

Geologic Assessment

Texas Commission on Environmental Quality

For Regulated Activities on The Edwards Aquifer Recharge/transition Zones and Relating to 30 TAC §213.5(b)(3), Effective June 1, 1999

To ensure that the application is administratively complete, confirm that all fields in the form are complete, verify that all requested information is provided, consistently reference the same site and contact person in all forms in the application, and ensure forms are signed by the appropriate party.

Note: Including all the information requested in the form and attachments contributes to more streamlined technical reviews.

Signature

To the best of my knowledge, the responses to this form accurately reflect all information requested concerning the proposed regulated activities and methods to protect the Edwards Aquifer. My signature certifies that I am qualified as a geologist as defined by 30 TAC Chapter 213.

Print Name of Geologist: Richard V. Klar, P.G.

Telephone: 210-699-9090

Date: September 23, 2019

Fax: 210-699-6426

Representing: Raba Kistner Environmental, Inc., TBPB #50220 / TBPE Firm #3257 for New Braunfels Utilities (Name of Company and TBPB or TBPE registration number)

Signature of Geologist:




Regulated Entity Name: NBU Property Expansion

Project Information

1. Date(s) of Geologic Assessment was performed: August 6, 7, 9, 15, 16, 19, and 28, 2019

2. Type of Project:

☒ WPAP

☐ SCS

☐ AST

☐ UST

3. Location of Project:

- ☒ Recharge Zone
☐ Transition Zone
☐ Contributing Zone within the Transition Zone

4. ☒ **Attachment A – Geologic Assessment Table.** Completed Geologic Assessment Table (Form TCEQ-0585-Table) is attached.

5. ☒ Soil cover on the project site is summarized in the table below and uses the SCS Hydrologic Soil Groups* (Urban Hydrology for Small Watersheds, Technical Release No. 55, Appendix A, Soil Conservation Service, 1986). If there is more than one soil type on the project site, show each soil type on the site Geologic Map or a separate soils map.

Table 1 - Soil Units, Infiltration Characteristics and Thickness

Soil Name	Group*	Thickness
Rumple-Comfort association, 1-8% slopes, undulating (RUD)	C	Veneer to 3.0 feet

**Soil Group Definitions (Abbreviated)*

- A. Soils having a high infiltration rate when thoroughly wetted.
B. Soils having a moderate infiltration rate when thoroughly wetted.
C. Soils having a slow infiltration rate when thoroughly wetted.
D. Soils having a very slow infiltration rate when thoroughly wetted.

6. ☒ **Attachment B – Stratigraphic Column.** A stratigraphic column showing formations, members, and thickness is attached. The outcropping unit, if present, should be at the top of the stratigraphic column. Otherwise, the uppermost unit should be at the top of the stratigraphic column.
7. ☒ **Attachment C – Site Geology.** A narrative description of the site specific geology including any features identified in the Geologic Assessment Table, a discussion of the potential for fluid movement to the Edwards Aquifer, stratigraphy, structure(s), and karst characteristics is attached.

8. ☒ **Attachment D – Site Geologic Map(s).** The Site Geologic Map must be the same scale as the applicant's Site Plan. The minimum scale is 1":400'.

Applicant's Site Plan Scale: 1" = 100'

Site Geologic Map Scale: 1" = 100'

Site Soils Map Scale (if more than 1 soil type): See Site Geologic Map

9. Method of collecting positional data:

☒ Global Positioning System (GPS) technology.

☐ Other method(s). Please describe method of data collection: ____

10. ☒ The project site boundaries are clearly shown and labeled on the Site Geologic Map.

11. ☒ Surface geologic units are shown and labeled on the Site Geologic Map.

12. ☒ Geologic or manmade features were discovered on the project site during the field investigation. They are shown and labeled on the Site Geologic Map and are described in the attached Geologic Assessment Table.

☐ Geologic or manmade features were not discovered on the project site during the field investigation.

13. ☒ The Recharge Zone boundary is shown and labeled, if appropriate.

14. All known wells (test holes, water, oil, unplugged, capped and/or abandoned, etc.): If applicable, the information must agree with Item No. 20 of the WPAP Application Section.

☐ There are ____ test holes/wells present on the project site and the locations are shown and labeled. (Check all of the following that apply.)

☐ The test holes/wells are not in use and have been properly abandoned.

☐ The wells are in use and will be properly abandoned.

☐ The well is not in use and complies with 16 TAC Chapter 76.

☒ There are no wells or test holes of any kind known to exist on the project site.

Administrative Information

- ☒ Submit one (1) original and one (1) copy of the application, plus additional copies as needed for each affected incorporated city, groundwater conservation district, and county in which the project will be located. The TCEQ will distribute the additional copies to these jurisdictions. The copies must be submitted to the appropriate regional office.

ATTACHMENTS

ATTACHMENT A

**GEOLOGIC ASSESSMENT TABLE
(TCEQ-0585-TABLE)**

**COMMENTS TO GEOLOGIC
ASSESSMENT TABLE**

FEATURE PHOTOGRAPH LOG

SOIL PROFILE

GEOLOGIC ASSESSMENT TABLE						PROJECT NAME: NBU Property Expansion - New Braunfels, Comal County, Texas (RKI Project No. ASF19-092-00)													
LOCATION			FEATURE CHARACTERISTICS											EVALUATION			PHYSICAL SETTING		
1A	1B *	1C*	2A	2B	3	4			5	5A	6	7	8A	8B	9	10	11		12
FEATURE ID	LATITUDE	LONGITUDE	FEATURE TYPE	POINTS	FORMATION	DIMENSIONS (FEET)			TREND (DEGREES)	DOM	DENSITY (NO/FT)	APERTURE (FEET)	INFILL	RELATIVE INFILTRATION RATE	TOTAL	SENSITIVITY	CATCHMENT AREA (ACRES)		TOPOGRAPHY
						X	Y	Z									<40	>40	
S-1	N29 42 19.8	W98 10 14.2	C	30	Kep	62.0	22.5	10.0	225° (NE-SW)	10			N, FS	35	75		✓	✓	Hilltop
S-2	N29 42 21.5	W98 10 19.3	C (Coreth Cave)	30	Kep	230.0	130.0	69.0	240° (NE-SW)	10			N, FS, X	35	75		✓	✓	Hilltop
S-3	N29 42 22.5	W98 10 21.5	SC	20	Kep	7.0	6.0	2.5	210° (NE-SW)	10			O, F	9	39	✓		✓	Hilltop
S-4	N29 42 22.3	W98 10 21.0	CD	5	Kep	8.0	5.0	2.5					F	6	11	✓		✓	Hilltop
S-5	N29 42 18.4	W98 10 30.4	CD	5	Kep	6.0	4.0	2.0					F	6	11	✓		✓	Hilltop
S-6	N29 42 18.4	W98 10 31.9	CD	5	Kep	8.0	6.0	3.0					F	6	11	✓		✓	Hilltop

* DATUM: NAD 83

Formations: Kep = Person Formation

2A TYPE	TYPE	2B POINTS
C	Cave	30
SC	Solution cavity	20
SF	Solution-enlarged fracture(s)	20
F	Fault	20
O	Other natural bedrock features	5
MB	Manmade feature in bedrock	30
SW	Swallow hole	30
SH	Sinkhole	20
CD	Non-karst closed depression	5
Z	Zone, clustered or aligned features	30

8A INFILLING	
N	None, exposed bedrock
C	Coarse - cobbles, breakdown, sand, gravel
O	Loose or soft mud or soil, organics, leaves, sticks, dark colors
F	Fines, compacted clay-rich sediment, soil profile, gray or red colors
V	Vegetation. Give details in narrative description
FS	Flowstone, cements, cave deposits
X	Other materials: Thick (veneer to 2 feet) bat guano deposits across majority of the cave floor.
12 TOPOGRAPHY	
Cliff, Hilltop, Hillside, Drainage, Floodplain, Streambed	

I have read, I understood, and I have followed the Texas Natural Resource Conservation Commission's Instructions to Geologists. The information presented here complies with that document and is a true representation of the conditions observed in the field.
My signature certifies that I am qualified as a geologist as defined by 30 TAC 213.



Date: 9/23/19

Sheet 1 of 1

COMMENTS TO GEOLOGIC ASSESSMENT TABLE
NBU Property Expansion
New Braunfels, Comal County, Texas

The locations of the following features are indicated on the *Site Geologic Map* provided as Attachment D of this report.

Caves

Feature S-1:

Feature S-1 consists of a sinkhole with associated cave development that collectively measures approximately 62 x 22 feet in plan view and has been exploited historically in association with past farm/ranch operations as a trash disposal site. The cave entrance and surrounding sinkhole depression were observed to contain ranch wastes and household rubbish consisting of tin cans, glass bottles, bailing wire, and automotive parts in addition to other minor debris. The cave entrance measures approximately 7.5 x 2.5 feet in length and width and opens to a small room. The cave is formed in the upper part of the Person Limestone and is inferred to extend approximately 10 feet below ground surface at its greatest depth.

No well-defined surface drainage features are associated with the cave. The cave is oriented along the dominant NE-SW structural trend although no well-defined fractures were observed within the cave. The cave was accessed by our field crew such that its maximum lateral extent could be determined. Observations within the cave confirmed slight air flow and the presence of normal cave fauna including spiders and crickets. The cave also appears to periodically host small animals including snakes, skunks, and porcupines. A plan view sketch of the cave is provided on the attached *Site Geologic Map*. Refer to photographs 1 through 12 in the attached *Feature Photograph Log*.

This feature is classified as sensitive owing to rapid infiltration potential.

Feature S-2:

Feature S-2 consists of a large sinkhole feature with extensive cave development that appears to have been well known and explored historically. The cave was most recently mapped by the Texas Speleological Society (TSS) in 1995 and designated as the Coreth Cave. The cave is also referred to as the R. R. Coreth Caverns and/or Corith Caves in *A Revised Checklist of Texas Caves prepared by the Texas Speleological Association (1966)*. The surface collapse feature and associated subsurface cave extent measures approximately 230 x 130 x 69 feet in length, width, and depth, respectively. The cave is formed completely within the upper part of the Person Formation and oriented along the dominant NE-SW structural trend, although no well-defined fractures were observed within the cave. The cave appears to have been formed by collapse associated with the surrounding sinkhole and the entrance consists of a vertical shaft that extends on the order of 15 feet to the cave floor and facilitates access to the cave by a small bat population.

In accordance with geologic assessment guidelines, accessible portions of the cave system were entered and visually surveyed on three separate occasions in order to develop an estimate of the cave's lateral and vertical extent. The estimated lateral extent of the cave that could be accessed by the survey team is depicted on the **Site Geologic Map**. Photographs 13 through 32 in the attached **Feature Photograph Log** depict the surroundings of the cave opening, contents, and extents of the cave interior.

A summary of pertinent observations taken in conjunction with the cave survey is as follows:

- From the primary entrance, the cave opens into a large and laterally extensive room measuring approximately 70 x 50 x 8 feet in length, width, and height respectively. The room trends to the east and connects to a primary passageway that roughly defines the lateral extent of the cave in the subsurface. The passageway is estimated to comprise more than 420 linear feet and becomes narrower with distance into the cave. Several small rooms and parallel chambers were observed along the primary passageway. The passageway slopes downward as it extends from the entrance, reaching a maximum estimated depth of about 69 feet relative to surrounding ground surface.
- The cave ceiling and upper portion of the room consists of gray honeycombed limestone. Moving downward into the cave, the walls and ceiling areas unaffected by secondary mineral growth are white to buff massive limestone with interbedded chert nodules. It appears that most of the cave formation was within this lower rock unit and in similar bedding units at deeper levels within the cave. As the cave has been enlarged by the periodic collapse of ceiling units in conjunction with limestone dissolution, several feet collapse materials cover the cave floor and no clear exposures of limestone were observed along the cave bottom throughout its accessible extent.
- The cave is host to a significant biologic population including bats. The cave floors within the majority of the rooms and passageways is covered with several feet to a veneer of bat guano in various stages of decomposition. Thriving insect populations that feed on the guano were observed including crickets and spiders of various types. Based on the guano accumulations, it appears that the cave has been inhabited by bats for many decades. At the time survey activities were conducted, a small bat population was present. The large room at the cave entrance also appears to periodically host small animals including snakes, skunks, and raccoons.
- Survey activities were conducted during dry weather conditions and cave conditions were generally moist with the exception of the rooms and passages throughout the lowermost cave levels, which exhibited water drips and drops on stalactites. General observations throughout the cave including the presence of speleothems and flow stone surfaces indicate the periodic migration of water to the subsurface.

This feature is classified as sensitive owing to rapid infiltration potential.

Solution Cavity

Feature S-3 (SC):

Feature S-3 consists of a solution cavity within a small depression that is completely rimmed and floored by intact limestone. The feature was apparently formed as the result of surface erosional processes. The depression measures approximately 7 x 6 x 2.5 feet in length, width, and depth respectively. The feature is located within the Person Formation on the hilltop near the north portion of the property. The solution cavity opening measures approximately 1.3 x 0.7 feet in length and width, respectively. Based on hand-excavation activities and probing, the feature is infilled with clay soils and some organic materials and is sometime host to burrowing animals. There was no channeling or preferential flow directed to this feature. See Photo #33 in the attached **Feature Photograph Log**.

Non-Karst Closed Depressions

Feature S-4

Feature S-4 consists of a non-karst closed depression formed by a tree root collapse along the base of a large Oak tree, which has been enhanced by animal burrowing. The feature is located within the north portion of the of the property. The feature dimensions are on the order of 8 x 5 x 2.5 feet in length, width, and height, respectively. The feature is completely contained within dark reddish-brown clay soil and with no connection to underlying limestone bedrock. There was no channeling or preferential flow directed to this feature. See Photo #34 in the attached **Feature Photograph Log**.

Feature S-5

Feature S-5 consists of a non-karst closed depression formed by a historical tree root collapse and enhanced by burrowing animals. The feature is located on the hillside within the west portion of the of the property. The feature dimensions are on the order of 6 x 4 x 2 feet in length, width, and height, respectively. The feature is completely contained within dark reddish-brown clay soil and with no connection to underlying limestone bedrock. There was no channeling or preferential flow directed to this feature. See Photo #35 in the attached **Feature Photograph Log**.

Feature S-6

Feature S-6 consists of a non-karst closed depression formed by tree root collapse. The feature is further enhanced in multiple locations by burrowing animals. The feature is located on the hillside within the west portion of the of the property, approximately 135 feet west of **Feature S-5**. The feature dimensions are on the order of 8 x 6 x 3 feet in length, width, and height, respectively. The feature is completely contained within dark reddish-brown clay soil and with no connection to underlying limestone bedrock. There was no channeling or preferential flow directed to this feature. See Photo #36 in the attached **Feature Photograph Log**.

FEATURE PHOTOGRAPH LOG

Feature S-1

Photo 1.



Photo 2.



Photo 3



Photo 4.



FEATURE PHOTOGRAPH LOG

Feature S-1

Photo 5.



Photo 6.



Photo 7.

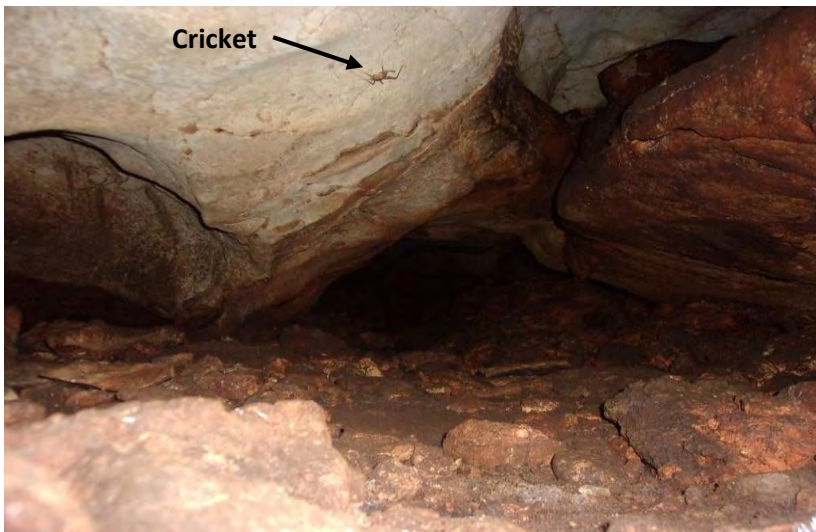


Photo 8.



FEATURE PHOTOGRAPH LOG

Feature S-1

Photo 9.



Photo 10.



Photo 11.



Photo 12.



FEATURE PHOTOGRAPH LOG

Feature S-2

Photo 13.



Photo 14.



Photo 15.



Photo 16.



FEATURE PHOTOGRAPH LOG

Feature S-2

Photo 17.



Photo 18.



Photo 19.



Photo 20.



FEATURE PHOTOGRAPH LOG

Feature S-2

Photo 21.



Photo 22.



Photo 23.

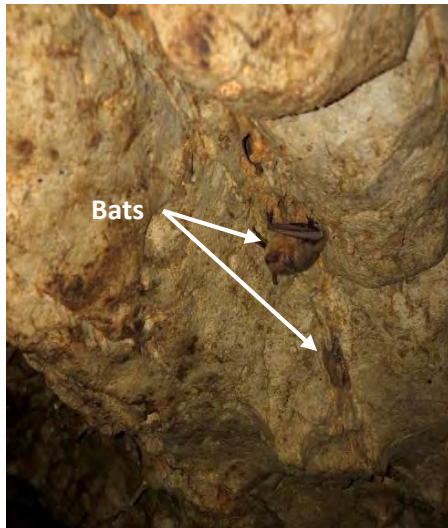


Photo 24.



FEATURE PHOTOGRAPH LOG

Feature S-2

Photo 25.



Photo 26.



Photo 27.



Photo 28.



FEATURE PHOTOGRAPH LOG

Feature S-2

Photo 29.



Photo 30.



Photo 31.



Photo 32.



FEATURE PHOTOGRAPH LOG

Features S-3, S-4, S-5, and S-6

Photo 33 – Feature S-3.



Photo 34 – Feature S-4.



Photo 35 – Feature S-5.



Photo 36 – Feature S-6.



SOIL PROFILE
NBU Property Expansion
New Braunfels, Comal County, Texas

SOIL SERIES	THICKNESS ON SITE	DESCRIPTION
Rumble-Comfort	Veneer - 3.0 feet	<i>Rumble-Comfort association, undulating (RUD):</i> Rumble soils compose an average of 60 percent, Comfort soils average 20 percent, and other soils mainly composed of Tarpley soils make up the remaining 20 percent of this association. Rumble soils are approximately 10 inches thick, dark reddish brown, and very cherty clay loam. The subsoil to a depth of 14 inches is dark reddish brown very cherty clay, and dark reddish brown extremely stony clay that is about 75 percent, by volume, limestone fragments to a depth of 28 inches. The underlying material is indurated fractured limestone. The soil is well drained, noncalcareous, and mildly alkaline.

The preceding table was prepared on the basis of information provided in the *Soils Survey of Comal and Hays Counties, Texas (June 1984)* in addition to field observations. As presented on the attached **Site Geologic Map** provided in **Attachment A** of this report, the entire subject property is mapped as Rumble-Comfort association, undulating (RUD). RUD soils are noted to have medium runoff and moderate hazard for erosion. The RUD soils are characterized as having a very low water capacity and a moderately slow permeability of approximately 0.06 to 0.6 inches per hour, considering both included soil types. RUD soils have a slow infiltration when the soils are wet and rapid when the soils are dry.

ATTACHMENT B

STRATIGRAPHIC COLUMN

STRATIGRAPHIC COLUMN
NBU Property Expansion
New Braunfels, Comal County, Texas

STRATIGRAPHIC FORMATION	THICKNESS	DESCRIPTION
Person Formation (Kep)	180-224 feet	(See descriptions below)
<i>Cyclic and Marine Members, undivided</i>	80-100 feet	Unit consists of massive mudstone to packstone; <i>miliolid</i> grainstone; and chert. Identified in the field by cycles of light tan, massive to relatively thin limestone bedding units with some occurrence of crossbedding that is laterally extensive and highly permeable. Exposures observed in patchy outcrops throughout the north and northwest portions of the SITE and within cave features (S-1 and S-2)
<i>Leached and Collapsed Members, undivided</i>	80–100 ft.	Unit consists of crystalline limestone, mudstone to grainstone and chert. Identified in the field by bioturbated iron-stained beds separated by massive limestone beds with extensive vertical karst development. This unit is highly permeable. Not exposed at the SITE.
<i>Regional Dense Member</i>	20-24 ft.	Unit consists of dense, argillaceous mudstone. Identified in the field by wispy iron-oxide stains. This unit has low permeability. Not exposed at the SITE.

Note: Stratigraphic Column adapted from Small and Hanson (1994).

ATTACHMENT C

NARRATIVE OF SITE SPECIFIC GEOLOGY

SITE GEOLOGY NARRATIVE
NBU Property Expansion
New Braunfels, Comal County, Texas

Introduction

The following is a site-specific discussion of existing geological conditions and potential recharge features identified within the referenced project site. This assessment was performed by **Raba Kistner, Inc. (RKI)** for New Braunfels Utilities (CLIENT), pursuant to applicable Edwards Aquifer Protection Program (EAPP) Rules as specified in *Title 30 of the Texas Administrative Code, Section 213 (30 TAC §213, effective April 24, 2008)*. This assessment report is in the format required by the Texas Commission on Environmental Quality (TCEQ) for the Geologic Assessment and was prepared in accordance with the revised *Instructions to Geologists for Geologic Assessments on the Edwards Aquifer Recharge/Transition Zones (TCEQ-0585)*, which are applicable to submittals received by the TCEQ after October 1, 2004.

This geologic assessment report documents conditions observed by **RKI** within the project boundaries on August 6, 7, 9, 15, 16, 19, and 28 2019.

Project Description and Background

Site Location. The project comprises a 48.575-acre tract of land (Tract 2) within the William Mockford Survey No. 2, which is located in the west sector of New Braunfels at the terminus of Westpointe Drive in New Braunfels, Comal County, Texas (hereinafter referred to as SITE). The subject property currently is vacant, although one unused metal cabin structure was observed near the central portion of the SITE. Based on review of official maps published by the Texas Commission on Environmental Quality (TCEQ), the entire SITE is located within the Edwards Aquifer Recharge Zone (EARZ). Given the SITE's location within the EARZ, performance of a geologic assessment is required to facilitate planned construction activities pursuant to applicable Edwards Aquifer Protection Program (EAPP) rules.

Topography and Drainage. Topographic contours on the U.S. Geological Survey (USGS, 2013) 7.5-minute topographic map (i.e., New Braunfels West Quadrangle) were reviewed to evaluate the general surface conditions and drainage patterns, along with more detailed 2-foot topographic contours obtained from the Comal County GIS website (i.e., <http://data2-newbraunfels.opendata.arcgis.com/datasets/contours-2ft>, dated 2017). The SITE consists of a gently sloping hilltop topography, exhibiting a maximum elevation of approximately 906 feet relative to mean sea level (MSL) near the north corner and a minimum elevation of approximately 884 feet in the south corner. As indicated by topographic contours presented on the **Site Geologic Map**, the local surface drainage patterns for the SITE are generally from upland (hilltop areas) to the east, south, and southwest toward unnamed tributaries to Dry Comal Creek.

A review of Flood Insurance Rate Map (FIRM 48091C0435F, FEMA, September 2, 2009) indicate that the entire SITE is contained within Zone X (i.e., an area determined to be outside of the defined 0.2% annual probability floodplain area).

Historical Property Use. Although research pertaining to past SITE operations and historical land use activities was beyond the scope of this assessment, historical aerial imagery was reviewed to evaluate

historical land use and the presence of lineations that could indicate the presence of normal faulting. The following aerial photographs were reviewed: 1995, 2005, 2008, 2010, 2012, 2014, 2016, and 2018. The 1995 through 2012 aerial photographs indicate the SITE to be undeveloped and wooded. The SITE appears to be part of a larger ranch land property. The 2014 aerial indicates the SITE to remain unchanged with development of an unpaved roadway, structures and a large aboveground water storage tank on adjacent properties to the northwest and southeast. The 2016 and 2018 aerial photographs indicate consistent conditions at the SITE.

As presented on the attached **Site Geologic Map**, current adjacent properties include vacant, undeveloped property to the north and east with a single-family residential community further north; New Braunfels Utilities drinking water chlorination facility to the southeast; and Cemex-Balcones Quarry to the west/southwest of the SITE.

Classification of Recharge Features: As further described herein, recharge features attributed to karstification of underlying geologic formations were identified within SITE boundaries to include a solution cavity and two caves. No manmade features were identified. The significance of these features was assessed using definitions and guidance provided in *Instructions to Geologists (TCEQ-0585-Instructions, revised October 1, 2004)*. All features within the SITE that met the criteria presented in this reference were mapped. The characteristics of all mapped features and the assessments of these features, as defined by the TCEQ, are presented in the attached **Geologic Assessment Table (TCEQ-0585)**.

Stratigraphy

As presented in the attached **Stratigraphic Column**, information pertaining to the lithologies and thickness of geologic units underlying the SITE was adapted from Small and Hanson (1994) and Collins (2000). Based on field mapping observations and review of published references, the SITE is underlain by the Person Formation (Kep), which comprises the uppermost portion of the Edwards Limestone as presented on the **Site Geologic Map**. The Kep is commonly subdivided into three discrete members as follows: (i) Cyclic and Marine Member, undivided – mudstone to packstone, grainstone, and chert; (ii) Leached and Collapsed Member, undivided - unit includes crystalline limestone, mudstone to grainstone, and chert; and (iii) Regional Dense Member - unit consists of dense, carbonate mudstone. Based on field observations and interpretation of published geologic information the Leached and Collapsed member of the Kep represents the portion of the Edwards Limestone directly underlying the SITE to depths on the order of 180 to 224 feet. Exposures of the Kep (i.e., Cyclic and Marine Member) were observed in patchy exposures throughout the SITE and within cave features assessed as part of this study. (i.e., **Features S-1 and S-2**).

Structure

This SITE is located along the southern edge of the Balcones Fault Zone and, as such, is expected to exhibit a similar dominant structural trend. The Balcones Fault Zone generally consists of a northeast-southwest trending, *en echelon* normal fault system, which juxtaposes Upper Cretaceous lithologies in the southeast with Lower Cretaceous lithologies in the northwest. As a result of this large-scale regional faulting, minor internal fault sequences and fractures exist within this zone which generally follow the same structural trend and accommodate localized displacement.

Based on review of historical aerial photographs, published maps, and in conjunction with field mapping efforts, no indications of lineations that could be associated with normal faulting were identified within the boundaries of the SITE.

Karst Features

As presented on the *Site Geologic Map*, three karst features were identified on the subject property:

Caves

Two caves were identified within SITE boundaries (**Features S-1 and S-2**). Both features were formed by collapse and dissolution of limestone bedrock associated with surrounding sinkhole development in the upper part of the Person Formation. In conjunction with this assessment, the **RKI** crew made three site visits to map the lateral extent of the caves. In addition, **RKI** conducted research with the Texas Speleological Society (TSS), which yielded a previous biological survey and cave map pertaining to **Feature S-2**. A description of cave features is provided below:

Feature S-1 consists of a sinkhole with associated cave development that collectively measures approximately 62 x 22 feet in plan view. The cave entrance and surrounding sinkhole depression were observed to contain ranch wastes and household rubbish consisting of tin cans, glass bottles, bailing wire, and automotive parts in addition to other minor debris. The cave entrance measures approximately 7.5 x 2.5 feet in length and width and opens to a small room. The cave is formed in the upper part of the Person Limestone and is inferred to extend approximately 10 feet below ground surface at its greatest depth.

The cave was accessed by our field crew such that its maximum lateral extent could be determined. Observations within the cave confirmed slight air flow and the presence of normal cave fauna including spiders and crickets. The cave also appears to periodically host small animals including snakes, skunks, and porcupines.

Feature S-2 consists of a large sinkhole feature with extensive cave development that appears to have been well known and explored historically. The cave was most recently mapped by the Texas Speleological Society (TSS) in 1995 and designated as the Coreth Cave and has also been referred to as the R. R. Coreth Caverns and/or Corith Caves. The surface collapse feature and subsurface cave extent measures approximately 230 x 130 x 69 feet in length, width, and depth, respectively. The cave entrance consists of a vertical shaft that extends on the order of 15 feet to the cave floor and facilitates access to the cave by a small bat population. From the primary entrance, the cave opens into a large and laterally extensive room measuring approximately 70 x 50 x 8 feet in length, width, and height respectively. The room trends to the east and connects to a primary passageway that roughly defines the lateral extent of the cave in the subsurface. The passageway is estimated to comprise more than 420 linear feet and becomes narrower with distance into the cave. Several small rooms and parallel chambers were observed along the primary passageway. The passageway slopes downward as it extends from the entrance, reaching a maximum estimated depth of about 69 feet relative to surrounding ground surface.

At the time survey activities were conducted, a small bat population was present. Based on the guano accumulations (i.e., 2 feet to veneer), it appears that the cave has been inhabited by bats for many decades. Thriving insect populations that feed on the guano were observed including crickets and spiders of various types. The large room at the cave entrance also appears to periodically host small animals including snakes, skunks, and raccoons.

Survey activities were conducted during dry weather conditions and cave conditions were generally moist with the exception of the rooms and passages throughout the lowermost cave levels, which exhibited water drips and drops on stalactites. General observations throughout the cave including the presence of speleothems and flow stone surfaces indicate the periodic migration of water to the subsurface.

No well-defined surface drainage features are associated with either cave. Both caves are oriented along the dominant NE-SW structural trend although no well-defined fractures observed. **Features S-1 and S-2** are classified as sensitive owing to rapid infiltration potential.

Solution Cavity

One solution cavity was identified at the hilltop area within the north-central part of the SITE as further described below.

Feature S-3 consists of a solution cavity within a small depression that is completely rimmed and floored by intact limestone. The feature was apparently formed as the result of surface erosional processes. The depression measures approximately 7 x 6 x 2.5 feet in length, width, and depth respectively. The feature is located within the Person Formation on the hilltop near the north portion of the property. The solution cavity opening measures approximately 1.3 x 0.7 feet in length and width, respectively. Based on hand-excavation activities and probing, the feature is infilled with clay soils and some organic materials and is sometime host to burrowing animals. There was no channeling or preferential flow directed to this feature.

This feature is classified as not sensitive, having a low potential of transmitting fluids into the Edwards. This classification is based upon its stratigraphic position, point assignment criteria presented in the Geologic Assessment Table (TCEQ-0585), and professional judgment.

Non-Karst Closed Depressions

Three non-karst closed depressions (CD) were mapped within the property boundaries. These features were formed by tree root collapse and enhanced by burrowing animals:

Feature S-4 consists of a non-karst closed depression located in the north portion of the property. The feature measures approximately 8 x 5 x 2.5 feet, in length, width, and height, respectively.

Feature S-5 consists of a non-karst closed depression located on the hillside within the west portion of the property. The feature measures approximately 6 x 4 x 2 feet, in length, width, and height, respectively.

Feature S-6 consists of a non-karst closed depression located on the hillside within the west portion of the property, approximately 135 feet west of **Feature S-5**. The feature, measures approximately 8 x 6 x 3 feet, in length, width, and height, respectively.

These three non-karst closed depression features are completely contained within dark reddish-brown clay soils and do not have capacity for rapid infiltration of surface runoff. These features are therefore considered not sensitive based upon the point assignment criteria set forth in the **Geologic Assessment Table (TCEQ-0585)** and professional judgment.

Manmade Features

No manmade features (e.g., buried utilities) were identified within SITE boundaries.

Potential for Fluid Migration to the Edwards Aquifer

Based on a review of SITE geology, topography and drainage conditions, and the results of our mapping efforts, the overall potential for fluid movement (i.e. surface-derived flow) to the Edwards Aquifer via infiltration in areas that are not adjacent to sensitive cave features is considered to be low to moderate. The following assessment findings support this conclusion:

- The majority of the SITE is overlain by surface soils ranging in thickness from a veneer to approximately 3 feet with reported slow infiltration rates. Patchy exposures of the Person Formation (Kep) are present throughout the SITE.
- The caves are classified as sensitive as these have a high rapid infiltration potential and represent a direct pathway for surface-derived fluids to enter the subsurface. Although no well-defined drainage features are associated with either cave, in accordance with applicable TCEQ rules, appropriate protective measure including a minimum of 50-foot buffer zones should be established. For illustrative purposes, the insets presented on the **Site Geologic Map** show the *minimum recommended buffer zone extents*.
- Given relatively thin to absent soil cover and presence of sensitive cave features at the SITE, it is possible that additional karst features are present in the shallow subsurface. If additional features are discovered in conjunction with future phases of land development (i.e., earthwork, excavation), it is recommended that a qualified geoscientist be consulted to assess, determine the level of sensitivity, and provide recommendations for protective measures, if warranted.

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ATTACHMENT D

**FEATURE POSITION TABLE
(GPS COORDINATES)**

SITE GEOLOGIC MAP

FEATURE POSITION TABLE
NBU Property Expansion
New Braunfels, Comal County, Texas
RKI Project No. ASF19-092-00

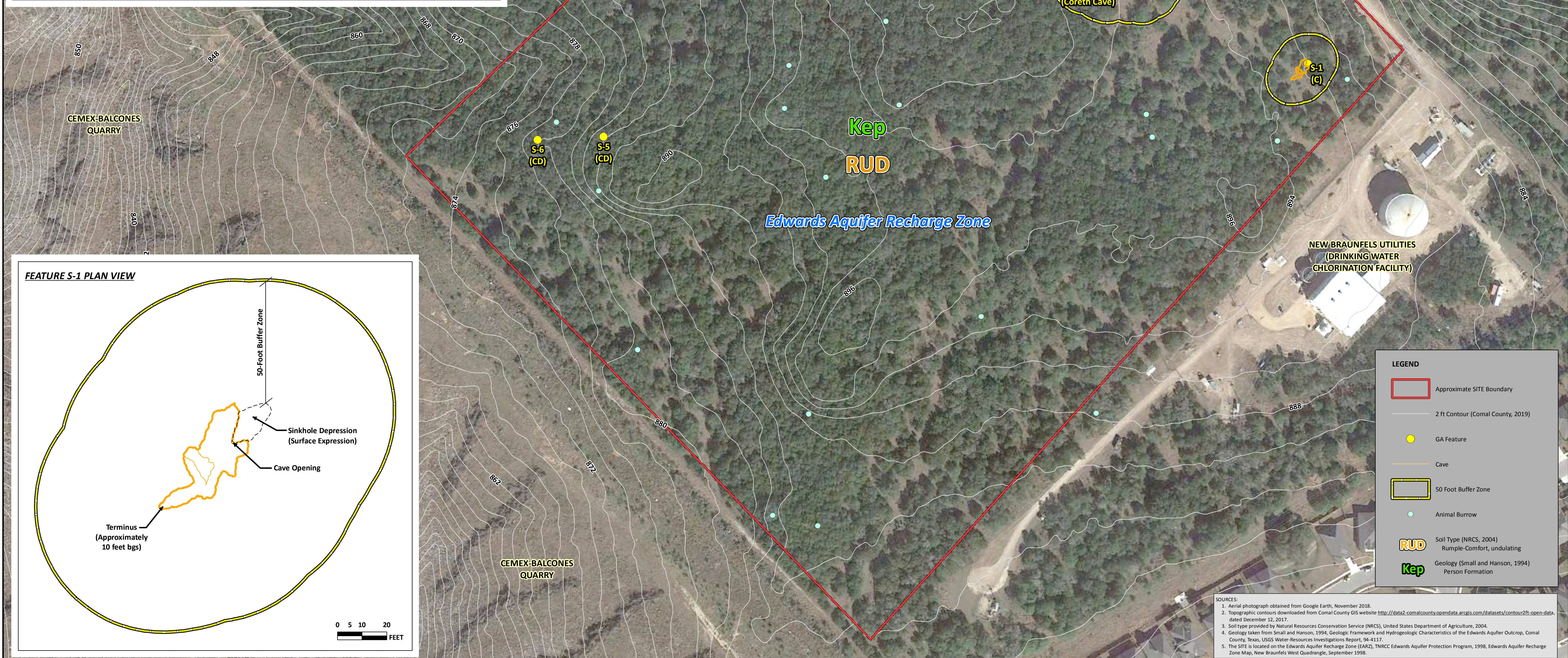
Feature Designation	Feature Type	Date Collected	North Latitude	West Longitude	UTM Northing (meters)	UTM Easting (meters)
S-1	Cave	8/6/2019	N29 42 19.8	W98 10 14.2	3286440	580229
S-2	Cave (Coreth Cave)	8/6/2019	N29 42 21.5	W98 10 19.3	3286493	580093
S-3	Solution Cavity	8/7/2019	N29 42 22.5	W98 10 21.5	3286524	580033
S-4	Non-karst closed depression	8/7/2019	N29 42 22.3	W98 10 21.0	3286515	580047
S-5	Non-karst closed depression	8/9/2019	N29 42 18.4	W98 10 30.4	3286395	579794
S-6	Non-karst closed depression	8/9/2019	N29 42 18.4	W98 10 31.9	3286393	5799753

NOTES:

- 1) Geographic coordinates are presented Degrees, Minutes, Decimal Seconds
- 2) Reference Datum is NAD 83.
- 3) Data were collected utilizing a **Garmin GPS 60cx Global Positioning System**.
- 4) Horizontal Accuracy: RMS Value < 3 meter ground resolution.
- 5) GPS data were collected by Rick Sample, Chris Murray, and Kyle Gillespie (**RKI Project Professionals**).
- 6) GPS coordinates correlate to the points on the map for each feature.


FEATURE S-2 PLAN VIEW
(CORETH CAVE)

This map illustrates the layout of Coreth Cave, showing the cave entrance (vertical shaft) and the approximate location of the sinkhole depression (surface expression). The cave entrance is located near the bottom left, and the sinkhole depression is located near the top left. The cave is divided into three rooms: Primary Room #1, Room #2, and Room #3. A winding passageway connects the rooms. A 50-foot buffer zone is indicated around the cave entrance. The map also shows a dashed line representing the boundary of the sinkhole depression, which is approximately 69 feet by 69 feet. A scale bar at the bottom right indicates distances in feet (0, 10, 20, 40).



A vicinity map showing the location of the 'SITE' (indicated by a red square) relative to the Edwards Aquifer Recharge Zone and Edwards Aquifer Transition Zone. The map includes major roads such as I-35, SR 337, and SR 46, and geographical features like Guadalupe Lake and Dunlap Lake. The site is located near the intersection of SR 337 and the Edwards Aquifer Transition Zone.

9/23/19



RICHARD V. KLAR
GEOLOGY
259
LICENSED
PROFESSIONAL GEOSCIENTIST

Richard V. Klar

SITE GEOLOGIC MAP

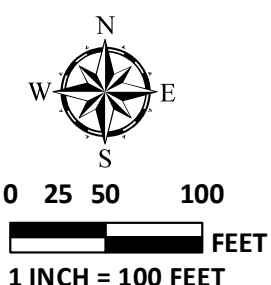
NBU PROPERTY EXPANSION

NEW BRAUNFELS, COMAL COUNTY, TEXAS

[illegible]

PROJECT No.:
ASF19-092-00

ISSUE DATE:	09-23-19
DRAWN BY:	LAW
CHECKED BY:	RAS/CRM
REVIEWED BY:	RVK



NOTE: This Drawing is Provided for Illustration Only, May Not be to Scale and is Not Suitable for Design or Construction Purposes