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DESPIAU ASSOCIATES
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Report for the Preliminary Subsurface Exploration (Geophysical (GPR) & Borings) and Geotechnical Engineering Assessments for the Proposed New Runway Project at Rafael Hernández International Airport (BQN) on Maleza Baja to Maleza Alta Wards of the Municipality of Aguadilla, Puerto Rico.

Job No. DA/18F3704

September 18, 2018

Prepared for:

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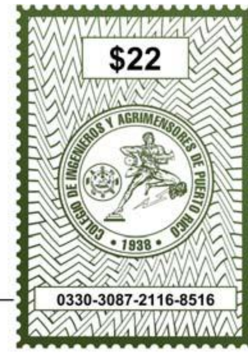
ESTAMPILLA DIGITAL ESPECIAL (EDE)



Ing. Jose R. Despiau Ramirez, PE

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September 18, 2018

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Attn.: Victor Morales, PE, Project Manager

Reference: Preliminary Subsurface Exploration (Geophysical (GPR) & Borings) and Geotechnical Engineering Assessments for the Proposed New Runway Project at Rafael Hernández International Airport (BQN) at Maleza Baja to Maleza Alta Wards of the Municipality of Aguadilla, PR.; Reference No. DA/18F3704

Dear Mr. Morales:

As requested, we have completed Preliminary Subsurface Exploration (Geophysical (GPR) & Borings) and Geotechnical Engineering Assessments for the Proposed New Runway Project at Rafael Hernández International Airport (BQN) at Maleza Baja to Maleza Alta Wards of the Municipality of Aguadilla, Puerto Rico.

The work was undertaken at the request of Mr. Victor Morales, PE, Project Manager of AECOM Caribe, LLC. The work was made with the approval of AECOM Caribe, LLC. in accordance to the Revised proposal No. DA/01-04-18R, dated May 14, 2018 in accordance to the Professional Services Agreement between Despiau Associates Corp. and AECOM Caribe, LLC.

This report presents the results of the field exploratory drilling, laboratory tests performed on secured soil samples, engineering analyses, summary of findings and the requested professional engineering assessment related to the subsoil conditions to assist in the preliminary design for the proposed New Runway at Rafael Hernández International Airport (BQN) located in the Municipality of Aguadilla, Puerto Rico.

The original and one (1) copy of the report are being submitted with this transmittal letter. It has been a pleasure to have been of your assistance in this project.

Respectfully Submitted,

DESPIAU ASSOCIATES

Jose R. Despiau, PE.
Consulting Engineer

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I. INTRODUCTION

This report discusses the results of the Preliminary Subsurface Exploration (Geophysical (GPR) & Borings) and Geotechnical Engineering Assessments for the Proposed New Runway Project at Rafael Hernández International Airport (BQN) at Maleza Baja to Maleza Alta Wards of the Municipality of Aguadilla, Puerto Rico.

The work was undertaken at the request of Mr. Victor Morales, PE, Project Manager of AECOM Caribe, LLC. The work was made with the approval of AECOM Caribe, LLC. in accordance to the Revised proposal No. DA/01-04-18, dated May 14, 2018 in accordance to the Professional Services Agreement between Despiau Associates Corp. and AECOM Caribe, LLC.

The purpose of this preliminary geotechnical and geophysical investigation was to establish a general geotechnical characterization of the site. Specifically, to assess the presence of possible fissure, cavities or voids among other anomalies, if any, and the assess the subsurface conditions along the proposed new runway alignment. Also, the field and laboratory test data gathered was used to provide preliminary foundation recommendations for the proposed New Runway, pavements section and required improvements at the site.

In addition to the geophysical investigation, the present geotechnical investigation originally contemplated fifteen (15) SPT Borings however, Borings No. 10 through 15 could not be performed since these were located within the Active Zone of BQN runway 8-26 and Taxiway “M” & “C”. Therefore, only nine (9) standard penetration tests (SPT) borings were performed to evaluate existing subsoil profile. The geophysical investigation was performed in twenty-one (21) pre-selected areas where it was suspected possible sinks existed. The geophysical evaluation was performed using a Ground Penetrating Radar (GPR), with a 400 MHz antenna and SIR-3000 processing computer, once the field data was gathered, then it was analyzed using RADAN and Voxler Software programs.

Prior to the actual field work the explored locations were stakeout at the field and a geophysical survey was conducted across the site in an effort to identify existing underground utility lines as well as underground structures to assure no exiting utilities were damage during the field drilling operation.

This report presents the results of our field investigation, laboratory tests performed on secured soil, engineering analyses, summary of findings and geotechnical engineering assessment related to the subsoil conditions to assist in the preliminary design of the proposed New Airport Runway and Environmental Site Assessment. However, the actual design of any structures, cost estimates, structural review, and the preparation of Civil Engineering Plans are beyond the scope of the present work.

The herein geotechnical engineering assessment is based on our field investigation (geotechnical/geophysical), observations, laboratory tests and engineering analyses. Thus, comments in this report are intended to be representative of observed and tested areas solely.

II. SITE AND PROJECT DESCRIPTION

The New Runway project / study area is found East of State Road PR-107 (Borinquen Ave.) and about (125 mts.- South offset) and parallel of the existing Runway-Centerline Alignment of Rafael Hernández International Airport (BQN) at Maleza Baja to Maleza Alta Wards Aguadilla, Puerto Rico.

Based on observations and available plans, the existing topography at the site is relatively leveled or flat. The existing topography lot shows gentle sloping grounds to the west. Based on the site plan submitted and spot elevation survey taken on the explored locations at the Runway, the surface elevation ranges from approximately EL. 237 ft. [Boring B-1] to the west to approximately EL. 188 ft. [Proposed Boring 15] at the easternmost sector.

The most prominent topographical features are several streams crossing the proposed Runway alignment from higher sectors to the south. Also, topographical depressions with occasional sinkholes were disclosed on study areas at several sporadic locations. These are typical of the karsts topography in the Aymamón Limestone Formation, expose near the study zone (See Figure 1B of Appendix A).

The enclosed site location map is a portion of US Geological Survey Service Topographical plan at a scale 1:20,000 in, Figure 1 of Appendix A.

III. FIELD SUBSURFACE AND SAMPLING PROGRAM

3.1 Surface and Subsurface Investigations

The present subsurface exploration originally contemplated fifteen (15) SPT Borings however, Borings No. 10 through 15 could not be performed since these were located within the Active Zone of BQN runway 8-26 and Taxiway “M” & “C”. Therefore, only nine (9) standard penetration tests (SPT) borings were performed to evaluate existing subsoil profile along the proposed new runway alignment. In addition, a geophysical investigation was performed in twenty-one (21) pre-selected areas of possible sinks.

The boreholes locations were initially selected by the undersigned and field located by our personnel. The final explored locations were surveyed by geophysical means (GPR) to identify existing underground utility lines as well as underground structures to assure no exiting utilities were damage during the field drilling operation. The actual boring location are shown in the accompanying Boring Location Plans, Figures 2 through 2J of Appendix A of this report.

The subsoil STP (Standard Penetration Test) borings were performed using a CME-55 Trailer Mounted Rig. The STP borings were drilled and sampled continuously to 10 ft. in depths beneath existing pavement section. All soil samples were taken with a 2"-O.D. split barrel sampler following the standard penetration test procedures in ASTM D-1586. Penetration resistance from the standard penetration resistance tests are recorded in the "N" column of the boring logs, where the record of the continuous driving process of the string of rods is recorded. Recovered Samples were tagged for identification, sealed to reduce moisture loss, and taken to our laboratory for further examination, testing, and classification. The procedures used for the laboratory tests, as well as the routine and special laboratory procedures used, for the determination of the index soil properties are contained in the following sections of this report and in the Appendices 1 & 3 of this report.

3.2 Geological Notes

The geological units that outcrop at and near the site, as shown in the US Geological Survey Map I-569 of the Aguadilla Quadrangle and Map I-565 of the Moca and Isabela Quadrangles, respectively prepared by Mr. Watson H. Monroe (1969) are as follows:

Beach Deposits (Qb) - Quartz sand, shell fragments, and scattered grains of other minerals resistant to weathering; cementation to beach-rock is common; older deposits inland from present shore are covered by a thin blanket of sand, blown from present beaches and dunes; gently crossbedded, generally dipping toward the sea.

Eolianite (Qe) – described as friable to consolidated, highly crossbedded, calcareous eolian sandstone composed of shell fragments and quartz grains; near Isabela consists of crossbedded white sandy chalk that weathers to red clayey sand.

Blanket sand deposits (QTbs) – described as mixtures of fine- to medium-grained quartz sand and light- to moderate-brown clay; all material mapped in this category has been lowered by solution of underlying limestone (Briggs, 1966).

Aymamón Limestone, upper member (Taz) - described as very pale orange to bright-yellow chalk containing many beds of large (as much as 156 cm long) Ostrea haitensis Gabb and other fossils. Interbedded with solution-riddled very pale orange to white hard limestone, some of which is fossiliferous in the upper part, commonly white, very pure, commonly recrystallized hard limestone like lower member; it intertongues toward the east with beds indistinguishable from upper beds of lower member.

No Fault lines were disclosed at or neat the site

3.3 Stratigraphic Units

Surface Layer

Generally, the results of the exploration disclosed a surface layer extending from 2.0 to 4.0 ft. in depth; namely a surface section of reddish brown, yellow brown, dark reddish brown, brown and reddish yellow sandy silt with limestone gravel fragments and sandy silty clay, with variable amounts of calcareous limestone gravel, with few to many roots at ground surface [Borings 1 to 9]. The standard resistance to penetration (N-values) of the upper surface layer varied from 6 to 20 blows/foot. A medium to very stiff state of consistency for the prominently clay soils can be predicted with these values. The natural moisture content values range from 11 to 20 percent. Random sample from the more cohesive layer has been identified for [Boring 4, from 2'-4'], as an A-6 (2) AASHTO Class type (USSCS – SC Clayey sand) with percent free swell value at 15 percent; and an Activity Ratio (Ac) of 0.27 and a Cation Exchange Activity (CEAC) equal to 0.41 values classified as "Interstratified" found with a low volume change potential.

Generally, below the surface layer it was found agriculturally modified fill section characterized by alternating layers clayey sandy silt, sandy silty clay and silty sand with traces of clay; with occasional traces of calcareous limestone gravel [Borings 1, 2, 3, 5, and 6]. The samples were generally found with (-) few roots, evidencing the agricultural use of the lands. The layer extends from 8 to 10 ft, in depth. The most prominent colors were the reddish brown, red, and reddish yellow. The standard resistance to penetration (N-values) of the lower surface fill layer varied from 5 to 29 blows/foot. A loose-medium to dense state of compaction for the prominently clay soils can be predicted with these values. The natural moisture content values range from 5 to 20 percent. Random classification tests were performed on samples from [Boring 1, from 4'-6'] which disclosed an A-6 (4) Class type (Unified Class type – CL Sandy lean clay) with percent free swell value at 20 percent.

Near Borings No. 3, 5 and 6, open channels and gully stream sectors of the Maleza Baja valley, where streams, agricultural man-made channels and depressions are evidenced in the original site topography; it was found alluvial soils, that extend to about 6 to 10 ft. in depth. The channels and intermittent streams and depressions in the site vicinity were filled with material from hills of the Aymamón Limestone, upper member (Taz), obtained from quarry operations south of the project lands. The fill consists of a mixture of clay, silt, sand, and variable amounts of calcareous eolian sandstone and sandy chalk that weathers to red clayey sand [Borings 3, 5 and 6]. The standard resistance to penetration (N-values) of the upper alluvial limestone layers varied from 12 to 29 blows/foot. The natural moisture content values range from 10 to 20 percent. Random classification tests were performed on samples from [Boring 3, from 4'-6'] disclosed an A-2-4 (0) Class type (Unified Class type – SC Clayey sand with stone fragments) with percent free swell value at 10 percent; from [Boring 6, from 6'-8'] disclosed an A-6 (4) Class type (Unified Class type – CL Sandy lean clay) with percent free swell value at 20 percent.

Blanket sand deposits

At sectors covered by [Borings 7 to 9] beneath the previously described surface layers, the alluvial soils extend to about 7 to 10 ft. in depth. The soil material consists of reddish brown, red, and reddish yellow, with mottled black sandy silty clay, silty sand and silty clay. The standard resistance to penetration (N-values) of the upper alluvial layers varied from 7 to 40 blows/foot.

The natural moisture content values range from 13 to 22 percent. Random classification tests were performed on samples from [Boring 7, from 4'-6'] which disclosed an A-6 (2) Class type (Unified Class type – SC Clayey sand) with percent free swell value at 15 percent; and samples from [Boring 8, from 2'-4'] which disclosed an A-6 (2) Class type (Unified Class type – SC Clayey sand) with percent free swell value at 15 percent. At the samples from [Boring 9, from 2'-4'] which disclosed an A-6 (5) Class type (Unified Class type – CL Sandy lean Clay) with percent free swell value at 20 percent.

Residual and Weathered Limestone Rock Material

The residual layers and Weathered Limestone material were found beneath the above surface soils material extending to the depth at which the borings were bottomed. The material generally described as yellow, very pale brown, light reddish brown, dense to very dense silty sand and sandy silt fines of very pale orange to white calcareous limestone and hard limestone, some of which is fossiliferous in the upper part, commonly white, very pure, commonly recrystallized hard limestone like lower member. These layers were described with variable amounts of sand and saprolitic material with completely weathered rock fragments, extending from the surface alluvial soils. The upper residual material was found to outcrop [Boring 4] at a depth of 4.0 ft. Generally, it was found at depths varying from 8 to 20 ft. in depth and extending to the depth at which the borings were bottomed. The standard resistance to penetration (N-values) of the upper residual layers varied from 42 to 99 blows/foot. Prominently, the sampling attempts through lower depths disclosed practical refusal to penetration, with values more than 75 blows for a few inches to penetration. The natural moisture content values range from 3 to 13 percent.

The graphical representation of the soil profiles is found in the boring logs included as Appendix (1) to this report.

3.4 Groundwater Levels

Groundwater within the open holes was not registered, as measured during the drilling period within the short amount of time the borings were left open and were measured from the existing ground surface prevailing during the period of the field work. However, the boreholes were backfilled at the termination of exploration, making subsequent water level readings unobtainable.

Groundwater level fluctuations occur due to seasonal variations in the amount of rainfall, runoff and other factors not evident at the time the borings were performed. It is logical to expect variation of the groundwater level as they will be influenced by the adjacent bodies of water, intermittent streams and channels. Consequently, groundwater levels during construction or at other times in the lifespan of the structures may vary.

The graphical representation of the soil profiles are found in the boring logs included as Appendix (1) of this report as well as on the report.

IV. GEOTECHNICAL ENGINEERING ASSESSMENTS

4.1 Subsoil Exploration

The present subsurface exploratory program originally contemplated fifteen (15) SPT Borings however, Borings No. 10 through 15 could not be performed since these were located within the Active Zone of BQN runway 8-26 and Taxiway “M” & “C”. Therefore, only nine (9) standard penetration tests (SPT) borings were performed to evaluate existing subsoil profile along the proposed new runway alignment. Also, the exploratory borings were used to confirm the observed irregularities (possible voids) found on the geophysical survey performed throughout the proposed project alignment.

In general, the results of the exploration disclosed a surface layer extending from 2.0 to 4.0 ft. in depth; namely a surface section of sandy silt with limestone gravel fragments and sandy silty clay, with variable amounts of calcareous limestone gravel, with few to many roots at ground surface [Borings 1 to 9]. Below the surface layer, it was found agriculturally modified fill section characterized by alternating layers clayey sandy silt, sandy silty clay and silty sand with traces of clay; with occasional traces of calcareous limestone gravel [Borings 1, 2, 3, 5, and 6], extending from 8 to 10 ft, in depth.

Near Borings No. 3, 5 and 6, it was found alluvial soils, extending to about 6 to 10 ft. in depth. It is in these areas where open channels and gully stream sectors of the Maleza Baja valley, are found. The channels, intermittent streams and depressions in the site vicinity were filled with material from hills of the Aymamón Limestone. These fills consist of a mixture of clay, silt, sand,

and variable amounts of calcareous eolian sandstone and sandy chalk that weathers to red clayey sand.

At sectors covered by [Borings 7 to 9] beneath the previously described surface layers, the alluvial soils extend to about 7 to 10 ft. in depth. The soil material consists of reddish brown, red, and reddish yellow, with mottled black sandy silty clay, silty sand and silty clay.

Thereafter, the residual layers and Weathered Limestone material were found beneath the above surface soils material extending to the depth at which the borings were bottomed. The material generally described as yellow, very pale brown, light reddish brown, dense to very dense silty sand and sandy silt fines of very pale orange to white calcareous limestone and hard limestone. These layers were described with variable amounts of sand and saprolitic material with completely weathered rock fragments, extending from the surface alluvial soils. Generally, it was found at depths varying from 8 to 20 ft. in depth and extending to the depth at which the borings were bottomed.

All nine (9) standard penetration resistance tests (SPT) borings were performed to depths varying between 20.0 to 25.0 ft. In none of the exploratory borings performed actual void were detected. However, loose to medium state of consistencies was found within the upper surface and alluvial layers found varying between 4.0 to 10 ft. in depth, which correlate to the found anomalies found in the geophysical investigation. Thus, since no actual cavity/void were encountered in the Borings of exploration, it is reasonable to believe these anomalies are voids filled with either agricultural fill, alluvial soils.

4.1.1 Laboratory Tests

As part of the herein evaluation, several laboratory tests were performed to characterize the subsoil profile along the proposed new runway alignment and to provide the A/E Design Team with preliminary design parameters. The laboratory tests performed on secured samples were the followings:

1. Description (visual-manual) of Soils
2. Classification Tests (USCS) – D2487
3. Atterberg Limits – (ASTM 4318)
4. Grain Size Analyses – (ASTM D 422)

5. Natural Moisture Contents of Soils – AASHTO T265
6. Soil Expansive Tests
7. Organic Content (AASHTO T194)

Secured samples taken from the SPT Borings were used for the special Soils Laboratory Tests and a summary of these results are presented in the following table. However, the laboratory test reports are included in Appendix 3 of this report.

Table No. 1 – Summary of Soil Laboratory Test

Boring No.	Layer Tested	Soil Classification USCS / AASHTO	Atterberg Limits	Organic Content (%)
B-1	Subgrade	CL / A-6 (4)	LL = 30.5 % PI = 15.8 %	6.6% @ 5’-6’-6” 1.2% @ 9’-6”-11’
B-2	Subgrade	Not Classified	Not Classified	1.5 % @ 4’-6’” 1.3% @ 8’-10’
B-3	Subgrade	SC / A-2-4 (0)	LL = 18.4 % PI = 7.5 %	Not Found
B-4	Subgrade	SC / A-6 (2)	LL = 27.7 % PI = 12.2 %	Not Found
B-6	Subgrade	CL / A-6 (4)	LL = 30.3 % PI = 12.4 %	Not Found
B-7	Subgrade	SC / A-6 (2)	LL = 26.5 % PI = 11.3 %	Not Found
B-8	Subgrade	SC / A-6 (2)	LL = 23.8 % PI = 11.0 %	Not Found
B-9	Subgrade	CL / A-6 (5)	LL = 28.7 % PI = 12.0 %	Not Found

4.2 Non-Destructive Testing

Considering the possibility of encountering a large amount of undisclosed underground utilities along the proposed runway alignment, a geophysical survey was performed to locate possible fissure, cavities or voids and any other anomalies along the new runway alignment and to clear all drill locations prior to the actual field operation.

The geophysical survey performed by Jaca & Sierra Testing Engineering, PSC, was made within accepted practices in the fields of non- destructive testing (NDT). The tests were performed using a ground penetrating radar (GPR) to detect voids within the soil profiles.

The geophysical investigation was performed at several (twenty-one) pre-selected locations along the proposed new runway alignment (to the south of Runway 8-26) at the Rafael Hernández Airport (BQN). The information gathered was used along with the geotechnical exploration performed to aid the A/E Design Team in the preliminary design.

4.2.1 Ground Penetrating Radar (GPR)

As part of the Non-Destructive Evaluation (NDE), several Non-Destructive Testing, by means of the GPR method, were performed at pre-selected areas where the possibility of encountering cavities/voids was present along the new runway alignment.

The GPR method consists of moving an antenna through the test area while a periodic pulse is transmitted and received in form of echoes. This electromagnetic wave pulses are transmitted at the antennas center frequency, which in this case a 400 MHz's Pulses was used. Pulses propagate through the test medium directly under the antenna. Some energy becomes reflected back whenever a change in electric impedance is encountered, such as at a rebar, conduit or void. The received echoes are amplified and filtered by the GPR computer SIR 3000.

A distance wheel oedometer records scan distance along test path, allowing for the determination of relative location of features from the start point. A GPR survey is designed by establishing X, Y Axes and performing scans along parallel lines drawn at an offset distance. The resulting raw data is obtained in the form of echo amplitude versus time. The material's dielectric constant is used to define velocity which is then used to convert echo time data to echo depth. The conversion may be explained by the following equations:

$$V_{EM} = c \,/\, \varepsilon r^{0.5} \qquad D = (V_{EM}\,T)/2$$

where, V_{EM} is the materials electromagnetic velocity, c is the speed of light, εr is the dielectric constant, D is depth and T is the two-way radar pulse travel time.

Scans are typically viewed as waterfall plots of all scans along test path. Lightness or darkness of the plot indicates amplitude and polarity. Refer to Appendix (4) for additional enclosed GPR sheets to view the obtained data.

4.2.2 GPR Results and Observations

As previously mentioned, the investigation was performed using the 400 MHz antenna with an SIR 3000 computer for data collection. Obtained data was then processed with RADAN GPR Software and Voxler 4.0 to estimate void size and location. The site's surface was in its majority exposed soil and vegetated areas (Grass and weeds). The maximum depth of penetration of the scans performed was 8.0 ft. A total of twenty-one (21) grids of varying sizes and scans/runs were performed throughout the project site. The following Table indicates the coordinates of each start point of said grids (0,0), however graphical representation of their location is illustrated in Figures 2A through 2J of Appendix A.

Table No. 2 – Grid Location and Maximum Depth to Possible Anomalies

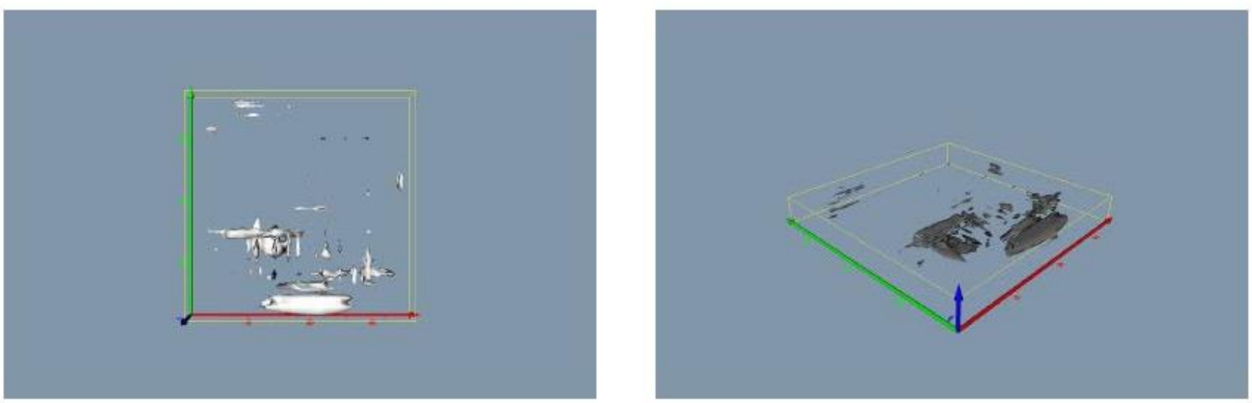
Grid ID No.	Latitude	Longitude	Range of Depth to Anomalies	Maximum Depth of Anomalies	Additional Comments
G1	18° 29' 20.32" N	67° 8' 40.21" W	0.5 -7.0 ft.	7.0 ft.	Near Boring 1
G2	18° 29' 22.19" N	67° 8' 32.21" W	3.0 - 8.0 ft.	8.0 ft.	Near Boring 2
G3	18° 29' 25.73" N	67° 8' 27.28" W	1.0 - 5.0 ft.	5.0 ft.	-
G4	18° 29' 24.66" N	67° 8' 24.43" W	2.0 - 5.0 ft.	5.0 ft.	Near Boring 3
G5	18° 29' 25.67" N	67° 8' 20.32" W	1.0 - 8.0 ft.	8.0 ft.	-
G6	18° 29' 26.39" N	67° 8' 16.42" W	2.0 - 8.0 ft.	8.0 ft.	Near Boring 4
G7	18° 29' 26.87" N	67° 8' 16.42" W	2.0 – 8.0 ft.	8.0 ft.	Near Boring 4
G8	18° 29' 27.58" N	67° 8' 16.60" W	2.0 – 2.5 ft.	2.5 ft.	Near Boring 4
G9	18° 29' 29.27" N	67° 8' 08.90" W	1.0 – 8.0 ft.	8.0 ft.	Near Boring 5
G10	18° 29' 31.71" N	67° 8' 00.98" W	6.0 – 8.0 ft.	8.0 ft.	Near Boring 6
G11	18° 29' 34.16" N	67° 7' 56.38" W	1.0 – 3.0 ft.	3.0 ft.	-
G12	18° 29' 34.01" N	67° 7' 53.36" W	2.0 - 8.0 ft.	8.0 ft.	Near Boring 7
G13	18° 29' 36.45" N	67° 7' 45.60" W	1.5 to 8.0 ft.	8.0 ft.	Near Boring 8
G14	18° 29' 38.28" N	67° 7' 39.05" W	Not found	Not found	Near Boring 9
G15	18° 29' 41.30" N	67° 7' 29.24" W	Not found	Not found	** See Note
G16	18° 29' 42.24" N	67° 7' 22.93" W	1.0 – 4.0 ft.	4.0 ft.	** See Note
G17	18° 29' 43.66" N	67° 7' 21.39" W	2.0 – 8.0 ft.	8.0 ft.	** See Note
G18	18° 29' 45.73" N	67° 7' 14.50" W	0.0 – 8.0 ft.	8.0 ft.	** See Note
G19	18° 29' 48.17" N	67° 7' 07.37" W	1.0 – 8.0 ft.	8.0 ft	** See Note
G20	18° 29' 50.50" N	67° 6' 58.92" W	4.0 – 6.25 ft.	6.25 ft.	** See Note
G21	18° 29' 52.86" N	67° 6' 51.08" W	2.0 – 5.0 ft.	5.0 ft.	** See Note

** NOTE: Confirmation by Drilling and/or Probing could not be performed because its location is an Active zone of the BQN. Special considerations (i.e. training, etc..) are required. This shall be performed during the final geotechnical exploration.

Grid spacing varied at the different surveyed locations and the survey scans were performed in several directions for the grids. Coordinates were taken using a handheld GPS at the start and end of each run. These coordinates were used to create the 3D grids at each surveyed location. Grid locations are included in Appendix 4.

When observing the data obtained from the GPR Software, it is noted that the clear signal penetration for the survey was limited to approximately 8.0 to 10 ft when measure from the surface. From the images obtained from RADAN as well as Voxler were used to determine the potential for voids at surveyed areas. The grids which have the most potential will be 1 through 6 and 16 through 21.

The potential void depth ranged from 1 ft to 8 ft (limit of the study) and the diameter of the voids ranged from 1 ft to 6 ft. See below sample image of Grid 19, which is where we observed the most potential for a larger void among all the areas scanned. All the 3D mapping imagery is included in Appendix 4.



GRID 19

Voids detected in our investigation may represent Air filled voids, Clay filled Voids and/or porosity. In general, the potential voids encountered seemed to be interconnected within the scanned areas. The information obtained in our investigation and NDT will be used as a tool to for the project Engineer to determine adequate solution for the foundation of the proposed structures.

4.2.3 Additional Comments on Field Non-Destructive Testing

Note that the herein given test results are based on the tests performed on locations, which are considered as representative of the conditions within the structure. However, this fact does not guarantee that the conditions found as per our test results will remain constant throughout the structure. Most of the surveyed areas where the geophysical evaluation was performed, SPT boring were also performed within the same grid area, however in none of the nine Borings of exploration actual cavity/void were found.

Therefore, it is highly recommended that additional non-destructive and destructive uncovering by means of probing, drilling, excavation or similar methods be implemented during the final subsoil exploration to be performed, especially on the easternmost sector of the proposed runway alignment (Grids No. 15 through 21).

4.3 Preliminary Soil Improvements Recommendations

As previously mentioned it is highly recommended that additional non-destructive and destructive uncovering by means of probing, drilling, excavation or similar methods be implemented during the final subsoil exploration to thoroughly evaluate the complete alignment of the proposed runway. However, should the disclosed subsoil conditions prevail throughout the complete area to be developed, two (2) preliminary soil improvement can be considered to cope with the possible voids loose to medium surface layers.

The first soil improvement alternative is the complete replacement of unsuitable surface fill layer with well compacted engineering fill section. Under this alternative, the previously deposited unsuitable fill section, shall be removed in their entirety in the initial construction phase, where scarifying, removal and replacement of the unsuitable surface layer shall be performed.

In lieu or in conjunction with the soil replacement procedure a stabilization procedure using geogrids can be considered. Therefore, a reinforced fill embankment using geogrids can also be considered. However, this preliminary alternative will also require the partial removal of the existing unsuitable fill section.

The actual extent of removal of either alternative and specific foundation design recommendations shall be determined and provided once the complementary subsoil exploration and geophysical study is performed.

4.4 Pavement Assessments

Assessment of the condition of the existing pavement is one of the most important and difficult steps in design, reconstruction or overlay of a pavement. The following sections detail information (CBR or subgrade modulus) to be utilized in the preliminary pavements design of the proposed runway pavements at the project site.

Severely distressed areas of the subgrade within the proposed new runway alignment shall be carefully studied to determine any potential mitigation procedures (i.e. re-compaction, soil replacement, etc..). Also, the subsurface drainage conditions should also be assessed carefully and corrected if found to be deficient. The construction of a new pavement structure without correcting poor subsurface drainage will usually result in poor performance.

The proposed design of Runway pavement shall consist of providing the following pavement components, based on FAA-AC 150/5320-6E:

1. The selected surface course

2. Base Course - The base course is the principal structural component of the flexible pavement. It has the major function of distributing the imposed wheel loadings to the pavement foundation, the subbase and/or subgrade. The base course must be of such quality and thickness to prevent failure in the subgrade, withstand the stresses produced in the base itself, resist vertical pressures tending to produce consolidation and resulting in distortion of the surface course, and resist volume changes caused by fluctuations in its moisture content. The quality of the base course depends upon composition, physical properties and compaction. Many materials and combinations thereof have proved satisfactory as base courses. They are composed of select, hard, and durable aggregates. Specifications covering the quality of components, gradation, manipulation control, and preparation of various base materials for use on airports for airplane design loads of 30,000 pounds or more are provided in FAA-AC 150/5320-6E.

3. Subbase **-** A subbase is included as an integral part of the flexible pavement structure in all pavements except those on subgrades with a CBR value of 20 or greater (usually GW or GP type soils). The function of the subbase is similar to that of the base course. However, since it is further away from the surface and is subjected to lower loading intensities, the material requirements are not as strict as for the base course.

4. The Subgrade - The subgrade soils are subjected to lower stresses than the surface, base, and subbase courses. Subgrade stresses attenuate with depth, and the controlling subgrade stress is usually at the top of the subgrade, unless unusual conditions exist. Unusual conditions such as a layered subgrade or sharply varying water contents or densities can change the location of the controlling stress. The ability of a particular soil to resist shear and deformation vary with its density and moisture content. Specification Item P-152 of FAA-AC 150/5320-6E, Excavation and Embankment, covers the construction and density control of subgrade soils. For the present project it shall consist of A-2-4 or better, as per AASHTO Classification, imparted with a minimum 98 percent compaction. The compacted Subgrade material shall be used to substitute the upper exposed native silty clay when removed according to the previously discussed depth of over excavation.

4.4.1 Subgrade Support

Subgrade soils are usually rather variable; therefore, the selection of a design California Bearing Ratio (CBR) value requires some judgment. The design CBR value should be equal to or less than 85 percent of all the subgrade CBR values. In some cases subgrade soils that are significantly different in strength occur in different layers. In these instances several designs should be examined to determine the most economical pavement section. In some cases, it may be more economical to remove and replace a weak layer than to design for it.

The following table provides preliminary CBR values of the in-situ soil, obtained from published literature to assist in the preliminary design and cost estimates purposes. The final design shall consider actual values resulting from California Bearing Ratio laboratory tests as per ASTM D1883 from secured samples of the final geotechnical exploration. As a minimum three points per samples shall be tested at different compaction efforts, to obtain a range of possible site conditions.

Table No. 3 – Summary of Laboratory CBR Tests

Boring No.	Layer Tested	Soil Classification USCS / AASHTO	CBR (%)
B-1	Subgrade	CL / A-6 (4)	5-15
B-3	Subgrade	SC / A-2-4 (0)	10-20
B-4	Subgrade	SC / A-6 (2)	10-20
B-6	Subgrade	CL / A-6 (4)	5-15
B-7	Subgrade	SC / A-6 (2)	10-20
B-8	Subgrade	SC / A-6 (2)	10-20
B-9	Subgrade	CL / A-6 (5)	5-15

The strength of materials intended for use in flexible pavement structures is measured by the CBR tests. Materials intended for use in rigid pavement structures are tested by the plate bearing method. The Resilient modulus is used for rigid pavement design because of the variable stress states. Elastic modulus is estimated from CBR and k using the following correlations:

$$E = 1500 \text{ X } CBR$$

and

$$M_R = 19.4 \text{ X } k$$

Based on the laboratory test results of the material at the site and published literature a Roadbed Resilient Modulus (M_R or E_{SG}) value varying between 1,900 to 5,820 psi can be assigned to the in-situ subgrade material.

These values are our best estimates for the in-situ and fill types being considered, placed and adequately compacted in accordance to the earthwork specifications. The actual base and surface course material thickness is a function of the design.

Based on FAA-AC 150/5320-6E, Airport Pavement Design and Evaluation to convert CBR to LBR, CBR shall be divided by 0.8.

4.4.2 Construction Considerations

Materials and construction of pavements should be in accordance with the requirements and specifications of the Standard Specification for Road and Bridge Construction of the Puerto Rico Department of Transportation and Public Works (2005 Revision). Base course or pavement materials should not be placed when the surface is wet. Surface drainage should be provided away from the edge of paved areas to minimize lateral moisture transmission into the subgrade.

Prevention of infiltration of water into the subgrade is essential for the successful performance of any pavement. Both the subgrade and the pavement surface should be sloped to promote surface drainage away from the pavement structure.

Maintenance should be planned and provided for through an on-going pavement management program in order to enhance future pavement performance. Maintenance activities are intended to slow the rate of pavement deterioration, and to preserve the pavement investment.

Preventative maintenance consists of both localized maintenance (e.g. crack sealing and patching) and global maintenance (e.g. surface sealing). Preventative maintenance is usually the first priority when implementing a pavement maintenance program. Additional engineering observation is recommended to determine the type and extent of a cost effective program. Even with periodic maintenance, some movements and related cracking may still occur and repairs may be required.

4.5 Seismic Design

Once the surface soil material of the sloping grounds is improved, the site will behave as Site Class D, as described in International Building Code 2009 Edition and the Puerto Rico Building Code 2011. Spectral Response Acceleration of 123 % of g. (probability of exceedance of 2% in 50 years) is identified for the Municipality of Aguadilla. The Soil Profile Types (from 2009 International Building Code), which shall be used for the determination of the base shear of the structure unit addition shall be as follows:

TABLE 4 - Soil Profile Types

Sector Covered	Range of Depths (ft.)	Soil Type
Borings 1, 3, 7, 8	0' to 10'	S_E
	Deeper than 10'	S_C
Borings 2	0' to 10'	S_E
	10' to 20'	S_D
	Deeper than 20'	S_C
Borings 4, 6, 9	0' to 4'	S_E
	Deeper than 4'	S_C
Borings 5	0' to 6'	S_E
	Deeper than 6'	S_D
Engineered Fill Section	-	S_D

V. LIMITATIONS OF THIS REPORT

This preliminary report is a decision-making tool and shall be used to complement the structural review, which include and is not limited to the preparation of plans, specifications and recommendations. Material Testing reports by themselves are not considered a structural report and do not make any recommendations in relation to any structural problems observed nor any solutions that maybe required. It may be used as an adjunct to a Structural Report, prepared by a suitably qualified registered structural engineer. For such purposes, we urge the structural designer to contact this office to clarify, review the designed process and to provide support in the preparation of the specifications for the required work.

Our review was based on our field investigation observations, and surveys performed. We have no direct knowledge of and offer no warranty regarding the condition of concealed construction or subsurface conditions beyond what was found in our evaluation. Any comments we offer regarding concealed construction are our professional opinions based on analyses, in situ testing, and our joint engineering experience and judgment, and are derived in accordance with the standard of care and practice for evaluations of building structures.

We have made every effort to reasonably study the various areas of concern, those identified during our site visits, and our analyses. Actual conditions, especially at intermediate locations, may differ from the information obtained in this investigation. If there are perceived omissions or misstatements in this report regarding the observations made, we urged the owner and/or A/E

Design Team to contact this office if different conditions than those herein described are encountered so that we can address them fully and in a timely manner. We reserve the right to amend/modify this report when and if new or additional information is provided to us.

The analysis and preliminary recommendations presented in this report were based on the documents provided, field investigation, observations, and our engineering analyses. The above soil parameters are based in the information and interpretation of laboratory data of the secured samples and test boring performed, and existing published correlations. Also, this preliminary report should not be considered valid until the Final Geotechnical exploration is performed and the final design parameters are submitted once the final design scheme is known and evaluated by the undersigned. The undersigned will not be responsible for any claims, damages, or liability associated with interpretation of subsurface data or reuse of the subsurface data or engineering analysis contained herein without his written consent.

The provision of services herein is specific to only providing documentation regarding existing conditions of the selected structural elements, geotechnical recommendations to be used in the Structural Evaluation for this project. All other engineering or non-engineering specifications are not included in the service herein provided. The scheduled fee does not cover any provision of any services beyond the issue of this report. All further documentation and/or inspections will be charged at a separate quoted fee. Also, if this report is used for construction and/or to obtain any Construction Permit it will be considered an acceptance by the client of all specifications and/or recommendations contained in this report.

Respectfully Submitted,

DESPIAU ASSOCIATES

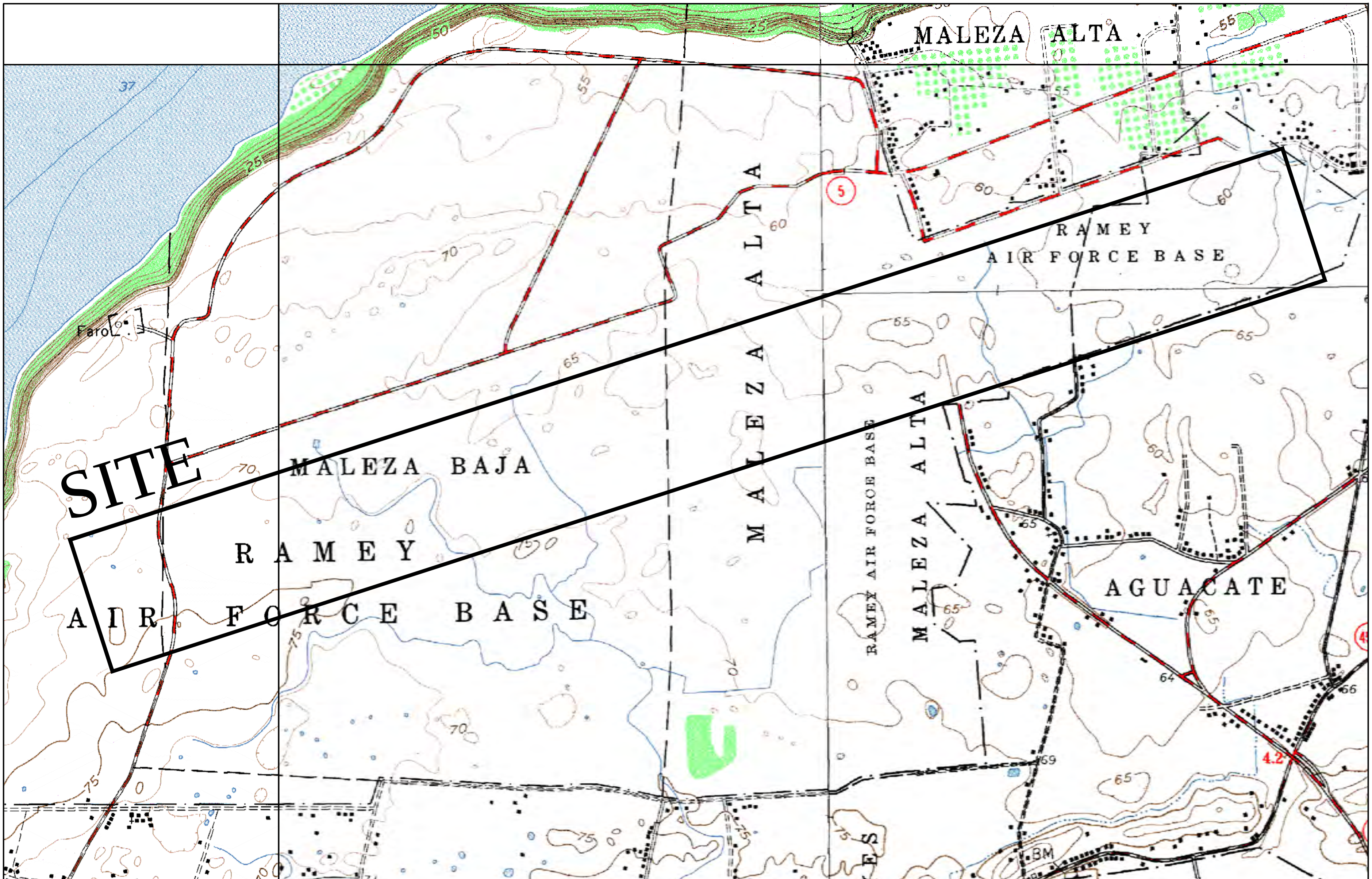
Jose R. Despiau, PE.
Geotechnical Engineer

Appendix (A) - Figures
- 1. US Geological Survey Service Topographical plan at a scale 1:20,000
- 1A. Geological Map
- 1B. US Geological Survey Service Topographical showing Possible Sinks
- 2. Boring and Geophysical Scans Location Plan

Appendix (1) - Boring Logs
Appendix (2) - Fill Specifications
Appendix (3) - Special Laboratory Tests
Appendix (4) – Geophysical Investigation Technology, Grid Location and Survey Runs 3D Rendering

APPENDIX (A)

Figures



NOTE: THIS DRAWING WAS TAKEN FROM THE US GEOLOGICAL SURVEY TOPGRAPHICAL MAP 1:20,000

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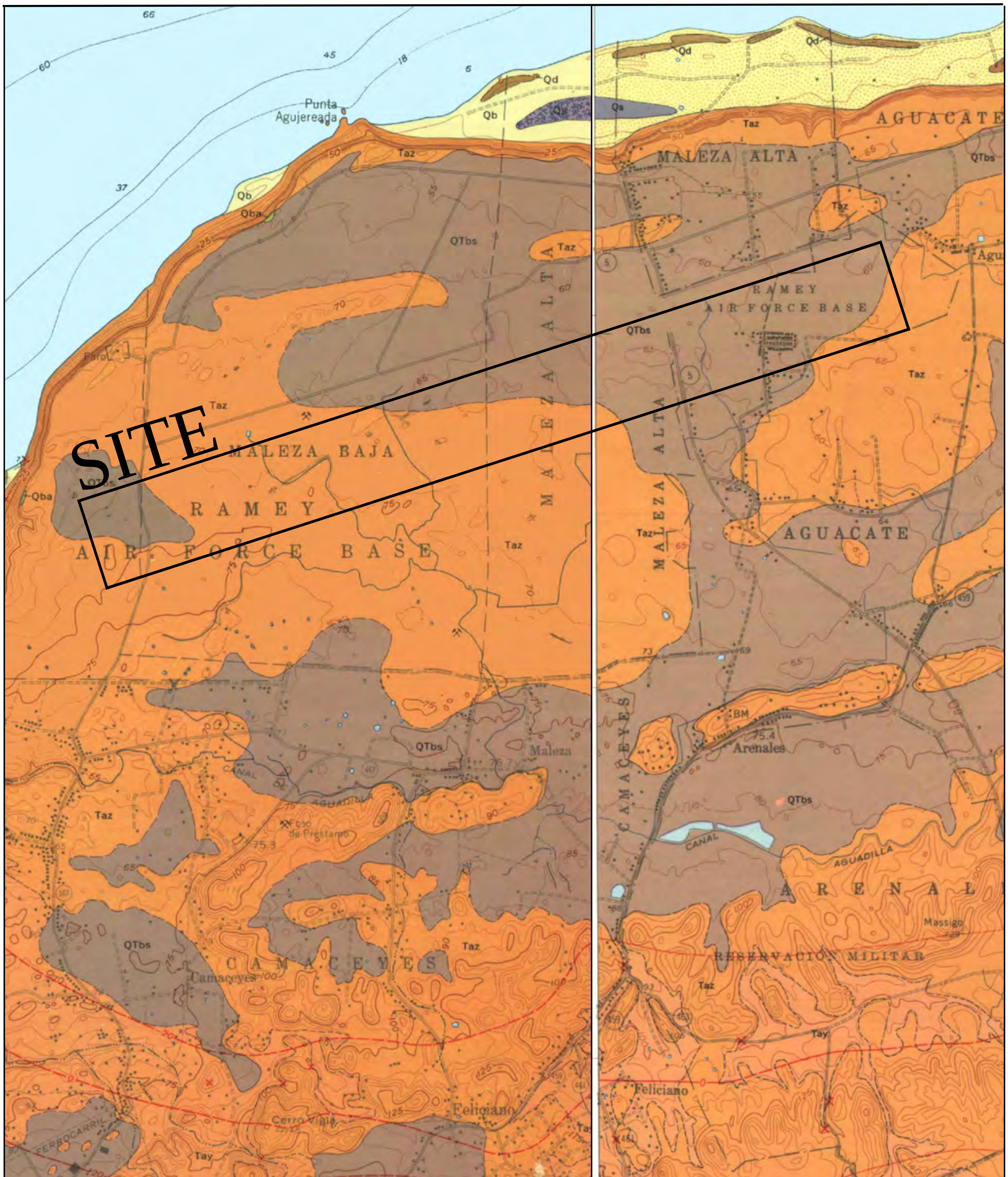
REFERENCE:DA/18F3704

1



NOTE:
THE GEOLOGICAL UNITS IDENTIFIED AT OR IN THE VICINITY OF THE PROJECT ARE INDICATED IN THE US GEOLOGICAL SURVEY MAP OF THE I-565 & I-569 OF THE AGUADILLA AND MOCA QUADRANGLE PREPARED BY WATSON H. MONROE (1969) FOR THE US DEPARTMENT OF INTERIOR.

SCAEL: NOT TO SCALE.

FROM US GEOLOGICAL SURVEY GEOLOGICAL MAP (I-569 & 565)

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SITE PLAN

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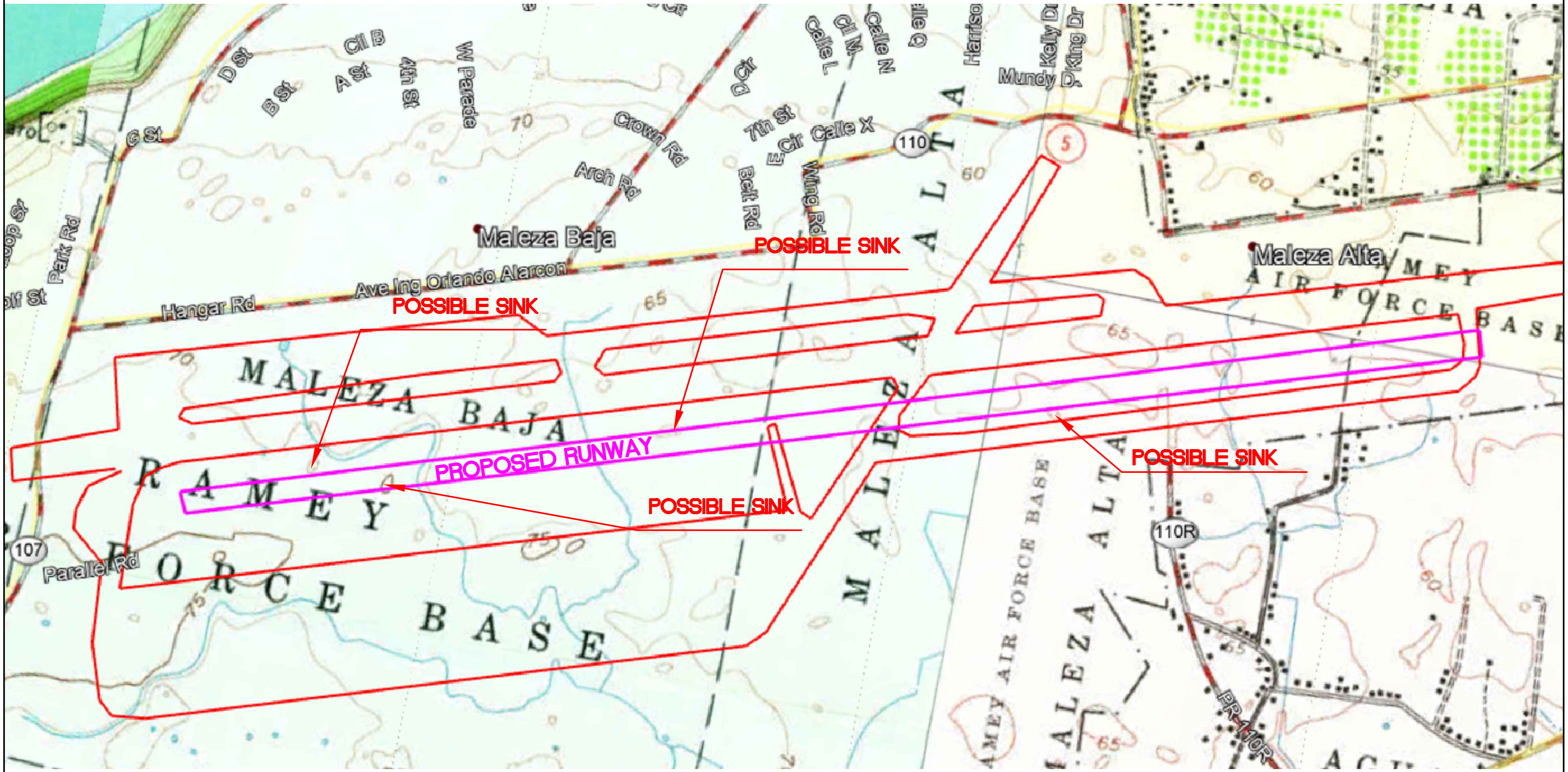

NOTE: THIS DRAWING ILLUSTRATE THE POSSIBLE SINKS AS SHOWN IN THE US GEOLOGICAL SURVEY TOPGRAPHICAL MAP

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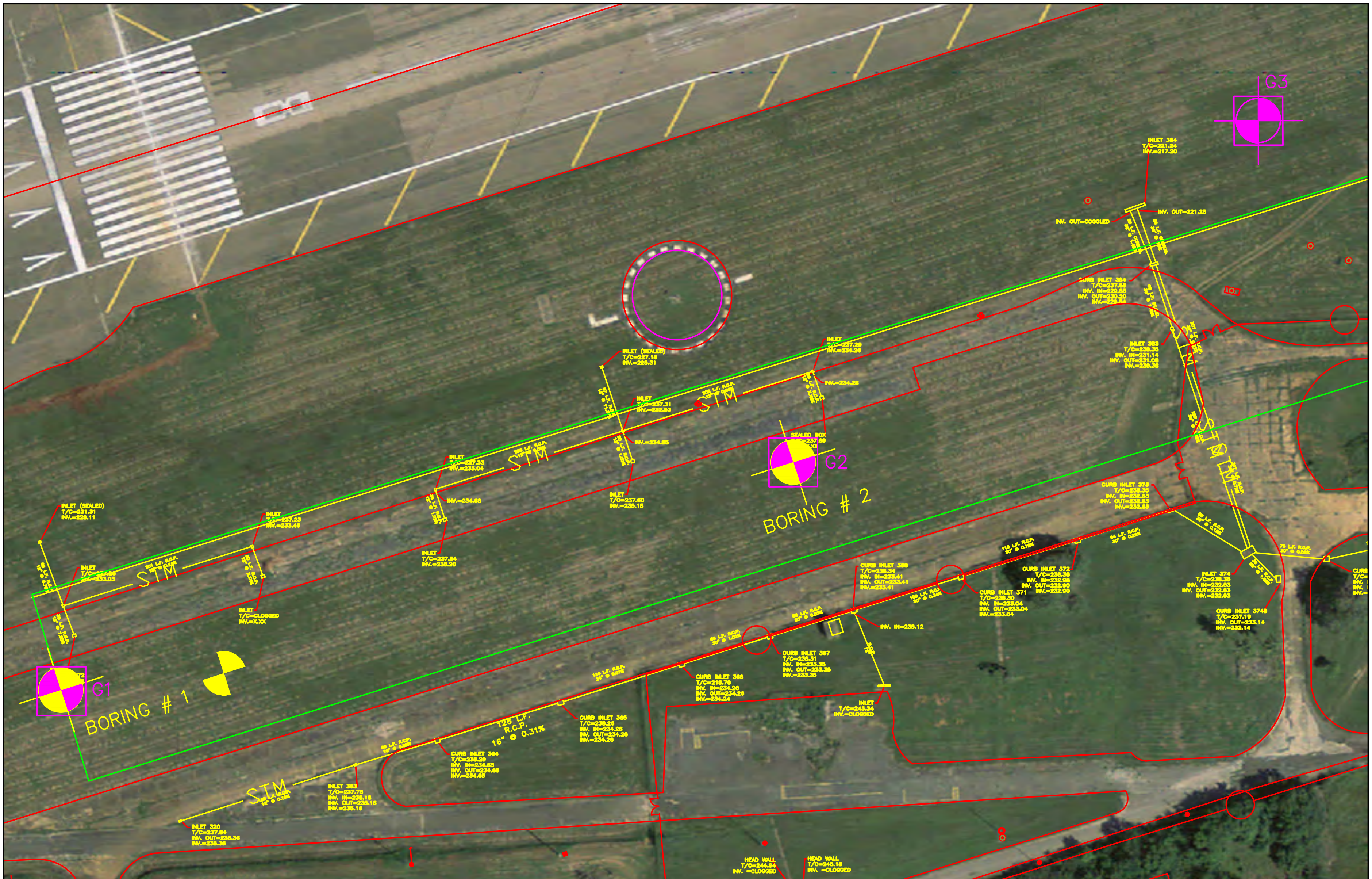

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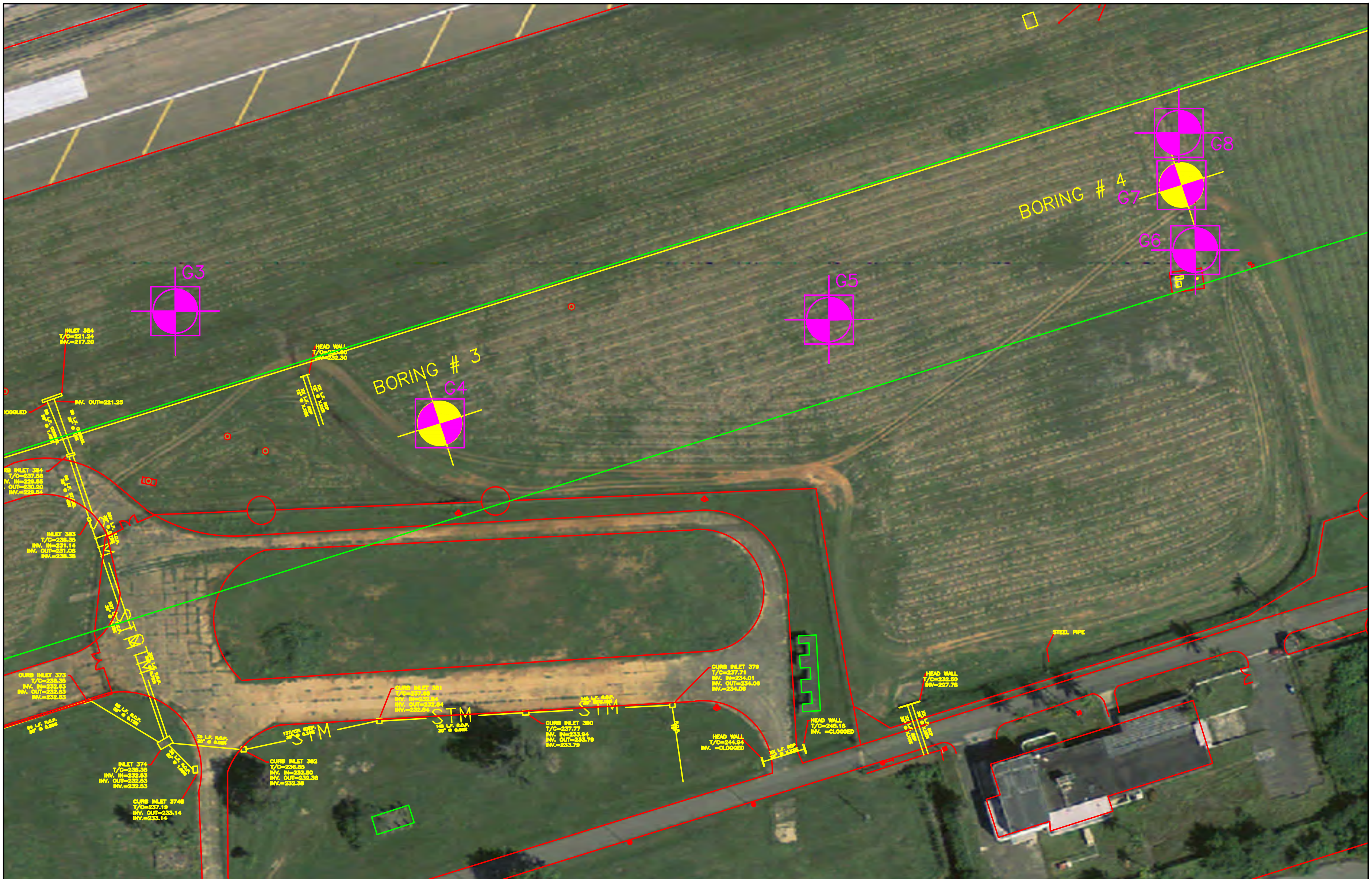

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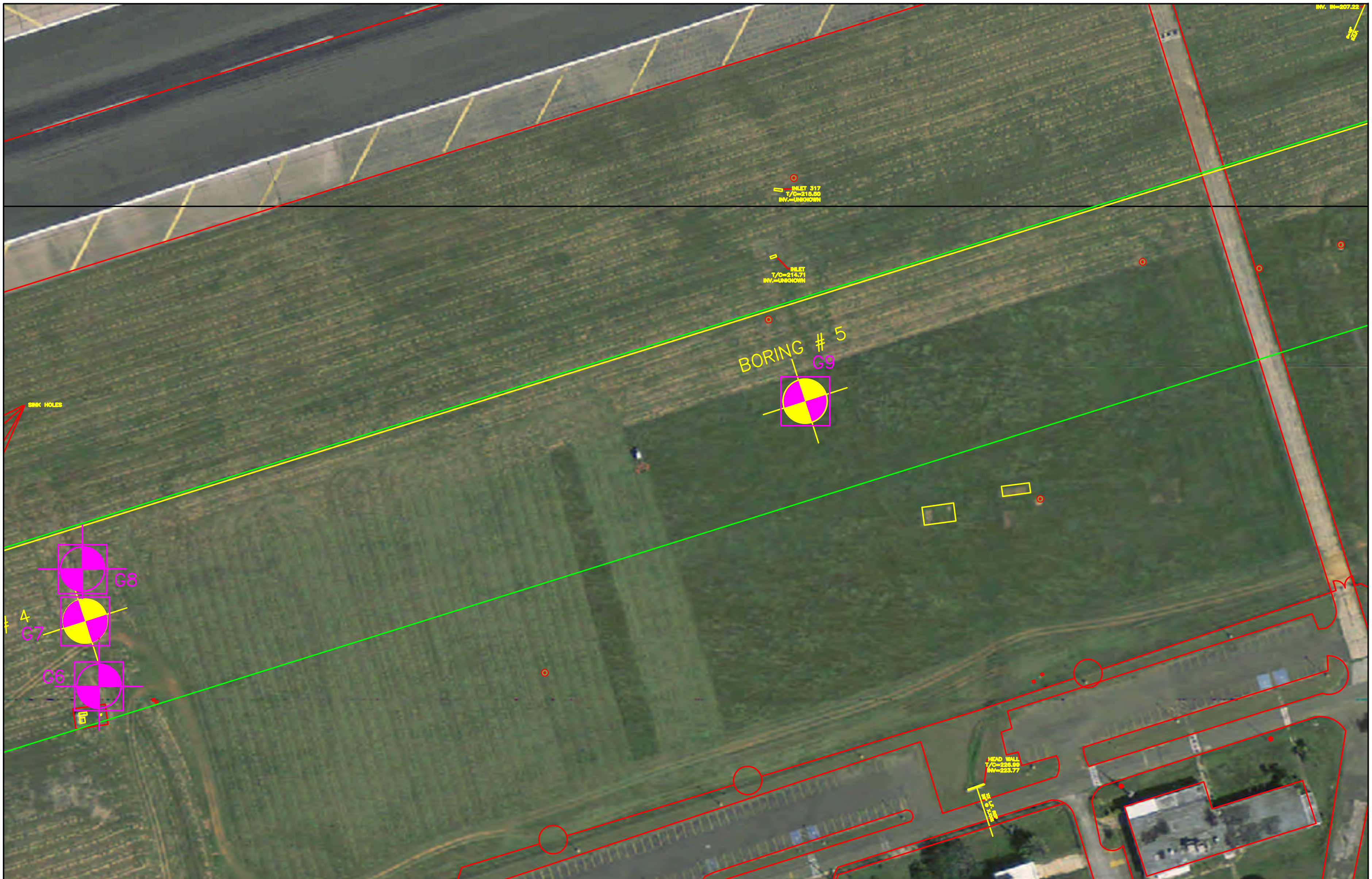

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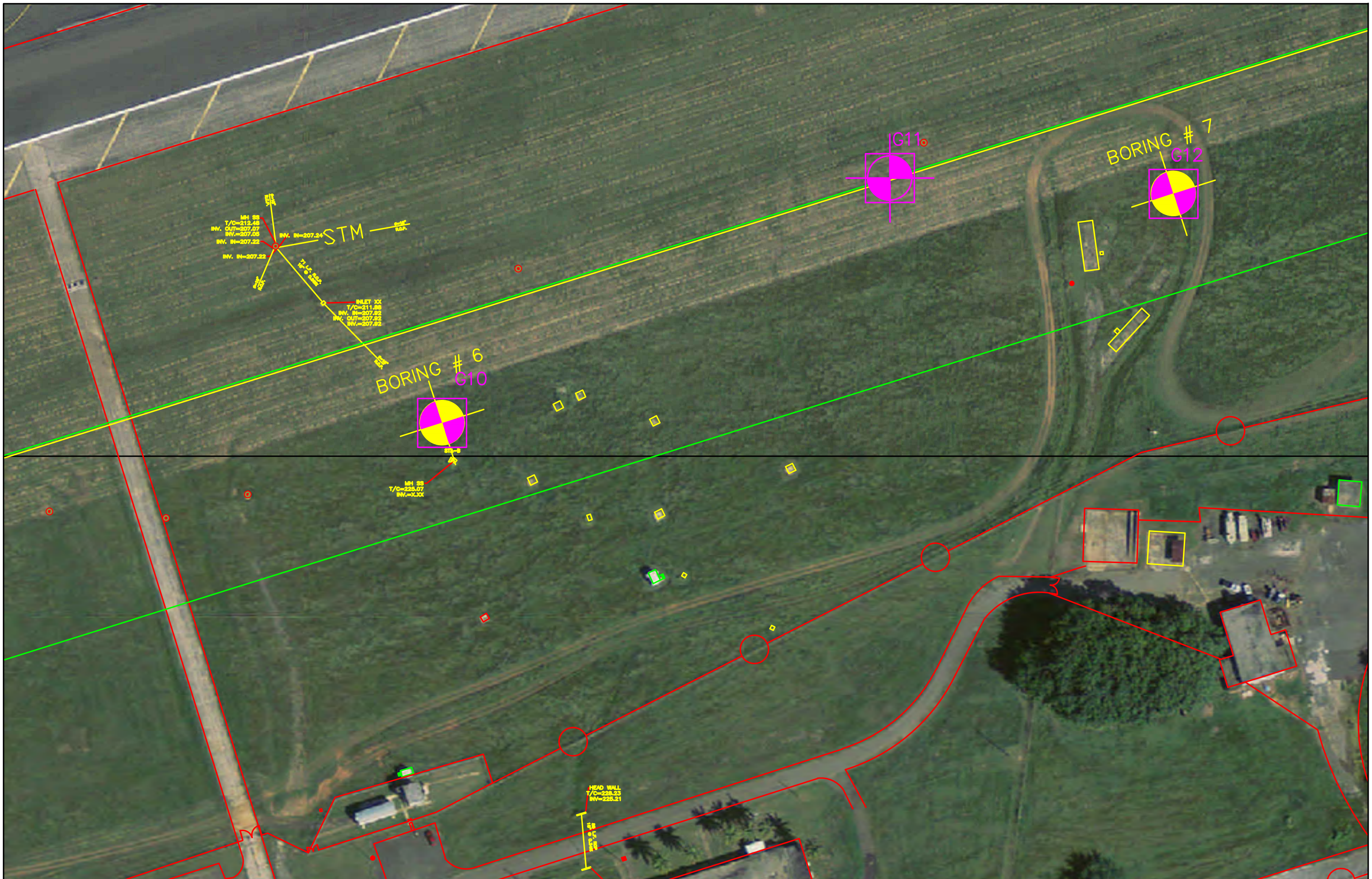

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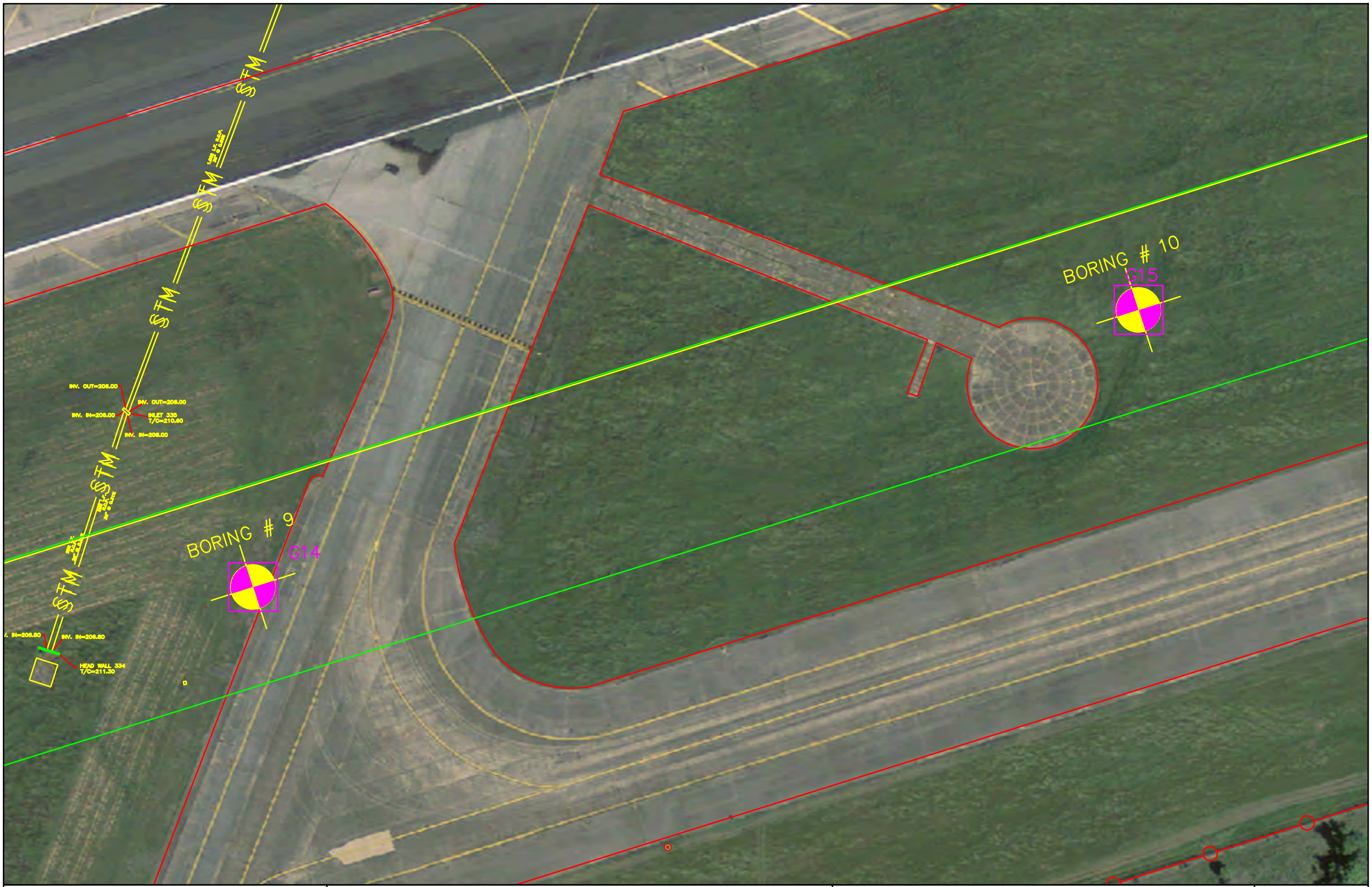

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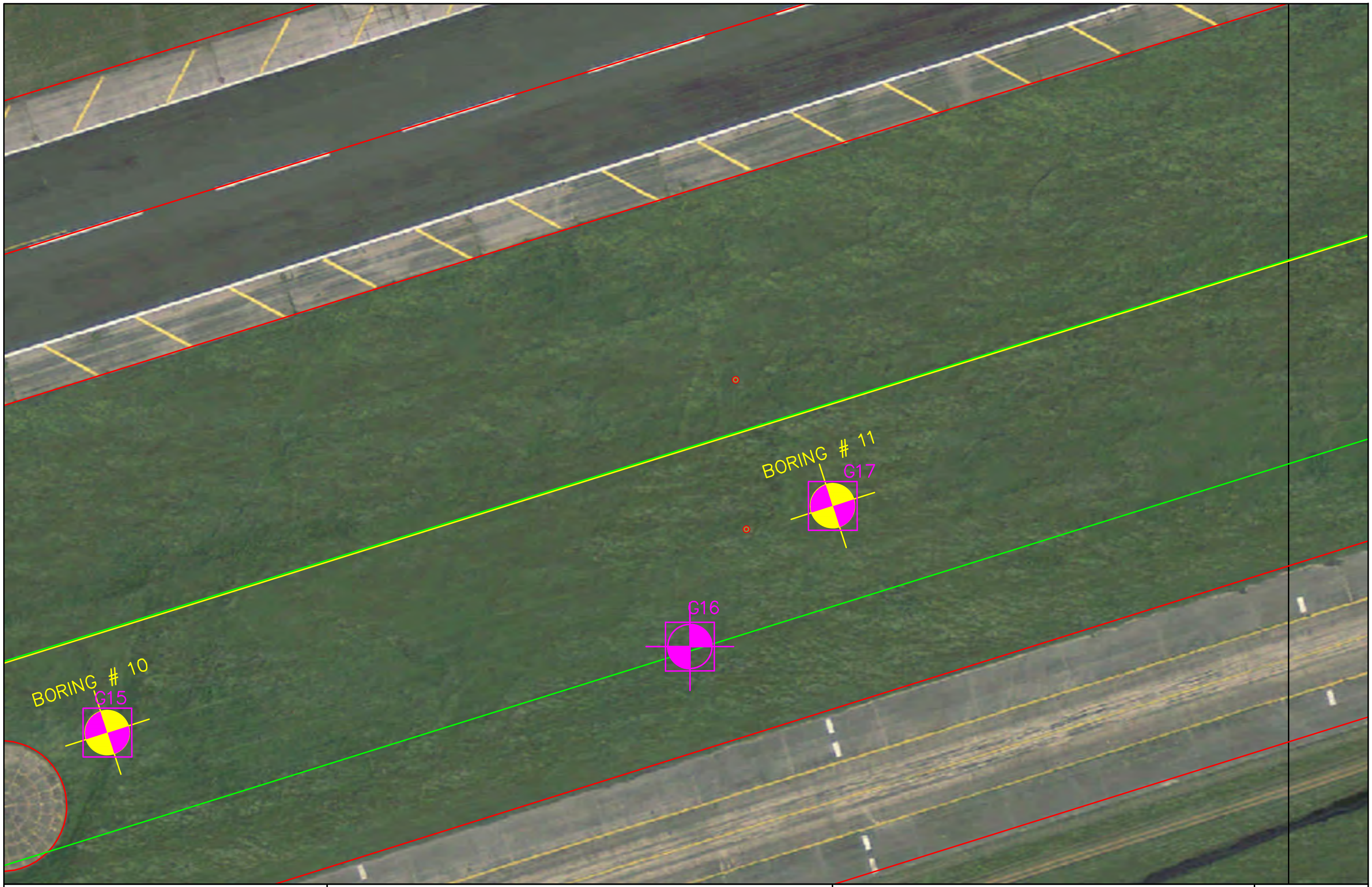

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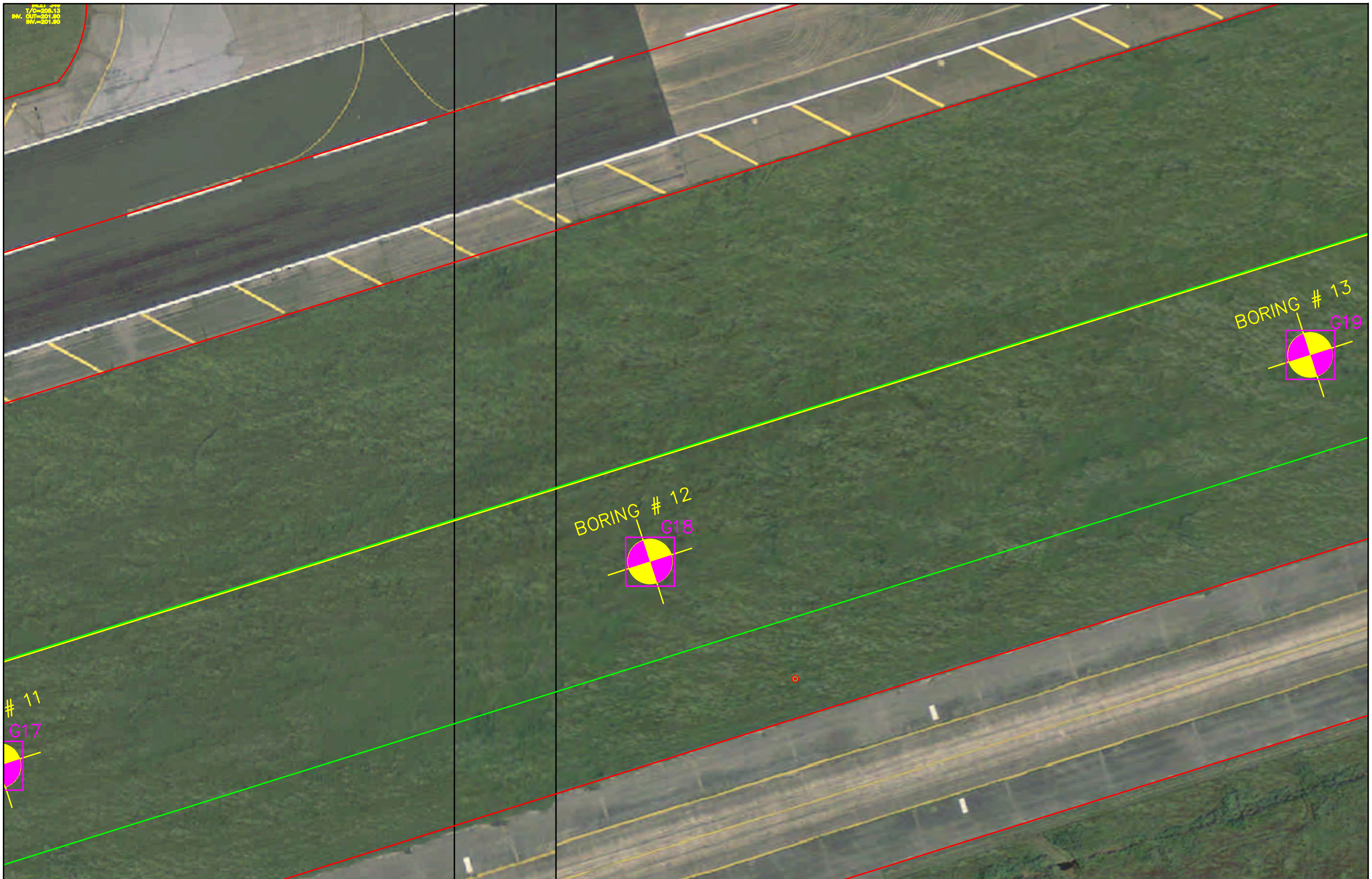

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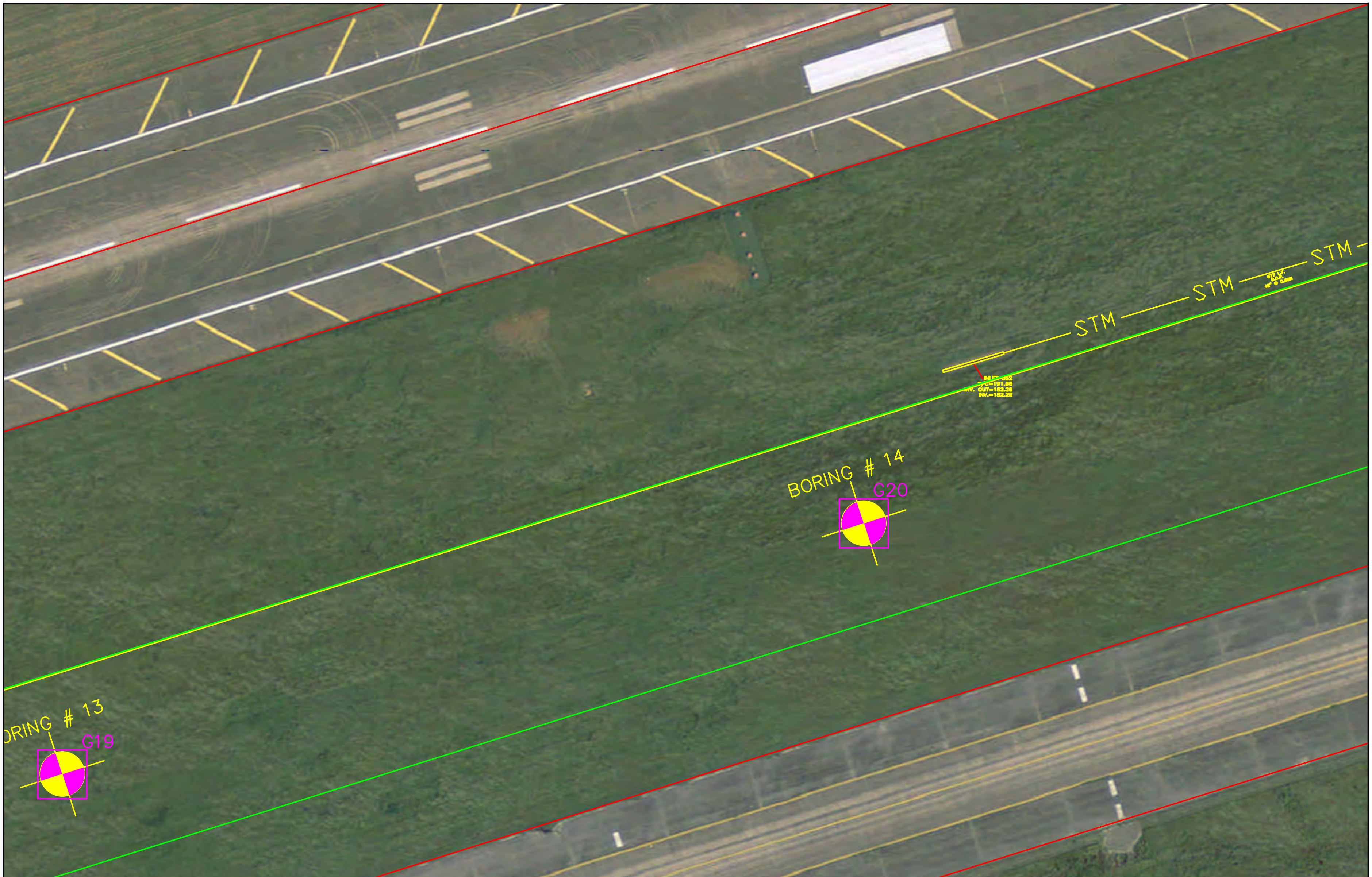

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2J

APPENDIX (1)

Boring Logs

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BORING NO.: 1
SHEET: 1 of 1
LOCATION: Aguadilla
NORTHING:
EASTING:

PROJECT: Rafael Hernández International Airport
REFERENCE NO.: DA/18F3704

DATE: 08-14-2018
GROUND ELEV.:
DEPTH OF HOLE (ft.): 20' 6"
DRILL MACHINE: CME-55
DRILLER: A. Ferrer
DRILL METHOD: 5-5/8" Auger

CASING:		SAMPLER:	
Hammer Weight (lb.):	Drop (in.):	Hammer Weight (lb.): 120	Drop (in.): 30
Type :	Size :	Type: Split Spoon Sampler	Size: 1-3/8" I.D

Depth (ft)	Sampler	Sample No.	Blows/6 in	SPT N-Value	Symbol	Material Description	% Recovery	R.Q.D.	Water Content (%)	qu	Water Level	Liquid Limit	Plasticity Index	Soil Classification
0						Ground Surface								
	SS	1	9-8-8	17		**Sandy Silt** Weathered limestone into very pale brown sandy silt, some calcareous limestone fragments.	67		17		Ground water level was not found within extended area			
	SS	2	9-8-7-3	15		**Silty Sand** Reddish brown silty sand, some clay.	100		6					
5	SS	3	5-6-7-6	13			100		17	4.0		30.5	15.8	A-6 (4) / CL
	SS	4	5-5-5-5	10			100		13	2.6				
	SS	5	4-4-3-5	7		**Silty Clay** Yellowish red, black mottled silty cay, some sand.	100		24	3.8				
10						**Sandy Silt (WC)** Weathered limestone yellow sandy silt, some calcareous limestone fragments.								
	SS	6	23-45-54	99			100		3					
15														
20	SS	7	47-31-75/5"	-			100		4					
25						Note: Weathered rock was broken by sampling device into described constituents.								
30														
35														
40														

q_u (TSF) - UNCONFINED COMPRESSION STRENGTH
wh = WEIGHT OF HAMMER TO DRIVE SAMPLE
W_n = NATURAL WATER CONTENT IN PERCENT OF DRY WEIGHT

▼ DEPTH OF WATER BEFORE COMPLETION
▽ DEPTH OF WATER AFTER 24 HOURS

DESPIAU ASSOCIATES CORP.
Soil / Geotechnical Engineering Laboratories

BORING NO.: 2
SHEET: 1 of 1
LOCATION: Aguadilla
NORTHING:
EASTING:

PROJECT: Rafael Hernández International Airport | REFERENCE NO.: DA/18F3704

DATE: 08-14-2018
GROUND ELEV.:
DEPTH OF HOLE (ft.): 20' 6"
DRILL MACHINE: CME-55
DRILLER: A. Ferrer
DRILL METHOD: 5-5/8" Auger

CASING:		SAMPLER:	
Hammer Weight (lb.):	Drop (in.):	Hammer Weight (lb.): 120	Drop (in.): 30
Type :	Size :	Type: Split Spoon Sampler	Size: 1-3/8" I.D

Depth (ft)	Sampler	Sample No.	Blows/6 in	SPT N-Value	Symbol	Material Description	% Recovery	R.Q.D.	Water Content (%)	qu	Water Level	Liquid Limit	Plasticity Index	Soil Classification
						Ground Surface								
0	SS	1	2-3-4-4	7		**Clayey Sandy Silt** Red, reddish brown clayey sandy silt, reddish brown silty sand and red sandy silt, some clay, few roots .	75		12		Ground water level was not found within extended area			
	SS	2	2-3-3-3	6			100		10	1.5				
5	SS	3	3-3-2-3	5		**Silty Sand** Red, reddish brown silty sand, trace clay, few roots (-).	100		10					
	SS	4	3-4-4-5	8			100		6					
	SS	5	4-4-4-3	8			100		5					
10						**Sandy Silty Clay** Reddish brown sandy silty clay and reddish yellow silty sand, some clay.								
	SS	6	7-7-8	15			100		7	3.6				
15	SS	7	6-7-9	16			100		5	1.8				
20						**Sandy Silt** Weathered limestone into very pale brown sandy silt, some calcareous limestone fragments..								
	SS	8	31-57-21	78			100		3					
25						Note: Weathered rock was broken by sampling devce into described constituents.								
30														
35														
40														

q_u (TSF) - UNCONFINED COMPRESSION STRENGTH
wh = WEIGHT OF HAMMER TO DRIVE SAMPLE
W_n = NATURAL WATER CONTENT IN PERCENT OF DRY WEIGHT

DEPTH OF WATER BEFORE COMPLETION
DEPTH OF WATER AFTER 24 HOURS

DESPIAU ASSOCIATES CORP.
Soil / Geotechnical Engineering Laboratories

BORING NO.: 3
SHEET: 1 of 1
LOCATION: Aguadilla
NORTHING:
EASTING:

PROJECT: Rafael Hernandez International Airport | **REFERENCE NO.:** DA/18F3704

DATE: 08-14-2018
GROUND ELEV.:
DEPTH OF HOLE (ft.): 20' 6"
DRILL MACHINE: CME-55
DRILLER: A. Ferrer
DRILL METHOD: 5-5/8" Auger

CASING:		SAMPLER:	
Hammer Weight (lb.):	Drop (in.):	Hammer Weight (lb.): 120	Drop (in.): 30
Type :	Size :	Type: Split Spoon Sampler	Size: 1-3/8" I.D

Depth (ft)	Sampler	Sample No.	Blows/6 in	SPT N-Value	Symbol	Material Description	% Recovery	R.Q.D.	Water Content (%)	qu	Water Level	Liquid Limit	Plasticity Index	Soil Classification
0						Ground Surface								
	SS	1	4-3-3-3	6		**Sandy Silty Clay** Dark reddish brown sandy silty clay, trace calcareous limestone fragments.	67		20					
	SS	2	5-6-6-9	12		**Clayey Sandy Silt**	100		11					
5	SS	3	11-15-14-10	29		Brown, reddish brown clayey sandy silt, trace calcareous limestone fragments, few roots (-).	100		12	1.7	Ground water level was not found within extended area	18.4	7.5	A-2-4 (0) / SC
	SS	4	11-14-14-12	28		**Sandy Silty Clay** Reddish brown and reddisah yellow sandy silty clay, trace calcareous limestone fragments.	100		13	2.6				
	SS	5	5-5-7-7	12		**Clayey Silty Sand** Reddish brown clayey silty sand.	100		10	2.7				
10						**Silty Sand (WC)** Weathered limestone into light reddish brown silty sand, some calcareous limestone fragments.								
	SS	6	51-31-63	94			100		8					
15														
20	SS	7	75/4"	-			100		5					
25						Note: Weathered rock was broken by sampling device into described constituents.								
30														
35														
40														

q_u (TSF) - UNCONFINED COMPRESSION STRENGTH
wh = WEIGHT OF HAMMER TO DRIVE SAMPLE
W_n = NATURAL WATER CONTENT IN PERCENT OF DRY WEIGHT

▼ DEPTH OF WATER BEFORE COMPLETION
▽ DEPTH OF WATER AFTER 24 HOURS

DESPIAU ASSOCIATES CORP.
Soil / Geotechnical Engineering Laboratories

BORING NO.: 4
SHEET: 1 of 1
LOCATION: Aguadilla
NORTHING:
EASTING:

PROJECT: Rafael Hernández International Airport
REFERENCE NO.: DA/18F3704

DATE: 08-14-2018
GROUND ELEV.:
DEPTH OF HOLE (ft.): 20' 6"
DRILL MACHINE: CME-55
DRILLER: A. Ferrer
DRILL METHOD: 5-5/8" Auger

CASING:
Hammer Weight (lb.): **Drop (in.):**
Type : **Size :**

SAMPLER:
Hammer Weight (lb.): 120 **Drop (in.):** 30
Type: Split Spoon Sampler **Size:** 1-3/8" I.D

Depth (ft)	Sampler	Sample No.	Blows/6 in	SPT N-Value	Symbol	Material Description	% Recovery	R.Q.D.	Water Content (%)	qu	Water Level	Liquid Limit	Plasticity Index	Soil Classification
						Ground Surface								
0	SS	1	3-7-7-8	14		**Sandy Silty Clay** Reddish brown sandy silty clay, some calcareous limestone fragments, few roots.	62		35		Ground water level was not found within extended area			
	SS	2	7-8-9-31	17			100		16	1.7				
5	SS	3	25-27-75/3"	-		**Silty Sand (WC)** Weathered limestone into light reddish brown, light gray mottled sillty sand, trace clay, some calcareous limestone fragments.	100		25			27.7	12.2	A-6 (2) / SC
	SS	4	35-75/3"	-			89		10					
10	SS	5	75/4"	-			100		4					
15	SS	6	75/5"	-			100		9					
20	SS	7	27-34-47	81			100		10					
25						Note: Weathered rock was broken by sampling device into described constituents.								
30														
35														
40														

q_u (TSF) - UNCONFINED COMPRESSION STRENGTH
wh = WEIGHT OF HAMMER TO DRIVE SAMPLE
W_n = NATURAL WATER CONTENT IN PERCENT OF DRY WEIGHT

DEPTH OF WATER BEFORE COMPLETION
DEPTH OF WATER AFTER 24 HOURS

DESPIAU ASSOCIATES CORP.
Soil / Geotechnical Engineering Laboratories

BORING NO.: 5
SHEET: 1 of 1
LOCATION: Aguadilla
NORTHING:
EASTING:

PROJECT: Rafael Hernández International Airport
REFERENCE NO.: DA/18F3704
DATE: 08-15-2018
GROUND ELEV.:

CASING:
Hammer Weight (lb.):
Drop (in.):
Type :
Size :

SAMPLER:
Hammer Weight (lb.): 120
Drop (in.): 30
Type: Split Spoon Sampler
Size: 1-3/8" I.D

DEPTH OF HOLE (ft.): 20' 6"
DRILL MACHINE: CME-55
DRILLER: A. Ferrer
DRILL METHOD: 5-5/8" Auger

Depth (ft)	Sampler	Sample No.	Blows/6 in	SPT N-Value	Symbol	Material Description	% Recovery	R.Q.D.	Water Content (%)	qu	Water Level	Liquid Limit	Plasticity Index	Soil Classification
						Ground Surface								
0	SS	1	2-3-5-9	8		**Sandy Silty Clay** Dark brown and reddish brown sandy silty clay, some calcareous limestone fragments, few roots.	75		16		Ground water level was not found within extended area			
	SS	2	13-9-11-9	20		**Silty Sand** Reddish brown, yellow mottled silty sand, some clay.	75		14					
5	SS	3	7-6-7-8	13			100		20					
	SS	4	7-10-10-9	20		**Sandy Silty Clay** Reddish brown, yellow mottled sandy silty clay.	83		17	0.8				
	SS	5	21-75/5"	-		**Silty Sand** Very pale brown silty sand, some calcareous limestone fragments.	91		13					
10														
	SS	6	23-21-21	42			100		11					
15														
20	SS	7	30-23-24	47			100		10					
25														
30														
35														
40														

q_u (TSF) - UNCONFINED COMPRESSION STRENGTH
wh = WEIGHT OF HAMMER TO DRIVE SAMPLE
W_n = NATURAL WATER CONTENT IN PERCENT OF DRY WEIGHT

DEPTH OF WATER BEFORE COMPLETION
DEPTH OF WATER AFTER 24 HOURS

DESPIAU ASSOCIATES CORP.
Soil / Geotechnical Engineering Laboratories

BORING NO.: 6
SHEET: 1 of 1
LOCATION: Aguadilla
NORTHING:
EASTING:

PROJECT: Rafael Hernández International Airport			**REFERENCE NO.: DA/18F3704**	**DATE: 08-15-2018**
				GROUND ELEV.:
CASING:		**SAMPLER:**		**DEPTH OF HOLE (ft.): 20' 6"**
Hammer Weight (lb.):	**Drop (in.):**	**Hammer Weight (lb.): 120**	**Drop (in.): 30**	**DRILL MACHINE: CME-55**
Type :	**Size :**	**Type: Split Spoon Sampler**	**Size: 1-3/8" I.D**	**DRILLER: A. Ferrer**
				DRILL METHOD: 5-5/8" Auger

Depth (ft)	Sampler	Sample No.	Blows/6 in	SPT N-Value	Symbol	Material Description	% Recovery	R.Q.D.	Water Content (%)	qu	Water Level	Liquid Limit	Plasticity Index	Soil Classification
						Ground Surface								
0	SS	1	2-3-5-9	8		**Clayey Sandy Silt** Reddish brown clayey sandy silt, few roots.	75		16		Ground water level was not found within extended area			
	SS	2	13-9-11-9	15			75		14					
5	SS	3	7-6-7-8	35		**Sandy Silty Clay** Red and reddish brown sandy silty clay.	100		20					
	SS	4	7-10-10-9	13			83		17	0.8		30.3	17.7	A-6(4) / CL
	SS	5	21-75/5"	36			91		13					
10						**Sandy Silty Clay** Red and reddish brown sandy silt clay and very pale brown silty sand, some calcareous limestone fragments.								
	SS	6	23-21-21	31			100		11					
15						**Silty Sand (WC)** Weathered limestone into very pale brown silty sand, some calcareous limestone fragments.								
20	SS	7	30-23-24	64			100		10					
25						Note: Weathered rock was broken by sampling device into described constituents.								
30														
35														
40														

q_u (TSF) - UNCONFINED COMPRESSION STRENGTH
wh = WEIGHT OF HAMMER TO DRIVE SAMPLE
W_n = NATURAL WATER CONTENT IN PERCENT OF DRY WEIGHT

DEPTH OF WATER BEFORE COMPLETION
DEPTH OF WATER AFTER 24 HOURS

DESPIAU ASSOCIATES CORP.
Soil / Geotechnical Engineering Laboratories

BORING NO.: 7
SHEET: 1 of 1
LOCATION: Aguadilla
NORTHING:
EASTING:

PROJECT: Rafael Hernández International Airport
REFERENCE NO.: DA/18F3704

DATE: 08-15-2018
GROUND ELEV.:
DEPTH OF HOLE (ft.): 20' 6"
DRILL MACHINE: CME-55
DRILLER: A. Ferrer
DRILL METHOD: 5-5/8" Auger

CASING:
Hammer Weight (lb.):
Drop (in.):
Type :
Size :

SAMPLER:
Hammer Weight (lb.): 120
Drop (in.): 30
Type: Split Spoon Sampler
Size: 1-3/8" I.D

Depth (ft)	Sampler	Sample No.	Blows/6 in	SPT N-Value	Symbol	Material Description	% Recovery	R.Q.D.	Water Content (%)	qu	Water Level	Liquid Limit	Plasticity Index	Soil Classification
						Ground Surface								
0	SS	1	5-4-5-7	9		**Silty Clay** Brown silty clay, some sand, trace calcareous limestone fragments, few roots.	100		14		Ground water level was not found within extended area			
	SS	2	5-10-8-8	18		**Silty Sand** Brown to dark brown silty sand and red, black mottled silty clay.	100		13					
5	SS	3	5-6-7-7	13			100		18	0.8				
	SS	4	4-4-3-3	7			100		14	1.7		26.5	11.3	A-6(2) / SC
10	SS	5	4-5-10-9	15			100		17	4.1				
15	SS	6	18-24-34	58		**Sandy Silt (WC)** Weathered limestone into very pale brown sandy silt, some calcareous limestone fragments.	100		8					
20	SS	7	56-75/5"	-			100		9					
25						Note: Weathered rock was broken by sampling device into described constituents.								
30														
35														
40														

q_u (TSF) - UNCONFINED COMPRESSION STRENGTH
wh = WEIGHT OF HAMMER TO DRIVE SAMPLE
W_n = NATURAL WATER CONTENT IN PERCENT OF DRY WEIGHT

▼ DEPTH OF WATER BEFORE COMPLETION
▽ DEPTH OF WATER AFTER 24 HOURS

DESPIAU ASSOCIATES CORP.
Soil / Geotechnical Engineering Laboratories

BORING NO.: 8
SHEET: 1 of 1
LOCATION: Aguadilla
NORTHING:
EASTING:

PROJECT: Rafael Hernández International Airport | REFERENCE NO.: DA/18F3704

DATE: 08-15-2018
GROUND ELEV.:
DEPTH OF HOLE (ft.): 20' 6"
DRILL MACHINE: CME-55
DRILLER: A. Ferrer
DRILL METHOD: 5-5/8" Auger

CASING:
Hammer Weight (lb.): | Drop (in.):
Type : | Size :

SAMPLER:
Hammer Weight (lb.): 120 | Drop (in.): 30
Type: Split Spoon Sampler | Size: 1-3/8" I.D

Depth (ft)	Sampler	Sample No.	Blows/6 in	SPT N-Value	Symbol	Material Description	% Recovery	R.Q.D.	Water Content (%)	qu	Water Level	Liquid Limit	Plasticity Index	Soil Classification
						Ground Surface					Ground water level was not found within extended area			
0	SS	1	2-5-5-3	10		**Sandy SIlty Clay** Reddish brown sandy silty clay, many roots.	100		20					
	SS	2	2-6-8-6	14		**Sandy Silty Clay** Reddish brown and yellowish red, black mottled, black joints sandy silty clay.	100		22	4.1				
5	SS	3	6-8-8-8	16			100		15	2.2		23.8	11.0	A-6(2) / SC
	SS	4	6-5-5-9	16			100		17	2.2				
10	SS	5	7-9-9-8	18			100		17	2.9				
15	SS	6	10-19-75/4"	-		**Sandy Silty Clay (WC)** Weathered limestone into yellowish red, black mottled sandy silty clay and pale yellow, very pale brown sandy silt, trace calcareous limestone fragments.	100		13	1.5				
20	SS	7	22-67-75/3"	-			100		9					
25						Note: Weathered rock was broken by sampling device into described constituents.								
30														
35														
40														

q_u (TSF) - UNCONFINED COMPRESSION STRENGTH
wh = WEIGHT OF HAMMER TO DRIVE SAMPLE
W_n = NATURAL WATER CONTENT IN PERCENT OF DRY WEIGHT

DEPTH OF WATER BEFORE COMPLETION
DEPTH OF WATER AFTER 24 HOURS

DESPIAU ASSOCIATES CORP.
Soil / Geotechnical Engineering Laboratories

BORING NO.: 9
SHEET: 1 of 1
LOCATION: Aguadilla
NORTHING:
EASTING:

PROJECT: Rafael Hernández International Airport **REFERENCE NO.: DA/18F3704**

DATE: 08-16-2018
GROUND ELEV.:
DEPTH OF HOLE (ft.): 20' 6"
DRILL MACHINE: CME-55
DRILLER: A. Ferrer
DRILL METHOD: 5-5/8" Auger

CASING:
Hammer Weight (lb.): **Drop (in.):**
Type : **Size :**

SAMPLER:
Hammer Weight (lb.): 120 **Drop (in.): 30**
Type: Split Spoon Sampler **Size: 1-3/8" I.D**

Depth (ft)	Sampler	Sample No.	Blows/6 in	SPT N-Value	Symbol	Material Description	% Recovery	R.Q.D.	Water Content (%)	qu	Water Level	Liquid Limit	Plasticity Index	Soil Classification
						Ground Surface								
0	SS	1	3-4-5-3	9		**Silty Clay** Reddish brown and reddish yellow, yellow mottled silty clay, some sand.	71		15		Ground water level was not found within extended area			
	SS	2	6-12-18-14	30		**Sandy Silty Clay** Reddish brown, reddish yellow mottled sandy silty clay.	100		15	5.0				
5	SS	3	5-7-14-23	21			87		20	2.4		28.7	12.00	A-6(5) / CL
	SS	4	22-17-23-24	40		**Silty Clay** Reddish brown, reddish yellow mottled, black joints silty clay, some sand.	100		13	5.0+				
10	SS	5	18-35-43-68	78		**Silty Clay (WC)** Weathered limestone into yellowish red, black joints silty clay, some sand and pale brown silty sand, some calcareous limestone fragments.	100		11	2.5				
15	SS	6	75/4"	-			100		8					
20	SS	7	21-17-75/3"	-			100		8					
25						Note: Weathered rock was broken by sampling device into described constituents.								
30														
35														
40														

q_u (TSF) - UNCONFINED COMPRESSION STRENGTH
wh = WEIGHT OF HAMMER TO DRIVE SAMPLE
W_n = NATURAL WATER CONTENT IN PERCENT OF DRY WEIGHT

DEPTH OF WATER BEFORE COMPLETION
DEPTH OF WATER AFTER 24 HOURS

ROUTINE LABORATORY TEST PROCEDURES

The subsurface exploration and testing program was directed toward the determination of problems, such as the presence of incompetent soils and a high groundwater table. In addition, the allowable bearing pressure of the soils and the foundation level is determined.

1. Classification

Visual-manual procedures, in accordance with ASTM D-2488, were employed to identify the subsoils at the site. Soils are described as one of the following: boulders, gravel, sand, silt, clay, organic soils and peat. Differentiation between the coarser soils is made by visual appreciation of predominant grain size. Fine grained soils (silt, clay, organic soils and peat) are partly identified using plasticity or dilatancy characteristics and the dry strength of the soil instead of the grain size.

2. Moisture Contents

The moisture content was determined for all samples obtained, and it is expressed in percentage of the given ratio of the weight of water and a given soil mass to the dry solid particles in it. The procedure used were in accordance to ASTM Designation D-2216.

3. Atterberg Limits

Designations: D-423 an D-424 establish respectively the standards for the determination of the liquid and plastic limits of the collected clayey samples. They are expressed as water contents and define the boundaries of three states in terms of "limits" as follows: (a) "liquid limit", the boundary between the liquid and the plastic states, and (b) "plastic limit", the boundary between the plastic and semi-solid states.

4. Volume Changes

Swelling characteristics are obtained in order to permit the expeditious identification of foundation soils which could be potentially troublesome due to excessive volume changes as shrinkage and swelling. The ratio of sample volume to its dry volume is recorded while immerse in distilled water for a period of 24 hours.

5. Unconfined Compressive Strengths (q-u)

A measure of shear strength was obtained for all cohesive soils sampled, where possible. The shear strength was determined either using a calibrated penetrometer, the unconfined compressive strength tester or the spring.

DESCRIPTIVE TERMINOLOGY CONSISTENCY OF COHESIVE SOILS AND RELATIVE DENSITY OF GRANULAR SOILS

To approximate the consistency of fine grained soils (soft, medium, stiff, very stiff, hard), a simple test is performed with the hand: a hard fine grain soil is difficult to indent with the thumbnail, a very stiff soil can be indented by the thumbnail, stiff soils are readily indented with the thumb, medium soils can be penetrated by moderate thumb pressure, soft soils are easily penetrated with the thumb, and soft soils run between the fingers when squeezed.

The consistency of cohesive soils has also been correlated to the results of the Standard Penetration Test, as shown below. The correlation, however, is greatly affected by the clay structures and factors as sensitivity.

TABLE 1 - DESCRIPTION OF SOIL DENSITY AND CONSISTENCY

COARSE GRAINED SOILS

Range of Standard Penetration Resistance (BPF)	Relative Density
0 - 4	Very loose
4 - 10	Loose
10 - 30	Medium
30 - 50	Dense
over 50	Very Dense

FINE GRAINED SOIL

Range of Standard Penetration Resistance (BPF)	Unconfined Compressive Strength (TSF)	Consistency
0 - 2	0 - 0.25	very soft
2 - 4	0.25 - 0.50	soft
4 - 8	0.50 - 1.00	medium
8 - 15	1.00 - 2.00	stiff
15 - 30	2.00 - 4.00	very stiff
over 30	over 4.00	hard

These are very approximate correlations which vary with, among other factors, overburden pressure, depth to water and grain size. These correlations are meaningless in soils with a significant amount of gravel or cobbles.

APPENDIX (2)

Earthwork Specifications

SPECIFICATIONS FOR PREPARATION
EXCAVATION, FILLING AND GRADING

1. CLEARING AND GRUBBING

All trees and brush, including large roots, within the contract limit lines shall be cleared by the Contractor and suitably disposed.

2. STRIPPING

Topsoil shall be stripped from the site in all areas of excavation or fill. Topsoil shall be removed to its entire depth, and stockpiled in areas designated, or removed from the site.

3. COMPACTION OF SUBGRADE

Following stripping, the sub grade in all fill areas the exposed grade shall be compacted sufficiently to develop to a depth of at least twelve (12) inches at least 90% of modified Proctor maximum density as determined in the laboratory in conformance with ASTM designation D-1557.

4. MATERIAL FOR FILL

Material for fill shall be approved by the Soils Engineer. The criteria for acceptance shall be based on tests made for liquid and plastic limits, sieve analysis, maximum density at optimum moisture, shearing strength, and expansive qualities. Potential volume change tests shall accompany field density test results as required by field conditions. The fill material shall be AASHTO Classification A-2-4 or better for general earthwork construction. It shall be free of stone or rock fragments larger than 4-inch in their greatest dimension. All fill material shall be of an inorganic and non-swelling nature.

5. PLACEMENT AND COMPACTION OF FILL MATERIAL

Prior to placing fill, the sub grade shall be graded to provide adequate drainage and shall be compacted as outlined in section 3.

(a) Placement of Fill:

The fill shall be spread evenly, in approximately horizontal layers of six (6) to twelve (12) inches loose thickness to be determined in the field by the Engineer.

(b) Moisture Control:

At the time of compaction, the material in each layer of fill shall have moisture content within 2% of optimum moisture content for compaction, as determined by ASTM D-1557 for determining the moisture-density relationship of the fill material.

(c) Drainage of the Site:

At all times the Contractor shall maintain and operate proper and adequate surface and subsurface drainage methods to the satisfaction of the Engineer to keep the construction site dry.

(d) Compaction Equipment:

It is the responsibility of the Contractor to select, furnish and properly maintain equipment which will compact the fill uniformly to the required density, however, the Contractor's selection of equipment is subject to approval by the Engineer. No fill shall be placed until approved compaction equipment is on the site and working condition.

(e) Compaction of Fill:

Each lift within load-bearing areas shall be uniformly compacted to at least 95% of Modified Proctor Maximum density as determined in the laboratory by the Engineer in accordance with ASTM designation D-1557. For sectors within non-load-bearing areas shall be uniformly compacted to at least 90% of the modified Proctor Maximum Density for each lift, unless otherwise required in the geotechnical report. Any lift, or portion thereof, which is not compacted in accordance with the specifications, shall be compacted or removed and replaced to the satisfaction of the Engineer. The degree of compaction of each lift shall be checked by the Engineer and each successive lift shall not be placed or compacted until the previous lift is inspected, tested and approved by the Engineer.

(f) Ground Slopes:

Existing ground slope surfaces, to be covered by the fill, steeper than 5.1 (horizontal: vertical) shall be scarified into steps or benches and the fill progresses to provide a bond and avoid any shear failure along the fill/natural ground interface. Refer to Appendix 2-A (Excavation and Earthwork Benching) contained herein.

(g) Slopes on Fill:

Slopes shall not be steeper than 2.0 to 1.0 (Horizontal to Vertical units). Drainage other than storm water falling directly to slope shall not be permitted to cut across slope areas. Protection of slopes by planting of grass and shrubs on the same shall be performed immediately upon their completion. Special sloping requirement may be established in the geotechnical report.

(h) Erosion Protection:

Embankment fills with slopes steeper than 1.5H: 1.0V (Horizontal: Vertical) shall be protected from runoff and erosion by an appropriate type of vegetation cover. This may be performed by hydro mulching in such a way as to cover the soil as fast as possible until evidence of "catch" or uniform stand to prevent erosion is achieved, at which time final acceptance will be given. The Contractor shall properly water, mow, and otherwise maintain all treated areas until final acceptance.

6. SLOPE CONTROL PLANTING

This item shall consist of the preparation of slopes for planting, fertilizing the soils, sowing the soil-fixing grasses, and permitting adequate growth of planted seeds.

(a) PREPARATION OF GROUND:

The top soil surface shall be uniformly trimmed and raked to true lines until it is free from unsightly variations such as humps, ridges, or depressions. All objectionable materials which might interfere with sowing of seeds, growth of grasses or subsequent maintenance of grass-covered areas, shall be removed or cleared.

Storm water run-off shall not be carried over the slopes. In cut sections, adequate protection must be provided by means of paved diversion ditches.

(b) FERTILIZERS:

Accepted fertilizers shall be thoroughly dissolved into the soil to a depth of at least three (3) inches, to promote rapid growth of the grass.

(c) SOIL FIXING GRASSES:

The following types of grasses are recommended in their order of preference; however, any other type of local grass acceptable to the engineer may also be used; (a) Bermuda grass and (b) St. Augustine grass.

(d) MAINTENANCE:

The contractor shall mow, water and otherwise maintain all seeded areas until the building is occupied. Any area shall fail to catch will have to be re seeded. Surfaces where erosion gullies develop or otherwise become damage due to over saturation shall be repaired

7. BENCHING

When embankment is to be placed and compacted on hillsides or when new embankment is to be compacted against an existing embankment, or when an embankment is built one-half (1/2) width at a time, the slopes that are steeper than four to one (4:1) when measured at right angles to the roadway shall be continuously benched over these areas as the work is brought up in layers. Benching shall be of sufficient width to permit operation if placing and compacting equipment. Each horizontal cut shall begin at the intersection of the original ground and the vertical sides of the previous cuts. Refer to Appendix 2-A (Excavation and Earthwork Benching) contained herein.

BD/sc
DA-09 revision

APPENDIX (3)

Special Laboratory Tests

SPECIAL LABORATORY TESTS

I. Laboratory Testing Procedures:

As may be required for the geotechnical evaluations, a series of non-routine or special tests could be performed to assist in the engineering analyses. The special tests performed are contained in separate sheets included in this Appendix. The special tests performed for the present project are included in the following list of laboratory tests, among other usually performed.

1. Vane Shear Test
2. Mechanical Analysis of Soils
3. Liquid & Plastic Limit Tests
4. Unit Weight Determination of Soils
5. Unconfined Compressive Strength Tests (Stress-Strain)
6. Compaction Tests
7. Free Swell Tests
8. Theoretical Maximum Specific Gravity (Gmm) And Density of Hot Mix Asphalt (HMA) Paving Mixtures
9. Bulk Specific Gravity (Gmb) of Compacted Asphalt Mixtures Using Saturated Surface-Dry Specimens
10. Percent Air Voids in Compacted Dense and Open Asphalt Mixtures

A brief description of the tests procedures which are used in the above list of special tests is as follows:

1. Vane Shear Test

A pocket vane shear test device was used to perform various vane shear tests on samples (i.e. SPT and Undisturbed Shelby Tubes). The results of the vane shear tests are given in tons per sq.-ft.

2. Mechanical Analysis of Soils

The process of separating the soil into particle-size groups, including both the sieve analysis of the coarser and fine grains was performed. Standard U.S. sieves were used to establish the Percent Finer by Weight of the samples. The percentage of fines was used to classify the samples in both the standard AASHTO and Unified Classification Systems.

3. Liquid & Plastic Limit Tests

The moisture content above which a soil readily becomes a liquid upon stirring is called the liquid limit. The standard Arthur Casagrande Device was use for such determination, following ASTM Specifications D423.

The plastic limit is defined as the minimum moisture content at which the soil mixture acts as a plastic solid. The standard ASTM specification D424 was followed in performing the tests.

From the above test results the plasticity index can be determined. It is defined as the numerical difference between the liquid limit and the plastic limit of the soil. In the data sheets the tests results given in the corresponding column are the Liquid Limit (LL) and the Plasticity Index (P.I.).

4. Unit Weight Determination of Soils

The wet unit weight of the samples was obtained by mass per unit volume from the sample, as secured from the field. Dry unit weight determinations were obtained and are specifically mentioned in some of the tables and graphs submitted.

5. Unconfined Compressive Strength Tests (Stress-Strain)

Basically the unconfined compressive strength test is performed by axially loading a cylinder without lateral confinement. In wet fine grained soils the tests are performed quickly. Different from the routine Qu tests, in the special unconfined compressive tests, which are performed in the triaxial compression chamber, the stress-strain at predetermined intervals are recorded. In the routine tests on SPT samples, the unconfined compression tests are performed by the spring tester. Sometimes, the pocket penetrometer device is used to determine the unconfined compressive strength. The test type is indicated in the corresponding column of test results.

6. Modified Proctor Compaction Tests

The laboratory compaction test consists of determining the maximum dry density and optimum moisture content of representative samples of potential borrow fill sources.

The Modified Proctor Density Tests are performed in accordance to the ASTM Designation D 1557, Standard Method for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures using a 10-lb.Rammer and 18-in. drop.

7. Free Swell Tests

The free swell tests are made in accordance to the procedures of the US Bureau of Reclamation, which provide percent total volume change from dry to a saturated condition.

8. Theoretical Maximum Specific Gravity (Gmm) And Density of Hot Mix Asphalt (HMA) Paving Mixtures - AASHTO T-209

This test procedure determines the maximum specific gravity (Gmm) of uncompacted hot mix asphalt (HMA) paving mixtures

9. Bulk Specific Gravity (Gmb) of Compacted Asphalt Mixtures Using Saturated Surface-Dry Specimens - AASHTO T-166

This test procedure determines the bulk specific gravity of specimens of compacted asphalt mixtures.

10. Percent Air Voids in Compacted Dense and Open Asphalt Mixtures - AASHTO T-269

This method covers determination of the percent air voids in compacted dense and open bituminous paving mixtures.

DESPIAU ASSOCIATES CORP.
Soil / Geotechncial Engineering Laboratories

CLIENT:	**AECOM Caribe, LLC**
	Miramar Center Plaza, Suite 304
	954 Ponce de León Ave.
	San Juan, PR 00907
	Ph: 787-723-3332
PROJECT:	Preliminary Geotechnical Investigation for the Proposed Runway at BQN Facilities, Aguadilla, PR.
JOB NO.:	DA/18F3704
DATE:	September 4, 2018

SUMMARY OF SOIL CLASSIFICATION TESTS AND FREE SWELL TESTS

Boring No.	Sample Depth	Liquid Limit %	Plasticity Index %	% Passing US Sieve			Classification		% Free Swell	Clay Type Class.	
				10	40	200	AASHTO	USCS		AC*	CEAC**
1	4'-6"-6'	30.5%	15.8%	100.0	94.7	50.6	A-6 (4)	CL	20%	0.31	0.5
3	4'-6"-6'	18.4%	7.5%	96.7	85.5	33.9	A-2-4 (0)	SC	10%	0.22	0.31
4	2'-4'	27.7%	12.2%	98.8	88.2	45.0	A-6 (2)	SC	15%	0.27	0.41
6	6'-8'	30.3%	12.4%	100.0	97.3	55.0	A-6 (4)	CL	20%	0.23	0.35
7	4'-6'	26.5%	11.3%	100.0	94.1	46.0	A-6 (2)	SC	15%	0.25	0.37
8	2'-4'	23.8%	11.0%	100.0	97.7	48.8	A-6 (2)	SC	15%	0.23	0.34
9	2'-4'	28.7%	12.0%	100.0	98.3	61.2	A-6 (5)	CL	20%	0.2	0.3

* Activity Ratio
** Cation Exchange Activity

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ORGANIC CONTENT DETERMINATION

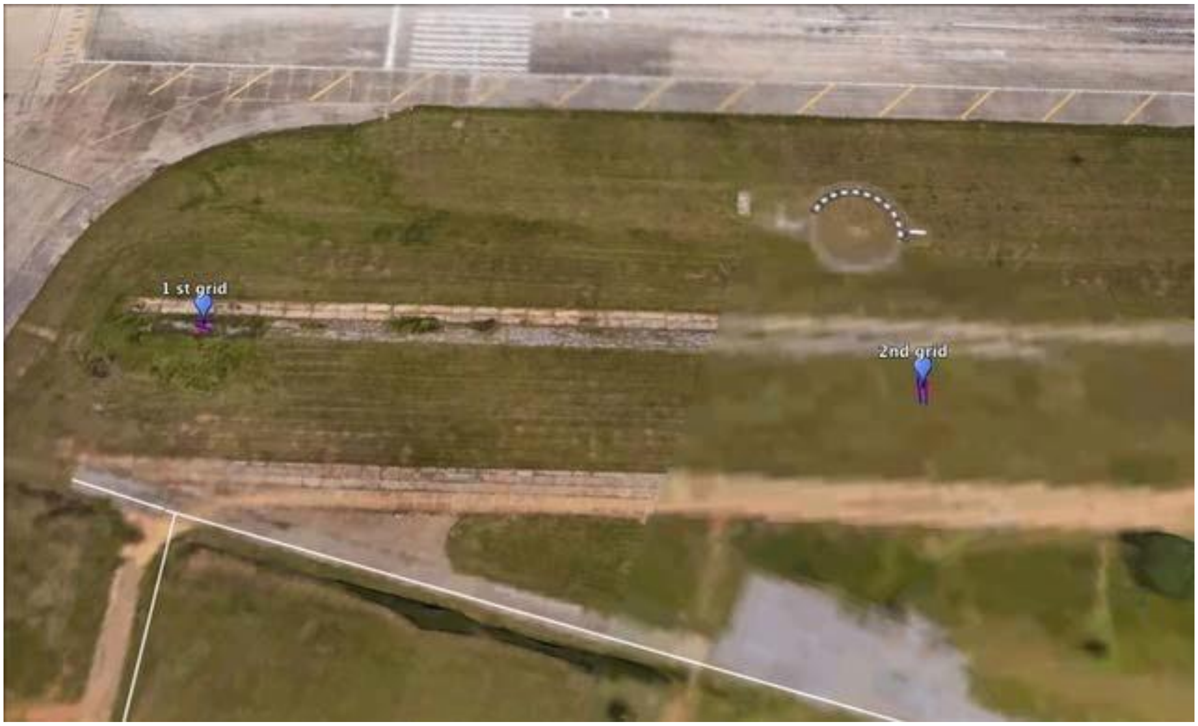
Boring No.	Sample Depth	Description	Organic Content %
2	4'-6'	Red sandy silt, trace clay, few roots (-).	1.5
2	8'-10'	Reddish brown silty sand, trace clay, few roots (-).	1.3

Remarks:

APPENDIX (4)

GEOPHYSICAL INVESTIGATION
GRID LOCATION AND SURVEY RUNS 3D RENDERING

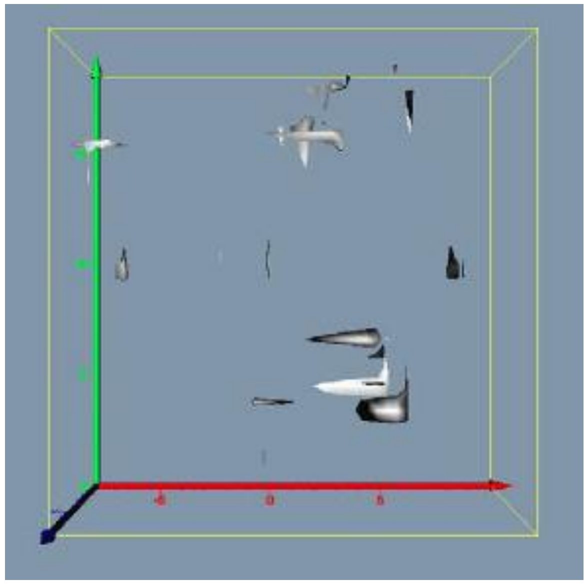
GRID LOCATIONS

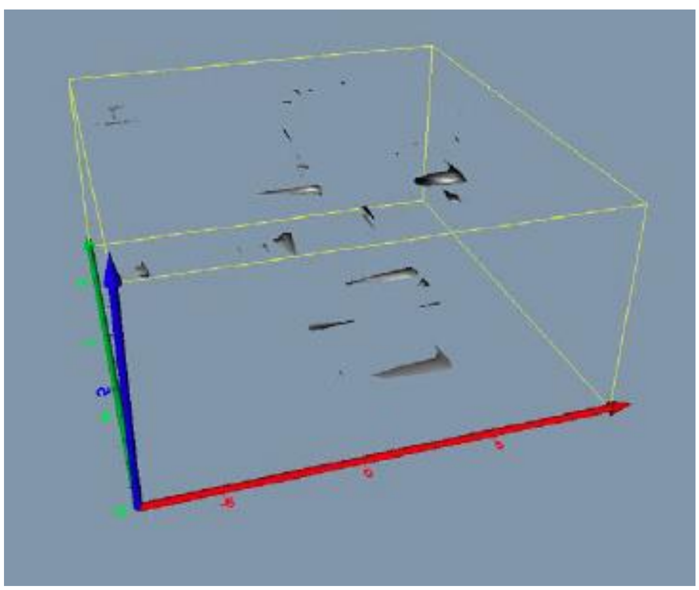



9th grid
10th Grid
11th Grid
12th Grid
13th Grid
14th Grid


15th Grid
17th Grid
16th Grid
18th Grid
19th Grid

GEOPHYSICAL SURVEY RUNS3D RENDERING





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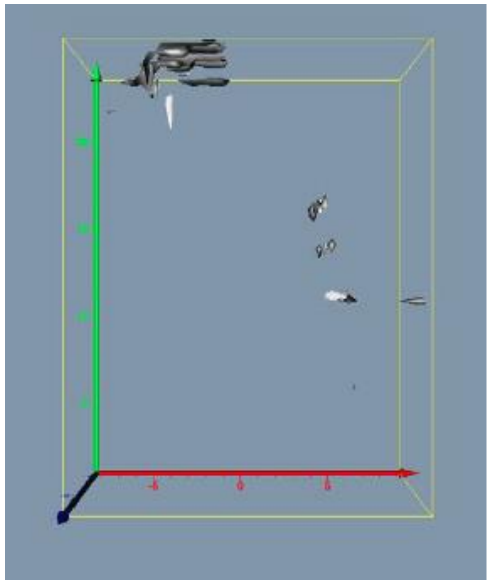

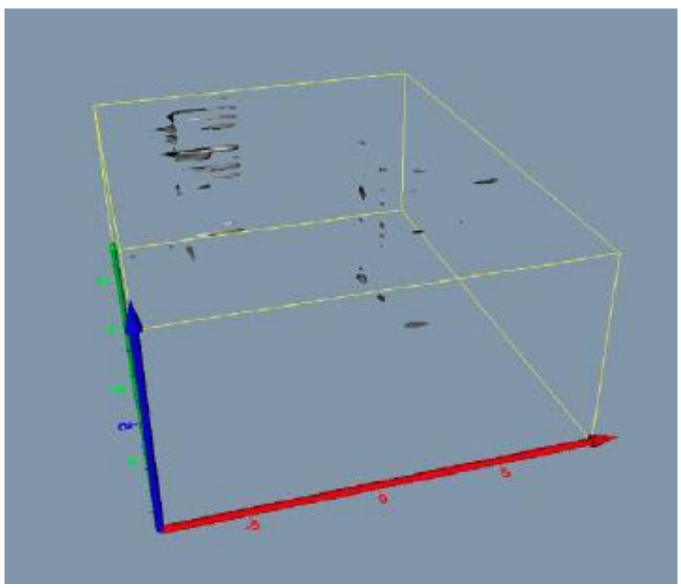

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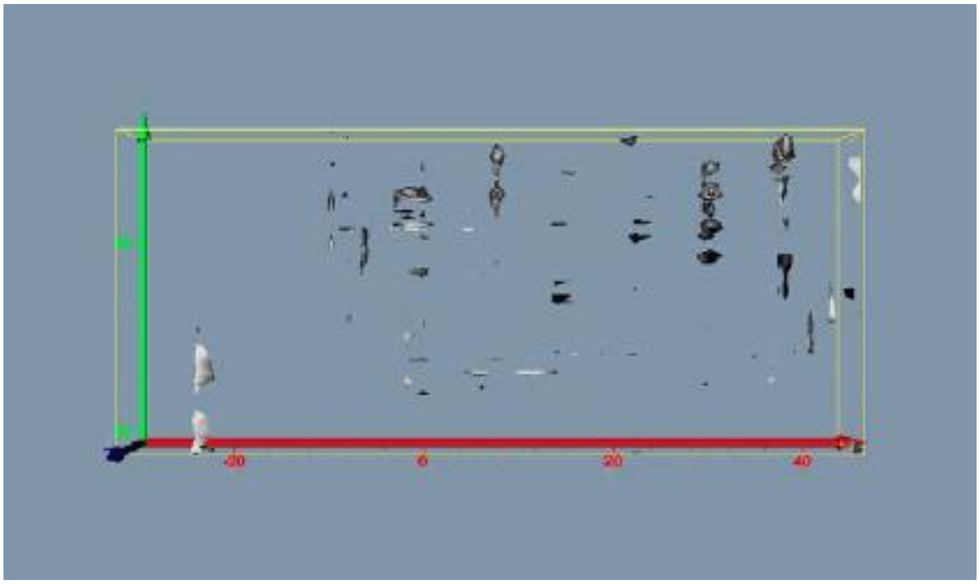

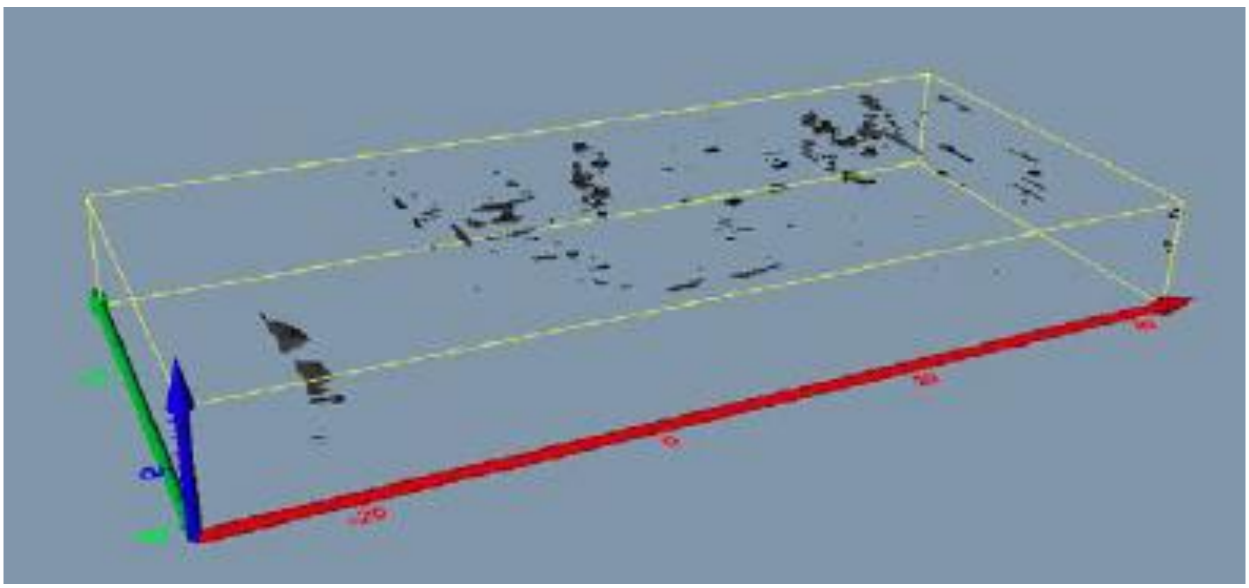

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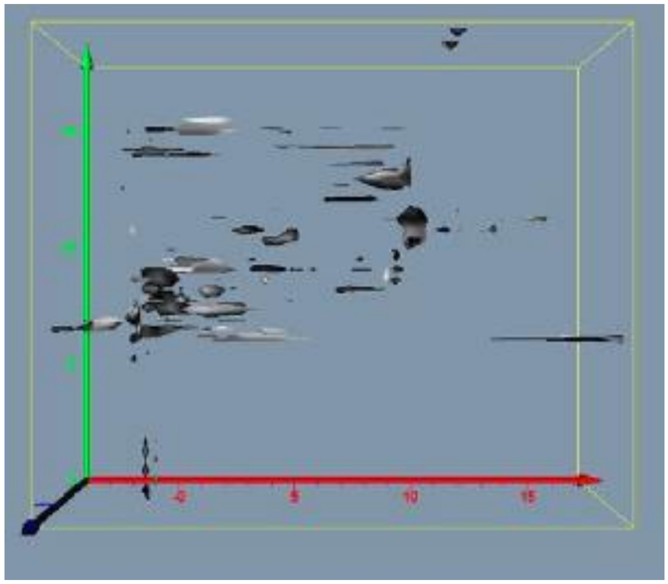

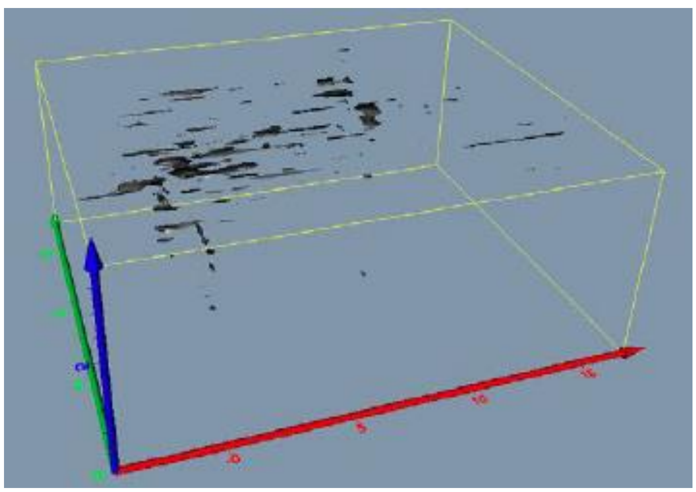

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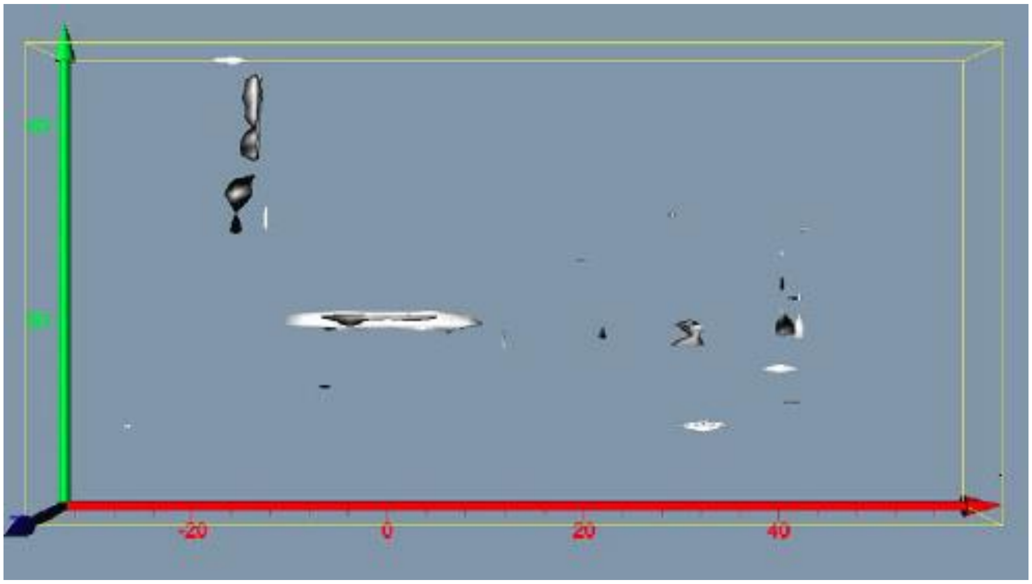

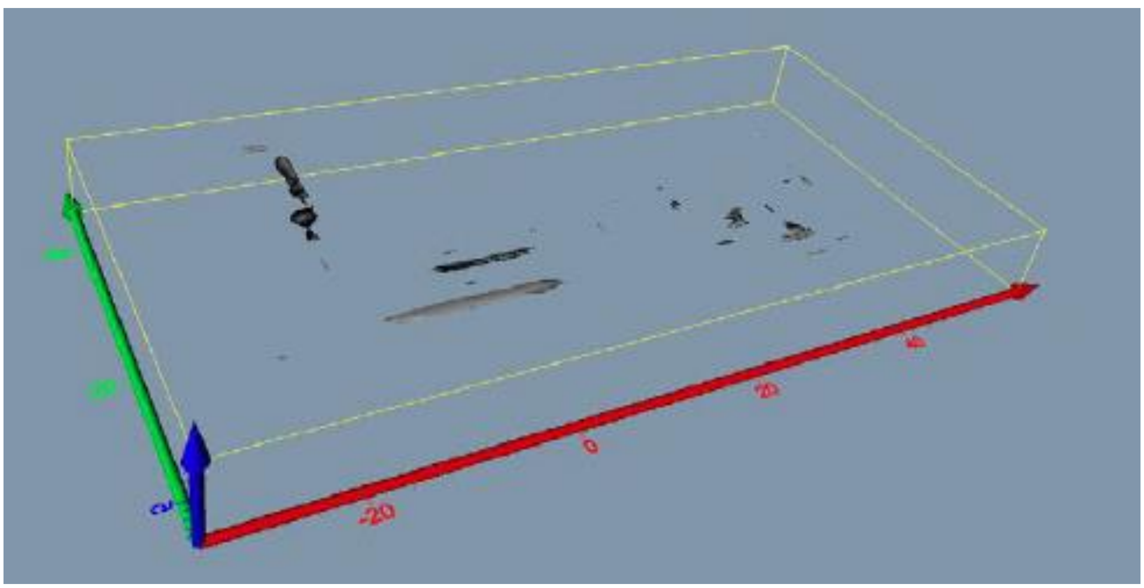

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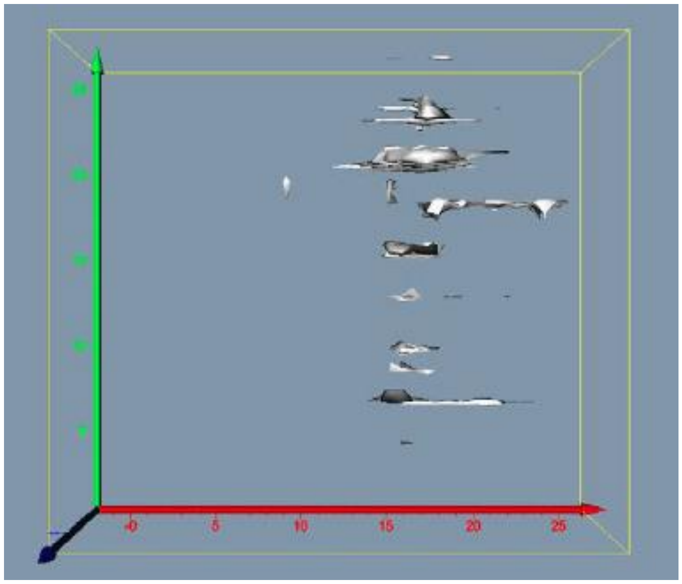

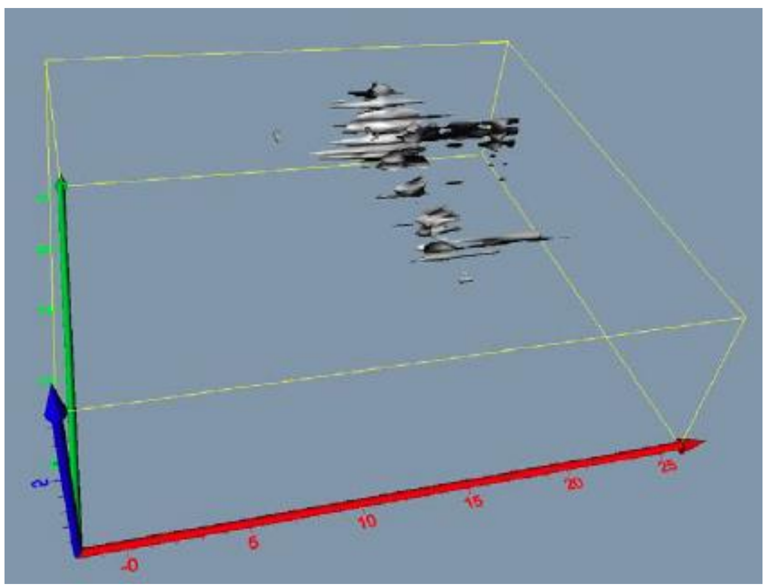

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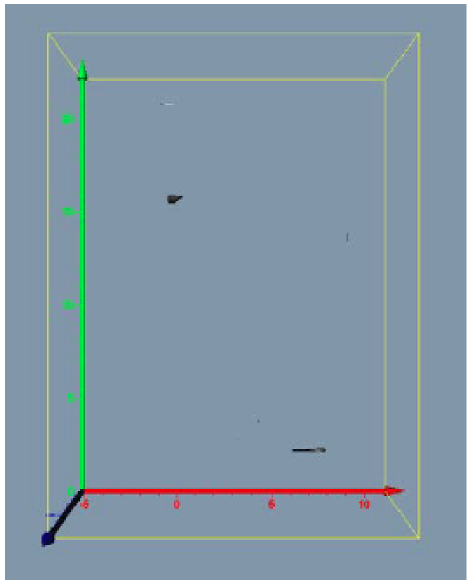

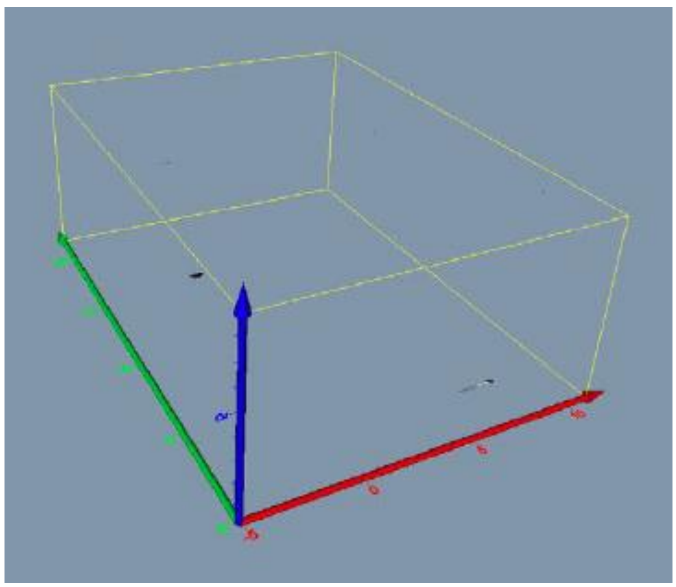

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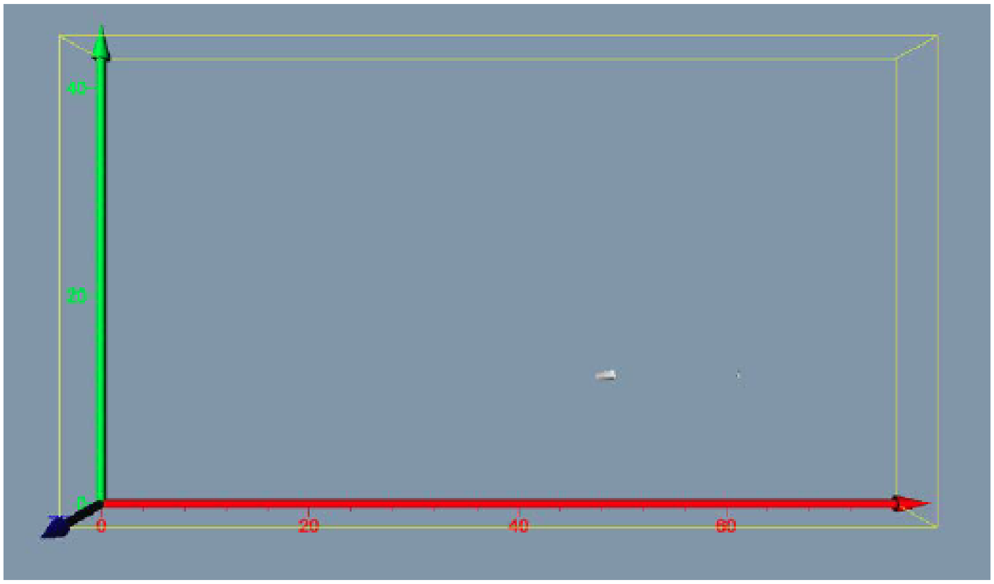

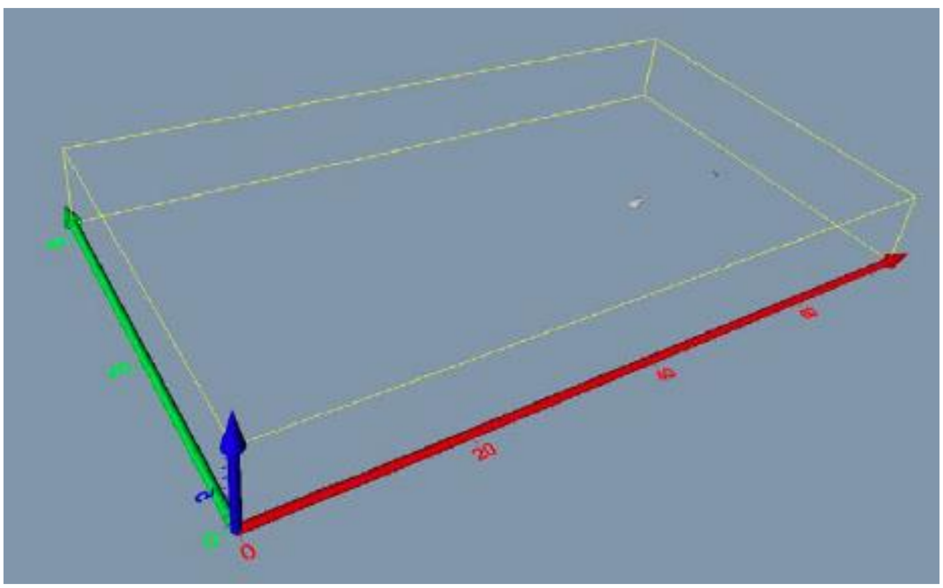

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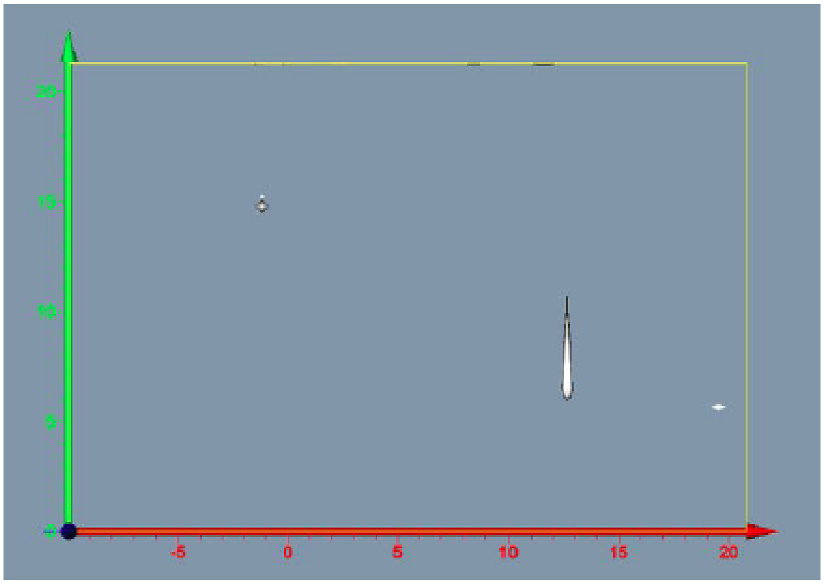

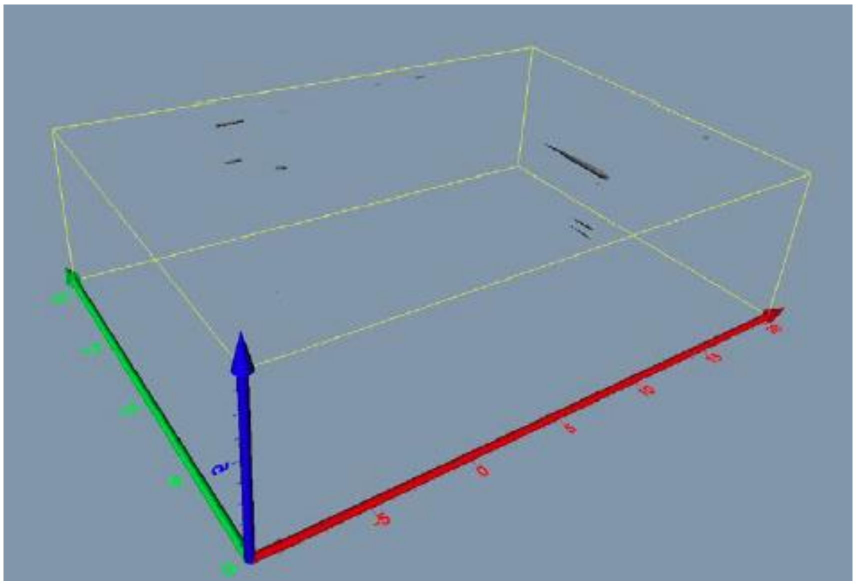

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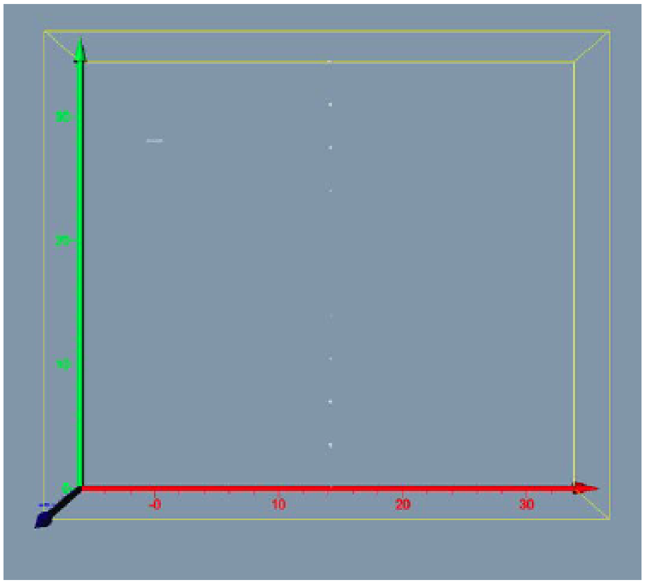

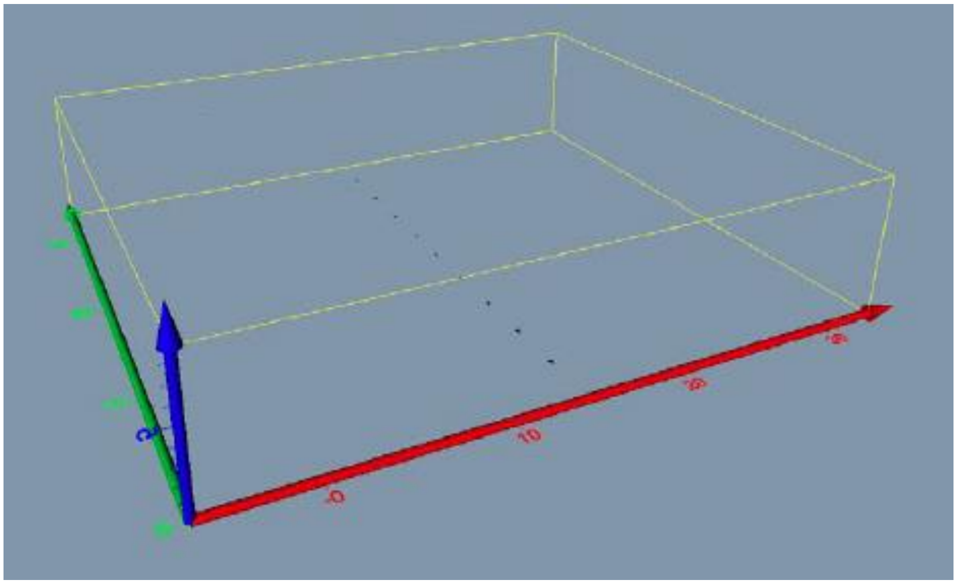

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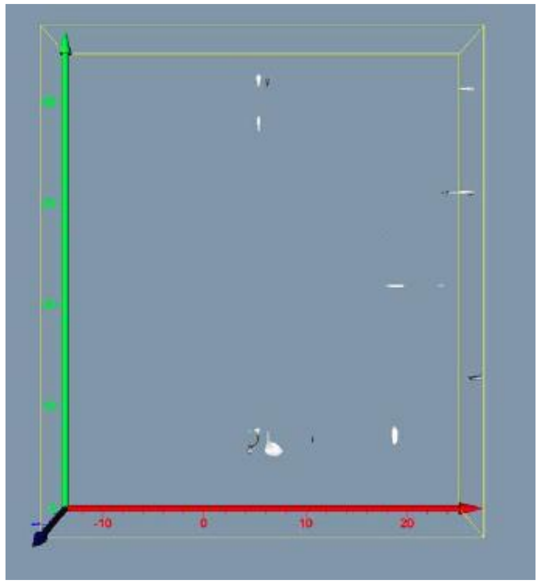

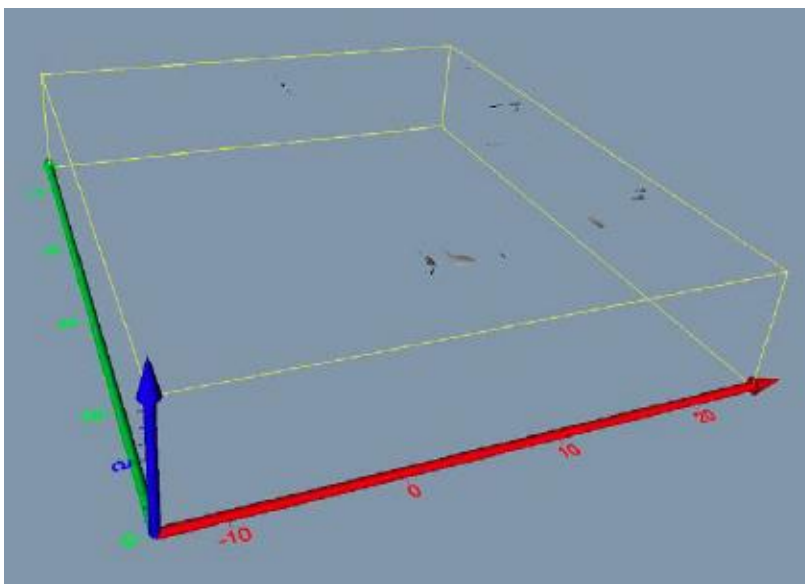

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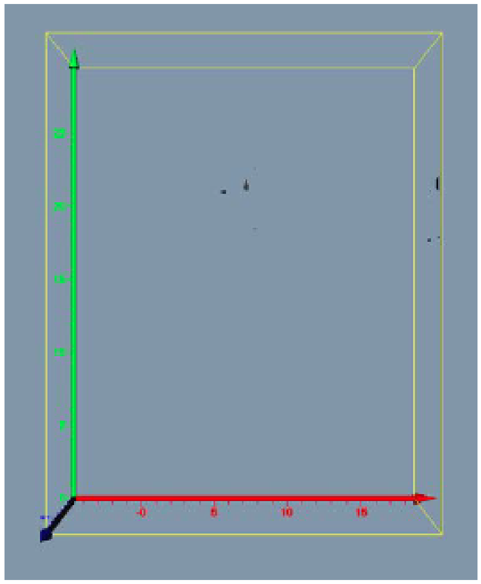

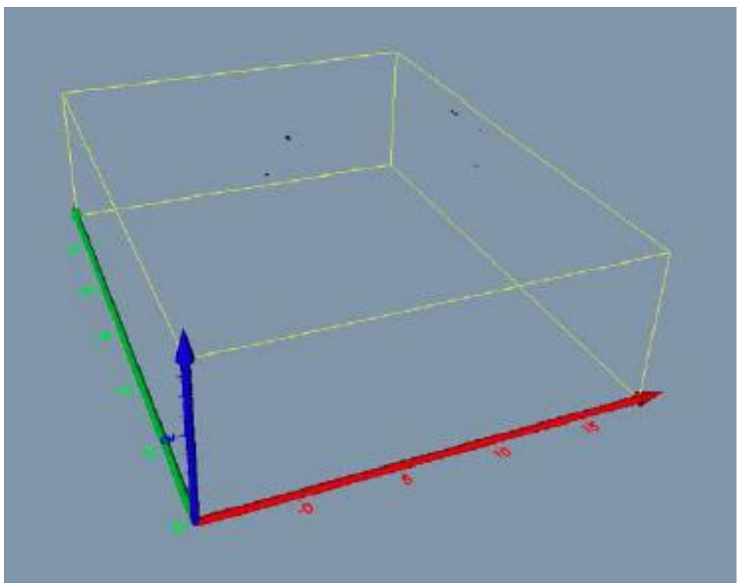

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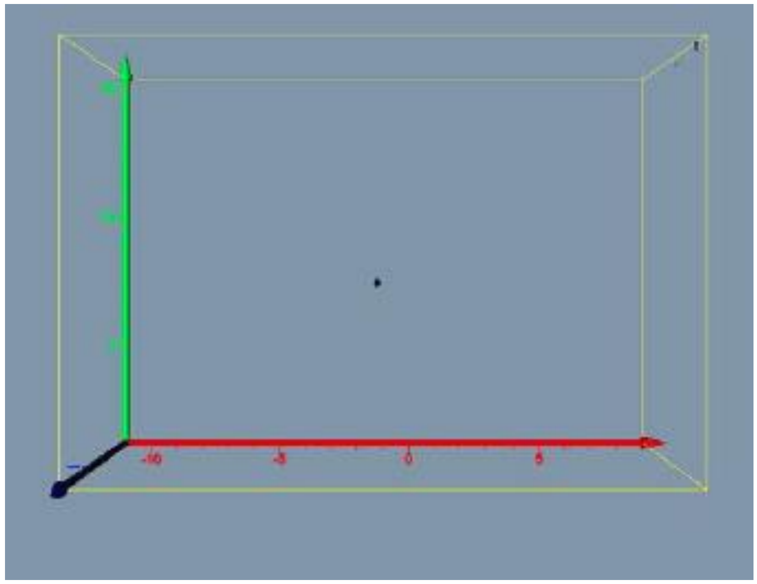

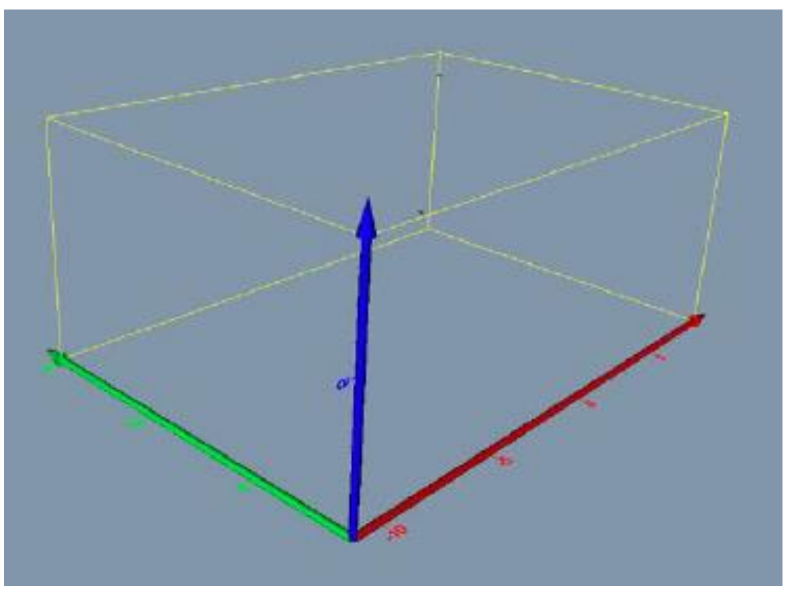

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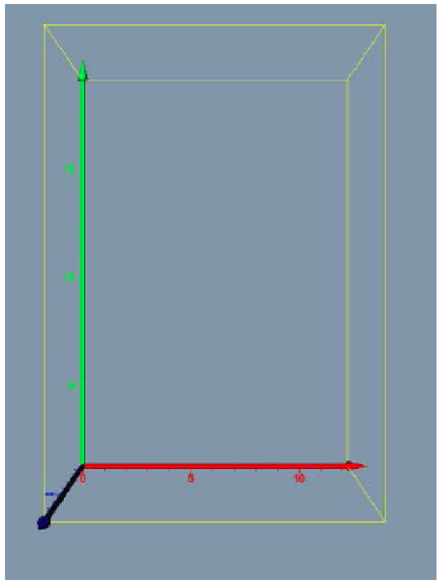

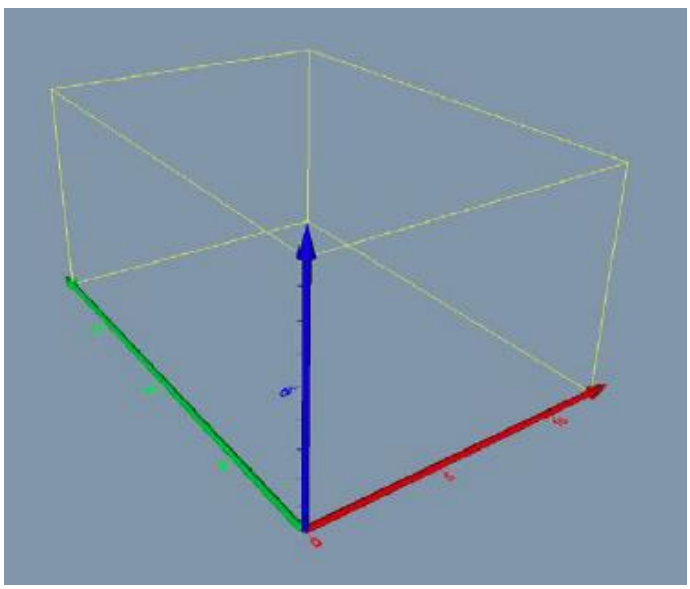

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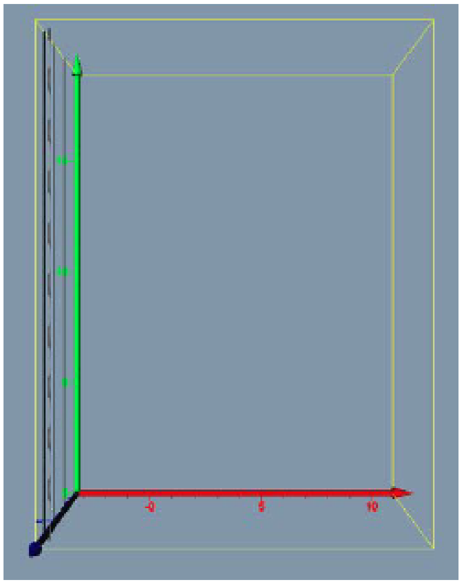

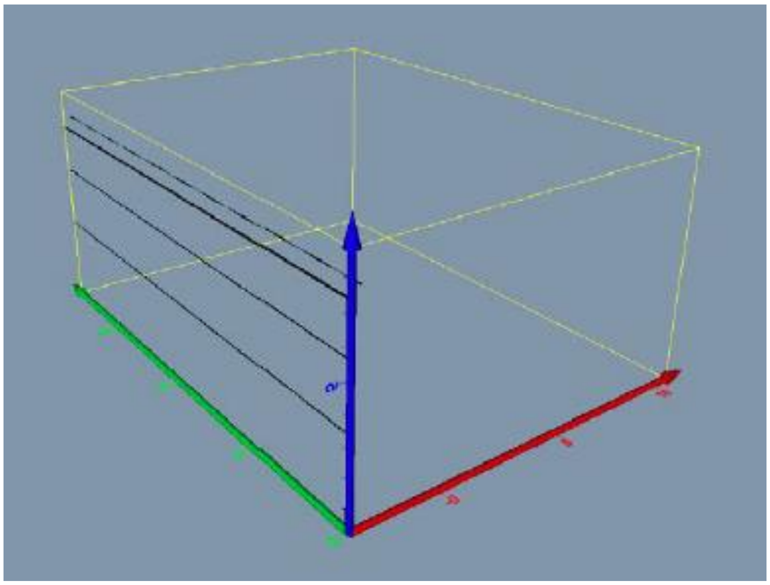

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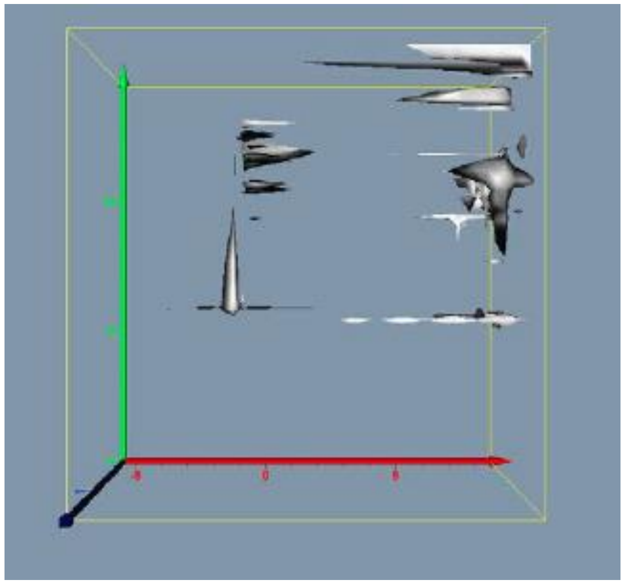

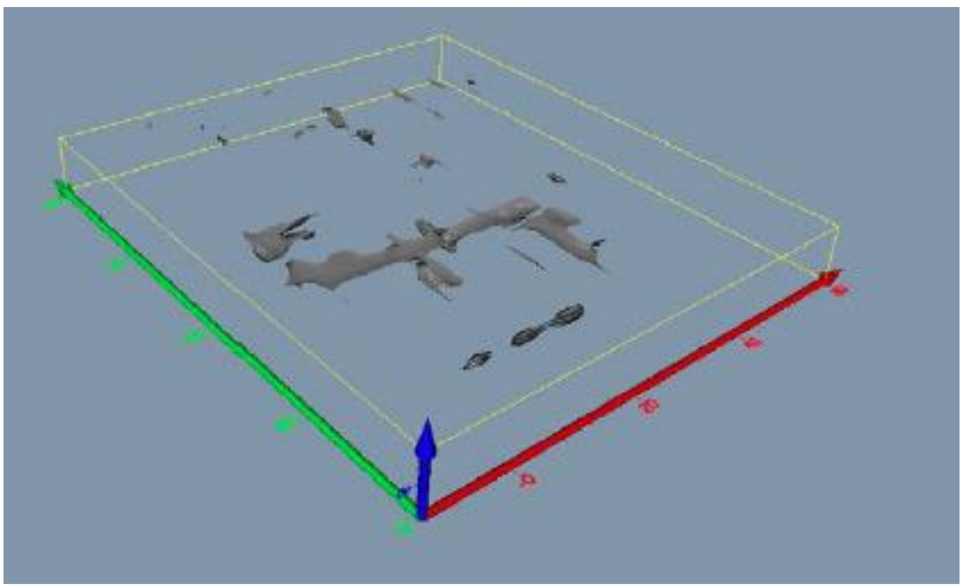

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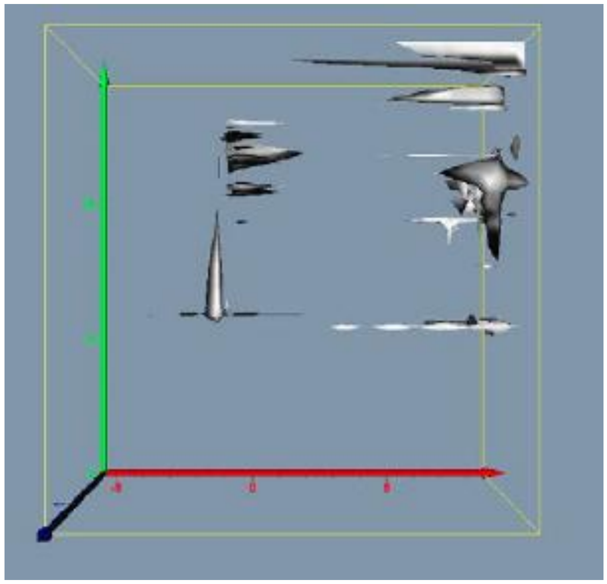

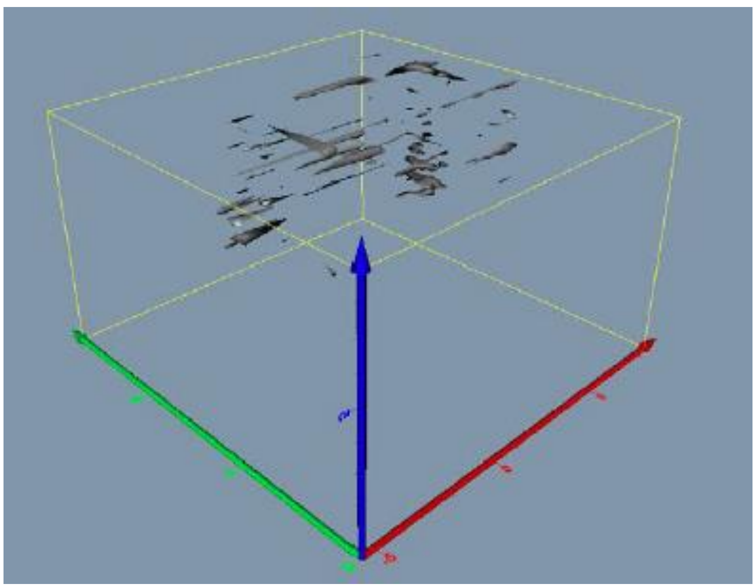

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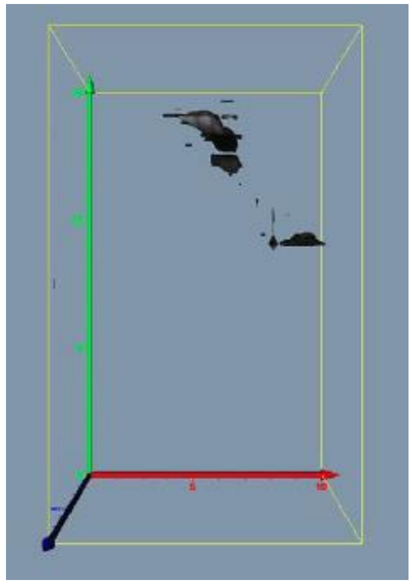

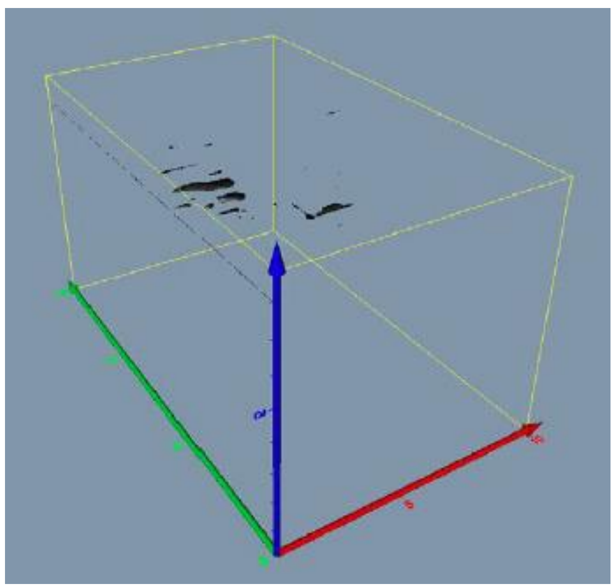

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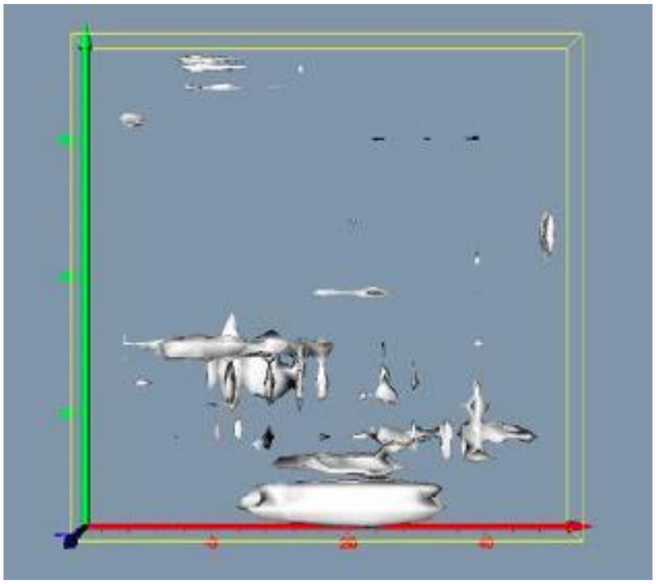

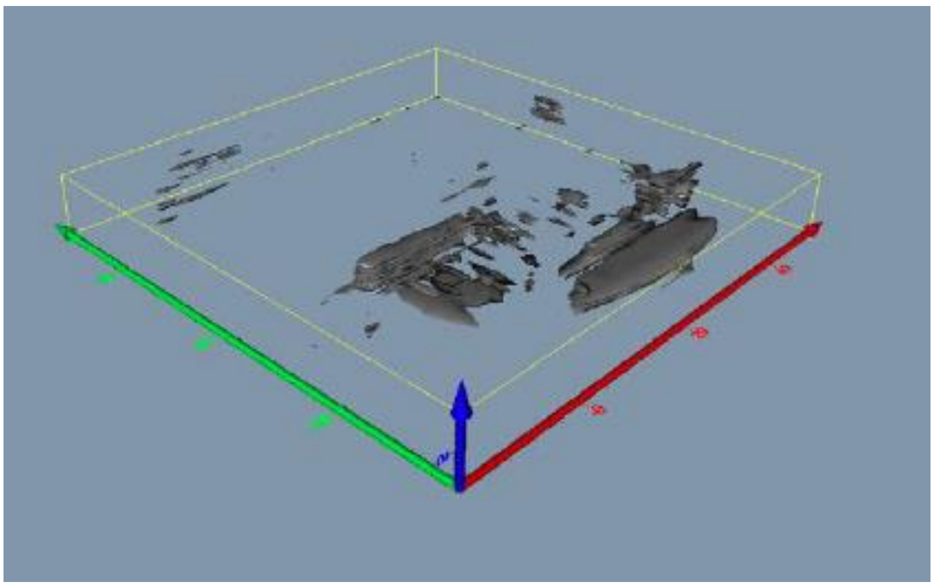

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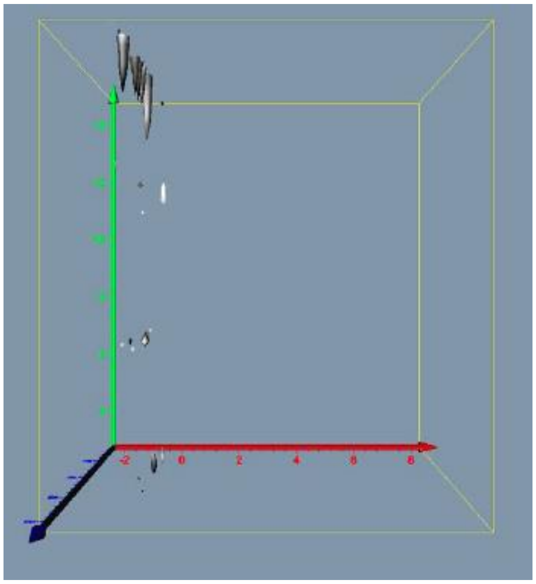

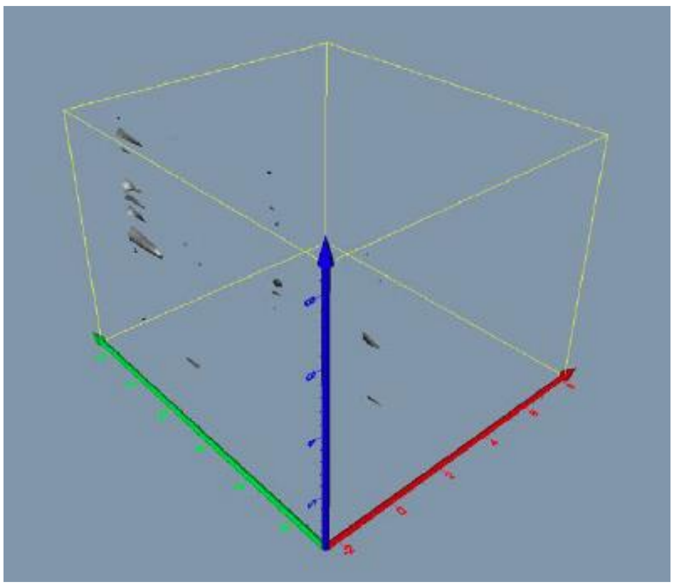

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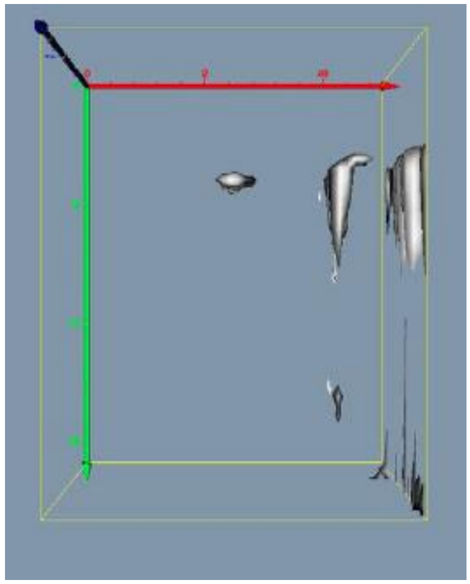

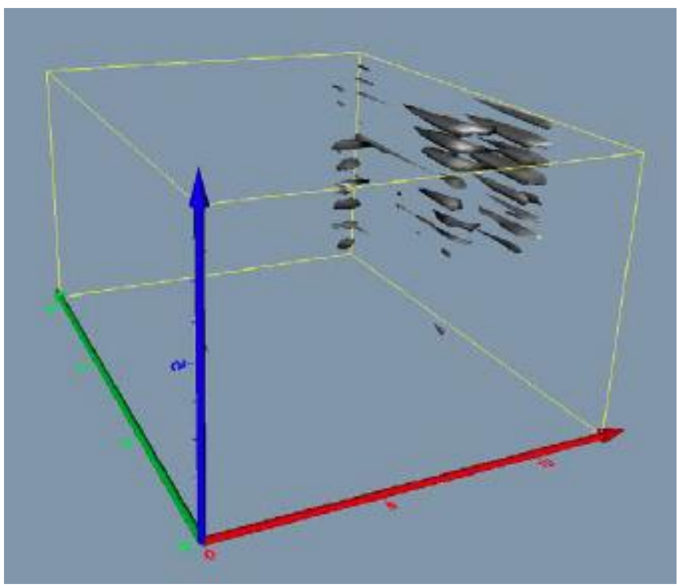

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