ANALYSIS OF BROWNFIELD CLEANUP ALTERNATIVES ORLANDO DOWNTOWN RECREATION COMPLEX AND TENNIS CENTRE PARCEL ORLANDO, ORANGE COUNTY, FLORIDA

Prepared for:

The City of Orlando
Public Works Division
5100 L.B. McLeod Road
Orlando, Florida, 32811
Service Authorization X
EPA Brownfield Cooperative Agreement BF-95498212

Prepared by:

ECT Environmental Consulting & Technology, Inc.
www.ectinc.com
3660 Maguire Boulevard, Suite 107
Orlando, Florida 32803

ECT Project No. 140432

March 2015

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

1.0 INTRODUCTION

Environmental Consulting & Technology, Inc. (ECT) has been retained by the City of Orlando to prepare this Analysis of Brownfields Cleanup Alternatives (ABCA) for the Orlando Downtown Recreation Complex and Tennis Centre (Site), which is located at the northeast corner of the intersection of North Parramore Avenue and Bentley Street, Orlando, Florida. The Site is currently in use and part of the Creative Digital Village Master Plan. This document was prepared using funding from Environmental Protection Agency (EPA) Brownfield Cooperative Agreement BF-95498212.

1.1 PURPOSES AND SCOPE

The purpose of this ABCA report is to:

1. Provide a summary of Site background and documented environmental impacts (including threats to public health and/or the environment) to support the need for environmental remediation and design testing on the southern half of the Site, where the Livingston Street extension is planned to occur in the near future. This area will be the focus of the ABCA and remedial activities planned in the EPA Brownfield Cleanup Grant 00-D10313. Active tennis courts currently occupy the northern half of the Site, and no remedial activity is planned for this area at this time. The clay and asphalt surfaces provide a sufficient barrier to prohibit dermal and/or inhalation exposure to the limited arsenic-impacted soils identified during Phase II Environmental Site Assessment (ESA) activities. No dieldrin impacted groundwater was identified in the northern half of the Site.
2. Evaluate appropriate remedial alternatives to address the arsenic exceedances in the soil at five locations in the southern half of the Site.
3. Evaluate appropriate design testing alternatives to reduce the dieldrin concentrations in the groundwater in the area of MW-1, MW-10, and MW-11.
4. Select the remedial alternative(s) or design testing alternative(s) that best meet the objectives and considerations for the Site, for Creative Digital Village, and meet the financial thresholds of Brownfield Cleanup Grant 00-D10313.
5. Present a general work plan for implementing the selected remedial alternative(s) and design testing alternative(s).

Information on known Site conditions is based on the results of investigations completed for various redevelopment and/or cleanup projects within Creative Digital Village. These investigations, which are summarized in Section 3.0, include the following:

- November 22, 2006, Phase II ESA, Professional Service Industry, Inc. (PSI)
- November 4, 2011, Draft ABCA, Cardno TBE
- October, 2012, Phase I ESA, Cardno TBE
- November 27, 2013, Phase I ESA, ECT
- August 2014, Phase II ESA, ECT

Consistent with the findings of these environmental investigations, environmental conditions at the Site that need to be addressed includes the following:

- Soil Cleanup Target Levels – Direct Exposure Residential (SCTL-DER) criteria exceedances per Chapter 62-777 Florida Administrative Code (FAC) for arsenic at five separate locations in the southern half of the Site.
- Groundwater Cleanup Target Level (GCTL) exceedance per Chapter 62-777 FAC for dieldrin at one general location in the southern half of the Site.

Each considered remedial alternative or design test was evaluated based on the following criteria:

- Effectiveness
- Implementability
- Cost

The ABCA, once approved by EPA, will be placed in the Administrative Record File (ARF) located at the Florida Agricultural and Mechanical University (FAMU) Law School library located at 201 Beggs Avenue in downtown Orlando. The document may also be placed in additional locations to facilitate public comment. Public notice will be given that the document is available for review and comment and a written response to significant comments will be provided and included in the ARF.

2.0 SITE BACKGROUND

The Site consists of three adjoining separate parcels totaling approximately 26.81 acres. The Site is bound by West Amelia Street to the north, North Parramore Avenue to the west, Bentley Street to the south, and vacant property (former Amway Center Parking lots) to the east. The Site consists of a main building with annex, several outbuildings that collectively comprise the multipurpose Orlando Downtown Recreation Complex, a detached maintenance building, and 16 tennis courts that collectively comprise the Orlando Tennis Centre. The Orange County Property Appraiser's Office information identifies the Site as parcel identification number 26-22-29-0000-00-007 located within Section 26 of Township 22 South, and Range 29 East in Orlando, Orange County, Florida. A Location Map is provided as **Figure 1**. A United States Geological Survey (USGS) Topographic Map, 1998, West Orlando, which includes the Site and the surrounding area, is provided as **Figure 2**. A Site Plan depicting the location of the proposed Livingston Street Extension is provided as **Figure 3**.

Historically, the Site appears to have been developed as early as 1919, based on review of Sanborn Maps. Past uses of the Site have included: 1) Armory and Naval Training Center; 2) Orange County and Orlando Fair Grounds/Exposition Center; 3) a horse racing track and stables; 4) ball fields and various athletic fields; 5) residential (northern portion of the property); 6) United States Department of Agriculture (USDA) Bureau of Entomology and USDA Essential Oils Branch; 7) Orlando Police Training facility; and 8) refrigeration sales.

2.1 ADJACENT PROPERTY LAND USE

The Site is located in a developed area of Orlando, the Parramore Heritage District. Vacant land and parking areas that are part of the Creative Digital Village Master Plan are located to the north and east. Nap Ford Charter School is located to the south. Mixed commercial, residential and vacant properties are to the west (including a coin operated laundry, Hope of Salvation Church and a convenience store).

2.2 FUTURE SITE USE

The Orlando Recreation Complex (Site) is part of Creative Digital Village, a project that involves the replacement of aging and obsolete public infrastructure currently in place to support the 60-acre City-owned Orlando Centroplex venue. Future redevelopment of the Site and the entire Creative Digital Village is rejuvenation to include a live, work, learn and play mixed-use community built around a foundation of technology based employment and educational opportunities, mixed-income and attainable housing, neighborhood commercial and public open spaces. The technology-based employment and educational expansion opportunities at Creative Digital Village will help expand the regional Orlando economic cluster of tech-based, digital media production, modeling and simulation industries.

3.0 SUMMARY OF PREVIOUS ASSESSMENT ACTIVITIES

In July 2005, (PSI) conducted a Phase I ESA for the Centroplex Site located at 600 Amelia Avenue, Orlando, FL. The results of that Phase I ESA identified several recognized environmental concerns (RECs) in connection with the Centroplex Site which includes the subject Site of this ABCA. The July 2005 Phase I ESA identified an armory, USDA automobile storage facility, and various USDA laboratories were historically located at the subject Site. Furthermore, review of Sanborn maps showed that an underground storage tank (UST) was on the property from at least 1950 to 1965.

Based on the RECs identified July 2005 Phase I ESA for the Centroplex Site, PSI conducted a Phase II ESA and the results of the investigation are described in a report dated November 23, 2006. The assessment identified benzo(a)pyrene in the soil exceeding SCTLs near the former UST, arsenic in the soil above SCTLs at three locations across the site, and dieldrin above GCTLs in the groundwater in one temporary monitoring well. PSI recommended further soil and groundwater assessments in the area of the former Armory/USDA laboratories to determine the vertical and horizontal extent of petroleum-related compounds, metals and pesticides in the soil and groundwater beneath the Site.

Additionally, Cardno TBE identified RECs at the adjacent property in a Phase I ESA for the New North Terry Avenue and West Livingston Street Alignments dated October 2012.

Based on information presented in the assessments discussed above, the City of Orlando requested ECT conduct a Phase I ESA for the Site to evaluate the presence/absence of RECs in anticipation of future redevelopment activities. The Phase I ESA dated November 2013, identified the following RECs associated with the Site: 1) former USDA facility, former USDA field laboratory (northeast portion of Site); 2) former USDA facility (west-central portion of Site); 3) former armory facility; and 4) the former Orlando Gasification Plant as benzene impacts were present on the southeastern portion of the Site.

Based on the opinions presented in the November 2013 Phase I ESA, ECT recommended a Phase II ESA be completed. The objective of the Phase II ESA was to determine the presence, magnitude, and distribution of soil and groundwater impacts, associated with the RECs identified during the previous investigations. The Phase II ESA was completed in 2014. Supplemental assessment data was obtained in 2015 to assist with horizontal and vertical delineation of the arsenic soil exceedances prior to source removal activities being implemented.

4.0 APPLICABLE REGULATIONS AND CLEANUP CRITERIA

The Florida Department of Environmental Protection (FDEP) will provide regulatory oversight of the assessment and remediation conducted at the Site. Daily direct oversight of remediation activities will be performed by a State of Florida licensed professional engineer, competent through education and experience to provide direction and oversight throughout the process. Additional review and regulatory oversight will be provided by the EPA Project Officer administering the grant activities. Copies of reports generated throughout the process will be submitted to both the FDEP and EPA for review and comment. In addition, Quarterly Reports will be submitted to the EPA Project Officer to document progress on the project. Consistent with criteria specific in Rule 62-777, FAC, the SCTL-DER criteria will be the remediation standard for this project. Based on previous assessment data, arsenic exceeded the referenced target level of 2.1 mg/kg at five locations at the Site.

The Florida GCTLs specified in Rule 62-777 FAC will be the groundwater contamination screening and remediation standards for this project. Based on data collected during previous assessment data, dieldrin exceeded the referenced target level of 0.002 ug/l in one general location at the Site.

In summary, the overriding remedial objectives for the Site will be designed to be protective of human health and the environment, based on anticipated residential/mixed-use assumptions, and will comply with applicable State and Federal laws.

5.0 EXPOSURE ANALYSIS

The ABCA process evaluates possible corrective actions and their respective costs to remedy affected areas. Remedies can include removal, physical or chemical treatment and may include other types of remedies such as institutional controls (e.g. prohibition regarding groundwater use), or engineering controls (e.g. an impermeable barrier to prevent direct contact). Excess human health or ecological risk requires four factors, all of which must be present to produce excess risk from contaminants at a Site. These are:

- A chemical with sufficient toxicity to do harm (whether acute or chronic),
- A sufficient quantity of the chemical to be toxic and do harm,
- A receptor on which to do harm, and
- A pathway by which a sufficient amount of the contaminant can actually reach a receptor and do harm.

Implementation of corrective actions reduces human health and ecological risk to acceptable levels. This has been accomplished by the development and implementation of FDEP regulatory programs to implement State standards (Chapter 62-780, F.A.C.).

5.1 EXPOSURE PATHWAYS

In order for possible contaminants of concern (COCs) to do harm to public health or the environment, they must occupy a point of exposure accessible to the population at risk. In other words the exposure pathway must be complete, connecting the COCs to the receptor(s). Compounds to which populations are not currently, or likely to be exposed, do not constitute a probable condition of elevated risk.

The three potential receptor populations are:

- Construction workers involved in the redevelopment of the property,
- Industrial/commercial workers who occupy the property under conditions of full-time employment, and
- Residents who visit or reside on or adjacent to the property.

Based on assessment data detailed in Section 3.0, the primary COC in soil is arsenic. Arsenic occurs naturally and can be further released into the environment through natural activities such as volcanic action, erosion of rocks and forest fires, or through human actions. Approximately 90 percent of industrial arsenic in the U.S. is currently used as a wood preservative, but arsenic is also used in paints, dyes, metals, drugs, soaps and semi-conductors. High arsenic levels can also come from certain fertilizers and animal feeding operations. It is assumed that the arsenic levels detected at certain locations at the Site above background are the result of the former USDA operations that occupied the site prior to 1925.

Risk of exposure to the site soils were examined for three potential receptor populations deemed most likely to be exposed to identified contaminants of concern. The primary exposure pathways identified at this site include the following:

Inhalation: This pathway is primarily associated with inhalation of potential fugitive dust emissions during site remediation and redevelopment activities. A Soil Management Plan (SMP) that will consider wind, dust suppression, pedestrian flow, etc. will be considered and/or implemented prior to soil remediation activities.

Dermal Absorption: Exposure via dermal absorption occurs when receptors are exposed to contaminant concentrations present in soil through direct contact with the skin. There appears to be a low risk of dermal absorption, since the soil exceeding SCTL-DER for arsenic is not within the 0-1'soil horizon. Construction workers will be required to wear protective clothing and gloves during soil remediation activities.

Active Ingestion: The active ingestion pathway represents exposure which may occur through the active ingestion of arsenic impacted soil. Construction workers will be required to wear protective clothing and gloves, and to be cognizant of direct hand-to-mouth contact. Hand washing stations will be available during soil remediation activities.

Incidental Uptake: This pathway is applicable when receptors may incidentally ingest/inhale impacted media in the form of contaminated dust or airborne soil particulates. Wind speed and dust suppression will be monitored during soil remediation activities.

Based on the groundwater data detailed in Section 3.0, the primary COC in groundwater is the insecticide dieldrin. Dieldrin is a by-product of the pesticide aldrin. From 1950 to 1974, dieldrin was widely used to control insects on cotton, corn and citrus crops. Also, dieldrin was used to control locusts and mosquitoes, as a wood preserve, and for termite control. Dieldrin is no longer produced in the US due to its harmful effects on humans, fish, and wildlife. Dieldrin is a persistent, bioacculumative, and toxic (PBT) pollutant targeted by EPA. It is assumed that the dieldrin levels detected in the groundwater at the Site are the result of the former USDA operations that occupied the site prior to 1925.

No potable wells exist on the Site or adjacent properties, no irrigation wells are planned at the Site and potable water is available from the City of Orlando; therefore, a completed pathway for the ingestion of site groundwater does not appear to be present.

6.0 EVALUATION OF CLEANUP ALTERNATIVES

Based on the evaluation of assessment findings presented in this ABCA and conservative assumptions of future site use for residential/mixed-use development, various alternatives were considered for managing the identified impacts, as discussed below.

6.1 SOIL REMEDIAL ALTERNATIVES

The alternatives for mitigating the risks associated with identified arsenic-impacted soil at the Site are summarized and compared in **Table 1**. A brief discussion of each alternative is provided below. The following four remediation alternatives were evaluated for the Site.

- No action
- Capping (engineering control)
- Excavation and offsite disposal
- In-situ solidification/stabilization

6.1.1 NO ACTION

Description: In this alternative, no action will take place.

Effectiveness: Because arsenic-impacted soils have been documented at the site, this option may result in future exposure potential as a result of redevelopement acivities. This potential for exposure does not meet the objectives of this ABCA and the No Action alternative has been omitted from further consideration. For the purposes of this ABCA, institutional controls are not considered an element of the No Action alternative.

6.1.2 CAPPING (ENGINEERING CONTROL)

Description

Capping involves placing an impermeable cover over contaminated materials. Caps do not remediate the contaminated media, rather they isolate and keep it in place so it will not come into contact with people or the environment.

Effectiveness

If designed appropriately, a cap can be effective in 1) stopping rainwater from seeping through contaminated material and carrying the contamination into groundwater or surface water features, 2) stopping wind from blowing contaminants throughout the site or off site, and 3) keeping people and animals from coming into direct contact with the impacted material.

Implementability
Cap design can range from the simple placement of a single layer of asphalt over the materials of concern to multilayer systems. The top layer is typically comprised of soil and vegetation to stabilize the site, uptake moisture, and prevent erosion. The second layer is typically comprised of a drainage system (pipes, gravel, etc.) to manage water the seeps through the top layer. A gas venting system is often placed beneath the drainage system, depending on the nature of the waste. The bottom layer is typically impermeable material; either clay or a geotextile barrier. While construction and maintenance of a cap is generally simple to implement, it is not practical for this Site for the following reasons:

1. The documented impacts to soil do not appear to be significant enough in areal extent to warrant large scale capping, and;
2. Site re-grading that will be required to complete installation of underground utilities, re-align roads and construct new buildings throughout the site make the construction and maintenance of a cap system impractical.

For these reasons, capping does not meet the objectives of this ABCA and this alternative has been omitted from further consideration.

6.1.3 EXCAVATION AND OFF-SITE DISPOSAL

Description
Excavation is digging up impacted soils from a site. Off-site disposal requires characterization of the waste characteristics, contamination levels, identification of the appropriate disposal or treatment facility, and a determination of transportation issues associated with transfer of the material (site access and distance to the disposal or treatment facility).

Effectiveness
Removal of contaminated material from a site is typically the most effective remediation technology that can be implemented, as it does not rely on chemical processes, dispersion and contact with reagents or binders, or soil conditions and is effective regardless of contaminant type (i.e. volatile organic compound (VOCs), semi-volatile organic compound (SVOCs), metals, etc.).

Implementability
Many factors affect the implementability of a soil excavation project. Access must be available to remove the impacted material and an appropriate treatment or disposal facility must be identified that can manage the levels and types of contamination. Generally, excavation is limited to materials that are unconsolidated and easily removed using backhoes, excavators, and similar equipment. The depths of excavation are also typically limited to approximately 20-ft, unless shoring or benching is implemented to access deeper soils. Shoring can be difficult in some instances, and benching can result in substantially increased volumes of soil being managed. Lastly, if excavation is extended below the water table, dewatering of the excavation area is required and treatment of

impacted groundwater is typically an additional component of the project. These factors can affect the cost and implementability of excavation at a given location.

Cost

The cost of excavation can vary based on the variables discussed above. Additionally, transportation and disposal costs off-site can also vary substantially based on the method of treatment or disposal, fuel costs, and the distance to the final disposal facility. Costs are typically separated based on the following tasks: excavation and staging of material, transportation and disposal, and backfilling and compaction.

Limited areas of subsurface impacts have been documented at the Site. Using the unit costs provided on **Table 1**, an estimated cost of $52,000 has been calculated for soil excavation for the five areas identified on **Figure 4**.

6.1.4 IN-SITU SOLIDIFICATION/STABILIZATION

Description

Solidification/stabilization is a cleanup method that prevents or slows the release of contaminants from impacted soils or sludge. Due to the presence of arsenic soil impacts, this technology was evaluated over other methods of in-situ treatment such as bioremediation (which would not address arsenic impacts effectively). This technology does not typically destroy the contaminants; rather, it prevents them from moving into the surrounding environment. Typically, cement or similar binding agents are used to solidify the impacted soil or sludge. Stabilization; however, may only consist of a chemical reagent that binds contaminants to the subsurface media, thereby preventing migration.

Effectiveness

Solidification/stabilization can be effective if future disturbances of the subsurface will not occur. However, changes in water chemistry can often result in leaching of contaminants from solidified/stabilized material, resulting in impacted groundwater or surface water. An institutional control to prevent future contact with and disturbance of the solidified/stabilized material is typically required. In addition, the effectiveness of this technology (particularly stabilization) relies on the injected stabilizer contacting all impacted material, which may prove difficult.

Implementability

Solidification involves mixing impacted soil with a substance (like cement) that causes the soil to harden. Soil mixing can be performed in-situ using large augers (deep) or land farming techniques (shallow), or the impacted soils can be excavated and mixed with binding agents ex-situ. Once the ex-situ mixture dries to form a solid block or granular aggregate, it can be returned to the site (left in place) or removed to another location. Stabilization typically involves the injection of chemicals that bind with the contaminated material to (in theory) render the material inert or non-leachable. Soils could be left in place beneath planned parking lots; however, leaving solidified soils in areas where residential buildings are to be constructed (including related buried utilities) could be problematic. Also, due to the challenge of ensuring adequate mixing and contact with the solidification/stabilization binding or chemical agents, especially under structures or roadways, effectiveness of the solidification/stabilization activities may be difficult to predict. In addition, on-going obligations in the form of long-term annual groundwater sampling may be required to monitor the effectiveness of the solidification/stabilization. For these reasons, solidification/stabilization is considered impractical for this Site.

Cost
The cost to solidify impacted material is directly related to the amount of material being addressed, the nature of the binding agent(s) used, and the final disposition of the solidified material. Additionally, costs for cement-based stabilization techniques may vary according to availability and short term cost variability for concrete, and the chemical nature of the contaminant. Costs for solidification/stabilization can vary between \$65 to \$105 per cubic yard for shallow applications typical of those at the Site. Using the unit costs provided on **Table 1**, an estimated cost of \$80,000 has been calculated for In-site soil solidification/stabilization soil excavation for the five areas identified on **Figure 4**.

6.2 GROUNDWATER DESIGN TESTING ALTERNATIVES

Design testing alternatives for mitigating the risks associated with dieldrin groundwater impacts at the Site are summarized and compared in **Table 2**. The following three (3) remediation alternatives are discussed further in the following sections.

- No action
- Groundwater pump and treat
- In-situ chemical reduction

Each of these alternatives has been evaluated with respect to effectiveness, implementability, and cost. The following sections provide a synopsis of each technology and the final evaluation results.

6.2.1 NO ACTION

Description: In this alternative, no action will take place.

Effectiveness:
Dieldrin exceeding the Natural Attenuation Default Concentration (NADC) criteria of 0.2 ug/l has been identified in three monitoring wells (MW-1, 10, and 11). The No Action alternative is not considered effective in reducing these concentrations to GCTLs in an acceptable time frame and will not be considered a viable design testing alternative.

6.2.2 GROUNDWATER PUMP AND TREAT

Description

Groundwater Pump and Treat (P&T) involves the withdrawal of groundwater from within the impacted portions of the site, followed by treatment to remove contaminants and/or discharge of the water in an acceptable manner. Impacts to groundwater are limited to VOCs, which are conducive to on-site treatment via air stripping or sorption onto carbon. Discharge could include permitted discharge into the Publicly Owned Treatment Works (POTW), or within surface water bodies under a National Pollutant Discharge Elimination System (NPDES) permit. Alternatively, treated groundwater could be re-injected into the subsurface through exfiltration galleries or wells. Any such discharge of treated or untreated water would require approval from the FDEP or other appropriate entities.

Effectiveness

Groundwater P&T can be very effective in lowering initial levels of contamination very quickly. However, slow diffusion of contaminants from subsurface soils can result in limited reductions of dieldrin at concentrations above the required GCTL levels. Since dieldrin concentrations exceed the natural attenuation default criteria (NADC) outlined in 62-777 FAC, P&T will be considered for design testing purposes and should be considered to be a practical, short-term remedial strategy. The information obtained from this design test could be incorporated into the other remedial or long term strategies throughout Creative Digital Village.

Implementability

Groundwater P&T implementation at the Site would require vertical recovery wells installed near MW-1, 10, and 11. The recovered groundwater would be pumped to either a centrally located portable treatment system or the POTW. The groundwater treatment system may consist of an air stripping tower, granulated activated carbon tanks, or other technologies that will remove the dieldrin from the influent groundwater.

Design testing P&T would require an appropriate treatment system, installation of a recovery and discharge well network, connection of sufficient electrical power systems, and operation and maintenance (O&M) costs for the duration of the treatment process.

Cost

The cost of P&T includes primarily well installations; treatment system design, and O&M throughout the remediation process. The cost of well construction can vary significantly based on design; however, well installations with pumps and piping could be installed above-grade. The selected treatment system could be rented, and the construction activities could be completed by the City of Orlando personnel. Therefore, short-term P&T will be considered in conjunction with other technologies. Assuming 14 days of design testing, the associated costs are estimated to be $65,000 for area of dieldrin impacts identified on **Figure 5**.

6.2.3 IN-SITU CHEMICAL REDUCTION

Description

In-situ chemical reduction (ISCR) technology involves the injection of oxidizing reagent(s) into the subsurface to react in-situ with contaminants, producing innocuous substance such as carbon dioxide, water, and/or inorganic chloride (chlorinated compounds only). For design testing purposes, EHC® by PeroxyChem is being considered.

Effectiveness

EHC® is the original patented combination of controlled-release organic carbon and zero valent iron (ZVI) used for the treatment of groundwater and saturated soil impacted by persistent halogenated compounds, including chlorinated solvents, pesticides and organic explosives. The EHC® formula is the culmination of years of research and successful field use. EHC® is comprised of a synergistic mixture of micro-scale ZVI and a solid organic carbon source, stimulating both abiotic and biotic dechlorination mechanisms.

Implementability

EHC® can address a wide range of contaminant concentrations and has successfully been applied to treat large dilute plume areas, groundwater hotspots, and high concentration source areas. Injection of EHC will be through direct-push technology (DPT) injection points at areas near, or adjacent to, MW-1, MW-10, and MW-11.

Cost

The cost of EHC® is related primarily to the number of injection points and the amount of reagent required to react in-situ with the dieldrin. The cost for preparing the design test plan, injection, and subsequent monitoring and reporting is estimated to be $50,000 for area of dieldrin impacts identified on **Figure 5**.

7.0 EVALUATION OF CLIMATE CHANGE

As directed under EPA's Climate Change Adaptation Plan, the ABCA must also include a discussion of observed and forecasted climate change conditions for the area of the project and the associated site-specific risk factors. In evaluating the cleanup alternatives, ECT considered the resilience of the strategies in light of reasonably foreseeable changing climate conditions. As part of this evaluation, ECT consulted the EPA-recommended United States Global Change Research Program (USGCRP) website (http://www.globalchange.gov/resources/federal-agency-adaptation-planning-resources), which provided a brief overview of the observed changes in the climate of the Southeast US as well as possible future climate conditions as simulated by climate models, based on two scenarios of future greenhouse gas emissions. The document summarized the observed climate trends of the southeastern United States (SE US), focusing mainly on temperature and precipitation, as well as other climate features, including heat waves, extreme precipitation, and hurricanes. The following trends were identified:

- Temperature: The SE US is one of the few regions globally not to exhibit an overall warming trend in surface temperature over the 20th century. In recent years (since the 1970s), however, temperatures have steadily increased across the region, with the most recent decade (2001-2010) being the warmest on record. The number of extreme hot days in the SE has tended to decrease or remain the same, while the number of warm summer nights has increased. The number of extreme cold days has decreased across the region.
    - Models predict statistically significant annual mean temperature increases across the SE, with the greatest warming simulated to occur in the northwest part of the region. The lack of mid-20th century warming in the SE is not simulated by the models. However, 21st century simulations of temperature indicate that future warming will be much larger than the observed values for the 20th century.

- Precipitation: For the SE US, long-term trends in precipitation are statistically significant for fall, which shows an upward trend, and summer, which shows a slight downward trend. Year-to-year variability in precipitation has increased over the last several decades across much of the region, with more exceptionally wet and dry summers. The frequency of extreme precipitation events has been increasing across the SE, particularly over the past two decades.
    - Models predict that the annual mean precipitation in the SE US will generally increase, with the greatest increases indicated for winter. Decreases are also simulated for some areas and seasons, and are greatest in summer. For the most part, any simulated changes in precipitation are either not statistically significant or the models are not in agreement on the

sign of the changes. There is significant uncertainty in the prediction of precipitation change scenarios in the models.

- Additional Climate Features: The decadal frequencies of both hurricane and major hurricane (category 3 and greater) landfalls have declined slightly over the last 100 years; however, there is large decade-to-decade variability. Sea levels across the extensive coastline of the SE US have slowly risen over the 20th century.

Considering that this project will be completed before September 30, 2016, no significant variation in approach is anticipated based on predicted trends for the Central Florida area. The recommend cleanup alternative is considered to be resilient to potential climate changes, including increasing temperatures and rainfall.

8.0 RECOMMENDED CLEANUP ALTERNATIVES

Based on the evaluations presented in this ABCA, excavation with off-site disposal is chosen as the soil remedy best suited to achieve the goals of protecting human health and the environment at this site. The groundwater remedy for the Site, and potentially other sites within the Creative Digital Village, will be determined at a later date, but design testing will consist of P&T and EHC® injection. Based upon the results of the design testing, a remedy for Site and/or Creative Digital Village may include one of these technologies. It is also anticipated that institutional/engineering controls will be used to prevent future groundwater use.

TABLES

TABLE 1: SOIL REMEDIAL ALTERNATIVES COST ESTIMATION

Site Name: Orlando Rec Centre
Site: 649 Bentley Street, Orlando, FL
BF Site ID No.: BF480401007

ALTERNATIVE	EFFECTIVENESS	COST	TIME	ESTIMATED RANGE	
No Action	Not Acceptable	$0	-	$0	$0
Excavation and off-site disposal	Interim Source Removal Plan	$10,000	4 months	$38,792	$77,583
	Source Removal & Disposal	$25,000			
	Backfill & Compaction	$10,000			
	Verification Sampling	$1,722			
	Interim Source Removal Report	$5,000			
	Estimated Total	$51,722			
In-situ solidification / stabilization	Design	$20,000	2 years	$54,375	$108,750
	Soil Stabilization	$40,000			
	Verification Sampling	$2,500			
	Reporting	$5,000			
	Monitoring	$5,000			
	Estimated Total	$80,000			

Notes:
The estimated range is based on 75% and 150% of the total cost.

TABLE 2: GROUNDWATER DESIGN TESTING ALTERNATIVES COST ESTIMATION

Site Name: Orlando Rec Centre
Site: 649 Bentley Street, Orlando, FL
BF Site ID No.: BF480401007

ALTERNATIVE	EFFECTIVENESS	COST	TIME	ESTIMATED RANGE	
No Action	Not Acceptable	$0	-	$0	$0
Groundwater Pump & Treat	Design Test Plan	$10,000	4 months	$48,750	$97,500
	Temp. System Install	$30,000			
	2 Weeks of O&M	$10,000			
	Temp. System Decomission	$5,000			
	Design Test Report	$10,000			
	Estimated Total	$65,000			
In-situ Chemical Reduction	Design	$10,000	1 year	$37,500	$75,000
	Injection	$20,000			
	Monitoring	$10,000			
	Reporting	$10,000			
	Estimated Total	$50,000			

Notes:

The estimated range is based on 75% and 150% of the total cost.

FIGURES

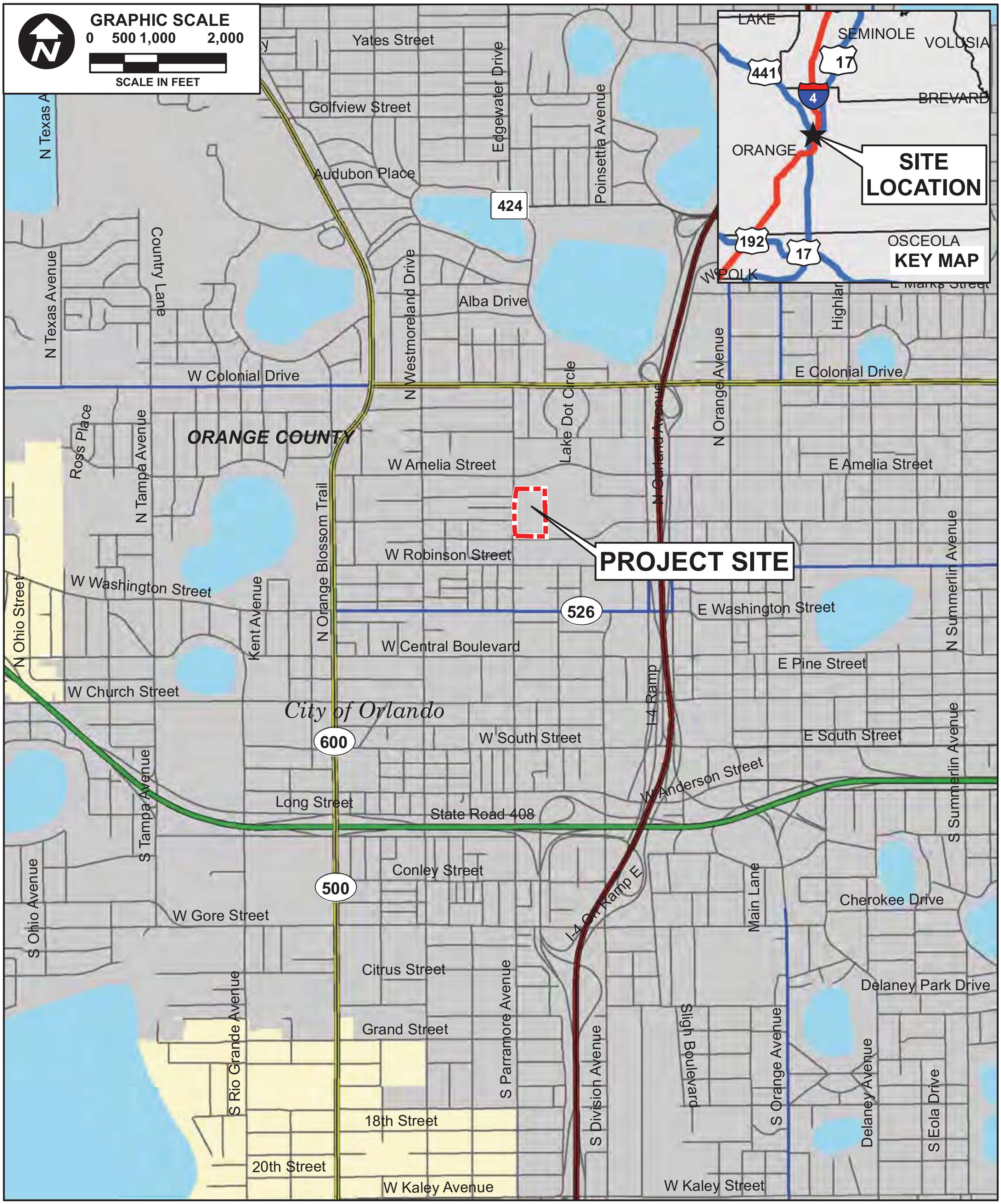

FIGURE 1.
LOCATION MAP
ORLANDO DOWNTOWN RECREATION COMPLEX & TENNIS CENTRE
CITY OF ORLANDO, ORANGE COUNTY, FLORIDA
SECTION 26, TOWNSHIP 22S, RANGE 29E
SOURCE: VARIOUS FGDL SOURCES; ECT, 2014.

ECT Environmental Consulting & Technology, Inc.

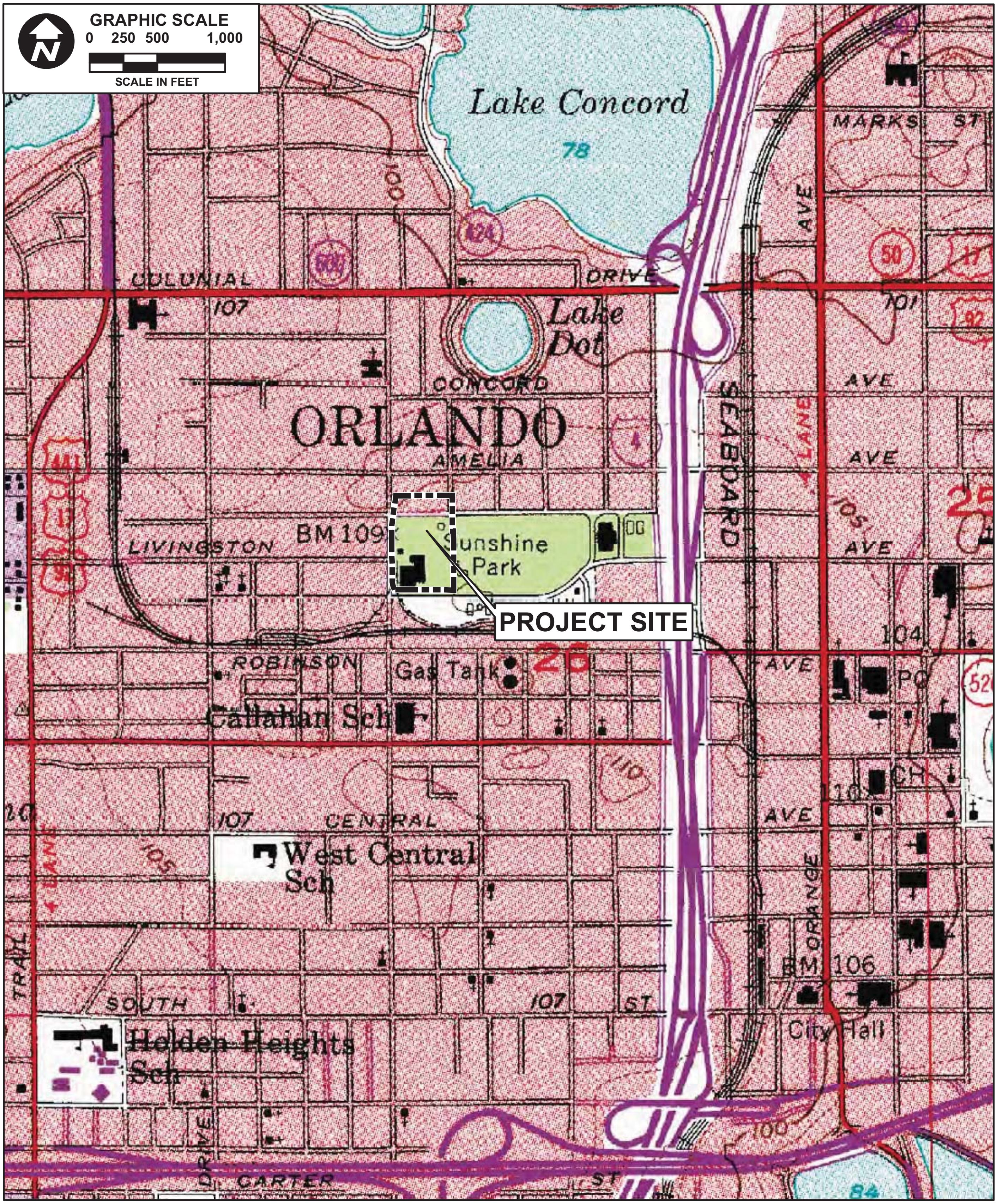

FIGURE 2.
USGS TOPOGRAPHIC MAP
ORLANDO DOWNTOWN RECREATION COMPLEX & TENNIS CENTRE
CITY OF ORLANDO, ORANGE COUNTY, FLORIDA
SECTION 26, TOWNSHIP 22S, RANGE 29E

SOURCE: USGS QUAD ORLANDO WEST, 3712 1980; ECT, 2014.

ECT Environmental Consulting & Technology, Inc.

O:_PROJECTS\2014\140365 Orlando BF-08 Rec Center - Supplemental Phase II ESA_4 Figures and Drawings\GIS\mxds\siteplan.mxd

Aug 23 2014 - 10:34:55 AM by

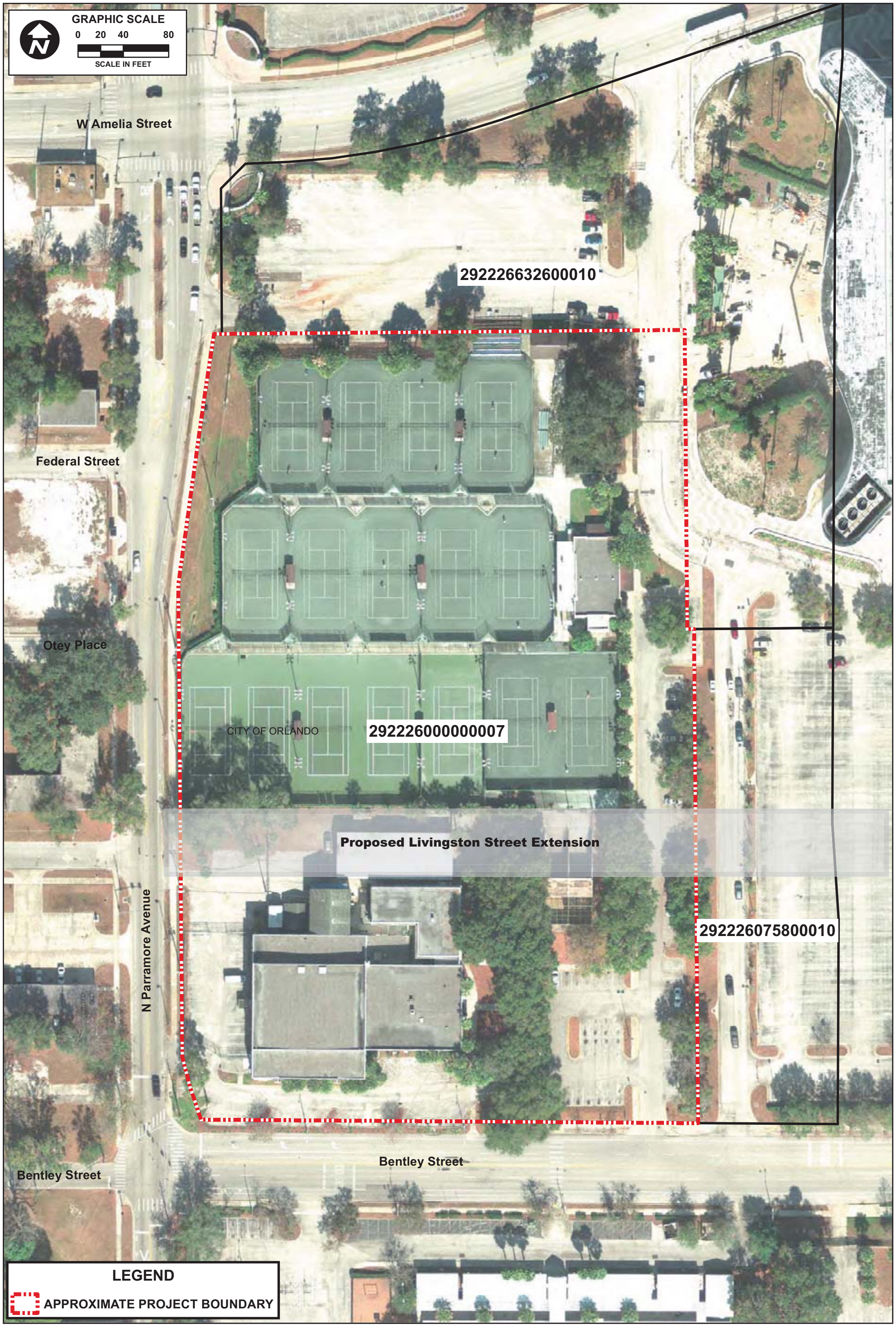

FIGURE 3.
SITE PLAN
ORLANDO DOWNTOWN RECREATION COMPLEX & TENNIS CENTRE
CITY OF ORLANDO, ORANGE COUNTY, FLORIDA
SECTION 26, TOWNSHIP 22S, RANGE 29E

SOURCE: FDOT Aerial, 2012; ECT, 2012.

ECT Environmental Consulting & Technology, Inc.

FIGURE 4
AREAS OF ARSENIC SOIL IMPACTS
ORLANDO DOWNTOWN RECREATION COMPLEX & TENNIS CENTRE
CITY OF ORLANDO, ORANGE COUNTY, FLORIDA
SECTION 26, TOWNSHIP 22S, RANGE 29E

SOURCE: FDOT Aerial, 2012; ECT, 2012.

ECT Environmental Consulting & Technology, Inc.

O:_PROJECTS\2014\140365 Orlando BF-08 Rec Center - Supplemental Phase II ESA_4 Figures and Drawings\GIS\mxds\siteplan.mxd

Aug 23 2014 - 10:34:55 AM by

FIGURE 5
AREA OF DIELDRIN GROUNDWATER IMPACTS
ORLANDO DOWNTOWN RECREATION COMPLEX & TENNIS CENTRE
CITY OF ORLANDO, ORANGE COUNTY, FLORIDA
SECTION 26, TOWNSHIP 22S, RANGE 29E

SOURCE: FDOT Aerial, 2012; ECT, 2012.

ECT Environmental Consulting & Technology, Inc.