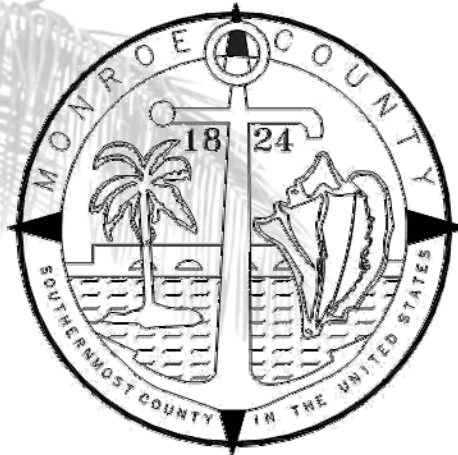


Exhibit B
Development Plan Description and
Ground Penetrating Radar Report

HIGGS BEACH PARK

MASTER PLAN REPORT



Prepared for:

Board of County Commissioners
of Monroe County, Florida
1100 Simonton Street
Key West, FL 33040

January 19th, 2011

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In Association with:



Mitchell Planning
& Design





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ACKNOWLEDGEMENTS

The consulting team of **William P. Horn Architect, PA** and our associate consultants would like to acknowledge the dedicated efforts of the **Board of County Commissioners of Monroe County**, especially the honorable Heather Carruthers, County Commissioner and Carol Schreck, Aide to Commissioner Carruthers.

Additionally, organized community efforts are also acknowledged including the **Friends of Higgs Beach Committee**, the **Higgs Beach Preservation Association**, the **Key West African Cemetery**, the **Key West Garden Club**, and the numerous citizens who gave of their time to attend multiple workshops and provide their constructive input and voice support for the Master Planning effort.



INTRODUCTION

Since the early days of Key West, the site we know as Clarence S Higgs Memorial Beach Park (aka Higgs Beach) has a past rich with historically significant events. Within the boundaries of the park, there are numerous cultural and recreational activities used by both residents and tourists. The sandy shoreline has withstood all that human nature and Mother Nature can deliver – from hurricanes to the notorious wreckers. Prior to the Civil War the beach was one of the early cemeteries on the island, not only for residents but also for African refugees rescued in the 1860's from slave ships bound for Cuban sugar plantations. Although storms removed many of the early gravesites, the location of the African refugee graves have been located as discussed later in this report. This section of coastline has protected the island community during wars that threatened not only Key West but also the entire Country. From the West Martello Fort, constructed in 1863 as the War Between the States loomed, to the barracks, gun turrets and radio tower built in the 1900's in response to the threat of World Wars. Henry Flagler's Railroad terminated near here and it is reported the rails from that infamous train track were used in the construction of the Reynolds Street pier in the 1940's.

The original beach was much smaller and centered around the end of Reynolds Street. At the close of World War II, the military barracks were no longer needed and negotiations began with Monroe County to surplus this land. In 1948 Monroe County accepted the beach and began to enhance the park. Early improvements included construction of bathrooms, expansion of the sand beach and maintenance on the Reynolds Street pier. The citizens of Monroe County and Key West have maintained a keen interest in this beach. It has acquired the moniker of the "locals beach". Time and again the residents of Key West and Monroe County have provided input, energy, time and money to improve the beach park.

It is this heritage the Design Team has endeavored to protect and enhance during this Master Planning process. Over the past eight months, the Team has met with many interested persons including residents, adjacent neighbors, business owners, as well as City and County staff. We have guided an information sharing process with as many stakeholders as possible in order to learn and listen to their desires and concerns. Information and work that was done prior to this contract was reviewed and acknowledged. The Team recognizes this special beach park is a unique respite for the residents and visitors of Key West. The improvements contemplated by the Master Plan are a response to all that was expressed and seeks to enhance the experience for all park users.



EXECUTIVE SUMMARY

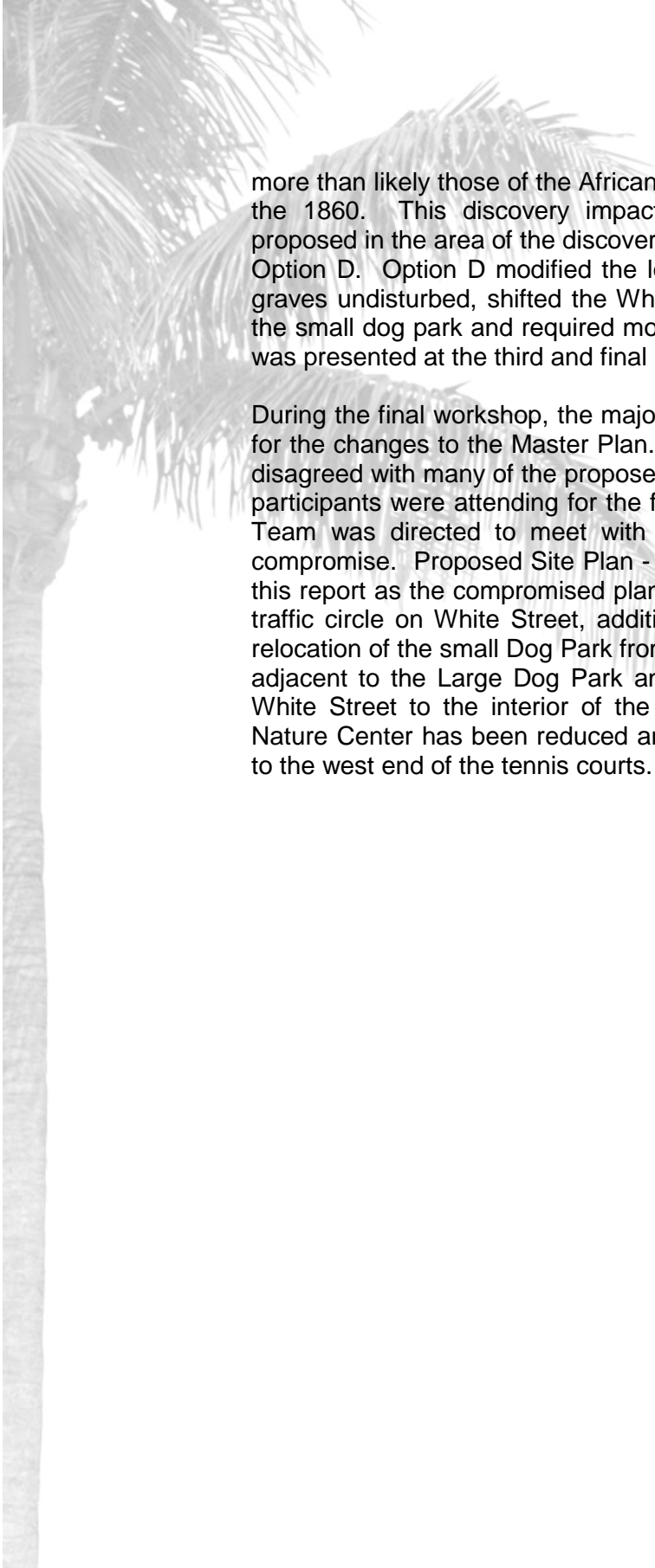
In March 2010, a contract was awarded to William P. Horn Architect PA for the development of a Master Plan for The Clarence S Higgs Beach Memorial Park. Mr. Horn assembled a Design Team of professionals with extensive local experience and knowledge to assist him in preparing the Master Plan. In the ensuing months, the Design Team, led by Mr. Horn, hosted and/or attended over thirty meetings throughout the Key West community. This information gathering process provided a wealth of data. The Team used this data to understand the relevant issues, assess the needs and incorporate the desires of the community as the Master Plan was developed.

Five Master Plan Options were developed during the course of this phase of the contract. The first two, Options A and B, were presented for discussion at the first Public Workshop held in June. This workshop began with a discussion of the existing conditions at the park as shown on the existing survey. Option A proposed maintaining Atlantic Blvd in the same location, relocating the parking facilities and proposed conceptual spaces for recreational activities. Option B shifted the road to the north, significantly increasing the beach area as well as reorganizing the parking facilities. As in Option A, similar conceptual spaces for park activities were shown. Upon conclusion of the design charrette, the workshop participants identified favorable concepts from A & B and directed the Design Team develop a combined scheme.

During the following month, the Design Team developed Option C and presented this plan, as well as Options A & B, as part of a progress update to the Monroe County Board of County Commissioners on July 21, 2010. Option C further defined the design concepts and ideas enumerated during the first public workshop. A central core for the park began to emerge. This core included an Art Park, Nature Center, parking and loading zones. A traffic circle was proposed for the intersection of White Street and Atlantic Blvd. The entrance to the park at Reynolds Street was studied and changes to calm traffic were included. The BOCC was informed of the activities to date and directed the Design Team to continue development of the plans and concepts.

The second public workshop was held on August 12, 2010. At this meeting Option C and C Alternate were presented to the group. The concepts were similar but different parking schemes were indicated on the plans. Again, with each plan, concepts and ideas began to solidify and mature. The consensus of the participants was to continue with Option C.

In the early fall, funding was made available for a Ground Penetrating Radar Survey of the middle and eastern sections of Higgs Beach. The City of Key West required the survey be conducted as part of the development approval process due to the anticipated location of archeological resources associated with the African Memorial. The survey was conducted in mid November and did locate additional human remains. Given the historical data available, these remains are



more than likely those of the African refugees rescued from slave trading ships in the 1860. This discovery impacted the Master Plan as development was proposed in the area of the discovered graves and resulted in the development of Option D. Option D modified the location of Atlantic Blvd in order to leave the graves undisturbed, shifted the White Street traffic circle to the north, relocated the small dog park and required modifications to the parking program. This plan was presented at the third and final public workshop on December 2, 2010.

During the final workshop, the majority of the participants understood the reason for the changes to the Master Plan. However, several adjacent property owners disagreed with many of the proposed concepts. Unfortunately a number of these participants were attending for the first time. In the following weeks, the Design Team was directed to meet with these neighbors in an attempt to reach a compromise. Proposed Site Plan - Option E was developed and is presented in this report as the compromised plan. The major changes include removal of the traffic circle on White Street, addition of a landscape median on White Street, relocation of the small Dog Park from the northeastern corner of the park to a site adjacent to the Large Dog Park and relocation of a proposed parking lot from White Street to the interior of the park. In addition, the size of the proposed Nature Center has been reduced and the Pickleball Courts have been relocated to the west end of the tennis courts.



SECTION 1: PROJECT RESEARCH AND DATA GATHERING

1A. BACKGROUND

In 1948, Monroe County accepted Higgs Beach. Over the years, the County has implemented improvements to the park. Currently, in addition to the sandy beach, the park contains tennis courts, West Martello Tower which is home to the Key West Garden Club, Salute Restaurant, Astro City, one bathroom building, concrete benches and cabanas, large and small dog parks, the Whistling Duck Pond, volleyball and handball courts, Reynolds Street Pier, the African Memorial and of course the swimming and snorkeling area adjacent to the beach. Within the boundaries of the park a fenced area with FAA tower and small concrete equipment building are located. The passage of time and the subtropical environment have taken their toll on most of the current park amenities.

Since 1999, a joint effort with the County, concerned residents and the Friends of Higgs Beach initiated discussions on the need for park improvements. Issues recognized included addressing security items, the impact of the homeless population, signage, parking, safe ingress and egress, trash and human waste impacts, increased vehicular traffic and site lighting. A Master Plan was commissioned and prepared in 2001. The overall plan was not funded for design and development although some of the recommendations were implemented.

In 2009, Commissioner Heather Carruthers's office facilitated the gathering of public input for Higgs Beach. Numerous public meetings were held and an Advisory Committee was established where both short and long term goals were identified. The minutes of these meetings are included in the Appendices attached to this report. Review of these minutes indicate that many of the issues such as safety, traffic flow, impact of the homeless population, etc were still of concern. In addition, a "Wish List" of improvements was developed and ranked. The Advisory Committee recommended that although some short-term improvements could be addressed, it would behoove the County to develop a new Master Plan that considered the most recent public input as well as current conditions.

A two-phase contract was awarded to William P Horn, Architect PA to develop this Master Plan in March 2010. For the first phase, development of the Master Plan, Mr. Horn assembled a team of professionals including Barbara Mitchell, Mitchell Planning and Design Inc., Ladd Roberts RLA, Landwise Design Inc and Allen Perez PE of Perez Engineering and Development Inc. This team has prepared the plan and this report for your review.

1B. STAKEHOLDER SURVEY

The first action taken by the Design Team was to meet with the Friends of Higgs Beach Board. This meeting was held on April 7, 2010. Mr. Horn was in attendance for the team. Minutes from this and subsequent meetings are included in the Appendices in chronological order. The following list had been prepared as a result of the work completed by the Advisory Committee during the previous year. It was provided to the Design Team as a starting point for the public input process. This list prioritized the improvements and amenities currently desired.

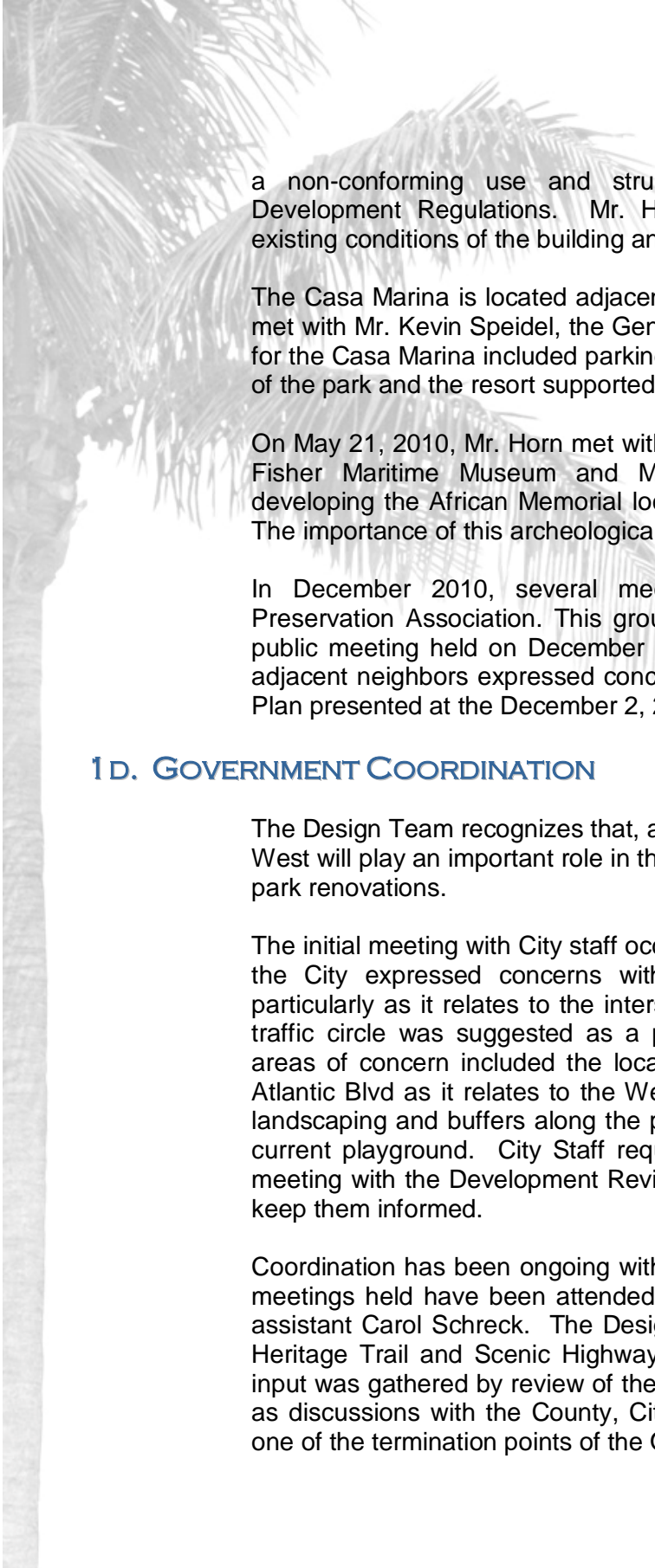
PRELIMINARY WISH LIST FOR HIGGS BEACH							
HIGGS BEACH WISH LIST	DESCRIPTION	RANK					
1	OUTFALL FILTERS	WATER QUALITY	33	26	AFRICAN CEMETERY MEMORIAL	FINISH (2-3 MORE PHASES?)	20
2	STORM WATER DRAINAGE	WATER QUALITY	33	27	TENNIS COURTS	5 CURRENTLY	20
3	RECYCLING & TRASH		30	28	VOLLEYBALL COURTS	ADDITIONAL COURTS(S), LIGHTING	19
4	BIKE RACKS	?	30	29	DOG PARK EQUIPMENT		19
5	IMPROVED SIDEWALKS	ADA, ATHLETIC TRAIL, ROLLER BLADING, ETC.	29	30	YOGA/MEDITATION		19
6	REPLACE LIGHTING	ECO / NEIGHBOR FRIENDLY LIGHTING	29	31	KID CONCERTS		19
7	DRINKING FOUNTAINS	THROUGHOUT PARK	28	32	COMMUNITY GARDEN	VEGETABLE AND FLOWER	18
8	FAMILY BATHROOM	NORTH SIDE OF PARK	27	33	BASKETBALL COURT		18
9	OPEN SPACE		27	34	KITE BOARDING		17
10	EXTEND SWIM PIER		27	35	COVERED TIKI HUT	YOGA MEDITATION	16
11	PAVILIONS, TIKI HUTS	FIX, PAINT, ADD UMBRELLA TABLES	26	36	PICKLE BALL	GROUP USE THE EASTSIDE OF TENNIS W/TAPE	16
12	SNORKELING		26	37	SHUFFLEBOARD	ONE CURRENTLY AND IN BAD SHAPE	15
13	FIRST AID STATIONS		25	38	HORSESHOES	ONE CURRENTLY AND IN BAD SHAPE	15
14	EVENTS	MONTHLY CONCERTS (SOUND SYSTEM/TENTS)	25	39	HANDBALL	2 CURRENTLY	14
15	COMMUNICATION	SIGNS, FLYERS, BROCHURES, WEBSITE	24	40	ULTIMATE FRISBEE GOLF		14
16	IMPROVED MARINE PARK	INC. NET AROUND SWIMMING AREA	24		ARTWORK	ADDED DURING OTHER SESSIONS	
17	FITNESS TRAIL/RUNNING TRACK		24		IMPROVED FENCING	ADDED DURING OTHER SESSIONS	
18	CONCESSIONS	ATHLETIC/REC SHOP (TENNIS, HOTDOGS, BIKES)	23		SEAWALL REPLACEMENT	ADDED DURING OTHER SESSIONS	
19	PLAYGROUND	REPLACE	23				
20	PEST CONTROL		22		NOTE: SECURITY WAS NOT ON LIST		
21	LOCKERS		22				
22	KAYAKING		22				
23	SHOWER ROOMS		22				
24	BUS/TROLLEY STOP		22				
25	SWIMMING TRACK/MARKERS	TWO SHALLOW INSIDE OF BARRICADE/PIER	21				

1C. COMMUNITY ORGANIZATIONS SURVEY

Prior to the first public meeting, Mr. Horn conducted several meetings with individual stakeholders and community organizations. The minutes of these meetings are included in the Appendices.

The surrounding residential community is very involved and interested in the plans for Higgs Beach. On April 14, 2010 a neighborhood meeting was held to inform the Design Team of the concerns of the neighborhood. During this meeting the public input process and schedule were outlined. The possible removal of the FAA tower was discussed. People in attendance introduced themselves and discussed their thoughts for the park.

The following day, Mr. Horn met with Mr. Richard Hatch, who currently leases and operates the Salute Restaurant from Monroe County. The restaurant is an important feature in the park. It is located adjacent to the beach, at grade, and is



a non-conforming use and structure according to the Key West Land Development Regulations. Mr. Hatch outlined his concerns, discussed the existing conditions of the building and suggested numerous improvements.

The Casa Marina is located adjacent to the park and on May 12, 2010 Mr. Horn met with Mr. Kevin Speidel, the General Manager of the resort. Primary concerns for the Casa Marina included parking on Reynolds Street, the overall appearance of the park and the resort supported improvements to the road.

On May 21, 2010, Mr. Horn met with Mr. Cory Malcom, archaeologist for the Mel Fisher Maritime Museum and Mr. Gene Tinnie an artist instrumental in developing the African Memorial located adjacent to the West Martello Garden. The importance of this archeological site was discussed.

In December 2010, several meetings were held with the Higgs Beach Preservation Association. This group formed in response to the third and final public meeting held on December 2, 2010. The group, composed primarily of adjacent neighbors expressed concern about several components of the Master Plan presented at the December 2, 2010 public meeting.

1 D. GOVERNMENT COORDINATION

The Design Team recognizes that, although this is a County Park, the City of Key West will play an important role in the ultimate development and permitting of the park renovations.

The initial meeting with City staff occurred on April 28, 2010. During this meeting the City expressed concerns with the safety of parking and traffic flow - particularly as it relates to the intersection of White Street with Atlantic Blvd. A traffic circle was suggested as a possible solution for this intersection. Other areas of concern included the location of the African graves, the alignment of Atlantic Blvd as it relates to the West Martello Garden, entry areas of the park, landscaping and buffers along the property line, and the upgrade/location of the current playground. City Staff requested the Design Team attend an informal meeting with the Development Review Committee (DRC) early in the process to keep them informed.

Coordination has been ongoing with Mayor Carruthers office, the majority of the meetings held have been attended by either Mayor Carruthers and/or her staff assistant Carol Schreck. The Design Team has coordinated with the Overseas Heritage Trail and Scenic Highway group. Formal meeting were not held but input was gathered by review of the Overseas Heritage Trail Master Plan as well as discussions with the County, City and State bicycle planners. Higgs Beach one of the termination points of the Overseas Heritage Trail Bicycle Path.

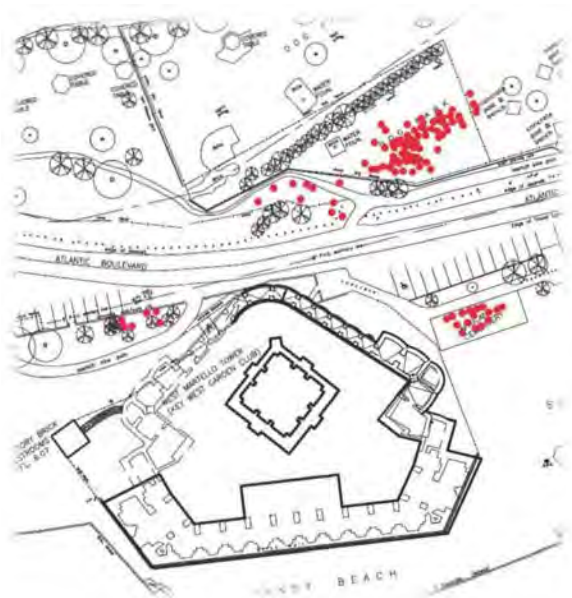
On July 21, 2010 an update was provided to the Monroe County Board of County Commissioners (BOCC). The Power Point presented is included in the Appendices.

On August 26, 2010 the Design Team presented the Conceptual Plans prepared to date at the Key West DRC. Official minutes from the City are not available. Generally the project was well received, several City Departments commented on the permit process and information that would be required; such as, an Environmental Resource Permit (ERP) for storm water system modifications, the HARC planner discussed the need for ground penetrating radar to locate the African grave sites, Bicycle Planner commented on White Street pedestrian access and signage requirements, and the Utility Companies provided information on existing service, City Planning discussed the possibility of City and County shared maintenance and recycling activities, legal non-conformity status of the restaurant, variance for landscape buffer requirements (in light of safety issues), and potential road relocation issues.

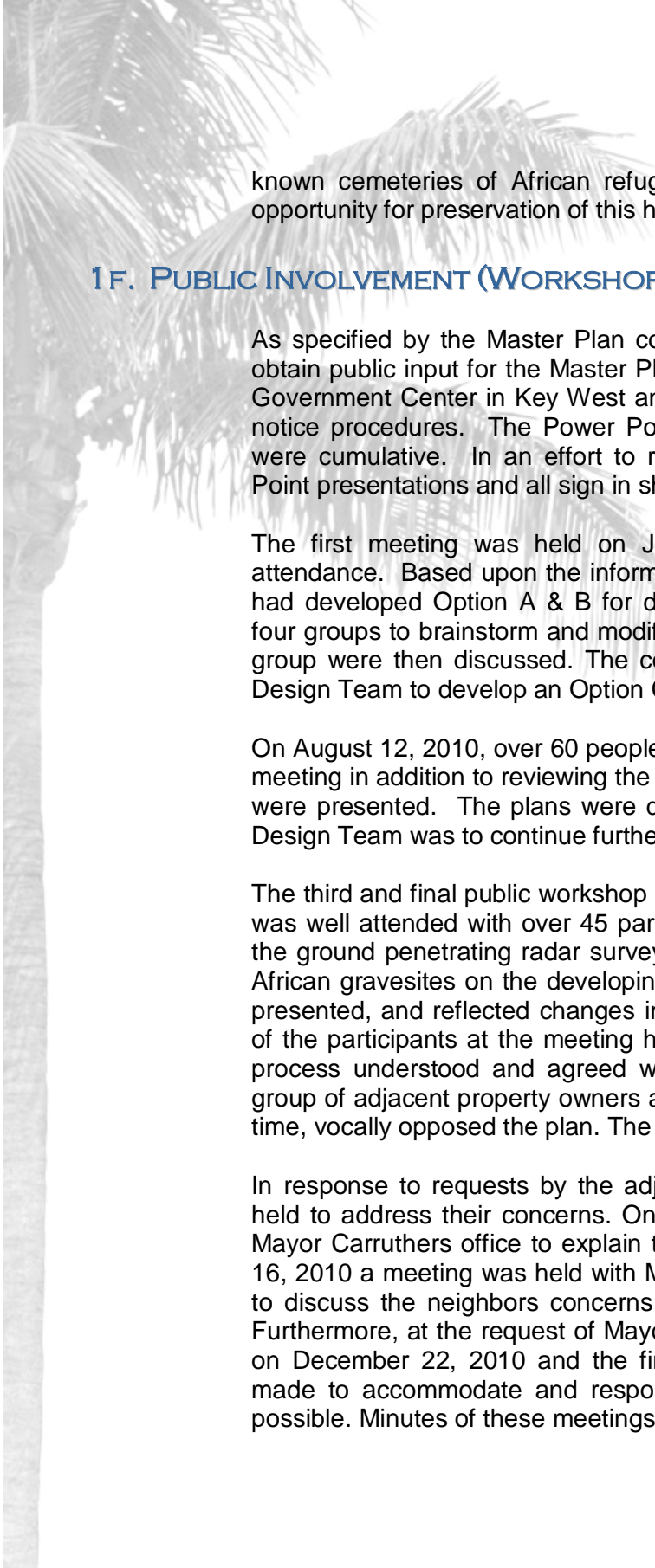
On October 13, 2010, a meeting was held with the Tourist Development Council, DAC 1, to present the Master Plan, Option C, and to inform the group of the progress to date.

1 E. ARCHAEOLOGICAL INVESTIGATION

Several years ago, a ground penetrating radar survey was conducted and identified nine gravesites located to the east of the West Martello Fort. At that time it was recognized that additional graves more than likely existed; however, funding was not available to continue the survey. From November 11 - 14, 2010, Dr. Laurence Conyers, University of Denver, with the assistance of Corey Malcom, Director of Archaeology Mel Fisher Maritime Heritage Society conducted a ground penetrating radar survey of the park area's most likely "hot spots". Gravesites were identified as



shown in the adjacent sketch with the red dots. It is likely that additional graves exist beneath the Atlantic Blvd although the radar technique used cannot penetrate paving surfaces. The Conceptual Master Plan developed to date was revised in order to accommodate an undisturbed area for the graves. The location of these graves is a significant archaeological discovery, one of the only



known cemeteries of African refugees in the United States and presents an opportunity for preservation of this historic discovery.

1 F. PUBLIC INVOLVEMENT (WORKSHOPS)

As specified by the Master Plan contract, three public workshops were held to obtain public input for the Master Plan. The workshops were held at the Harvey Government Center in Key West and were advertised in accordance with public notice procedures. The Power Point presentations presented at the meetings were cumulative. In an effort to reduce redundancy, the first and last Power Point presentations and all sign in sheets are included in the Appendices.

The first meeting was held on June 22, 2010. There were 40 people in attendance. Based upon the information accumulated to date, the Design Team had developed Option A & B for discussion. The attendees were divided into four groups to brainstorm and modify the proposed plans. Comments from each group were then discussed. The consensus of the workshop was to direct the Design Team to develop an Option C including components of A & B.

On August 12, 2010, over 60 people attended the second public meeting. At this meeting in addition to reviewing the two previous plans, Option C and C Alternate were presented. The plans were discussed and the direction expressed to the Design Team was to continue further development of Option C.

The third and final public workshop was held on December 2, 2010. The meeting was well attended with over 45 participants. During this meeting, the findings of the ground penetrating radar survey and the impact of the location of additional African gravesites on the developing Master Plan was discussed. Option D was presented, and reflected changes implemented due to the radar survey. Many of the participants at the meeting had been in attendance throughout the entire process understood and agreed with the modifications as presented. A small group of adjacent property owners attended, some of whom attended for the first time, vocally opposed the plan. The discussion of the project was extensive.

In response to requests by the adjacent property owners three meetings were held to address their concerns. On December 14, 2010 a meeting was held at Mayor Carruthers office to explain the rationale for the Option D. On December 16, 2010 a meeting was held with Mayor Carruthers and Key West Mayor Cates to discuss the neighbors concerns expressed during the December workshop. Furthermore, at the request of Mayor Carruthers an additional meeting was held on December 22, 2010 and the final Master Plan, Option E reflects changes made to accommodate and respond to the neighbor's concerns as much as possible. Minutes of these meetings are included in the Appendices.

SECTION 2: HIGGS BEACH MASTER PLAN

2A. MASTER PLAN

The Master Plan, Option E, presented in this Master Plan Report is the culmination of public, private and government input garnered through multiple workshops and data collection conducted by the Design Team during the past eight months. In this section of the report, Option E is presented and specific components of the plan are discussed. (Option E illustrated below)



During the master planning process, it became evident to the Design Team that maintaining or enlarging open space; addressing safety concerns; improving pedestrian and vehicular circulation, access and parking; responding to various user group needs for improved facilities; accommodating the Overseas Heritage Trail; preserving the existing historical resources; and preserving and enhancing the existing tree canopy were the primary goals expressed by the constituents participating in this process. The following discusses how these goals are addressed.

2B. PLAN COMPONENTS – ROAD MODIFICATIONS

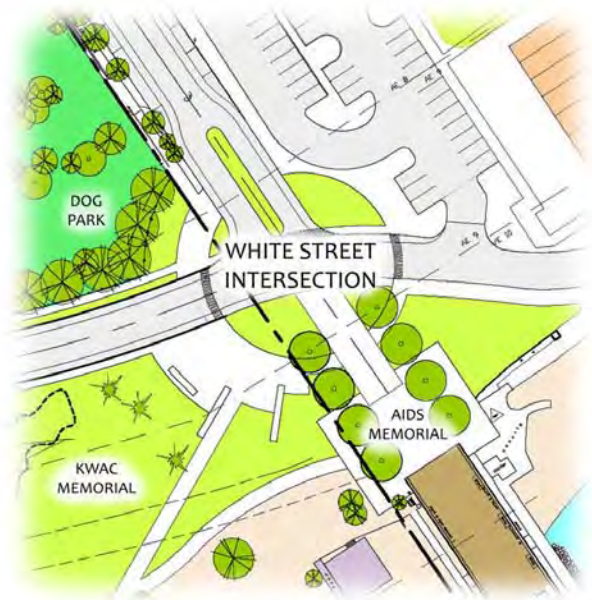
ATLANTIC BOULEVARD

Atlantic Boulevard is the lifeblood of the park and provides the primary access for many residents and visitors. During the design process, the safety concerns expressed included the proximity of the road to the West Martello Gardens, pedestrian and bicycle conflicts, loading zones for the restaurant and Gardens, the relationship of the current parking areas to the travel lanes of the road, intersections of the road with Reynolds Street and White Street. The proposed design, keeps the road alignment in the same location adjacent to the tennis courts. However, beyond the tennis courts, the road has been shifted to north and a gentle curve to facilitate traffic calming has been designed. Relocating the road has provided the additional area needed to enlarge the beach, provide room for the new playground and to preserve the recently discovered additional graves of African refugees. The parking areas have been redesigned to include crosswalks and reduce conflict points with pedestrians. The proposed design of the road has also been widened to accommodate bicycle lanes on both sides.



ATLANTIC BLVD & WHITE STREET INTERSECTION

The intersection with White Street has been changed as a result of the northern shift of Atlantic Blvd. Early in the design process, preliminary research indicated there was a need to review this location. There is no doubt that White Street and Atlantic Blvd is a very busy intersection. The potential for accidents exists due to the sheer number of automobiles, scooters, trolleys, pedestrians and bicyclists that traverse this area on a daily basis. Initial designs explored the concept of a traffic circle or "round-a-bout". The current plan provides the ambiance of a traffic circle; but retains the existing traffic pattern. It will create a sense of place for the end of White Street as well as an entrance to the park. Furthermore, it enlarges and provides an opportunity to enhance the entrance to White Street Pier and the AIDS Memorial. The median on White Street has been proposed to indicate entrance into the Casa Marina residential neighborhood. The proposed design will require the modification of the existing parking at Indigenous Park. Officials for the City of Key West have been briefed on this design proposal and its potential impact and improvement to the area.



ATLANTIC BLVD & REYNOLDS STREET INTERSECTION

The Reynolds Street entrance to the park has been modified to improve circulation and enhance this access point to the park. The parking adjacent to the tennis courts has been removed, and two Pickleball Courts are proposed. Parking for these activities has been relocated to the east end of the tennis courts. The widened roadway allows for the radius of the curve to be increased, a landscape median added, room for the bicycle lanes and a canoe/kayak drop off area.



2c. PLAN COMPONENTS – INTERIOR MODIFICATIONS

The Florida Keys Overseas Heritage Trail and the Florida Keys Scenic Highway Master Plan are two concurrent and complementary planning processes sponsored by the Florida Department of Environmental Protection and the Florida Department of Transportation respectively. Among the missions for these projects is to provide a conduit for sustainable tourism journeys into the non-traditional world of heritage and ecotourism. Both of these plans recognize Higgs Beach as an important asset and suggest a rest area or other structures to accommodate users of these trails. The Design Team studied the plans and proposes a Visitor Nature Center and other amenities in order to resonate with the spirit and mission of these significant opportunities.

VISITOR NATURE CENTER

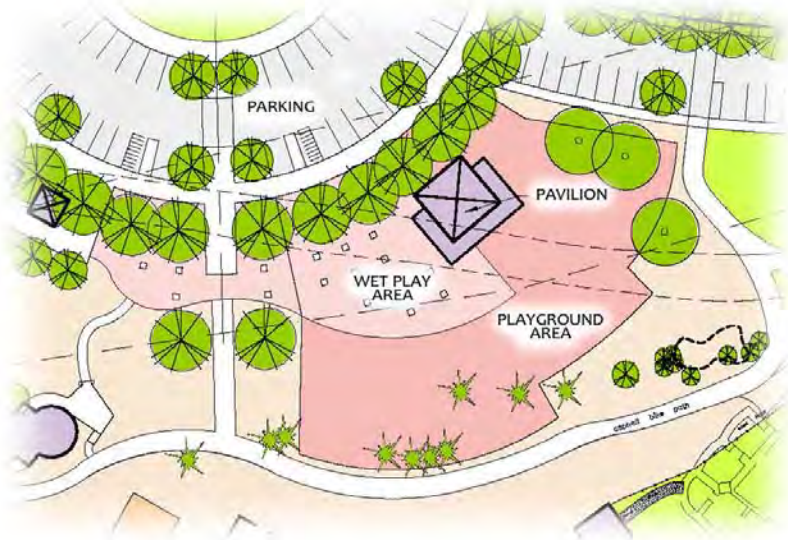
The core feature of the park is the proposed Nature Center. This central feature acts as an axis for park activities. The Center will help to create a synergy with Salute Restaurant and the relocated Astro City. The building will include a restroom for users on the north side of the park.



It provides a central location for parking and loading of pedestrians. An Art Park is suggested and retail kiosks are proposed near Salute Restaurant. To the east of the building is open green space intended for passive and active recreational activities. The dotted line indicates the existing FAA Tower boundaries. The fitness course and Whistling Pond nature area are located to the north. Landscaping will buffer these passive activities from the adjacent residential neighborhood. Although the ultimate program for the building has not been finalized, one proposed use is to provide ecological and environmental information for residents and visitors alike.

ASTRO CITY

During the public workshops, the Design Team listened to many participants discuss the status of the existing children's playground. The primary concern was for the safety of the children, the relationship of the road and parking to the playground, the lack of shade within the play area, the absence of restrooms, and the lack of access to the beach. Alternate locations with respect to the road were presented for discussion. It was generally agreed that locating the playground on the south side of the road was preferable.



The pavilion located within the playground will include restrooms and shade opportunities for users. This will separate the children's restroom from restrooms used by the general public. Many workshop participants voiced the separation of restrooms being of significant importance. A Wet Play Area comprised of ground fountains (water emitters) are shown on the proposed plan. The area will be secured with ornamental fencing for the safety and security of the children.

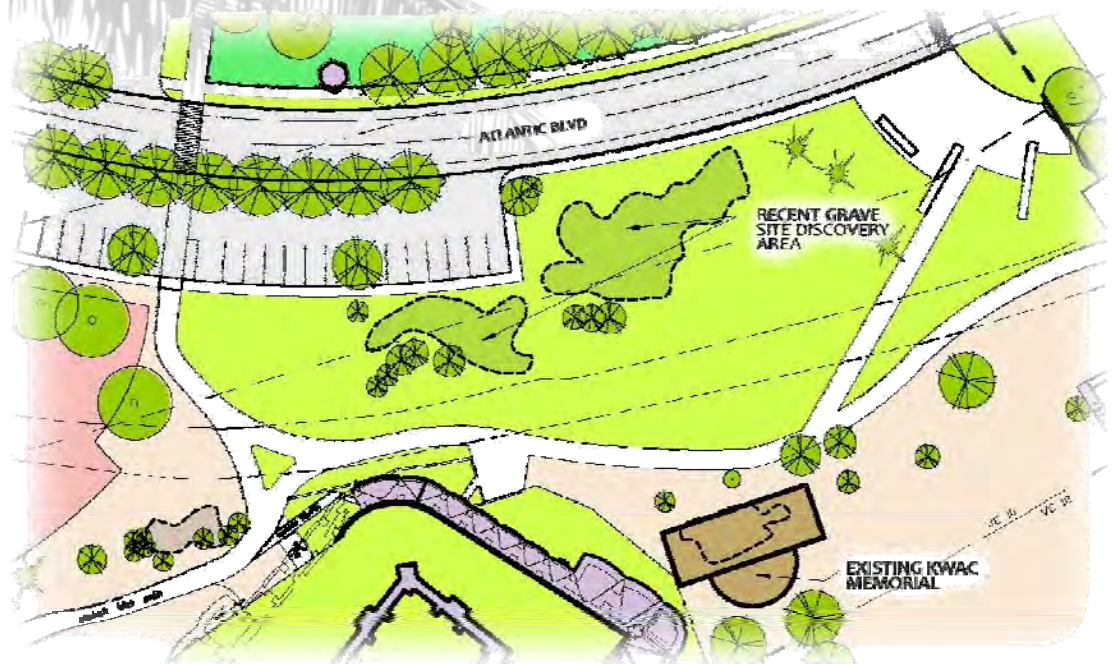
PAR FITNESS COURSE



Located on the northern boundary of the park is a Par Fitness Course. The course is comprised of solitary stations located at intervals along a path. The core concepts of par fitness courses are for the equipment to blend into the outdoor environment and to keep it simple. Par course exercise equipment includes strength training, plyometric and stretching stations. The course has been located intentionally away from the beach area in order to encourage use by all shapes and sizes of people.

AFRICAN MEMORIAL AND GRAVEYARD

As discussed earlier in this report, a ground penetrating radar survey was conducted in November 2010. This survey revealed a significant number of graves located as shown in Section 1 of this document. The boundaries of the survey conducted extended beyond the location of the found graves. Upon completion of the survey, the Master Plan was revised to relocate the Small and Large Dog Parks, shift the road and relocate proposed parking in order to remove all development from the grave area. It is expected that additional



graves are located beneath the existing road (shown by the dashed lines in the above picture). Once the road has been removed, these too shall be preserved. The history of the African refugees and the West Martello Fort are linked together. The opportunity to preserve and enhance these two parts of island history adds another gem to the features of Higgs Beach Park. An additional benefit is the further protection of the West Martello Fort due to the relocation of the road away from the Fort. During the public workshops, members of the Key West Garden Club provided insight into their use of the Fort and their impact during special events held at the Fort. Primarily, their concern was for adequate parking and the ability for loading and unloading supplies needed for special events such as the annual Garden show and catered events that occur at the Fort. Although the discovery of the graveyard precluded the location of parking adjacent to the Fort, the pathways planned are of a sufficient width to accommodate delivery vehicles when needed for special occasions.



OTHER IMPROVEMENTS

The Master Plan developed proposes to significantly expand the sandy beach area on both sides of the Fort. This will provide room for expansion of the current Volleyball Courts. The Salute Restaurant has remained the same, as required by the City of Key West Land Development Regulations, but access and parking for the restaurant have been expanded and a loading zone and recycle area have been proposed. Overall, the parking quantity provided by the new design is consistent with the current parking count. The proposed parking has been designed and is compliant with Key West City Code. The band stands (aka gun turrets) and the existing restrooms remain intact. The existing Australian Pines are shown on the plan and, at this time are scheduled to remain.

By shifting the road to the north, the safety of pedestrian circulation has been increased. There is less of an opportunity for conflict between people and vehicles. While some of the current beach sidewalks will remain the same; others are proposed for widening to accommodate all users groups.

Additional upland improvements include investigation of the Whistling Duck Pond to improve its viability as a fresh water pond, possibly integrate it with the overall Storm Water Plan and reduce the mosquito infestation. The Master Plan anticipates the removal of the FAA Tower. The area occupied by the Tower is intended for green space and open playing fields. The major improvements proposed for the park are not located within the Tower area and therefore, an extended timeframe for removal of the Tower should not impact the implementation of other park elements.



SECTION 3: PLAN IMPLEMENTATION

3A. PLANNING PROCESS

The first step in implementation of the Master Plan for Higgs Beach will be to acquire development approval through the City of Key West Planning Department and City Commission. Applications for Conditional Use Approval will be required. These applications will include conceptual Site, Building (Floor and Elevations), Storm Water, and Landscape Plans. A traffic study will more than likely be needed to review the impact of the proposed changes to White Street. It is anticipated that due to funding constraints the time needed for development will exceed that authorized by a City Development Order. Therefore, a Development Agreement between Monroe County and the City of Key West will be required. The City staff, the Development Review Committee, the Tree Commission and the Planning Board, will review the Conditional Use application. Any variances will require approval by the Board of Adjustment. The Development Agreement will be reviewed in the same fashion, with final approval by the City Commission.

3B. PERMITTING PROCESS

Upon receipt of development approval outlined above, the permitting process begins. Development of construction drawings will be required. An Environmental Resource Permit (ERP) granted by the South Florida Water Management District (SFWMD) will be needed.

3C. POTENTIAL PHASING

The potential phasing plan cannot be determined as this time. The Monroe County Board of Commissioners will need to prioritize the improvements suggested by the Master Plan. It is expected that FDOT funds for improvements/relocation of the road will be funded in the FY 2014/15 budget.

3D. COST ESTIMATE

Please see the following spreadsheet.

MONROE COUNTY				HIGGS BEACH PARK		
				CONCEPTUAL MASTER PLAN		
				PRELIMINARY ESTIMATE OF PROBABLE COST		
Estimates based on take-offs derived from Site Plan 'E' -Revised 1/19/2011				January 19th, 2011		
ELEMENTS OF DEVELOPMENT	UNITS	QTY	UNIT COST	TOTAL COST	PHASE I COST	PHASE II COST
Components of Construction					N/A	N/A
GENERAL COST						
1 Mobilization	LS	1	25,000 \$	25,000		
2 Clearing and Grubbing	LS	1	25,000 \$	25,000		
3 Maintenance of Traffic	LS	1	5,000 \$	5,000		
DEMOLITION & SITE PREPARATION						
4 Asphaltic Area (existing road, parking, etc..including sub-base)	SY	11,232	5 \$	56,160		
5 Asphaltic Area (existing bike paths)	SY	847	4 \$	3,388		
6 Concrete Area (existing sidewalks, courts, etc...assuming 4" thickness)	SY	1,166	4 \$	4,664		
7 Misc. Drainage Structures, Signs, Pipes, Etc..	LS	1	18,000 \$	18,000		
8 Concrete Structures (assumed rod reinforcement i.e.-existing picnic structures)	LS	1	10,000 \$	10,000		
9 F.A.A. Antenna/Associated Structures (verify with appropriate agencies)	n/a		\$	-		
10 Dog Park Equipment Removal/Storage	LS	1	5,000 \$	5,000		
11 Astro Park Demolition	LS	1	5,000 \$	5,000		
12 Sediment Barriers / Silt Fence	LS	1	2,500 \$	2,500		
HORIZONTAL ELEMENTS						
13 Roadway	SY	6,683	85 \$	568,055		
14 Parking Area	SY	6,115	80 \$	489,200		
15 Sidewalk	SF	62,785	8 \$	502,280		
16 New Beach Area - Sand	SY	3,053	30 \$	91,590		
17 Whistling Duck Pond Improvements	LS	1	100,000 \$	100,000		
18 Site Drainage System (actual estimate pending final drainage design)	LS	1	350,000 \$	350,000		
19 Site Utilities (actual estimate pending final utility design)	LS	1	250,000 \$	250,000		
VERTICAL ELEMENTS						
20 Nature Center Bldg	LS	1	1,500,000 \$	1,500,000		
21 Maintenance Bldg	LS	1	300,000 \$	300,000		
22 Playground Restroom / Shade Structure	LS	1	200,000 \$	200,000		
23 Park Pavilions	LS	2	15,000 \$	30,000		
AMENITIES						
24 PAR Fitness Course	LS	1	50,000 \$	50,000		
25 New Playground (dry equipment and installation)	LS	1	100,000 \$	100,000		
26 Playground Base and Surface Material w/Filter Fabric	SF	15,000	3.00 \$	45,000		
27 New Playground - Wet Play Area	LS	1	70,000 \$	70,000		
28 Volley Ball Court	LS	2	8,000 \$	16,000		
29 Pickle Ball Courts	LS	2	9,000 \$	18,000		
30 Way-Finding / Informative Kiosks	LS	1	1,600 \$	1,600		
31 Open Green Space (see landscape seed/sod)	SY	160,000	0.65 \$	104,000		
32 Dog Park Construction (Potentially done by volunteers at no cost)	LS	1	20,000 \$	20,000		
33 Decorative Fencing (4') (dog park and playground)	LF	1,564	60 \$	93,840		
34 Decorative Fencing (6') (along white street only)	LF	325	80 \$	26,000		
35 Interpretive Signage	LS	1	10,000 \$	10,000		
36 KWAC Memorial Improvements (potentially done by KWAC)	n/a		\$	-		
37 Site Furnishings						
38 Picnic Tables	EA	12	1,200 \$	14,400		
39 Bike Racks	EA	6	600 \$	3,600		
40 Benches	EA	12	750 \$	9,000		
41 Trash Receptacles	EA	16	750 \$	12,000		
42 Entry Monuments	EA	2	15,000 \$	30,000		
LANDSCAPING						
43 Tree Protection Barriers	LF	1	15,000 \$	15,000		
44 Landscaping (materials and installation)	SF	1	297,500 \$	297,500		
45 Temporary / Fixed Irrigation	LS	1	60,000 \$	60,000		
46 Seed/Sod (open green space)	LS	210,000	0.65 \$	136,500		
				Sub-total	\$ 5,673,277	
CONTINGENCY						
Estimating Contingency	@15%			\$	850,992	
				TOTAL PROJECT COST	\$ 6,524,269	
ESTIMATE NOTES:						
***Project phasing is contingent upon funding sources yet to be determined and by staff/county priorities; no phasing suggestions are presented at this time.						
***Unit pricing values are based on current/relevant contractor pricing.						
***Lump sum values are target allowances contingent upon design development and final construction specifications and are subject to change.						
***All demolition and removal assumes proper and legal disposal of materials demolished.						
***All estimates of cost are based on a conceptual master plan and should be regarded as conceptual in accuracy, contingency applied may be plus/minus.						
***FAA Antenna Demolition, KWAC Memorial, Permitting Fees and Design Service Fees not included in estimate of cost.						
<i>William P. Horn Architect, P.A.</i>						

WILLIAM P. HORN
ARCHITECT, P.A.

WILDLIFE
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MITCHELL PLANNING & DESIGN

INNOVATIVE ENGINEERING
GROUP INC.

TRAFFIC TECH ENGINEERING

ISLAND SURVEYING INC.



S.A.L.

THESE ARE PRELIMINARY
NOT BE PROCEEDED
WITHOUT THE
APPROVAL OF THE
WILLIAM P. HORN

DATE
06-22-10

REVISIONS
12-30-10

DRAWN BY
EMA

CHECKED BY
WILLIAM P. HORN
1994



A-3



- ADDITIONAL IMPROVEMENTS POSSIBLE WITH RELOCATING ROAD NORTHWARD**
- * CREATES MORE AREAS BEACHSIDE
 - * PLAYGROUND MOVES TO BEACHSIDE
 - * VISITOR NATURE CENTER GOES TO PARK SIDE OF ROAD AND SUPPORTS SPORTS USES AND MULTIPURPOSE FIELD EVENTS
 - * ROAD MOVES AWAY FROM FORT AND GRAVES SITES
 - * ALLOWS POSSIBLE REDESIGN OF END OF WHITE STREET AND ENTRY TO PARK

- ① FITNESS TRAIL STOP
- COVERED TABLE
- ☒ SHADE STRUCTURE

SCALE: 1" = 40'-0"

PROPOSED SITE PLAN - OPTION E

SITE PLAN BASED ON INFORMATION OBTAINED FROM SURVEY PREPARED BY FREDERICK H. HILDEBRANDT, SURVEYOR DATED ON 04-23-10

CLARENCE HIGGS BEACH - MASTER PLAN

KEY WEST, FLORIDA



Ground Penetrating Radar Archeological Report

Ground-penetrating radar mapping in the search for graves Higgs Beach area, Key West, Florida

Lawrence B. Conyers, PhD
Geophysical Investigations Inc.
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Denver, CO 80210

Prepared for:

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Introduction

Ten grids of ground-penetrating radar (GPR) data were collected in various areas to the north and on Higgs Beach along the south coast of Key West, Florida in November, 2010. The purpose of this study was to search for graves of various ages (Malcolm 2010) that might still exist in this area, in preparation for a re-development of the general area and possible relocation of Atlantic Blvd. The area studied were agreed on jointly by William Horn, Corey Malcolm, Johnny King and myself prior to beginning the surveys, and modified somewhat during the data acquisition as preliminary results were available and we were able to assess what areas needed to be tested further. Corey Malcolm and C. Michael Nalepa were involved in all data collection.

A GSSI SIR-3000 GPR system was used for all collection with 400 MHz antennas and a survey wheel for distance calibration. All reflection profiles were collected with a 40 nanosecond time window (equal to about 2 meters depth or 6 feet in the ground). Reflection traces were collected with 30 per meter along transects. Recorded amplitudes were gained automatically at each location where data were collected depending on the materials in the ground. Profiles were spaced 1 meter apart except for Grids 3 and 9 which had 50 cm profile spacing for greater subsurface resolution.



Figure 1: GPR system used in collection was the GSSI SIR-3000 system, 400 MHz antenna (orange box) and an attached survey wheel for distance calibration.

All data were saved to disk and then processed into profiles and horizontal amplitude slice-maps. In Table 1 are the profiles collected within each grid.

Table 1: Grid locations and profiles in each

Grid	Location	Reflection profile files
1	Higgs Beach between fort and bandstand	1-51
2	Small grid E. of Higgs Beach north of bike trail	52-84
3	High resolution grid within Grid 2	85-97
4	North of Atlantic Blvd. south of small dog park	98-108
5	Small dog park	109-131
6	Picnic area west of dog parks	132-183
7	Southern edge of big dog park	184-194
8	Western edge of small area in big dog park	195-205
9	Re-do of small dog park in high resolution	206-256
10	North of hand ball courts	257-269

The GPR Method

Ground-penetrating radar data are acquired by transmitting pulses of radar energy into the ground from a surface antenna, reflecting the energy off buried objects, features, or bedding contacts and then detecting the reflected waves back at the ground surface with a receiving antenna where it is recorded as digital wave forms on a computer in the main system (Conyers 2004). As radar energy moves through various materials, the velocity of the waves changes depending on the physical and chemical properties of the material through which they are traveling (Conyers 2004). When travel times of energy pulses are measured, and their velocity through the ground is known, distance (or depth in the ground) can also be accurately measured (Conyers and Lucius 1996), making GPR a powerful method for many historic and archaeological applications. The greater the contrast in electrical (and to some extent magnetic) properties between two materials at a buried interface, the stronger the reflected signal, and therefore the greater the amplitude of reflected waves (Conyers 2004). In grave mapping, reflections are usually created from the tops of caskets, void spaces that exist in the burial, burial goods and the discontinuities between the natural strata and soils and the homogeneous fill within the burial trenches.

Standard GPR antennas propagate radar energy that varies in frequency from about 10 megahertz (MHz) to 1000 MHz. Low frequency antennas (10-120 MHz) generate long wavelength radar energy that can penetrate up to 50 m in certain conditions, but are capable of resolving only very large buried features. In contrast, the maximum depth of penetration of a 900 MHz antenna is about one meter in typical materials, but its generated reflections can resolve features with a maximum dimension of a few centimeters. A trade-off therefore exists between depth of penetration and subsurface resolution. In this project the 400 MHz antennas were used, which produced data of good resolution at depths up to about 2 meters (6 feet) and resolved features as small as about 20 cm in dimension, which was quite good for resolving burials and many other features in the ground.

Reflection data were collected in transects spaced either 1 meter or 50 cm apart depending on the resolution necessary. Reflections obtained from within the ground were collected every 3.3 cm apart in these linear transects, within grids. All reflection data were first analyzed in two-dimensions to determine the nature of subsurface reflections, their wavelength, depth of penetration, amount and nature of background interference, and the velocity of radar energy in the ground. These reflection profiles were looked at first, and often buried features were visible in real-time on the radar computer screen during collection (Figure 1). When reflection data from field profiles were especially noisy, they were filtered later before the final products were produced for this report. Noise usually comes in the form of electromagnetic radio interference from radio, TV and cell phone transmissions. The radar antennas used for this project are within the frequency bands of these other transmissions, and therefore filtering was necessary.

In all cases the two-dimensional reflection profiles were not sufficient to show the aerial extent and origin of important reflections in the ground. This was especially true when dealing with many graves in a small area, and with other large buried features. Using a method called amplitude slice-mapping, however, the changes in reflections along and in between profiles were compared, gridded, and mapped spatially to produce images of reflection amplitude changes over an area at various depths in the ground (horizontal levels). When this was done, the layout of complex burials

and other materials in the ground became visible (Conyers 2004). In amplitude slice maps colors of the rainbow are placed on the range of amplitudes with red being strong reflections (high amplitudes) and blue little or no reflection. Slices were produced at various depths, depending on the nature of reflections and the types of features to be visualized in each grid. Approximate depths of each slice are shown on each individual map. The amplitude slice maps are analogous to arbitrary horizontal excavation levels in standards archaeological studies.

In reflection profiles two-dimensional slices through the ground from the surface (at the top) to depth were produced, which are analogous to looking at features in the wall of a trench. In these images time was placed on the left axis, measured as the two way travel time that radar waves took to travel from the antenna, into the ground, and back to the antenna (measured in nanoseconds). Velocities were calculated for this area and in general each 5 nanoseconds in two-way travel time are equal to approximately 40 cm depth in the ground. There are some variations in velocity across the area of study, but the changes were minor and therefore this velocity-depth correction was used throughout. In the reflection profiles black and white colors are showing very high amplitude reflections and shades of gray are the low amplitude areas.

Grid 1: Higgs Beach between fort and bandstand

In this grid many complex bedrock features were visible including what might be an old sea wall, inland from the present wall, and cut and fill features from many erosion events from storms. The bedrock can be seen as high reflections (Figure 2) and the beach sand as more horizontally layered lower amplitude reflections. Walls are visible as distinct hyperbolic reflections.

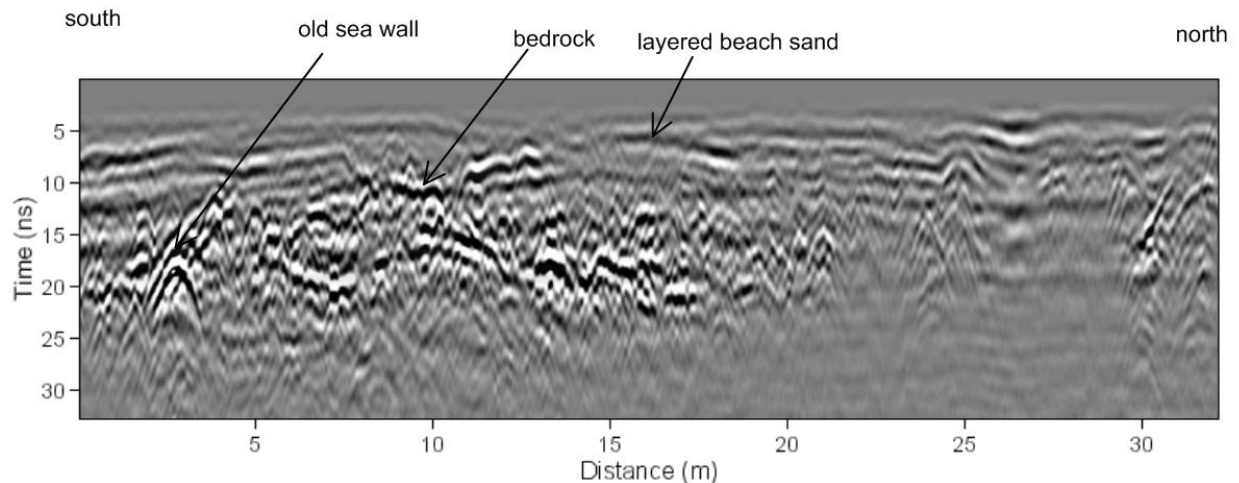


Figure 2: Reflection profile across the beach showing bedrock and beach sand reflections.

No graves were visible in the beach sand, and it is unlikely any still exist after all the erosion from hurricane flooding and placement of sand back on the beach, which Johnny King noted had occurred often. Many of these erosion channels and bedrock ledges and knobs are visible beneath the sand (Figure 3).

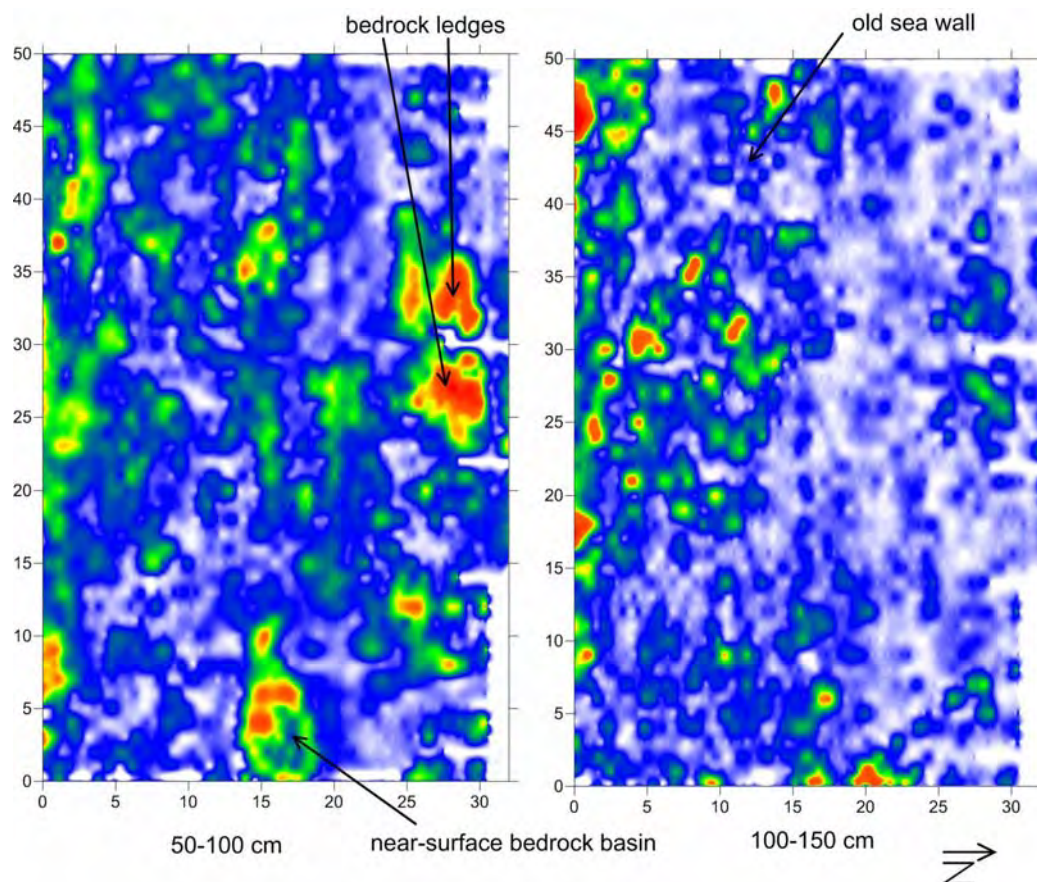


Figure 3: Amplitude slice maps of the area of Higgs Beach between the fort and the bandstand showing bedrock features and a possible old sea wall.

Grid 2: Small grid E. of Higgs Beach north of bike trail

This small grid immediately located a number of graves in its eastern portion, which we noticed on the system computer screen during collection. They appear to be intact coffins with void spaces, which are much different than most of the other graves that we located elsewhere in this study. Other interesting objects are also visible in this area behind the fort, which no doubt complicate things (Figure 4). There is also a large artifact scatter located directly next to the fort, which Corey Malcom excavated in the past when the restroom was being constructed. The realization that the material used to make the bike trails is very attenuating to radar was also first discovered during collection of the data in this grid. This problem was encountered in other areas as well. Johnny King was not able to help us with the chemistry of this material, which must be very electrically conductive and destroys much of the radar energy that attempts to pass through it. A more detailed grid of data was produced in this same area (Grid 3), where the details of the burials are much more apparent.

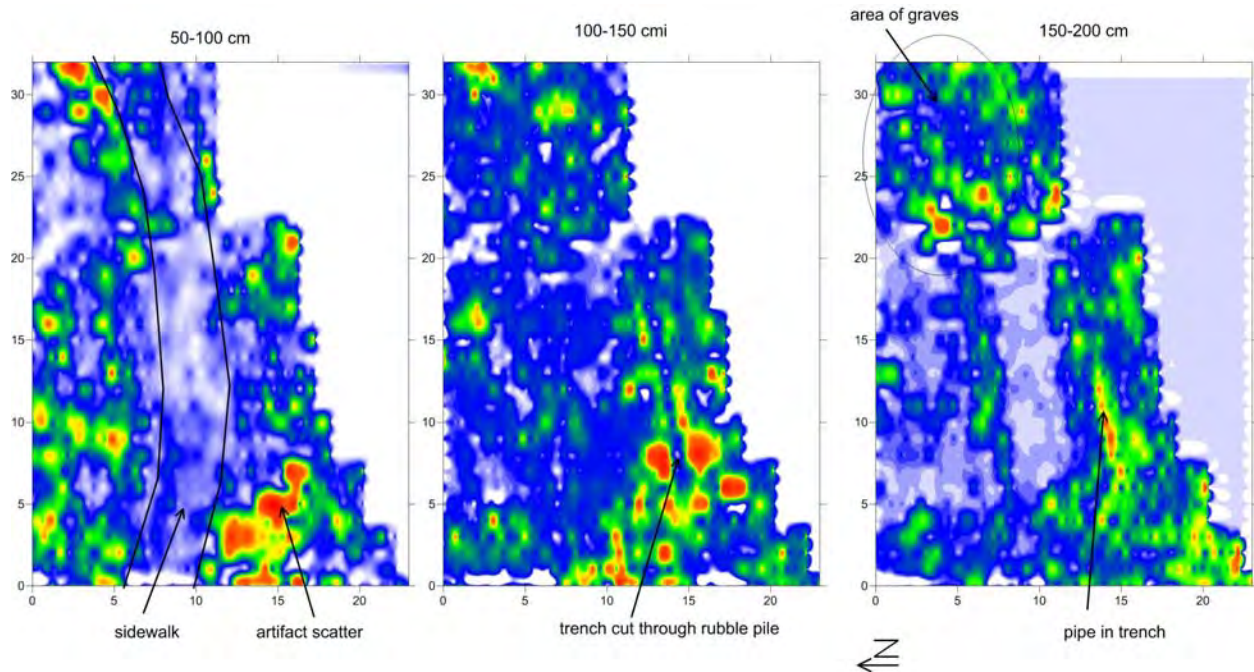


Figure 4: Amplitude slice maps just north of the fort showing the artifact scatter, an area of graves, and a few pipes. The sidewalk destroys all energy that attempts of penetrate it.

Grid 3: High resolution grid within Grid 2

The graves discovered during the acquisition of Grid 2 were re-surveyed with profiles spaced 50 cm apart and oriented north-south. Individual caskets were apparent, some of which still have void spaces in them, which are highly reflective (Figure 5).

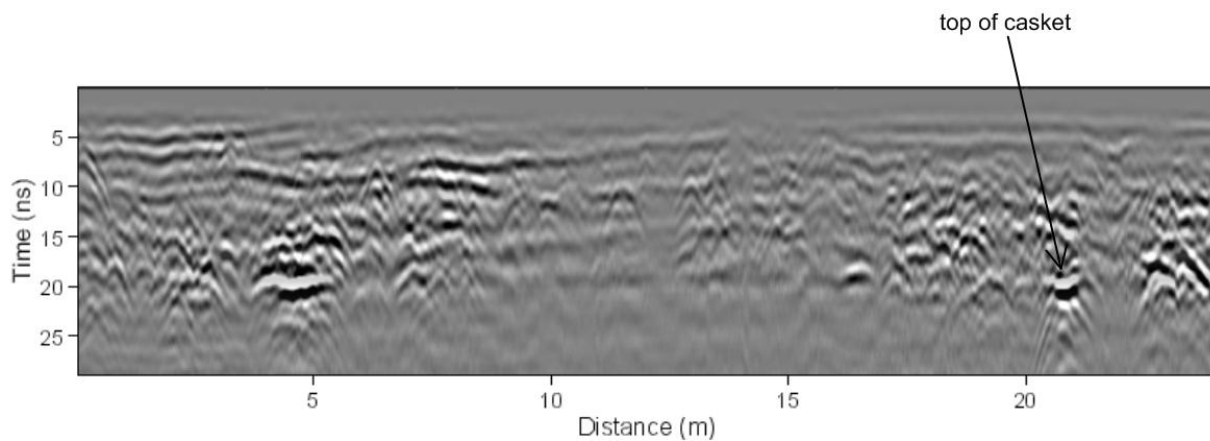


Figure 5: Reflection profile showing a casket, which likely contains a void space, producing a very high amplitude reflection.

Other graves in this grid are more subtle, which are likely less formal burials, or contain caskets that have collapsed and have no void spaces to reflect energy (Figure 6). One large complex feature is also visible in this grid, whose origin is not known (Figures 6 and 7).

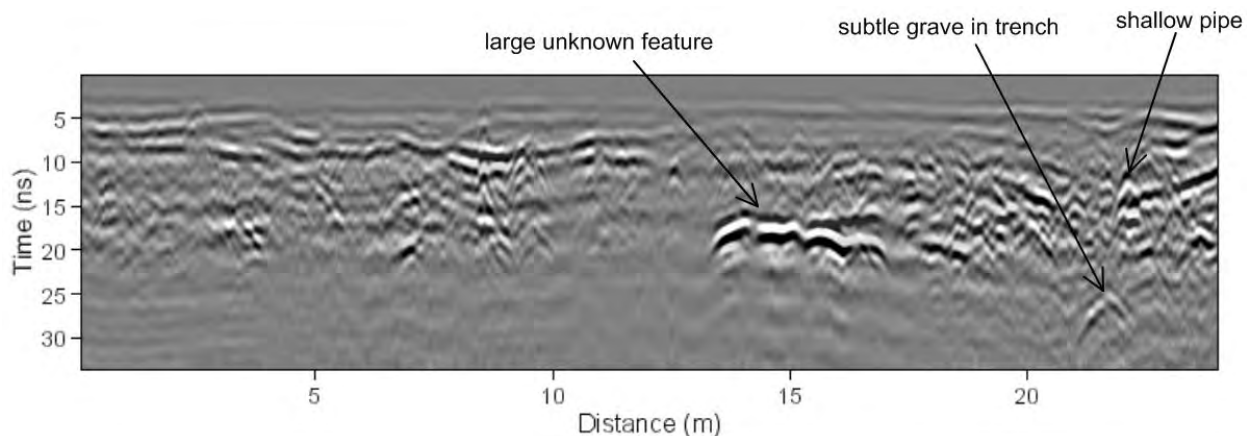


Figure 6: Reflection profile showing a subtle grave in a trench, and a large unknown feature, which may be related to activities that occurred at the fort, or the military barracks that were once located in this area.

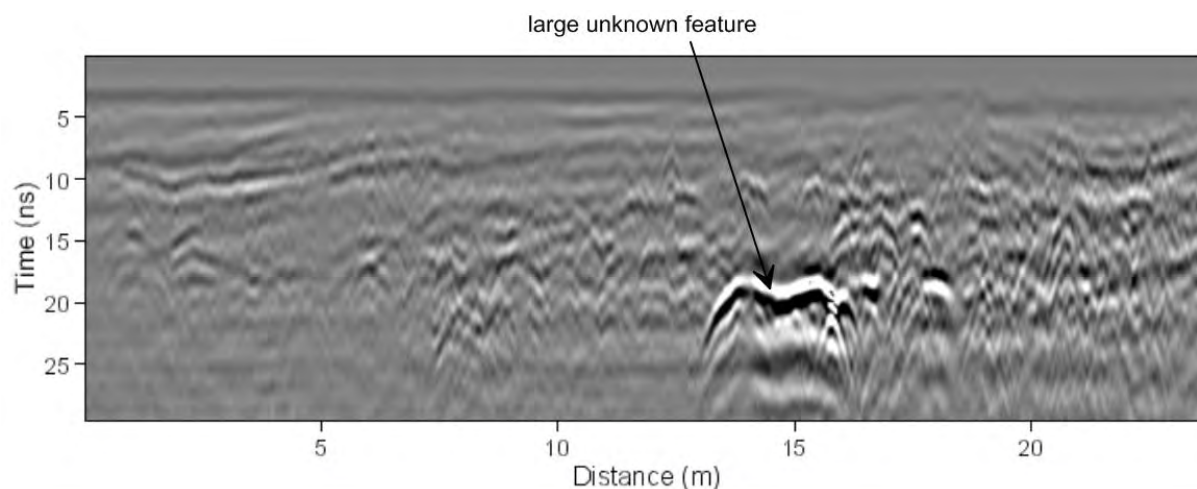


Figure 7: The same unknown feature visible in Figure 6, which is highly reflective, and contains objects within or under it.

The amplitude maps of this grid show the location of the large object, and many graves in the eastern portion of the grid (Figure 8). The graves appear to be oriented north-south, which is interesting and puzzling. My experience in other cemeteries indicate that most Christian burials are east-west oriented. But the African graves discovered to the east of the fort (Conyers and Malcom 2002) were also oriented north-south, which perhaps indicates that there is something different with burial orientations in Key West.

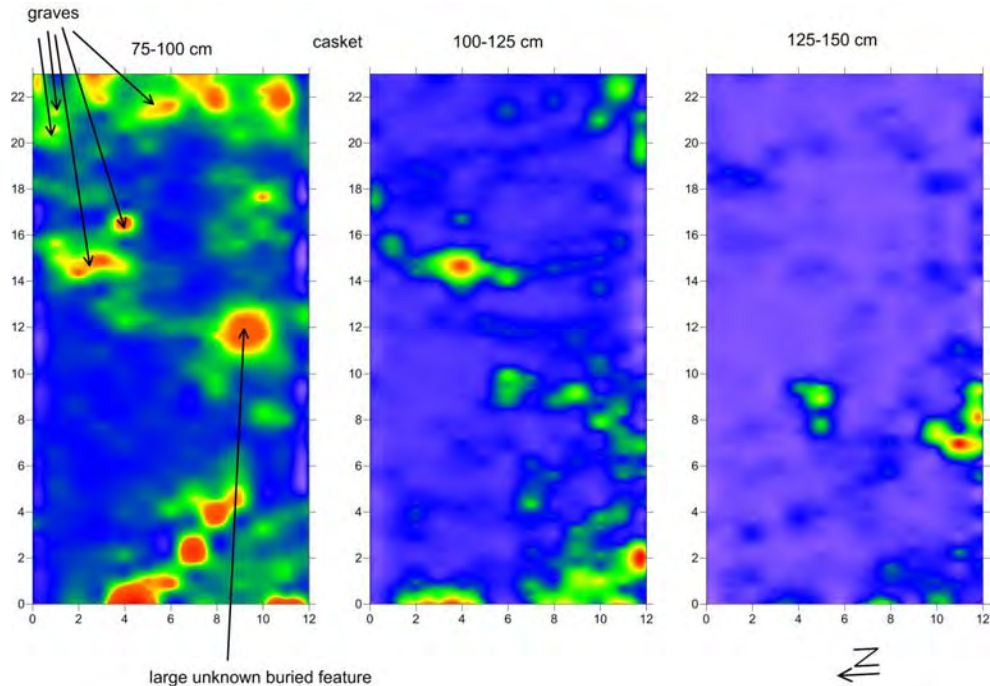


Figure 8: Amplitude slice-maps showing the large unknown object and the graves within this high resolution grid.

Grid 4: North of Atlantic Blvd. south of small dog park

This small grid showed a number of graves that are similar to those found in Grid 3. They appear to be caskets, some of which have intact void spaces (Figure 9). The ground in this grid is full of other objects as well, which make the reflections somewhat cluttered. I suspect the busy nature of these data is related to the proximity to the barracks that used to exist in this general area and a variety of surface trash or other objects that accumulated.

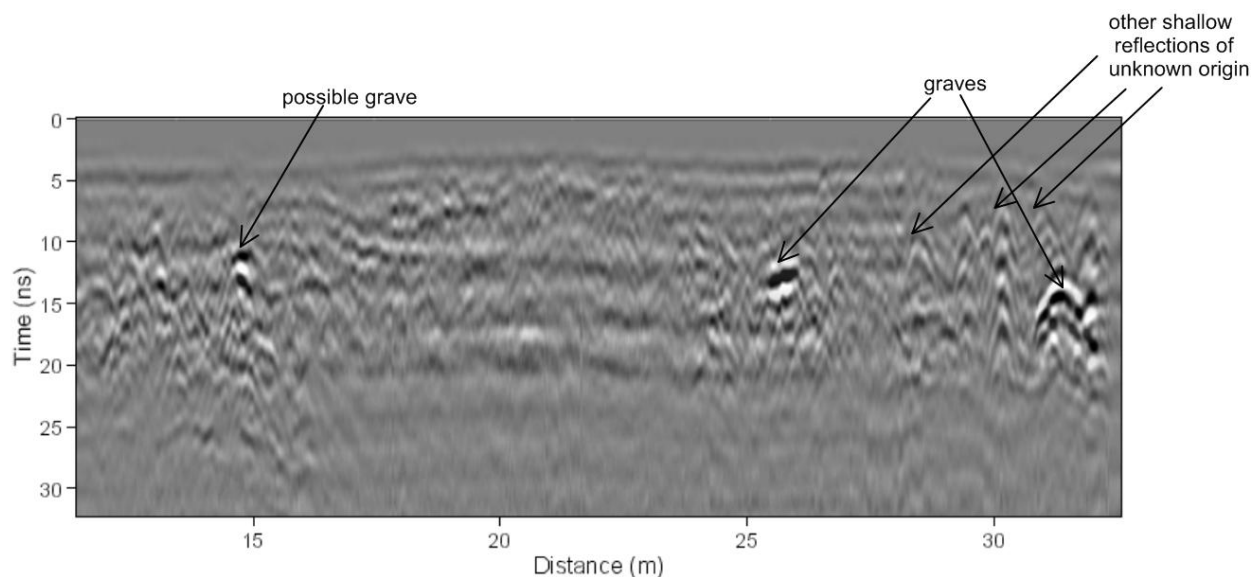


Figure 9: Reflection profile showing a few graves in Grid 4, but many other reflections of unknown origin, probably related to trash that accumulated in proximity to the fort and the historic barracks.

The amplitude slice-maps show the location of the graves in this grid, but also many other small reflections, which are likely trash that accumulated in this area related to the barracks, the fort, or road and bike trail building activities (Figure 10).

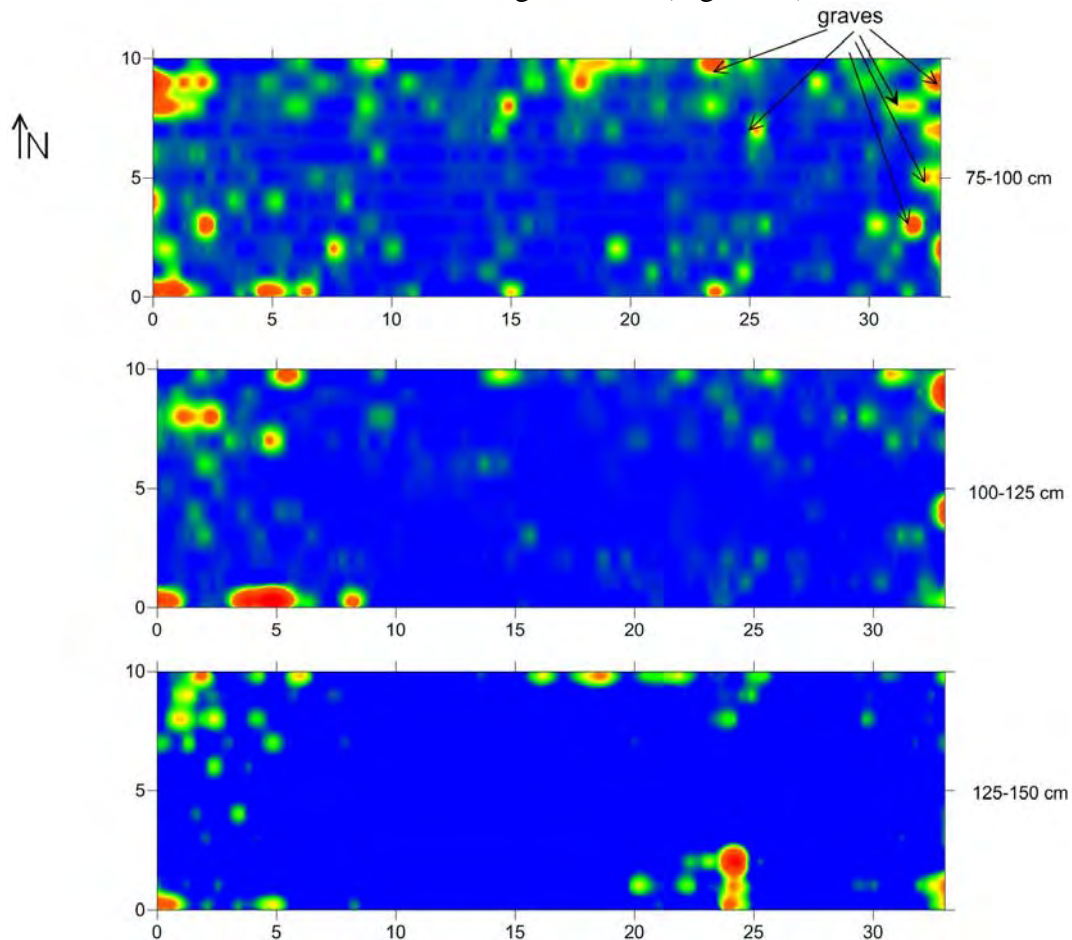


Figure 10: Amplitude slice maps of Grid 4 showing some graves and other debris that produces small reflections in the shallowest slices illustrated.

Grid 5: Small dog park

This grid in the small dog park immediately located a number of graves and what appears to be a “pit” that is filled with objects (Figure 11). So many graves were visible in this grid during collection that it was decided to collect an additional higher resolution grid (Grid 9) to better identify the burial features (Figure 12).

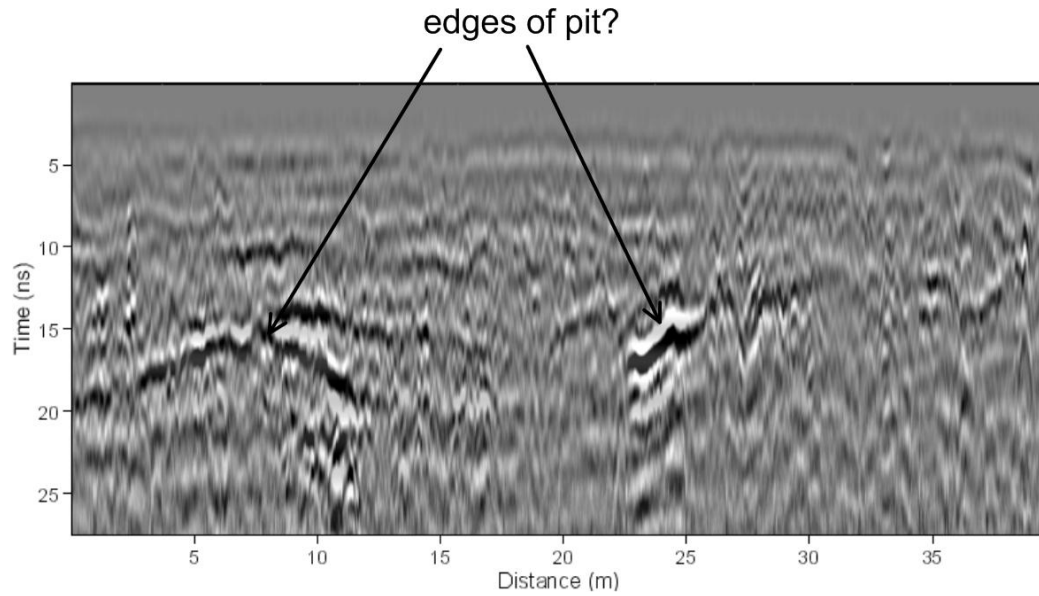


Figure 11: Reflection profile showing the edges of a pit within Grids 5 and 9 in the small dog park.

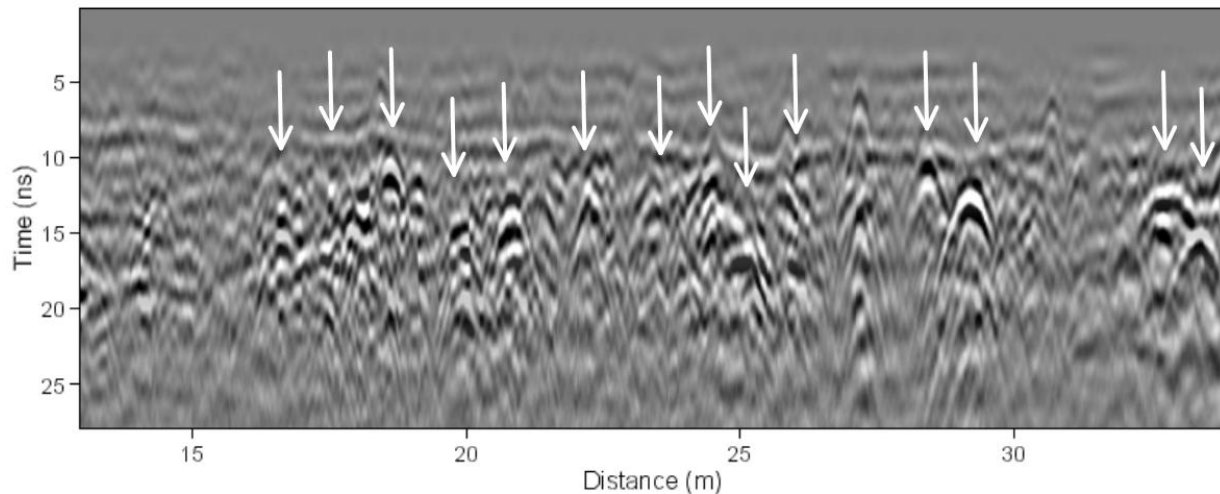


Figure 12: Reflection profile showing all the graves in this area, shown as distinct hyperbolic reflections and identified by arrows. This area has deeper bedrock than other areas mapped in the area, which is likely why there is such a concentration of graves, as the digging was much easier.

Where bedrock was closer to the surface, no graves are seen (Figure 13), indicating why graves are found in such a high concentration within the small dog park grids.

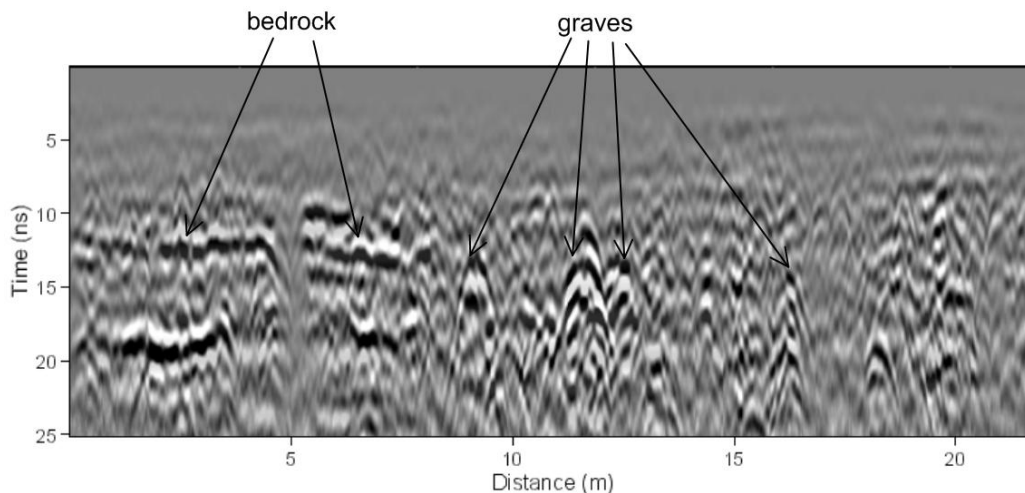


Figure 13: Reflection profile showing that when bedrock is near the surface, there were no graves dug, and areas with bedrock much deeper contain many burials.

The amplitude slice maps show a general area of graves, but because profiles were spaced only a meter apart, they are not easily identified (Figure 14). The bedrock areas near the surface can be easily identified by the red areas on the maps.

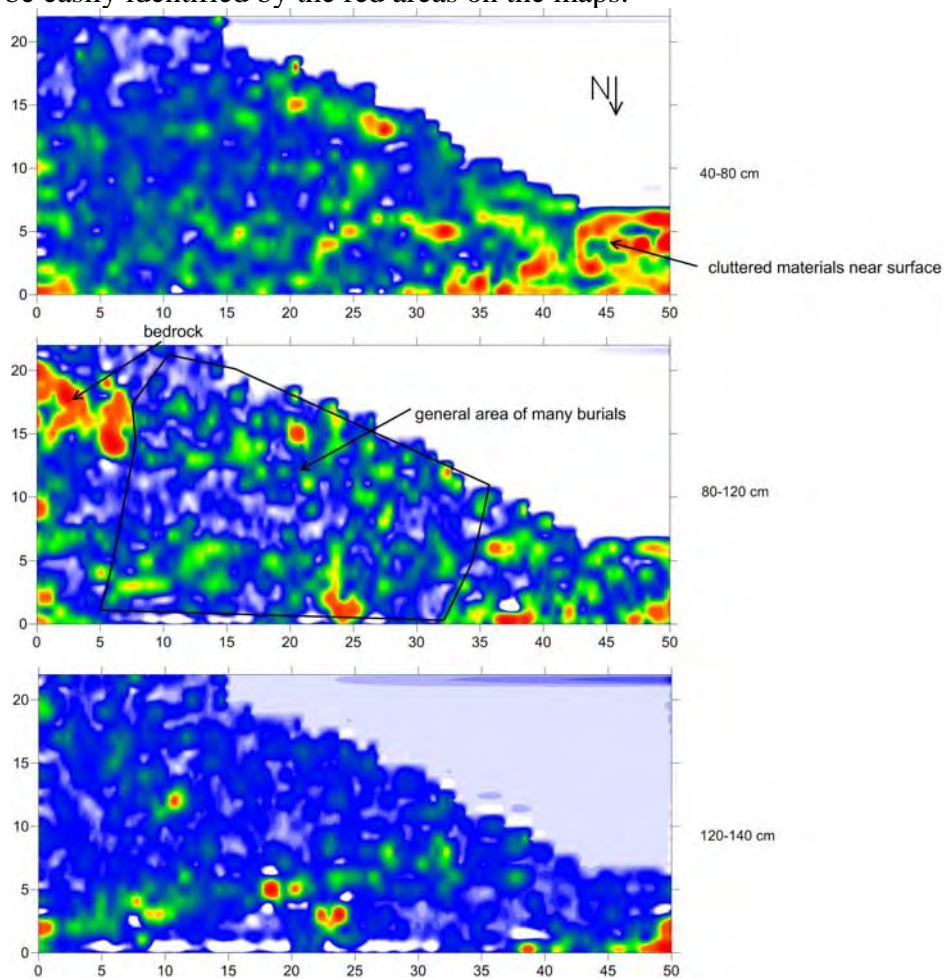


Figure 14: Amplitude slice-maps of Grid 5 showing the general area of graves in the small dog park, and the bedrock near the surface.

Grid 6: Picnic area west of dog parks

No graves were found in this large grid, but some other interesting features that help with an understanding this complex area in general. In general bedrock is close to the surface throughout the grid, which has been cut into to lay pipes (Figure 15). Other interesting features are of unknown origin, and could be related to the barracks that were located in this area.

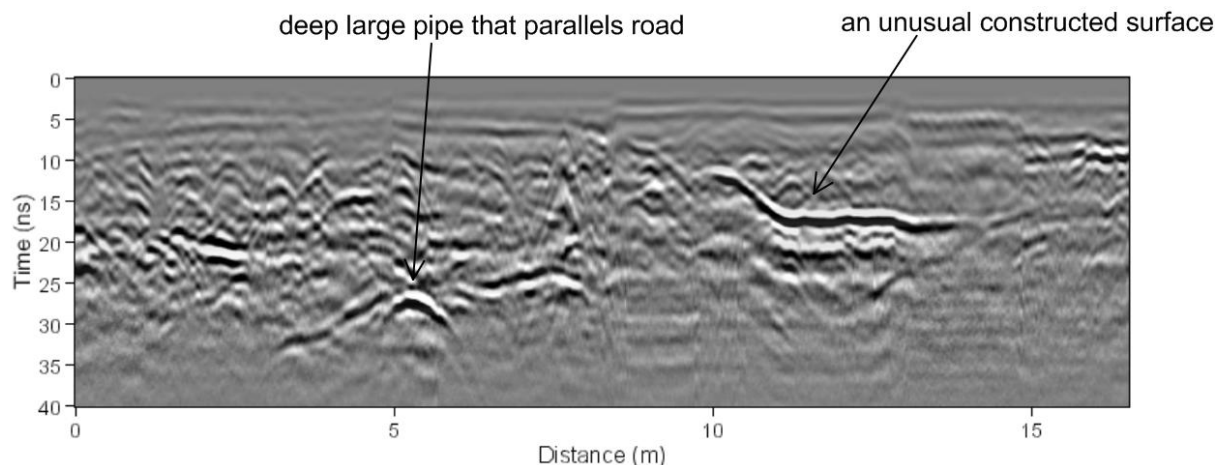


Figure 15: Reflection profile showing a deep pipe and a constructed surface of unknown origin, perhaps related to the historic barracks.

In much of the grid bedrock is very close to the surface and produces a very distinct reflection, which is sometimes very flat, and other times undulating (Figure 16).

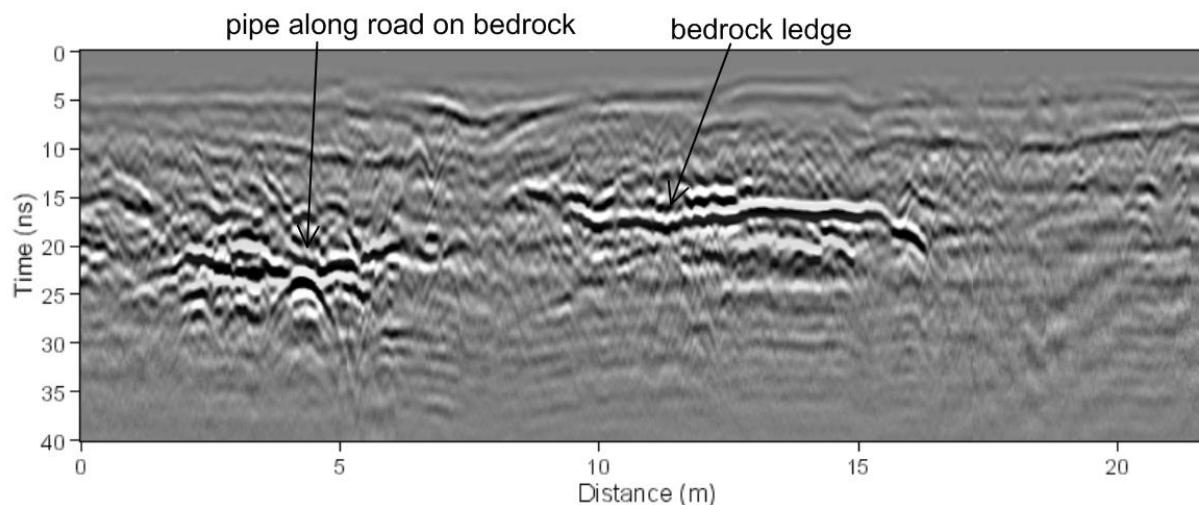


Figure 16: Reflection profile showing a buried pipe and complex bedrock reflections common in Grid 6.

In places horizontal reflections are visible filling in what was an undulating ground surface, likely produced from flooding during hurricanes. The sand fill is visible as low amplitude horizontal reflections (Figure 17).

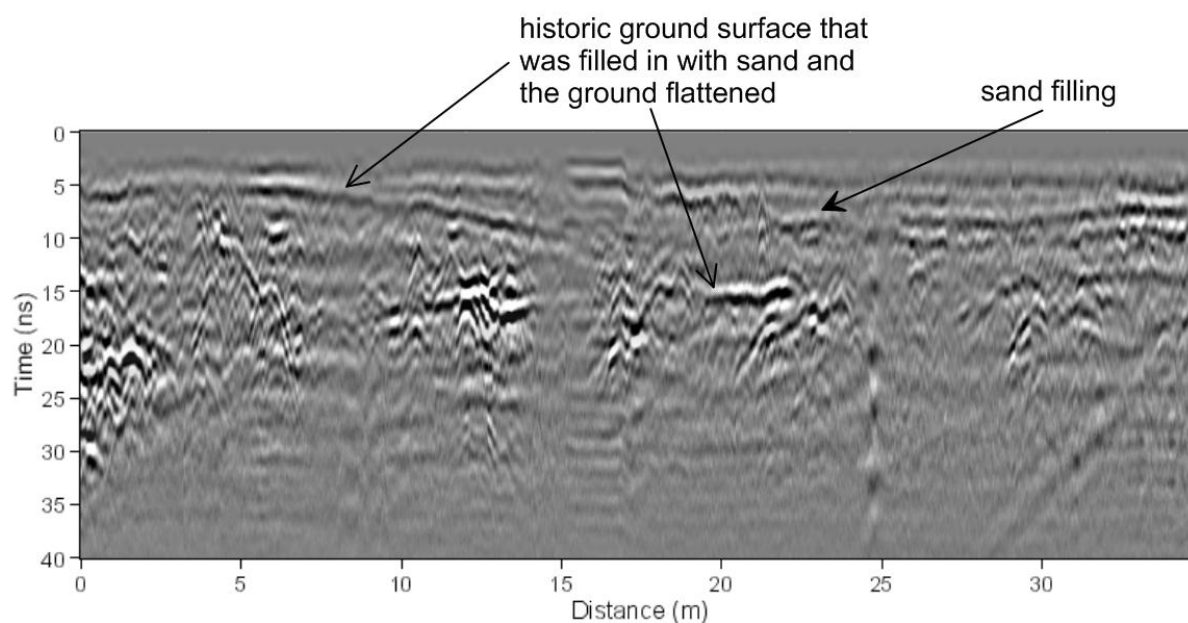


Figure 17: Reflection profile showing the sand filling that was used to level the area after channeling from flooding during past storms.

In places the bedrock is severely channeled, creating an undulating buried bedrock surface (Figure 18).

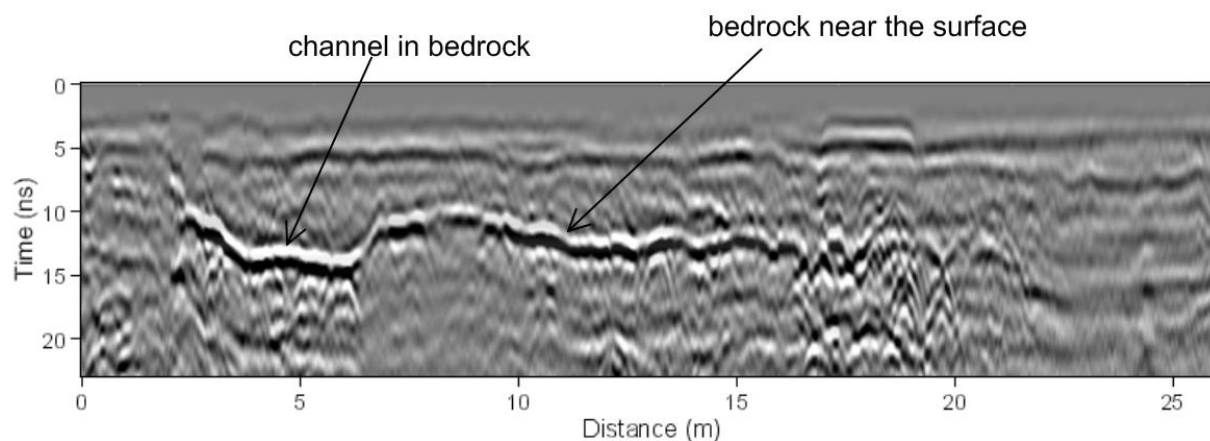


Figure 18: Reflection profile showing channeling in the bedrock.

The amplitude slice maps are complex, but potentially interesting. In a shallow slice a square feature is visible, which might be the remains of a foundation from the barracks (Figure 19). Other visible features in this grid are related to bedrock ledges and knobs that are now buried by sand to level the present ground surface.

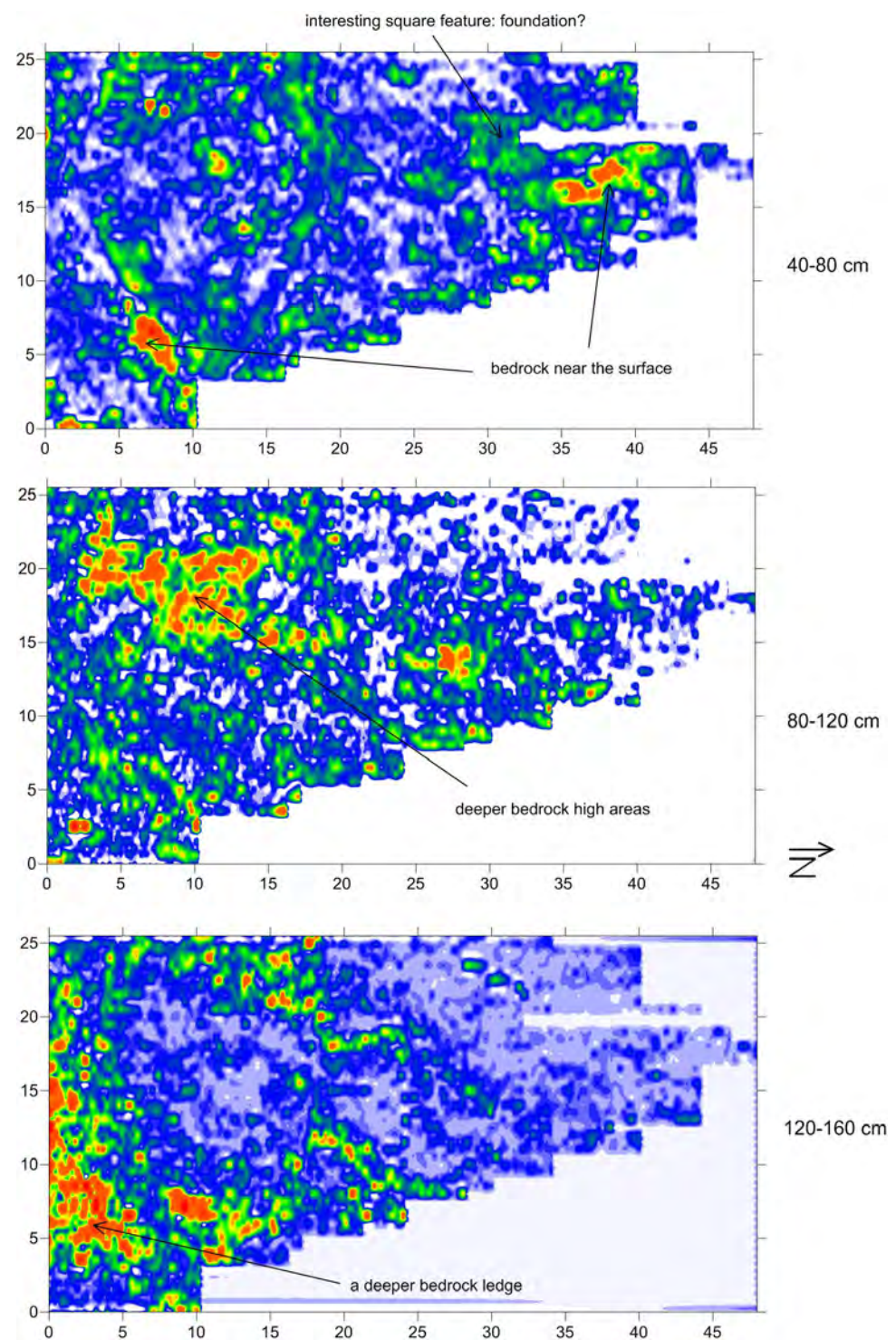


Figure 19: Amplitude slice maps of Grid 6 showing many bedrock features and one square feature, which is likely a building foundation in the 40-80 cm slice.

Grid 7: Southern edge of big dog park

Bedrock is very close to the surface in this area and no graves were found. The lack of graves in this area north of the small dog park is likely related to bedrock being located near the

surface (Figure 20). One distinct incision is visible, likely a trench for a pipe, which is no longer in the ground.

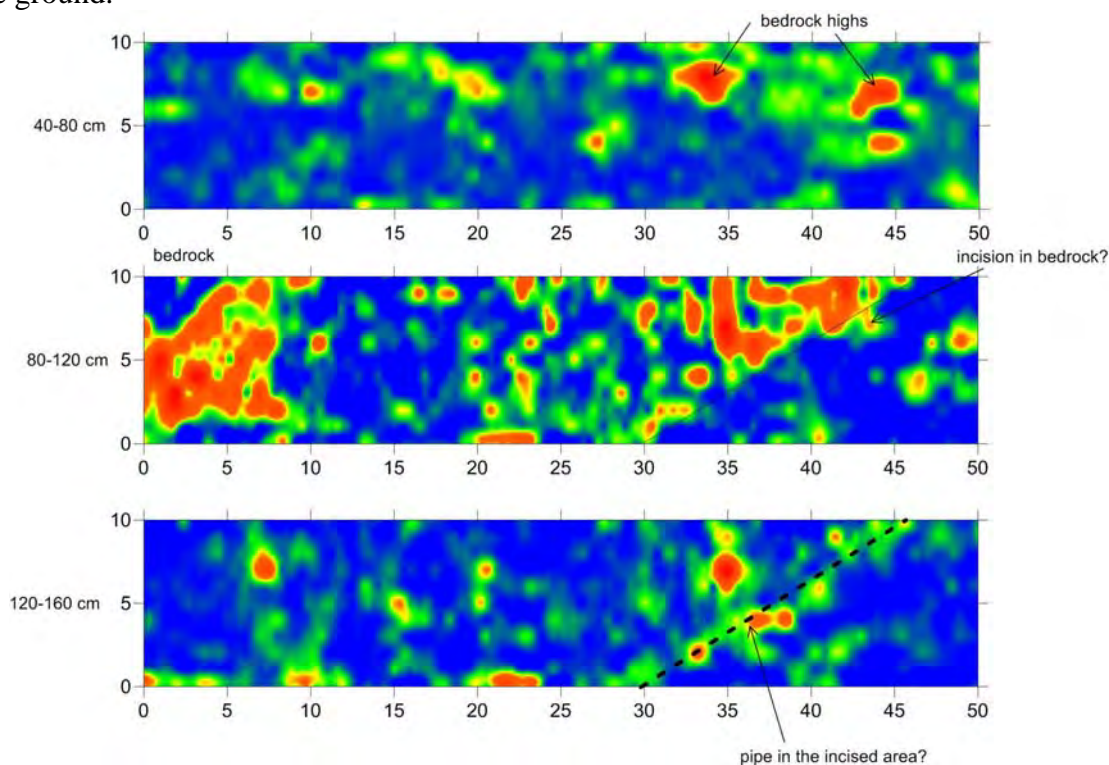


Figure 20: Amplitude slice maps of Grid 7 showing bedrock features near the surface.

Grid 8: Western edge of big dog park

A few graves were found in this grid to the west of the small dog park along the north-south fence separating the large and small dog parks. One very unusual buried object was also found in this grid (Figure 21) of unknown origin.

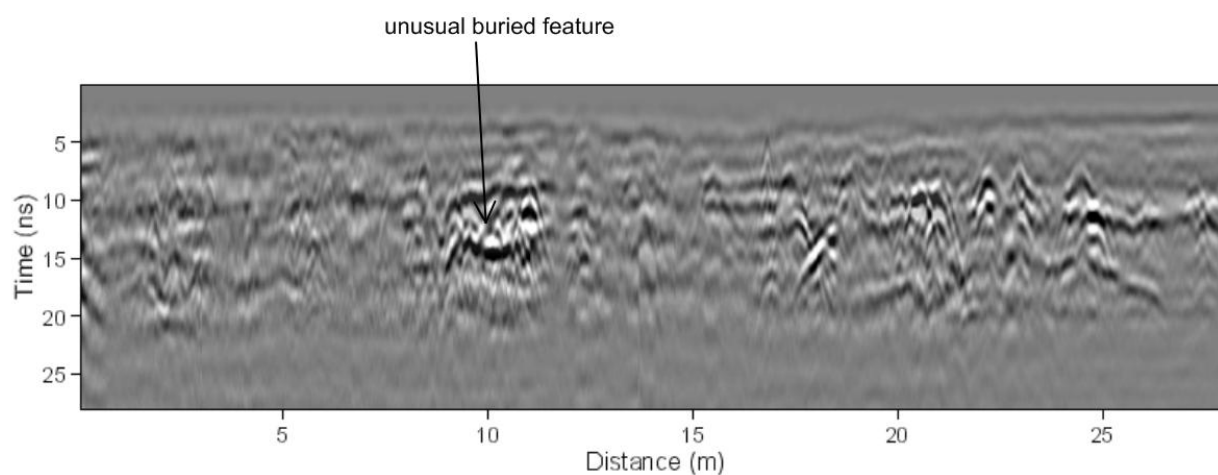


Figure 21: Reflection profile showing a large unusual object found in Grid 8.

In much of this grid bedrock is very close to the surface and only a few graves are found in the easternmost portion of the grid along the fence separating this area from the small dog park (Figure 22).

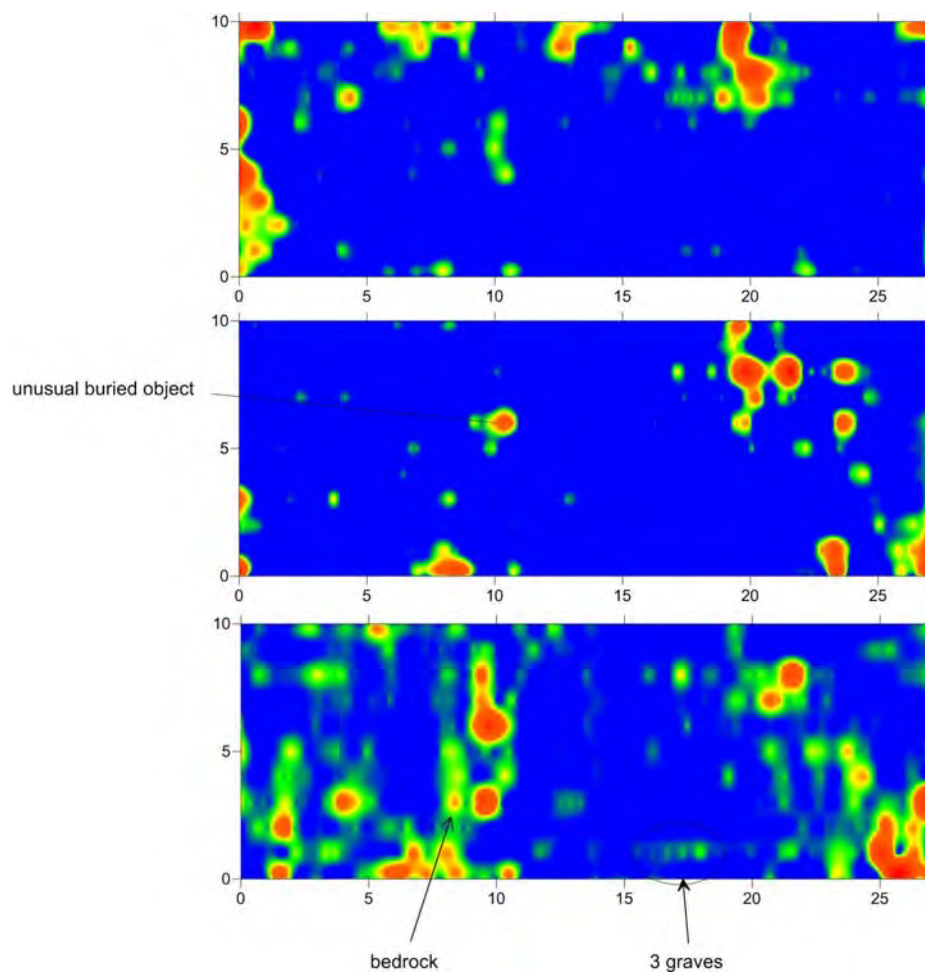


Figure 22: Amplitude slice maps of Grid 8 showing a few graves along the fence, and an unusual object (Figure 21) in the middle of the grid.

Grid 9: Re-do of small dog park in high resolution

A high resolution grid of data was collected over the same area as covered in Grid 5, in the small dog park, where the possible pit and associated graves was found (Figure 14). This grid had profiles spaced 50 cm apart, and profiles were oriented north-south instead of the east-west orientation used in Grid 5. Many burials were again found in this grid, but they could be discerned more accurately. In addition an east-west oriented pipe that crosses the burials (and cuts some of these burials) was visible in the deepest slices (Figure 23).

The graves in this grid are found everywhere there is not bedrock near the surface. Bedrock close to the surface was no doubt the limiting factor in digging trenches deep enough to bury the dead. Everywhere in this grid, this is the case. Bedrock limits the burial depth to the

north, east and west. The limits of burials to the south are not known, as the southern fence of the dog park, the bike trail and Atlantic Boulevard are found in that area and GPR surveying was impossible. It is likely that graves continue under the road in the direction where the African Cemetery is located, where burials were discovered in 2001 using similar GPR methods (Conyers and Malcom 2002).

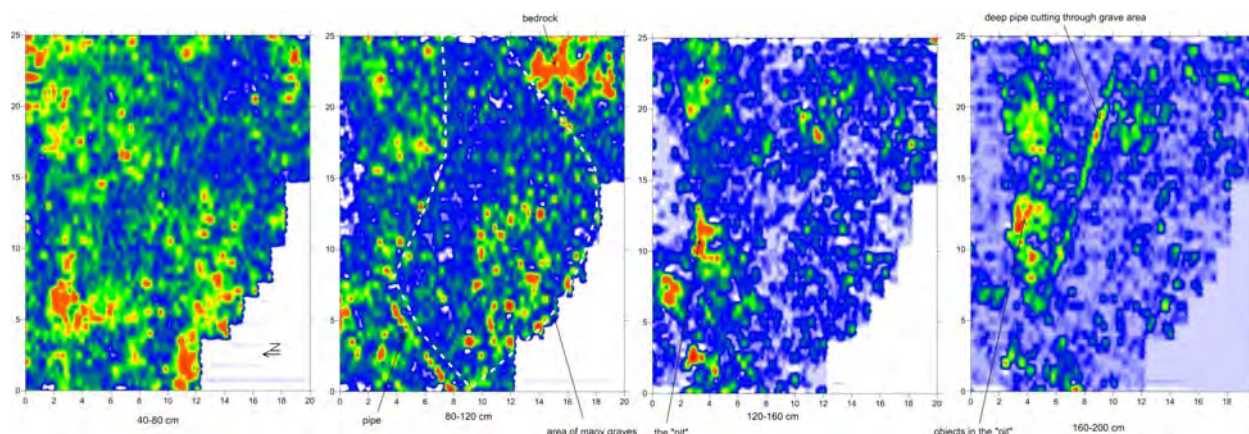


Figure 23: Amplitude slice maps of Grid 9 showing many graves in the white dashed outlined area in the second slice, the “pit” in slice 3, and the pipe crossing the area in the fourth slice.

A different look at “the pit” can be seen in many profiles in this grid (Figure 24). The pit is not a trench but instead a broad pit, which contains a number of reflective objects, whose origin is not known. The objects in the pit are jumbled, but little else can be said about them.

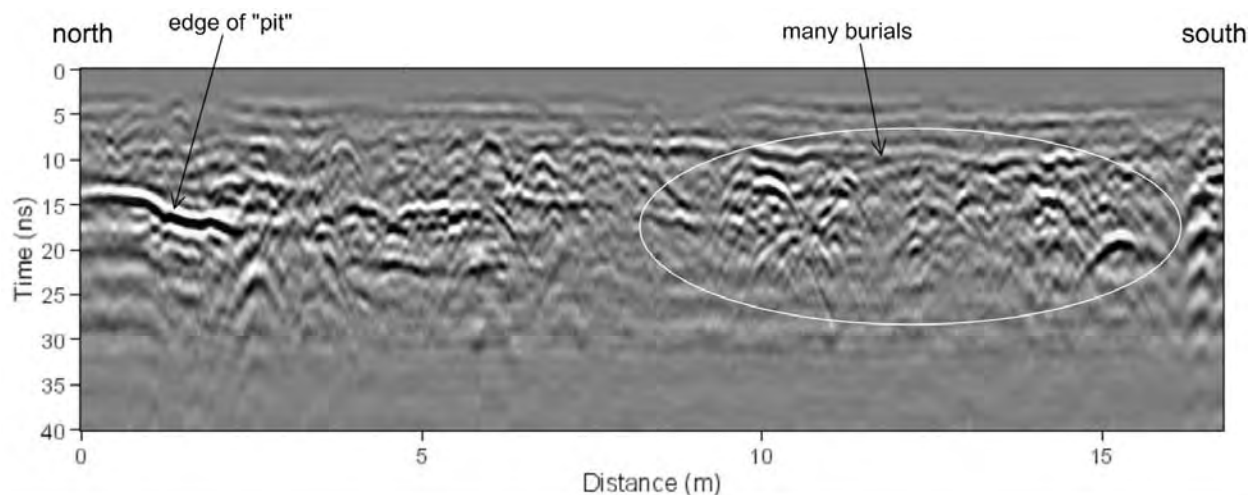


Figure 24: Reflection profile showing the north edge of the pit and burials located to the south.

A composite map, which is somewhat busy, but contains much information, is found in Figure 25. This image contains amplitudes from Grid 8 and 9, with crosses marking the most distinct graves. This image does not contain the slice showing the “pit”, but does have the individual graves located in more detail. In Figure 25 sixty-seven graves are marked, which were placed on this image based on amplitude signatures in the slice maps and also reflection

hyperbolas visible in each of the two-dimensional profiles (eg. Figures 12, 13 and 24). Two pipes also cross this area, which cut some of the graves and likely exhumed bones and other burial remains when the trenches for them were excavated. In addition it appears that some of the graves were incised into preexisting burials, making this area very complex. If some of the burials were not within coffins or informal burials of other sorts they would also be more difficult to image using GPR. So I suspect there are many more burials in this area than the 67 that are marked in Figure 25.

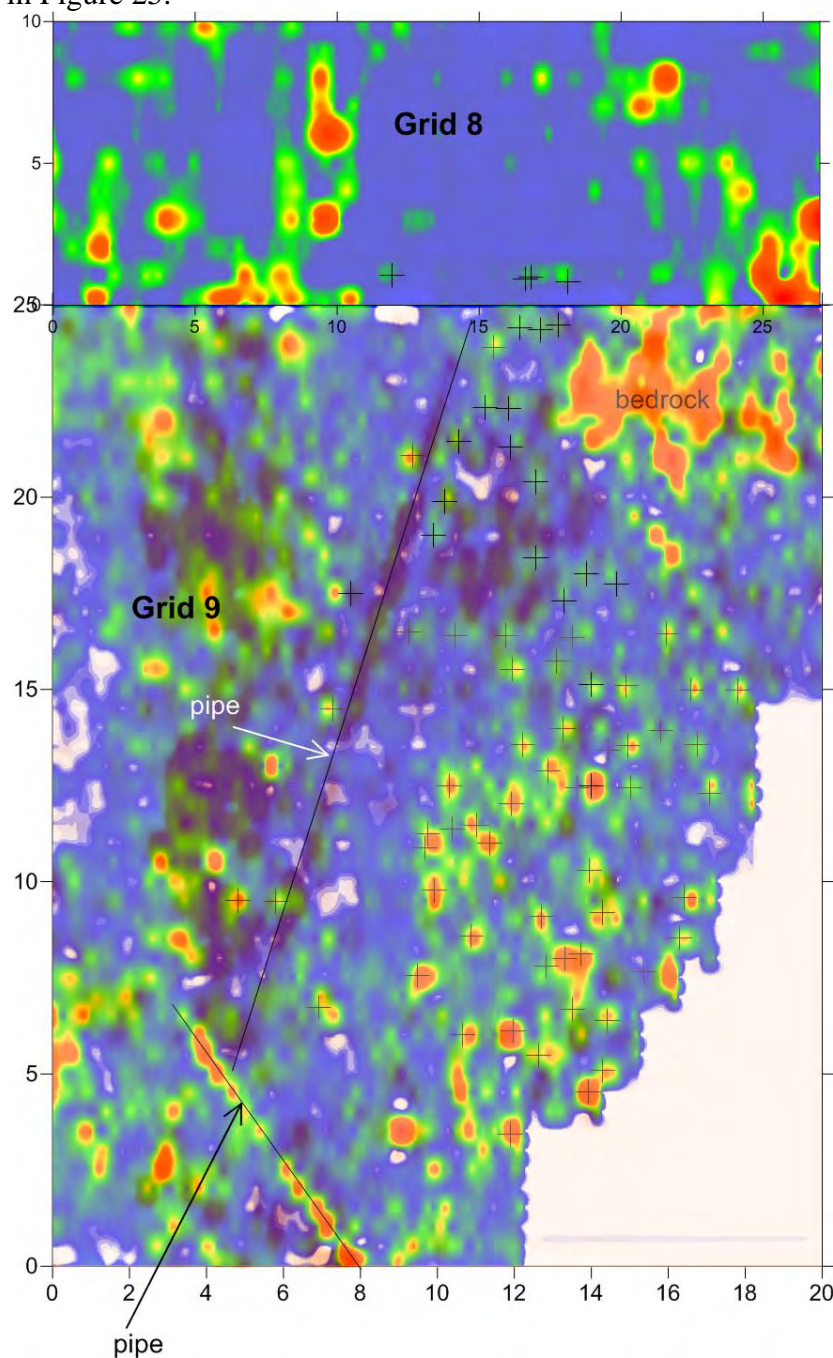


Figure 25: Composite amplitude maps of Grids 8 and 9 with crosses indicating the most distinct burials and the two most prominent pipes crossing the area.

Grid 10: North of hand ball courts

The area north of the handball courts had a good deal of the material used for paving the bike trails remaining on the surface. This mystery material, which attenuates radar energy at the surface, precluded energy penetration deeper than a few inches in the ground (Figure 26). Even with those technical problems it is apparent that bedrock is located very close to the surface in this area, and therefore would not be an area suitable for burials. No burials that are at all similar to those found elsewhere in the other grids were found in this grid, and only reflections from bedrock near the surface (Figure 27).

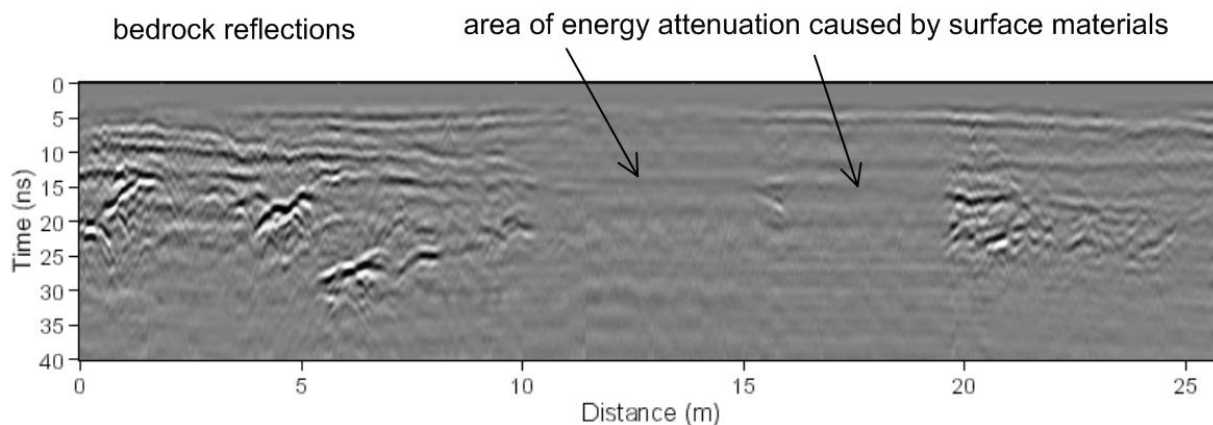


Figure 26: Reflection profile showing attenuation caused by paving materials stored on the surface.

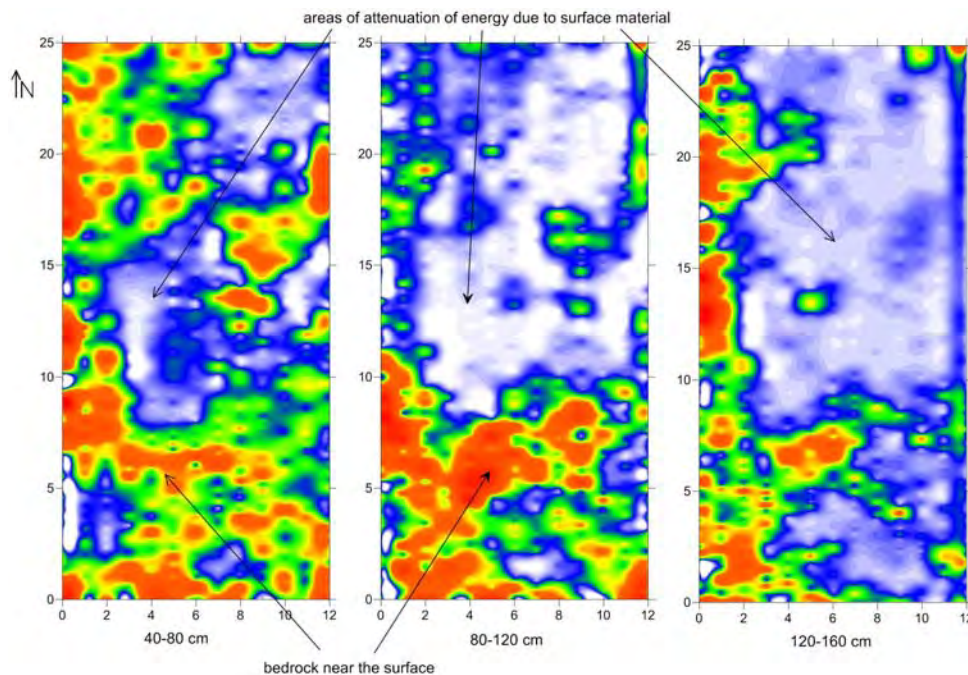


Figure 27: Amplitude slice maps of Grid 10 showing areas of attenuation and bedrock located very near the surface through the area surveyed.

Conclusions

Radar energy penetration and reflection was excellent throughout the area surveyed in the Higgs Beach area. Radar penetration was in excess of 2 meters (6 feet) throughout the area using the 400 MHz antennas. Bedrock reflections were the most common feature found in most grids and when bedrock was close to the surface (shallower than 1 meter: 3 feet) appears to have been the limiting factor in burials. The abundance of burials were found in portions of Grid 3, 4, 5, 8 and 9, which in all cases were in areas where bedrock was deeper than two meters below the ground (6 feet). An outline of the general areas of graves is found in Figure 28, which covers much of the small dog park and adjoining areas, and a small area in a grassy space adjacent to the bike trail west of the fort.

While GPR was excellent at mapping many graves in this area, it is likely that subtle graves exist, which did not produce significant reflections. No method exists to produce images of these kinds of subtle graves short of excavations. In addition graves likely exist under the bike trail and Atlantic Boulevard, which were not surveyed. A major undertaking to remove the asphalt and all other surface materials prior to surveying with GPR would be necessary to locate those areas, and it is probably best to work under the assumption that they are there, and be careful with all excavation operations in the area.

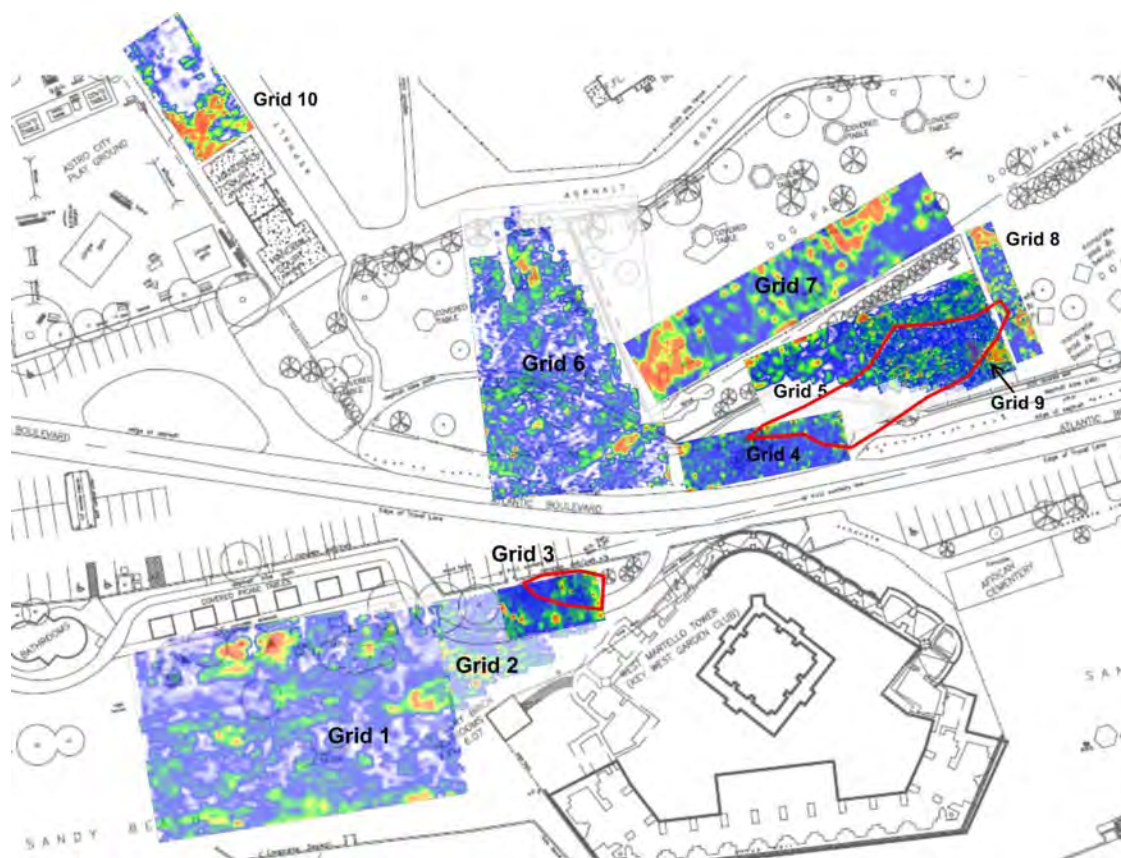


Figure 28: Composite base map of all grids with the areas where graves were identified shown in red.

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