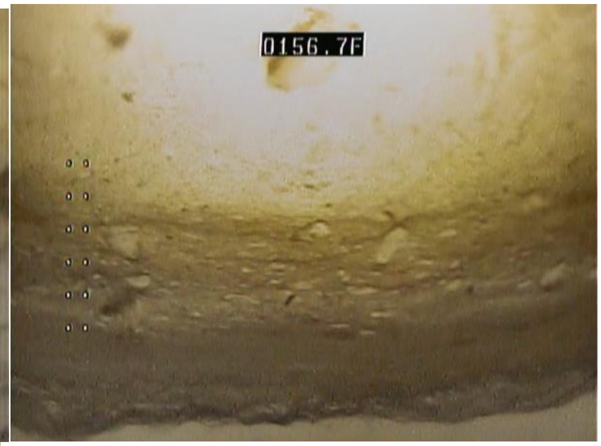


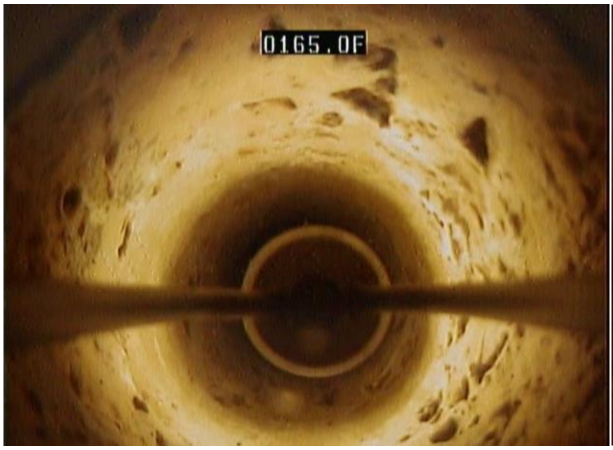




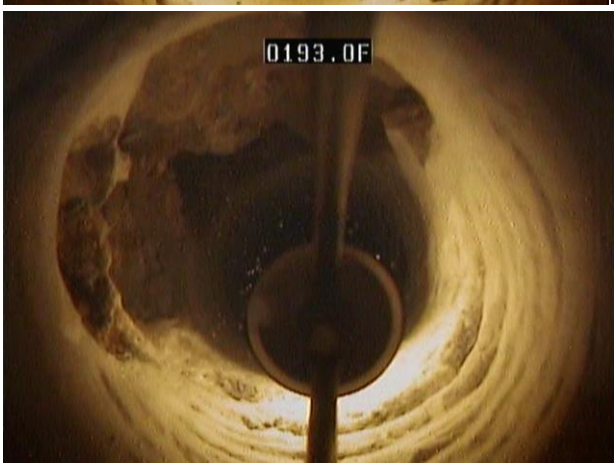
LOWER GLEN ROSE:






0165.0F

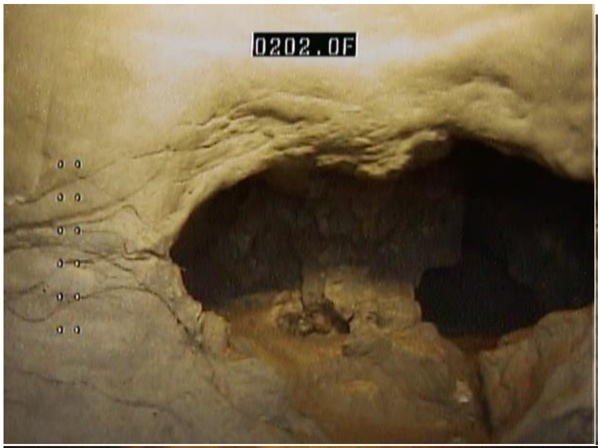

0176.5F


0193.0F


0194.5F


0194.7F

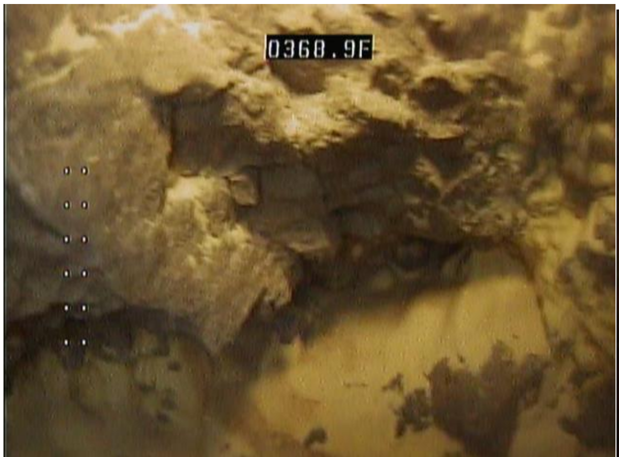

0199.3F



HENSEL:

PALEOSOL:

COW CREEK:



1. (Kgru, 67.4’) Water table
2. (Kgru, 89.7’) Above view of “drop void”
3. (Kgru, 91.0’) “drop void”
4. (Kgru, 99.2’) Wavy irreg. bedding
5. (Kgru, 104.5’) “Vug”
6. (Kgrl, 130.8’) Wavy irreg. bedding with styolites
7. (Kgrl, 156.7’) Carbonaceous bedding plane
8. (Kgrl, 160.9’) Wackestone with skeletal (oyster) frags
9. (Kgrl, 160.2’) Start of upper carbonate
10. (Kgrl, 165.0’) “vugs” in upper carbonate
11. (Kgrl, 176.5’) “vugs” in upper carbonate
12. (Kgrl, 193.0’) “drop void”
13. (Kgrl, 194.5’) “drop void”
14. (Kgrl, 194.7’) “drop void”
15. (Kgrl, 199.3’) “solution cavity”
16. (Kgrl, 202.0’) “solution cavity”
17. (Kgrl, 216.2’) “solution cavity”
18. (Kgrl, 267.3’) “vugs” in lower carbonate
19. (Kgrl, 277.0’) “vugs” in lower carbonate

20. (Khe, 308.9’) Hensel
21. (Khe, 314.0’) Hensel
22. (Khe, 325.3’) “small vug”
23. (Khe, 326.7’) Hensel
24. (Paleosol, 334.1’) View from above
25. (Paleosol, 334.8’) Unconformity
26. (Paleosol, 335.4’) Brecciated dolomite
27. (Paleosol, 335.4’) Brecciated dolomite with caliche
28. (Kcc, 347.8’) View of bottom of paleosol from above
29. (Kcc, 357.4’) Cow Creek, caliche
30. (Kcc, 363.3’) Carbonaceous bedding plane
31. (Kcc, 364.2’) “cave” with fractured/brecciated dolomite with caliche
32. (Kcc, 368.9’) “cave” with dolomite and caliche
33. (Kcc, 390.5’) Dolomite with caliche
34. (Kcc, 404.3’) “drop void”
35. (Kcc, 417.7’) Bottom of well, “drop void”, filled with sediment