

## Section 7 East Kalihi Geographic Zone (T-021 through T-047)

### 7.1 Overall Location

For reporting purposes for this AIS, the City Center Section 4 of the HHCTCP has been divided into 11 zones based on geographical and cultural boundaries. The East Kalihi Geographic Zone is located within the eastern portion of Kalihi Ahupua'a, Honolulu District, Island of O'ahu, in a physiographic division known as the Pearl Harbor Plain (Armstrong 1983:36). The East Kalihi Zone extends approximately 0.6 km along Kamehameha Highway and Dillingham Boulevard and extends from the western side of Laumaka Street on the west to Kalihi Street on the east.

As part of the City Center AIS, a total of 27 test excavations (T-021 through T-047) were excavated in the East Kalihi Zone along and adjacent to Kamehameha Highway and Dillingham Boulevard. Test excavation numbering proceeds from northwest to southeast. Test excavations documented within the East Kalihi Zone fall primarily under the jurisdiction of the City and County of Honolulu (T-021 through T-030, T-033, T-041, T-043, and T-045 through T-047), while those located in lots adjacent to Dillingham Boulevard are privately owned by Florante S. Sebastian, LLC (T-031, T-032, T-035, T-038, T-039, and T-042); Kam, Michael H. M. Trust (T-034, T-036, T-037, and T-040); and Rosebud Holdings, Ltd. (T-044). T-031 through T-032, T-035, T-038, T-039, and T-042 are located within TMK [1] 1-2-09:001; T-034, T-036, T-037, and T-040 are located within TMK [1] 1-2-10:068; and T-044 is located within TMK [1] 1-2-03:018; The remaining test excavations are located within TMK Plats [1] 1-2-003 (T-043 and T-045 through T-047), [1] 1-2-009 (T-027 through T-030, T-033, T-041), and [1] 1-2-013 (T-021 through T-026), and are within the Dillingham Boulevard right-of-way (see Vol. IVA Section 2).

### 7.2 Geography, Geology, and Land Forms

The East Kalihi Zone is situated along the low-lying coastal flats immediately inland of Ke'ehi Lagoon, an embayment or estuary of the Kalihi Stream. Elevations in the zone range from approximately 3.50 to 7.25 m above mean sea level, and the average annual rainfall measures 760 to 810 mm (30 to 32 inches) (Giambelluca et al. 2011). The East Kalihi Zone consists of a portion of the emerged reef in southern O'ahu that formed during the 7.5 m (Waimanalo) stand (Macdonald et al. 1983:420-421). In general, the East Kalihi Zone is located between 1.0 and 1.5 km inland from the modern shoreline. At the end of the nineteenth century, the shore of Ke'ehi Lagoon was between 0.5 and 1.0 km away from the East Kalihi Zone. Vegetation in the study area and immediate vicinity is primarily the result of landscaping and includes but are not limited to: *kukui* (*Aleurites moluccana*), *noni* (*Morinda citrifolia*), coconut (*Cocos nucifera*), mango (*Mangifera*), banana (*Musa*), Cook pine (*Araucaria columnaris*), plumeria (*Plumeria obtusa*), monkeypod (*Albizia saman*), and Bougainvillea.

According to the U.S. Department of Agriculture Soil Survey Geographic (SSURGO) Database (2001) and soil survey data gathered by Foote et al. (1972), soils within the East Kapālama Zone consist exclusively of Ewa silty clay loam (EmA) (Figure 63). Ewa silty clay loam soils are described as:

...well-drained soils in basins and on alluvial fans... [that] developed in alluvium derived from basic igneous rock... These soils are used for sugarcane, truck crops, and pasture. The natural vegetation consists of fingergrass, kiawe, koa haole, klu, and uhaloa [Foote et al. 1972:29].

### **7.3 Modern Land Use and Built Environment**

The East Kalihi Zone traverses a predominantly urban environment, through the neighborhoods of coastal Kalihi. The centerline of the project alignment is generally within Kamehameha Highway and Dillingham Boulevard Right of Ways. Parcels bordering the roads and highways include a mix of commercial, industrial, and residential developments. Large developments in the vicinity of the geographic area include the Oahu Community Correctional facility. A massive utility corridor is also present throughout the East Kalihi Zone containing electrical, gas, water, sewer, and storm lines. The number and distribution of these existing utilities indicates that this East Kalihi portion of Dillingham has been heavily disturbed in the past.

### **7.4 GPR Sediment Summery**

Test excavations in the East Kahili Geographic Zone (Zone 2) revealed that the area was predominantly fill material truncating naturally deposited Ewa silty clay loam (EmA) as predicted by the U.S.G.S Soil survey map of the zone (Figure 63). The transition from fill material to the naturally deposited silty clay was generally within the range of the GPR and could be clearly observed in the processed GPR profiles. The coral shelf was also observed in T-046 within the range of clean signal return. The average depth of clean signal return for this area was approximately one meter. Test Excavations that contained naturally deposited sediments with in the GPR clean signal range are included in Table 3. Representative signal texture profiles for Zone 2 are shown in Figure 64. Signal texture profiles were only collected if the signal return was clear and the stratum was at least 0.25 m thick.

Table 3. Naturally deposited sediments within the range of clean GPR signal return for Zone 2

<b>ZONE 2-EAST KALIHI (T-021 TO T-47)</b>			
<b>TEST EXCAVATION</b>	<b>STRATUM</b>	<b>MATERIAL</b>	<b>STRATUM ORIGIN (mbs)</b>
22	II	Sandy clay loam	1.5
25	II	silty loam	0.6
27	II	silty clay	0.3
28	II	silty clay	0.3
29	II	silty clay	0.3
31	II	silty clay loam	0.65
32	IIA	silty clay loam	0.5
33	II	silty clay	0.35
34	II	silty clay	0.65
35	IIA	silty clay	0.4
36	II	silty clay loam	0.45
37	II	silty clay loam	0.6
38	IIA	silty clay loam	0.6
39	IIA	silty clay loam	0.4
40	II	silty clay loam	0.5
41	II	silty clay loam	0.35
43	II	silty clay loam	0.3
44	II	silty clay loam	0.25
45	II	silty clay loam	0.35
46	II	coral shelf	0.35
47	II	silty clay loam	0.4

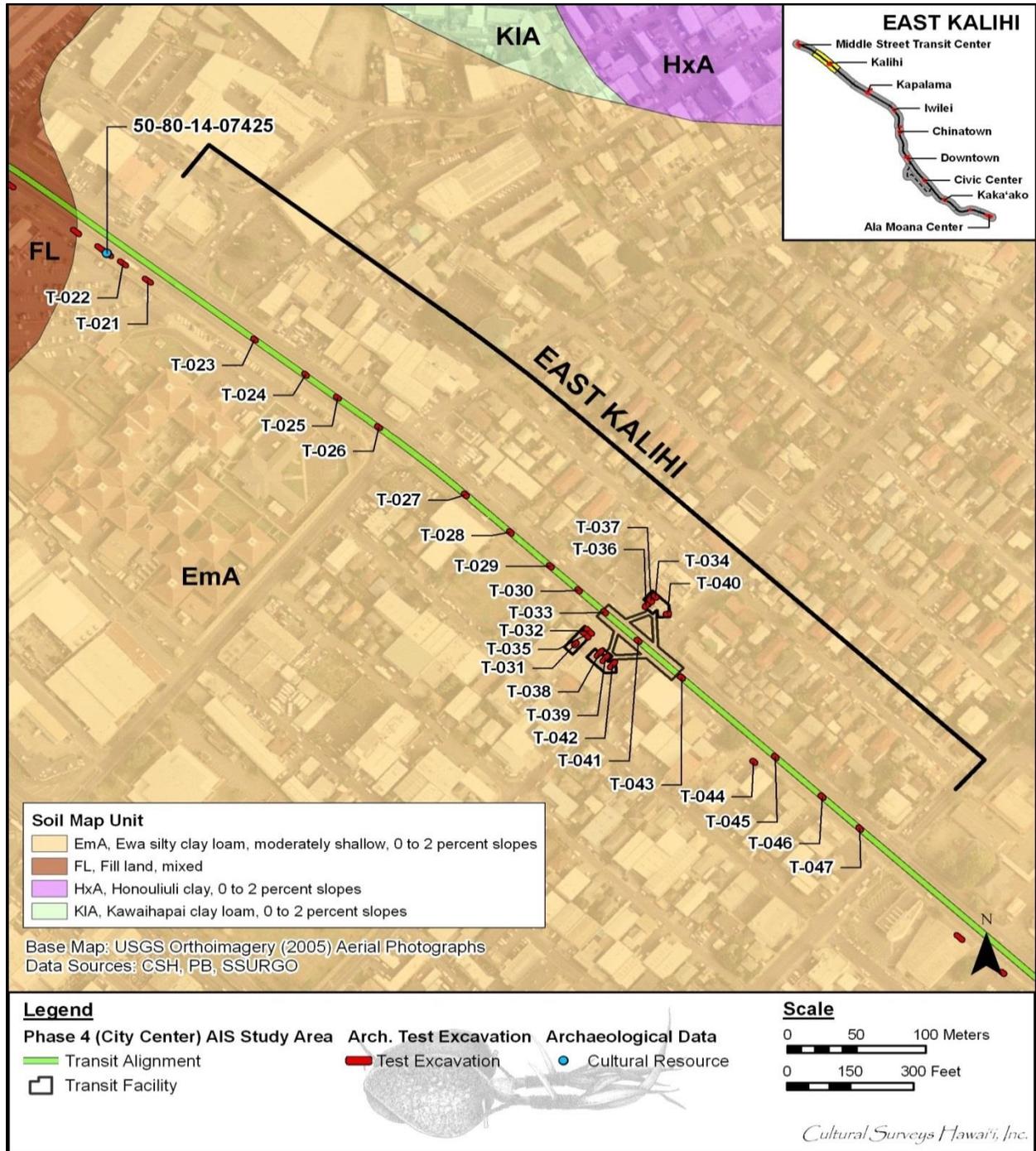


Figure 63. Aerial photograph (source: U.S. Geological Survey Orthoimagery 2005) with overlay of the Soil Survey of Hawai'i (Foote et al. 1972) showing sediment types within and in the vicinity of the East Kalihi Zone

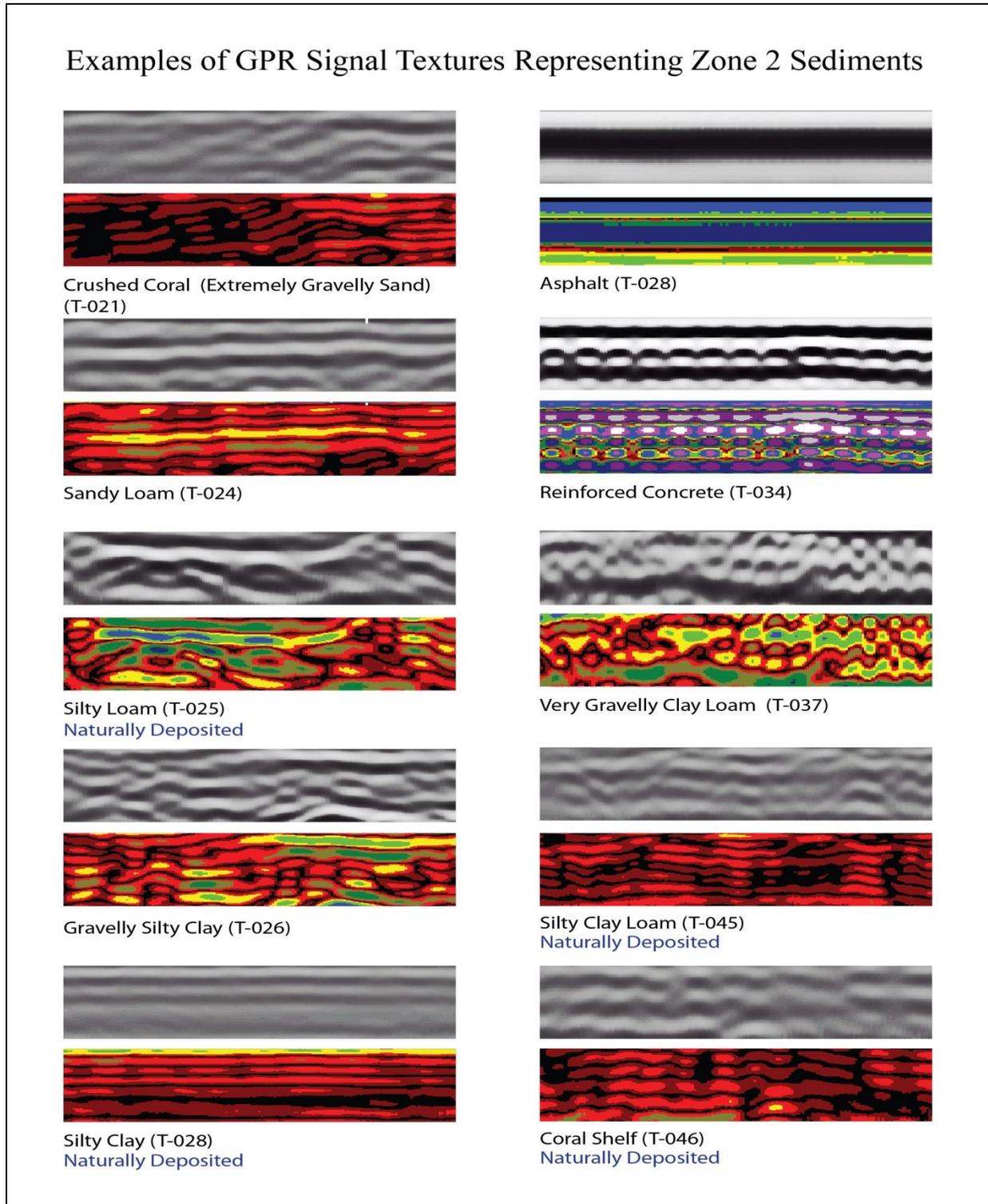


Figure 64. Examples of GPR signal textures representing Zone 2 sediments

## Test Excavation 21

T-021 measured 0.6 m by 6.0 m and was oriented northwest to southeast and located within the road cut of Kamehameha Highway in the eastbound right lane, 30.0 m west of Kamehameha Highway and Laumaka Street intersection. The GPR grid measured 2.0 m by 6.0 m with 0.25 m spacing between Y transects and 1.0 m spacing between X transects. Utilities near the excavation include: electrical line 4.0 m southwest and 4.0 m northeast, sewer line 4.9 m northeast and 5.3 m southeast. No utilities transected the GPR grid or excavation location.

A review of amplitude slice maps indicated no linear features which might have indicated the presence of utilities. Reflectivity was relatively uniform throughout the grid and decreased with depth. A transition from higher reflectivity to lower reflectivity was observed at approximately 0.75 mbs (Figure 65).

GPR depth profiles for T-021 identified horizontal banding, commonly associated with stratigraphic layering, throughout the survey area (Figure 66). This banding corresponded to variations of density and chemical composition within fill deposits. The profile also indicated a change in reflectivity which occurred around 0.25 mbs and again around 0.75 mbs. No utilities were observed in the profile. The maximum depth of clean signal return was approximately 1.25 mbs.

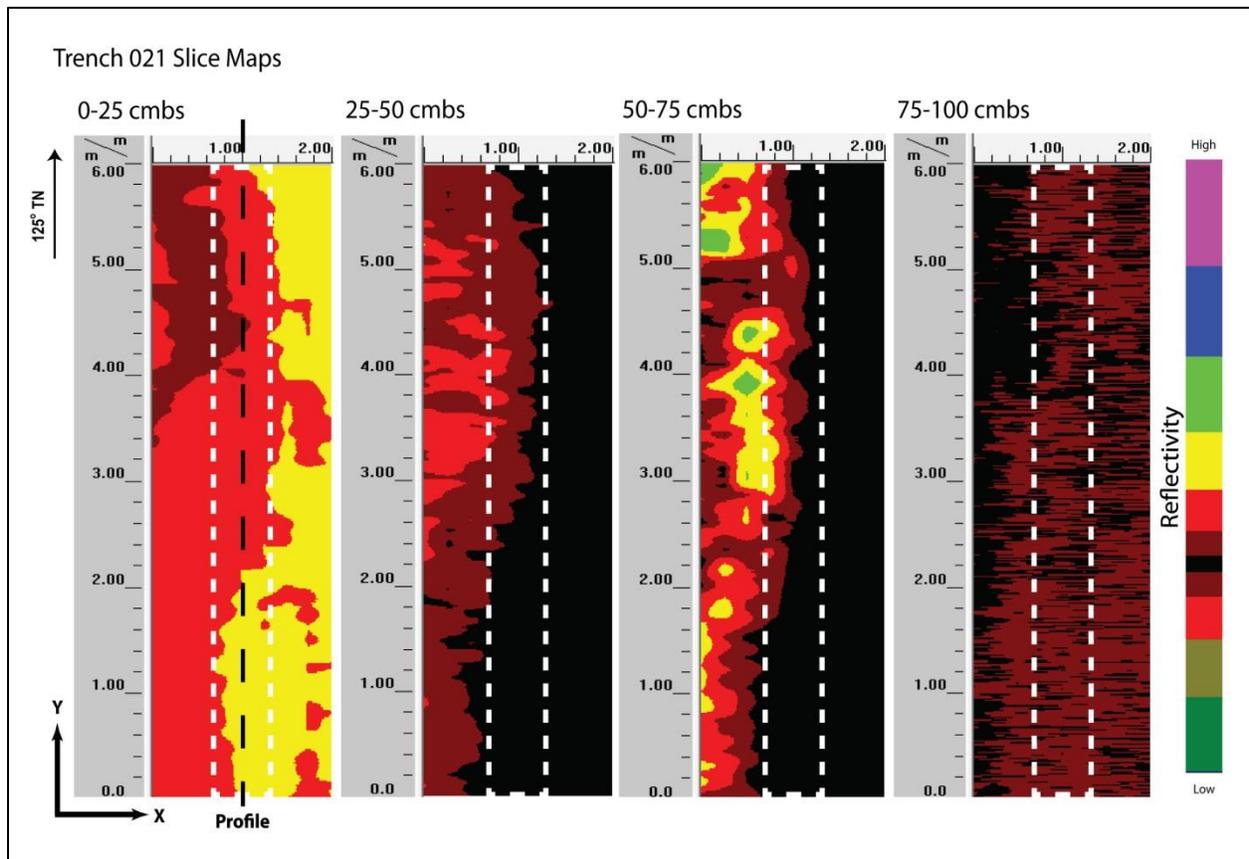


Figure 65. Slice maps of T-021 at 25cm depth intervals

A visual comparison of the excavated profile and the GPR signal profile showed a moderate correlation in stratigraphic transitions (Figure 66). Strata Ia to Ib were clearly observed and occurred at the ground-truthed depths. An increase in reflectivity was observed around 0.75 mbs and does not seem to correspond to a sediment transition or a utility. The transition to Stratum Ic was not clearly observed in the GPR profile. No discrete objects or other stratigraphic transitions were observed in the GPR results.

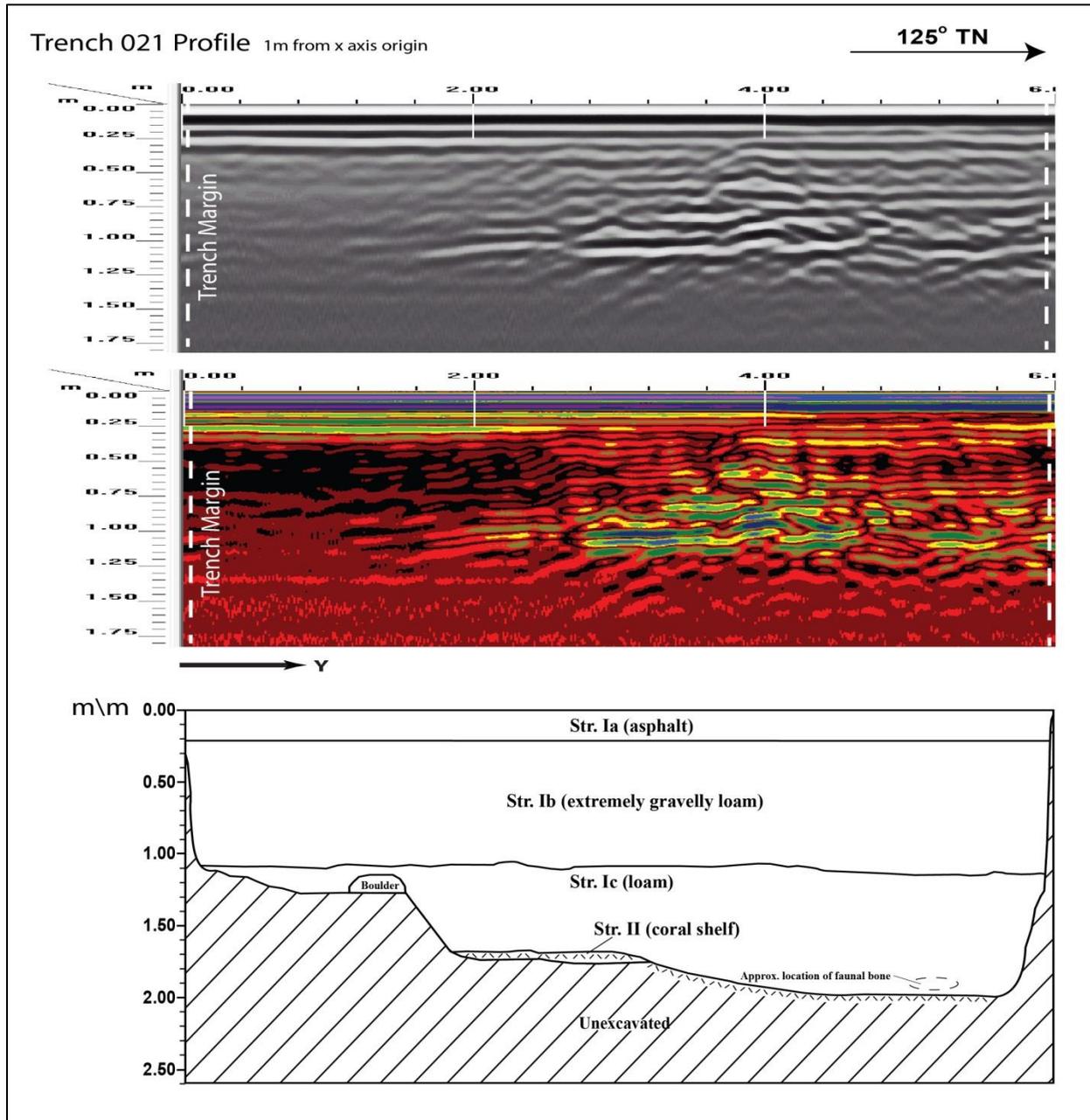


Figure 66. Visual comparison of excavated profile and GPR signal profile of T-021

## Test Excavation 22

T-022 measured 0.6 m by 6.0 m and was oriented northwest to southeast and was located within the road cut of Kamehameha Highway in the eastbound lane and parallel to the curb, 48.0 m west of Kamehameha Highway and Laumaka Street intersection. The GPR grid measured 3 m by 8.5 m with 0.25 m spacing between Y transects and 1.0 m spacing between X transects. Utilities located near the excavation include: Electric line 3.8 m southwest and 4.6 m northeast, water drainage 5.8 m northeast, and a water line 6.6 m northeast. No utilities transected the excavation location.

A review of amplitude slice maps indicated no linear features which might have indicated the presence of utilities. Reflectivity was relatively uniform throughout the grid and decreased with depth. A transition from higher reflectivity to lower reflectivity was observed at approximately 0.5 mbs (Figure 67).

GPR depth profiles for T-022 identified horizontal banding, commonly associated with stratigraphic layering, throughout the survey area (Figure 68). This banding corresponded to variations of density and chemical composition within fill deposits. The profile also indicated a change in reflectivity which occurred around 0.2 mbs. No utilities were observed in the profile. The maximum depth of clean signal return was approximately 1.1 mbs.

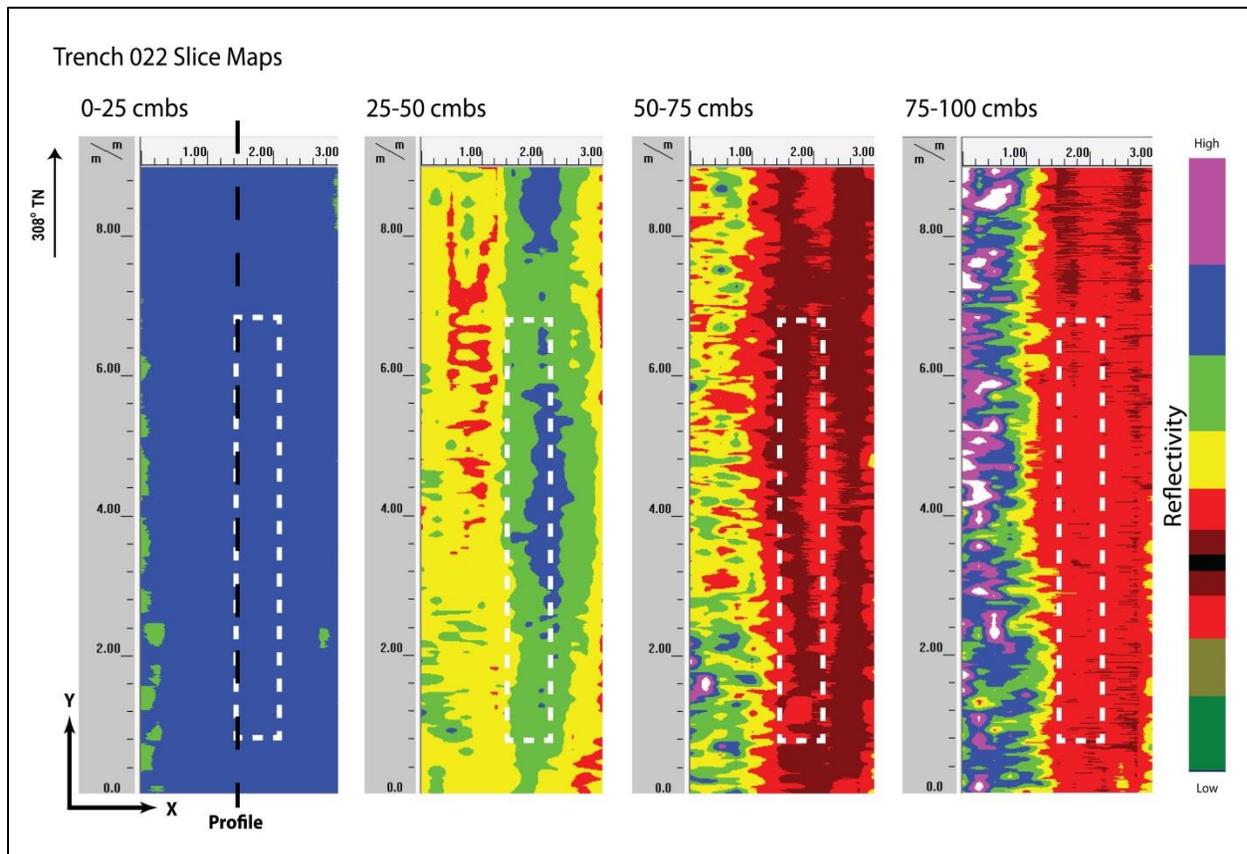


Figure 67. Slice maps of T-022 at 25cm depth intervals

A visual comparison of the excavated profile and the GPR signal profile showed a strong correlation in stratigraphic transitions (Figure 68). Strata Ia and Ib were clearly observed and occurred at the ground-truthed depths. Textural changes in the form of multiple small hyperbolas were apparent in Stratum Ib which was extremely gravelly loam fill. No discrete objects were observed in the GPR results or subsequent excavation.

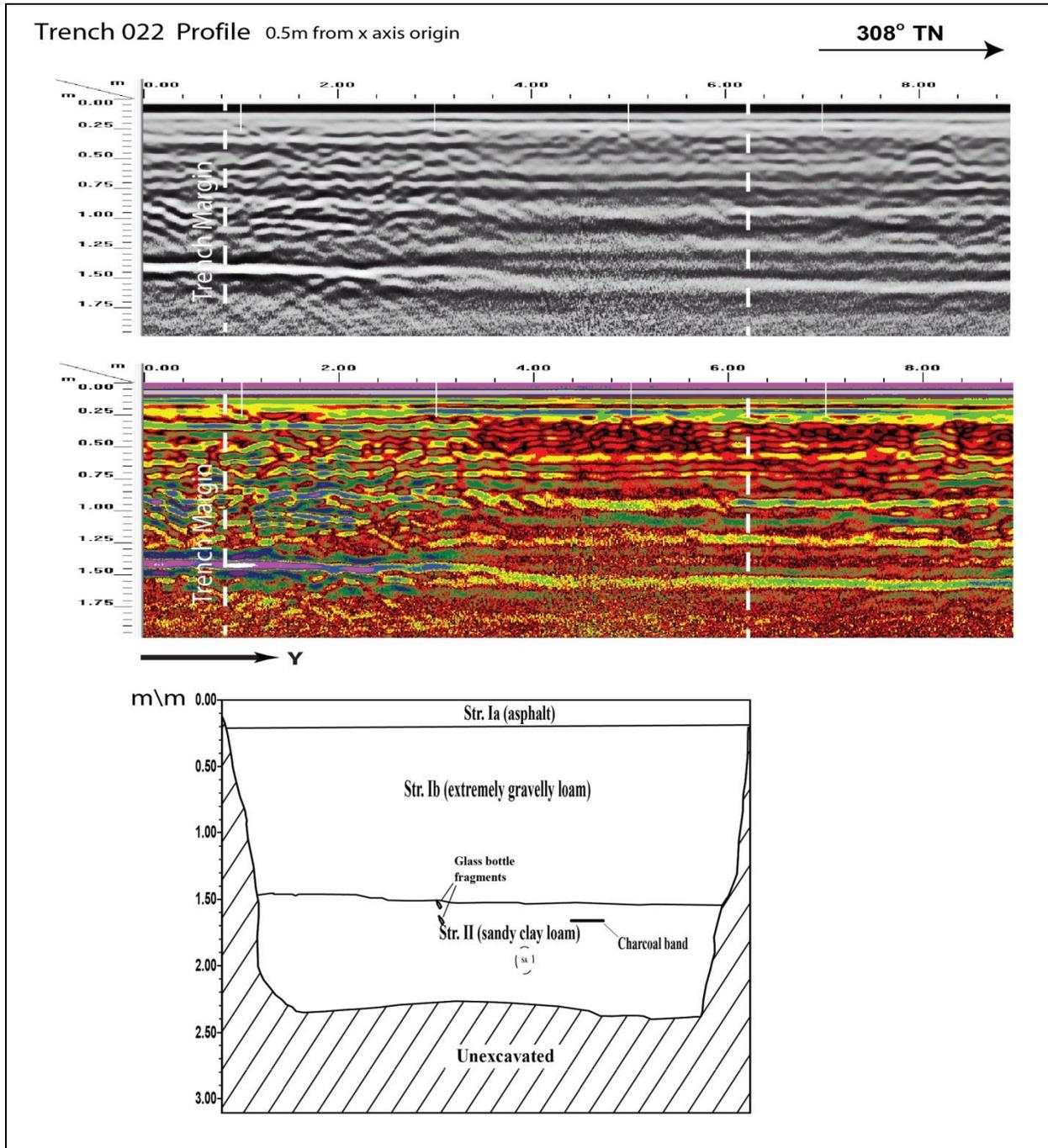


Figure 68. Visual comparison of excavated profile and GPR signal profile of T-022

### Test Excavation 23

T-023 measured 0.6 m by 3.0 m and was oriented northwest to southeast and located within the road cut of Kamehameha Highway in the center lane, 66.0 m southeast of Kamehameha Highway and Laumaka Street. The GPR grid measured 2.0 m by 6.0 m with 0.25 m spacing between Y transects and 1.0 m spacing between X transect. Utilities located near the excavation include: water line 3.0 m southwest, sewer line 2.0 m northeast, and an electric line 4.0 m southwest. No utilities transected the GPR grid or excavation location.

A review of amplitude slice maps indicated no linear features which might have indicated the presence of utilities. Reflectivity was relatively uniform throughout the grid and decreased with depth. A transition from higher reflectivity to lower reflectivity was observed at approximately 0.5 mbs (Figure 69).

GPR depth profiles for T-023 identified horizontal banding, commonly associated with stratigraphic layering, throughout the survey area (Figure 70). This banding corresponded to variations of density and chemical composition within fill deposits. The profile also indicated a change in reflectivity which occurred around 0.15 mbs and again around 0.5 mbs. No utilities were observed in the profile. The maximum depth of clean signal return was approximately 0.65 mbs.

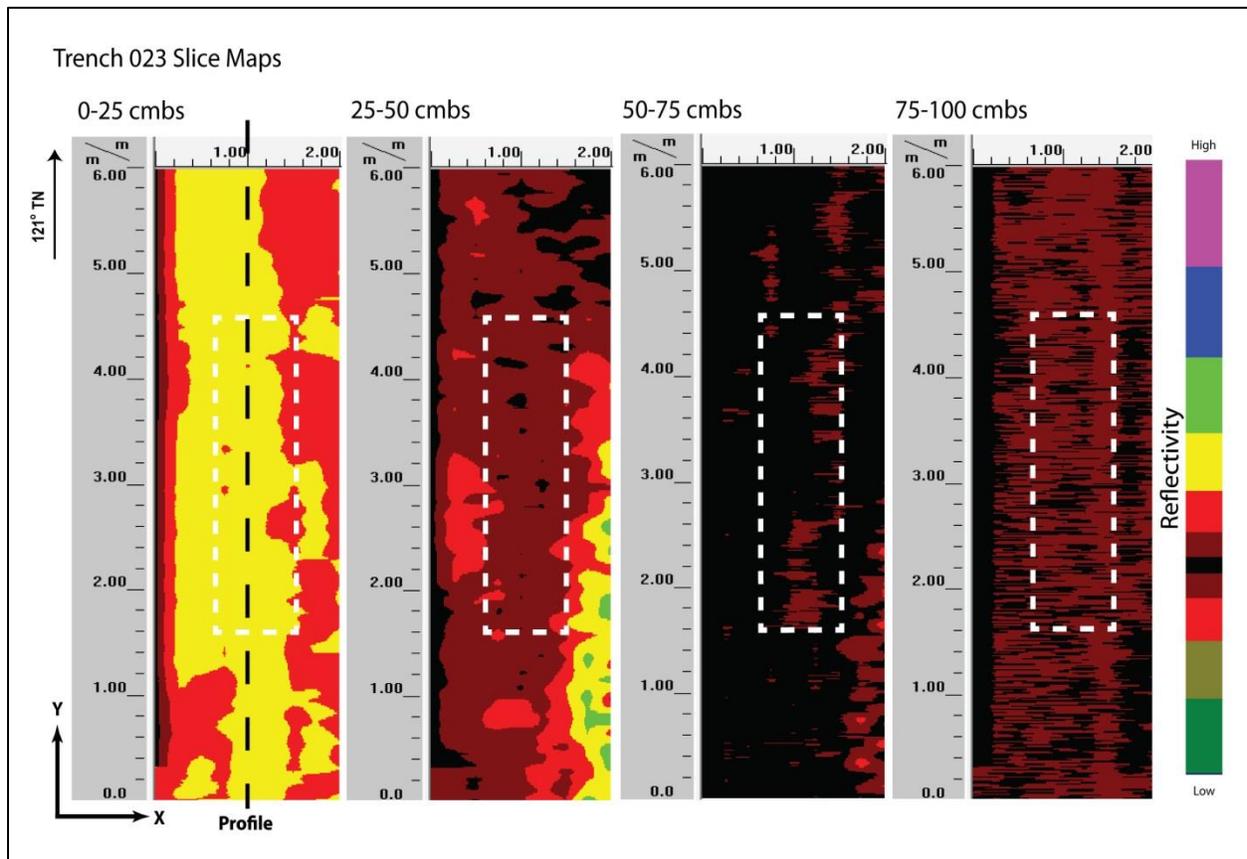


Figure 69. Slice maps of T-023 at 25cm depth intervals

A visual comparison of the excavated profile and the GPR signal profile showed a strong correlation in stratigraphic transitions (Figure 70). Strata Ia through Ic were clearly observed and occurred at the ground-truthed depths. Strata included a layer of asphalt on top of extremely gravelly loam fill and followed by a silty loam fill on top of the coral shelf. No discrete objects or other stratigraphic transitions were observed in the GPR results or subsequent excavation.

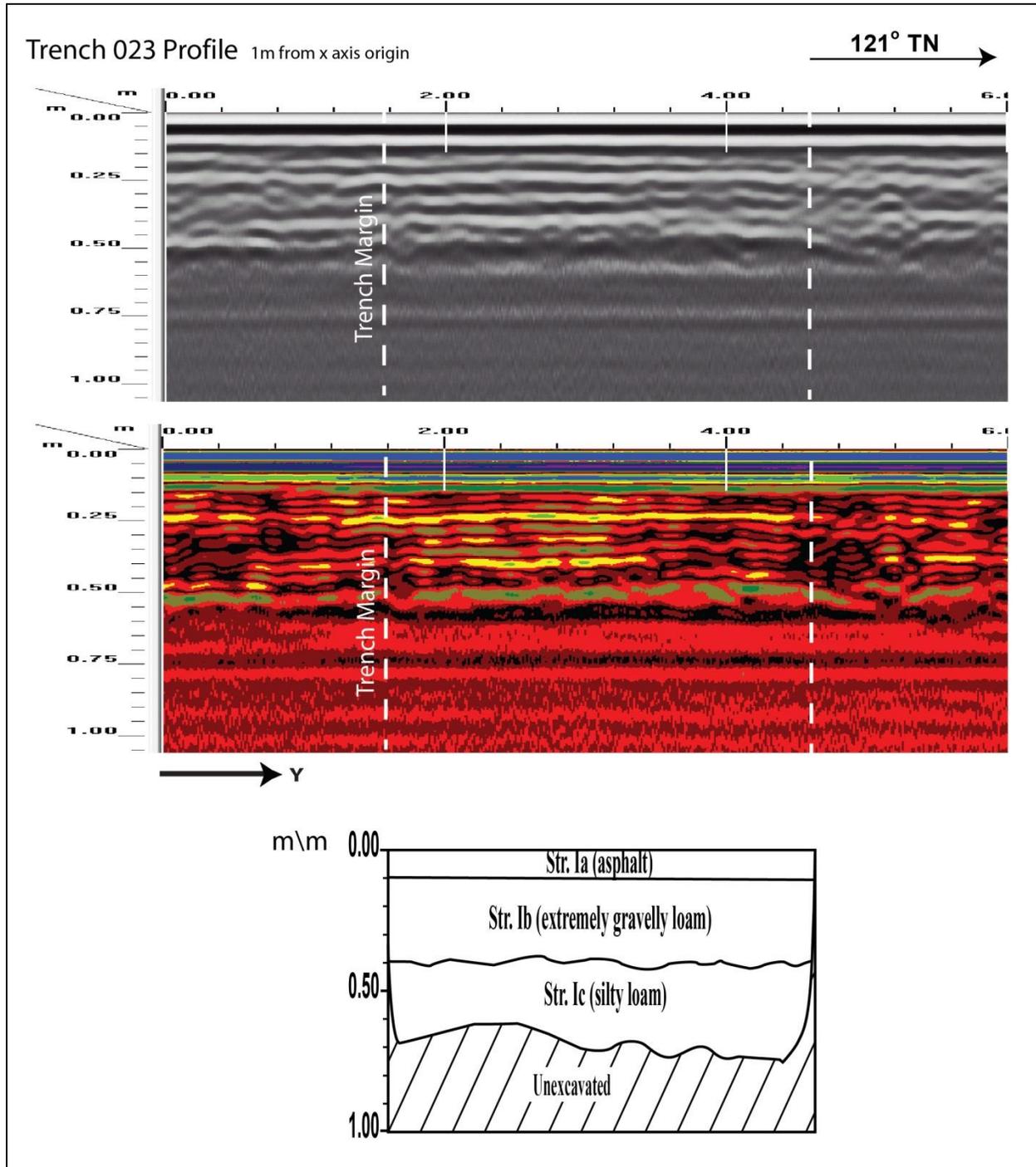


Figure 70. Visual comparison of excavated profile and GPR signal profile of T-023

### Test Excavation 24

T-024 measured 0.9 m by 3.0 m and was oriented northwest to southeast and located within the road cut of Kamehameha Highway in the center lane, 88.0 m northwest of Kamehameha Highway and Puuhale Road intersection. The GPR grid measured 2.0 m by 6.0 m with 0.25 m spacing between Y transects and 1.0 m spacing between X transects. Utilities located near the excavation include: sewer line 1.4 m northeast and a waterline 3.2 m southwest. No utilities transected the GPR grid or excavation location.

A review of amplitude slice maps indicated no linear features which might have indicated the presence of utilities. Reflectivity was relatively uniform throughout the grid and decreased with depth. A transition from higher reflectivity to lower reflectivity was observed at approximately 75 mbs (Figure 71).

GPR depth profiles for T-024 identified horizontal banding, commonly associated with stratigraphic layering, throughout the survey area (Figure 72). This banding corresponded to variations of density and chemical composition within fill deposits. The profile also indicated a change in reflectivity which occurred around 0.2 mbs. No utilities were observed in the profile. The maximum depth of clean signal return was approximately 1.0 mbs.

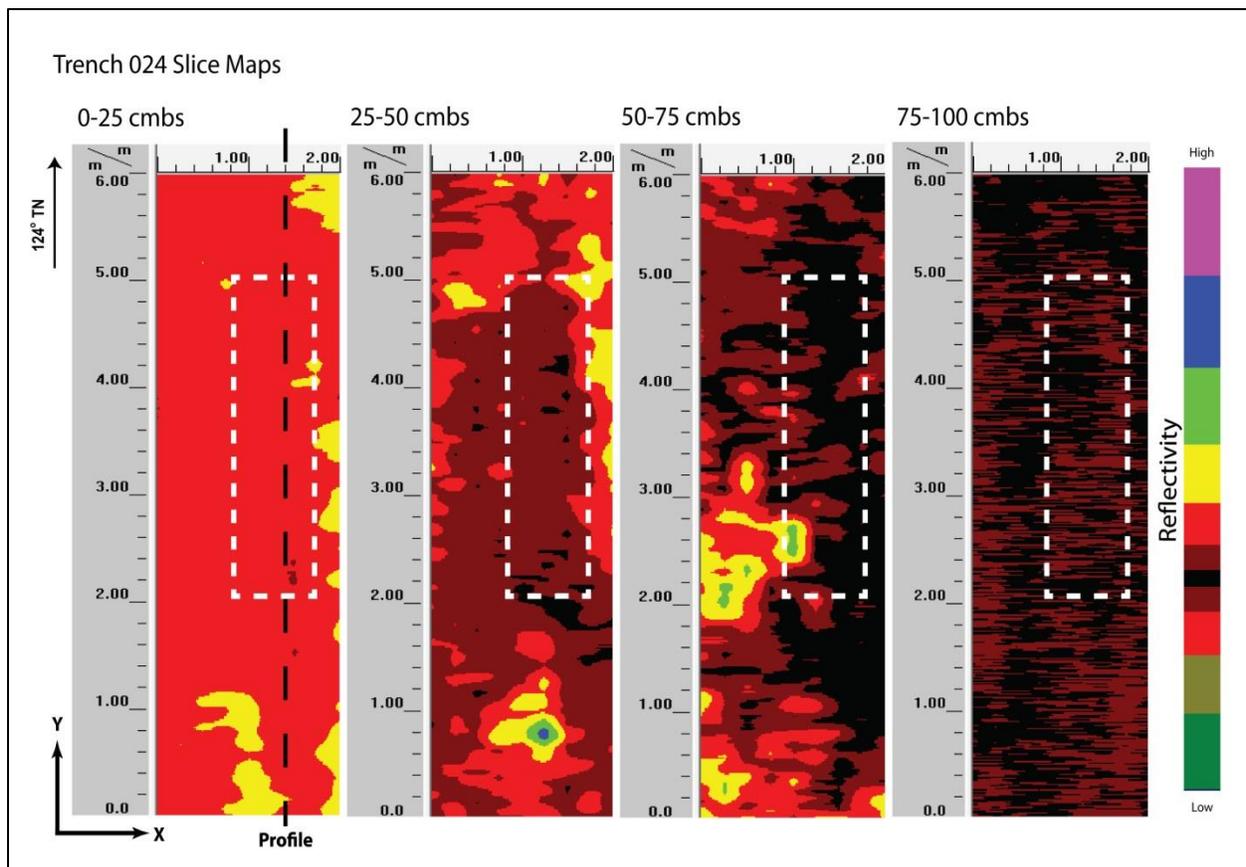


Figure 71. Slice maps of T-024 at 25cm depth intervals

A visual comparison of the excavated profile and the GPR signal profile showed a strong correlation in stratigraphic transitions (Figure 72). Strata Ia and Ib were observed and occurred at the ground-truthed depths. Strata included a thin layer of asphalt on top of a sandy loam fill until the coral shelf was encountered around 0.5 mbs. No discrete objects were observed in the GPR results or subsequent excavation.

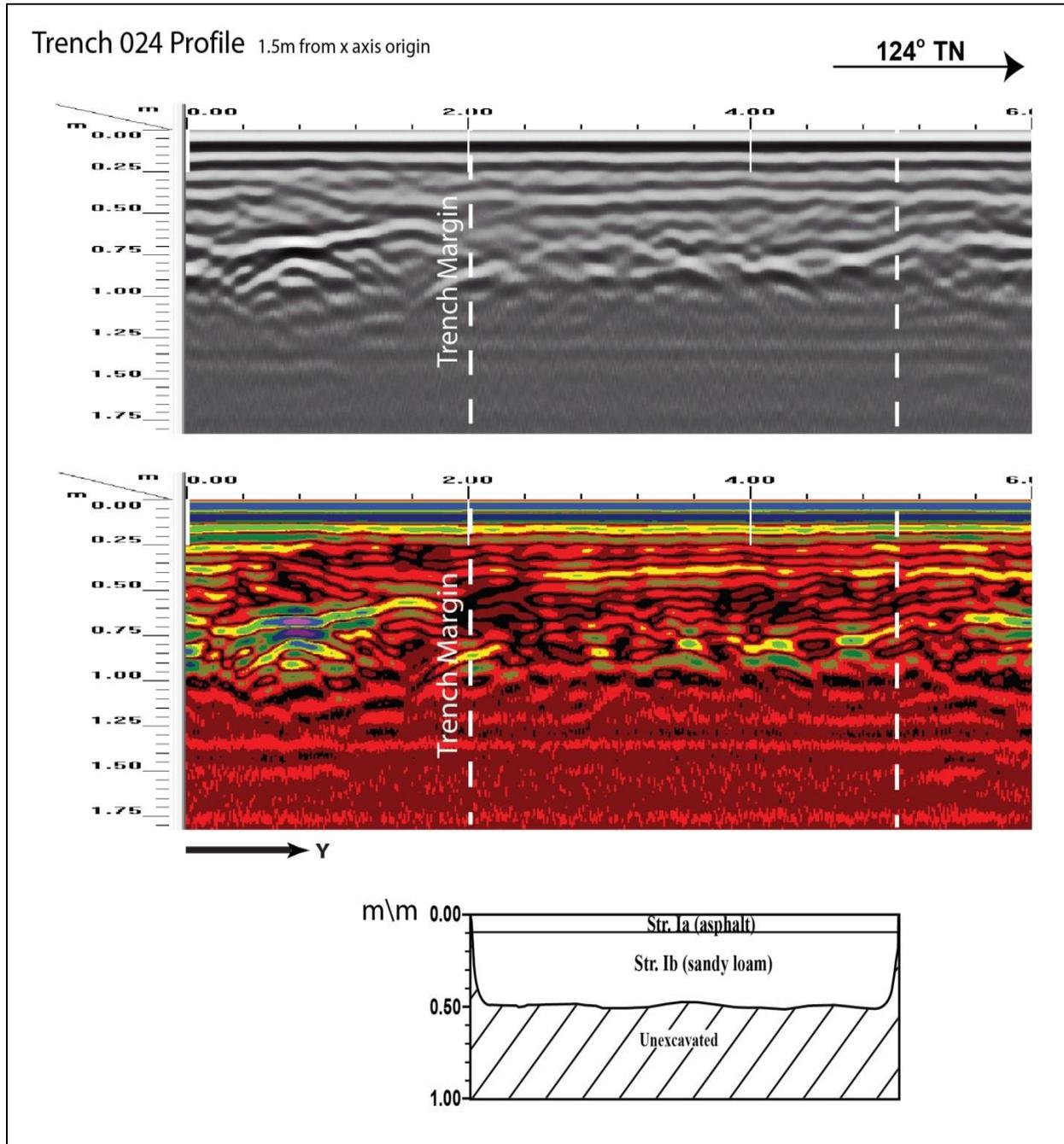


Figure 72. Visual comparison of excavated profile and GPR signal profile of T-024

## Test Excavation 25

T-025 measured 0.6 m by 3.0 m and was oriented northwest to southeast and located within the road cut of Kamehameha Highway in the center lane, 60.0 m northwest of Puuhale Road. The GPR grid measured 2.0 m by 6.0 m with 0.25 m spacing between Y transects and 1.0 m spacing between X transects. Utilities located near the excavation include: sewer line 1.7 m northeast, and water line 2.7 m southwest. No utilities transected the GPR grid or excavation location.

A review of amplitude slice maps indicated no linear features which might have indicated the presence of utilities. Reflectivity was relatively uniform throughout the grid and decreased with depth. A transition from higher reflectivity to lower reflectivity was observed at approximately 0.5 mbs (Figure 73).

GPR depth profiles for T-025 identified horizontal banding, commonly associated with stratigraphic layering, throughout the survey area (Figure 74). This banding corresponded to variations of density and chemical composition within fill deposits. The profile also indicated a change in reflectivity which occurred around 0.15 mbs and again around 0.6 mbs. No utilities were observed in the profile. The maximum depth of clean signal return was approximately 1.0 mbs.

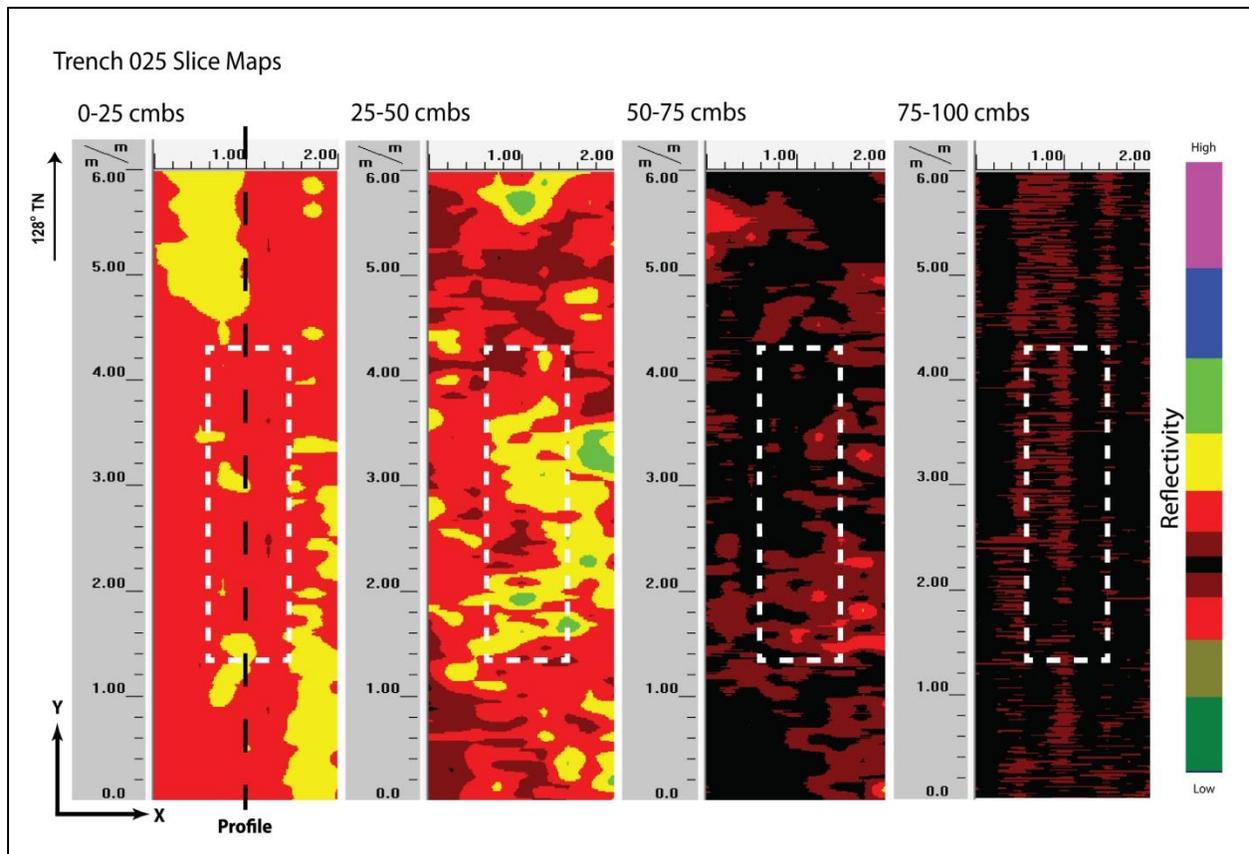


Figure 73. Slice maps of T-025 at 25cm depth intervals

A visual comparison of the excavated profile and the GPR signal profile showed a strong correlation in stratigraphic transitions (Figure 74). Strata Ia through II and the coral shelf were clearly observed and occurred at the ground-truthed depths. An increase in reflectivity occurs as Stratum Ib transitions to Stratum II, which was a natural silty loam. No discrete objects or other stratigraphic transitions were observed in the GPR results or subsequent excavation.

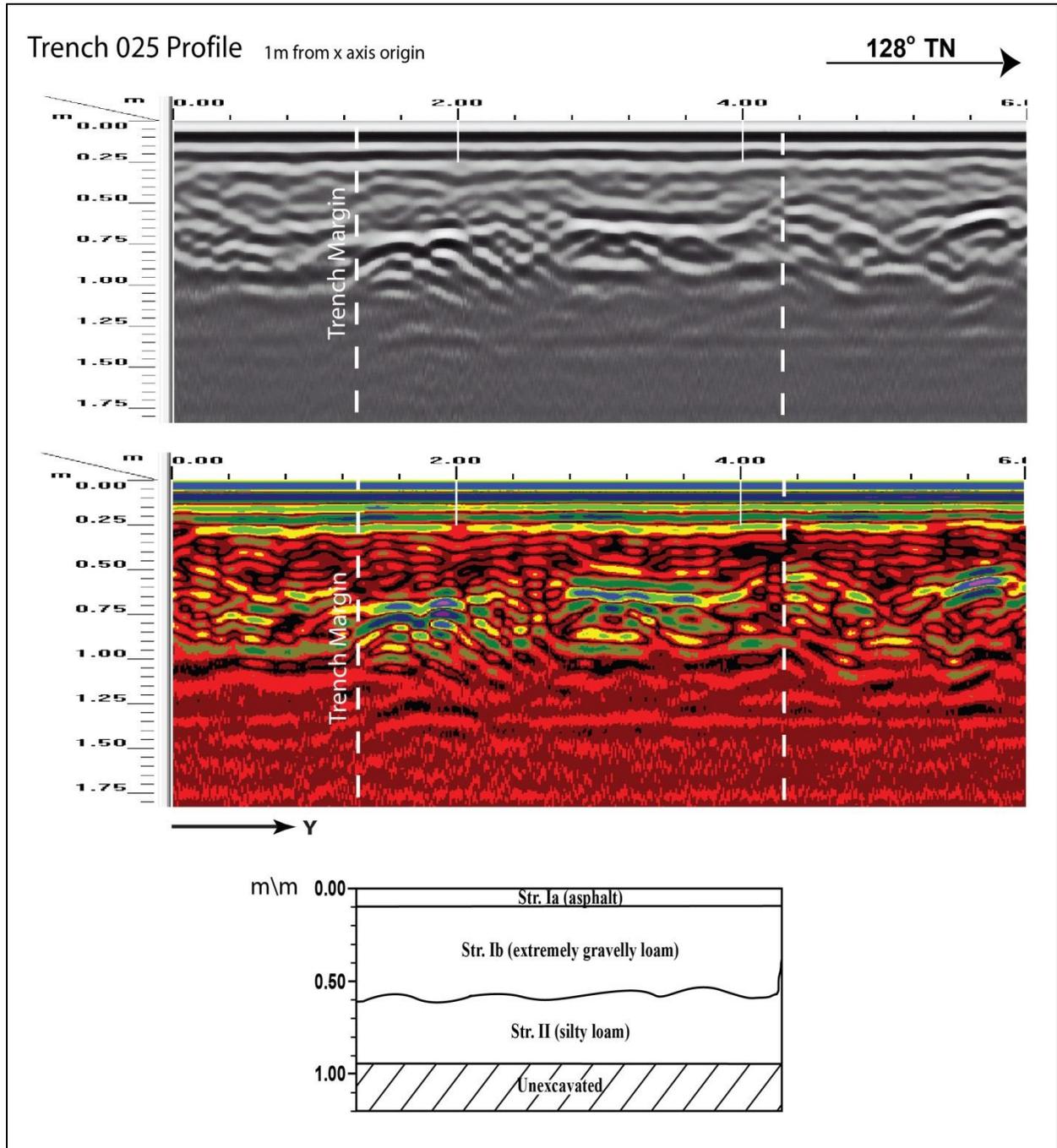


Figure 74. Visual comparison of excavated profile and GPR signal profile of T-025

## Test Excavation 26

T-026 measured 0.6 m by 3.0 m and was oriented northwest to southeast and located within the road cut of Kamehameha Highway in the center lane, 18.0 m northwest of Kamehameha Highway and Puuhale Road intersection. The GPR grid measured 2.0 m by 6.0 m with 0.25 m Y transects and 1.0 m spacing between X transects. Utilities located near the excavation include: sewer line 1.7 m northeast and water line 2.7 m southwest. A utility pipe was encountered approximately 0.9 mbs in the northwest end of the excavation.

A review of amplitude slice maps indicated no linear features which might have indicated the presence of utilities. Reflectivity was relatively uniform throughout the grid and decreased with depth. A transition from higher reflectivity to lower reflectivity was observed at approximately 0.5 mbs (Figure 75).

GPR depth profiles for T-026 identified horizontal banding, commonly associated with stratigraphic layering, throughout the survey area (Figure 76). This banding corresponded to variations of density and chemical composition within fill deposits. The profile also indicated a change in reflectivity which occurred around 0.15 mbs and again around 0.75 mbs. No utilities were observed in the profile. The maximum depth of clean signal return was approximately 1.0 mbs.

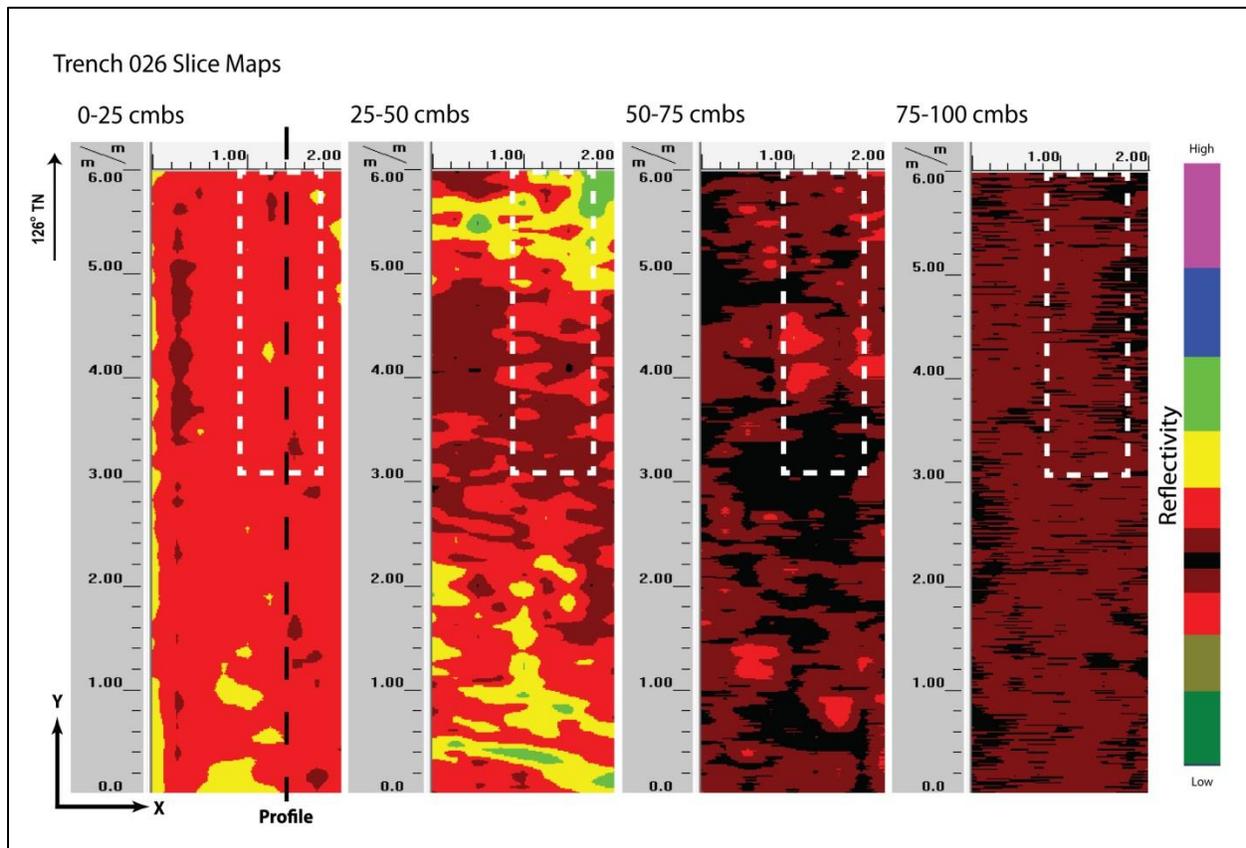


Figure 75. Slice maps of T-026 at 25cm depth intervals

A visual comparison of the excavated profile and the GPR signal profile showed a strong correlation in stratigraphic transitions (Figure 76). Strata Ia through II were all clearly observed and occurred at the ground-truthed depths. An increase in reflectivity between 0.50 and 0.95 mbs represents Stratum II. A void was truncating Stratum II which corresponded to Stratum Ic. A utility pipe was located at about 0.9 mbs. This pipe did not show up on the profile or slice maps. This may be due to the fact that the pipe was empty or because it was near the maximum depth for clean signal return. No other discrete objects were observed in the GPR results or subsequent excavation.

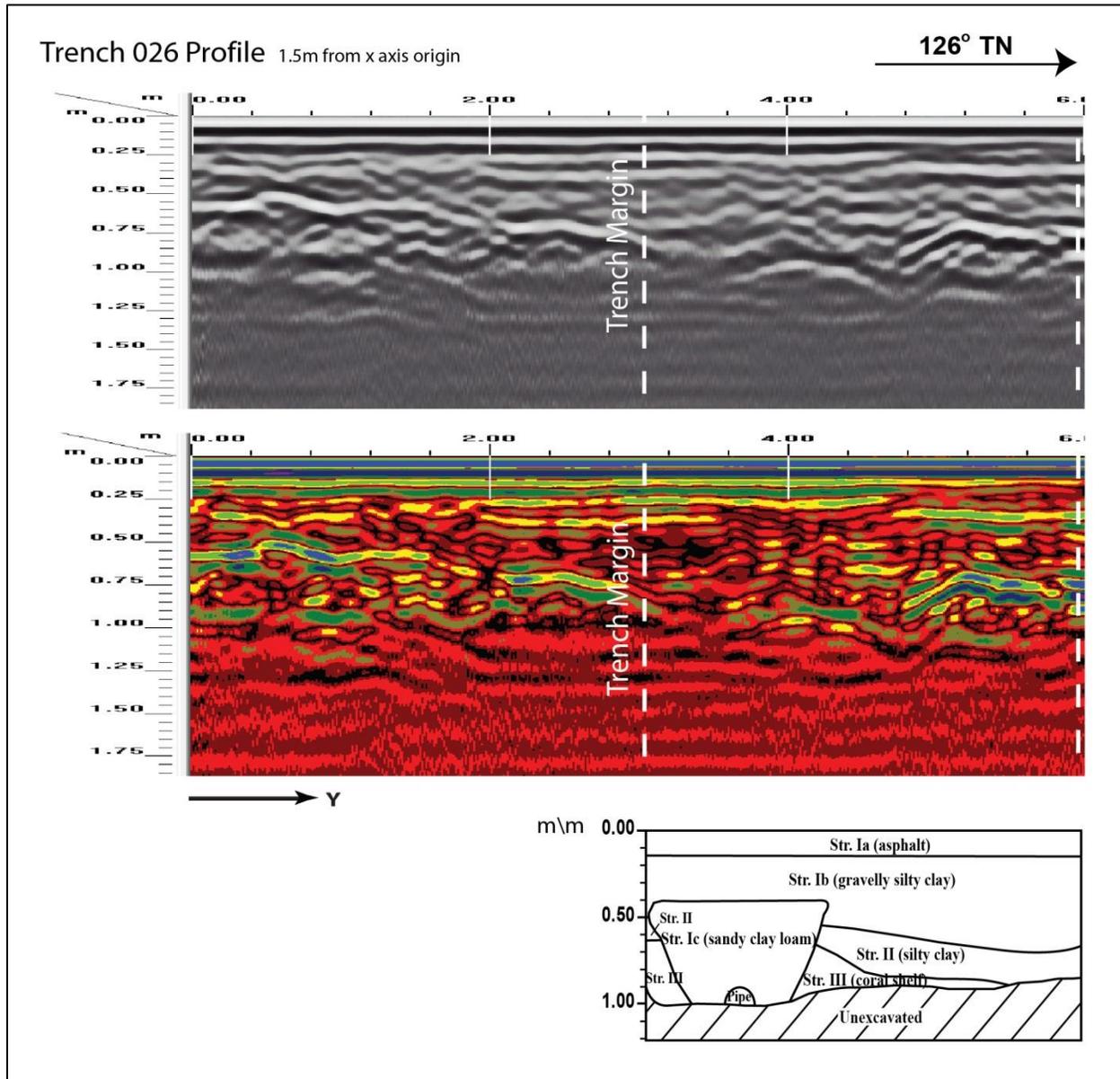


Figure 76. Visual comparison of excavated profile and GPR signal profile of T-026

## Test Excavation 27

T-027 measured 0.9 m by 3.0 m oriented northwest to southeast and was located within the road cut of Dillingham Boulevard in the center median, 60.0 m southeast of Kamehameha Highway and Puuhale Road intersection. The GPR grid measured 2.0 m by 10.0 m with 0.25 m spacing between Y transects and 1.0 m spacing between X transects. Utilities located near the excavation include: water line 3.3 m northeast and 3.7 m southeast, and a sewer line 4.4 m northwest. A street monument transected the GPR grid and proposed excavation location therefore T-027 was relocated approximately 1 m to the southeast.

A review of amplitude slice maps indicated no linear features which might have indicated the presence of utilities. Reflectivity was relatively uniform throughout the grid and decreased with depth except for the street monument. A transition from higher reflectivity to lower reflectivity was observed at approximately 0.25 mbs (Figure 77).

GPR depth profiles for T-027 identified horizontal banding, commonly associated with stratigraphic layering, throughout the survey area (Figure 78). This banding corresponded to variations of density and chemical composition within fill deposits. The profile also indicated a change in reflectivity which occurred around 0.15 mbs and again around 0.8 mbs. No utilities were observed in the profile. The maximum depth of clean signal return was approximately 0.9 mbs.

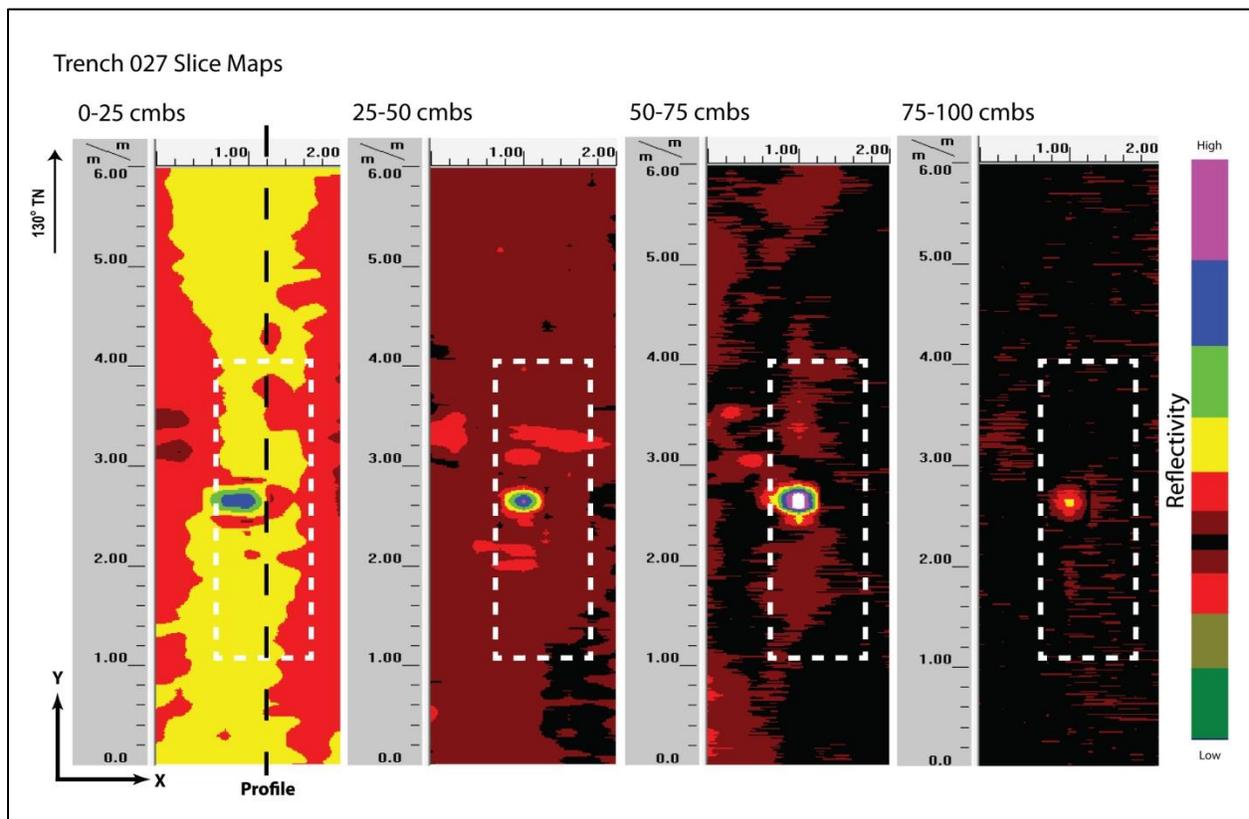


Figure 77. Slice maps of T-027 at 25cm depth intervals

A visual comparison of the excavated profile and the GPR signal profile showed a strong correlation in stratigraphic transitions (Figure 78). Strata Ia through Ic were clearly observed and occurred at the ground-truthed depths. Strata included a layer of asphalt on top of extremely gravelly loam fill followed by natural silty clay which continued until it hit the coral shelf. No discrete objects or other stratigraphic transitions were observed in the GPR results or subsequent excavation.

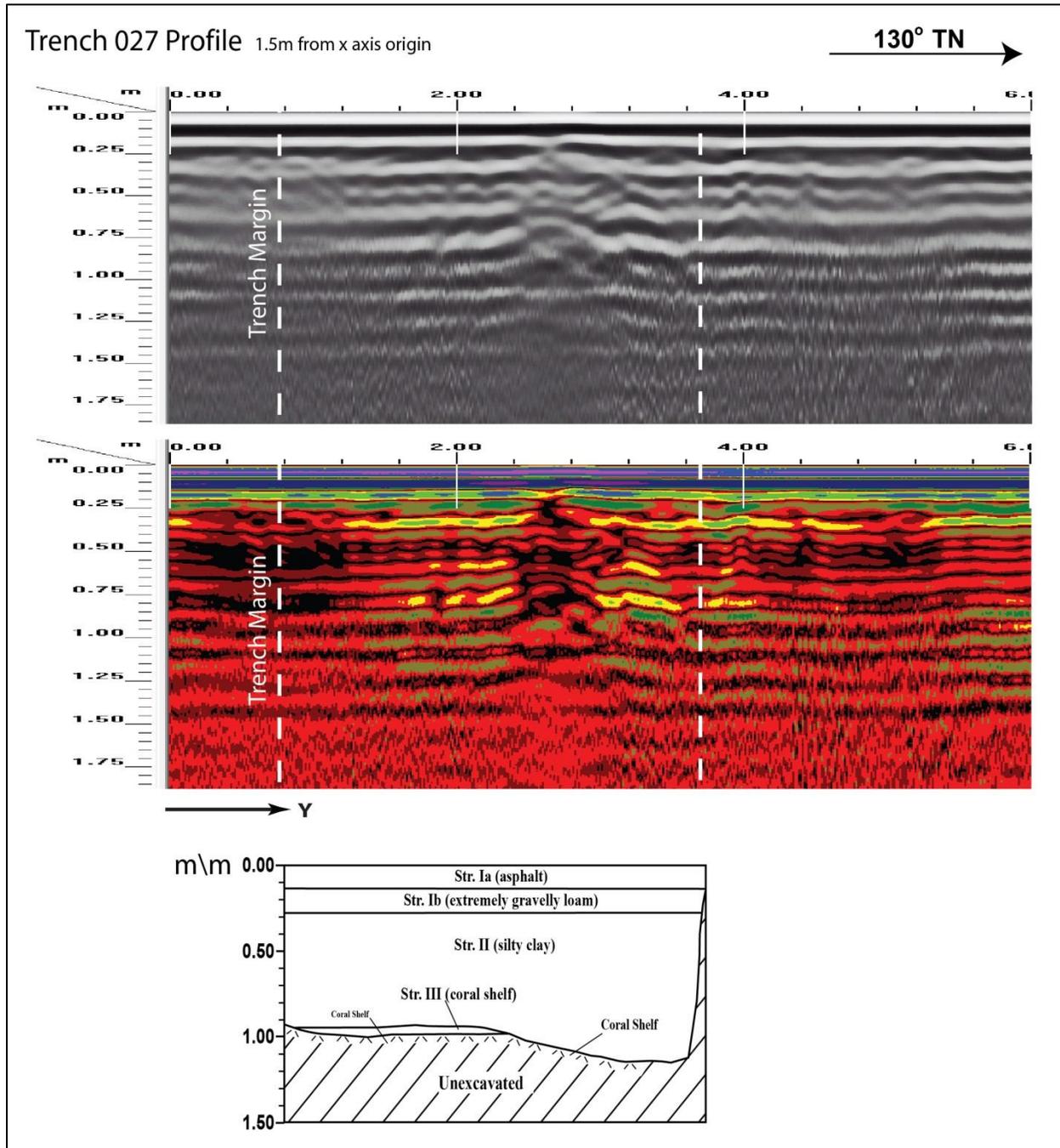


Figure 78. Visual comparison of excavated profile and GPR signal profile of T-027

## Test Excavation 28

T-028 measured 0.9 m by 3.0 m and was oriented northwest to southeast and was located within the road cut of Dillingham Boulevard, 100.0 m southeast of Dillingham Boulevard and Puuhale Road intersection. The GPR grid measured 2.0 m by 6.0 m with 0.25 m spacing between Y transects and 1.0 m spacing between X transects. Utilities located near the excavation include: water line 1.3 m northwest and 2.8 m northeast, electrical line 2.6 m southwest. No utilities transected the GPR grid or excavation location.

A review of amplitude slice maps indicated no linear features which might have indicated the presence of utilities. Reflectivity was relatively uniform throughout the grid and decreased with depth. A transition from higher reflectivity to lower reflectivity was observed at approximately 0.5 mbs (Figure 79).

GPR depth profiles for T-028 identified horizontal banding, commonly associated with stratigraphic layering, throughout the survey area (Figure 80). This banding corresponded to variations of density and chemical composition within fill deposits. The profile also indicated a change in reflectivity which occurred around 0.25 mbs. No utilities were observed in the profile. The maximum depth of clean signal return was approximately 0.85 mbs.

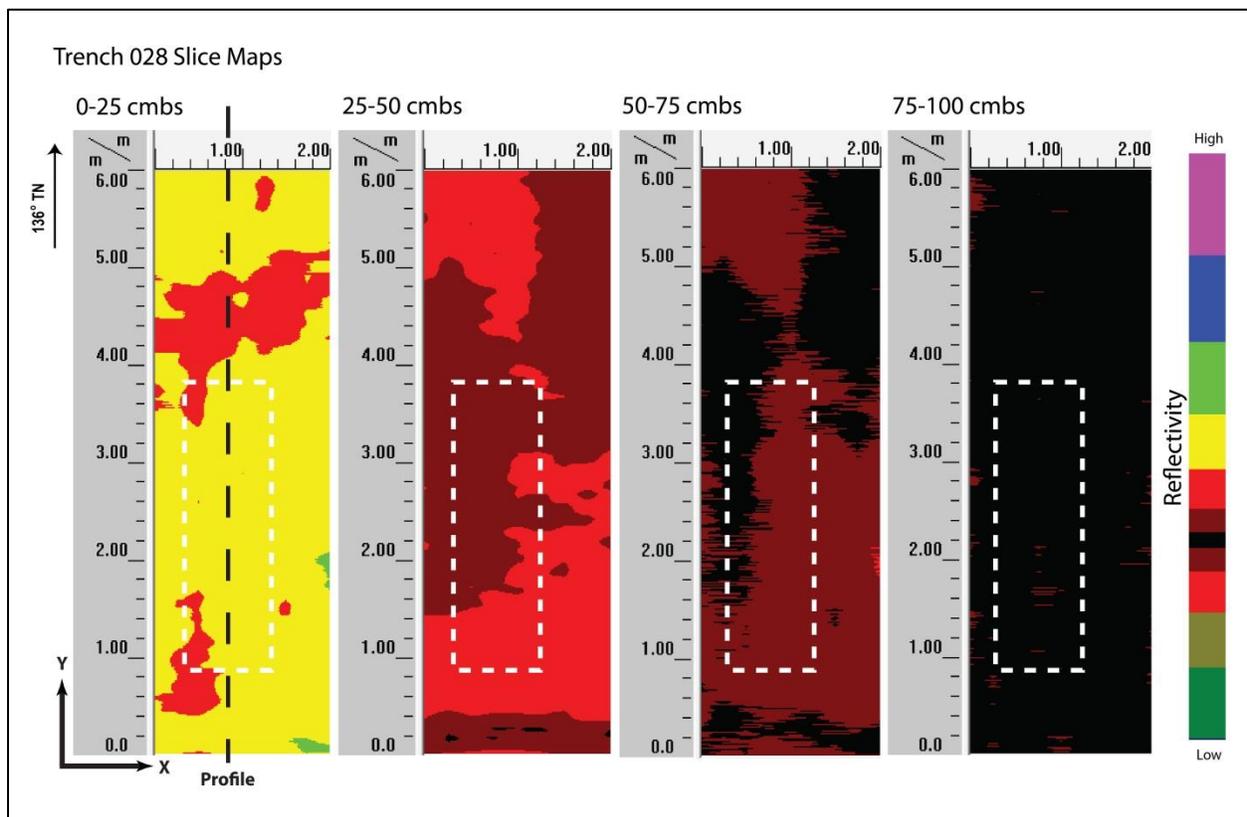


Figure 79. Slice maps of T-028 at 25cm depth intervals

A visual comparison of the excavated profile and the GPR signal profile showed a strong correlation in stratigraphic transitions (Figure 80). Strata Ia through II were clearly observed and occurred at the ground-truthed depths. Strata include a layer of asphalt on top of extremely gravelly loam fill followed by a natural silty clay until the coral shelf was reached. No discrete objects or other stratigraphic transitions were observed in the GPR results or subsequent excavation.

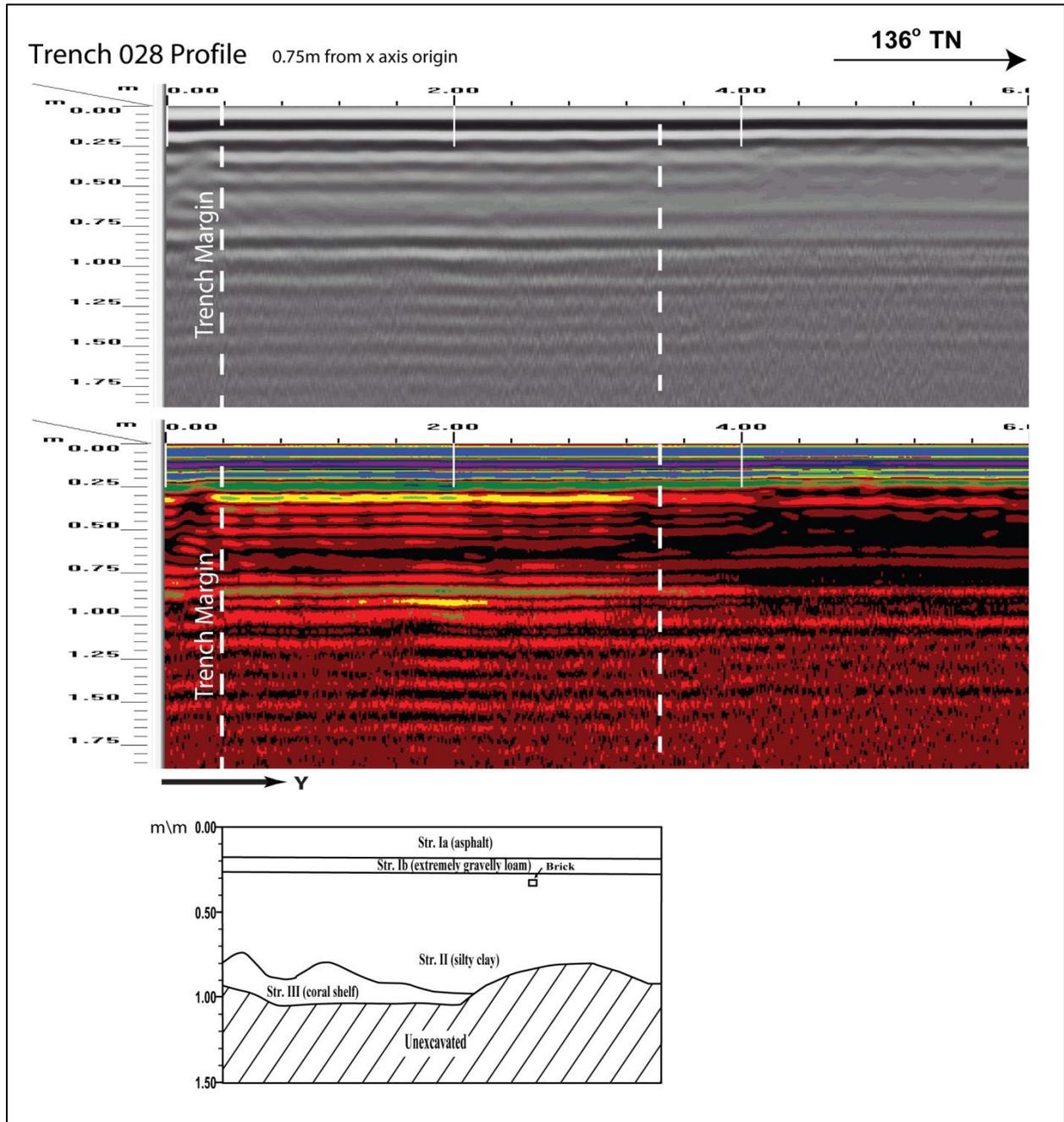


Figure 80. Visual comparison of excavated profile and GPR signal profile of T-028

## Test Excavation 29

T-029 measured 0.9 m by 3.0 m and was oriented northwest to southeast and was located within the road cut of Dillingham Boulevard, 100.0 m northwest of Dillingham Boulevard and Mokauea Street intersection. The GPR grid measured 2.0 m by 6.0 m with 0.25 m spacing between Y transects and 1.0 m spacing between X transects. Utilities located near the excavation include: sewer line 2.4 m southeast, electrical line 2.8 m southwest, water line 3.2 m northeast. No utilities transected the GPR grid or excavation location.

A review of amplitude slice maps indicated no linear features which might have indicated the presence of utilities. Reflectivity was relatively uniform throughout the grid and decreased with depth. A transition from higher reflectivity to lower reflectivity was observed at approximately 0.25 mbs (Figure 81).

GPR depth profiles for T-029 identified horizontal banding, commonly associated with stratigraphic layering, throughout the survey area (Figure 82). This banding corresponded to variations of density and chemical composition within fill deposits. The profile also indicated a change in reflectivity which occurred around 0.4 mbs and again around 0.75 mbs. An anomaly was observed in the profile however no utilities were observed during excavation. The maximum depth of clean signal return was approximately 1.0 mbs.

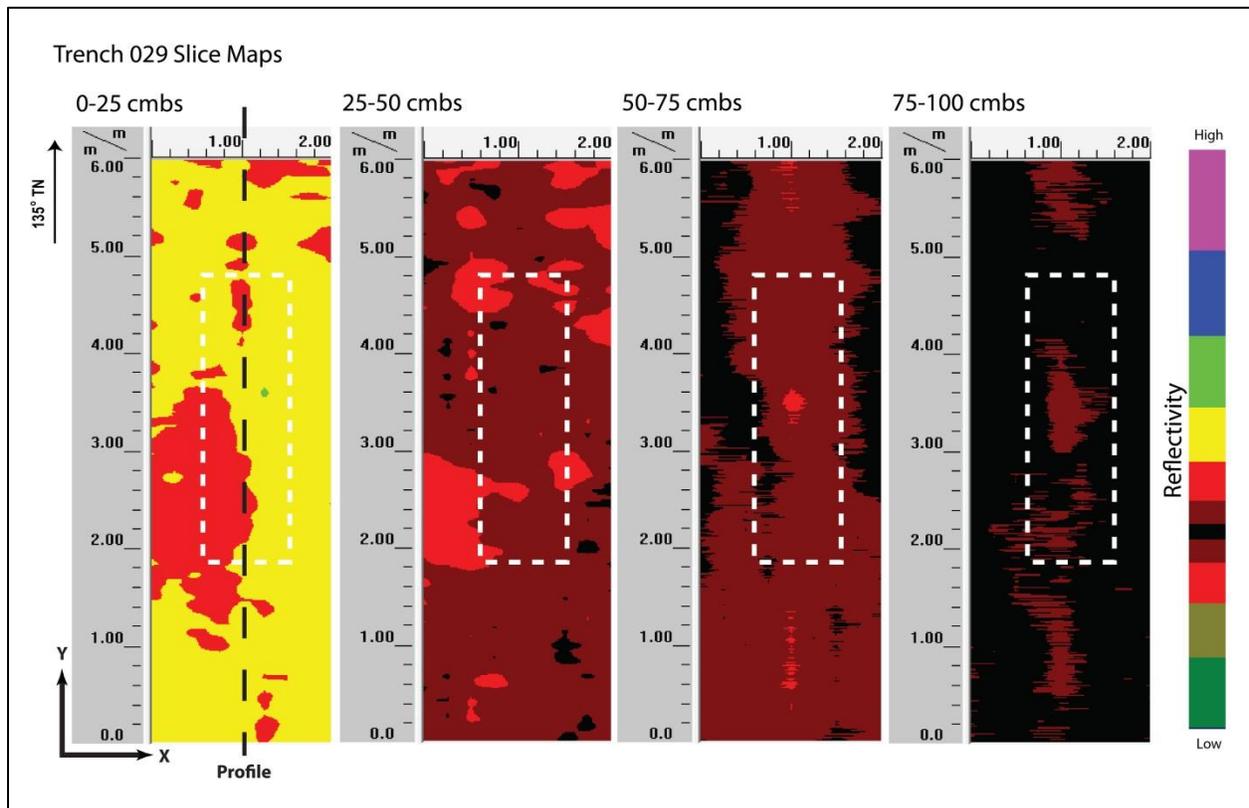


Figure 81. Slice maps of T-029 at 25cm depth intervals

A visual comparison of the excavated profile and the GPR signal profile showed a strong correlation in stratigraphic transitions (Figure 82). Strata Ia through Ic were clearly observed and occurred at the ground-truthed depths. Strata included a layer of asphalt on top of extremely gravelly loam fill followed by a natural silty clay loam layer that continued to 2.7 mbs. An increase in reflectivity and a large hyperbola occurred between 0.4 and 0.9 mbs but no utility or sediment transition were observed. All other sediment transitions occurred below the max clean signal depth. No other discrete objects were observed in the GPR results or subsequent excavation.

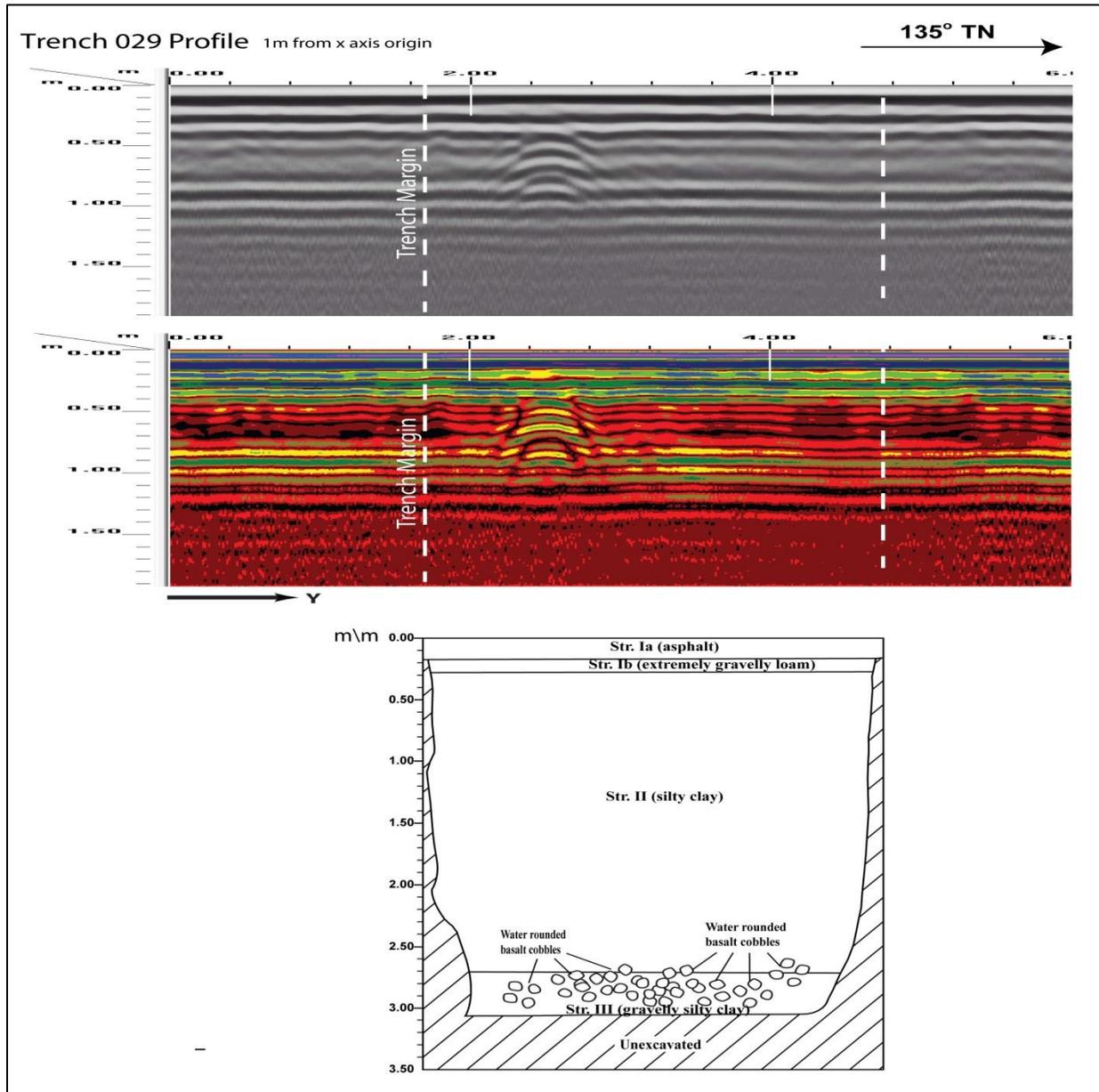


Figure 82. Visual comparison of excavated profile and GPR signal profile of T-029

## Test Excavation 30

T-030 measured 0.9 m by 3.0 m and was oriented northwest to southeast and was located within the road cut of Dillingham Boulevard, 45.0 m northwest of Dillingham Boulevard and Mokauea Street intersection. The GPR grid measured 2.0 m by 6.0 m with 0.25 m spacing between Y transects and 1.0 m spacing between X transects. Utilities located near the excavation include: electrical line 2.8 m southwest, water line 3.4 m northeast, sewer line 4.4 m southeast. No utilities transected the GPR grid or excavation location.

A review of amplitude slice maps indicated no linear features which might have indicated the presence of utilities. Reflectivity was relatively uniform throughout the grid and decreased with depth. A transition from higher reflectivity to lower reflectivity was observed at approximately 0.75 mbs (Figure 83).

GPR depth profiles for T-030 identified horizontal banding, commonly associated with stratigraphic layering, throughout the survey area (Figure 84). This banding corresponded to variations of density and chemical composition within fill deposits. The profile also indicated a change in reflectivity which occurred around 0.2 mbs. No utilities were observed in the profile. The maximum depth of clean signal return was approximately 0.85 mbs.

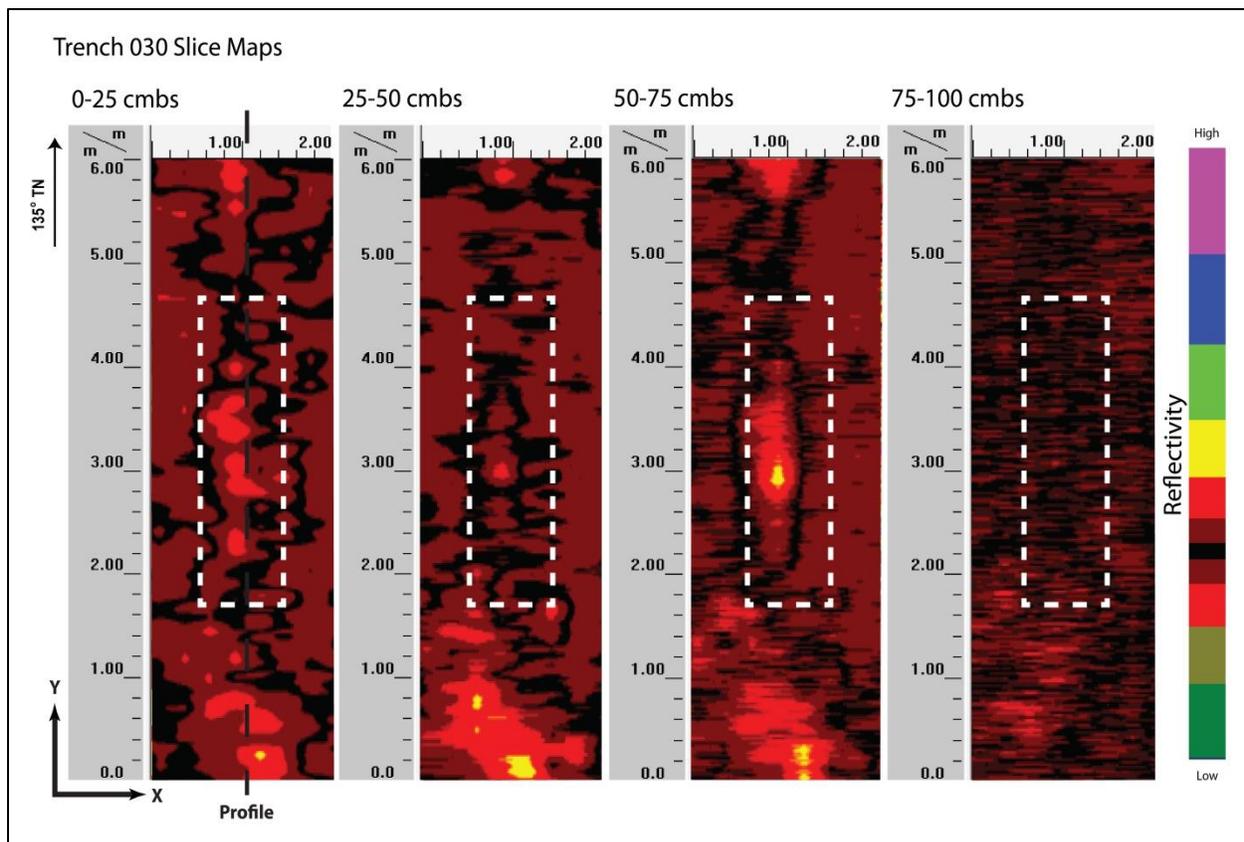


Figure 83. Slice maps of T-030 at 25cm depth intervals

A visual comparison of the excavated profile and the GPR signal profile showed a moderate correlation in stratigraphic transitions (Figure 84). Strata Ia to Ic were clearly observed and occurred near the ground-truthed depths. The transition from Stratum Ic to Stratum II was not clearly depicted in the GPR profile. No discrete objects or other stratigraphic transitions were observed in the GPR results.

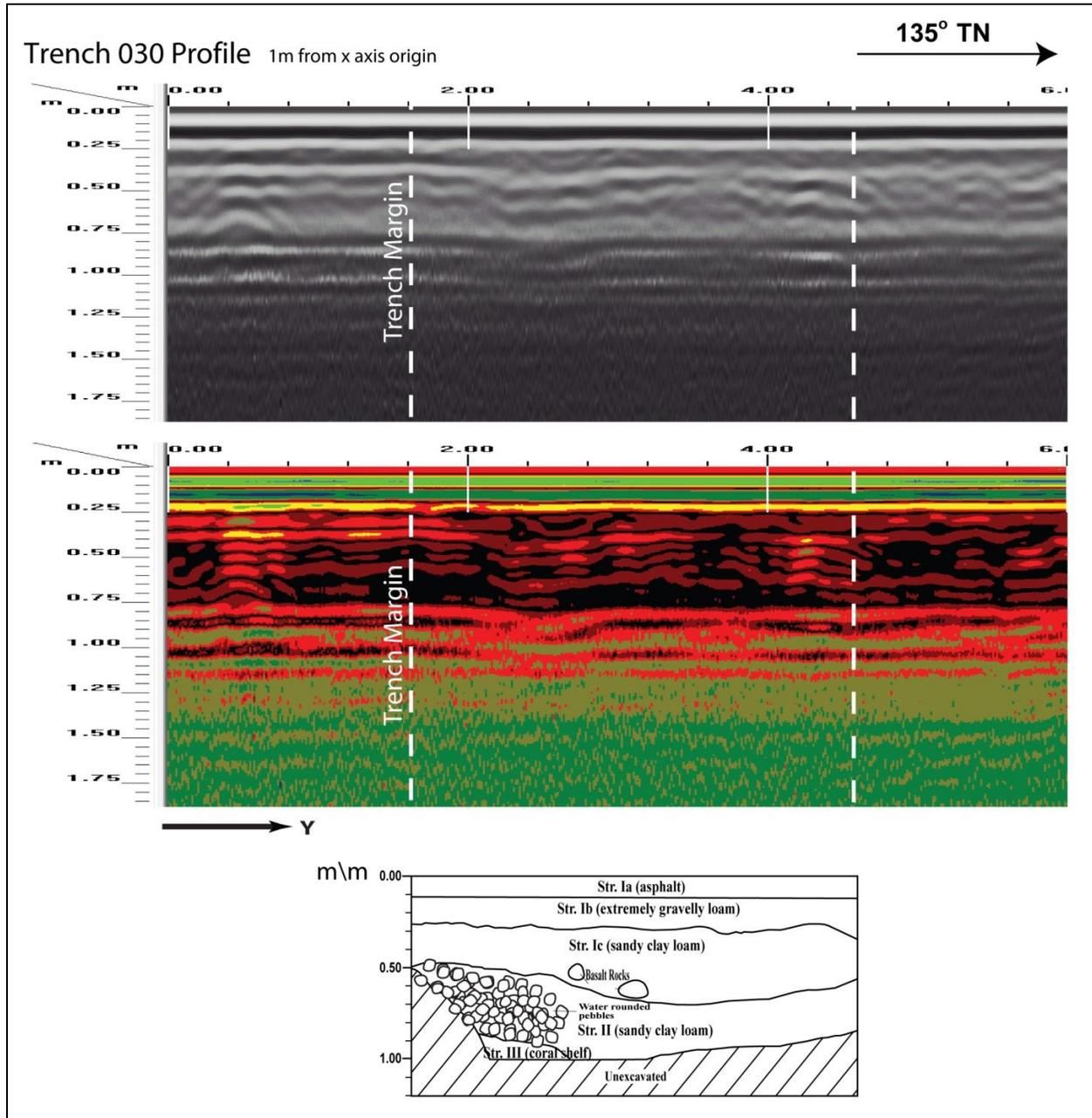


Figure 84. Visual comparison of excavated profile and GPR signal profile of T-030

### Test Excavation 31

T-031 measured 0.9 m by 3.0 m and was oriented northeast to southwest and located within Dillingham Café, 55.0 m west of Dillingham Boulevard and Mokauea Street intersection. The GPR grid measured 2.0 m by 5.0 m with 0.25 m spacing between Y transects and 1.0 m spacing between X transects. According to the PB CADD, there were no utilities within close proximity of the excavation location. Several abandoned metal utility pipes were encountered approximately 0.6 mbs in the northeast end of the excavation.

A review of amplitude slice maps indicated no linear features although several metal utility pipes were encountered during excavation. Reflectivity was relatively uniform throughout the grid and decreased with depth. A transition from higher reflectivity to lower reflectivity was observed at approximately 0.5 mbs (Figure 85).

GPR depth profiles for T-031 identified horizontal banding, commonly associated with stratigraphic layering, throughout the survey area (Figure 86). This banding corresponded to variations of density and chemical composition within fill deposits. The profile also indicated a change in reflectivity which occurred around 0.35 mbs. No utilities were observed in the profile although several utilities were encountered during excavation. The maximum depth of clean signal return was approximately 0.75 mbs.

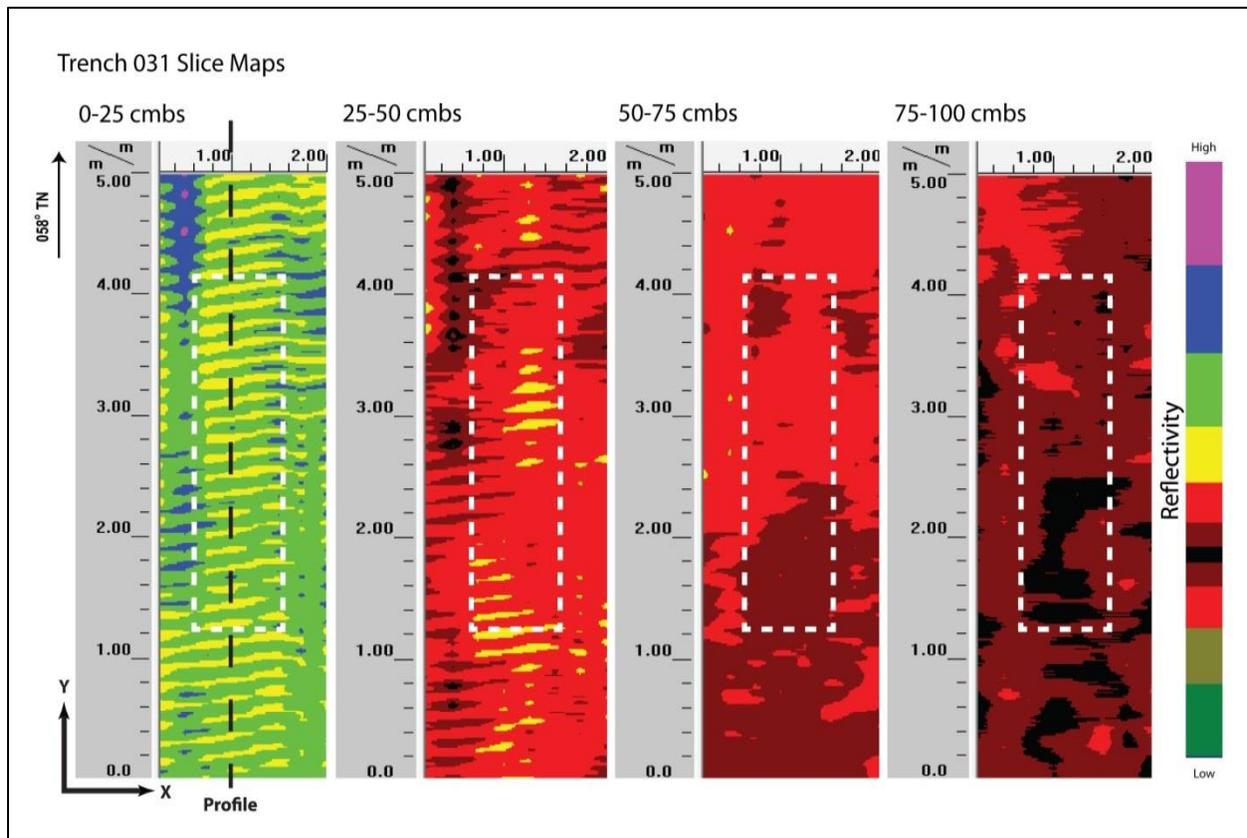


Figure 85. Slice maps of T-031 at 25cm depth intervals

A visual comparison of the excavated profile and the GPR signal profile showed a moderate correlation in stratigraphic transitions (Figure 86). Strata included a layer of concrete (Ia) on top of several thin layers of variations of a gravelly loam (Ib-Ie) which continued down to .6 mbs. Strata Ia through Ie were not individually discernible, possibly due to the fact that they were very thin layers of compacted fill, but based on reflectivity and horizontal banding it was apparent that there were multiple layers of fill events. Several metal utilities were located about 0.6 mbs. These utilities were not picked up on the slices or profile. This may be due to the fact that the pipes were empty or that they were very small. No other discrete objects were observed in the GPR results or subsequent excavation.

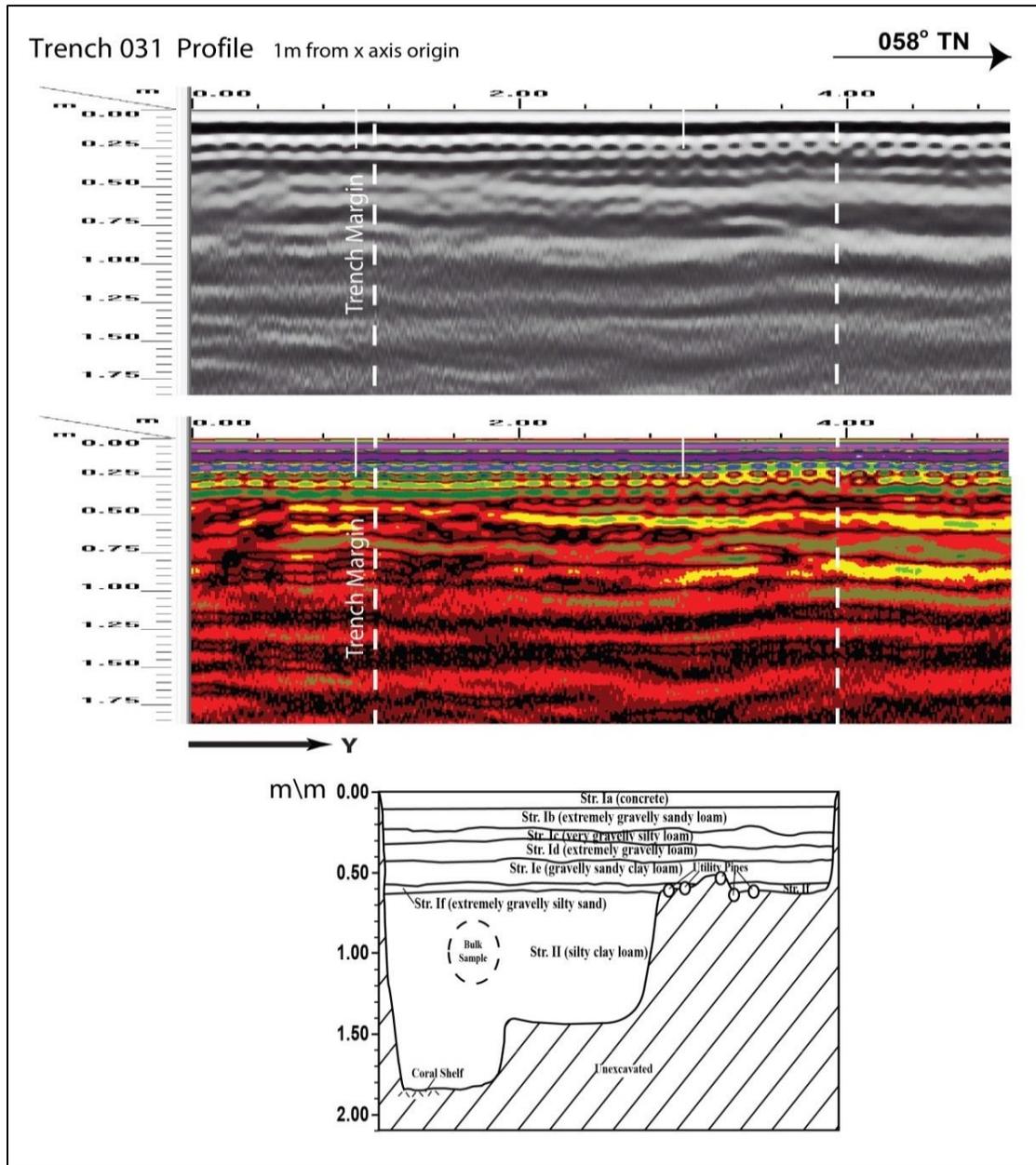


Figure 86. Visual comparison of excavated profile and GPR signal profile of T-31

### Test Excavation 32

T-032 measured 0.6 m by 6.0 m and was oriented northwest to southeast and located within Dillingham Café parking lot, 55.0 m west of Dillingham Boulevard and Mokauea Street intersection. The GPR grid measured 3.0 m by 8.0 m with 0.25 m spacing between Y transects and 1.0 m spacing between X transects. According to the PB CADD, there were no utilities within close proximity to the excavation. A concrete slab was encountered about 0.28 mbs spanning the entire length of the excavation.

A review of amplitude slice maps indicated no linear features although a concrete slab was encountered during excavation. Reflectivity was relatively uniform throughout the grid and decreased with depth. A transition from higher reflectivity to lower reflectivity was observed at approximately 0.75 mbs (Figure 87).

GPR depth profiles for T-032 identified horizontal banding, commonly associated with stratigraphic layering, throughout the survey area (Figure 88). This banding corresponded to variations of density and chemical composition within fill deposits. The profile also indicated a change in reflectivity which occurred around 0.15 mbs. No utilities were observed in the profile although a concrete slab was encountered during excavation. The maximum depth of clean signal return was approximately 0.9 mbs.

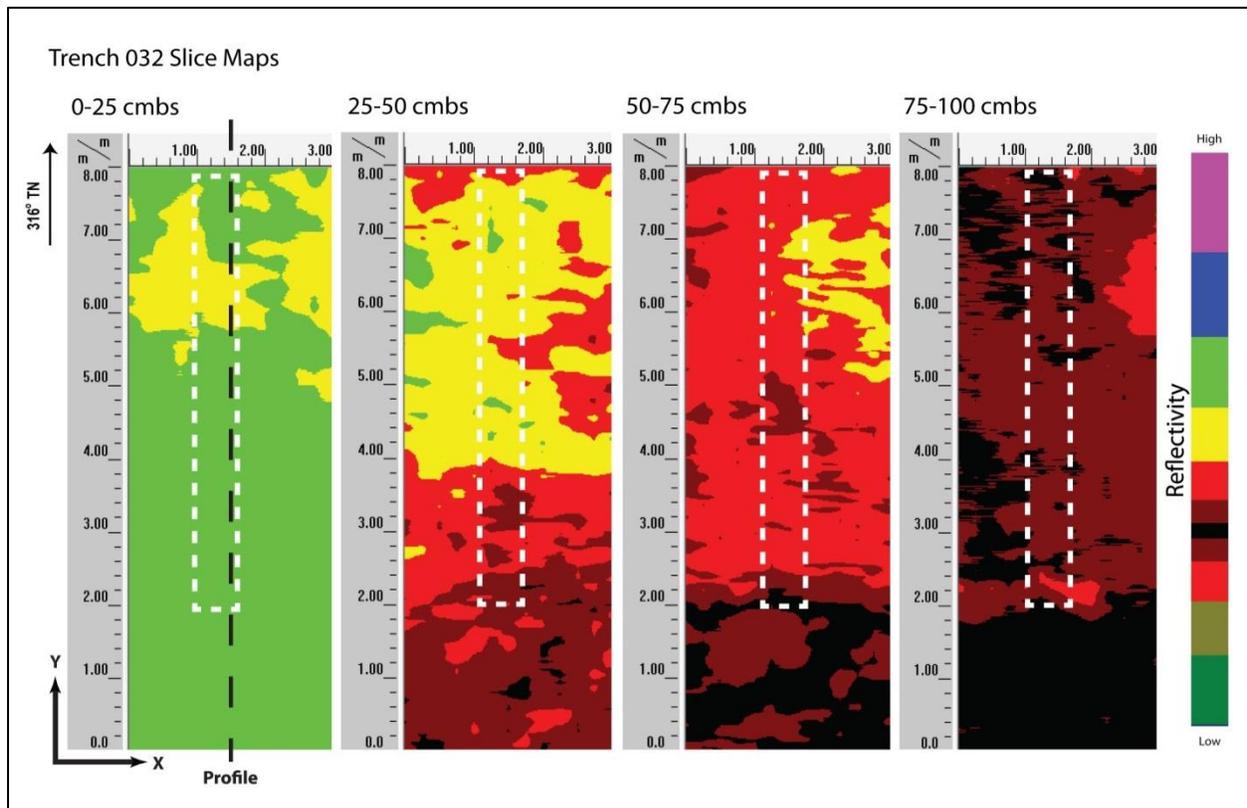


Figure 87. Slice maps of T-032 at 25cm depth intervals

A visual comparison of the excavated profile and the GPR signal profile showed a moderate correlation in stratigraphic transitions (Figure 88). Strata Ib and IIa were clearly observed and occurred at the ground-truthed depths. Strata included a thin layer of asphalt on top of very gravelly sandy loam fill followed by a concrete slab and then a natural silty clay loam. Strata Ia and Ib were not individually discernible. Stratum Ic, a concrete slab, was not clearly picked up on the GPR profile possibly due to the fact that it was not reinforced with steel (rebar). Textural changes in the form of multiple small hyperbolas were apparent in Stratum IIa which was a silty clay loam. No discrete objects or other stratigraphic transitions were observed in the GPR results.

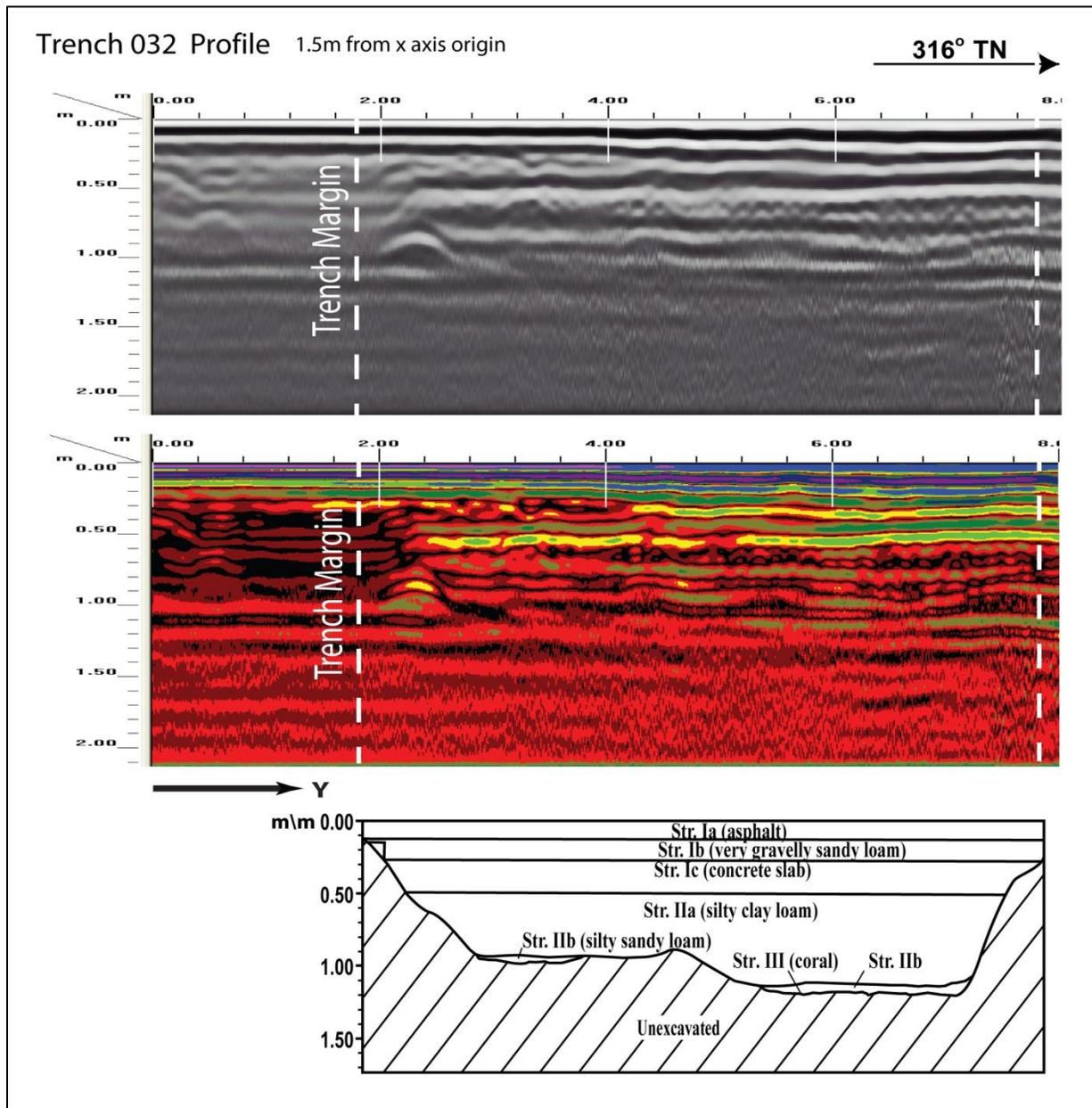


Figure 88. Visual comparison of excavated profile and GPR signal profile of T-032

### Test Excavation 33

T-033 measured 0.9 m by 3.0 m and was oriented northwest to southeast and was located within the road cut of Dillingham Boulevard, 46.0 m northwest of Dillingham Boulevard and Mokauea Street intersection. The GPR grid measured 2.0 m by 6.0 m with 0.25 m spacing between Y transects and 1.0 m spacing between X transects. Utilities located near the excavation include: electrical line 3.0 m southwest, telephone line 3.9 m southwest, water line 3.9 m northeast and 4.3 m northwest.

A review of amplitude slice maps indicated a linear feature however no utility was encountered during excavation. Reflectivity was relatively uniform throughout the grid and decreased with depth except for the linear feature (Figure 89). A transition from higher reflectivity to lower reflectivity was observed at approximately 0.25 mbs.

GPR depth profiles for T-026 identified horizontal banding, commonly associated with stratigraphic layering, throughout the survey area (Figure 90). This banding corresponded to variations of density and chemical composition within fill deposits. The profile also indicated a change in reflectivity which occurred around 0.45 mbs. No utilities were observed in the profile. The maximum depth of clean signal return was approximately 0.8 mbs.

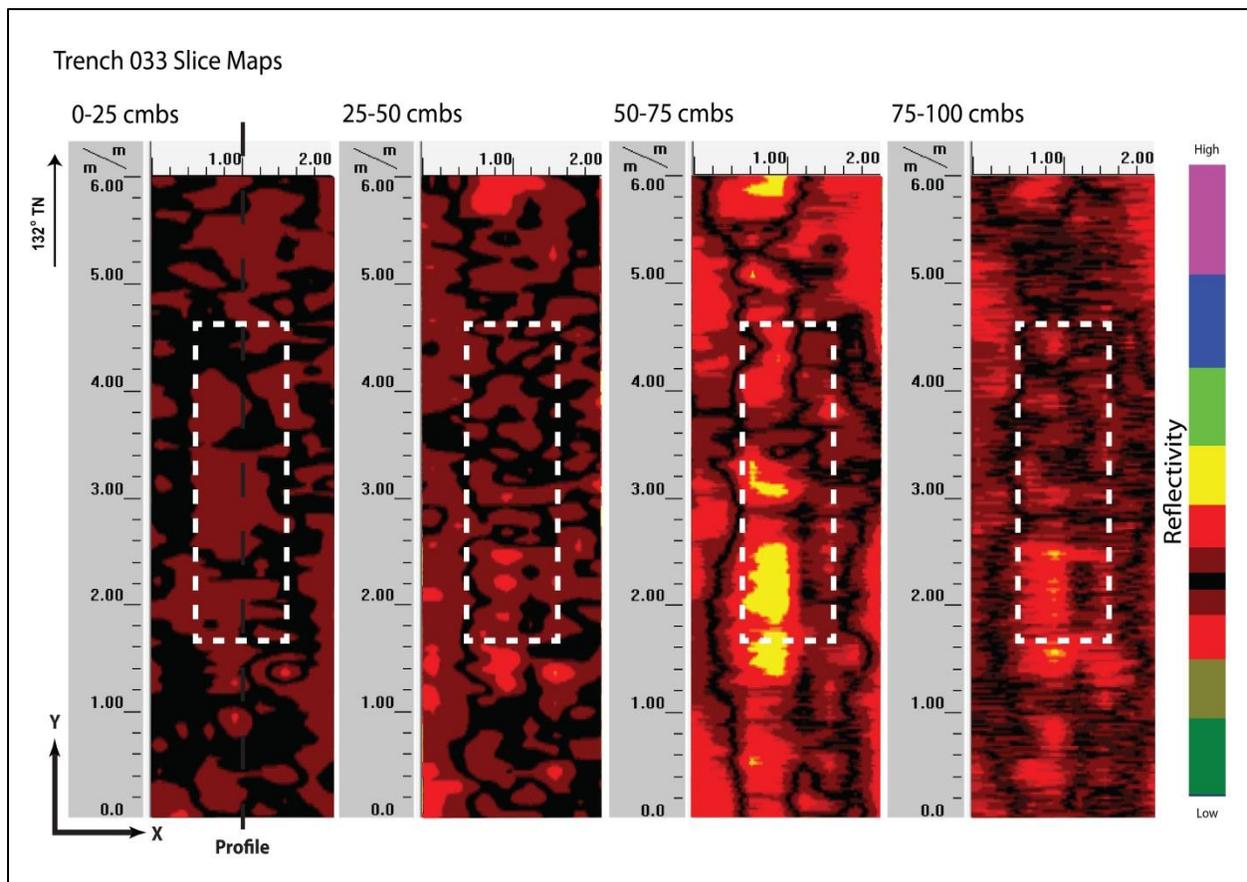


Figure 89. Slice maps of T-033 at 25cm depth intervals

A visual comparison of the excavated profile and the GPR signal profile showed a strong correlation in stratigraphic transitions (Figure 90). Strata Ia through II were clearly observed and occurred at the ground-truthed depths. Textural changes in the form of multiple hyperbolas were apparent in Stratum II which was silty clay. All other sediment transition occurred below the maximum clean signal return depth. No discrete objects were observed in the GPR results or subsequent excavation.

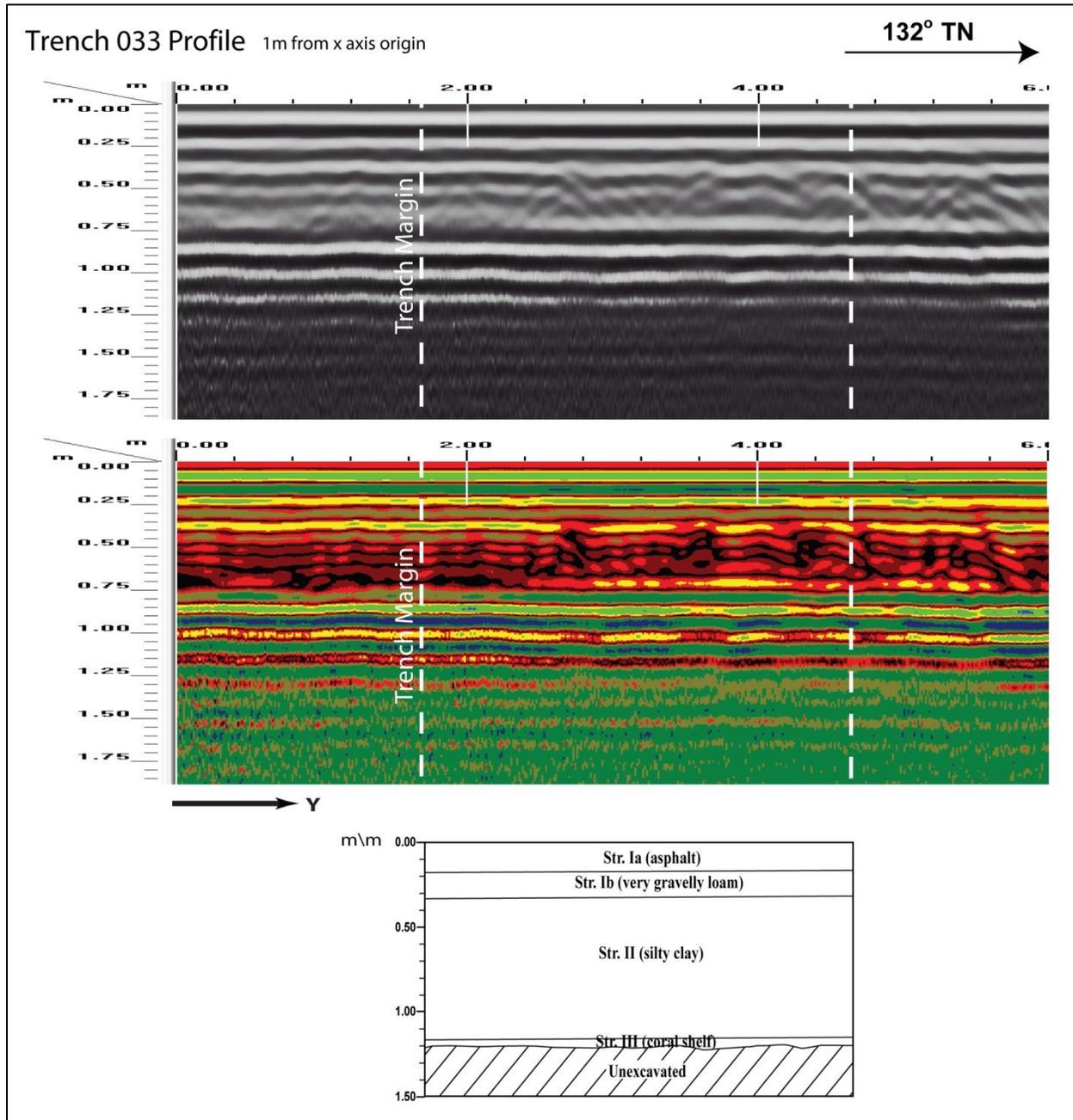


Figure 90. Visual comparison of excavated profile and GPR signal profile of T-033

### Test Excavation 34

T-034 measured 0.9 m by 3.0 m and was oriented northwest to southeast and was located within the 7-11, 37.0 m northwest of Dillingham Boulevard and Mokauea Street intersection. The GPR grid measured 3.0 m by 6.0 m with 0.25 m spacing between Y transects and 1.0 m spacing between X transects. According to the PB CADD, there were no utilities within close proximity to the excavation. An abandoned PVC pipe was encountered 0.63 mbs on the northwestern end of the excavation.

A review of amplitude slice maps indicated no linear features although a dead PVC pipe was encountered during excavation. Reflectivity was relatively uniform throughout the grid and decreased with depth. A transition from higher reflectivity to lower reflectivity was observed at approximately 0.75 mbs (Figure 91).

GPR depth profiles for T-034 identified horizontal banding, commonly associated with stratigraphic layering, throughout the survey area (Figure 92). This banding corresponded to variations of density and chemical composition within fill deposits. The profile also indicated a change in reflectivity which occurred around 0.3 mbs. No utilities were observed in the profile although a dead PVC pipe was encountered during excavation. The maximum depth of clean signal return was approximately 1.0 mbs.

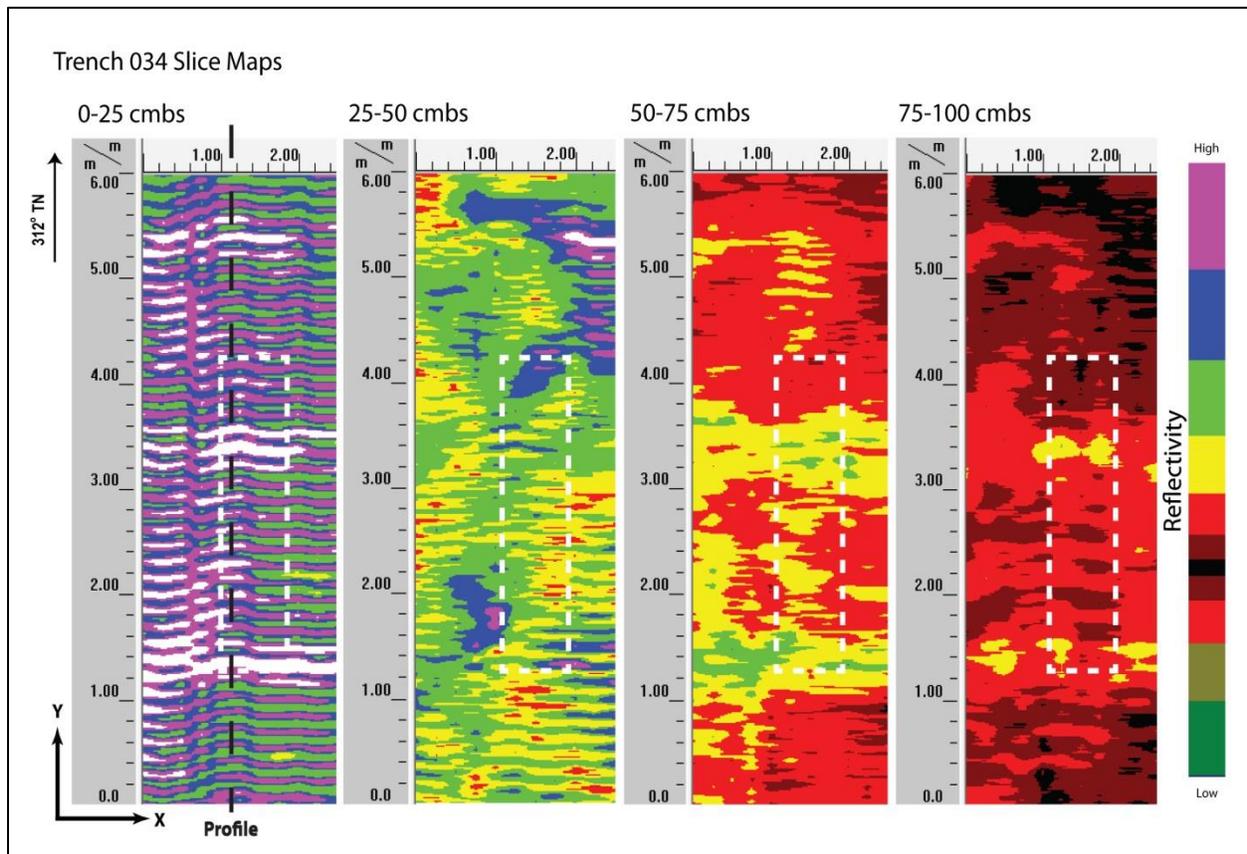


Figure 91. Slice maps of T-034 at 25cm depth intervals

A visual comparison of the excavated profile and the GPR signal profile showed a strong correlation in stratigraphic transitions (Figure 92). Strata Ia through II were clearly observed and occurred at the ground-truthed depths. Strata included a layer of concrete on top of gravelly silty clay loam fill and followed by a natural silty clay loam layer that continued to 1.5 mbs. This was well beyond the maximum depth of clean signal return. No discrete objects or other stratigraphic transitions were observed in the GPR results or subsequent excavation.

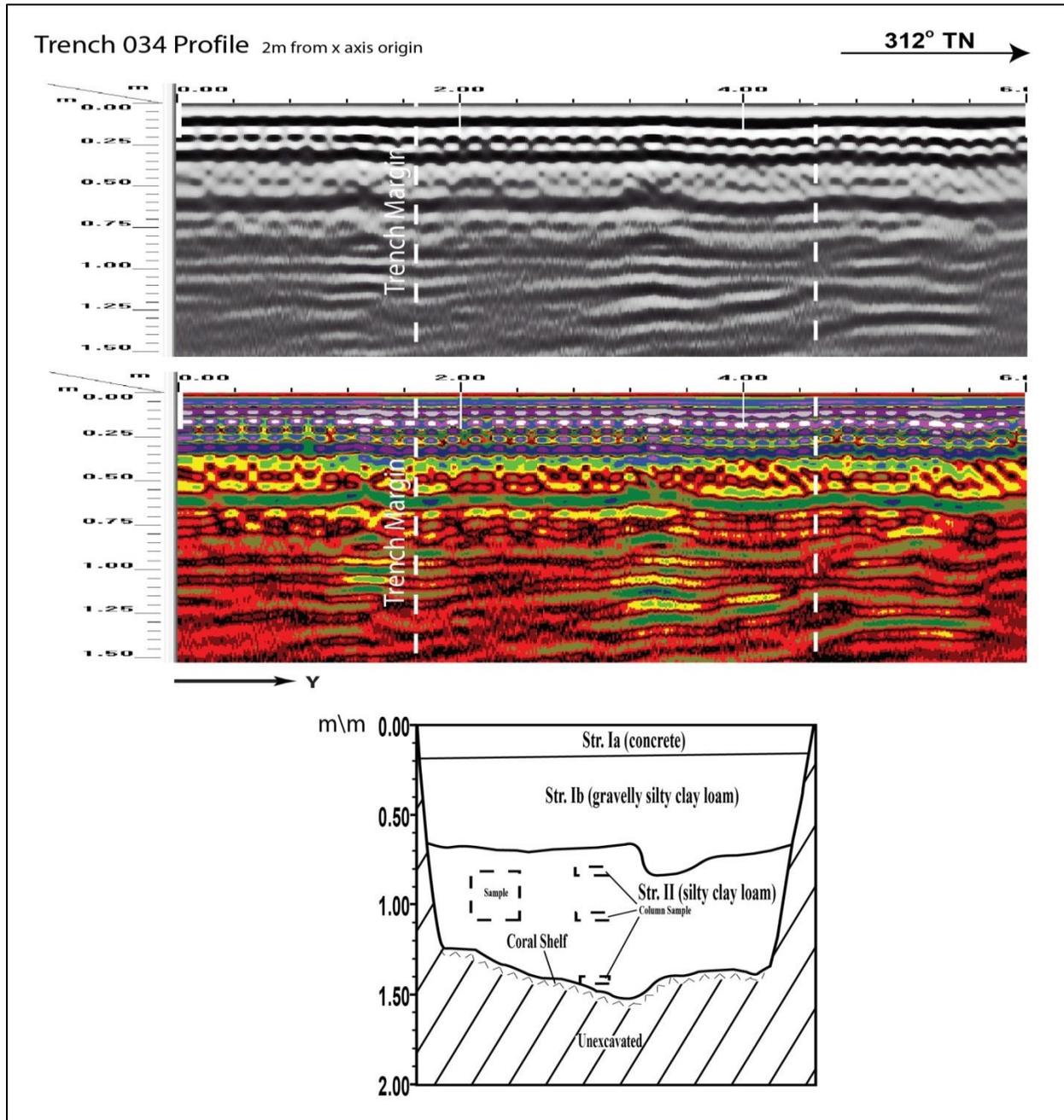


Figure 92. Visual comparison of excavated profile and GPR signal profile of T-034

### Test Excavation 35

T-035 measured 0.6 m by 6.0 m and was oriented northwest to southeast and located within the Dillingham Café parking lot, 51.0 m west of Dillingham Boulevard and Mokauea Street. The GPR grid measured 3.0 m by 8.0 m with 0.25 m spacing between Y transects and 1.0 m spacing between X transects. According to the PB CADD, there were no utilities within close proximity to the excavation location.

A review of amplitude slice maps indicated no linear features which might have indicated the presence of utilities. Reflectivity was relatively uniform throughout the grid and decreased with depth. A transition from higher reflectivity to lower reflectivity was observed at approximately 0.75 mbs (Figure 93).

GPR depth profiles for T-035 identified horizontal banding, commonly associated with stratigraphic layering, throughout the survey area (Figure 94). This banding corresponded to variations of density and chemical composition within fill deposits. The profile also indicated a change in reflectivity which occurred around 0.25 mbs. An anomaly was observed in the profile and could correspond to the basalt cobbles encountered during excavation. The maximum depth of clean signal return was approximately 0.75 mbs.

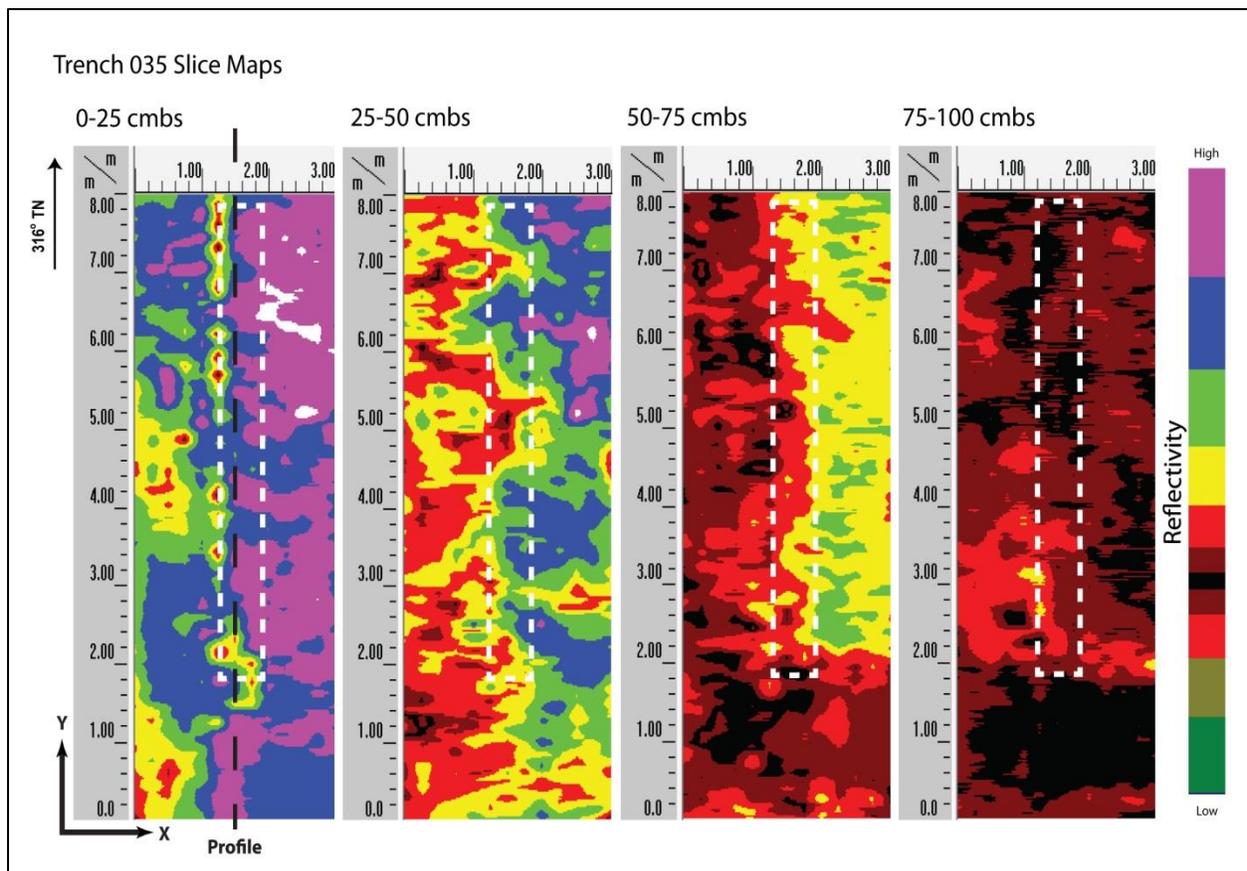


Figure 93. Slice maps of T-035 at 25cm depth intervals

A visual comparison of the excavated profile and the GPR signal profile showed a weak correlation in stratigraphic transitions (Figure 94). Strata included a layer of asphalt on top of a thin layer of very gravelly loam, followed by a thin layer of silty clay fill, then another thin layer of concrete, and then a natural silty clay loam that continued down to 1.4 mbs and stopped at the coral shelf. These transitions were not clearly depicted in the GPR profile at the depths that they occurred. There was an anomaly observed on the GPR profile that may correspond to the water rounded cobbles that were encountered. All other sediment transitions occurred below the maximum clean signal return depth. No other sediment transitions or discrete objects were observed in the GPR results.

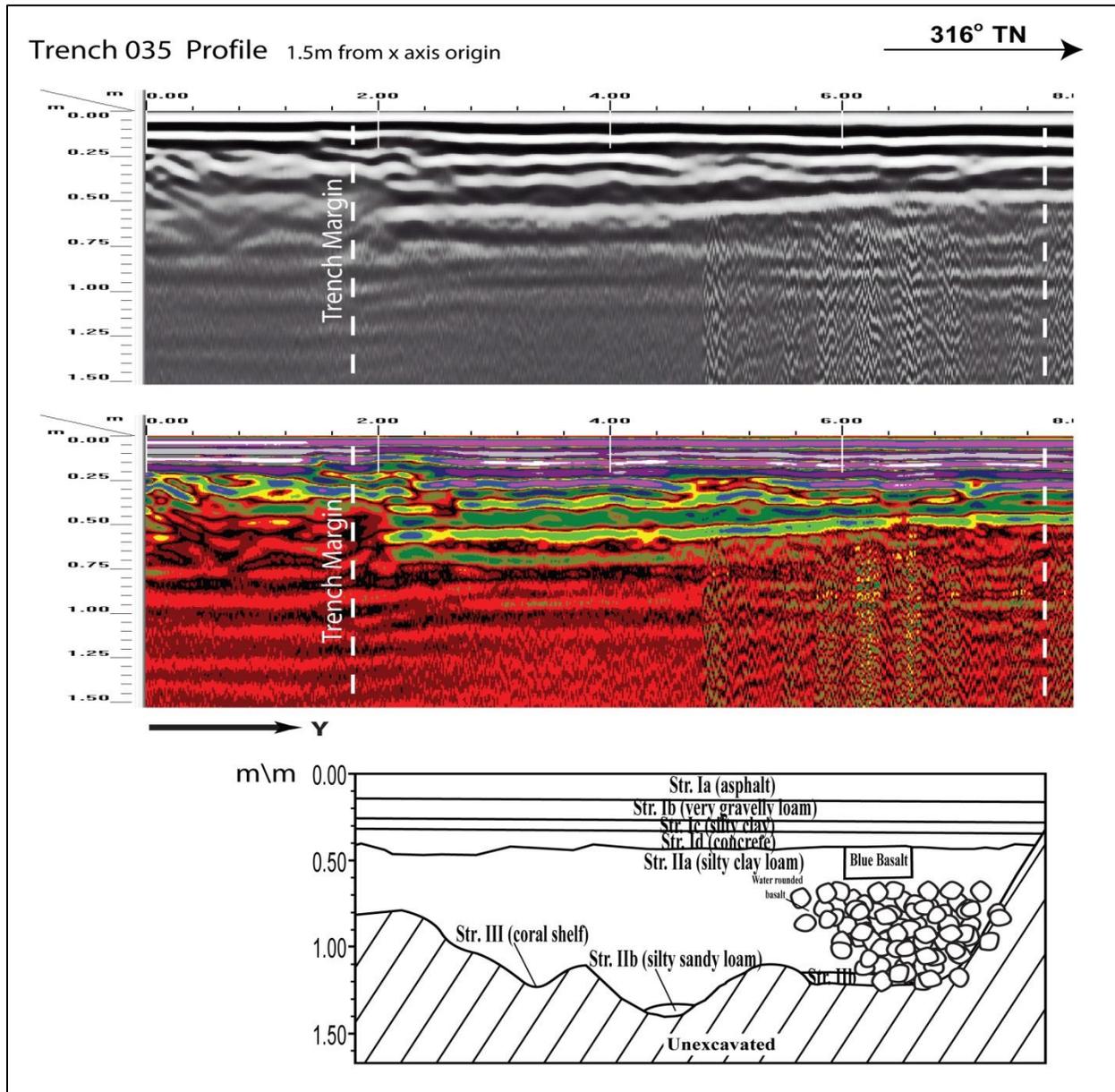


Figure 94. Visual comparison of excavated profile and GPR signal profile of T-035

### Test Excavation 36

T-036 measured 0.9 m by 3.0 m and oriented northeast to southwest and was located within the 7-11 parking lot, 30.0 m north of Dillingham Boulevard and Mokauea Street intersection. The GPR grid measured 3.0 m by 6.0 m with 0.25 m spacing between Y transects and 1.0 m spacing between X transects. According to the PB CADD, there were no utilities within close proximity to the excavation location. An abandoned lead utility pipe was encountered 0.53 mbs running parallel and through the center of the excavation.

A review of amplitude slice maps indicated a linear feature that corresponded to the lead utility pipe was encountered during excavation. Reflectivity was relatively uniform throughout the grid and decreased with depth except for the sidewalk. A transition from higher reflectivity to lower reflectivity was observed at approximately 0.5 mbs (Figure 95).

GPR depth profiles for T-036 identified horizontal banding, commonly associated with stratigraphic layering, throughout the survey area (Figure 96). This banding corresponded to variations of density and chemical composition within fill deposits. The profile also indicated a change in reflectivity which occurred around 0.4 mbs. No utilities were observed in the profile although an abandoned lead utility pipe was encountered during excavation. The maximum depth of clean signal return was approximately 0.8 mbs

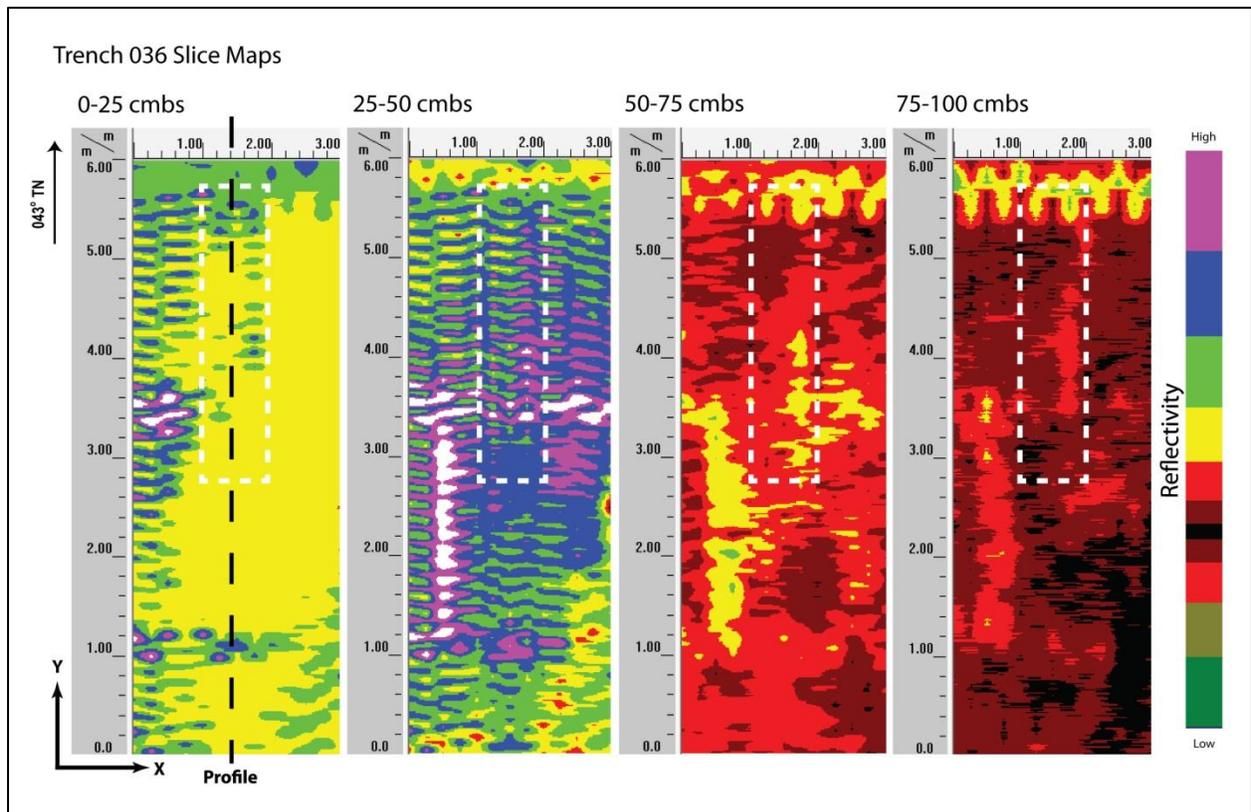


Figure 95. Slice maps of T-036 at 25cm depth intervals

A visual comparison of the excavated profile and the GPR signal profile showed a strong correlation in stratigraphic transitions (Figure 96). Strata Ia through II were clearly observed and occurred at the ground-truthed depths. Textural changes in the form of multiple small hyperbolas were apparent in Stratum Ib which was a very gravelly sandy clay loam fill layer. An abandoned utility pipe was located 0.53 mbs. This did not show up on the GPR profile but it was observable in the slices. No other discrete objects or other stratigraphic transitions were observed in the GPR results or subsequent excavation.

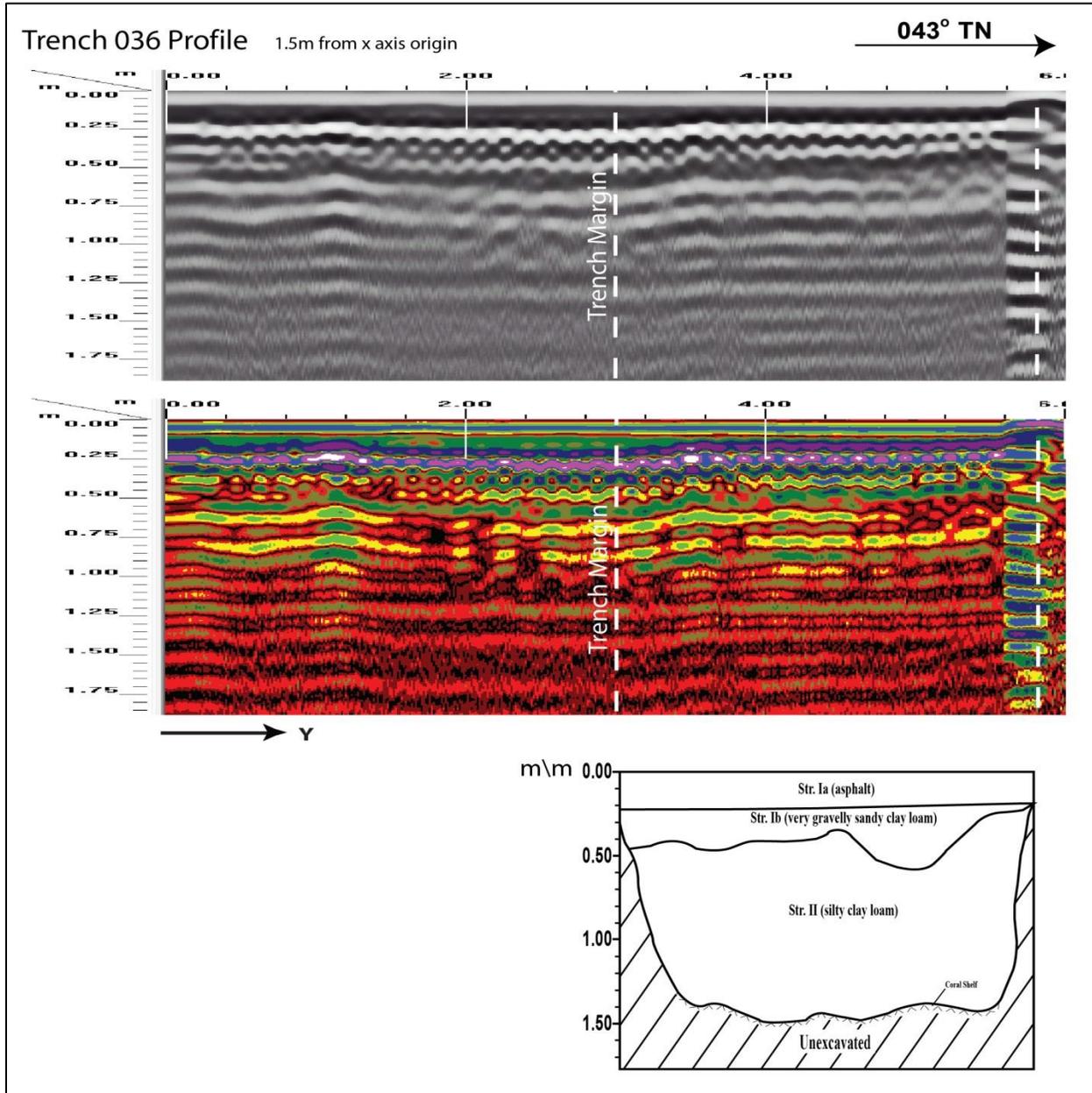


Figure 96. Visual comparison of excavated profile and GPR signal profile of T-036

### Test Excavation 37

T-037 measured 0.9 m by 3.0 m and was oriented northwest to southeast and was located within the 7-11, 33.0 m north of Dillingham Blvd and Mokauea Street. The GPR grid measured 2.5 m by 6 m with 0.25 m spacing between Y transects and 1.0 m spacing between X transects. According to PB CADD, there were no utilities within close proximity to the excavation location. An abandoned utility pipe was encountered 0.72 mbs on the northwestern end of excavation.

A review of amplitude slice maps indicated some linear features but were not within the excavation boundaries but a utility pipe was encountered during excavation. Reflectivity was relatively uniform throughout the grid and decreased with depth. A transition from higher reflectivity to lower reflectivity was observed at approximately 0.75 mbs (Figure 97).

GPR depth profiles for T-037 identified horizontal banding, commonly associated with stratigraphic layering, throughout the survey area (Figure 98). This banding corresponded to variations of density and chemical composition within fill deposits. The profile also indicated a change in reflectivity which occurred around 0.35 mbs. No utilities were observed in the profile although a utility was encountered during excavation. The maximum depth of clean signal return was approximately 0.8 mbs.

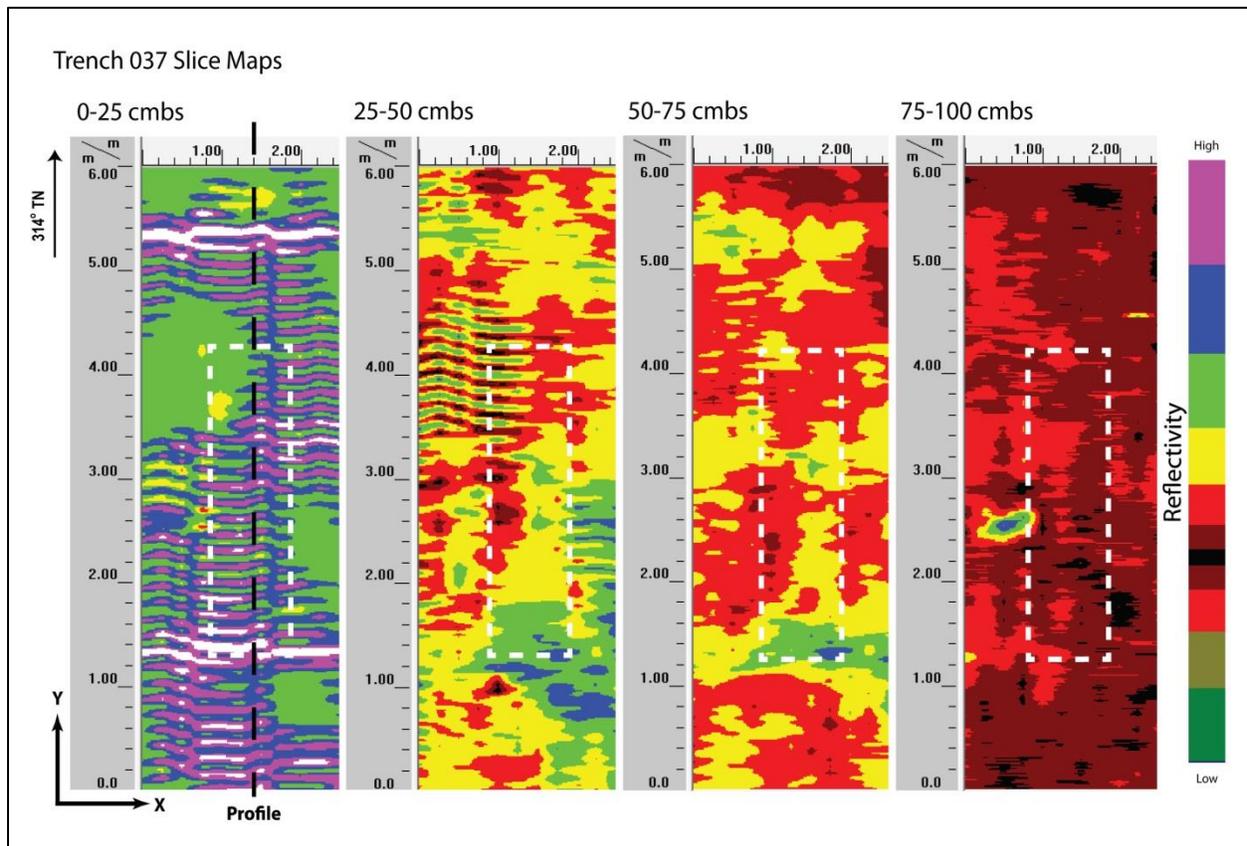


Figure 97. Slice maps of T-037 at 25cm depth intervals

A visual comparison of the excavated profile and the GPR signal profile showed a moderate correlation in stratigraphic transitions (Figure 98). Strata Ia to Ib were all clearly observed and occurred near the ground-truthed depths. The transition from Ib to II was not clearly depicted in the GPR profile at the depths that it occurred. A utility pipe was found 0.72 mbs. This pipe did not show up on the profile or slice maps and this might be due to the fact that the pipe was empty. No discrete objects or other stratigraphic transitions were observed in the GPR results or subsequent excavation.

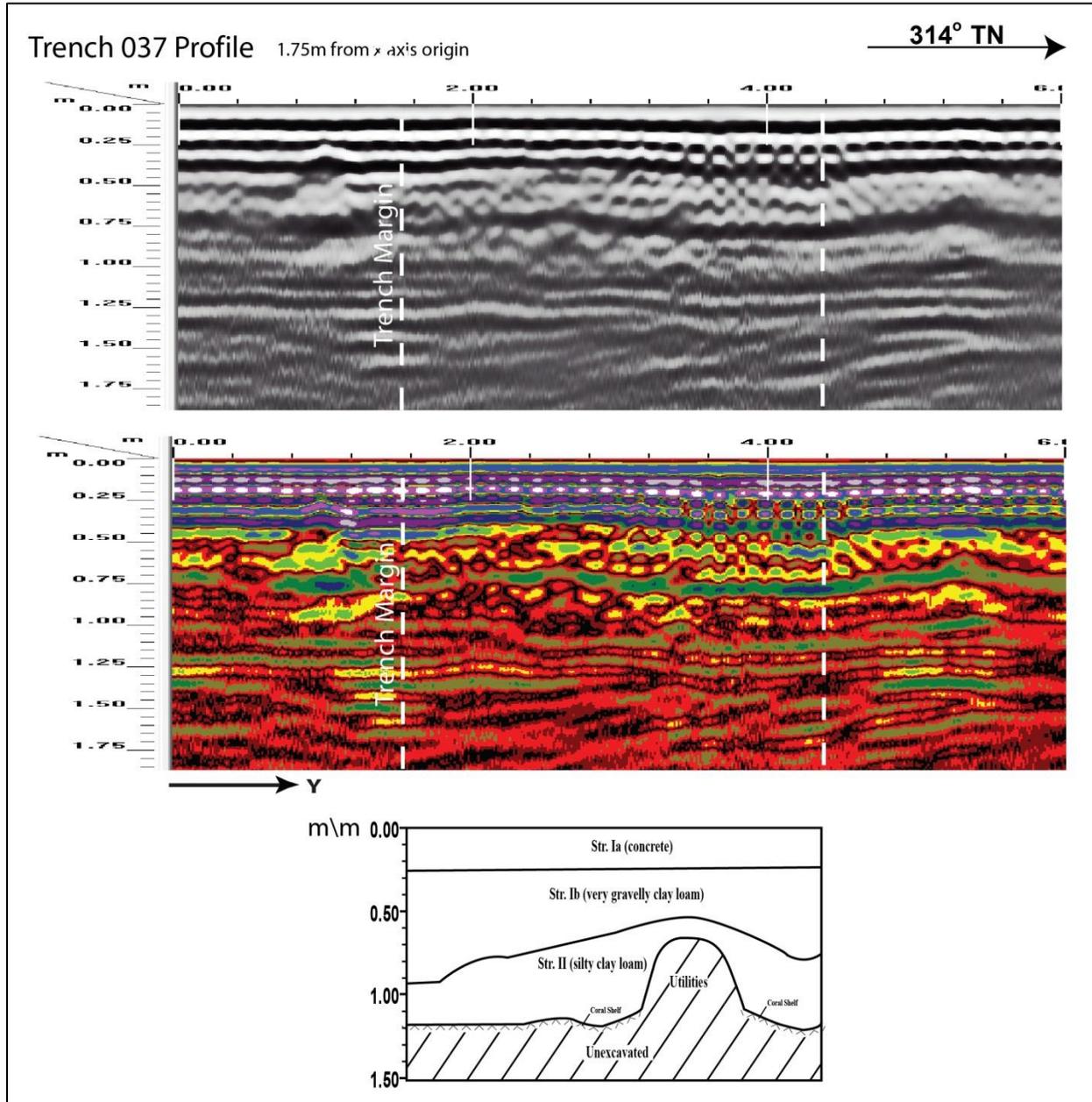


Figure 98. Visual comparison of excavated profile and GPR signal profile of T-037

### Test Excavation 38

T-038 measured 0.6 m by 6.0 m and was oriented northeast to southwest and was located within the parking lot of Dillingham Café, 36.0 m west of Dillingham Boulevard and Mokauea Street intersection, The GPR grid measured 3.0 m by 8.0 m with 0.25 m spacing between Y transects and 1.0 m spacing between X transects. There were no utilities within close proximity of the excavation. A concrete jacket was encountered 0.04 mbs and extended 3.6 m across the southwestern end and an abandoned utility pipe was encountered 0.75 mbs in the northeast end of the excavation.

A review of amplitude slice maps indicated no linear features although a concrete jacket and utility pipe were encountered during excavation. Reflectivity was relatively uniform throughout the grid and decreased with depth. A transition from higher reflectivity to lower reflectivity was observed at approximately 0.5 mbs (Figure 99).

GPR depth profiles for T-038 identified horizontal banding, commonly associated with stratigraphic layering, throughout the survey area (Figure 100). This banding corresponded to variations of density and chemical composition within fill deposits. The profile also indicated a change in reflectivity which occurred around 0.25 mbs and again around 0.5 mbs. An anomaly was observed in the profile and corresponded to the concrete jacket encountered during excavation. The maximum depth of clean signal return was approximately 0.75 mbs.

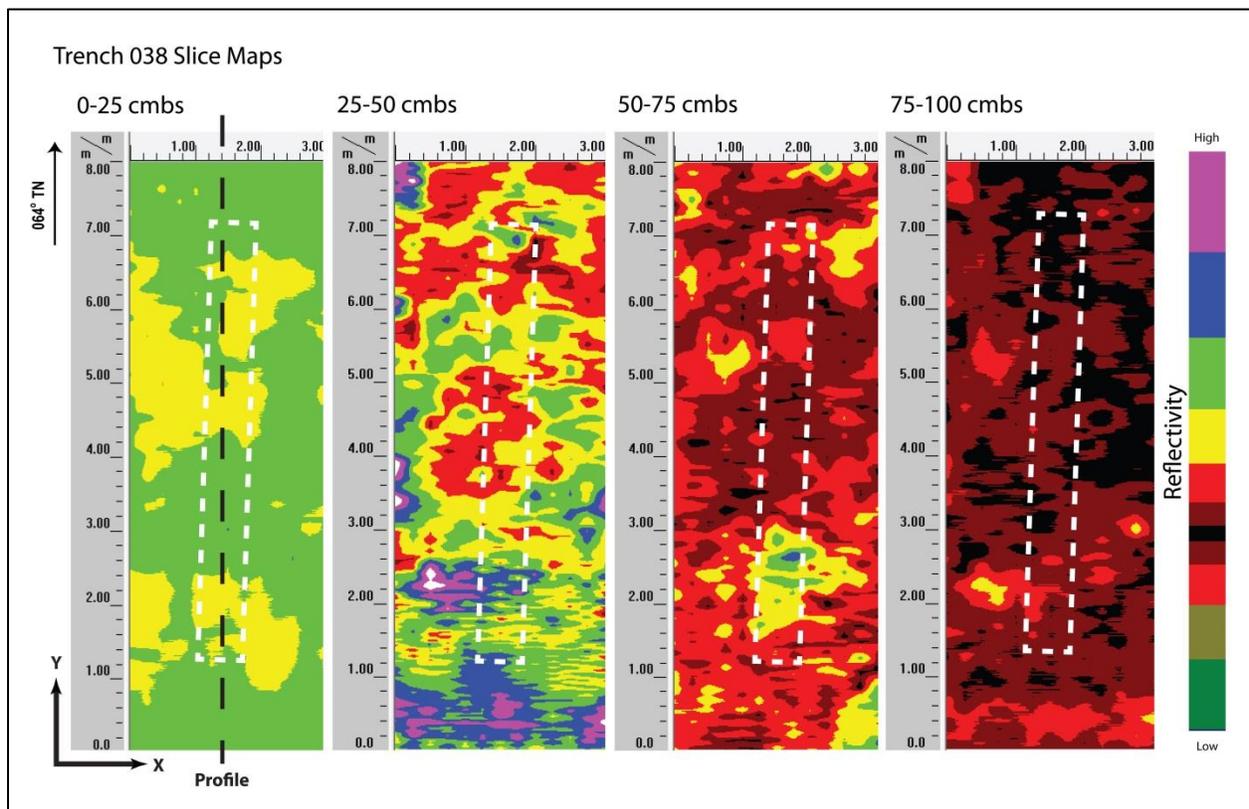


Figure 99. Slice maps of T-038 at 25cm depth intervals

A visual comparison of the excavated profile and the GPR signal profile showed a moderate correlation in stratigraphic transitions (Figure 100). Stratum Ia was clearly observed and occurs at the ground-truthed depths. Strata included a layer of asphalt on top of a silty clay loam fill, followed by very gravelly silty loam, gravelly silty loam, very gravelly sandy loam, silty clay loam, silty sandy loam and then the coral shelf. These transitions were not clearly depicted in the GPR profile. An increase in reflectivity was observed around 0.15 mbs and represents the utility jacket that was encountered. A utility pipe was found 0.75 mbs. The pipe did not show up on the profile possibly due to the fact that it was at the maximum depth of the clean signal return. The pipe was also empty and very small which could contribute to the fact that it was not observed in the profile. No other discrete objects or other stratigraphic transitions were observed in the GPR results.

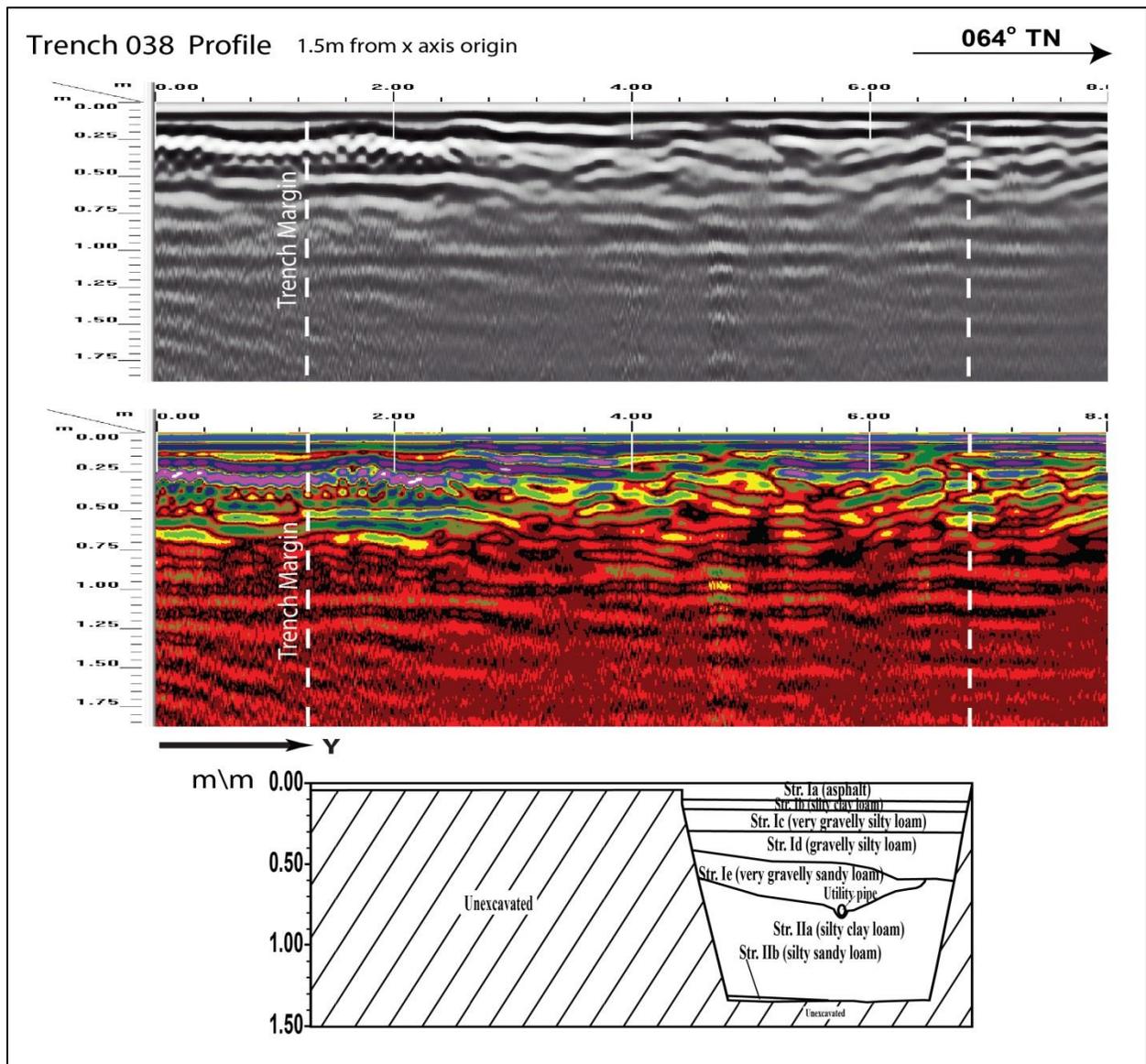


Figure 100. Visual comparison of excavated profile and GPR signal profile of T-038

### Test Excavation 39

T-039 measured 0.6 m by 6.0 m and was oriented northeast to southwest and located within the parking lot of Dillingham Café, 35.0 m west of Dillingham Boulevard and Mokauea Street intersection. The GPR grid measured 3.0 m by 8.0 m with 0.25 m spacing between Y transects and 1.0 m transects between X transects. According to PB CADD, there were no utilities within close proximity to the excavation location. No utilities transected the GPR grid or excavation location. Two utilities were encountered: 0.4 mbs on the southwest end and 0.99 mbs on the northeast end of the excavation.

A review of amplitude slice maps indicated no linear features although two utilities were encountered during excavation. Reflectivity was relatively uniform throughout the grid and decreased with depth. A transition from higher reflectivity to lower reflectivity was observed at approximately 0.5 mbs (Figure 101).

GPR depth profiles for T-039 identified horizontal banding, commonly associated with stratigraphic layering, throughout the survey area (Figure 102). This banding corresponded to variations of density and chemical composition within fill deposits. The profile also indicated a change in reflectivity which occurred around 0.15 mbs and again around 0.5 mbs. Anomalies were observed in the profile and correspond to the utilities encountered during excavation. The maximum depth of clean signal return was approximately 0.85 mbs.

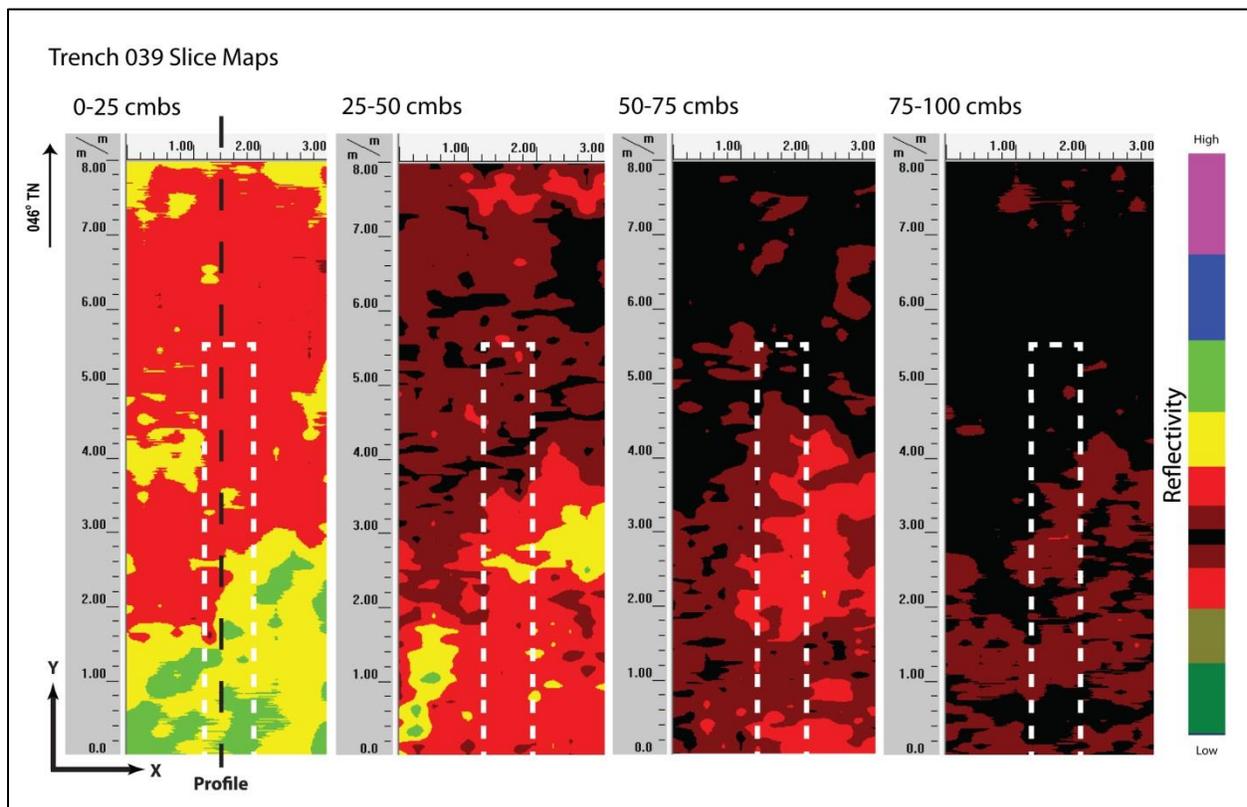


Figure 101. Slice maps of T-039 at 25cm depth intervals

A visual comparison of the excavated profile and the GPR signal profile showed a moderate correlation in stratigraphic transitions (Figure 102). Strata included a layer of asphalt on top of several thin layers of a very gravelly sandy loam fill, a silty clay loamfill, a gravelly to cobbly sand fill and then a natural silty clay loam. Strata Ia was observed in the GPR profile but strata Ib through Id were not individually discernible, possibly due to the fact that they were very thin layers of compacted fill. Stratum IIa was apparent due to some horizontal banding at the transition from Id to IIa. All other sediment transitions were below the maximum depth of clean signal return. Two voids were apparent in the profile and correspond to utilities that were found during excavation. No other discrete objects were observed in the GPR results or subsequent excavation.

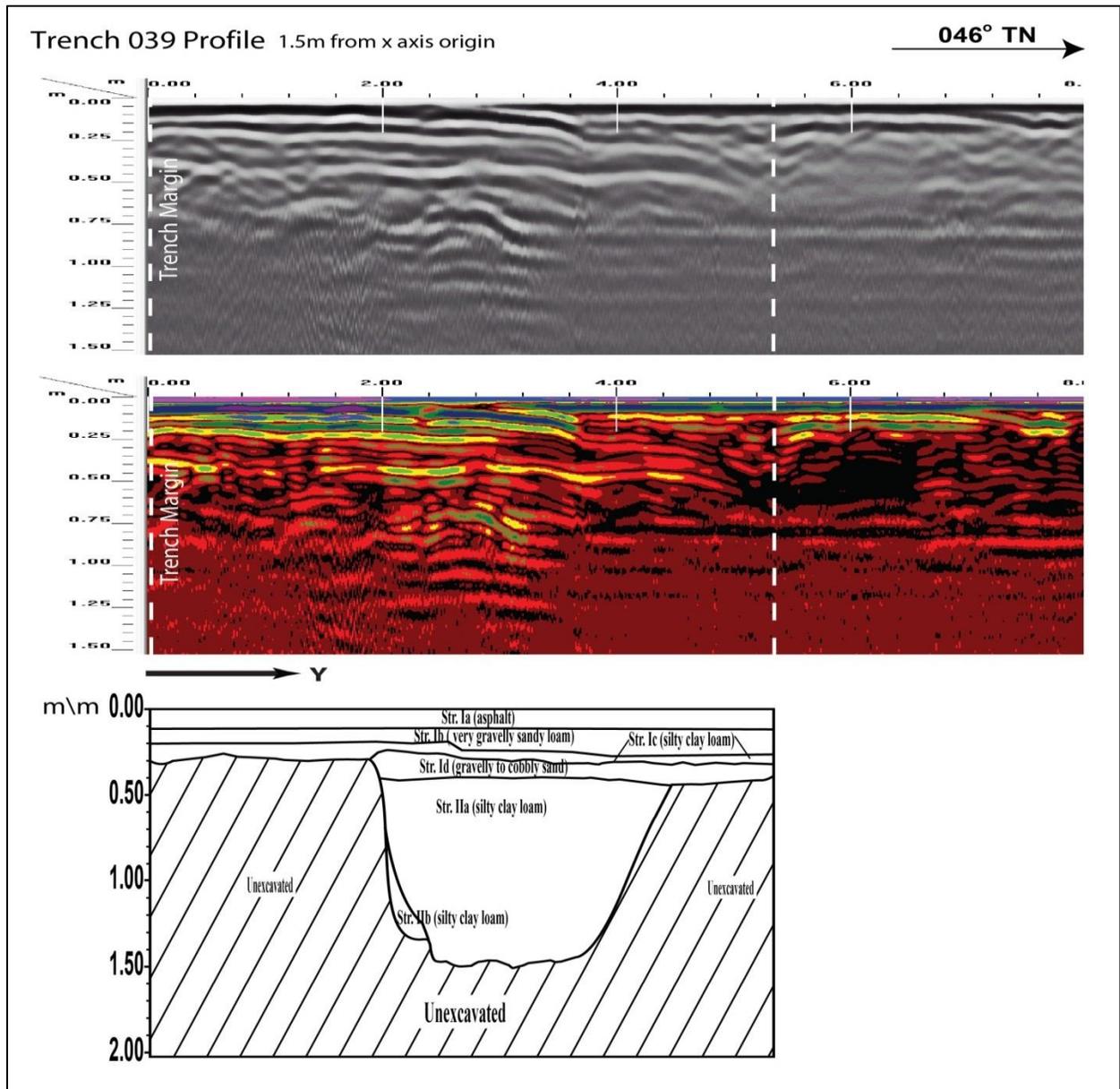


Figure 102. Visual comparison of excavated profile and GPR signal profile of T-039

### Test Excavation 40

T-040 measured 0.9 m by 3.0 m and was oriented east to west and was located within the parking lot of the 7-11, 30.0 m north of Dillingham Boulevard and Mokauea Street intersection. The GPR grid measured 3.0 m by 5.0 m with 0.25 m spacing between Y transects and 1.0 m spacing between Y transects. Utilities located near the excavation include an electric cable 11.0 m to the east. A concrete jacket was encountered 0.4 mbs on the western end of the excavation.

A review of amplitude slice maps indicated no linear features although a concrete jacket was encountered during excavation. Reflectivity was relatively uniform throughout the grid and decreased with depth. A transition from higher reflectivity to lower reflectivity was observed at approximately 0.25mbs (Figure 103).

GPR depth profiles for T-040 identified horizontal banding, commonly associated with stratigraphic layering, throughout the survey area (Figure 104). This banding corresponded to variations of density and chemical composition within fill deposits. The profile also indicated a change in reflectivity which occurred around 0.2 mbs. No utilities were observed in the profile although a concrete jacket was encountered during excavation. The maximum depth of clean signal return was approximately 1.0 mbs.

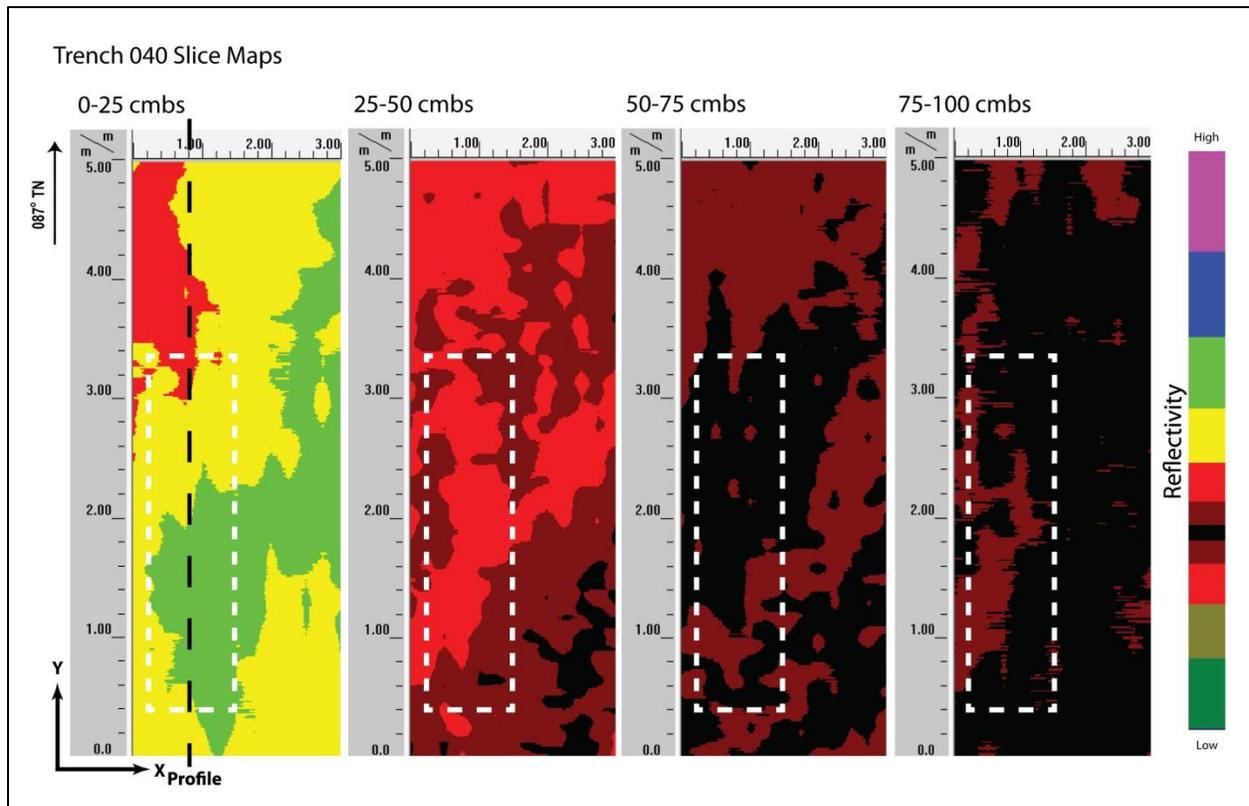


Figure 103. Slice maps of T-040 at 25cm depth intervals

A visual comparison of the excavated profile and the GPR signal profile showed a weak correlation in stratigraphic transitions (Figure 104). Strata included a thin layer of asphalt on top of a gravelly clay loam fill followed by a natural silty clay loam. These transitions were not clearly depicted in the GPR profile at the depths that they occurred. A utility jacket was located at about 0.4 mbs. This utility jacket did not show up on the profile or slice maps. No other discrete objects or other stratigraphic transitions were observed in the GPR results or subsequent excavation.

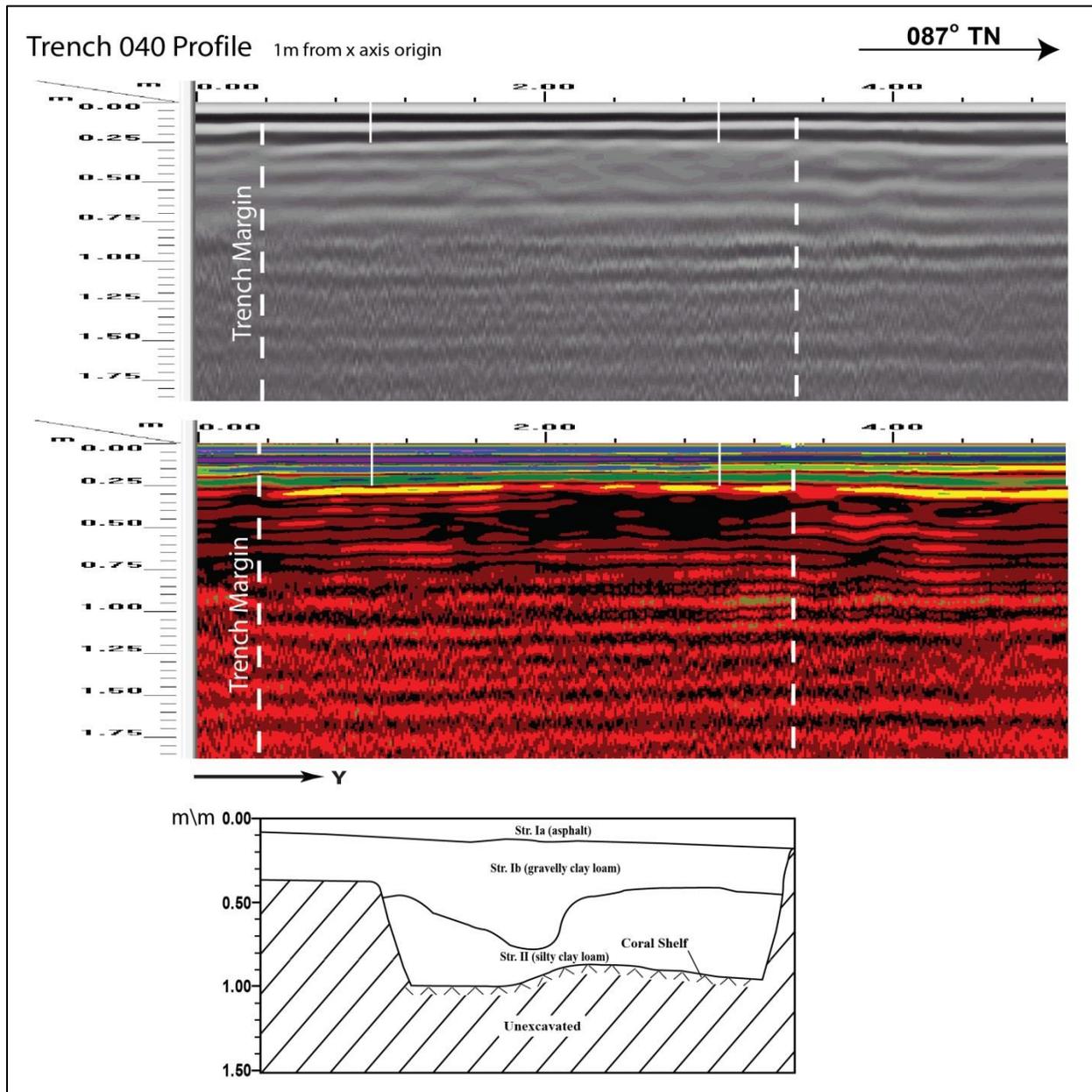


Figure 104. Visual comparison of excavated profile and GPR signal profile of T-040

## Test Excavation 41

T-041 measured 0.9 m by 3.0 m and was oriented northwest to southeast and was located within the road cut of Dillingham Boulevard in the center lane, 15.0 m northwest of Dillingham Boulevard and Mokauea Street intersection. The GPR grid measured 3.0 m by 8.5 m with 0.25 m spacing between Y transects and 1.0 m spacing between X transects. Utilities located near the excavation include: waterline 2.5 m northeast and an electrical line 3.7 m southwest. No utilities transected the GPR grid or excavation location

A review of amplitude slice maps indicated a linear feature but was not encountered during excavation. Reflectivity was relatively uniform throughout the grid and decreased with depth. A transition from higher reflectivity to lower reflectivity was observed at approximately 0.75 mbs (Figure 105).

GPR depth profiles for T-041 identified horizontal banding, commonly associated with stratigraphic layering, throughout the survey area (Figure 106). This banding corresponded to variations of density and chemical composition within fill deposits. The profile also indicated a change in reflectivity which occurred around 0.25 mbs. An anomaly was observed in the profile but was not encountered during excavation. The maximum depth of clean signal return was approximately 1.0 mbs.

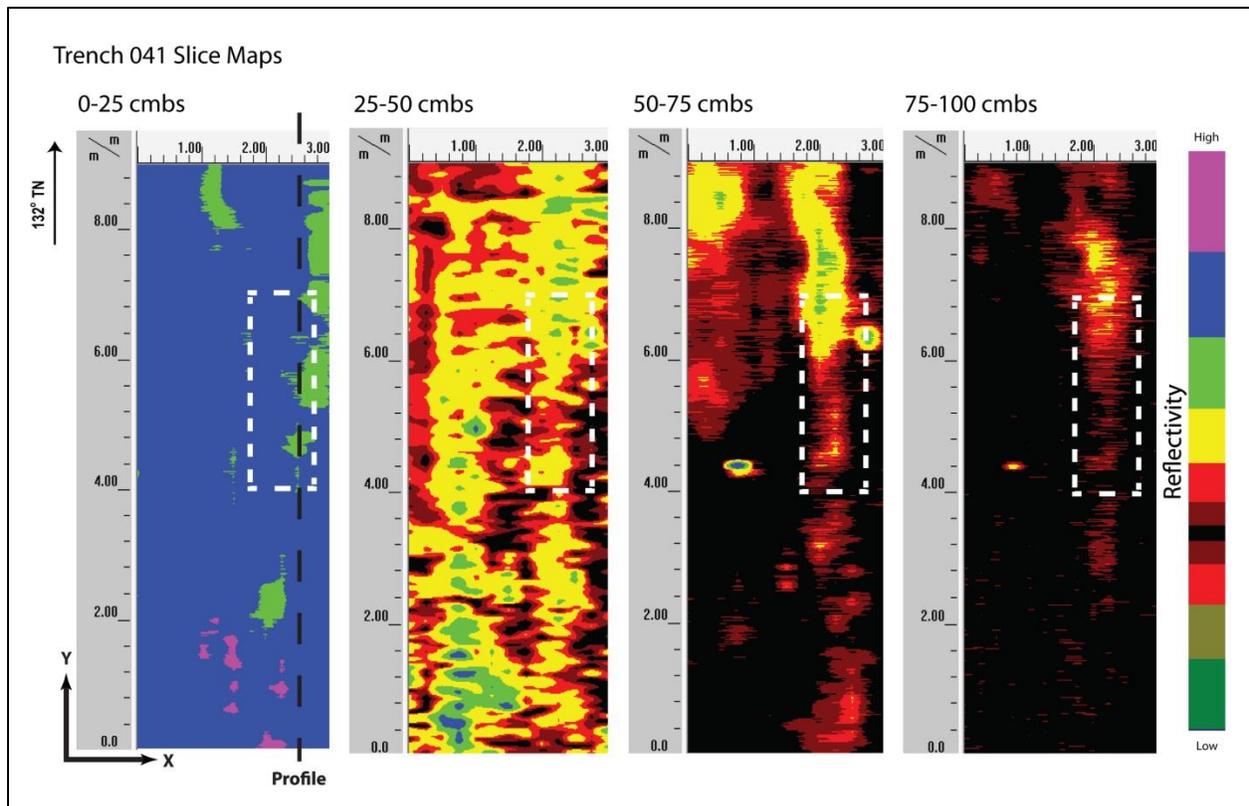


Figure 105. Slice maps of T-041 at 25cm depth intervals

A visual comparison of the excavated profile and the GPR signal profile showed a strong correlation in stratigraphic transitions (Figure 106). Strata Ia through III were clearly observed and occurred at the ground-truthed depths. Textural changes in the form of multiple small hyperbolas were apparent in Stratum Ib which was extremely gravelly sand. An increase in reflectivity was observed around 0.35 and could represent a large piece of coral within Stratum Ib. No discrete objects or other stratigraphic transitions were observed in the GPR results or subsequent excavation.

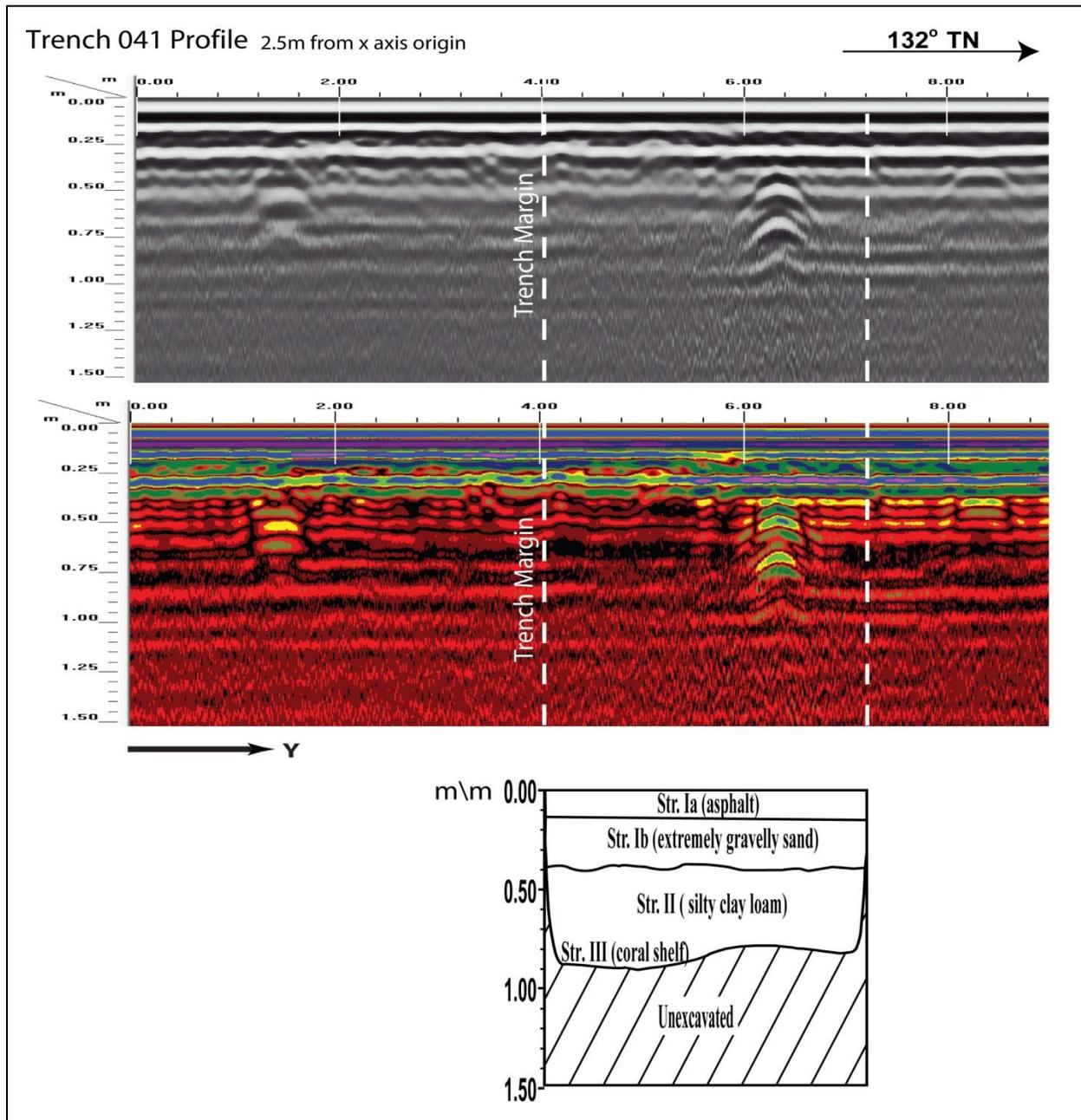


Figure 106. Visual comparison of excavated profile and GPR signal profile of T-041

## Test Excavation 42

T-042 measured 0.6 m by 6.0 m and was oriented northeast to southwest and was located within the parking lot of Dillingham Café, 30.0 m west of Dillingham Boulevard and Mokauea Street intersection. The GPR grid measured 3.0 m by 8.0 m with 0.25 m spacing between Y transects and 1.0 m spacing between X transects. Utilities located near the excavation include a sewer line 12.8 m northeast. No utilities transected the GPR grid or excavation location. Several utilities were encountered during excavation: 3 metal pipes 50 mbs and a concrete jacket 0.41 mbs on the southwestern end and steel pipe 0.93 mbs and copper pipe 1.0 mbs on the northeastern end of the excavation.

A review of amplitude slice maps indicated a linear which could correspond to the metal pipes and concrete jacket encountered in the southwestern end of the excavation. Reflectivity was relatively uniform throughout the grid and decreased with depth. A transition from higher reflectivity to lower reflectivity was observed at approximately 0.5 mbs (Figure 107).

GPR depth profiles for T-042 identified horizontal banding, commonly associated with stratigraphic layering, throughout the survey area (Figure 108). This banding corresponded to variations of density and chemical composition within fill deposits. The profile also indicated a change in reflectivity which occurred around 0.15 mbs and again around 0.8 mbs. Two anomalies were observed in the profile and correspond to the utilities encountered in the southwest and northeast ends of the excavation. The maximum depth of clean signal return was approximately 1.15 mbs.

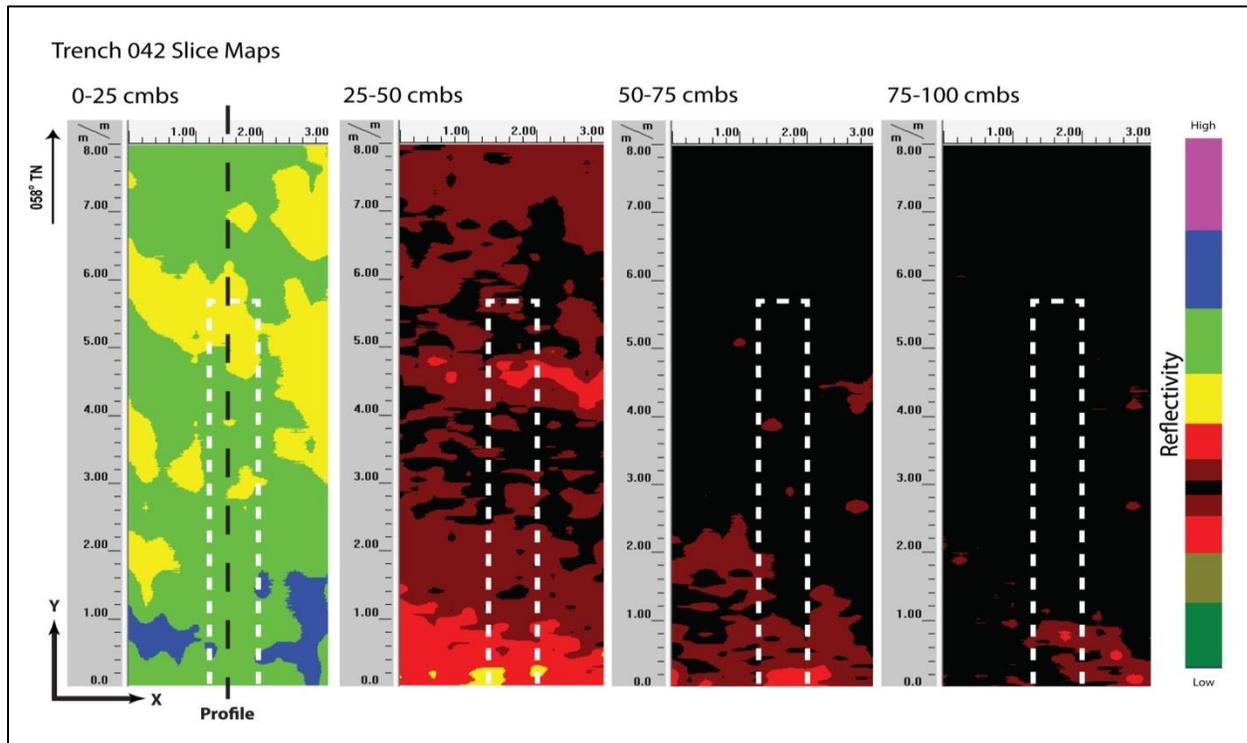


Figure 107. Slice maps of T-042 at 25cm depth intervals

A visual comparison of the excavated profile and the GPR signal profile showed a moderate correlation in stratigraphic transitions (Figure 108). Strata Ia and Ic were clearly observed and occurred at the ground-truthed depths. The transition to Stratum Id was not discernible in the GPR profile. Two voids on either end of the excavation correspond to the utility jacket and a utility pit found during excavation. No other discrete objects or other stratigraphic transitions were observed in the GPR results.

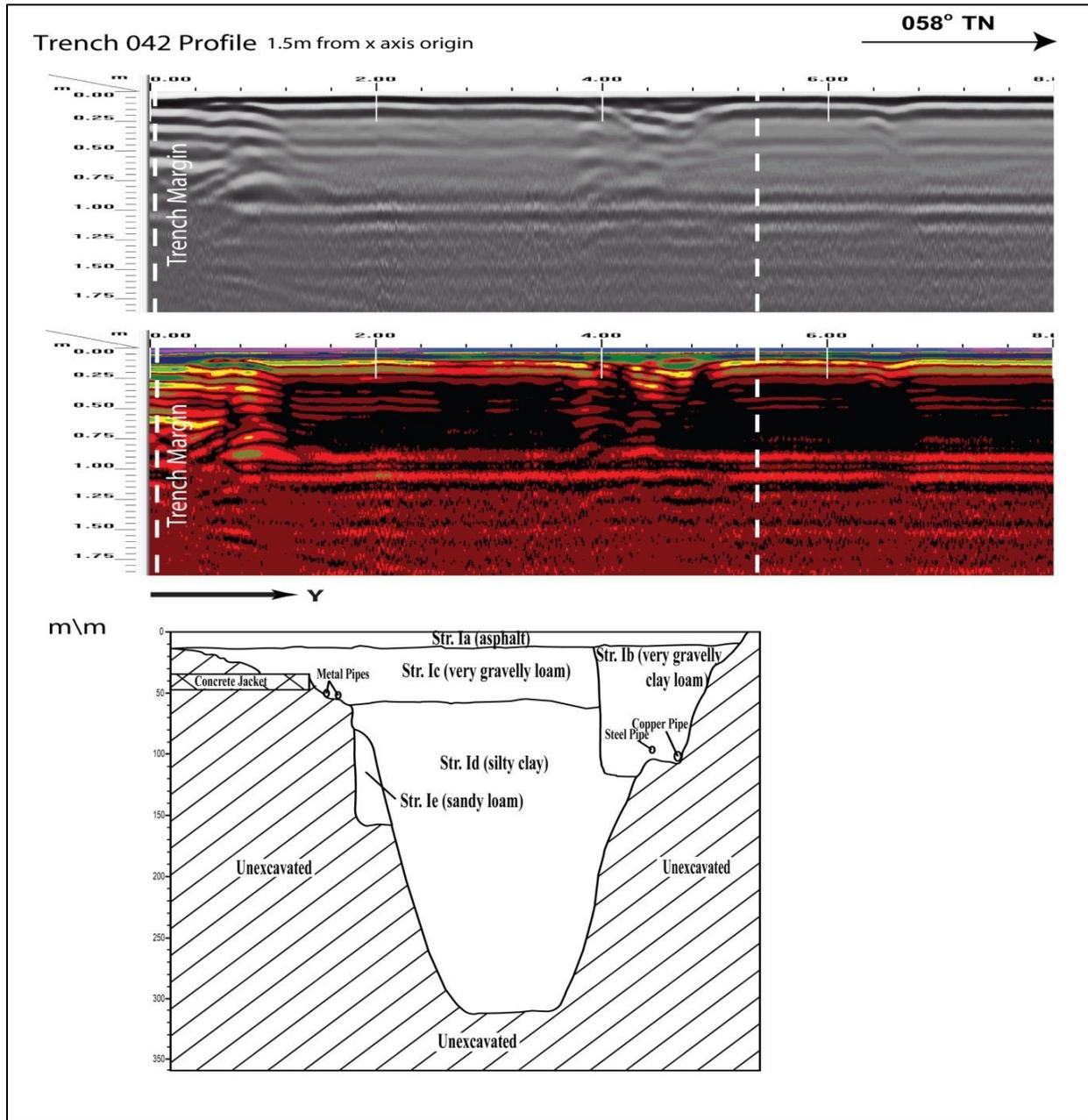


Figure 108. Visual comparison of excavated profile and GPR signal profile of T-042

### Test Excavation 43

T-043 measured 0.9 m by 3.0 m and was oriented northwest to southeast and was located within the road cut of Dillingham Boulevard, 24.0 m southeast of Dillingham Boulevard and Mokauea Street intersection. The GPR grid measured 6.0 m by 3.0 m with 0.25 m spacing between Y transects and 1.0 m spacing between X transects. Utilities located near the excavation include: water line 4.2 m northeast, gas line 4.3 m northeast. No utilities transected the GPR grid or excavation location.

A review of amplitude slice maps indicated no linear features which might have indicated the presence of utilities. Reflectivity was relatively uniform throughout the grid and decreased with depth. A transition from higher reflectivity to lower reflectivity was observed at approximately 0.25 mbs (Figure 109).

GPR depth profiles for T-043 identified horizontal banding, commonly associated with stratigraphic layering, throughout the survey area (Figure 110). This banding corresponded to variations of density and chemical composition within fill deposits. The profile also indicated a change in reflectivity which occurred around 0.4 mbs. No utilities were observed in the profile. The maximum depth of clean signal return was approximately 0.9 mbs.

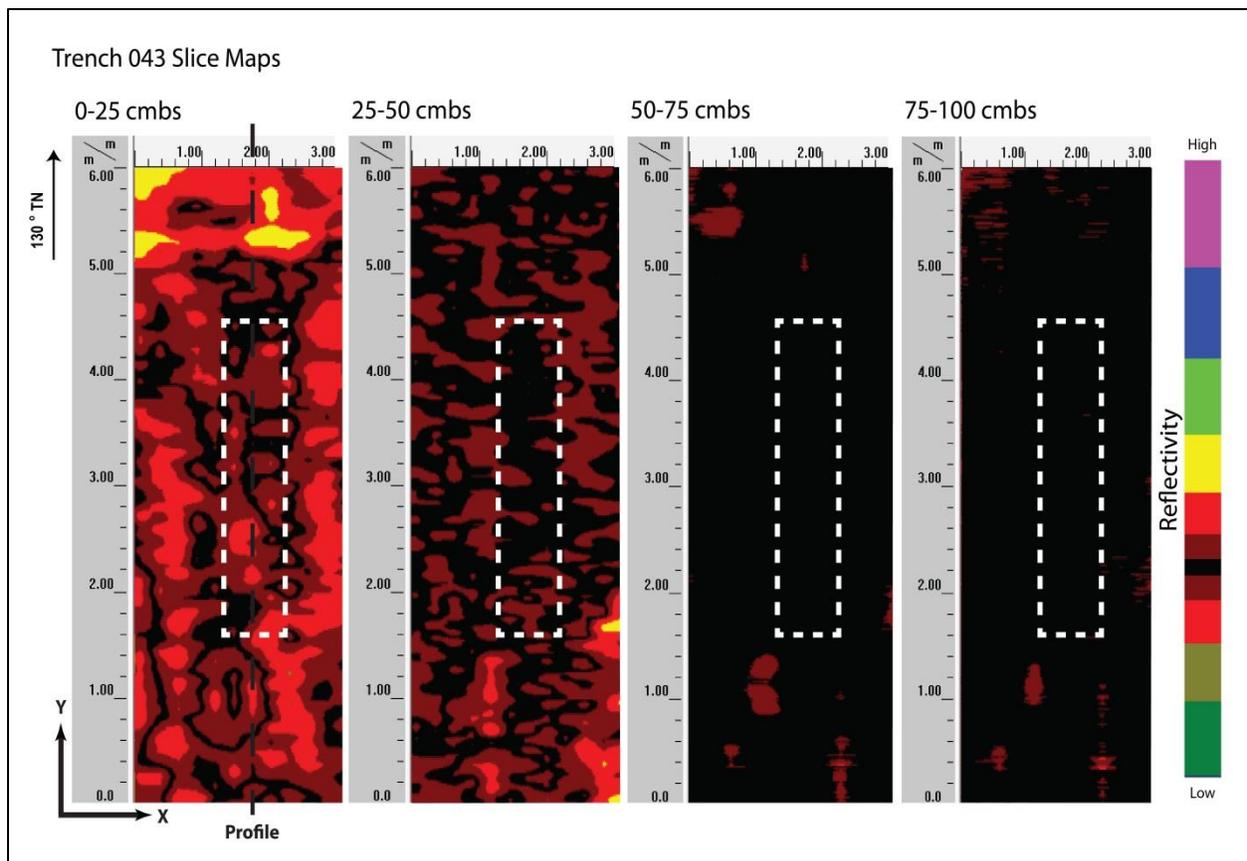


Figure 109. Slice maps of T-043 at 25cm depth intervals

A visual comparison of the excavated profile and the GPR signal profile showed a strong correlation in stratigraphic transitions (Figure 110). Strata Ia to II were all clearly observed and occurred near the ground-truthed depths. Textural changes in the form of multiple small hyperbolas were apparent in Stratum Ib which was extremely gravelly sand. All other sediment transitions were below the maximum clean signal return. No discrete objects were observed in the GPR results or subsequent excavation.

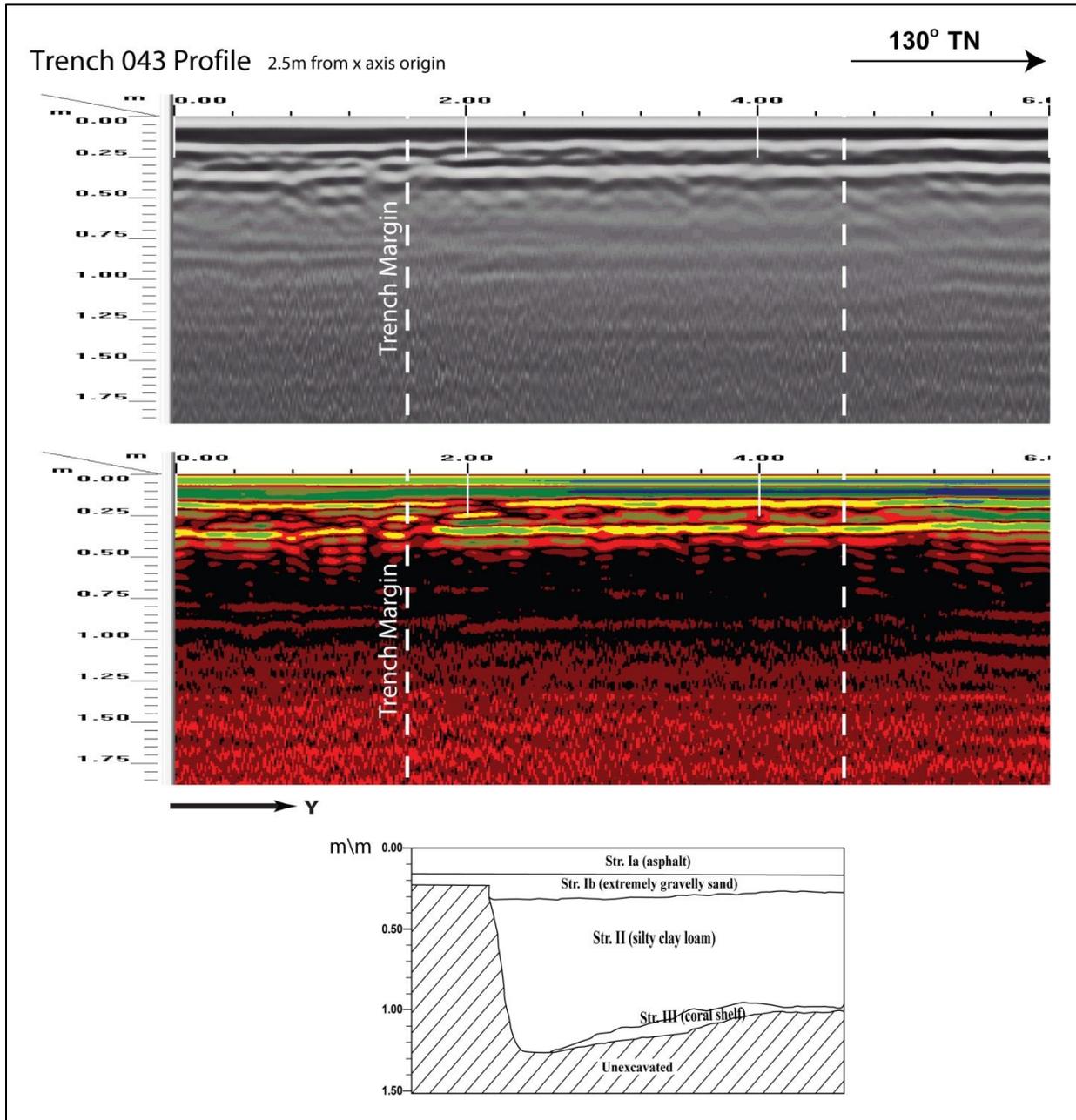


Figure 110. Visual comparison of excavated profile and GPR signal profile of T-043

### Test Excavation 44

T-044 measured 0.9 m by 3.0 m and was oriented northwest to southeast and was located within a parking lot, 4.2 m southwest of Dillingham Boulevard, between Kalihi Street and Mokauea Street intersection. The GPR grid measured 3.0 m by 6.0 m with 0.25 m spacing between Y transects and 1.0 m spacing between X transects. Utilities located near the excavation include: electrical line 1.4 m northeast and 3.5 m south, sewer line 1.5 m northeast. Two water lines were encountered 0.03 mbs one within the center and the other on the southeastern end of the excavation.

A review of amplitude slice maps indicated two linear features that may correspond to the utilities encountered during excavation. Reflectivity was relatively uniform throughout the grid and decreased with depth. A transition from higher reflectivity to lower reflectivity was observed at approximately 0.25 mbs and increases again around 0.5 mbs (Figure 111).

GPR depth profiles for T-044 identified horizontal banding, commonly associated with stratigraphic layering, throughout the survey area (Figure 112). This banding corresponded to variations of density and chemical composition within fill deposits. The profile also indicated a change in reflectivity which occurred around 0.25 mbs. Several anomalies were observed in the profile and these correspond to the utilities encountered during excavation. The maximum depth of clean signal return was approximately 1.0 mbs.

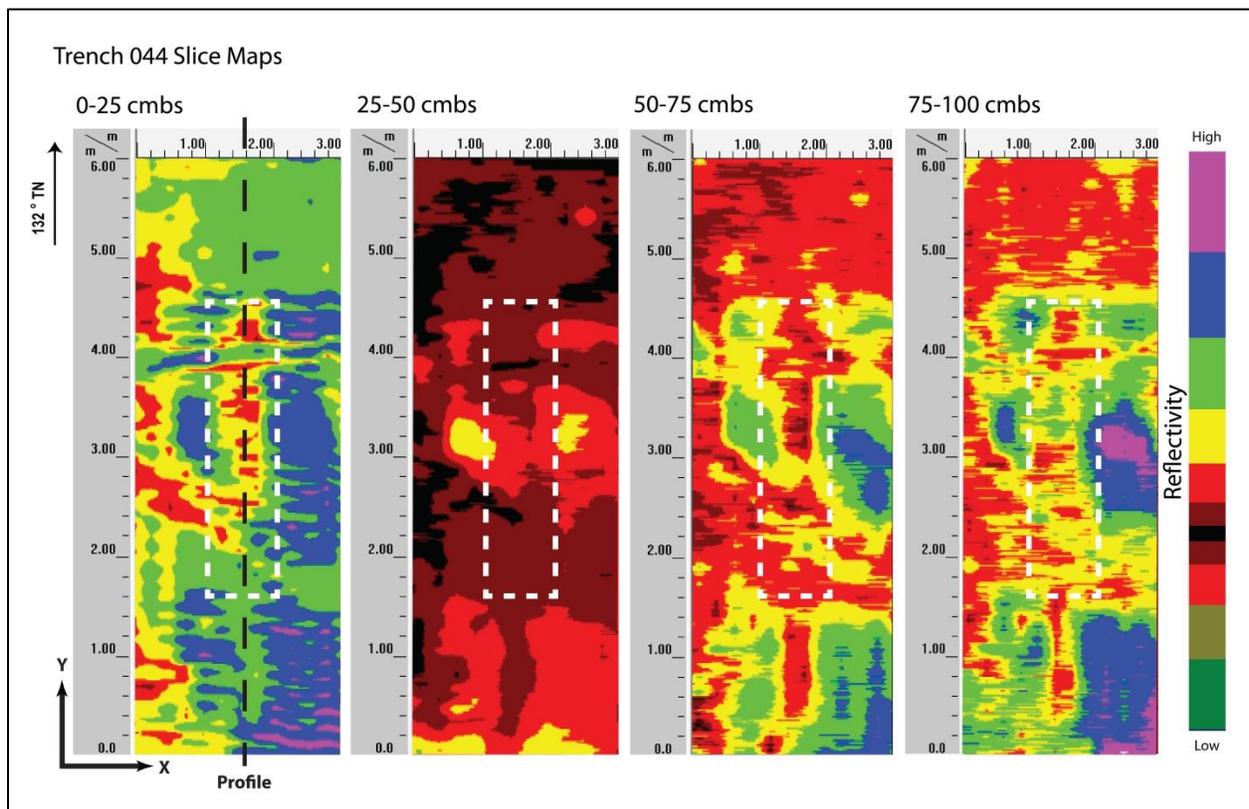


Figure 111. Slice maps of T-044 at 25cm depth intervals

A visual comparison of the excavated profile and the GPR signal profile showed a weak correlation in stratigraphic transitions (Figure 112). Strata included a thin layer of asphalt on top of a gravelly sandy clay loam fill followed by a natural silty clay loam layer down to 1.7 mbs. These transitions were not clearly depicted in the GPR profile at the depths that they occurred. Two water pipes were encountered 0.03 mbs. These pipes could correspond to anomalies observed in the profile. No other sediment transitions or discrete objects were observed in the GPR results or subsequent excavation.

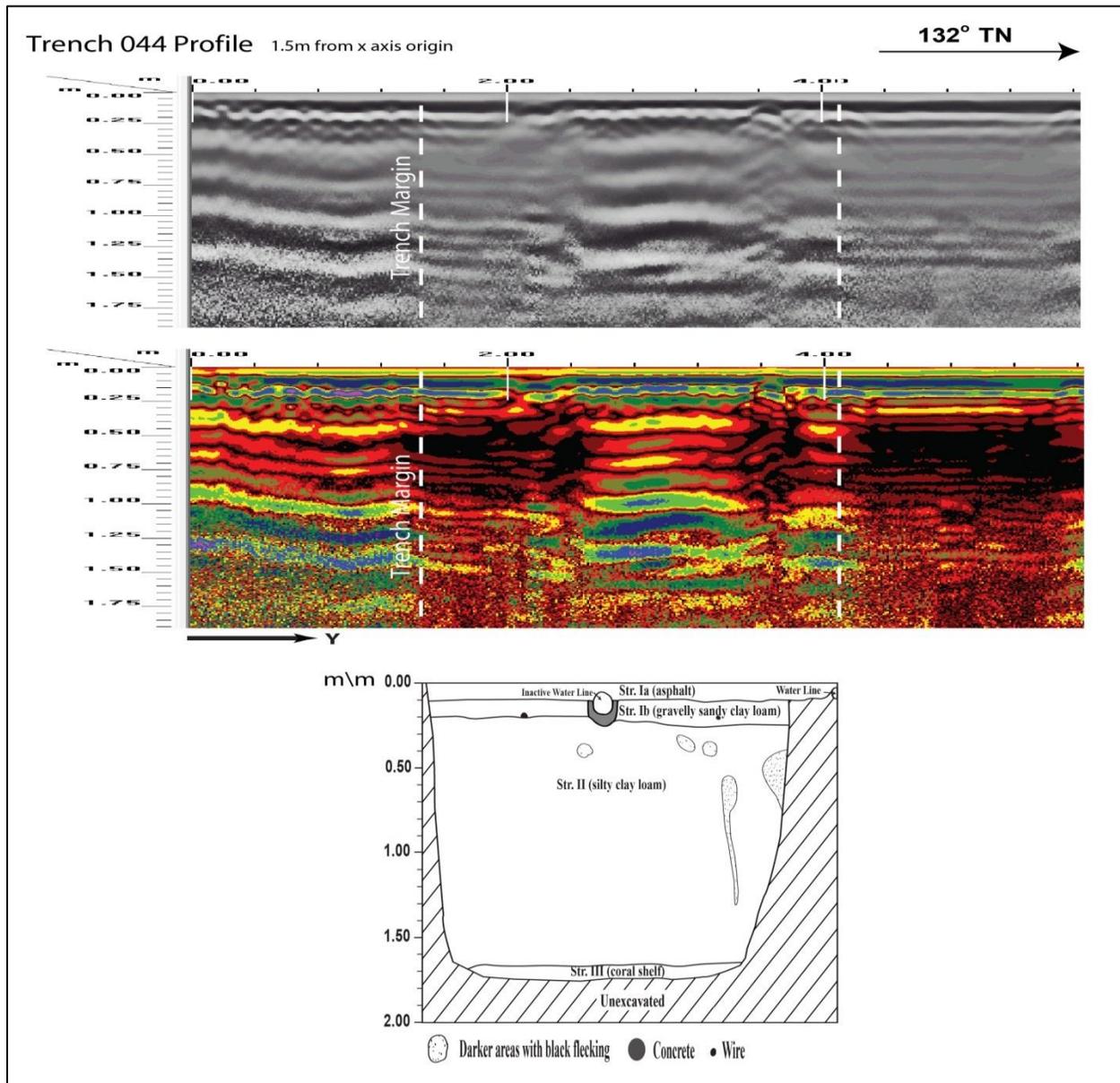


Figure 112. Visual comparison of excavated profile and GPR signal profile of T-044

### Test Excavation 45

T-045 measured 0.9 m by 3.0 m and was oriented northwest to southeast and was located within the road cut of Dillingham Boulevard, 110.0 m northwest of Dillingham Boulevard and Kalihi Street intersection. The GPR grid measured 2.0 m by 6.0 m with 0.25 m spacing between Y transects and 1.0 m spacing between X transects. Utilities located near the excavation include: water line 3.3 m northeast, gas line 5.2 m northeast, and electrical line 6.0 m southeast. No utilities transected the GPR grid or excavation location.

A review of amplitude slice maps indicated no linear features which might have indicated the presence of utilities. Reflectivity was relatively uniform throughout the grid and decreased with depth. A transition from higher reflectivity to lower reflectivity was observed at approximately 0.25 mbs (Figure 113).

GPR depth profiles for T-045 identified horizontal banding, commonly associated with stratigraphic layering, throughout the survey area (Figure 114). This banding corresponded to variations of density and chemical composition within fill deposits. The profile also indicated a change in reflectivity which occurred around 0.15 mbs. No utilities were observed in the profile. The maximum depth of clean signal return was approximately 1.0 mbs.

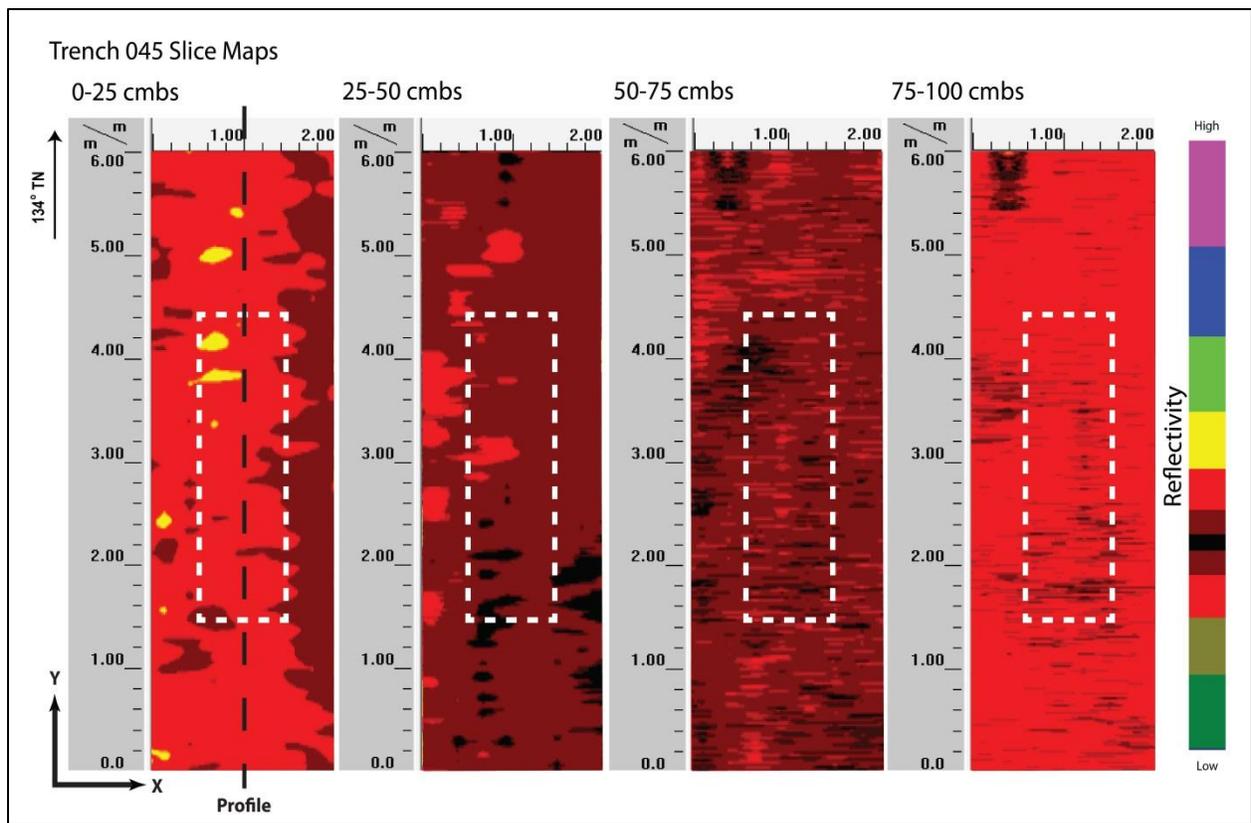


Figure 113. Slice maps of T-049 at 25cm depth intervals

A visual comparison of the excavated profile and the GPR signal profile showed a moderate correlation in stratigraphic transitions (Figure 114). Strata Ib to II were all clearly observed and occurred near the ground-truthed depths. Strata Ia and Ib were not individually discernable on the GPR profile. The transition from II to III was not observed on the profile. No discrete objects or other stratigraphic transitions were observed in the GPR results or subsequent excavation.

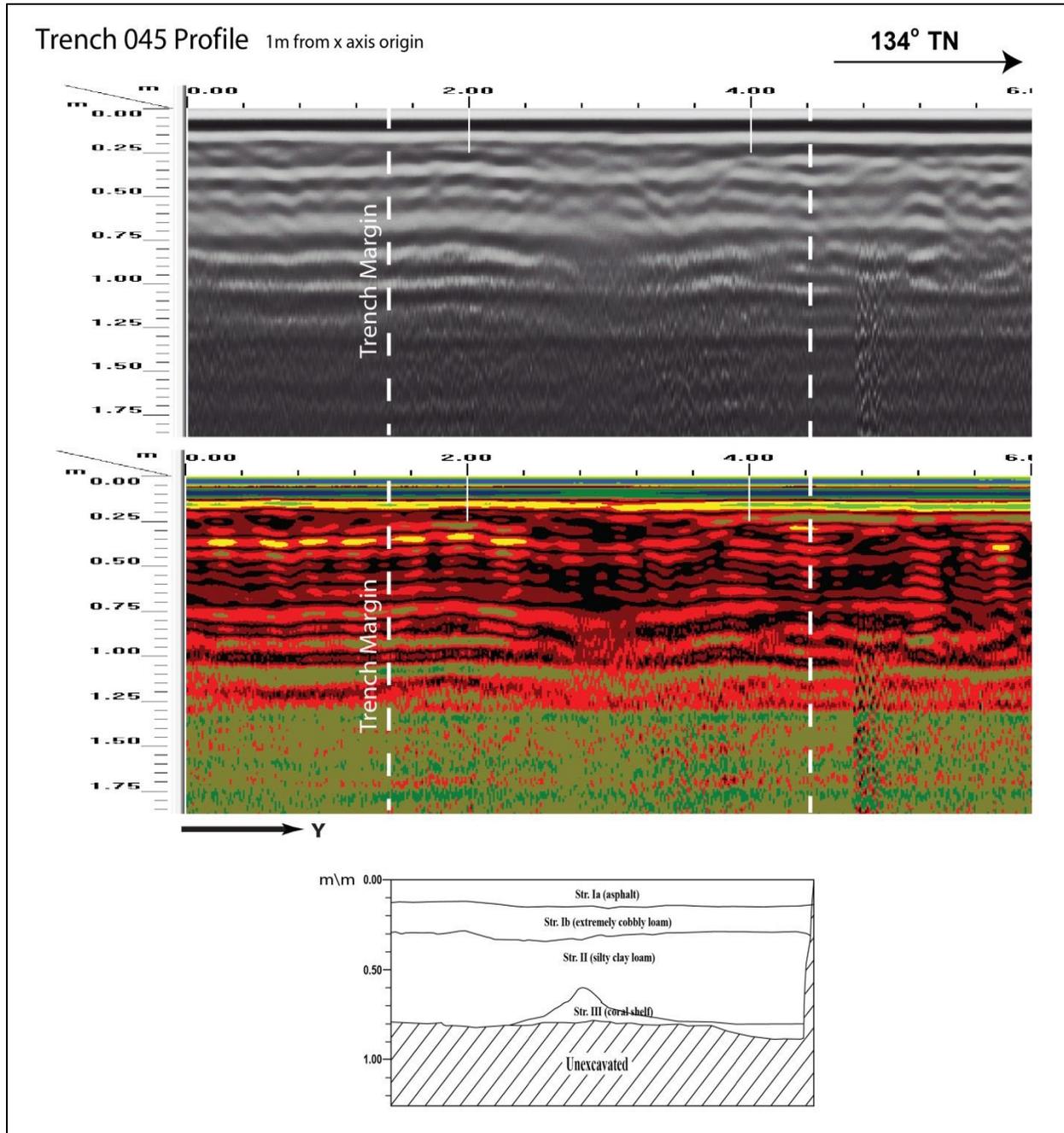


Figure 114. Visual comparison of excavated profile and GPR signal profile of T-045

### Test Excavation 46

T-046 measured 0.9 m by 3.0 m and was oriented northwest to southeast and was located within the center of the road cut of Dillingham Boulevard, 66.0 m northwest of Dillingham Boulevard and Kalihi Street intersection. The GPR grid measured 6.0 m by 2.0 m with 0.25 m spacing between Y transects and 1.0 m spacing between X transects. Utilities located near the excavation include: sewer line 1.0 m northwest, electrical line 3.4 m southwest, water line 3.6 m northeast, and gas line 5.3 m northeast.

A review of amplitude slice maps indicated no linear features which might have indicated the presence of utilities. Reflectivity was relatively uniform throughout the grid and decreased with depth. A transition from higher reflectivity to lower reflectivity was observed at approximately 0.25 mbs (Figure 115).

GPR depth profiles for T-046 identified horizontal banding, commonly associated with stratigraphic layering, throughout the survey area (Figure 116). This banding corresponded to variations of density and chemical composition within fill deposits. The profile also indicated a change in reflectivity which occurred around 0.2 mbs. No utilities were observed in the profile. The maximum depth of clean signal return was approximately 1.0 mbs.

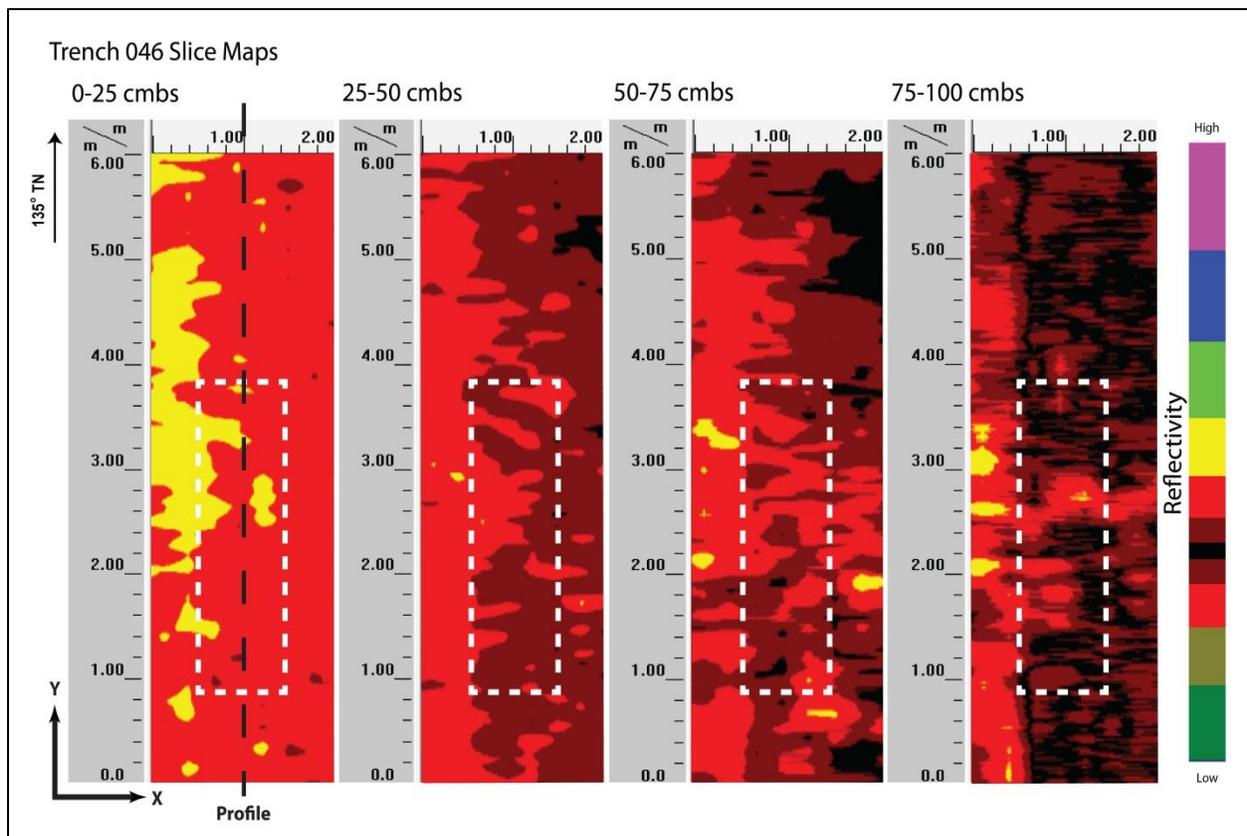


Figure 115. Slice maps of T-046 at 25cm depth intervals

A visual comparison of the excavated profile and the GPR signal profile showed a strong correlation in stratigraphic transitions (Figure 116). Strata Ia through Ic were clearly observed and occurred at the ground-truthed depths. Strata included a layer of asphalt on top of a extremely gravelly sand and followed by a clay loam fill down to the coral shelf at 0.4 mbs. No discrete objects or other stratigraphic transitions were observed in the GPR results or subsequent excavation.

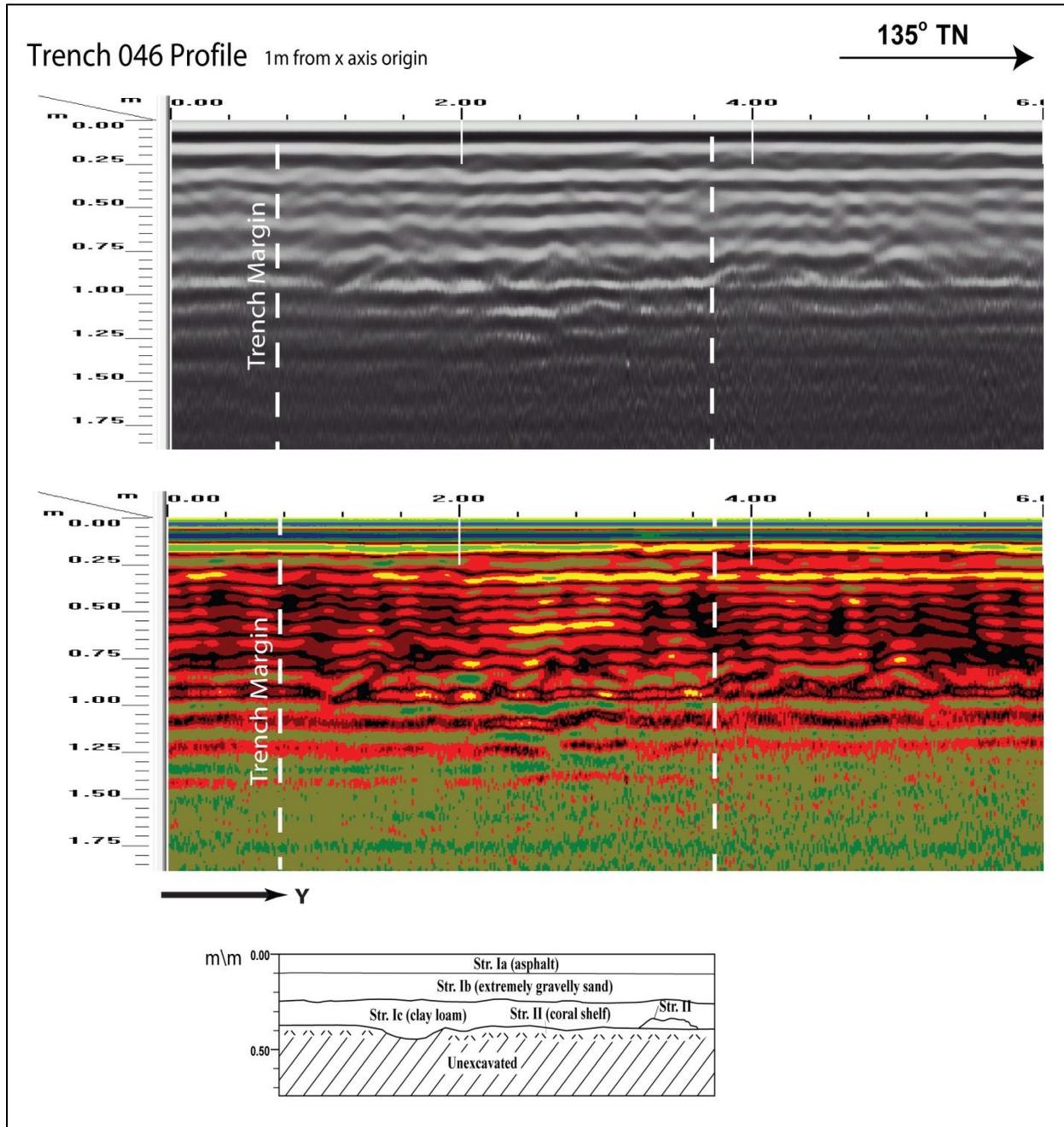


Figure 116. Visual comparison of excavated profile and GPR signal profile of T-046

### Test Excavation 47

T-047 measured 0.9 m by 3.0 m and was oriented northwest to southeast and was located within the center median of Dillingham Boulevard, 29 m northwest of Dillingham Boulevard and Kalihi Street intersection. The GPR grid measured 3.0 m by 6.0 m with 0.25 m spacing between y transects and 1.0 m spacing between X transects. Utilities located near the excavation include: water line 1.8 m northeast, sewer line 3.2 m southwest, and an electrical cable 3.5 m southwest. No utilities transected the GPR grid or excavation location.

A review of amplitude slice maps indicated a linear feature but it was not encountered during excavation. Reflectivity was relatively uniform throughout the grid and decreased with depth. A transition from higher reflectivity to lower reflectivity was observed at approximately 0.5 mbs (Figure 117).

GPR depth profiles for T-047 identified horizontal banding, commonly associated with stratigraphic layering, throughout the survey area (Figure 118). This banding corresponded to variations of density and chemical composition within fill deposits. The profile also indicated a change in reflectivity which occurred around 0.3 mbs. Several anomalies were observed in the profile but were not encountered during excavation. The maximum depth of clean signal return was approximately 1.0 mbs.

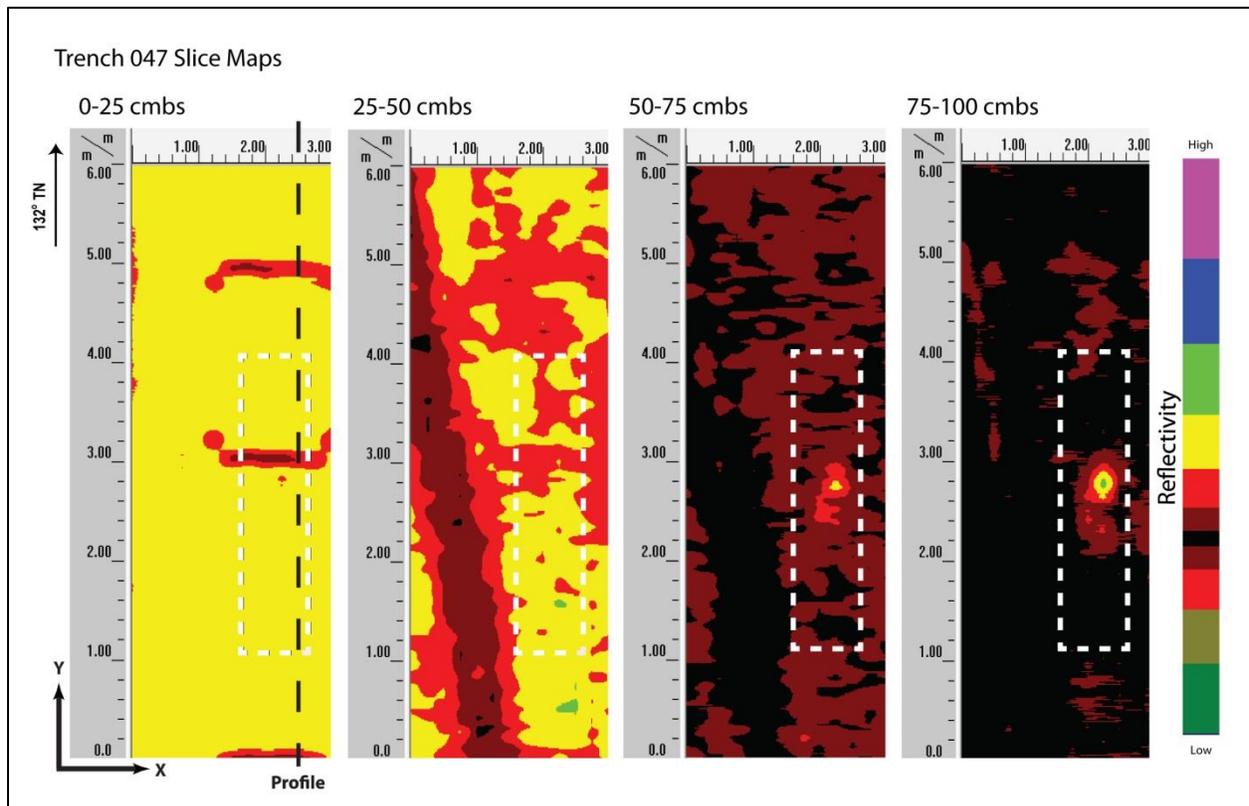


Figure 117. Slice maps of T-047 at 25cm depth intervals

A visual comparison of the excavated profile and the GPR signal profile showed a moderate correlation in stratigraphic transitions (Figure 118). Strata included a thick layer of asphalt on top of extremely gravelly loam followed by a cobbly silt clay loam and then a degrading coral shelf. Stratum Ia and Ib were not distinguishable but the transition to Ic was able to be observed. No other sediment transitions or discrete objects were observed in the GPR results or subsequent excavation.

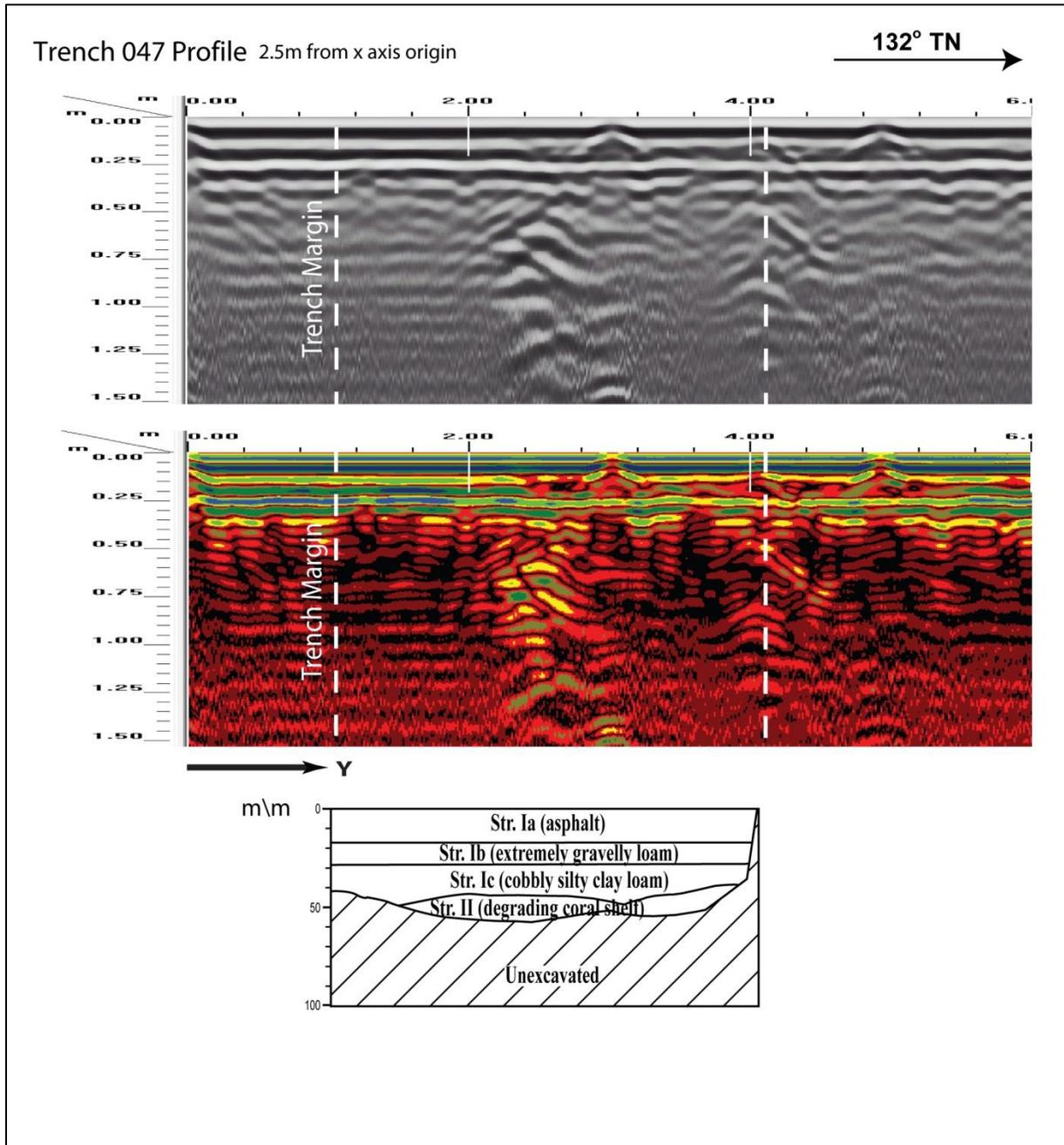


Figure 118. Visual comparison of excavated profile and GPR signal profile of T-047