Health Consultation

ST. JOHNS RIVER – GREEN COVE SPRINGS

CLAY COUNTY, FLORIDA

Prepared by
Florida Department of Health

JUNE 8, 2016

Prepared under a Cooperative Agreement with the
U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Agency for Toxic Substances and Disease Registry
Division of Community Health Investigations
Atlanta, Georgia 30333

Health Consultation: A Note of Explanation

A health consultation is a verbal or written response from ATSDR or ATSDR's Cooperative Agreement Partners to a specific request for information about health risks related to a specific site, a chemical release, or the presence of hazardous material. In order to prevent or mitigate exposures, a consultation may lead to specific actions, such as restricting use of or replacing water supplies; intensifying environmental sampling; restricting site access; or removing the contaminated material.

In addition, consultations may recommend additional public health actions, such as conducting health surveillance activities to evaluate exposure or trends in adverse health outcomes; conducting biological indicators of exposure studies to assess exposure; and providing health education for health care providers and community members. This concludes the health consultation process for this site, unless additional information is obtained by ATSDR or ATSDR's Cooperative Agreement Partner which, in the Agency's opinion, indicates a need to revise or append the conclusions previously issued.

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Foreword

The Florida Department of Health (DOH) evaluates the public health threat of hazardous waste sites through a cooperative agreement with the federal Agency for Toxic Substances and Disease Registry (ATSDR) in Atlanta, Georgia. This health consultation evaluates potential health effects associated with eating blue crabs harvested from the St. Johns River - Green Cove Springs site. The DOH evaluates site-related public health issues through the following processes:

Evaluating exposure: DOH scientists review available information about environmental conditions at the site. The first task is to find out how much contamination is present, where it is on the site, and how human exposures might occur. The Florida Wildlife Conservation Commission (FWC) collected the blue crabs and the Florida Department of Environmental Protection (DEP) provided the data analysis for this assessment.

Evaluating health effects: If we find evidence that exposures to hazardous substances are occurring or might occur, DOH scientists next determine whether that exposure could be harmful to human health. We focus on potential health effects for the community as a whole. We base our conclusions and recommendations on current scientific information.

Developing recommendations: DOH lists its conclusions regarding any potential health threat posed by environmental contamination. DOH then offers recommendations for reducing or eliminating human exposure. The role of the DOH in dealing with hazardous waste sites is primarily advisory. Our public health assessments and health consultations will typically recommend actions for other agencies including the U.S. Environmental Protection Agency (EPA) and DEP. If a health threat is actual or imminent, DOH will issue a public health advisory warning people of the danger and will work with the regulatory agencies to resolve the problem.

Soliciting community input: The evaluation process is interactive. DOH starts by soliciting and evaluating information from various government agencies, individuals, or organizations responsible for cleaning up the site, and those living in communities near the site. We share any conclusions about the site with the groups and organizations providing the information, and we ask for feedback from the public.

If you have questions or comments about this report, please write to us at

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Division of Disease Control and Health Protection
4052 Bald Cypress Way, Bin # A-12
Tallahassee, FL 32399-1720
Or, call us at (850) 245-4401 or toll-free in Florida: 1-877-798-2772

Summary

INTRODUCTION	The Florida Department of Health (DOH) and the U.S. Agency for Toxic Substances and Disease Registry's (ATSDR) top priority is to ensure nearby residents have the best information to safeguard their health. At the request of the Florida Department of Environmental Protection (DEP), DOH evaluated health risks from exposure to crabs caught at the St John's River - Green Cove Springs site in Clay County, Florida. In the 1940s and 1950s, the US Navy maintained ships at the Lee Field Pier Area (LFPA), located along the St. Johns River in Green Cove Springs. Maintenance operations resulted in polychlorinated biphenyl (PCB) contamination of sediments in the adjacent St Johns River. Blue crabs harvested from the St. Johns River near the site contain PCBs. Recreational crabbing is a common pastime in this area. DOH reached the following conclusion.
CONCLUSION	DOH concludes that eating PCBs in blue crabs from the St. Johns River - Green Cove Springs site is not expected to harm people's health.
BASIS FOR DECISION	DOH found that PCB levels in crab hepatopancreas (also known as "tomalley" or "crab mustard") are not high enough to cause non-cancer health effects for people who eat them once per week for many years. PCB levels in whole crab are not high enough to cause non-cancer health effects for people who eat them twice per week for many years. Consuming PCBs in crabs in both of these scenarios would pose, at most, a very low increased cancer risk.
NEXT STEPS	DOH does not recommend any further actions at this time. DOH will consider review of new data when requested.
LIMITATIONS OF FINDINGS	All risk assessments, to varying degrees, require the use of assumptions, judgments, and incomplete data. These contribute to the uncertainty of the final risk estimates. Some more important sources of uncertainty in this health consultation include exposure parameter estimates and present toxicological knowledge. We may overestimate or underestimate risk because of these uncertainties. This health consultation does not represent an absolute estimate of

	risk to persons exposed to chemicals at or near where crabs were caught for this study.
FOR MORE INFORMATION	If you have concerns about your health or the health of your children, you should contact your health care provider. You may also call the DOH toll-free at 877-798-2772 and ask for information about this report.

Background and Statement of Issues

The purpose of this health consultation report is to assess the public health threat from consuming polychlorinated biphenyls (PCBs) in blue crabs harvested from the St. Johns River near Green Cove Springs. The Florida Department of Environmental Protection (DEP) requested this assessment.

People reportedly catch and eat blue crabs from the St Johns River near Green Cove Springs. This assessment estimates the health risk for individuals exposed to the average level of PCB contamination in these crabs. Some may not eat these crabs at all or eat crabs with lower contaminant concentrations.

Site Description

The St. Johns River - Green Cove Springs site is approximately 1.5 miles northwest of the Shands Bridge. Green Cove Springs is a city of approximately 7,000 residents in Clay County, Florida (Figure 1). The St. Johns River makes up its eastern boundary. In the 1980s, Green Cove Springs annexed Reynolds Industrial Park [Green Cove Springs 2015], including the former Lee Field Pier Area (or LFPA).

The LFPA is an active marine facility, and extends over 1,800 feet into the St. Johns River (Figure 2). It has 12 piers that are built on approximately 300 acres of submerged lands [DEP 2014].

The Navy owned the LFPA from the 1940s to 1963, and operated the LFPA as part of the U.S. Naval Station Lee Field. In the mid-1940s, the Navy began to use the LFPA to dock inactive vessels. By 1947, the Navy had docked over 600 vessels on the piers. The Navy repaired and maintained these ships onsite [DEP 2014].

The Navy placed electric transformers on each pier to provide electricity for ship maintenance activities. Workers regularly filtered or replaced Askarel dielectric fluid (30% to 99% PCBs) in the transformers. Workers reportedly disposed of used filters and transformer fluid in the St Johns River adjacent to the piers. In 1956, the U.S. Army Corps of Engineers (USACE) dredged approximately 700,000 cubic yards of sediments around the piers to maintain the river depth. The USACE deposited the sediments in Spoils Area #1 of the St. Johns River, approximately 1 mile north-northeast of the piers (Figure 3) [DEP 2014].

The Navy decommissioned Lee Field at the end of 1959. In 1965, J. Louis Reynolds purchased the property and began to operate the Reynolds Industrial Park. Clay County Port Inc. purchased the property in 1981, and continues to operate it as Reynolds Industrial Park [DEP 2014].

Between 2009 and 2014, contractors for the USACE, the Clay County Development Authority, and the Clay County Port Inc. found PCBs in sediments near LFPA piers during separate environmental investigations [DEP 2014; Tetra Tech 2015]. In 2015,

contractors for the U.S. Environmental Protection Agency (EPA) tested the sediment of Spoils Area #1 for PCBs and also found PCBs in sediments [Tetra Tech 2015].

Early in 2014, DEP asked DOH to help assess potential health risks associated with consuming PCBs in blue crabs. People eat blue crabs from this area of the St. Johns River and PCBs are known to bioaccumulate in blue crabs.

Demographics

DOH examines demographic and land use data to identify sensitive populations, such as young children, the elderly, and women of childbearing age, to determine whether these sensitive populations are exposed to any potential health risks. Demographics also provide details on population mobility and residential history in a particular area. This information helps DOH evaluate how long residents might have been exposed to contaminants.

The demographics of the population who eat blue crabs from this part of the St. Johns River are unknown.

Land Use

The area in the St. Johns River where the crabs were sampled is approximately 1.5 miles northwest of the Shands Bridge (Figure 4). This portion of the river is bordered to the southwest by Reynolds Industrial Park, and to the northeast by undeveloped land.

Community Health Concerns

DOH reviewed previous contamination assessment reports and news reports [Davis 2015] and communicated with a state environmental official but is unaware of any community health concerns.

Discussion

Environmental Data

In October 2014, the Florida Fish and Wildlife Conservation Commission (FWC) collected 15 blue crabs near Spoils Area #1 (Figure 4). FWC shipped the crabs on ice to the DEP laboratory in Tallahassee, Florida. DEP analyzed the crab muscle (meat) and hepatopancreas (also known as “tomalley” or “crab mustard”). Although people are more likely to eat the crab meat rather than the hepatopancreas, some people consider it a delicacy [ATSDR 2008; Blue Crab Archive 2015].

DEP used EPA method 8270D to analyze for PCBs. This method analyzes 19 of the possible 209 congeners, including PCBs 8, 18, 28, 44, 52, 66, 77, 101, 105, 118, 126, 128, 138, 153, 170, 180, 187, 195, and 206. DOH estimated the total PCBs in each

sample by doubling the sum of the 19 congeners. The rationale for this method of estimating total PCBs is described in NOAA Technical Memorandum NOS ORCA 71 [NOAA 1993].

In the crab meat, all of the PCB concentrations were below detection limits, except in one sample (Table 1). In one crab, DEP detected PCB 153 at a concentration of 0.00021 mg/kg (slightly above the detection limit of 0.0002 mg/kg). In the crab hepatopancreas, concentrations of total estimated PCBs ranged from 0.065 mg/kg to 0.190 mg/kg (Table 1). Median and average total estimated PCB concentrations were 0.103 mg/kg and 0.105 mg/kg, respectively [DEP, unpublished data, 2015].

Pathway Analyses

Chemical contamination in the environment can only harm someone's health if he or she contacts those contaminants. If there is no exposure, there can be no associated harm to health. If exposure does occur, how much of the contaminants someone contacts (concentration), how often the contaminants are contacted (frequency), for how long they are contacted (duration), and the danger of the contaminant (toxicity) all contribute to the risk of harm.

To assess any contaminant's public health importance, we estimate the frequency with which people could have contact with that contaminant. The method for assessing whether people face a health risk is to determine whether a completed exposure pathway connects them to a contaminant source, and whether exposures to that contaminant source are high enough to be of health concern.

The Exposure Pathway

An exposure pathway is a series of steps starting with the release of a contaminant in environmental media and ending at contact with the human body. A completed exposure pathway consists of five elements:

1. Source of contamination, such as a hazardous waste site;
2. An environmental medium such as air, water, or soil that can hold or move the contamination;
3. A point where people come into contact with a contaminated medium, such as water at the tap or soil in the yard;
4. An exposure route, such as ingesting (contaminated soil or water) or breathing (contaminated air); and
5. A population, such as people who live near or work on a contaminated waste site.

Generally, ATSDR/FDOH consider three exposure categories:

- Completed exposure pathways—all five elements of a pathway are present;

- Potential exposure pathways—one or more of the elements might not be present, but information is insufficient to eliminate or exclude the element; and
- Eliminated exposure pathways—at least one element is not present and will not likely be present.

Exposure pathways evaluate specific ways in which people were, are, or might be exposed to environmental contamination in the past, present, and future.

Completed Exposure Pathways

DOH evaluated one completed pathway: ingestion of crab. This is a past, current, and future exposure pathway (Table 2).

Two possible sources of PCB contamination of crab in the St. Johns River are the LFPA and Spoils Area #1. Crabs are migratory and could have encountered PCBs in other locations in the St. Johns River, however. Blue crabs are the environmental medium of concern. The point of exposure is Spoils Area #1. The exposure route is ingestion of blue crabs. The exposed population are people who eat recreationally-caught blue crabs from this area. Harvesting blue crabs is a common pastime along this part of the river [Sutton 2011].

Public Health Implications

DOH provides site-specific public health recommendations based on toxicological literature, levels of environmental contaminants, evaluation of potential exposure pathways, duration of exposure, and characteristics of the exposed population. Whether a person will be harmed depends on the type/amount of contaminant, how they are exposed, how long they are exposed, how much contaminant is absorbed, genetics, and individual lifestyles.

Dose

After identifying contaminants of concern, DOH evaluates exposures by estimating daily doses for children and adults. Kamrin [1988] explains the concept of dose as follows:

> "…all chemicals, no matter what their characteristics, are toxic in large enough quantities. Thus, the amount of a chemical a person is exposed to is crucial in deciding the extent of toxicity that will occur. In attempting to place an exact number on the amount of a particular compound that is harmful, scientists recognize they must consider the size of an organism. It is unlikely, for example, that the same amount of a particular chemical that will cause toxic effects in a 1-pound rat will also cause toxicity in a 1-ton elephant.
>
> Thus instead of using the amount that is administered or to which an organism is exposed, it is more realistic to use the amount per weight of the organism. Thus, 1 ounce administered to a 1-pound rat is equivalent to 2,000 ounces to a 2,000-

pound (1-ton) elephant. In each case, the amount per weight is the same; 1 ounce for each pound of animal."

This amount per weight is the *dose*. Toxicology uses dose to compare toxicity of different chemicals in different animals. They use the units of milligrams (mg) of contaminant per kilogram (kg) of body weight per day (mg/kg/day) to express doses in this assessment[1].

To calculate the daily doses from ingestion of PCBs in crabs, the DOH uses standard factors for dose calculation [ATSDR 2005; EPA 2011]. DOH assumes that people are exposed to the average concentration measured and makes the health protective assumption that 100% of the ingested chemical is absorbed into the body. The percent actually absorbed into the body is likely less. The general formula for estimating a dose is:

$$D = (C \times IR \times EF \times CF) / BW$$

Where:
D = exposure dose (mg/kg/day)
C = contaminant concentration (mg/kg)
IR = intake rate (amount per day; (mg/day)
EF = exposure factor (unit less)
CF = conversion factor (10^{-6} kg/mg)
BW = body weight (kilograms or kg)

$$EF = F \times ED / AT$$

Where:
EF = exposure factor (unitless)
F = frequency of exposure (days/year)
ED = exposure duration (years)
AT = averaging time (days) (ED × 365 days/year for non-carcinogens; 78 years × 365 days/year for carcinogens)

ATSDR groups health effects by duration (length) of exposure. Acute exposures are those with duration of 14 days or less; intermediate exposures are those with duration of 15 – 364 days; and chronic exposures are those that occur for 365 days or more (or an equivalent period for animal exposures). ATSDR Toxicological Profiles also provide information on the environmental transport and regulatory status of contaminants.

To estimate exposure from incidental ingestion (swallowing) of contaminated crab, DOH used the following assumptions:

1) A crab meal size is 90 g for all ages (the 90th percentile of national crab consumption data from the 2005-2006 National Health and Nutrition

[1] A milligram is 1/1,000 of a gram; a kilogram is approximately 2 pounds.

Examination Survey (NHANES). This value was also used in an analysis of seafood safety related to the Deepwater Horizon oil spill [FDA 2010].

2) Children under age 2 do not eat significant amounts of crabmeat.
3) For the purposes of estimating concentrations of PCBs in whole crabs, DOH assumes 70% of each crab is meat and 30% of each crab is hepatopancreas. Estimates of crab hepatopancreas mass relative to the entire edible crab mass range from less than 20% [NJ DEP 2002] to 30% [ATSDR 2008].
4) People consume a meal consisting solely of hepatopancreas at a maximum rate of one meal a week (13 g/day); people consume meals consisting of total edible crab (70% crab meat and 30% hepatopancreas) at a maximum rate of twice a week (26 g/day). These estimates are similar to the EPA's recommendation for fish consumption rates for recreational fishers (17.5 g/day) [EPA 2000]. DOH is not aware of any subsistence crab consumers in the area (Clay County Health Department, personal communication, 2015).
5) Average human weights vary with age: (2 to 6 years: 17.4 kg), (6 to 11 years: 31.8 kg), (11 to 16 years: 56.8 kg), (16 to 21 years: 71.6 kg), (Adult over 21 years: 80 kg).
6) People eat crab every week, 52 weeks/year.
7) All PCBs in crabmeat were either not detected or measured below detection limits except for one measurement for PCB 153 (0.00021 mg/kg), which was only slightly over the detection limit (0.0002 mg/kg).
8) People who eat blue crab hepatopancreas consume the average concentration of PCBs measured in the 15 crab hepatopancreas samples tested.
9) A standard residential occupancy period is 33 years [EPA 2011].

Non-cancer doses were calculated for children (2-21 years old) and adults. For non-cancer illnesses, DOH first estimates the health risk by comparing the exposure dose for children to chemical-specific minimal risk levels (MRLs).

ATSDR MRLs are estimates of exposure levels below which non-cancerous harmful effects are unlikely, even after daily exposure over a lifetime. ATSDR developed MRLs to protect the most sensitive, vulnerable individuals in a population. Exceeding a comparison value does not imply adverse health effects are likely, however. If contaminant concentrations are above comparison values, DOH further analyzes exposure variables (for example, duration and frequency), toxicology of the contaminants, past epidemiology studies, and the weight of evidence for health effects. DOH uses chronic MRLs where possible because exposures are usually longer than a year. If chronic MRLs are not available, DOH uses intermediate length MRLs [ATSDR 2005]. In this study, DOH used the ATSDR Chronic MRL for Aroclor 1254, a commonly used commercial PCB mixture, for evaluation of non-cancer health effects. Although people are environmentally exposed to PCB mixtures of different congeneric composition than commercial PCB mixtures, there are insufficient mixture toxicity data on which to directly base MRLs for environmental PCBs (ATSDR 2000).

DOH and ATSDR use the following equation to estimate increased cancer risk:

$$Risk = D \times SF$$

Risk = Cancer risk
D = Age-specific exposure dose (mg/kg/day)
SF = Slope factor $(mg/kg\text{-}day)^{-1}$

This is a conservative estimate of the increased cancer risk. The actual increased cancer risk is likely lower.

Identifying Contaminants of Concern

DOH selected PCBs as a contaminant of concern because concentrations of PCBs in the tested blue crab hepatopancreas samples exceed the DOH's Fish Tissue Screening Guideline of 0.050 mg/kg. Selection of this contaminant does not necessarily mean there is a public health risk. Rather, DOH selected this contaminant for closer scrutiny, which has been conducted as part of this this assessment.

PCBs (Polychlorinated Biphenyls)

PCBs are a group of synthetic organic chemicals. The U.S. once used PCBs as coolants and lubricants in transformers, capacitors, and other electrical equipment. The U.S. stopped making PCBs in 1977 because of evidence that they may cause harmful effects to health and the environment. PCBs enter the environment as mixtures containing a variety of congeners, or individual chlorinated biphenyl components. Once in the environment, they persist and can bioaccumulate in animal tissues, especially in fatty tissues [ATSDR 2000]. In crabs, PCBs tend to accumulate in the hepatopancreas, an organ that functions as both a liver and a pancreas.

People exposed to high levels of PCBs may experience skin conditions, nose and lung irritation, gastrointestinal discomfort and changes in the blood and liver. The U.S. Department of Health and Human Services (DHHS) found that PCBs may be reasonably anticipated to be carcinogens, and EPA and the International Agency for Research on Cancer have determined PCBs are probably carcinogenic to humans [ATSDR 2000].

Non-cancer risk: DOH estimated PCB ingestion doses for children between 2 and 6 years old, 6 and 11 years old, 11 to 16 years old, 16 to 21 years old, and adults (Tables 3 and 4). Doses estimated for children between 2 and 6 years old and 6 and 11 years old exceeded the ATSDR MRL for chronic-duration oral exposure to PCBs (2×10^{-5} mg/kg/day). DOH therefore compared non-cancer doses to the Lowest Observable (LOAEL to further evaluate the potential for non-cancer health effects.

Female Rhesus monkeys exposed to PCBs experience decreased antibody response at a Lowest Observable Adverse Effect Level (LOAEL) of 0.005 mg/kg/day [Tryphonas et al. 1989; Tryphonas et al.1991]. Interpretation of the adversity of this effect is complicated, however, by a lack of data on immunocompetence and inconclusive findings on the other tested end points [ATSDR 2000]. Another study [Arnold et al, 1993] found indications of

mild toxicity (eyelid and toe/finger nail changes) in some monkeys at doses as low as 0.005 mg/kg/day. The highest estimated PCB dose (0.00008 mg/kg) for children eating blue crabs caught near Green Cove Springs is much lower than the LOAEL and doses associated with health effects in animals; therefore DOH does not expect non-cancer health effects from eating these crabs.

Cancer risk: DOH estimated doses and increased cancer risk for individuals who eat blue crab as children between 2 and 21 years, and as adults (over 21) for 33 years. Adults and children who eat meals composed entirely of crab hepatopancreas once per week have a "very low" increased cancer risk, at most approximately two in one hundred thousand or 2×10^{-5} (Table 5). To put this into context, the Oregon Cancer Foundation estimates that one out of every three Americans (or 33,333 in 100,000) will be diagnosed with some form of cancer in their lifetime [Oregon Cancer Foundation 2015]. Adding the greatest estimated increased cancer risk from exposure to PCBs in crabs would increase the cancer incidence from 33,333 in 100,000 to 33,335 in 100,000.

Adults and children who eat the whole crab (meat and hepatopancreas) up to twice a week also have a very low increased cancer risk, at most approximately one in one hundred thousand or 1×10^{-5} (Table 6).To put this into context, the Oregon Cancer Foundation estimates that one out of every three Americans (or 33,333 in 100,000) will be diagnosed with some form of cancer in their lifetime [Oregon Cancer Foundation 2015]. Adding the highest estimated increased cancer risk (from Tables 5 and 6) from exposure to PCBs in total edible crab would increase the cancer incidence from 333,333 in 100,000 to 33,334 in 100,000.

General Limitations of Findings

This assessment requires the use of assumptions and judgments, and relies on limited data. Some more important sources of uncertainty in this health consultation include exposure parameter estimates and present toxicological knowledge. These factors contribute to uncertainty in evaluating the health threat. Whenever possible, assumptions and judgments in the assessment of the site's impact on public health err on the side of protecting public health and may overestimate the risk.

This health consultation does not represent an absolute estimate of risk to all persons exposed to chemicals in the St Johns River where the FWC caught crabs for this evaluation. However, it does provide an assessment of the potential for health effects based on the scenarios evaluated in this report.

Site-specific Limitations of Findings

DOH based its analysis on the average concentration of PCBs in 15 blue crabs caught at the St. Johns River - Green Cove Springs site. PCB concentrations in other blue crabs may be higher or lower.

Approximately 25% of PCBs in blue crabs are lost during cooking [Zabik 1992]. Therefore, concentrations of PCBs in cooked crabs are likely less than those used in this

analysis. DOH did not consider this loss, however, as PCBs lost during boiling or steaming may be retained in water used for soups or stews.

Conclusions

DOH concludes that eating PCBs in blue crabs harvested from the St. Johns River - Green Cove Springs site is not expected to harm people's health. DOH found that PCB levels in crabmeat and crab hepatopancreas (also known as "tomalley" or "crab mustard") are not high enough to harm human health for people who eat them one or two times per week for many years. PCB levels measured in crab are unlikely to cause non-cancer health effects in children and adults. Consuming PCBs in crabs poses a very low increased cancer risk.

Recommendations

DOH does not have any recommendations at this time.

Public Health Action Plan

Actions planned

DOH will consider review of new data when requested.

Report Preparation

This Health Consultation for the St. Johns River – Green Cove Springs site was prepared by the DOH under a cooperative agreement with ATSDR. It is in accordance with the approved agency methods, policies, procedures existing at the date of publication. The cooperative agreement partner completed the editorial review. ATSDR has reviewed this document and concurs with its findings based on the information presented.

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References

[Arnold et al, 1993] Arnold, DL, Bryce, F, Karpinski, K. Toxicological Consequences of Aroclor 1254 Ingestion by Female Rhesus (*Macaca Mulatta*) Monkeys. Part 1A. Prebreeding phase: Clinical Health Finding. Food Chemical Toxicology 31(11) 799-810. Cited in: [ATSDR 2000] Agency for Toxic Substances and Disease Registry. Toxicological Profile for PCBs. Atlanta: U.S. Department of Health and Human Services, Atlanta, GA. November 2000. p. A8.

[ATSDR 2000] Agency for Toxic Substances and Disease Registry. Toxicological Profile for PCBs. Atlanta: U.S. Department of Health and Human Services, Atlanta, GA. November 2000.

[ATSDR 2005] Agency for Toxic Substance and Disease Registry. Public Health Assessment Guidance Manual (Update). U.S. Department of Health and Human Services, Atlanta, GA. January 2005.

[ATSDR 2008] Agency for Toxic Substance and Disease Registry. Evaluation of Contaminant Exposures from Human Consumption of Crabs and Oysters near the Atlantic Wood Industries Site. U.S. Department of Health and Human Services, Atlanta, GA. June 2008.

[Blue Crab Archives 2015]. Cooking-Related Frequently Asked Questions [accessed July 15, 2015]. Available from: https://www.bluecrab.info/cooking_faq.htm.

[Davis 2015] Davis, Clifford. Green Cove Springs Mothball Fleet Left More Behind Than Memories. The Florida Times-Union. July 28, 2015.

[DEP 2014] Florida Department of Environmental Protection. Preliminary Assessment, Lee Field Pier Area, Green Cove Springs, Clay County, FL, EPA ID#: FLN000401045, COMET site ID #: 296092. June 16, 2014.

[EPA 1996] U.S. Environmental Protection Agency, Integrated Risk Information System (IRIS) Chemical Assessment Summary, Polychlorinated biphenyls (PCBs) [accessed June 2, 2016]. Available from: https://cfpub.epa.gov/ncea/iris/iris_documents/documents/subst/0294_summary.pdf.

[EPA 2000] U.S. Environmental Protection Agency. Guidance for Assessing Chemical Contaminant Data for Use in Fish Advisories, Volume 2. Washington DC. November 2000.

[EPA 2010] U.S. Environmental Protection Agency. Environmental Justice Geographic Assessment Tool. U.S. Census Bureau American Community Survey 2008-2010.

Washington, DC [accessed July 15, 2015]. Available from: http://epamap14.epa.gov/ejmap/entry.html.

[EPA 2011] U.S. Environmental Protection Agency, Office of Research and Development. Exposure Factors Handbook: 2011 Edition. EPA/600/ R-090/052F.

[FDA 2010] U.S. Food and Drug Administration. Protocol for Interpretation and Use of Sensory Testing and Analytical Chemistry Results for Re-Opening Oil-Impacted Areas Closed to Seafood Harvesting Due to the Deepwater Horizon Oil Spill. July 2010 [updated November 2010; accessed June 2, 2016]. Available from: http://www.fda.gov/Food/ucm217601.htm.

[Google Earth 2015] Lee Field Pier Area. 30°29'16.26"N, 87°16'12.59"W, elevation one foot [accessed July 13, 2015].

[Green Cove Springs 2015] City of Green Cove Springs, 2015. Green Cove Springs History [accessed July 2, 2016]. Available online: http://www.greencovesprings.com/residents/index.php.

[Kamrin 1988] Kamrin, Michael. Toxicology – A Primer on Toxicology Principles and Applications. Lewis Publications: Chelsea MI. 1988.

[NJ DEP 2002] New Jersey Department of Environmental Protection. Estimate of Cancer Risk to Consumers of Crabs Caught in the Area of the Diamond Alkali Site and Other Areas of the Newark Bay Complex From 2,3,7,8-TCDD and 2,3,7,8-TCDD Equivalents. New Jersey Department of Environmental Protection. April 25, 2002.

[Oregon Cancer Foundation 2015] Oregon Cancer Foundation [accessed June 2, 2016]. Available from: http://www.oregoncancerfoundation.org/.

[NOAA 1993]. Sampling and Analytical Methods of the National Status and Trends Program, National Benthic Surveillance and Mussel Watch Projects 1984-1992, Volume 1, Overview and Summary of Methods. July 1993. Available online: Sampling and Analytical Methods of the National Status and Trends Program, National Benthic Surveillance and Mussel Watch Projects 1984-1992, Volume 1, Overview and Summary of Methods. July 1993 [accessed July 2, 2016]. Available from: http://docs.lib.noaa.gov/noaa_documents/NOS/ORCA/TM_NOS_ORCA/nos_orca_71v1.pdf.

[Sutton 2011] Sutton, Jim. Where the Fish Come to You: Area's Best Places to Fish Without a Boat. The Florida Times-Union. July 16, 2011.

[Tryphonas et al. 1989] Tryponas H, Hayward S, O'Grady L, Loo J, Arnold DL, Bryce F, Zawidzka ZZ. Immunotoxicity studies of PCB (Aroclor 1254) in the adult rhesus (*Macaca Mulatta*) monkey — preliminary report 11(2), 199-206. Cited in: [ATSDR

2000] Agency for Toxic Substances and Disease Registry. Toxicological Profile for PCBs. Atlanta: US Department of Health and Human Services, Atlanta, GA. November 2000. p. A7.

[Tetra Tech 2015] Tetra Tech. Final Site Inspection Report, Lee Field Spoil Area 1 Site Inspection, Green Cove Springs, Clay County, Florida. U.S. EPA ID No. FLN000403489. September 16, 2015.

[Tryphonas et al. 1991] Tryphonas H, Luster MI, White PH, Naylor MR, Erdos GR, Burleson D, Germolec M, Hodgen S, Hayward S, Arnold DL. Effects of PCB (Arochlor 1254) on Non-specific Immune Parameters in Rhesus (*Macaca Mulatta*) Monkeys 13(6), 639-648. Cited in: [ATSDR 2000] Agency for Toxic Substances and Disease Registry. Toxicological Profile for PCBs. Atlanta: US Department of Health and Human Services, Atlanta, GA. November 2000. p. A7.

[Zabik 1992] Zabik ME, Harte JB, Zabik MJ, and Dickmann M. Effect of Preparation and Cooking on Contaminant Distributions in Crustaceans: PCBs in Blue Crab. Journal of Agriculture and Food Chemistry. 40(7):1197–1203.

Appendices

Tables

Table 1. Contaminants of Concern in Blue Crabs

Contaminants of Concern	Concentration Range (mg/kg)	Average Concentration (mg/kg)	Screening Guideline* (mg/kg)	Source of Screening Guideline	Number Above Screening Guideline/Total Number
Total estimated PCBs in crab (meat)	BDL – 0.00021(I)	NA	0.05	DOH Fish Tissue Screening Guideline	0/15
Total estimated PCBs in crab (hepatopancreas)	0.065– 0.190	0.105	0.05	DOH Fish Tissue Screening Guideline	15/15

BDL = below detection limits
DOH = Department of Health
I = Reported value is between the lab method detection limit and the laboratory quantitation limit
mg/kg = milligrams per kilogram
NA = not applicable
PCBs = polychlorinated biphenyls
*Guidelines only used to select chemicals for further evaluation, not to the judge the risk of illness.
Source of data: (DEP, unpublished data, 2015)

Table 2. Completed Human Exposure Pathway: St. Johns River – Green Cove Springs Site

COMPLETED PATHWAY NAME	COMPLETED EXPOSURE PATHWAY ELEMENTS					TIME
	SOURCE	ENVIRONMENTAL MEDIA	POINT OF EXPOSURE	ROUTE OF EXPOSURE	EXPOSED POPULATION	
Ingestion of Crabs	Unknown, but possibly the LFPA and/or Spoil Area #1	Crabs	Spoil Area #1	Ingestion	People eating recreationally-caught crab	Past, present and future

LFPA = Lee Field Pier Area

Table 3. Estimated Non-Cancer Doses - Ingestion of PCBs in Crab Hepatopancreas (One Meal per Week Meal Frequency)

Age Group (years)	Body Weight (kg)	Average Total PCB Concentration in Hepatopancreas (mg/kg)*	Consumption Rate	ATSDR MRL (mg/kg/day)**	Estimated Non-Cancer Ingestion Dose in Hepatopancreas (mg/kg/day)
2 – <6	17.4	0.105	13 g/day	2×10^{-5}	8×10^{-5}
6 – <11	31.8	0.105	13 g/day	2×10^{-5}	4×10^{-5}
11– <16	56.8	0.105	13 g/day	2×10^{-5}	2×10^{-5}
16 – <21	71.6	0.105	13 g/day	2×10^{-5}	2×10^{-5}
>21 (Adult)	80	0.105	13 g/day	2×10^{-5}	2×10^{-5}

ATSDR = Agency for Toxic Substances and Disease Registry
g/day = grams per day
mg/kg = milligrams per kilogram
MRL = minimal risk level
PCBs = polychlorinated biphenyls
*Assumes meal is composed of 30% hepatopancreas (0.105 mg/kg total PCBs).
**The ATSDR MRL is for Aroclor 1254, a commonly used PCB mixture.

Shaded doses exceed the ATSDR MRL.

Table 4. Estimated Non-Cancer Doses - Ingestion of PCBs in Total Edible Crab (Two Meals per Week Meal Frequency)

Age Group (years)	Body Weight (kg)	Average Total PCB Concentration in Total Edible Crab (mg/kg)*	Consumption Rate	ATSDR MRL (mg/kg/day)**	Estimated Non-Cancer Ingestion Dose – Total Edible Crab (mg/kg/day)
2 – <6	17.4	0.032	26 g/day	2×10^{-5}	5×10^{-5}
6 – <11	31.8	0.032	26 g/day	2×10^{-5}	3×10^{-5}
11 – <16	56.8	0.032	26 g/day	2×10^{-5}	1×10^{-5}
16 – <21	71.6	0.032	26 g/day	2×10^{-5}	1×10^{-5}
>21 (Adult)	80	0.032	26 g/day	2×10^{-5}	1×10^{-5}

ATSDR = Agency for Toxic Substances and Disease Registry
g/day = grams per day
mg/kg = milligrams per kilogram
MRL = minimal risk level
PCBs = polychlorinated biphenyls
*Assumes meal is composed of 30% hepatopancreas (0.105 mg/kg total PCBs).
**The ATSDR MRL is for Aroclor 1254, a commonly used PCB mixture.

Shaded doses exceed the ATSDR MRL.

Table 5. Estimated Doses and Increased Cancer Risk from Ingestion of PCBs in Crab Hepatopancreas (One Meal per Week Meal Frequency)

Age Group (years)	Average PCB concentration in hepatopancreas (mg/kg)*	Consumption Rate	Estimated Dose (mg/kg/day)	Oral Slope Factor $(mg/kg/day)^{-1}$	Source of Oral Slope Factor	Estimated Increased Cancer Risk
2 – <6	0.105	13 g/day	4×10^{-6}	2	EPA IRIS	8×10^{-6}
6 – <11	0.105	13 g/day	3×10^{-6}	2	EPA IRIS	5×10^{-6}
11 – <16	0.105	13 g/day	2×10^{-6}	2	EPA IRIS	3×10^{-6}
16 – <21	0.105	13 g/day	1×10^{-6}	2	EPA IRIS	2×10^{-6}
Total Childhood Risk (2 - <21)						**2×10^{-5} (very low)*** **
>21 (Adult)**	0.105	13 g/day	7×10^{-6}	2	EPA IRIS	**1×10^{-5} (very low)**

EPA IRIS = U.S. Environmental Protection Agency Integrated Risk Information System [EPA 1996]
mg/kg = milligrams per kilogram
PCBs = polychlorinated biphenyls
*Assumes meal is composed entirely of hepatopancreas
**Assumes 33-year residential occupancy period
***Summed cancer risk of all age groups, between 2 to <21 years; individual age groups are shown only to show the derivation of the total childhood risk between ages 2 to <21 years.

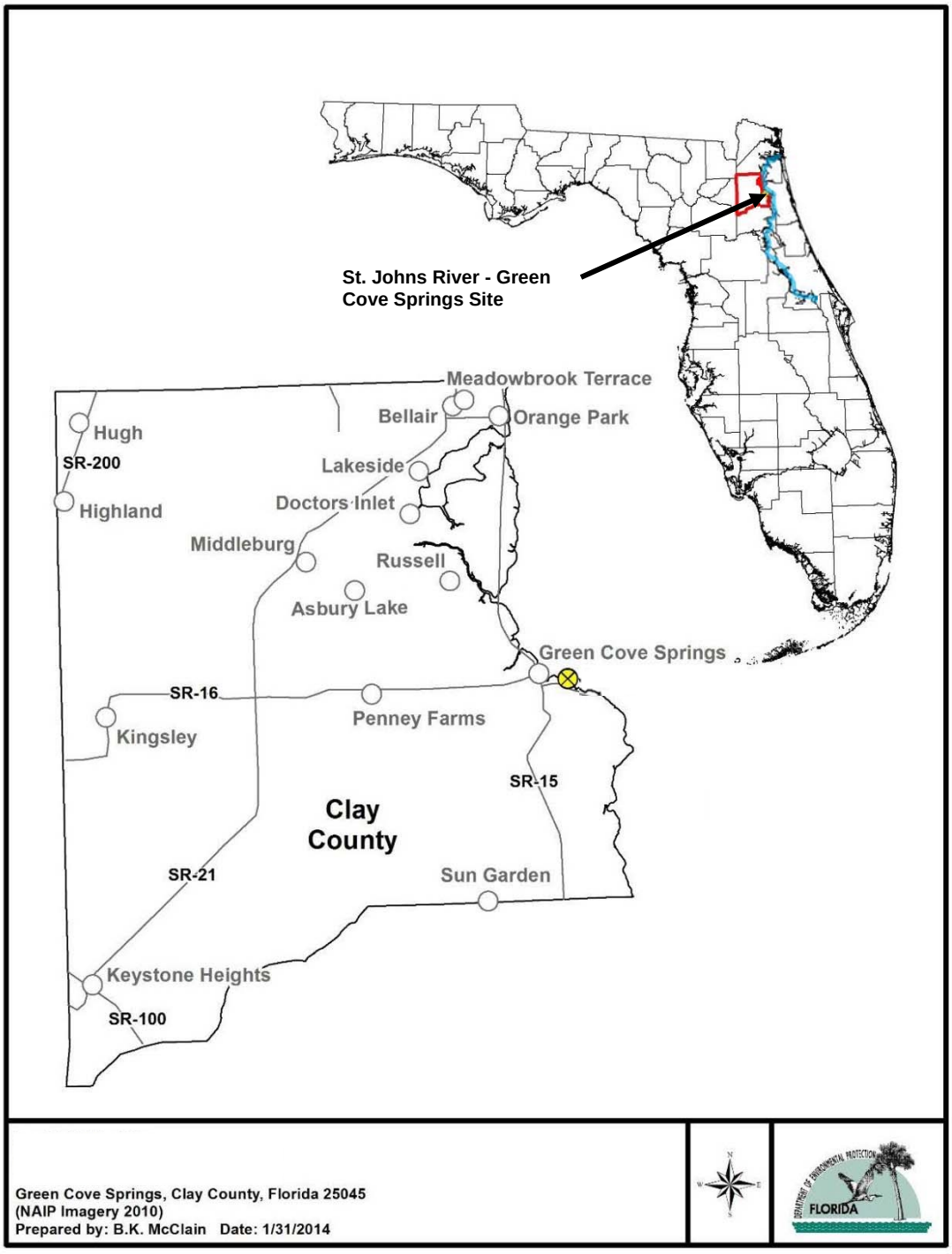
Table 6. Estimated Doses and Increased Cancer Risk from Ingestion of PCBs in Total Edible Crab (Two Meals per Week Meal Frequency)

Age Group (years)	Average PCB concentration in total edible crab (mg/kg)*	Consumption Rate	Estimated Dose (mg/kg/day)	Oral Slope Factor $(mg/kg/day)^{-1}$	Source of Oral Slope Factor	Estimated Increased Cancer Risk
2 – <6	0.032	26 g/day	2×10^{-6}	2	EPA IRIS	5×10^{-6}
6 – <11	0.032	26 g/day	2×10^{-6}	2	EPA IRIS	3×10^{-6}
11 – <16	0.032	26 g/day	9×10^{-7}	2	EPA IRIS	2×10^{-6}
16 – <21	0.032	26 g/day	7×10^{-7}	2	EPA IRIS	1×10^{-6}
Total Childhood Risk (2 – <21)						**1×10^{-5} (very low)*** **
>21 (Adult)**	0.032	26 g/day	4×10^{-6}	2	EPA IRIS	**9×10^{-6} (very low)**

EPA IRIS = U.S. Environmental Protection Agency Integrated Risk Information System [EPA 1996]
mg/kg = milligrams per kilogram
PCBs = polychlorinated biphenyls
*Assumes meal is composed of 30% hepatopancreas (0.105 mg/kg total PCBs).
**Assumes 33-year residential occupancy period
***Summed cancer risk of all age groups, between 2 to <21 years; individual age groups are shown only to show the derivation of the total childhood risk between ages 2 to <21 years.

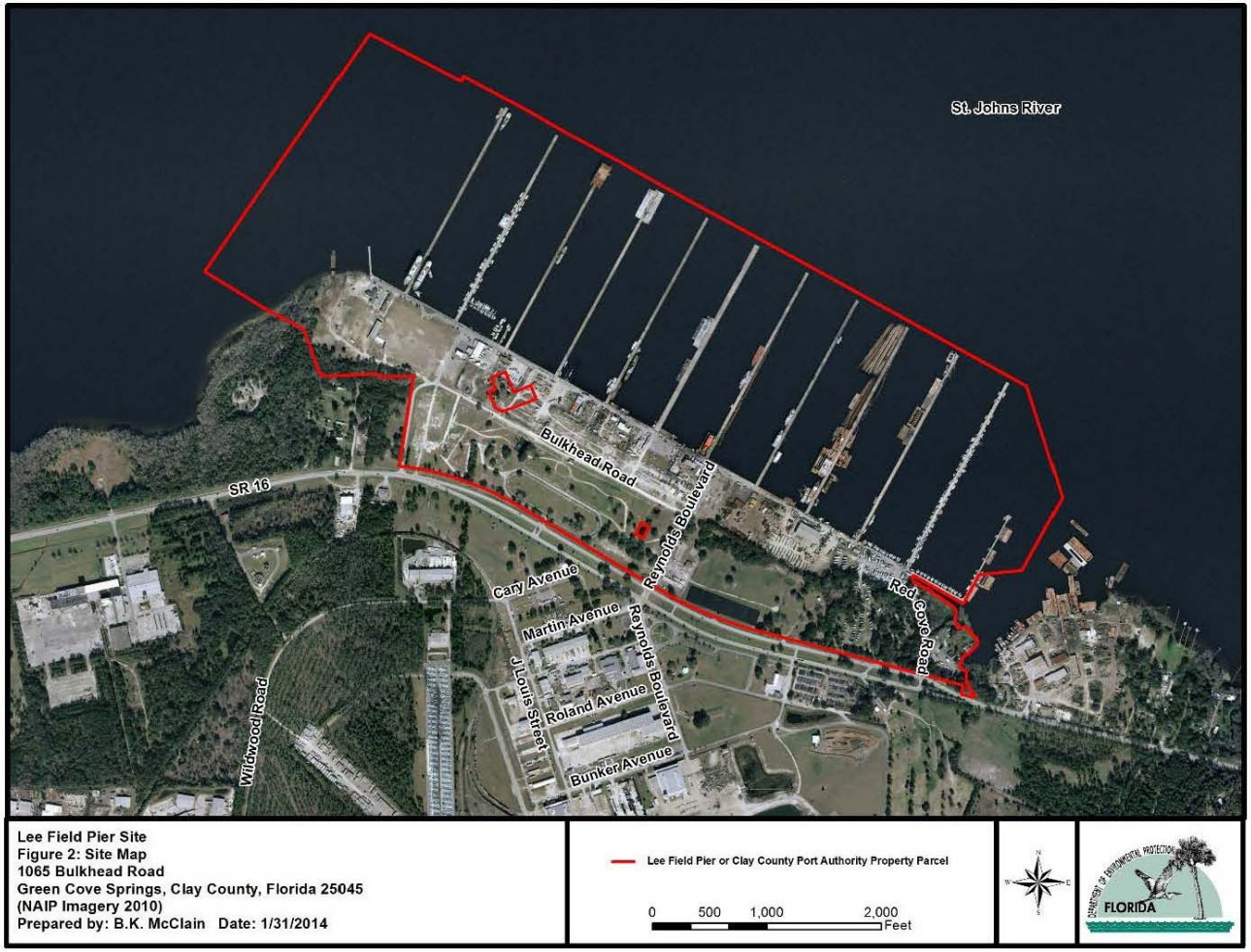
Figures

Figure 1: Site Location



[Adapted from DEP 2014]

Figure 2. Aerial Photograph of the Lee Field Pier Area, Green Cove Springs



[DEP 2014]

Figure 3. Location of Spoils Area #1

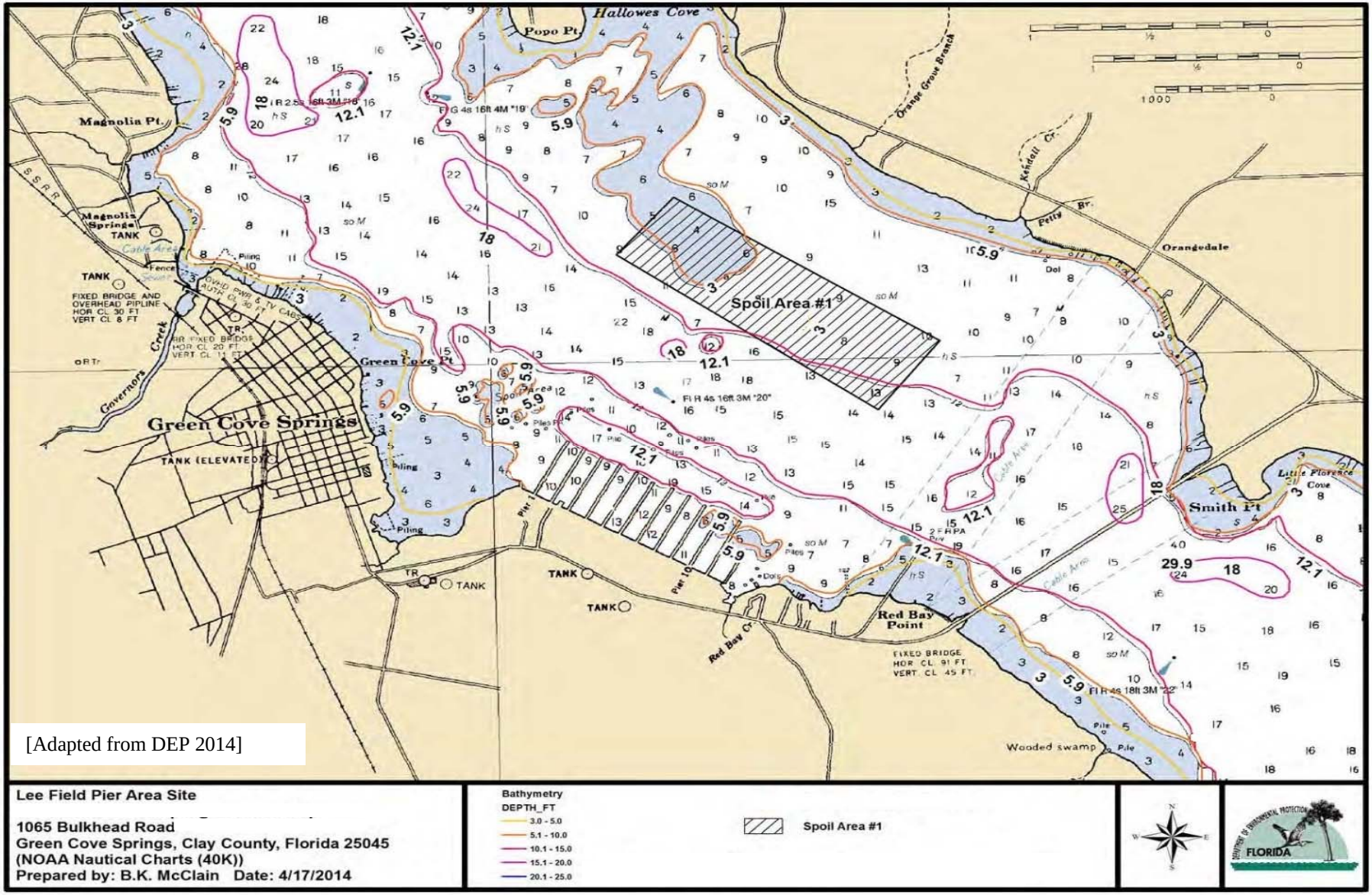
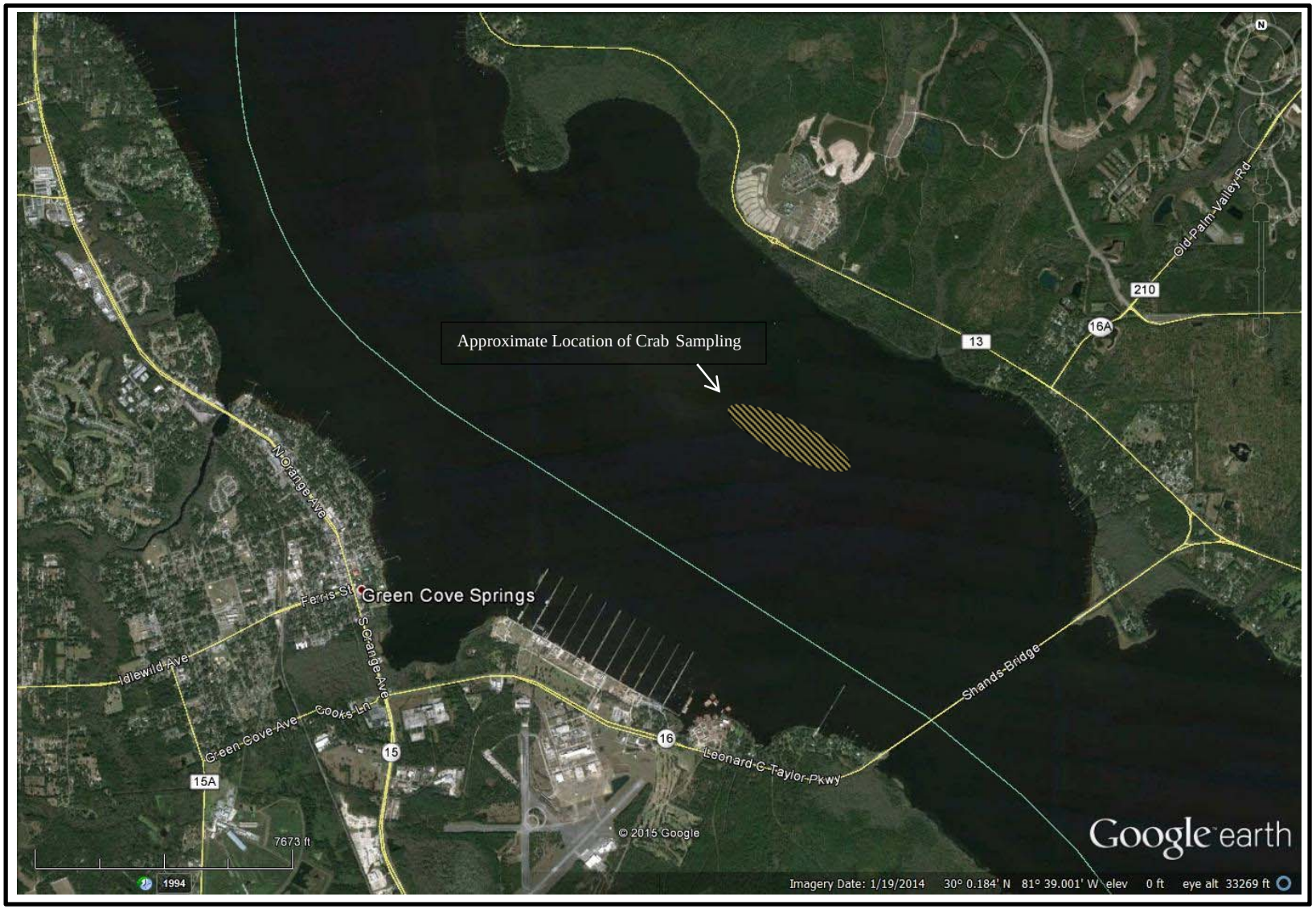


Figure 4. Blue Crab Sample Area



[Google Earth 2015]

Glossary

Acute
Occurring over a short time [compare with **chronic**].

Acute exposure
Contact with a substance that occurs once or for only a short time (up to 14 days) [compare with **intermediate duration exposure** and **chronic exposure]**.

Adverse health effect
A change in body function or cell structure that might lead to disease or health problems.

Cancer
Any one of a group of diseases that occurs when cells in the body become abnormal and grow or multiply out of control.

Cancer risk
A theoretical risk of for getting cancer if exposed to a substance every day for 78 years (a lifetime exposure). The true risk might be lower.

Carcinogen
A substance that causes cancer.

Chronic
Occurring over a long time (more than 1 year) [compare with **acute**].

Chronic exposure
Contact with a substance that occurs over a long time (more than 1 year) [compare with **acute exposure** and **intermediate duration exposure**].

Comparison value (CV)
Calculated concentration of a substance in air, water, food, or soil that is unlikely to cause harmful (adverse) health effects in exposed people. The CV is used as a screening level during the public health assessment process. Substances found in amounts greater than their CVs might be selected for further evaluation in the public health assessment process.

Completed exposure pathway [see **exposure pathway**].

Concentration
The amount of a substance present in a certain amount of soil, water, air, food, blood, hair, urine, breath, or any other media.

Contaminant
A substance that is either present in an environment where it does not belong or is present at levels that might cause harmful (adverse) health effects.

Detection limit
The lowest concentration of a chemical that can reliably be distinguished from a zero concentration.

Dose (for chemicals that are not radioactive)
The amount of a substance to which a person is exposed over some time period. Dose is a measurement of exposure. Dose is often expressed as milligram (amount) per kilogram (a measure of body weight) per day (a measure of time) when people eat or drink contaminated water, food, or soil. In general, the greater the dose, the greater the likelihood of an effect. An "exposure dose" is how much of a substance is encountered in the environment. An "absorbed dose" is the amount of a substance that actually got into the body through the eyes, skin, stomach, intestines, or lungs.

Environmental media
Soil, water, air, biota (plants and animals), or any other parts of the environment that can contain contaminants.

Environmental media and transport mechanism
Environmental media include water, air, soil, and biota (plants and animals). Transport mechanisms move contaminants from the source to points where human exposure can occur. The **environmental media and transport mechanism** is the second part of an **exposure pathway**.

EPA
United States Environmental Protection Agency.

Exposure
Contact with a substance by swallowing, breathing, or touching the skin or eyes. Exposure may be short-term [**acute exposure**], of intermediate duration, or long-term [**chronic exposure**].

Exposure pathway
The route a substance takes from its source (where it began) to its end point (where it ends), and how people can come into contact with (or get exposed to) it. An exposure pathway has five parts: a **source of contamination** (such as an abandoned business); an **environmental media and transport mechanism** (such as movement through groundwater); a **point of exposure** (such as a private well); a **route of exposure** (eating, drinking, breathing, or touching), and a **receptor population** (people potentially or actually exposed). When all five parts are present, the exposure pathway is termed a **completed exposure pathway**.

Hazard
A source of potential harm from past, current, or future exposures.

Hazardous waste
Potentially harmful substances that have been released or discarded into the environment.

Health consultation
A review of available information or collection of new data to respond to a specific health question or request for information about a potential environmental hazard. Health consultations are focused on a specific exposure issue. Health consultations are therefore more limited than a public health assessment, which reviews the exposure potential of each pathway and chemical [compare with **public health assessment**].

Ingestion
The act of swallowing something through eating, drinking, or mouthing objects. A hazardous substance can enter the body this way [see **route of exposure**].

Inhalation
The act of breathing. A hazardous substance can enter the body this way [see **route of exposure**].

Intermediate duration exposure
Contact with a substance that occurs for more than 14 days and less than a year [compare with **acute exposure** and **chronic exposure**].

Lowest-observed-adverse-effect level (LOAEL)
The lowest tested dose of a substance that has been reported to cause harmful (adverse) health effects in people or animals.

mg/kg
Milligram per kilogram.

Minimal risk level (MRL)
An ATSDR estimate of daily human exposure to a hazardous substance at or below which that substance is unlikely to pose a measurable risk of harmful (adverse), noncancerous effects. MRLs are calculated for a route of exposure (inhalation or oral) over a specified time period (acute, intermediate, or chronic). MRLs should not be used as predictors of harmful (adverse) health effects [see **reference dose**].

Point of exposure
The place where someone can come into contact with a substance present in the environment [see **exposure pathway**].

Population
A group or number of people living within a specified area or sharing similar characteristics (such as occupation or age).

ppb
Parts per billion.

ppm
Parts per million.

Public health assessment (PHA)
An ATSDR document that examines hazardous substances, health outcomes, and community concerns at a hazardous waste site to determine whether people could be harmed from coming into contact with those substances. The PHA also lists actions that need to be taken to protect public health [compare with **health consultation**].

Receptor population
People who could come into contact with hazardous substances [see **exposure pathway**].

Risk
The probability that something will cause injury or harm.

Route of exposure
The way people come into contact with a hazardous substance. Three routes of exposure are breathing [**inhalation**], eating or drinking [**ingestion**], or contact with the skin [**dermal contact**].

Sample
A portion or piece of a whole. A selected subset of a population or subset of whatever is being studied. For example, in a study of people the sample is a number of people chosen from a larger population [see **population**]. An environmental sample (for example, a small amount of soil or water) might be collected to measure contamination in the environment at a specific location.

Source of contamination
The place where a hazardous substance comes from, such as a landfill, waste pond, incinerator, storage tank, or drum. A source of contamination is the first part of an **exposure pathway**.

Substance
A chemical.

Survey
A toxicological profile also identifies significant gaps in knowledge on the substance and describes areas where further research is needed.

Toxicology
The study of the harmful effects of substances on humans or animals.