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July 29, 2006

**Mr. Steven Schleder**
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**Re: Saint Mary's Cemetery Geophysical Investigation**

An exploratory geophysical investigation was performed on September 11th and 12th of 2004 as well as on May 27th, 2006 with the primary intent being to investigate the shallow subsurface of the cemetery, now referred to as "St. Mary's Cemetery" in San Buenaventura, California (Figure1). Geophysical data was collected within three (3) grids located at specific areas of the property; the northeastern corner of the cemetery grounds (an asphalt paved parking lot referred to as the "Western 110' Section"), the area immediately to the east, just over the chain link fence separating the parking lot from the grass area and the sloping grass area to the south of the parking lot (Figure 2).

The purpose of the geophysical investigation was to collect data about the subsurface in order to compare areas of known cemetery burials with other areas of unknown, or disputed, previous site usage. The asphalt paved parking lot (the Western 110' Section) is the primary area of contention and it is, therefore, the focus of this geophysical investigation.

A dual approach was utilized in order to obtain, not only the best data sets possible, but to gain useful insights into previous site usage. The two geophysical methodologies applied to the survey are electromagnetic (EM) induction and ground penetrating radar (GPR). Multiple methods were utilized because each instrument senses different material properties of the ground and buried objects. At any given site the situation, geologic and cultural (manmade), may be such that one or more of the instruments may record excessive "noise", the ground may not provide sufficient contrasts, or there may be overlapping anomalies, for a given instrument to be effective. Summarily stated, there are generally instrumental limits and interpretational impediments. Consequentially, we cannot guarantee that all problems in all cases will be solved with geophysical surveying; however, our interpretation will be based on the best reconciliation of the data sets acquired. Nevertheless, we can, and do, certify that we own state-of-the-art instruments, we are trained and experienced, are committed to acquiring the best data sets possible, and will bring to bear our expertise in formulating the interpretation.

**Brief Description of the Geophysical Methods Applied** - The EM-61 instrument is a high resolution; time-domain device for detecting buried conductive objects. It consists of a powerful transmitter that generates a pulsed primary magnetic field when its coils are energized, which induces eddy currents in nearby conductive objects. The decay of the eddy currents, following the input pulse, is measured by the coils, which in turn serve as receiver coils. The decay rate is measured for two coils, mounted concentrically, one above the other. By making the measurements at a relatively long time interval (measured in milliseconds) after termination of the primary pulse, the response is nearly independent of the electrical conductivity of the ground. Thus, the instrument is a super-sensitive metal detector. Due to its unique coil arrangement, the response curve is a single well-defined positive peak directly over a buried conductive object. This facilitates quick and accurate location of subsurface targets.

# SITE LOCATION MAP

## St. Mary's Cemetery, San Buenaventura, California


FIGURE 1

# GRID LOCATION MAP

## Geophysical Investigation of Historical Site, San Buenaventura, California


The historical map shown above is accurate in terms of significance to the cemetery. The map is overlain upon an aerial photgraph taken in 1946 showing the cemetery grounds. The imaginary extension of N. Crimea St. into the cemetery (yellow line) was establish with the aid of a California Licensed Professional Surveyor.

FIGURE 2

The ground penetrating radar (GPR) instrument beams energy into the ground from its transducer/antenna, in the form of electromagnetic waves. A portion of this energy is reflected back to the antenna at a boundary in the subsurface across which there is an electrical contrast. The instrument produces a continuous record of the reflected energy as the antenna is traversed across the ground surface. The greater the electrical contrast, the higher the amplitude of the returned energy. The radar wave travels at a velocity unique to the material properties of the ground being investigated, and when these velocities are known, the two-way travel times can be converted to depth. The depth of penetration and image resolution produced are a function of ground electrical conductivity and dielectric constant.

**Findings** - Interpretation took place in real time as the surveys progressed and all EM data was downloaded to a computer, processed and interpreted while on the site. The intent of this document is to demonstrate the procedure, and report the findings of the work.

The areas to be searched were determined by the need for data within areas of contention, accessibility and any area clear of surface cultural effects (manmade metallic objects at the surface) namely, parked cars. At each area of investigation a formal rectilinear grid was established to guide data acquisition. EM-61 data were collected at stations every 0.6 feet along south to north oriented survey lines spaced five (5) feet apart. The use of the EM-61 in a grid fashion allows for rapid examination of the subsurface in order to locate anomalously high zones of conductors (or metallic objects) beneath the grass and asphalt surfaces of the site(s).

Ideally, any EM anomalies encountered within any of the three (3) grids would be examined with the GPR system in order to possibly identify the cause of the anomaly (i.e. metallic coffin hinges, collapsed palling fences, metallic bases upon which crosses or ornamental statues once stood anchored into the ground or large jewelry pieces buried with the deceased) but the high concentration of clay within the local soils prohibited penetration by the ground radar into the soil. At literally all test areas, the GPR maximum depth of penetration was less than two (2) feet. Nonetheless, GPR data was collected over the entire asphalt surface of the Western 110' (a present day parking lot) in order to make a scientific comparison to other areas of known burials. The EM data sets from Grids A, B and C will be addressed first, followed by the ground radar data obtained within Grid B. It should be noted that ground radar data was collected over known grave sites within Grid A so as to compare responses to the full coverage obtained over the parking lot (the Western 110').

**Geophysical Grid A** - In order to detect some of the smallest of subsurface conductors each EM data set presented in this report is presented in a contoured format with a contour interval set at a 5 millivolts (Mv) interval. What this means is that all subsurface conductors that can hold an electrical charge of only 5 Mv, or more, will be presented within the contoured data. This allows for the detection of very small conductors beneath the ground, such as fragmented iron palling fence pieces or other small metals that can hold an electrical charge, to be seen in the data set. Therefore larger conductive "targets" will tend to "glow" in the data and appear as very dense areas of electrical conductivity, such as the metallic trash can shown in the Grid A plot (Figure 3).

What is apparent within the data from Grid A is that there are several regions of subsurface conductors that are likely to be associated with ornamental objects, so often found in cemeteries, dating back to the late 1800's. Site photographs dating back to 1927 clearly show a great deal of intricate statues, crosses and family mausoleums on the cemetery grounds. The rounded anomalies present within Grid A are higher than 50 Mv, indicating that the conductors have very measurable mass. Without useful GPR data (due to lack of penetration into the host material) it is impossible to ascertain what the actual causes of the EM anomalies are. The only means of discovery would be ground truthing (i.e. excavation). One possible explanation would be that the rounded anomalies are caused by the remnants of metallic bases upon which crosses or ornamental statues once stood.

# SITE INTERPRETATION MAP

## EM-61 Grid A; St. Marys Cemetery

contour interval = 5 Millivolts (Mv)

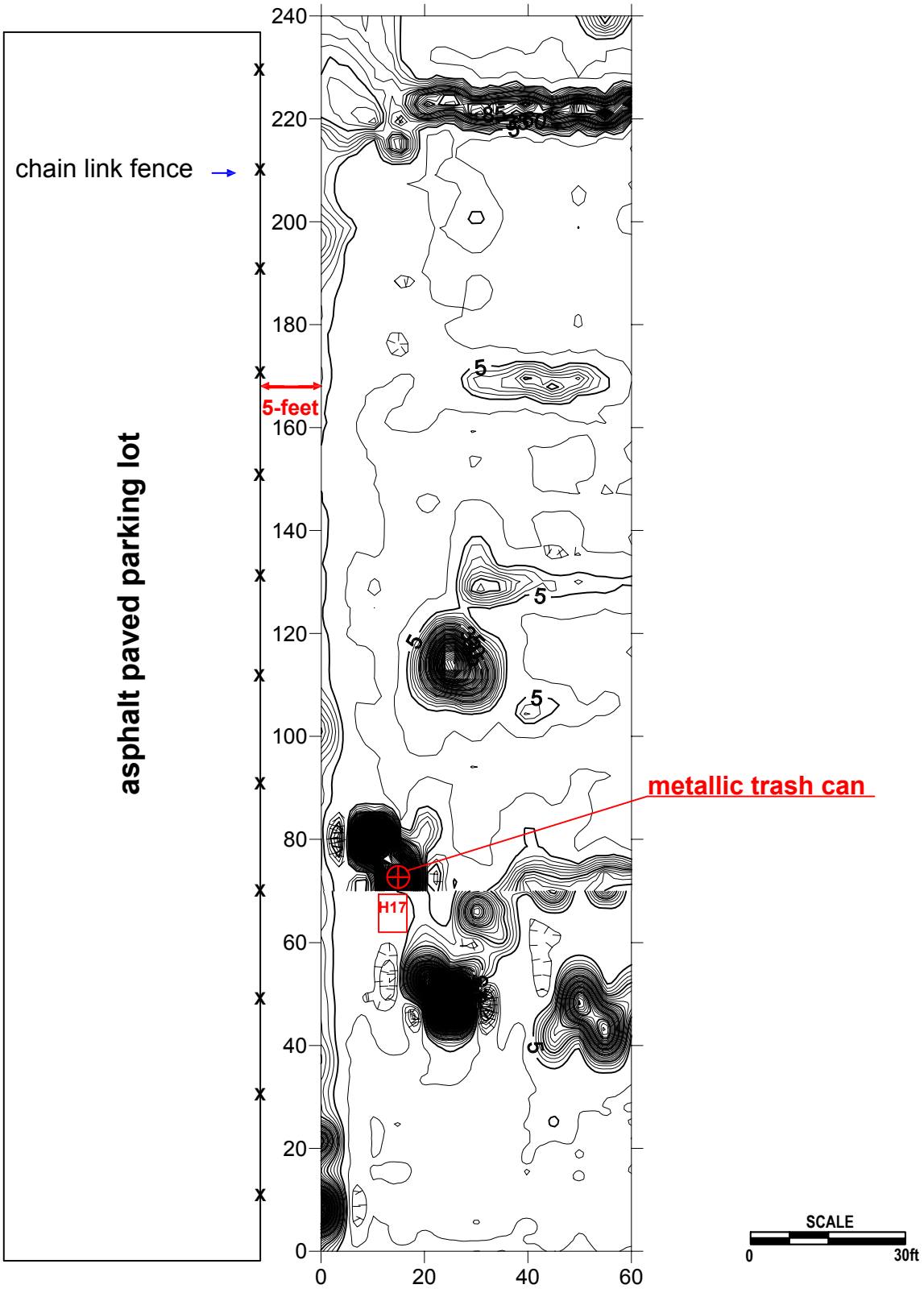



FIGURE 3

All of the EM data presented within this report will be referenced to a grid coordinate system. The “X” coordinate is the distance shown at the bottom of the data set where zero feet is the west edge of the grid, and distances increase to the east. The “Y” coordinate is the distance shown along the left side of the data set where zero feet is to the south and distances increase going up towards the north.

There are some other compelling conductive anomalies present within the data of Grid A. One of which is located at grid coordinate X= 30-55, Y= 170. The anomaly is elongated, with the long axis running east to west. The conductive target is far too large to be a single grave with an iron palling fence around it. Again, if one were to speculate as to the possible cause of the anomaly, one may suggest that this target could be the remnants of a small mausoleum foundation, or a crypt made with some metal. Unfortunately, the lack of GPR penetration prohibits any further analysis of the target(s). All other subsurface anomalies within grid A appear to be a smaller conductor (within the 5-15 Mv range) which is indicative of a large conductive debris field below the grass area. This small debris field appears to be all that is left of the original cemetery burial grounds.

The very long target at the top of the data set, grid coordinate X=20-60, Y=225, could actually be a metal pipeline. The conductive anomaly is almost a textbook example of a steel pipeline, which is buried just south of the sidewalk that runs along Poli Street.

**Geophysical Grid B** - Photographs showing the cemetery that date back to 1927 and 1946 do not show an asphalt paved parking lot in the northwestern quadrant of the cemetery property. Instead, the photographs show a large white two-story house located at the corner of Poli Street and Crimea Street (the house is still there today) directly across the street from the present day parking lot. What is compelling about the photograph and cemetery grid over-lay (please see “Grid Location Map” Figure 2) from 1946 is that there is clear evidence of burial plots, walkways and vegetation directly across the street from the large white two-story house. This is the area of the highest contention concerning the prior site usage of St. Mary’s Cemetery (aka Cemetery Park).

Although it is not the scope of work for a geophysical investigation to determine what is “right” or “wrong” about prior site usage, it is quite feasible (from a “forensic geophysical” standpoint) that geophysical data sets can aid in establishing a pattern in the data that may be indicative of man’s workings on the site in question. At this particular 7.3 acre site questions, and rumors, abound over the primary issue of whether or not there are graves below the present day asphalt paved parking lot, known as the “Western 110’ Section”.

Geophysical Grid B was established, and EM data was collected, over the northeastern quadrant of the cemetery property. Figure 4 shows the EM data set obtained over Grid B. The grid measured 200 feet north-to-south and 95 feet east-to-west.

# SITE INTERPRETATION MAP

## EM-61 Grid B; St. Marys Cemetery

contour interval = 5 Millivolts (Mv)

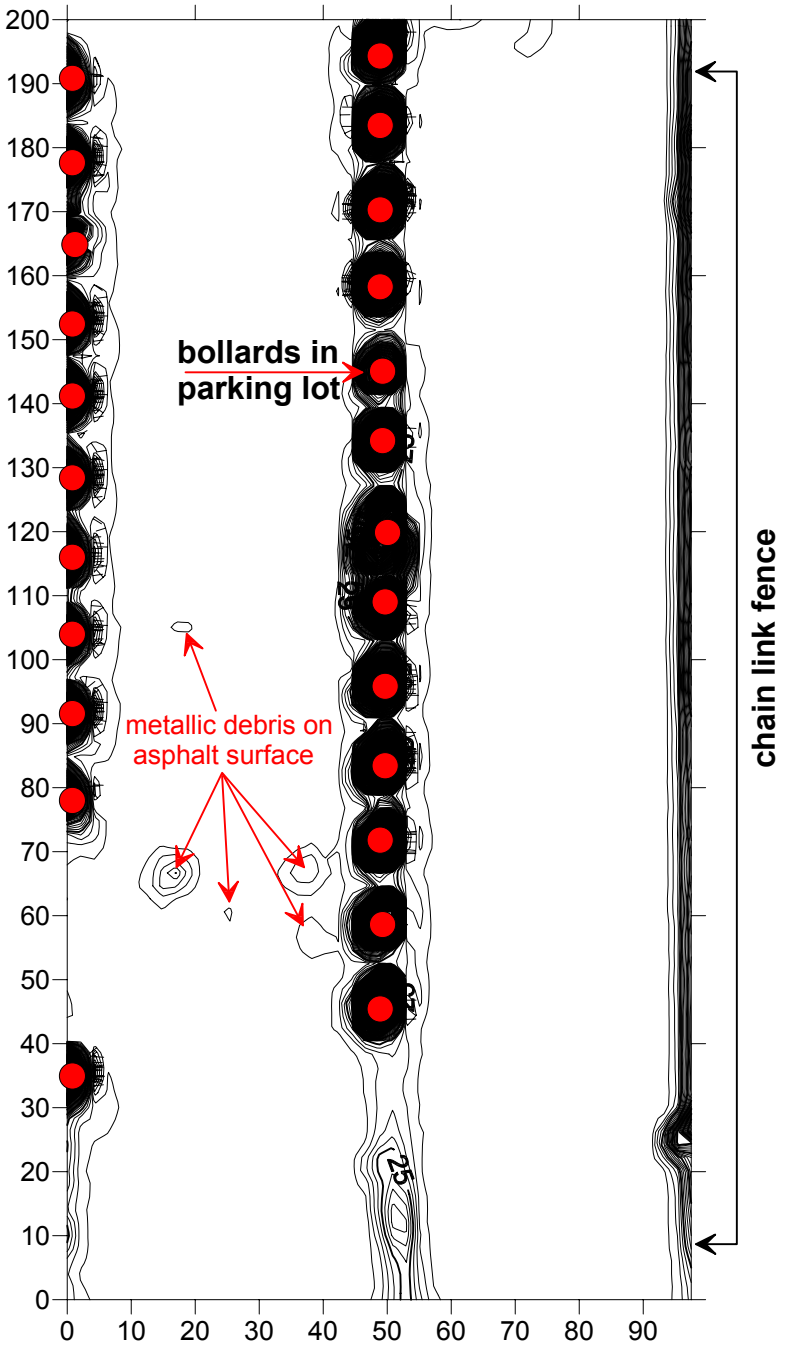



FIGURE 4

Grid B data indicates the obvious cultural effects present at the surface of the parking lot (steel bollards and the chain link fence to the east) but the subsurface is not at all similar to EM Grids A or C! The five (5) small conductive "targets" present within the data set were investigated immediately after data collection and found to be caused by surface metallic debris (steel bolt, bottle cap and various debris). There are absolutely no metallic (conductive) remnants from prior site usage present below the asphalt surface of the parking lot. This alone would suggest that the subsurface has been "sterilized" by engineering means prior to the application of the asphalt. It is common practice today that engineer's will "condition" soils before applying asphalt by clearing, compacting, grading, conditioning and grading again prior to the application of the asphalt material. These engineering methods may not have been in use during the late 1800's, but the EM data do strongly suggest that the subsurface below the "Western 110" has been severely altered, thus rendering any identification, or denial, of graves (or mans workings) virtually impossible!

**Geophysical Grid C** - Immediately south of the parking lot is a gently sloping grass area that is the location of the former "civic recreation center". The center was built around 1955, but was later demolished (due to structural problems) in 1972. The expansive lawn area is thought to have been the burial site(s) of the Chinese, Chumash Indian and "other races", according to cemetery records.

Grid C measures 170 feet north-to-south and 60 feet east-to-west. The data presented in Figure 5 are contoured at 5 Mv. Due to the construction of the civic recreation center over this locale; the data show a great deal of subsurface conductive highs and lows. The digging (for the building foundations) has greatly impacted much of the evidence from previous site usage. There is a great deal of conductive high regions within the data, but equally many conductive low regions (areas with the hatched markings). There does not appear to be a pattern in this data set, but there does seem to be a vast amount of subsurface conductive debris similar to what was found in Grid A. Is this attributable to a mass grave, building foundations or a highly impacted portion of a cemetery? Again, the lack of GPR penetration into the host material prevents any identification of the subsurface conductors! The two (2) water utilities noted along Hemlock Lane are the only conductors present within the data set that can be explained.

**Ground Penetrating Radar Data** – The use of ground penetrating radar in forensic investigations is not a new breakthrough in technology. GPR was first utilized as a means to image the subsurface within permafrost regions. The success of this application gave birth to a multitude of different uses in various geological settings around the world. Today the use of GPR is almost commonplace; however, the general public does not often see the data, nor would most people comprehend what they are looking at. It is for this reason that GPR data from a previous cemetery investigation is shown in Figure 6 of this report.

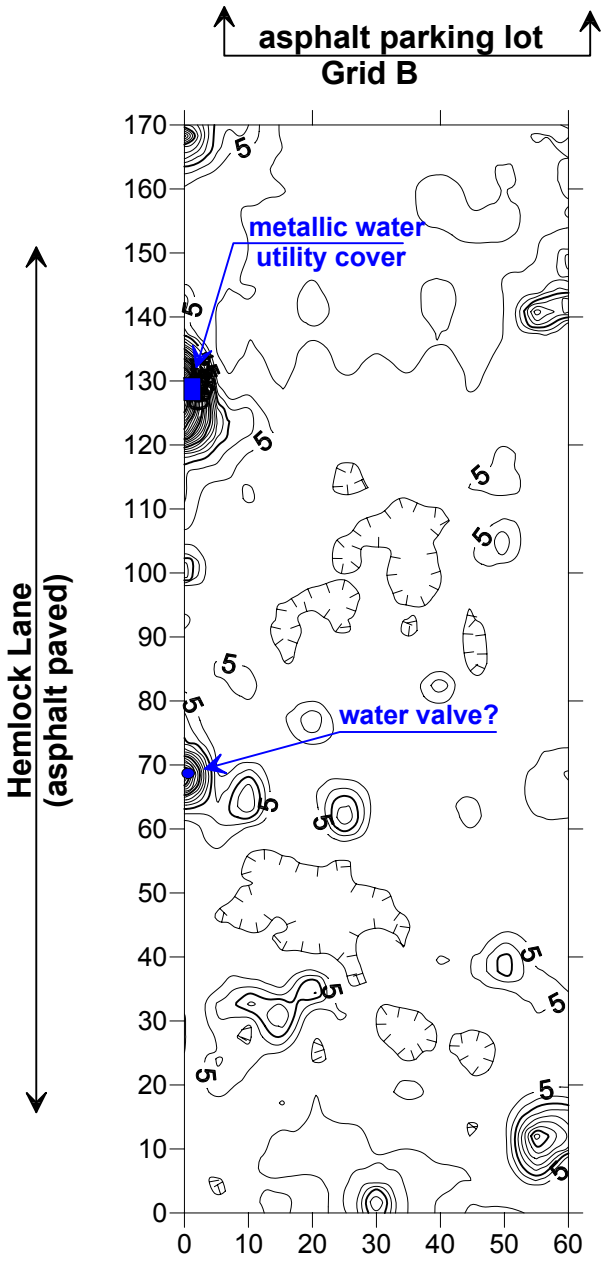
The radar images shown in Figure 6 are from a cemetery that has not been altered from previous site usage. That is to say, no grading was done, no soil was imported in order to landscape, and no asphalt pavement was installed. The cemetery was fully intact when the GPR data was collected. Even the untrained eye can see that there is a great deal of impact to the subsurface just inches below the ground surface! This is not only typical of most cemeteries, but it is often seen anywhere that man has altered the shallow subsurface for building, farming or other reasons.

The various excavations, tree roots and burials are noted in order to aid the reader in identifying how some "targets" appear in radar data. GPR data obtained within Grids A, B and C of St. Mary's Cemetery was collected at the identical center-cut frequency (500 MHz.) as the cemetery data shown in Figure 6.

# SITE INTERPRETATION MAP

## EM-61 Grid C; St. Marys Cemetery

contour interval = 5 Millivolts (Mv)

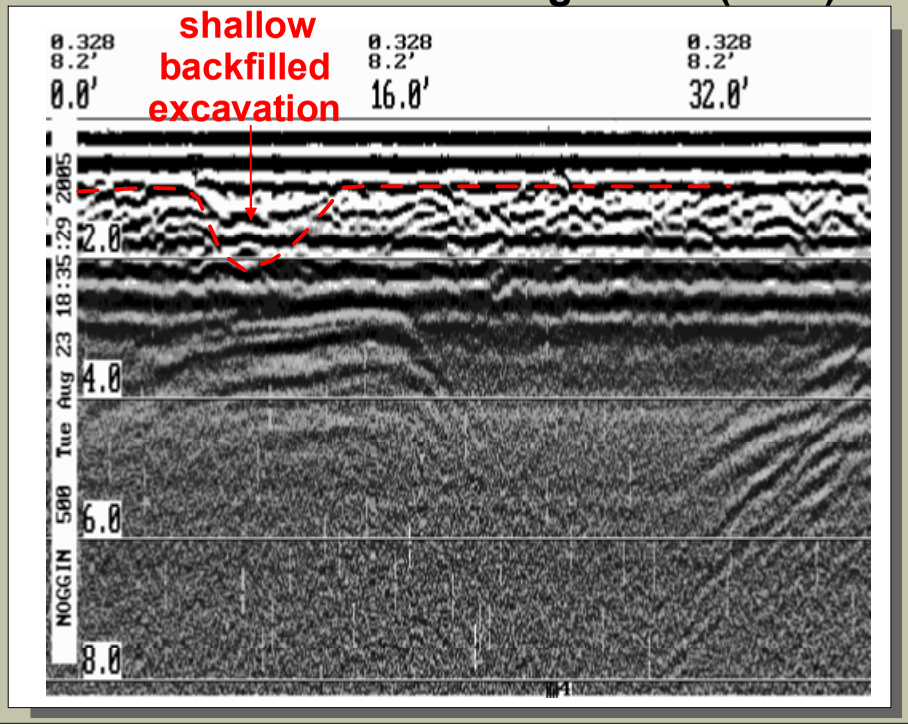



SCALE
0 30ft

FIGURE 5

# FORENSIC GEOPHYSICS

## Ground Penetrating Radar (GPR)



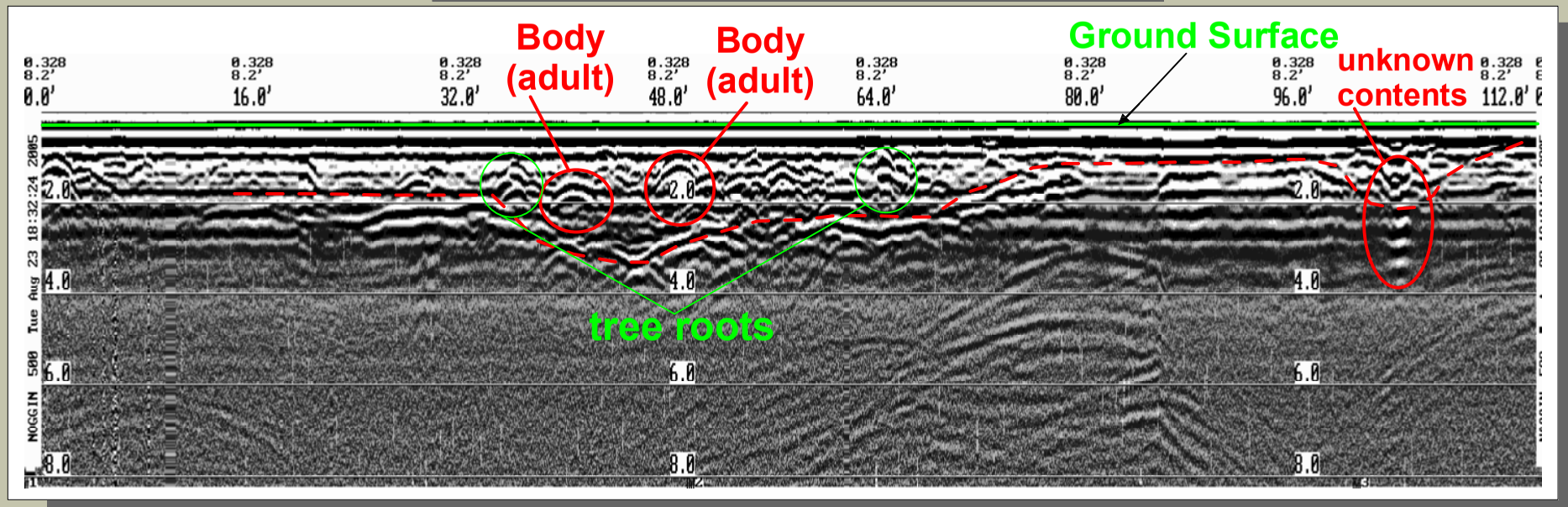




Figure 6

Grid B was re-occupied with the GPR system where data was collected in a south-to-north orientation over the asphalt parking lot. Each GPR traverse (line) was spaced 2.5 feet apart and all lines were collected in one direction in order to aid in the presentation and interpretation of the data. Each line was approximately 194 feet in length.

A total of thirty-eight (38) lines of GPR data were collected within Grid B of the "Western 110". Due to the complete lack of both penetration (no deeper than 2 feet) and any anomalous conditions present below the parking lot of St. Mary's Cemetery, it would be useless to display all of the radar data obtained on the site. To summarize what the full data set showed, the term "perfectly homogeneous" would be applicable. All of the data is identical (with the exception of a small east-to-west buried pipeline present at the far north end of some traverses) from one line to the next throughout the entire Grid B. As an example, Figures 7 and 8 are included in this report to illustrate what was observed in all of the traverses obtained over the parking lot.

The radar data shown in Figures 7 and 8 clearly have no subsurface anomalies of any kind. The rich history involving St. Mary's Cemetery (beginning with the first burial on October 21st, 1862) includes many items from the past including, but not limited to some trees or bushes that were present on the cemetery grounds when the photograph in Figure 2 was taken in 1946. It should be noted that the photograph from 1946 clearly illustrates that Grid B was directly over a portion of the cemetery that was occupied by some burials and pathways to and from the other cemetery burial grounds. It is apparent from the GPR data obtained over the "Western 110" that the subsurface shows no evidence of prior site usage. It is simply because of this that no conclusions pertaining to whether or not there are graves below the asphalt paved surfaces of the parking lot can be made.

As further evidence of the "sanitization" of the subsurface below the parking lot, additional GPR data was obtained directly over known grave sites within EM Grid A (Figure 9). Although the ground radar "signature" of the grave sites shown in Figure 9 is not as compelling as the grave sites shown in Figure 6, it is apparent that if the subsurface grounds of St. Mary's Cemetery were left relatively untouched by man, evidence could be collected illustrating where graves were located. The high soil conductivity present throughout the cemetery grounds makes ground radar a secondary tool for exploring the shallow subsurface of St. Mary's Cemetery.

**Conclusions** – Geophysical data obtained within electromagnetic (EM) Grids A and C are consistent with previous site usage, namely a burial ground. The EM data collected within the asphalt paved parking lot (Grid B) also referred to as the "Western 110' Section, is unique in that the subsurface is devoid of any conductive debris from historical site usage. The soils below the asphalt pavement contain no observable EM anomalies of any kind to a detectable depth of 9-feet below ground surface. Photographic evidence dating back to 1946 illustrates that Grid B would certainly contain pathways and bushes, as well as very likely burials. The burials and the ornamental statues and crosses (and possibly some palling fences) would remain as buried conductive evidence of previous site usage. Grid B is completely clean, so clean in fact, it is considered unnatural.

Additional geophysical data (ground penetrating radar) obtained over Grid B clearly show that the shallow subsurface below the asphalt pavement has been severely altered by engineering means. Present day soil preparations are performed prior to the application of asphalt surfacing (grading, compaction and conditioning) but it is not known if this was an engineering standard back in the mid 1950's when the "Western 110" was converted to a parking lot. What is known today, as a result of this geophysical investigation, is that the shallow subsurface beneath the parking lot cannot be classified as "clear of burials" nor can it be confidently determined that there are, or were, graves beneath the parking lot.

# GROUND RADAR SCANS WITHIN GRID B (PARKING LOT)

## Western 110' Section of St. Mary's Cemetery, San Buenaventura, California

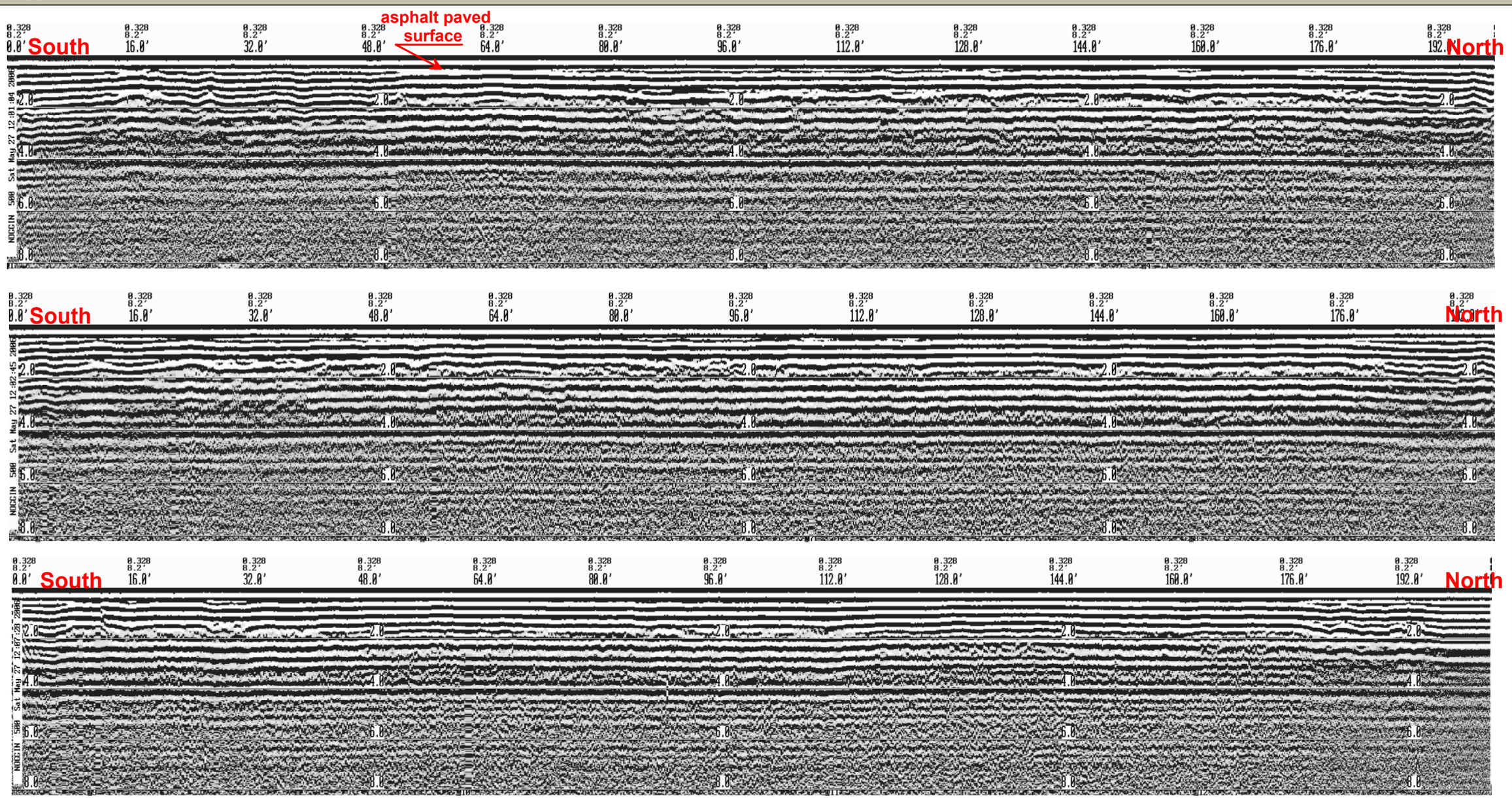



Figure 7

# GROUND RADAR SCANS WITHIN GRID B (PARKING LOT)

## Western 110' Section of St. Mary's Cemetery, San Buenaventura, California

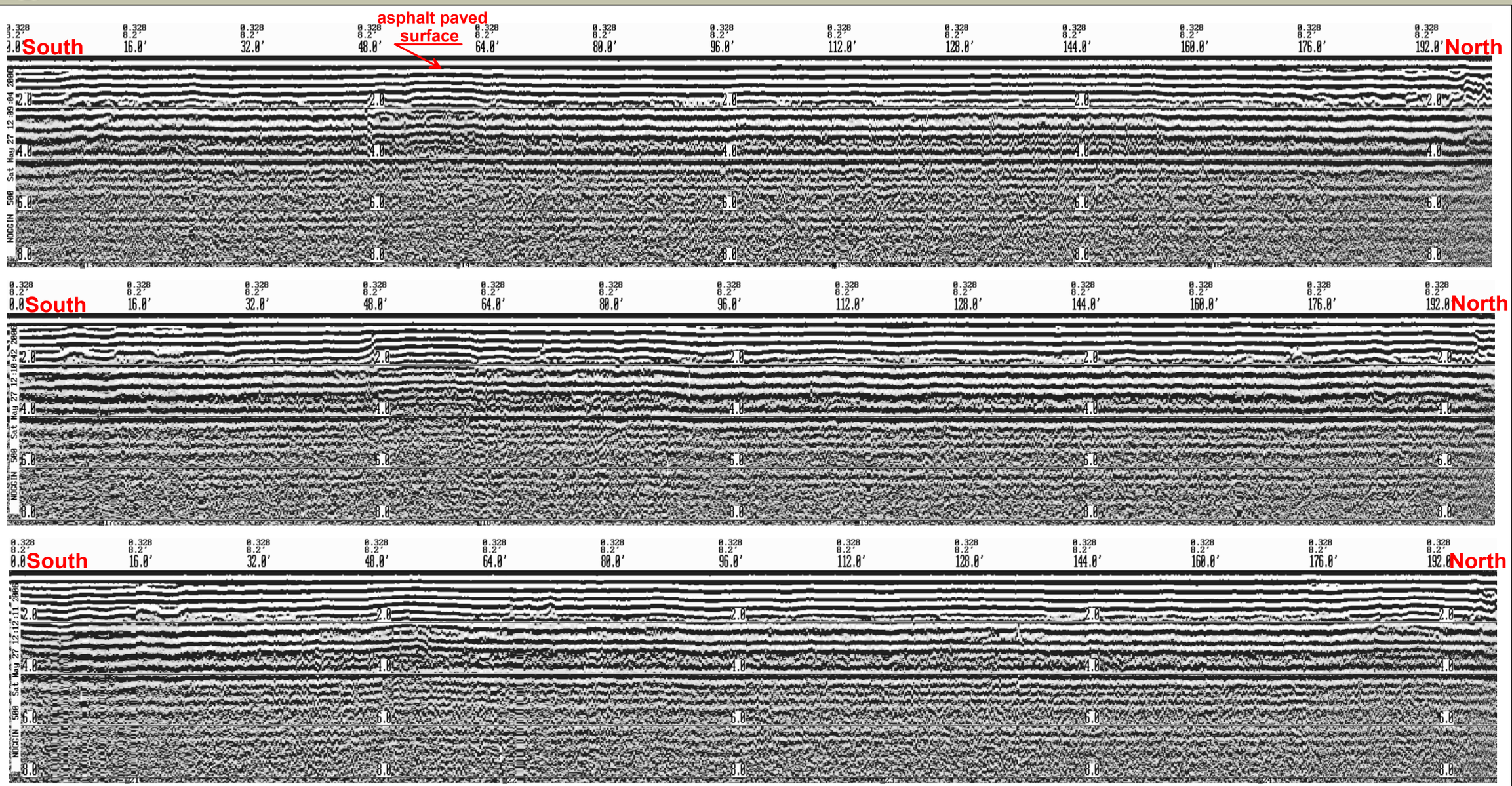
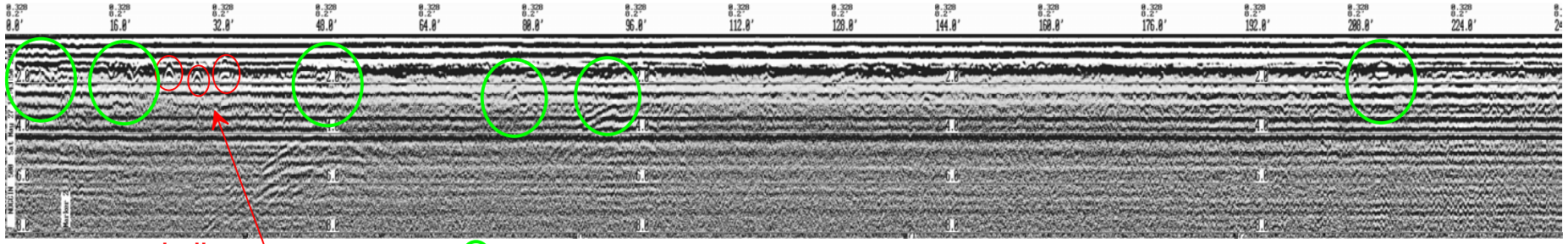



Figure 8

# RADAR RECORDS

## Ground Radar Data Over Known Graves in Grid A

### St. Mary's Cemetery, San Buenaventura,California




= Denotes a known grave (with a stone marker at the surface)

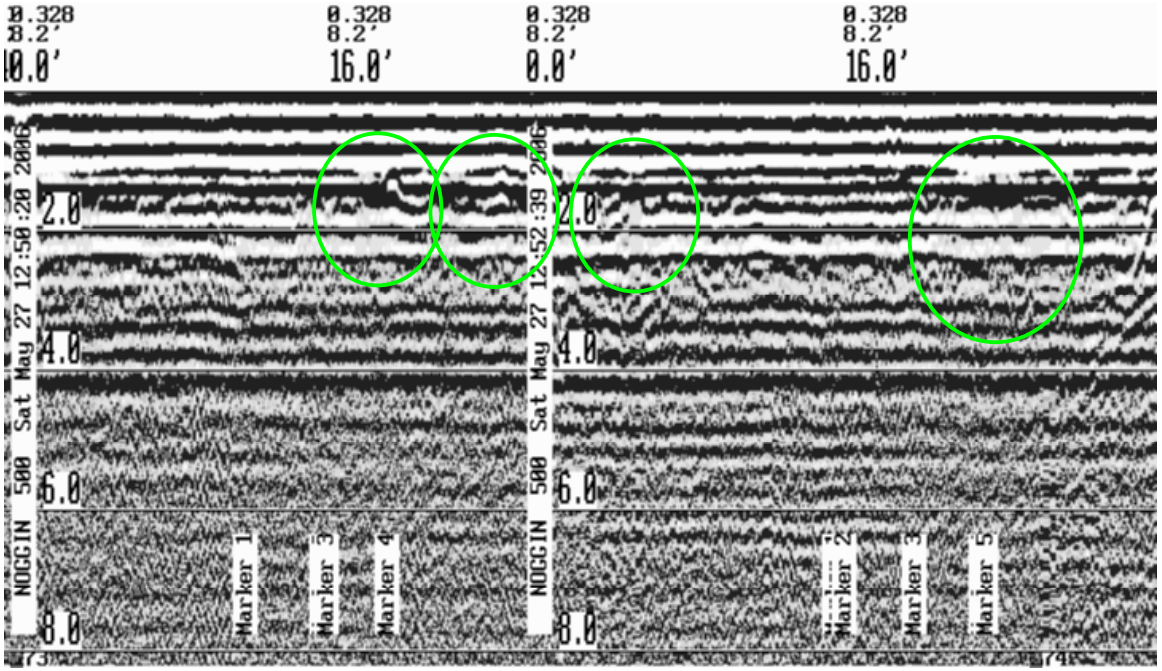



FIGURE 9

Radar penetration into the ground and resolution of the GPR images produced are a function of ground electrical conductivity and dielectric constant. Images tend to be graphic, even at considerable depth, in sandy soils, but penetration and resolution may be limited in drastically more conductive clayey moist ground. At this site (St. Mary's Cemetery) the depth of ground radar penetration was limited to two (2) feet.

Previous cemetery investigations performed by SubSurface Surveys & Associates, Inc. have typically involved at least one (1) archeological excavation, which is highly recommended for this survey at St. Mary's Cemetery due to the contention over the Western 110' Section.

All data, and this written report, have been reviewed by a California State Registered Geophysicist prior to release.

*Subsurface Survey's professional personnel are trained and experienced and have completed thousands of projects since the company's inception in 1988. It is our policy to work diligently to bring this training and experience to bear to acquire quality data sets, which in turn, can provide clues useful in formulating our interpretations. Still, non-uniqueness of interpretations, methodological limitations, and non-target interferences are prevailing problems. Subsurface Surveys makes no guarantee either expressed or implied regarding the accuracy of the interpretations presented. And, in no event will Subsurface Surveys be liable for any direct, indirect, special, incidental, or consequential damages resulting from data sets, interpretations and opinions presented herewith.*

All data generated on this project are in confidential file in this office, and are available for review by authorized persons at any time. The opportunity to participate in this investigation is very much appreciated. Please call, if there are questions.

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Gary W. Crosby

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Gary W. Crosby, PhD, GP960
Chief Geophysicist