3-31-2005

Impacts on Oak Ridge Landowners of Off-Site Releases to the Environment from the Y-12 Plant and Associated Long-Term Stewardship Issues

Institute for Technology, Social, and Policy Awareness, Inc. (ITSPA)

Susan Arnold Kaplan

Impacts on Oak Ridge Landowners of Off-site Releases to the Environment from the Y-12 Plant and Associated Long-term Stewardship Issues

BY

INSTITUTE FOR TECHNOLOGY, SOCIAL, AND POLICY AWARENESS, INC.

IMPACTS ON OAK RIDGE LANDOWNERS OF OFF-SITE RELEASES TO THE ENVIRONMENT FROM THE Y-12 PLANT AND ASSOCIATED LONG-TERM STEWARDSHIP ISSUES

PERFORMED FOR
INSTITUTE FOR TECHNOLOGY, SOCIAL, AND POLICY AWARENESS, INC.

PERFORMED BY
KAPLINE ENTERPRISES, INC.

SUSAN ARNOLD KAPLAN
PRINCIPLE INVESTIGATOR

MARCH 31, 2005

4121 Guinn Road
Knoxville, TN 37931
Tel: (865) 927-3784 • Fax: (865) 927-1772

TABLE OF CONTENTS

TABLE OF CONTENTS (CONT.)

TABLE OF CONTENTS (CONT.)

TABLE OF CONTENTS (CONT.)

TABLE OF CONTENTS (CONT.)

TABLE OF CONTENTS (CONT.)

TABLE OF CONTENTS (CONT.)

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDIX TABLES

ii. FOREWORD

I am a relative newcomer to the mercury saga, although I did not realize it when I got involved in 2000, over 15 years after the issue surfaced. Doing the research for this project showed me just how little I knew when I started, how far into the timeline I entered the picture, and just how sensitive members of the community are about this subject.

I would especially like to thank those who helped me with this project, particularly those property owners and tenants who responded to the short-form survey that was delivered to their home and those who agreed to a tape-recorded interview. I realize the decision to participate in a controversial study that has the potential to impact property values can be a difficult one, particularly in a small town like Oak Ridge.

I owe a debt of gratitude to Dr. Gordon Blaylock of SENES Oak Ridge Center for Risk Analysis, who served as the technical expert for this project. He spent untold (and often uncompensated) hours working with me, helping me to understand what data meant, sorting through the numerous technical documents and newspaper articles, attending related meetings, and reading (and rereading) the report.

I would also like to thank RESOLVE, Inc., the administrator of the Community Monitoring and Technical Assessment (CMTA) Fund, for their patience during the production of this report. I would particularly like to thank my grant administrator, Bruce Stedman. ITSPA received the CMTA Fund grant in November 2001 and I was diagnosed with a rare cancer in my foot in December 2002, which significantly interfered with my efforts on this project. Over the last several years, I have poured my heart and soul into researching this document, which turned into a "labor of love" for me—one that I have to admit I'm glad to have off my shoulders, but which I’m proud to have completed.

iii. DEDICATION

This report is dedicated to those Oak Ridge residents who have concerns that illnesses may have been caused by past exposure to releases of contaminants from the nuclear facilities in Oak Ridge and from fallout that occurred as a result of the Atomic Energy Commission's above-ground nuclear weapons testing.

My report is also dedicated to all the property owners across the country that purchased land in the path of the releases from the DOE facilities. In particular, I would like to dedicate my report to Wayne Clark and Melvin Sturm, two East Fork Poplar Creek (EFPC) property owners. I became involved in this project because of my interaction with Wayne, and it was his experiences that motivated me to apply for a grant from the Citizens' Monitoring and Technical Assessment (CMTA) Fund to further explore the issue of property owner impacts, the use of the 400 part per million cleanup limit in Oak Ridge, and the issue of long-term stewardship of contaminated lands. I would also like to thank Mel, who kept meticulous records on the EFPC issue. This project would have been much more difficult to accomplish without his extensive collection of newspaper articles, reports, and notes.

iv. DISCLAIMER

All information contained in this report should be independently verified by the user. ITSPA, its employees, agents, personnel, and subcontractors disclaim, and shall not be held liable for, any and all damage, loss or liability, whether direct, indirect, or consequential, which arises or may arise from this report or the use thereof by any person or entity.

v. EXECUTIVE SUMMARY

Past releases to the environment from the U.S. Department of Energy's (DOE) Y-12 Plant have been of continuing concern to Oak Ridge and downstream communities since the release of mercury, uranium, and other contaminants were made public beginning in 1983. These releases continue to affect the region in many ways today. The intent of this report is to ensure we do not forget what has transpired in this community and to provide a clearer understanding of the impacts on local property owners, particularly those along the East Fork Poplar Creek (EFPC).

This document is intended to serve as an all-inclusive reference document that can be used by community members and others interested in the DOE releases from Y-12. It particularly focuses on past releases via the EFPC. This report looks at impacts on EFPC property owners (e.g., economic and day-to-day land maintenance issues) and on members of the public (e.g., children who play in the floodplain or the creek and those who eat fish from the creek and/or downstream waterways).

From the property owner's and community member's perspectives, the contamination of the EFPC and other areas in the community has been confusing, frustrating, and often costly. Examples of difficulties and concerns encountered by property owners include trouble renting and selling property as a result of newspaper coverage of the contaminant issue, loss of use of land for 15 years or more while waiting for remediation to take place, concern about being liable and/or co-liable with DOE for future impacts on others, lost logging contracts due to concern about contamination, concern about flood water redepositing and resuspending contamination from the floodplain, loss of tourism revenue for downstream communities, and concern about future releases further contaminating property.

Questions also remain regarding the health effects of contaminants released via the creek and numerous other pathways from Y-12 (not to mention the other two DOE facilities) on residents, people who farm and/or maintain the land, and members of the public—especially children and fishermen who use the creek for recreation. Therefore, this document discusses public health activities that have been triggered by past releases. Only one Public Health Assessment (PHA) out of nine (perhaps ten) planned by the Agency for Toxic Substances and Disease Registry (ATSDR) has yet been released (i.e., Y-12 uranium). Unfortunately, it was released with the concerns of the Environmental Protection Agency (EPA) regarding past exposures remaining unanswered.

The following are especially important issues associated with the creek, which are discussed below: (1) legal and ethical issues associated with real estate sales along the creek—issues created by Tennessee's real estate disclosure law and the government's use of the "homogenized" sampling technique for Phase 1B samples, (2) what the public has been told about the creek and the floodplain, and (3) what the public needs to know. Also summarized below are recommendations and conclusions by the Institute for Technology, Social, and Policy Awareness, Inc. (ITSPA).

Legal and Ethical Issues

The fact the EFPC winds its way through much of Oak Ridge raises both legal and ethical concerns regarding the sale and lease of real estate along the creek. Tennessee's real estate disclosure law, combined with the government used the "homogenized" sampling technique (i.e., the blending of a 16-inch sample prior to analysis rather than dividing into smaller segments to determine the maximum contaminant level) during Phase IB sampling, raises some tricky legal and ethical issues. Of particular concern is how "homogenized" sampling can be misleading when used to determine levels of contamination. For example, a reading of 400 parts per million (ppm) could actually represent a sample that has mercury in the thousands of ppm, which could potentially introduce health concerns depending on the form of the mercury. The form of mercury has been assumed to be primarily the sulfide form, which is very insoluble, stable, and expected to pose little health threat. However, the fact that mercury levels in downstream fish are rising raises questions about this assumption (see below, i.e., *What the Public Has Been Told* for 2003 and 2004).

What the Public Has Been Told

Many years have passed since the mercury releases were made public, and property owner workshops are no longer held to discuss the Lower EFPC (LEFPC). The only information the public receives is an occasional newspaper article and the annual *State of the Creek Address* (which few attend). However, this address is scientific in nature and does not address the day-to-day questions a property owner might have about dealing with the creek. It is likely that many members of the public do not understand the scientific information presented at the annual presentation. In fact, many probably do not even know these addresses are held. The following are summaries of what the public has been told at the annual *State of the Creek Address* for 2001 to 2004:

2001: The following is a synopsis of what was presented to the public at the Oct. 9, 2001, *State of the Creek Address*—the first ever given in a public forum. Dr. James Loar (Environmental Sciences Division, Oak Ridge National Laboratory) reported detecting the following improvements in the EFPC: (1) mercury has decreased steadily in water during the past decade, (2) bypassing Lake Reality has diminished methylmercury in the downstream water, (3) fish health continues to improve, (4) fish and invertebrate communities are now more similar to reference communities, and (5) no toxicity has been observed in the required toxicity tests of EFPC water since flow management.

2002: The second annual *State of the Creek Address* was given Oct. 16, 2002, with similar conclusions reported. Loar reported the following continuing concerns: (1) polychlorinated biphenyls (PCBs) and mercury are not decreasing in Upper EFPC (UEFPC) fish, (2) metals are increasing in UEFPC periphyton, (3) fish and invertebrate communities in UEFPC remain impacted as compared with reference communities, (4) the rate of colonization of EFPC by sensitive fish and benthic invertebrate species has slowed, and (5) toxicity is still detected by some *in situ* and laboratory tests. [The Upper EFPC is located on the DOE reservation.]

2003: In the third address, Loar indicated that *fish samples taken farther from Y-12 now have higher methylmercury than ones taken close to the Plant.* This is in contrast to what was reported in "Contaminant Releases and Public Health Risks: Results of the Oak Ridge Health Agreement Studies," presented by the TN Dept. of Health (July 2000). In that report, the section "Mercury Releases From the Y-12 Plant" states: "The level of mercury exposure depends partly on how close the fish were to Y-12; the closer to the plant the fish were caught, the higher the dose and risk." *It appears this is no longer true.*

2004: At the fourth address, Loar indicated that statistical tests have shown the increase in mercury is not an artifact of fish size, gender, or season and that ecological changes in trophic status or bioenergetic efficiency do not account for the increase. Aqueous methylmercury concentrations have decreased in LEFPC over the past two decades, but the mechanism driving the change in bioaccumulation remains unknown and is under investigation. Loar offered two hypotheses for the increases in mercury in fish: (1) there has been a change in the rate at which methyl groups are removed (i.e., demethylation), and (2) the form of mercury present closer to Y-12 may be affected by bacterial action. The increased levels of mercury in fish were measured at East Fork Kilometer (EFK) 6.3. The levels of PCBs in fish in EFPC also are elevated and are not decreasing.

What The Public Needs to Know

EFPC residents are not routinely offered the opportunity to be educated in practical terms what the posting of signs on the creek banks means, as they are given the opportunity to be educated about the creek in scientific terms. In fact, there seems to be a Catch 22 situation in that the signs warn against fishing and water contact, but property owners are told by the city they are responsible for bank stabilization and vegetation removal. However, these activities could potentially expose them to the posted water unless proper precautions are taken. ITSPA found no city or Tennessee Department of Environment and Conservation (TDEC) literature or website discussing such precautions, although at the city's website (www.cortn.org), there is a historical discussion of the creek and the path leading to remediation of the creek in 1996.

Numerous questions regarding the creek and the floodplain remain unanswered. Of concern are the results of ITSPA's short-form survey of EFPC residents, which indicate some do not even know the creek could pose a risk and requested additional information. The following are questions that ITSPA believes have not been effectively answered by the government agencies responsible for the environment and the health, safety, and welfare of the public:

- What are the public health implications of the use of "homogenized" samples during Phase IB sampling of the EFPC and its floodplain?

- Does the fact that in past health consultations ATSDR has found the 400 ppm cleanup level acceptable for use absolve a property owner of having to disclose that the property lies on or near a stream impacted by the Y-12 Plant and may be located on or near a potentially mercury-contaminated floodplain?

- Must (or should) the property owner inform potential buyers the stream is posted despite the fact there are no signs on the creek bank adjacent to the property?

- What if the developer maintains a buffer area separating the property from the creek? What is the property owner's obligation to disclose the property's close proximity to EFPC?

- Does the ATSDR position of "no threat to human health" apply to the creek itself and its banks, as opposed to the floodplain soils, which are specified in the Health Consultations?

- What safeguards are in place to prevent the spread of mercury-containing soil at greater than 400 ppm during future city and construction projects?

- Since little human health data are available, particularly on environmental exposures, is a system in place to track the actual long-term health impacts on children who currently play in the creek and have played there in the past?

- Has any work been done to generate or gather data regarding absorption of inorganic mercury salts via inhalation and dermal exposures? ATSDR indicated in the 1993 Health Consultation that no quantitative data were available.

- How much mercury is reintroduced to the floodplain during floods today and where are the problem areas?

- Can property owners safely perform maintenance operations on their creek-front property (e.g., bank stabilization and vegetation removal), which the city has indicated is expected of them? This appears to put the property owners in a Catch 22 situation because of the creek posting.

- If someone comes into contact with the posted water, what decontamination steps should they take?

- Does everything that comes into contact with the creek water and sediments have to be packaged, handled, and disposed of as hazardous waste, as one property owner indicated to ITSPA he was told in 2000, and which resulted in the loss of tens of thousands of dollars?

- Spills still occur periodically at Y-12. Should property owners be warned immediately so they can take extra precautions to keep humans and pets out of the creek as the contaminant plume passes? Does a mechanism exist to immediately notify residents along the EFPC of a spill other than the general siren?

- Should residents place a grill in the floodplain near the creek and use it as a picnic area? How are residents educated about this use of the floodplain?

- Should parents place a swing-set in the floodplain and allow their child to play and dig there? How are residents educated about this use of the floodplain?

- What should a parent do if a child wanders into the creek, digs in the sediments, and becomes covered with that sediment? Are the children who are regularly exposed to the water and/or sediments at risk for future health problems? Has this risk been quantified and communicated to residents?

- What about the feeder streams that back up during floods and have fish and turtles that likely have contaminant levels of concern? Are these feeder streams posted by the state?

Recommendations and Conclusions

EFPC property owners deserve relief from the dilemma they face—perhaps unknowingly. In particular, property owners should be provided guidance on exactly how they can safely and legally use their property along the creek and the buffers that have been established by neighborhood developers.

- **Buyer Notification and Real Estate Disclosure Laws:** Because of the homogenized sampling method used in Phase IB sampling of the EFPC, it is very likely that bands of soil contaminated to a level much greater than 400 ppm have been left in place (perhaps in the range of thousands of ppm). *Therefore, ITSPA recommends that the buyer of property near and on the creek be informed of this possibility both by the realtor/seller and by deed restrictions.* However, because the government's position is that no contamination has been left in place, it appears no disclosure or deed restrictions are currently required. In addition, ITSPA believes there are an alarming number of exclusions to the Tennessee real estate disclosure law. *Therefore, ITSPA believes the law should be amended to eliminate these exclusions.*

- **Property Use Guidelines:** Government agencies need to better understand the financial impacts of their decisions on these property owners, and should *develop a set of consistent guidelines* that property owners can follow in the use and care of their creek-front and/or flood-impacted property. Such guidelines will help property owners as they deal with independent contractors performing maintenance work along the creek.

- **Community Sampling:** There is a disconcerting absence of soil sampling and surface smear data in Oak Ridge. This greatly impacts the public's trust of DOE and the quality of decisions made by public health officials regarding the impacts of releases from the ORR. The data that does exist has been called into question because of the use of "homogenized" samples, not to mention the serious conflict of interest that exists because DOE is the funding source for all of these activities. *Therefore, a widespread Oak Ridge sampling program (deep soil cores and surface smears)—having appropriate community input and independent*

oversight—should be developed as part of the upcoming Federal Facilities Agreement (FFA) milestone (Appendix E – Other).

- **Signs Along The Creek:** TDEC must be more diligent in its efforts to *ensure that signs are posted and visible along the EFPC. This is particularly true in the summer months when children are more likely to play in the creek*. ITSPA observed vegetation blocking the visibility of some of the signs during its tour last summer. In addition, the agency must *ensure that signs are in place along the creek in the new subdivisions in the west end of Oak Ridge*.

- **EFPC Resident Education Program:** Because of unanswered questions regarding the EFPC and its use, *ITSPA recommends that an educational program geared towards residents near the waterway be developed*. Information should be disseminated via pamphlet, web site, local science museum, public library, school outreach effort, churches, daycares, etc. The program should answer questions such as the ones raised by ITSPA and provide a web site, as well as a point of contact where the public can get accurate and consistent answers to their questions.

vi. INTRODUCTION

The EFPC issue has spanned a period of over 20 years (beginning in 1983) and there is no end in sight for discussion of issues concerning the creek. This section provides: (1) an overview of what has occurred in the past, (2) a brief discussion of what is occurring in the present, and (3) some concerns for the future.

The Past

The public first learned of DOE environmental releases in 1983 when the agency announced the release of mercury from the Y-12 Plant in Oak Ridge, Tennessee. The announcement, which was prompted by a Freedom of Information Act (FOIA) request by Ed Slavin,[1] marked the beginning of DOE's Environmental, Safety, and Health (ES&H) projects nationwide.[2] As a result of this FOIA request, DOE announced that 2.4 million pounds of mercury were unaccounted for.[3] It later acknowledged that other contaminants such as uranium, PCBs, and volatile organics had been released to the air, surface water, and groundwater as well. The peak year for *air* **mercury** releases was 1955 when approximately 22,000 pounds of mercury were released. The peak year for *water* was 1957, when approximately 72,000 pounds were released to EFPC. The peak year for total releases was 1957, when approximately 78,000 pounds (*air and water*) were released. Peak **uranium** air releases were approximately 14,000 pounds in 1959.[4] Other than 1944 when almost 73,000 pounds of uranium were released from Y-12 (to both EFPC and Bear Creek), the peak year of uranium releases to surface waters was 1968 when almost 40,000 pounds were released.

Both the mercury and uranium released off-site went primarily to EFPC, a small surface-water stream that originates near the Y-12 facility and winds its way through the city of Oak Ridge before joining Poplar Creek, the Clinch River, the Watts Bar Reservoir, and eventually the Tennessee River system. Local waterways were given sign postings by the State of Tennessee to discourage eating fish and contact with the water and sediments. These waterways include EFPC (posted for mercury, polychlorobiphenols or PCBs, and bacteria}, Poplar Creek embayment (posted for mercury and PCBs), Watts Bar Reservoir - Clinch River arm (posted for PCBs), and Watts Bar Reservoir -

---

[1] Then-editor of *Appalachian Observer* (no longer published) who is now an attorney outside of Tennessee

[2] Handouts from a talk entitled, "Mercury—Much Ado About Nothing?" given by Caroline Hay Krause, a science writer and editor for the Oak Ridge National Laboratory who is working on a history of the mercury issue in Oak Ridge in her spare time. Material for this report also came from an unpublished document dated 3/13/95 by Krause entitled *ORNL, Mercury, and the Environment.*

[3] According to *The Oak Ridger* ("Creek Cleanup Takes Step Forward," 10/8/02), an estimated total of 700,000 pounds of mercury were lost to the environment, with around 280,000 pounds lost to East Fork Poplar Creek, and about 1.3 million pounds unaccounted for through bookkeeping errors.

[4] Provided in an email to the author (2/24/05) from Dr. William Taylor of the Agency for Toxic Substances and Disease Registry (ATSDR) who gathered the data from the Task 2 report of the Oak Ridge Dose Reconstruction. [Source: Reports of the Oak Ridge Reservation Dose Reconstruction, Vol. 2, The Report of Project Task 2, Mercury Releases from Lithium Enrichment at the Oak Ridge Y-12 Plant – a Reconstruction of Historical Releases and Off-Site Doses and Health Risks, ChemRisk: A Service of McLaren/Hart, July 1999. The water data is from Appendix I of Vol.2. The air data is presented in Table 4-5 (p. 4-33) and Appendix H of Vol.2.]

Tennessee River portion (posted for PCBs).[5,6] Bear Creek forms just west of the Y-12 Plant and flows southwesterly down Bear Creek Valley for about 8.5 miles to where Pine Ridge ends. It then turns northwest and enters EFPC about 1.5 miles above its confluence with Poplar Creek. Unlike EFPC, Bear Creek does not receive many direct wastewater discharges from Y-12. Nevertheless, the quality of Bear Creek waters in the upper reaches has traditionally been seriously impacted by pollutant seepage and contaminated runoff from substandard waste disposal facilities

According to science writer Caroline Krause (see Footnote 2), the Tennessee Valley Authority (TVA) sampled the EFPC floodplain and creek sediments for the interagency Oak Ridge Task Force. This was in response to a recommendation made at a Congressional Hearing held by Albert Gore and Marilyn Lloyd in July 1983. TVA personnel collected and analyzed soil samples from the floodplain as well as sediment, vegetation, water, and groundwater samples to obtain a complete mercury profile. The task force found that most of the floodplain was contaminated with mercury.

In addition to contamination of the EFPC, a deposit of pollutants including uranium was found a couple of feet down in the sediments of Watts Bar Lake. Generally, whenever mercury was present, so were uranium and other pollutants. Uranium was found present in elevated amounts in EFPC and Bear Creek, both of which receive drainage from the plant at the east and west ends. The creeks eventually join and flow into Poplar Creek, which empties into the Clinch River near Watts Bar Lake. DOE indicated that about 280,000 pounds of uranium had been discharged into the creeks from Y-12 over the past three decades. However, DOE also indicated the amounts were probably higher because they could not find environmental records for Y-12's first 13 years of operation. An Oak Ridge National Laboratory (ORNL) scientist, Ralph Turner, who had studied the sediments in the Bear Creek drainage system, said uranium deposits as high as 5,000 ppm had been found in the creek's upper stretch, but a more typical level was 1,000 to 2,000 ppm. DOE indicated the highest level of uranium found in EFPC samples was about 500 ppm.[7]

Since the public first learned of the releases of contaminants to EFPC, the level of risk posed by these contaminants has been a matter of confusion and controversy. According to science writer Caroline Krause, the 1983 announcement of environmental releases prompted government funding for broader studies of releases of contaminants locally and at other DOE sites. As a result of this influx of funding, more than 100 environmental companies had established offices in the Oak Ridge area by 1997, a number of which remain in operation today performing cleanup at the DOE facilities. The studies prompted the removal in 1996 of highly contaminated soils from the EFPC

[5] See Appendix 1-1 for maps provided by Tennessee Department of Environment and Conservation (TDEC) that show the specified locations for these signs along the EFPC.

[6] The list of fish advisories is published in Tennessee Wildlife Resources Agency's (TWRA) annual fishing regulations and is posted on TDEC's website at http://www.state.tn.us.environment/wpc/publications/advisories.pdf.

[7] "Cold War Fears Added To Pollution of Streams (Uranium Pollution—Our Nuclear Legacy)," Knoxville News Sentinel, 6/28/85.

floodplain at the National Oceanographic and Atmospheric (NOAA) and the Bruner sites (also includes the Clark and Sturm sites).[8]

However, proposed remedial actions resulting from the studies, such as removing the top soil from large areas along the creek, generated concern and, in some cases, great opposition from residents and property owners. Opposition particularly arose from some along EFPC who did not want their beautiful, pastoral property torn up by the remediation or their property values to decline further. In fact, one property owner who raised his family along the creek on a small farm led the fight for a much higher cleanup limit than was originally proposed.[9] In addition, two of the largest property owners who had the highest levels of mercury found on private property sued and eventually settled with the government for tying up their land for almost 15 years and preventing its development.[10]

Concerns were also expressed about the inequity of the area waterway postings when, in fact, numerous other waterways in Tennessee were and are polluted (generally by sources other than DOE), but were/are not posted.[11] Watts Bar Reservoir resort owners experienced a significant decline in tourists because of the posting of the waterway. As a result, they also sued DOE's primary contractor in Oak Ridge and later settled with them.[12]

Even Oak Ridge residents who were not directly affected by the contamination expressed concern about the potential loss of aesthetics and the truck traffic that would result from a large remediation effort. Because of the public's concern, DOE established a local work group to give the property owners and members of the public a means of staying informed on the remediation effort.

The following is a summary of the remediation efforts and plans by the DOE Environmental Restoration Program that were presented at an *EFPC Property Owner Workshop*, [13] along with the target dates:

---

[8] DOE Fact Sheet (Spring 1995), "Environmental Restoration Program for Lower East Fork Poplar Creek," summarizes the cleanup project.

[9] "Costs of A Cleanup" (*Knoxville News Sentinel*, Frank Munger, 9/27/93), which includes an interview of Al Brooks, a property owner along EFPC.

[10] See Personal Interviews #1 and #4 in Section 7.3.3, which provides a summary of the interviews of these property owners.

[11] The article, "Despite Law, It's Clear Water in State, Nation Far From Clean, Experts Report" (*Knoxville News Sentinel*, Jim Balloch, 10/18/02), provides information from the Tennessee Valley Authority on the quality of waters in the state.

[12] "Watts Bar Lake Resorts Sue Over Contamination" (*The Oak Ridger,* 9/1/91) and *"Resort Owners at Watts Bar Settle Out of Court With MMES"* (*The Oak Ridger*, 8/5/94).

[13] An *East Fork Poplar Creek Property Owner Workshop* was held in November, 1991, for the DOE Environmental Restoration Program by Radian Corp. and SAIC). Participants at this workshop included: Bob Sleeman (DOE), David Page (DOE), Richard P. Nicholson (DOE Realty Officer, Procurement and Contracts Div.), Sandy Perkins (DOE), Wayne Tolbert (SAIC), Doug Combs (SAIC), Pat Ryan (SAIC), Jim Rogers (SAIC), and Tim Myrick (SAIC). Appendix 1-2 provides the sign-in sheet for a public meeting held on 8/14/96 and debrief notes for that workshop.

- Oak Ridge Task Force formed – 1983
- Contaminated soil removed from a private residence – 1984
- Contaminated soil removed from sewerline beltway at Civic Center (Note: 10 ppm cleanup level used) – 1985
- Public scoping meeting – 1988
- Contaminated soil removed from sewerline beltway, Emory Valley Rd. – 1989
- Oak Ridge Reservation (ORR) placed on the Comprehensive Environmental Response, Compensation, and Liability (CERCLA) National Priorities List (NPL) for cleanup – December 1989
- Field work for Remedial Investigation – October 1990
- Phase 1A Sampling Analysis Planning and Sampling – mid-1990 to mid-1991
- Environmental Impact Statement Implementation Plan – 1990
- Phase 1B Sampling Analysis Planning and Sampling – mid-1991 to late-1991
- Remedial Investigation – 1990-1992
- Citizens Working Group formed (May 1992)
- Feasibility Study/Environmental Impact Statement – 1993 (Actual: April 1993)
- Proposed Plan – 1993
- Record of Decision – 1994 (Actual: Approved September 1995)[14]
- Public Meeting discussing raising cleanup level to 400 ppm – January 26, 1995
- Remediation of EFPC to 400 ppm – Phase I completed September 1996, Phase II began in April 1997 and was completed October 1997

The Present

ITSPA identified a number of commercial enterprises and residential properties along the creek in the real estate analysis performed as part of this project. Of particular interest are two residential communities that were built along the EFPC in the late-1990s, well after the contaminant releases were made public. Wiltshire Estates is a community of five-acre baby farms that has some properties abutting the creek, and a subdivision known as Southwood also has a number of homes near the creek. However, the Southwood developer maintains ownership of a strip of land adjacent to EFPC, which serves as a buffer between these homes and the creek. In the west end of Oak Ridge, a significant amount of creek-fronting property remains undeveloped and owned by the individuals who purchased the land from the government.

Today, the EFPC project is widely touted by DOE and its proponents as a success story, being the first time the agency included the public in a decision-making process, and as a model for saving taxpayer money. Caroline Krause (see Footnote 2) also has pointed out that a positive result of all the Oak Ridge remediation studies is the education of people in general about the risks of exposure to mercury from all sources—not just

[14] Appendix 1-3 provides the description of the selected remedy from the Record of Decision. ITSPA could not find an internet link to the Record of Decision (ROD).

EFPC.[15,16] Others, however, view the EFPC project as a disconcerting precedent in using employees, former employees, and consultants for DOE to manipulate the decision-making process and to influence public opinion under the guise of "stakeholder" and "public" participation. Some believe that, while such individuals certainly have much to contribute when their motives are in the public's interest, they also can be used to "stack the deck" in the government's favor.

Various government officials and others have declared the region around the ORR safe to live in today.[17] However, the Public Health Assessments (PHAs) being conducted since 2000 by ATSDR with funding from DOE, are far from complete. The PHAs are designed to determine if the public has been affected by releases in the past or present.[18] The effort in Oak Ridge is being conducted under the oversight of a federal advisory panel, i.e., the Oak Ridge Reservation Health Effects Subcommittee (ORRHES), on which the author of this report has served since its inception in 2000.

While the government acknowledges the health of some workers at the DOE facilities has definitely been affected by exposures to contaminants and radiation, few official statements have been made about the health of residents living nearby. The consensus to date seems to be that all is safe. However, because of the long latency times for many of the diseases associated with environmental exposures to chemicals and radiation, chronic illnesses such as cancer are only now becoming evident for individuals exposed 20 to 40 years ago. Nevertheless, it will be extremely difficult to ever "prove" that any health effects of residents have been caused by environmental exposures to contaminants released from the ORR, particularly considering the displacement of populations in our highly mobile society. The following is from "Burdens of Proof,"[19] which discusses science and public accountability in the field of environmental epidemiology with a focus on low dose radiation and community health studies.

> "Epidemiologic studies of environmental exposures frequently involve small populations with exposures that are not large enough to cause widespread disease—even though the exposures may pose health risks to the population.

---

[15] Emissions from power plants are a major source of environmental mercury and many other contaminants. Eating certain types of fish (i.e., tuna, steak swordfish, shark, tilefish, and king mackerel) is the primary pathway for ingestion of methylmercury (a highly toxic form of mercury) by humans. The following types of fish generally have low levels of mercury: salmon, flounder, cod, catfish, trout, Pollock, clams, shrimp, scallops, and lobster. (*USA Today*, 11/5/02, front page).

[16] "Power Stations Threaten People and Wildlife with Mercury Poisoning," United Nations Environment Programme, available at: http://www.unep.org/Documents.Multilingual/Default.asp?DocumentID=284&ArticleID=3204&l=en (For More Information contact Eric Falt, Spokesperson/Director of UNEP's Division of Communications and Public Information, on Tel: 254 2 623292, E-mail: eric.falt@unep.org or Nick Nuttall, UNEP Head of Media, on Tel: 254 2 623084, E-mail: nick.nuttall@unep.org. For the Governing Council and a copy of the full report see http://www.unep.org/ GoverningBodies/GC22/ and for World Water Day see www.waterday2003.org.

[17] "OR Gets Clean Bill Of Health," *The Oak Ridger*, 2/26/02.

[18] PHAs for all sites nationally can be accessed through http://www.atsdr.cdc.gov/HAC/PHA/.

[19] "Burdens of Proof," Tim Connor, *Energy Research Foundation*, April 1997. Another relevant document is "Inconclusive By Design" by Sanford Lewis, Brian Keating, and Dick Russell (*Environmental Health Network/National Toxics Campaign Fund*, 1991.

> Under these conditions, it is more likely than not that epidemiologists will find no statistically significant relation between exposure and disease—even if a relation exists. Environmental health is almost exclusively concerned with very small effects that are at the limit of detection by epidemiologic means. Because of this, we must be particularly concerned with issues of power and bias. Even large studies will have low power for detecting small effects if they are real, and thus negative studies cannot be considered convincing proof of the null hypothesis." [Note: The null hypothesis assumes there will be no difference between the observed number of illnesses or deaths in an exposed population relative to the number of health effects expected if there were no exposures.]
>
> "What undoubtedly exacerbates community frustration is the frequency with which findings from non-conclusive studies are simplified in media accounts and construed as "not guilty" verdicts that vindicate industry assurances of safety. If and when this happens, it is proper to point out that inconclusive results do not exonerate a pollution source as a potential cause of cancer and other illnesses."

The Future

The public's perception of Oak Ridge problems not only pertain to historical releases, but also are fueled by the public's fear of future releases, and the impact of such releases on their family's health and wealth. It is possible that the war on terrorism has only exacerbated the public's fear of living near nuclear facilities such as Y-12, ORNL, and K-25.

It is especially disconcerting to Oak Ridge and other nearby residents that U.S. Representative Christopher Shays (R-CT), who held a series of hearings in Congress on nuclear weapons complex security, told a national magazine in the fall of 2003: "My concerns about Los Alamos pale in comparison to the Y-12 facility at Oak Ridge, Tennessee. That is a very vulnerable site. [It has] too many structures and not enough buffer zone [around it]. By the time the defenders knew that a security threat existed, it would be too late to respond. I know that they're working on it, but it has to be fixed today." The Government Accountability Office (GAO) research agency has similarly noted that Y-12 poses the greatest security concern of all facilities in the complex. An independent oversight group, Project On Government Oversight (POGO), has also expressed concern about Y-12. They point out that the facility's six aging buildings were never designed to meet modern-day security threats. POGO is concerned if a suicidal terrorist succeeded in getting in, he or she could create an improvised nuclear detonation that would devastate Oak Ridge, Knoxville and the surrounding areas. [20]

[20] Wackenhut's Witch Hunt Tale," The Oak Ridger, 11/12/04.

CHAPTER 1.0. SCOPE, PURPOSE, AND GOALS

This chapter explains why this project was undertaken and describes its scope, purpose, and goals.

1.1 SCOPE

The primary scope of this study is to evaluate the effects of releases from the Y-12 Plant on property owners along the EFPC (focusing particularly on mercury, although some radioactive and other materials are considered). Property owners along adjoining bodies of water [21] may be affected by releases as well, but they are only briefly addressed in this report. Two other DOE facilities (i.e., the former K-25 Site and ORNL) also contribute to impacts on property owners along the other downstream waterways. The former K-25 Site, now known as the East Tennessee Technology Park (ETTP), released contaminants to Poplar Creek and the Clinch River, and ORNL releases contaminants to the Clinch River via White Oak Creek. Therefore, the Clinch River downstream of the former K-25 Site receives contaminants released from all three DOE facilities in Oak Ridge, while EFPC receives releases only from Y-12.

In addition to the DOE sites, other polluters include off-site private-sector facilities and the Tennessee Valley Authority, which is one of the largest polluters to the Clinch River. Private-sector facilities include a waste processing plant located on Bear Creek Road (formerly Scientific Ecology Group (SEG) and now Duratek), a depleted uranium processing facility located on Illinois Avenue (i.e., Manufacturing Sciences Corp., owned by British Nuclear Fuels LLC), a company located on Flint Road in Oak Ridge (i.e., formerly American Ecology and now Toxco), and a waste processing facility located on Gallaher Road near Kingston, i.e., Diversified Scientific Services, Inc. (DSSI). However, assessing their impacts is beyond the scope of this project.

1.2 PURPOSE AND GOALS

The primary purpose of this report is to ensure that what has transpired in this community is not forgotten and to provide a clear understanding of the extent of impacts on property owners—particularly those along the East Fork Poplar Creek—from past and on-going releases of contaminants from the Y-12 Plant. This report presents the results of ITSPA's research and analysis. The following is a list of the goals from the proposal to the Citizens' Monitoring and Technical Assessment (CMTA) Fund,[22] the sponsor of this project. Note, however, there were many additional accomplishments that resulted from ITSPA's primary and secondary research activities.

---

[21] EFPC joins Poplar Creek (PC mile 6), which flows into the Clinch River (CR mile 12), which flows into the Watts Bar Reservoir and the Tennessee River System.

[22] The CMTA Fund was established as a result of the settlement of a lawsuit against DOE by the National Resources Defense Council and a large group of other non-profit organizations.

Project Goals

Goal 1. Identify and discuss issues affecting current property owners along the creek and to document and quantify impacts when possible,
Goal 2. Identify ways to lessen the effects of DOE releases on the property owners along EFPC and other Oak Ridge property owners,
Goal 3. Document the approved and non-approved uses of the creek and restrictions on the floodplain,
Goal 4. Identify issues associated with the creek that directly impact the public and recommend ways to minimize impacts, and
Goal 5. Explore and explain the use of the 400 ppm cleanup limit in Oak Ridge.

1.3 WHY THIS STUDY WAS DONE

ITSPA believed this project was needed for a number of reasons. The major reason is the state of confusion that exists in the community regarding what the EFPC remediation really accomplished and what it means in practical terms for the property owners and the general public. Another reason is the lack of public trust of information provided by government agencies. Therefore, this ITSPA study is an attempt to document and clarify the issues surrounding the EFPC and to recommend ways to lessen the impacts on property owners and the public.

1.3.1 Confusion in the Community

There is confusion among community members regarding exactly what was accomplished by the cleanup and what members of the public and property owners are allowed (and expected) to do along the creek. Also, there is confusion in the community about potential health risks and effects of exposure to contaminants in the creek.

1.3.1.1 About the Creek

The following question and answer from "Ask Inky" (*The Oak Ridger*, 5/24/02) illustrates the confusion that exists in the community regarding the creek:

> **Q** "Now that Jackson Crossing is a subdivision and not a private farm, who can help in the recent flooding of the East Fork Poplar Creek? The Dept. of Energy cleaned up downstream at one time due to contaminated soil. Who can fill in dirt, rock the banks, clean out debris, etc.? Anything to help. Who owns the creek? Who is responsible?"
>
> **A** "Oak Ridge Public Works Director Gary Cinder responds that natural drainage conveyances such as East Fork Poplar Creek are the responsibility of the property owner over which the waterway flows. By law, no property owner may impede the natural flow of water across their property. The city practice has been that

> major obstructions to creek flow such as debris that has washed down, or other blockages adversely affecting water flow, will be removed by city crews with permission of the property owner involved. The city does not perform bank stabilization or vegetation removal, etc. This is the responsibility of the landowner."

Cinder's response places property owners in a "Catch 22" situation. He indicates property owners are responsible for maintaining the natural drainage conveyance, bank stabilization, and vegetation removal. However, because the creek is posted as a hazard by the State of Tennessee with signs indicating there should be no contact with the water and sediments, the property owner cannot easily fulfill these obligations without ignoring the posting. Cinder's response does not even mention the issue of potential risk to human health or the fact the creek is posted.

In addition, his 2002 response does not specifically answer the question that was asked of who owns the creek. Perhaps an even more important question than ownership is who is legally responsible if claims of health or other impacts arise in the future. It appears that most of the floodplain is owned by private property owners. It also appears these owners have not specifically been granted legal indemnity by DOE or the city, except for the two property owners who obtained indemnity as part of a lawsuit.

ITSPA spoke with Cinder on 2/28/05 to determine if the city now provides additional guidance to property owners along the posted creek. He indicated that to his knowledge there is no information on this issue available through the city. Cinder also indicated that, because the creek had been remediated and is no longer considered to be a problem, he and his staff treat the creek and floodplain sediments just like any other dirt in town. He knows of no restrictions on property owners in terms of coming into contact with the waters, sediments, and soils of the creek and the floodplain.

According to the TDEC,[23] the state owns the water, while private property owners own the creek bed, the creek bank, and the floodplain. TDEC also indicated that, although the creek is posted, it is just an advisory. This means it is not forbidden (or illegal) to come into contact with the water or sediments of a posted waterway. In the newly developed subdivision in the west end of town, Southwood, the developer maintained ownership of strips of land to serve as a buffer between the creek and the buyers. However, there is no physical barrier, such as a fence, to keep people out, and during ITSPA's driving tour, there were no signs posted.

The letter below illustrates the frustration and confusion that exists in the community regarding the EFPC. This letter was received by ITSPA in response to the

[23] The TDEC DOE Oversight Division was established on May 13, 1991, by an agreement entered into between the DOE and the State of Tennessee. TDEC is the state-designated lead agency for the purpose of the agreement. The funding is supported by three (3) separate grants, which provide funding for the state's participation in: (1) non-regulatory independent environmental monitoring and oversight program to supplement activities conducted under applicable environmental laws and regulations; (2) a regulatory based program to support the state's participation in the activities conducted under the Federal Facility Agreement (FFA) for the Oak Ridge Reservation; and (3) emergency response activities to assist the state and local governments in preparing for potential off-site impacts from DOE activities conducted on the Oak Ridge Reservation.

short-form survey (discussed in Section 7.3.2) that was delivered to residents living along or near the creek.

Sept. 18, 2002

Dear ITSPA:

JUST A FEW COMMENTS ABOUT THIS CREEK THAT RUNS ALONG AUBURN HILLS APTS. (FOR THE ELDERLY) AT TUSCULUM DRIVE.
I FIRST MOVED INTO THESE APTS. 2-15-2000, AT THAT TIME THE CREEK (I DON'T KNOW ITS' NAME) WAS BEAUTIFUL TO SEE WITH THE FLOWING WATER. THERE WAS A SIGN BY THE BRIDGE AT TULSA RD. AND TUSCULUM DR., WARNING NOT SAFE TO GO INTO THE WATER.
THAT SIGN IS GONE (HIDDEN BACK IN THE WOODS THERE.)
THE CREEK IS LOW ON WATER AND DOES NOT FLOW NOW BY THE ELDERLY APTS. (DUE TO DROUGHT CONDITIONS) BUT, IT DOES HAVE TRASH IN IT AND IS OVERGROWN WITH TREES AND BRUSH ON BOTH SIDES OF THE CREEK.
AT THE BRIDGE BY AUBURN HILLS APTS, THE WATER IS STAGNANT AND SMELLS BAD PLUS MOSQUITOS ARE BAD AT THAT POINT.
I HAVE SEEN 2 LITTLE BOYS PARK THEIR BICYCLES AND ROLL UP THEIR PANT LEGS TO WADE IN THE CREEK, I TOLD THEM THE WATER WAS NOT SAFE BUT THEY IGNORED ME.
I DON'T KNOW WHO IS RESPONSIBLE FOR THE CREEK AND THE TRASH IN IT, BUT MY LANDLADY SAYS WE ARE NOT.
I WOULD LIKE TO SEE SOMEONE TAKE RESPONSIBILITY FOR THIS FILTHY CREEK AREA AND CLEAN IT UP TO THE ORIGINAL BEAUTY I SAW 2½ YEARS AGO!
THANK YOU,

The following is from a letter written on 7/6/95 by a property owner to Nelson Lingle, chief of the Oak Ridge Remediation Branch, raising questions about what happens once DOE is off his property and construction begins on a project. The owner asked these questions:

> "What if the contractor stumbles across soil that happens to contain high levels of mercury and spreads it around the site? Who has to clean it up? Is the property owner held harmless, because the land was purported to have been cleaned up under the Superfund by DOE? Is the development put on hold? Will financial lending institutions agree to make a loan? Can the owner obtain liability insurance?"

This property owner indicated he had repeatedly requested that the landowners be held harmless from litigation relating to any DOE facility-caused contamination. However, as a result of the EFPC Public Meeting, January 26, 1995, the property owner indicated he had become concerned about the government's intentions.

1.3.1.2 About Potential Health Risks and Effects

The following is a quote from an EFPC property owner regarding health risks:

> "When talking about health risks every agency and expert qualifies their comments to cover only short term risks. No one is yet able to guarantee anything regarding long-term health risks."

It is these long-term risks that are of most concern. Although the government claims to have remediated areas along the creek that were contaminated at levels greater than 400 ppm, it is possible that areas with high levels of mercury contamination will eventually be discovered—particularly if land in the floodplain fringe is developed. Risks of future health effects due to mercury may go unrecognized because of the government's position that the creek has been effectively remediated. At particular risk are children who exhibit soil-related pica behavior, i.e., feeling compelled to eat dirt. Another major concern is the government's assumption that the mercury will remain in a non-toxic, non-mobile form.

There appears to be confusion over health risks and effects, which can be either acute (i.e., immediate), such as those caused by E. Coli bacteria in a creek, and chronic, such as cancer or kidney damage caused by long-term exposure to a contaminant. Chronic diseases such as cancer caused by environmental exposures often have long latency periods (i.e., 20 to 40 years), which often makes it very difficult to pinpoint the cause.

1.3.2 Revisiting the 400 ppm Mercury Cleanup Level

The thought of revisiting the 400 ppm cleanup limit for mercury upsets some local property owners and community members, particularly those who were instrumental in getting the level raised from 10 ppm to 50 to 180 and, finally, to 400 ppm. If some of these individuals had their way, the limit would have been as high as 1,200 ppm. They believe the government agencies and stakeholders worked together through the "public participation process" to "resolve" this issue once and for all, so it simply should not be "stirred up" again.

The following comments were part of a case study on EFPC by the National Center for Environmental Decision-making Research (NCEDR).[24] The workshop report indicates there was some "sense that the issue of how well the Remedial Goal Objective (i.e., 400 ppm) addresses ecological risk might arise again in the future." The report states, "The ***lack of definitive data*** can cause decisions to require revisiting in the future, potentially limiting their durability. This is illustrated in the LEFPC case by the

[24] The case study by NCEDR was on the decision-making related to the cleanup of mercury contamination at Lower EFPC. A workshop on the EFPC Remediation was held in August 1996 to gather information from those individuals who had been most intimately involved with the decision-making process. (Appendix 1-2 provides the sign-in sheet for attendees of that workshop.)

requirement for post-remediation environmental monitoring as a "risk management" technique to ensure that the 400 ppm standard is adequate to protect aquatic and terrestrial ecosystems over time. Perhaps the broader message here is that complex environmental problems, such as those pertaining to long-term management of toxic wastes, often resist simple or permanent solutions, requiring instead an ongoing, flexible, and incremental approach. Revisiting decisions in the future, while time-consuming and sometimes costly, may be essential for such complex problems."

The following comments were made by Dr. Elmer Akin, former head of the EPA Office of Health Assessment and former ORRHES liaison member (now retired).

> "There's not enough evidence to determine the bioavailability of mercuric chloride and mercuric sulfide in man." "If this number goes higher than what it is, I think there's very few ecologists who are going to agree it's protective of the ecosystem; " "there are laws on the book that says the agency is responsible for protecting the ecosystem"…"and the number (180/200), is going to be one of the highest mercury numbers we've ever agreed with as it is. The ecologists are kind of going nuts about that number as being high." "But to make the assumption that all this mercury is forevermore non-bioavailable, 100 percent, is quite a stretch; and that is not a very protective position for this agency to take if that's the way we're headed here." [25]

A summary of a public hearing on the cleanup was written by Carolyn Hay Krause (See Footnote 2) in *ORNL, Mercury, and the Environment*: [26]

> "A public hearing was held 1/26/95 at Pollard Auditorium in Oak Ridge….The opponents' arguments were later summarized in a letter to the editor by former ORNL associate director William Fulkerson, president of Friends of ORNL (FORNL). The group argued that the risk assessors based the 180-ppm goal on the assumptions that 30% of the mercury in the soil would be taken into the body and that the uptake rate for children eating the soil would be 133 milligrams per day based on rats' uptake of highly soluble mercuric chloride. But, they noted, studies indicated that the soil mercury is mostly insoluble mercury sulfide and that rats fed mercuric sulfide at 7000 times the rate of the reference dose retained no significant amounts of mercury in any studied organs. They concluded that the absorption factor for the soil mercury should be only 3% (based on a number used by EPA in California for a site containing mercuric sulfide) and that only soil containing a mercury level above 900 ppm should be remediated."

[25] Proceedings of the EFPC Public Meeting on 1/26/95, p.86, 122, 130.

[26] Unpublished 3/13/95 document written by Carolyn Hay Krause on personal time (See Footnote 2).

A local newspaper[27] also covered that meeting:

> "The methods for calculating risks to humans and the environment from the mercury deposited in the soil along EFPC are much too conservative, according to almost all of the people who spoke Thursday night at a public meeting. … DOE's plan would remove and replace soil that has mercury concentrations of more than 180 ppm. That would require 54,000 cubic yards to be removed in six places, covering 18.2 acres. The estimated cost for the project is $69 million for cleanup and operations. However, Wayne Tolbert, vice president and senior project manager for Science Applications International Corp. (SAIC), said the figure is an average and the range of potential costs are $36 million to $78 million.
>
> The question-and-answer portion of the meeting lasted nearly two hours, double the time allotted on the agenda, and nearly all of those who spoke opposed the suggested cleanup. Most of the speakers said the figure is "extremely conservative." Elmer Akin, chief of the Office of Health Assessment, EPA, noted in his presentation that the standard is conservative. "When we err, our obligation (under the federal Superfund laws) is to err on the side of protecting human health and environment."
>
> Those objecting insisted the same goal could be accomplished with a much higher standard for removal of the dirt. Suggestions for that standard ranged from 600 to 2,600 ppm. After several speakers, Bill Burch, W. Outer Dr., asked, "Will EPA revisit (the cleanup standard)? Is that really possible or are we just talking tonight?" Akin admitted he did not know the answer. He said he had never been in a public meeting in which people asked for cleanup standards to be lower (Author's note: less stringent) than the government suggested.
>
> Fred Maienschein, the first speaker, set the tone for most of the remainder of the meeting. He said the basis for the cleanup standard is too uncertain. Necessary information to make a reasonable decision, he said, "is simply not available." He maintained the recommended standard is too conservative by a factor of at least 10….Al Brooks endorsed Maienschein's comments.[28] He said the mercury in the floodplain is "essentially innocuous" because it is "one of the most insoluble chemicals known." Brooks maintained the "other stream" near EFPC is "far more hazardous" to humans than the creek. That stream is the Oak Ridge Turnpike, he said. A couple of speakers suggested the increased traffic—21 dump trucks per day for 12 months—would be as much or more hazardous than the mercury. One woman suggested building a road to the proposed Y-12 landfill to keep that traffic

[27] "Brace for Cleanup Cuts, OR is Told: Creek Cleanup Plan Attacked at Meeting, EPA Unaccustomed to Oak Ridge-style Criticism," *The Oak Ridger,* 1/27/95.

[28] Bill Burch served as the Division Director of the Fuel Recycle Division at ORNL. Fred Maienschein served as the Division Director of Engineering Physics and Mathematics at ORNL and is a Fellow of the American Nuclear Society. Alfred Brooks, a former ORNL manager and chemist, owns property along EFPC that has mercury levels approaching 300 ppm. His land would have been part of the cleanup effort if the 400 ppm level had not been adopted.

> off the Turnpike. Bob Peele, former Roane County commissioner and long-time activist, …said "I believe we should follow roughly, the plan DOE has outlined." But he said the standard should be higher—600 ppm. …A "record of decision"—agreement between all the government agencies—is expected late this year."

According to another newspaper article [29] that discussed this meeting, "Al Brooks recommended raising the cleanup level for mercury to 1,200 ppm." The following is comment made by Brooks in a letter to Joe LaGrone, then-manager of DOE (also published as a letter to the editor of *The Oak Ridger*), which was upsetting to some:

> "I would especially like to thank Mr. David Page [30] and many others of the DOE and the contractor staff who assisted me in the presentation of the opposition view during the last several months."

This is what one property owner documented in his personal notes about this statement by Brooks:

> "To me (this was) an extraordinary disclosure: DOE coaching a person or persons to appear at a formal public meeting to pressure EPA and the State of Tennessee to accept higher cleanup limits, when such higher limits accrues direct benefits to DOE." "This was part of the picture that helped reduce the area along EFPC to be remediated. This has to do with getting a higher ppm limit for cleanup. The other part…final 1B sampling (approx. 3000 samples) being determined as 0- to 16-inch homogenized soil cores when in reality the mercury was deposited in strata measuring from 3 inches up to 11 inches depending on each particular core. Both serve to reduce the need for cleanup." [31]

In fact, two property owners were so concerned by what was going on that they wrote to government officials to express their concern. One of the property owners had this to say this regarding the audience participation at the Jan. 26, 1995, Public Meeting.

> "The first two speakers, of the 21 persons who spoke, took the floor 14 different times and occupied some 17 ½ pages of the transcript of the meeting."[32]

The following is a synopsis by ITSPA of a memo dated 7/6/95, which was written to Nelson Lingle, Chief of DOE's Oak Ridge Remediation Branch:

---

[29] "DOE Mercury Cleanup Called Costly, Harmful," *Knoxville News Sentinel,* 1/27/95.

[30] David Page served as the DOE Team Leader of the EFPC floodplain remediation project.

[31] Comments extracted from personal documentation of the EFPC issue by a property owner.

[32] Comment obtained from a memo sent by an EFPC property owner to Al Robison of the Tennessee Fish and Wildlife Agency. The memo referenced the enclosure of a typed sheet summarizing the audience participation at the 1/26/95 public meeting.

The property owner indicated he developed a concern "when two citizens (out of 21 audience speakers) spoke 14 times with great confidence and apparent technical authority while being critical of the decisions of the professionals working on this problem." The property owner asked in the memo, "Who is making the decision here?" Before the Record of Decision (ROD) was issued he learned the 180 ppm limit had been increased to 400 ppm. He asked how this had gotten by his attention when he had been a loyal participant of the EFPC Work Group. The property owner indicated he had been told by DOE staff there would not be another public hearing after the decision was made to change the limit to 400 ppm. He indicated that not having a public hearing before approval of the ROD upon changing from 180 to 400 ppm appeared dishonest. However, the property owner stated it was good that DOE reconsidered and held a public meeting.

The property owner then commented on the open letter to Joe LaGrone, DOE, from Al Brooks, a citizen thanking David Page for help in preparing his technical criticism of the selected 180 ppm of mercury cleanup level. "Something here appears all wrong. Al Brooks spoke nine times at the public meeting (more times and more pages of transcript than anyone else). Were the proceedings manipulated?" In this memo, the property owner also raised the issue of sampling and homogenization of 16-inch core samples, which he indicated very seriously masks the potentially real level of contamination within the bands that were probably deposited during major rain/flood events.

The property owner indicated that, in a report (*EFPC—Sewer Line Beltway Remedial Investigation Report*, p. 3-250), he found in a section called "Vertical Integration Study" data about his property that had never been shared with him—and the contaminations showed were as high as (in the thousands of ppm mercury).

In conclusion, the property owner posed the following: "I have very low confidence that the mercury contamination will be cleaned up to 400 ppm or to any other agreed to cleanup level. If this be so, then building foundation construction in the future will probably expose mercury contamination above the cleanup limit. Then what happens?"

1.3.3 Long-term Stewardship

The issue of long-term stewardship of the ORR and off-site contaminated areas is of great importance to residents of the surrounding communities. This is particularly true for property owners along or near the EFPC and other impacted waterways. Because there is still a possibility that areas with high levels of mercury contamination could eventually be discovered in the EFPC floodplain and creek bank and/or that the form of mercury could change from the low-toxic sulfide form to the more toxic organic form (i.e., methylmercury), the issue of long-term (and short-term) stewardship has not been effectively resolved.

Because the government claims that no contamination was left in place (i.e., nothing below 400 ppm is considered to be contaminated), there are no deeds restrictions on properties along EFPC notifying current and future owners of the possible need for taking precautions (in case the government assumptions were wrong) or of the need to watch for dark soil taken from the creek and the floodplain that could contain high levels of mercury. At least one area with a mercury level of 1,600 ppm was left out of an important report and the property would not have been remediated if it were not for the diligence and insistence of the property owner. [33] Therefore, it is possible that other high-level areas were left out as well.

Long-term stewardship also is extremely important for families who are dependent on wells for their drinking water, which could or could eventually become contaminated by underground plumes from the other DOE facilities since the plumes likely are still migrating. While there are no known wells along EFPC, some may exist along Poplar Creek and the other impacted waterways, as well as other outlying areas.

There are long-term stewardship issues regarding land along the creek that has recently been developed for residential use. In one such development there were no signs indicating that the creek is posted. Also, perhaps even more disturbingly, real estate disclosure laws do not require buyers to be informed of a potential hazard (1) if "no hazards" were knowingly left in place by the government and (2) if the homes were purchased from a developer or through some other excluded mechanism.[34] Many of the new lots lie along a narrow buffer owned by the developer, technically making them non-creek-front properties. However, a number of these properties still lie close to accessible portions of the creek and perhaps are adjacent to the EFPC floodplain.

Uninformed property owners—and ITSPA discovered some through the short-form survey—might decide to use the creek sediment as potting soil or for other uses or allow their children to play and/or dig in the creek sediments or floodplain soil. ATSDR indicated in the 1993 Health Consultation that "long-term exposure to soil at this site containing mercury at concentrations of 1,010 ppm may result in body burdens of mercury that could result in adverse health effects."[35] It is very likely that mercury at that level remains in the creek bank and the floodplain. However, it appears that ATSDR may revisit this calculation in its upcoming PHA.

---

[33] On 5/9/95, it was pointed out by an EFPC property owner that one transect of soil samples, six cores, had been omitted on Map 6, sheet 2 or 3, of the SAIC report dated 4/13/93 (*EFPC—Sewer Line Beltway Remedial Investigation Report*, Volume V, Maps 1-7) containing ORAU Historical Data (Rapid Scan Survey, page 6). This transect contained soil sample 85-0487, which showed 1,600 ppm on parcel 563. DOE indicated to the property owner that this was probably an oversight.

[34] Title 66 Property law, Chapter 5 Conveyances of Property (www.state.tn.us/commerce/boards/trec/rulesandlaws.html/t66/t_66_ch_5.htm)

[35] http://www.atsdr.cdc.gov/HAC/PHA/efork1/y12_toc.html

Because the government claims that no contaminants are known to remain in place, the CERCLA requirement for a 5-year review is not legally mandated.[36] However, because the State and EPA are interested in the floodplain, the state indicated to ITSPA it requires sampling by DOE. These results are reported annually by DOE in the *Remediation Effectiveness Report* (RER).

Regarding DOE's plans for the future, the following are comments (dated 6/28/02) that were submitted to DOE by the Oak Ridge Reservation Local Oversight Committee Citizen's Advisory Panel (LOC-CAP) regarding the draft of DOE's *Oak Ridge Performance Management Plan*:

> "There is no mention of LEFPC even though its water, sediments, and fish remain contaminated. No health consultation[37] from the ATSDR has been issued and the creek continues to be posted for unclear reasons. DOE should acknowledge that cleaning up remaining contamination in LEFPC is an important priority that affects the Oak Ridge community more than some of the other accelerated projects."

Later in 2002, the local newspaper reported that "mercury contamination could be reduced in UEFPC as cleanup takes a much-awaited stride forward."[38] However, a cleanup of the UEFPC does not address the issue of management of contaminated creek sediments located off the ORR in LEFPC—and it could even increase mercury contamination in LEFPC as remediation projects often do. UEFPC is located on the Y-12 Site, as opposed to the lower portion that runs off the ORR through residential parts of Oak Ridge and which is the primary focus of this report.

1.3.4. Big Picture Perspective

The EFPC certainly is not unique in that it is polluted and can potentially cause both acute and chronic health effects. However, the fact the pollution comes from a nuclear facility in Oak Ridge, Tennessee—builder of the bomb that ended World War II—makes it different from most other creeks in the mind of the public. Accordingly, this results in more regulatory scrutiny and public attention than many other contaminated streams receive. The handling of issues regarding this creek has a wide impact, involving both EFPC property owners and landowners on other contaminated streams and properties. For this reason, it is extremely important for the issues surrounding the EFPC to be documented, clarified, and understood.

---

[36] See TDEC's response to ITSPA's question #16 and #17 in Section 7.4.1.

[37] There has not been a specific health consultation on the creek bed or sediments. There were consultations on the proposed clean-up limits for the EFPC floodplain and on the Lower Watts Bar Reservoir. The internet links to the health consultation reports by ATSDR are provided in Appendix 1-10.

[38] "Creek Cleanup Takes Step Forward," R. Cathey Daniels, *The Oak Ridger*, 10/8/02.

CHAPTER 2.0. REPORT HIGHLIGHTS AND ACCOMPLISHMENTS

This section provides the highlights and accomplishments of this report and they are summarized in Table 1, which is broken into two parts. The first part is highlights and accomplishments that resulted from the original project goals included in the proposal to the Citizens' Monitoring and Technical Assessment (CMTA) Fund.[39] It was these goals that guided ITSPA's primary and secondary research efforts. The second part provides other highlights and accomplishments that have resulted from ITSPA's efforts. This table provides the sections in the report where the discussion in the report can be found.

TABLE 1
REPORT HIGHLIGHTS AND ACCOMPLISHMENTS

Accomplishments Based on Original Project Goals

- Identified and discussed issues affecting current property owners along the creek and documented and quantified impacts when possible (Chapters 1, 3, 5, and 9),
- Identified ways to lessen the effects of DOE releases on the property owners along EFPC and other Oak Ridge property owners (Chapter 9),
- Documented the approved and non-approved uses of the creek and restrictions on the floodplain (Section 1.3.1.1, Section 7.4.1),
- Identified issues associated with the creek that directly impact the public and recommended ways to minimize impacts (Chapters 1, 5, and 9), and
- Explored and explained the use of the 400 ppm cleanup limit in Oak Ridge (Sections 1.3.2, 3.4, 4.3.1.6, 5.5.1.2, 9.4.3).

Other Project Highlights and Accomplishments

- Documented the history of the public's discovery of mercury releases from the Y-12 Plant, as well as DOE's acknowledgement and handling of the problem (Section vi).
- Provided mercury test results of properties tested in 1984/85 as a result of the Sewerline Beltway Project (Table 2 in Section 3.1, Appendix Tables 1-9-6, 1-9-7, and 1-9-8).
- Presented perspective of EFPC with other urban creeks (Section 3.6)
- Documented public health and related activities that have taken place in Oak Ridge (Chapter 4), captured EPA's concerns regarding the ATSDR PHA on Y-12 uranium releases (Section 4.5) and (Appendix 1-4), and captured important related ORRHES issues and problems (Sections 5.4 and 5.5),
- Provided equations and variables for calculating exposure doses for mercury-contaminated soil (Section 4.3.1.7).

[39]The CMTA Fund was established as a result of the settlement of a lawsuit against DOE by the National Resources Defense Council and a large group of other non-profit organizations.

- Provided an overview of the issues impacting property owners (Chapters 3 and 5)
  - ⇒ What's the meaning of "free use" (Section 5.1)
  - ⇒ On-going releases to EFPC (Section 5.2)
  - ⇒ What's hazardous and what's contaminated (Section 5.3)
  - ⇒ Conflicts of interest (Section 5.4)
  - ⇒ Lack of, questionable, censored, or classified/reclassified data (Section 5.5)
  - ⇒ Lack of knowledge (Section 5.6)
  - ⇒ Lack of trust (Section 5.7)
- Identified the widespread area impacted and potentially impacted by the DOE facilities in Oak Ridge (Chapter 6),
  - ⇒ By neighborhood or area (Section 6.1)
  - ⇒ Remediated community sites (Section 6.2)
  - ⇒ Fish advisories issued for area waterways (see Footnote 6)
  - ⇒ Sign locations along EFPC maintained by Tennessee Department of Environment and Conservation, i.e., TDEC (Appendix 1-1).
- Identified specific properties along EFPC and their distances from the creek (Section 7.2, Tables 4, 5, and 6),
- Developed a narrated slideshow of the driving tour that was conducted to identify properties along EFPC.[40]
- Documented the appraisal value, tax value, and, where possible, actual sale price of properties along EFPC (data not included in this report, but available upon request),
- Provided a discussion of the EFPC issue by ITSPA's subject matter expert, Dr. Gordon Blaylock of SENES Oak Ridge Inc. Center for Risk Analysis (Chapter 8).
- Provided a discussion of the legal and ethical issues, particularly those regarding real estate disclosure, associated with the government's use of the homogenized sampling technique and the 400 ppm cleanup limit (Section 9.1)
- Provided a discussion of what the public has been told and what ITSPA believes they should be told (Sections v and 9.2),

[40] ITSPA will provide a CD of the slideshow upon request. However, the software used by ITSPA in 2002 (i.e., Living Album from www.clubphoto.com) is no longer supported or provided by the company.

CHAPTER 3. OVERVIEW OF ISSUES IMPACTING PROPERTY OWNERS

There are several aspects of the EFPC problem and this chapter gives an overview of the issues associated with the creek that impact property owners. These issues are (1) the contaminant release problem, (2) the image problem, (3) the resulting real estate problem, (4) the real estate disclosure problem, and (5) economic and other impacts.

This chapter also attempts to put the EFPC into perspective with other urban creeks. The EFPC is not unique in that it is polluted and can potentially cause both acute and chronic health effects. However, the fact the pollution comes from a nuclear facility makes it different from most other local creeks in the mind of the public, which makes it draw more regulatory scrutiny and public attention than many other contaminated streams. Therefore, the issues discussed here (particularly regarding real estate disclosures) have significance for EFPC property owners and landowners on other contaminated streams and properties.

3.1 THE "RELEASE" PROBLEM

As a result of operations at the Y-12 Weapons Plant in Oak Ridge, Tennessee, DOE contaminated the publicly accessible EFPC and its floodplains with over 280,000 pounds of mercury and other contaminants. While this is not the only historical release pathway from the ORR, it is one of the major ones.

Table 2 provides a summary of 1984/85 test results for properties in Oak Ridge that were thought possibly contaminated with mercury. Some of the property owners indicated at that time they wanted their results kept confidential, while some of the owners indicated they did not. For that reason some of the addresses are not provided in the table below. Note that all of these properties would have required remediation if the original cleanup level of 10 ppm (used for the Oak Ridge Civic Center cleanup) was used. Additional sampling data are provided in Appendix 1-9.

TABLE 2
CITY OF OAK RIDGE MERCURY RESULTS (MARCH 1984/85)

ADDRESS	WANTED TO KEEP CONFIDENTIAL	MAX. MERCURY, PPM
1. Confidential	**Y**	6700
2. Confidential	**Y**	2100
3. Confidential	**Y**	510
4. Confidential	**Y**	180
5. Confidential	**Y**	110
6. Confidential	**Y**	59
7. Confidential	**Y**	57
8. Confidential	**Y**	56
9. Confidential	**Y**	52
10. Confidential	**Y**	50
11. Confidential	**Y**	23

Continued…

TABLE 2 (CONT.)
CITY OF OAK RIDGE MERCURY RESULTS (MARCH 1984/85)

ADDRESS	WANTED TO KEEP CONFIDENTIAL	MAX. MERCURY, PPM
12. 101 Carnegie Dr. (across from), city road	N	239
13. 104 Colgate Rd.	N	14
14. 107 Culver Rd.	N	116
15. 100 Grandcove	N	95
16. 100 Grandcove Lane	N	76
17. 147 Grandcove Lane	N	30
18. 150 Gum Hollow Rd. (Country Club)	N	250
19. 171 LaSalle Rd.	N	76
20. 109 Lincoln (West) Rd.	N	560
21. 109 Lincoln (West) Street	N	150
22. 1660 Oak Ridge Turnpike (YWCA)	N	52
23. Oak Ridge Turnpike (old Jefferson Tennis Court area)	N	45
24. Oak Ridge Turnpike (Parcel 563, Block 17-BU)	N	1600
25. Oak Ridge Turnpike (south side, south of Jefferson Ave.) Sample #85-0233-850262??	N	110
26. 2291 Oak Ridge Turnpike	N	120
27. 2383 Oak Ridge Turnpike	N	94
28. 2383 Oak Ridge Turnpike	N	44
29. Purdue, N./Rutgers (where sewer belt crosses)	N	420
30. 112 Tulsa Rd. (La Petite Academy)	N	46
31. 12 Van Hicks Place (public housing)	N	42
32. Vanderbilt Dr. and Illinois Ave. (Polaris Travel)	N	110
33. 100 Wilshire Dr.	N	278
34. 101 Wiltshire Dr.	N	140
35. 107 Wiltshire Dr.	N	160
Note the cleanup level was originally 10 ppm, which was used for the cleanup of the Civic Center. However, this level was eventually raised to 400 ppm.[41]		

Source: Compiled by ITSPA and KapLine Enterprises, Inc. from City of Oak Ridge Interim Action Study Group Survey Report, March 1984/March 1985

Steps taken by DOE to prevent further releases of contaminants were discussed in a DOE fact sheet (Spring 1995) describing the LEFPC cleanup project. It indicates that corrective actions required for a Clean Water Act National Pollutant Discharge Elimination System (NPDES) permit for the Y-12 site were completed and concentrations of mercury in the creek water had decreased substantially since corrective actions began in the mid-1980s. This was due primarily to several treatment systems that

[41] The standard was raised to 400 ppm as a result of community action, which led to a chemical analysis to determine the actual form of mercury in the soil. In a highly controversial decision-making process, it was concluded the form of mercury present in the soil was not the highly toxic methylmercury, but rather was the less toxic mercuric sulfide. This was used to justify raising the cleanup standard to 400 ppm. There also is controversy regarding the blending/dilution of mercury in soil samples due to the "homogenizing" method called for in the 1B sampling procedure (see Section 5.5.1.2).

were in place and various corrective actions. The NPDES permit goal originally was five grams per day (0.012 microgram per liter). However, because the facility could not meet this standard, it was exempted from NPDES requirements and was to be regulated under CERCLA. [Note: Enforcement by CERCLA is said to be less stringent than if it had been decided that Resource Conservation and Recovery Act (RCRA) requirements were to apply to the facility.]

A ROD documenting the remedial action of the LEFPC and floodplain was approved in September 1995 and DOE completed Phase I in September 1996 (see Appendix 1-3). Phase I involved excavating approximately 4,300 cubic yards of soil with a mercury concentration above 400 ppm at the NOAA site located west of South Illinois Avenue in Oak Ridge. These contaminated soils were disposed of in a Y-12 landfill. The NOAA site was backfilled with clean soil and the excavated area was restored with grass, trees, and shrubs. Phase II, which was completed in October 1997, removed approximately 22,700 cubic yards of soil (above 400 ppm) at the NOAA and Bruner sites (which includes the Sturm and Clark sites). These sites were excavated, the soil was disposed, and the sites were backfilled and restored. Monitoring is to continue indefinitely to ensure the effectiveness of the remediation. The state-required sampling is conducted by DOE and these results are reported annually by DOE in the RER, which is available through DOE's Public reading Room.

Today, DOE has significantly reduced the amount of mercury released from the plant (i.e., an average of 35 grams per day reported for 1998, down from hundreds of grams per day) through the Reduction of Mercury in Plant Effluents Project. These data are discussed publicly at the annual "State of the Creek" address made by scientific personnel charged with monitoring EFPC pollution. Beginning in 2001, this address has been done for the public as well as internal staff.[42]

3.2 THE "IMAGE" PROBLEM

Despite the floodplain cleanup effort and the reductions in the release of contaminants, the historical releases to the environment from Y-12 and the other DOE facilities continue to have a negative impact on the city and its residents. Because the EFPC runs through the heart of Oak Ridge with warning signs in selected locations along its banks, in conjunction with the city's public notoriety resulting from its prominent role in the Manhattan Project and its continued nuclear mission, individuals may be hesitant to live in (or even visit) Oak Ridge.

Especially impacted by this problem are the landowners along EFPC, although city land that has not been directly impacted by creek flooding has a cloud over it as well.[43] As a result, even Oak Ridge homeowners not along the creek and not directly

[42] See Section v for an overview of the conclusions presented by Dr. Loar.

[43] There was no private ownership of land in Oak Ridge until the late 1950s, so when the land along the creek was originally purchased by private individuals, the public was not aware that significant quantities of contaminants had been (and were being) released to the environment from the DOE facilities. Information regarding the pollution was not widely known to the public until the mid-1980s/early 1990s.

impacted by the releases may have difficulty selling their property.[44] Although declining employment opportunities over the last decade contributed greatly to this difficulty, the city's negative image also appeared to play a large role.

Particular damage to the city's image resulted from the use of contaminated soil from the banks of the EFPC as fill dirt for community areas, such as playgrounds, and home gardens. It is often said that, in the past, K-25 sewage sludge bearing contaminants was used by employees in their home gardens. In the EFPC and the floodplain, mercury from Y-12 has been the primary contaminant of concern in the soil and sediments, but other heavy metals, radionuclides such as uranium, and some organic compounds also were present in smaller quantities.

Because of contamination, clean topsoil was placed on the softball field of Robertsville Middle School in 1983. Soil taken from the EFPC area for use as fill dirt along sewer line construction in front of Jefferson Junior High School was removed and replaced. Contaminated soil greater than 10 ppm of mercury was removed and replaced at the Civic Center in 1984. Advertisements were run in the local newspaper offering to test community soils thought to be contaminated. These test results are found in Table 2 found in Section 3.1. Additional data can be found in Appendix Tables 1-9-6, 1-9-7, and 1-9-8.

In 2002, a group of concerned citizens undertook a volunteer project to help improve Oak Ridge's image and to promote the concept that contamination is not found throughout the community, but is mainly isolated to the ORR. This group published a document called "Oak Ridge—Citizens Guide to the Environment." One of the major problems with this publication is that it could be perceived as having ties to DOE, its contractor and subcontractors, and organizations having an economic interest in promoting the city. The document was published without a listing of the names of the individuals who helped write it—an issue that was pointed out in an Ask Inky question.[45]

3.3 THE RESULTING "REAL ESTATE" PROBLEM

The Oak Ridge real estate market experienced a serious decline starting in the late 1980s, and community members in Oak Ridge and the surrounding regions became concerned about values and property marketability. However, the market seems to be showing some signs of recovering today. Developers are building new homes in several new developments, and attracting new residents is a major goal for city officials and the local Chamber of Commerce. One of the bright spots in the Oak Ridge market is its high-

---

[44] Area home sales were analyzed and quantified by the author of this ITSPA study in a report entitled, "Oak Ridge Employment and Housing Market Study—Looking Back to Help Choose a Path Forward," May 2000. However, the current state of home sales was not reevaluated for this ITSPA project.

[45] *The Oak Ridger*, 7/26/02. In the response to the question, Bill Pardue, one member of the group who worked on the report, said a broad group of citizens were involved. He said there was no intent to hide the authors, but there were just too many to list them all. Bill Pardue is a retired senior manager from DOE contractor Battelle, and he was heavily involved in UT-Battelle's bid to manage ORNL. Pardue also is a former member of ORRHES.

quality school system, which serves to attract new residents. There are plans to build a new high school, which also is a very positive move by the city. Unfortunately, concern in the last decade about job instability and home resale potential has tempered the benefit of the school system.

3.4 REAL ESTATE DISCLOSURE

The release of mercury and other contaminants to the EFPC and other areas of Oak Ridge raises serious issues regarding Tennessee real estate disclosure laws. This is particularly true since property owners have not been granted official legal indemnity by DOE for problems associated with contaminants in the creek bed, the creek bank, or the floodplain. Therefore, this issue has the potential for significant economic impact on buyers of EFPC and other affected property.

ITSPA spoke with Oak Ridge attorney, David Flitcroft, who wrote a series of articles on real estate disclosure law. These articles were published on 5/24/02, 7/19/02, and 7/26/02 in *The Oak Ridger* (see Appendix 2). Flitcroft indicated that an owner could, in some cases, become subject to the disclosure law despite not having been notified by the realtor or the seller. He indicated the legal obligation to disclose to the next buyer could occur when the owner becomes aware there is a problem. Another important fact that potential buyers need to know is that the statute of limitations for filing a lawsuit can be as little as one year.

According to Flitcroft, the real estate licensee or professional has seven obligations to a potential buyer and every party to a transaction, but the obligation relevant here pertains to disclosing adverse facts about the property. Tennessee law requires the real estate professional to disclose any matters of which they have personal knowledge. Thus, if the Realtor knows of a condition that would significantly affect the value of the real estate which the owner fails to disclose, the Realtor has an obligation to disclose it—regardless of whom he or she represents.[46] However, there are a number of exclusions where disclosure is not required.[47]

In the case of EFPC, the government claims the property has been officially cleaned up and has been cleared for "free use." Therefore, this appears to eliminate the legal obligation to inform a potential buyer of the history of the property. Of particular

---

[46] "Part One: Agency Law for Real Estate Professionals," Attorney David Flitcroft, *The Oak Ridger,* 5/24/02.
"Part One: Residential Property Disclosure," David Flitcroft, *The Oak Ridger,* 7/19/02.
"Part Two: Residential Property Disclosure," David Flitcroft, *The Oak Ridger,* 7/26/02.
"It is a Good Time to Sell Your House," David Flitcroft, *The Oak Ridger*, 9/20/02.

[47] There are a number of exclusions in Tennessee's real estate disclosure law (Title 66 Property law, Chapter 5 Conveyances of Property, www.state.tn.us/commerce/boards/trec/rulesandlaws.html/t66/t_66_ch_5.htm). Quite relevant to EFPC property buyers is the exclusion of a purchase of a new home from a developer that offers a one-year warranty. The following are other examples of exclusions, which were obtained from "Part Two: Residental Property Disclosure" (*The Oak Ridger*, 7/26/02, Attorney David Flitcroft): "…the disclosure only applies to residential property. So, if you are buying farm property, industrial or commercial property or raw land, it does not apply. It is appropriate to work with your real estate professional to fashion a disclosure to apply. Certain sellers are exempt from the disclosure law: court-ordered sales, foreclosure sales, bankruptcy sales, sale by a fiduciary…, transfer termination a tenancy in common, certain family transfers, transfer pursuant to divorce, tax sales, property sold at auction, first-time sale of a dwelling provided the builder offers a written warranty, transfers in which the owner has not resided on the property within three years from the date of transfer. In my practice, if the sale is exempt from the residential disclosure, I would recommend that a professional home inspection be done."

concern to ITSPA is the fact the government has not specifically agreed to indemnify property owners if contamination is later found, despite being pressed to do so by EFPC owners. As a result, only two property owners were granted such indemnification—and they won it through legal action.

A major concern is for non-locals who come to Oak Ridge for a job opportunity or retirement. These individuals tend to be uninformed about the issues surrounding this beautiful creek and creekside properties, which would otherwise be considered prime acreage. For example, see the letter in Section 1.3.1 regarding one new resident who does not even know the name of the creek.

There are no signs on the part of the creek flowing behind the new west-end development, Southwood. The ITSPA team walked this part of the creek during the driving tour (see Section 7.1) and observed that no signs were present. However, TDEC told ITSPA that the lack of signs on the creek in this private development violates no laws. In fact, TDEC indicated they have to get the owner's permission to put a sign up and the owner is then under no legal obligation to leave it in place.

The Southwoods development is in close proximity to the creek and the floodplain, and this beautiful creekside environment is a certain draw to children. At least one child's swing set was observed near the creek. Perhaps there is no cause for concern if the levels left in place are less than 400 ppm—although even that assumption is questionable, particularly if the form of mercury converts from sulfide to some other more toxic form. It is not unfeasible to assume that a child could be exposed to much higher levels of contaminants due to the "homogenized" sampling method used, which makes it very likely that bands of soil contaminated to a level greater than 400 ppm have been left in place.

However, because the government's position is that no contamination has been left in place, no disclosure to property buyers is required. Nevertheless, ITSPA believes the current property owners should have been informed of the potential hazard and that all future potential buyers should be informed of the history of the property and the potential risks.

3.5 ECONOMIC AND OTHER IMPACTS

3.5.1 Economic

There have been significant economic impacts on EFPC property owners. Below are three examples that were discovered by ITSPA:

1. An EFPC property owner found Pine Beetle-damaged trees on their property and attempted to enter into a contract with a logger to harvest the trees before they were too damaged to use for lumber. However, a temporary bridge over EFPC was needed to provide access for the logger. In discussions with federal, state, and city officials, the property owner was told that, not only did everything have to removed from the

creek at the end of the project (as expected), but everything removed from the creek had to be packaged, handled, and disposed of as hazardous waste (rather than simply being piled on the property as was expected). There also were questions about whether the logger's equipment, which likely would come into contact with the creek water, would be considered to be contaminated—and there would be no fresh water present at the job site to rinse the contamination off. As a result of these issues, the logging contract was not completed and the trees died, resulting in significant economic loss (i.e., tens of thousands of dollars) to the property owner.

3 Before the mercury releases were public knowledge, housing units near Country Club Road (along the Turnpike near the old gates) were built. This development backs up directly to the creek, and developers invested in building condominiums or rental units. The units were completed and ready to be occupied, leased, or sold when the news broke about the EFPC contamination. As a result, nothing sold…no one would live there. Although people eventually started to live there and currently still live there, the developers experienced a significant economic impact.

3 The following information was obtained from Footnote 157 in Personal Interview #1 of a large EFPC property owner: After 15 years of being told he could not use the land or he would be co-liable with DOE, the property owner finally received a $175,000 settlement (which he points out was 10% of the claim) as a result of a joint lawsuit with another large property owner. This owner estimates he was owed $1.5 million rent by the government for tying up the use of hundreds of acres of his land. The other property owner indicated to ITSPA he received a settlement of $120,000, likely because he owned less land and had a lower level of contamination. These property owners also were granted legal indemnity from future claims of impacts from the property and the creek. Note that they are the only owners who have been granted such indemnity. In addition to economic impacts, these property owners point out they paid a severe personal price for challenging DOE in a DOE-dominated community, not to mention they spent hundreds, maybe thousands, of hours dealing with this problem, i.e., performing research and attending public meetings, legal proceedings, etc.

3.5.2 Public Health

Evaluating health impacts are under the purview of ATSDR, which has been studying since 2000 the health impacts on residents of all the contaminants of concern that were released from the ORR. ATSDR's PHA on Y-12 uranium releases was issued in January 2004 and is discussed in Section 4.5. The mercury PHA is still underway so those findings cannot be discussed in this report. A number of other public health activities have been conducted in Oak Ridge over the years and these activities are discussed in Section 4.1.

ORRHES, which is overseeing ATSDR's PHA activities in Oak Ridge, has heard several presentations on mercury, which took place in the Public Health Assessment Work Group (PHAWG) on 4/7/03, 7/8/03, 8/18/03, 9/2/03, 9/15/03, and 10/6/03 and at

one Subcommittee meeting (4/13/04). Minutes of these meetings should be available through the ATSDR Oak Ridge Field Office as well as on the web at www.atsdr.cdc.gov/HAC/oakridge/. A videotape of the one Subcommittee meeting also is available from ATSDR.

3.6 EFPC IN PERSPECTIVE WITH OTHER URBAN CREEKS

Although the EFPC certainly has been and remains polluted, the public also should understand that there are polluted waterways all across the country and around the world. An article that ran in the *Knoxville News Sentinel*[48] may help the public put the issue of the EFPC into perspective. The following is a quote from that article: "In Knoxville, McKinney said, there are portions of First, Second, and Third Creeks where the level of human waste is 1,000 times the acceptable levels. Last year, he said, a University of Tennessee (UT) student was thrown into Second Creek by his fraternity brothers as a prank. He swallowed some of the water, and he was in the hospital for a week."

State officials have publicly indicated that EFPC poses more of an acute risk to humans from the bacteria levels (i.e., from the waste treatment facility and other sources such as wildlife waste) than it does chronic risks from the Y-12 contaminants. However, ITSPA believes that both acute and chronic risks are serious (particularly for exposure to floodplain soils), and the public deserves to know and understand the risks and to know how to avoid them if they so choose.

[48] "Despite Law, It's Clear Water in State, Nation Far From Clean, Experts Report," Knoxville News Sentinel, Jim Balloch, 10/18/02.

CHAPTER 4. PUBLIC HEALTH AND RELATED ACTIVITIES

It appears that the first mercury-related public health activity in Oak Ridge was a pilot survey of mercury levels done in 1985 by the Centers for Disease Control and Prevention (CDC) and the Tennessee Department of Health and Environment (TDHE). However, follow-on work was not begun until the Health Studies Agreement Project began a decade after the mercury was made public. It was around this time that ATSDR began work on a series of health consultations and activities in the region. ATSDR was mandated by CERCLA (i.e., Superfund) to conduct a public health assessment for each facility listed on the NPL. The ORR was placed on the NPL in 1989 and the Oak Ridge Dose Reconstruction project began in 1992. Neither CDC nor ATSDR was directly involved in this project, but the National Center for Environmental Health (NCEH) represented CDC.

ATSDR performed one Health Consultation in 1993 and two in 1995 looking at the EFPC cleanup level. The City of Oak Ridge Environmental Quality Advisory Board (EQAB) had requested that DOE ask ATSDR to evaluate the EFPC cleanup level. In the June 1995 health consultation, DOE had proposed the 400 ppm cleanup level after considering data on the forms of mercury in the soil. Because DOE's basis for changing the cleanup level from 180 to 400 ppm was the speciation of mercury in the EFPC floodplain, there was much discussion. As a result, ATSDR convened a panel of experts to help resolve the issue. The findings of the panel were that speciation was difficult to measure and different methods led to different results, but what was more important was bioavailability. Most of the mercury in the floodplain was in chemical forms that are not readily bioavailable. As a result, ATSDR supported DOE's reduction of bioavailability from 30 percent (used to calculate the 180 ppm cleanup level) to 10 percent (used to calculate the 400 ppm cleanup level).

Final technical reports of the Oak Ridge Dose Reconstruction (ORDR) were completed in 1998-99, but were not made public until 2000. However, some believe the work was brought to an end prematurely and without adequate technical peer review. (See the reviewers comments in Section 4.1, December 1999 Timeline entry.)

The ORDR recommended follow-up studies involving further testing, but ATSDR began working on the PHAs in 2000 without the additional data. The agency chose to rely instead on the historical data and conclusions of the ORDR. Because the recommended community-wide sampling and more scientifically rigorous modeling of transport of contaminants in the community were not done, community members have challenged this ATSDR activity, asking how the agency can make accurate health calls on either past or present exposures without this important information.

4.1 TIMELINE OF PUBLIC HEALTH AND RELATED ACTIVITIES

The following is a detailed timeline for mercury- and uranium-related public health activities in Oak Ridge: [49]

- In October 1985, the CDC and the TDHE issued "Pilot Survey of Mercury Levels in Oak Ridge, Tennessee." See Section 4.4.1 for details of this study.

- In December 1989, the ORR was placed on the Comprehensive Environmental Response, Compensation, and Liability (CERCLA) National Priorities List (NPL) for cleanup.

- In October 1990, the field work for the Remedial Investigation began.

- In mid-1991, Phase 1A sampling analysis planning and sampling was completed.

- In late 1991, Phase 1B sampling analysis planning and sampling was completed.

- In 1992, the Remedial Investigation was completed.

- In 1992, DOE conducted a *Background Soil Characterization Project* (BSCP) in the area around Oak Ridge (DOE 1993).[50] Because many substances of potential concern for human health occur naturally at low concentrations in undisturbed soils, the BSCP was undertaken to provide background concentration data on potential contaminants (organic compounds, inorganics, and radionuclides) in relatively undisturbed soils on the ORR. The objectives of the BSCP were to provide: (a) baseline data for contaminated site assessment and (b) estimates of potential human health risk associated with background concentrations of hazardous and other constituents in natural soils. Background soil characterization data was to be used for three purposes. (1) The first use was in differentiating between naturally occurring constituents (including global or regional fallout) and site-related contamination. This information was necessary for enabling a constituent known to be a contaminant to be eliminated from a risk assessment. (2) The second use was in calculating baseline risks against which site-specific contamination risks could be compared. (3) The third use was in establishing corrective action (i.e., cleanup) levels for contaminated soils on the ORR.

- In May 1992, the Citizens Working Group was formed.

- In August 1992, the *Health Studies Agreement Project* involving the state of Tennessee, DOE, and the Tennessee Department of Health launched Phase I of

[49] http://www.atsdr.cdc.gov/HAC/oakridge/phact/c_4.html is a compendium of ATSDR activities and this document was the source for some of ITSPA's information in this section.

[50] http://www.atsdr.cdc.gov/HAC/PHA/oakridgey12/y12a.pdf (page129).

the Dose Reconstruction studies of Oak Ridge. The purpose of the Oak Ridge health studies project was to evaluate exposure of off-site populations to hazardous substances released into the environment from operations at the ORR since its creation. This "independent" state evaluation (funded by DOE) of exposure to hazardous substances released from past operations at the reservation was overseen by the Oak Ridge Health Agreement Steering Panel (ORHASP). The panel was comprised of experts and local citizens who provided direction, recommendations, and oversight of the dose reconstruction project. Phase I of the study began in August 1992 and the final documents were released in October 1993. NCEH represented the CDC on ORHASP. (See July 1999 entry for Phase II description.)

- In April 1993, the "Remedial Investigation/Feasibility Study" (RI/FS) on LEFPC was completed by SAIC and Radian for DOE. This study was performed as a CERCLA requirement to assess contamination resulting from releases since 1950 from the Y-12 plant. The objectives of the study were to determine the extent of contamination of the EFPC floodplain, to develop a baseline risk analysis based on the level of contaminants, and to determine whether remedial action was required. DOE indicated this study was submitted to EPA and the State of Tennessee in July 1994. Note that CERCLA calls for a review within five years after commencement of remedial action to ensure that the actions adequately protect human health and the environment. However, TDEC pointed out to ITSPA that this only applies if contaminants are known to remain in place. In the case of EFPC, the government claims that no contaminants remain, so they are exempt from this requirement.

- In April 1993, ATSDR issued "Public Health Consultation on Y-12 Weapons Plant Chemical Releases Into EFPC." The ATSDR Health Assessors for this project were Dr. Robert Williams (Toxicologist) and Jack Hanley (Masters of Public Health, MPH).[51]

- In 1993, the Proposed Plan for EFPC cleanup was issued.

- In 1994, the "Chestnut Ridge East Borrow Area Study" was initiated by TDEC. Its purpose was to locate groundwater exit pathways across the eastern boundaries of the ORR on Chestnut Ridge. This project ran through 1995 and was reported in TDEC's 1995 "Environmental Monitoring Report."[52]

- In May 1994, ATSDR issued "Toxicological Profile for Mercury."[53]

---

[51] "Y-12 Weapons Plant Chemical Releases into East Fork Poplar Creek" (4/5/93) http://www.atsdr.cdc.gov/HAC/PHA/efork1/y12_toc.html

[52] http://www.atsdr.cdc.gov/HAC/PHA/efork3/hc_toc.html - Section 3.2.13 of the ATSDR Compendium. ITSPA could not find the consultation itself on the Internet.

[53] http://atsdr1.atsdr.cdc.gov/toxprofiles/tp46-c2.pdf

- In January 1995, a public meeting was held to discuss raising the cleanup level to 400 ppm.

- In January 1995, ATSDR issued "Health Consultation on the Proposed Mercury Cleanup Level for the EFPC Floodplain Soil." This consultation approved the use of 180 ppm as the cleanup level. The ATSDR Health Assessors were Jack Hanley and Dr. William Taylor (PhD).[54]

- In March 1995, the RI/FS on the Watts Bar Reservoir was published by DOE. A ROD was finalized in September 1995. This study assessed contamination in the Watts Bar Reservoir from the ORR and was performed as a requirement of CERCLA. The objectives of the study were to determine the extent of contamination of the Watts Bar Reservoir due to the ORR, to develop a baseline risk analysis based on the concentration levels of the contaminants, and to determine whether remedial action was required. Monitoring activities are ongoing and CERCLA also required a review within five years after commencement of remedial action to ensure that the actions adequately protect human health and the environment. [Available through the DOE information center.]

- In June 1995, the public comment version of the ATSDR health consultation approving the proposed mercury cleanup level of 400 ppm was issued (i.e., "Health Consultation on the Proposed Mercury Cleanup Level for the EFPC Floodplain Soil"). It appears that this was also the final version issued. The ATSDR Health Assessors were Jack Hanley (MPH) and Carol Connell (Health Physicist). [Note this report is not posted on the ATSDR website, but is mentioned in the ATSDR Compendium (see Footnote 49 for the web site).]

- In June 1995, the Health Consultation on the Lower Watts Bar Reservoir Operable Unit was issue.[55]

- In August 1995, ATSDR held a science panel meeting on the bioavailability of mercury in soil. According to ATSDR, after a review of the DOE studies and investigations on mercury in the floodplain and the clean-up levels, ATSDR determined that outside experts would be required to evaluate some technical mercury issues, such as speciation and bioavailability. In addition, ATSDR determined that an assessment of these technical issues by an independent scientific body would be especially warranted in presenting information to the community, which had been divided concerning the proposed mercury clean-up

[54] "Proposed Mercury Clean-up Level for the East Fork Poplar Creek Flood Plain Soil" (Jan. 1995): Evaluates 180 ppm cleanup level http://www.atsdr.cdc.gov/HAC/PHA/efork2/oak_toc.html.

[55] "Health Consultation on the Lower Watts Bar Reservoir Operable Unit "(June 1995) http://www.atsdr.cdc.gov/HAC/PHA/efork3/hc_toc.html - Section 3.2.8 of the ATSDR Compendium. ITSPA could not find the consultation itself on the Internet.

levels. The purpose of the panel meeting was to identify methods and strategies for the development of data-supported, site-specific estimates of the bioavailability of inorganic mercury and other metals from soils. Three technical papers and an ATSDR overview paper on the findings of the panel meeting were published in 1997 in the *International Journal of Risk Analysis* (Volume 17:5). [56]

- In September 1995, the Record of Decision was approved.

- In March 1996, the Clinch River/Poplar Creek RI/FS was published by DOE as a requirement of CERCLA. Its purpose was to investigate the impact of current and historical releases to the off-site surface water environment to determine whether remedial action was required at the site. A Record of Decision was finalized in September 1997. The Remedial Action Report was approved in February 1998. CERCLA called for review within five years after commencement of remedial action to ensure that the actions taken adequately protect human health and the environment.

- In September 1996, Phase I remediation of EFPC to 400 ppm was completed.

- In September 1996, community and physician education on PCBs in fish was initiated by ATSDR. This on-going health education program was conducted to inform local residents and physicians of the health risks associated with PCBs in fish in the Watts Bar Reservoir.[57] [Note: PCBs are a problem not just in Oak Ridge, but all over the U.S. and the world.]

- In April 1997, the Phase II remediation of EFPC to 400 ppm began and was completed in October 1997.

- In May 1997, the results of the *Watts Bar Reservoir and Clinch River Turtle Sampling Survey* were published by ATSDR. The survey was undertaken to determine body burdens of contaminants in snapping turtles in the Watts Bar Reservoir and Clinch River.[58]

- Between September 1997 and March 1998, the *Watts Bar Reservoir Exposure Investigation* took place. The exposure investigation was conducted by ATSDR to measure actual PCBs and mercury levels in people consuming moderate to large amounts of fish and turtles from the Watts Bar Reservoir and to determine if these people were being exposed to high levels of PCBs and mercury. In March 1998,

[56] www.atsdr.cdc.gov/HAC/oakridge/phact/c_4.html - Section 3.2.5 of the ATSDR Compendium. ITSPA could not find the consultation itself on the Internet.

[57] http://www.atsdr.cdc.gov/HAC/PHA/efork3/hc_toc.html - Section 3.2.10 of the ATSDR Compendium. ITSPA could not find the consultation itself on the Internet.

[58] http://www.atsdr.cdc.gov/HAC/PHA/efork3/hc_toc.html - Section 3.2.11 of the ATSDR Compendium. ITSPA could not find the consultation itself on the Internet.

"Serum PCB and Blood Mercury Levels in Consumers of Fish and Turtles from Watts Bar Reservoir" was published. The ATSDR Health Assessor/Medical Officer was Robert H. Johnson, MD.[59]

- In May 1998, the *Scarboro Community Environmental Study* was initiated. The purpose of the study was to address community concerns about environmental monitoring in the Scarboro neighborhood. These concerns included the validity of measurements taken at Air Monitoring Station 46 (located in the Scarboro community) and external radiation results collected during past aerial surveys. The study was designed to incorporate community input and meet the requirements of an EPA investigation of this type. The analytical component of the study was conducted by the Environmental Sciences Institute at Florida Agriculture and Mechanical University (FAMU) and its contractual partners at the Environmental Radioactivity Measurement Facility at Florida State University and the Bureau of Laboratories of the Florida Department of Environmental Protection, and by DOE subcontractors in the Neutron Activation Analysis Group at the Oak Ridge National Laboratory. The final study was released in September 22, 1998, during a Scarboro community meeting.[60,61]

- In September 1998, CDC released the preliminary results of the *Scarboro Community Health Investigation*, a community health survey that was administered to the members of each household in that community. Its purpose was to determine if the rates of certain diseases were higher in Scarboro than elsewhere in the U.S. and to determine if exposure to various factors increased residents' risk for health problems. In addition, information regarding occupations, occupational exposures, and general health concerns was collected for adults. The participation/response rate of the health investigation survey was 83 percent (220/264 households) and included 119 questionnaires about children living in these households and 358 questionnaires about adults.[62]

- In July 1999, the findings of the *Oak Ridge Health Studies - Phase II* (see August 1992 entry for Phase I) were released and seven technical reports were issued in their final form. (Reports had been released for review in the fall of 1997 and spring of 1998. Final draft reports were released in the summer and fall of 1998.) Phase II of the Oak Ridge Health Studies reconstructed past releases of mercury, PCBs, radioactive iodine, radionuclides from White Oak Creek, and uranium, and it estimated the past exposure or doses of these hazardous substances to off-site

[59] http://www.atsdr.cdc.gov/HAC/PHA/efork3/hc_toc.html - Section 3.2.12 of the ATSDR Compendium. ITSPA could not find the consultation itself on the Internet.

[60] http://www.atsdr.cdc.gov/HAC/PHA/efork3/hc_toc.html - Section 3.2.13 of the ATSDR Compendium. ITSPA could not find the consultation itself on the Internet.

[61] http://www.atsdr.cdc.gov/HAC/PHA/oakridgey12/y12a.pdf (p.29)

[62] http://www.atsdr.cdc.gov/HAC/PHA/oakridgey12/y12a.pdf (pp. 26-28)

populations. The estimated exposure or doses were used to help determine which off-site populations were exposed to hazardous substances and what resulting adverse health effects they might have experienced. It is these documents upon which ATSDR is basing its PHAs in Oak Ridge. Most pertinent to the EFPC are the reports on mercury (Vols. 2 and 2A of the Reports of the Oak Ridge Dose Reconstruction), uranium (Vol. 5), and PCBs (Vol. 3).[63] Preliminary screening during the ORDR ruled out beryllium as an off-site hazard. [Phase I screening was based on a relative ranking of hazards. Phase II screening used fractions of an EPA reference dose and a one chance in 10,000 to 100,000 life-time risk of cancer incidence as quantitative screening criteria.]

- In December 1999, ORHASP issued a summary report with recommendations. The following are some important recommendations made by this group:

  (1) "DOE, EPA, the state (and perhaps other agencies) should undertake a coordinated program to obtain needed information and satisfy stakeholder concerns. A *soil sampling* program is vital to gain information relevant to the historic contamination levels in residential areas closest to the ORR plants. Detailed sampling is recommended in all of the most closely situated neighborhoods and also in a few residential areas at greater distances. *Any decision about additional dose reconstruction studies should be deferred until the results of the recommended soil sampling program have been obtained and carefully interpreted.*"
  (2) DOE should undertake a program to measure the *atmospheric dispersion* of controlled tracer releases from representative stacks and vents at Y-12. The primary goal of these measurements would be to define the transport of a non-depositing tracer such as SF6 from the Y-12 plant to populated areas of Oak Ridge, including the Scarboro and Woodland communities, which are both relatively close to the plant.
  (3) More definitive information is needed to better understand the potential toxic effects of exposures to *mixtures of contaminants*—mercury and PCBs, for example—on the same organ systems. Studies relating to this topic should be undertaken by one or more appropriate government-sponsored public health research agencies. (4) In the area of statewide health effects registries, (a) the state should continue efforts to improve the accuracy and completeness of the *cancer incidence registry*, and (b) the state should continue to seek funding for a statewide *birth defects registry*.

- In November 2000, ATSDR began the PHA process with the initiation of a Community Health Needs Assessment (CHNA) and a number of PHAs on the

[63] The following documents comprise the ORDR: "Iodine-131 Releases from Radioactive Lanthanum Processing at the X-10 Site" (Vols. 1 and 1A); "Mercury Releases from Lithium Enrichment at the Oak Ridge Y-12 Plant – a Reconstruction of Historical Releases and Off-site Doses and Health Risks" (Vols. 2 and 2A of the Reports of the Oak Ridge Dose Reconstruction), "PCBs in the Environment near Oak Ridge Reservation" (Vol. 3); "Radionuclide Releases to the Clinch River from White Oak Creek on the ORR" (Vols. 4 and 4A); "Uranium Releases from the ORR" (Vol. 5); "Screening-level Evaluation of Additional Potential Materials of Concern" (Vol. 6); and "Oak Ridge Dose Reconstruction Project Summary Report" (Vol. 7).

most significant contaminants released by DOE from the ORR. However, the work began without following the ORHASP recommendations, particularly no community sampling or additional modeling was performed. The PHAs will cover: (1) iodine-131, (2) Y-12 uranium, (3) K-25 releases (e.g., radionuclides and fluoride), (4) PCBs, (5) mercury, (6) White Oak Creek radionuclides, (7) groundwater, (8) the Toxic Substances Control Act (TSCA) Incinerator, and (9) screening of environmental data (e.g., arsenic, polyaromatic hydrocarbons (PAH), pesticides, fluorine, etc.). ATSDR once indicated that exposure to mixtures would likely be covered in a "catch-all" summary document, although it is unclear if this is still being planned. The PHA[64] process is being overseen by the ORRHES.[65,66] To date, only one PHA has been issued by ATSDR (i.e., Y-12 uranium). However, it was released amid much controversy, in particular regarding EPA's rejection of ATSDR's finding of no health impacts in the past.[67] In addition, ATSDR recently announced the CHNA would not be completed. Refer back to Section 5.5.1.4 for an explanation of this controversial decision (that now appears to have been reversed). Jack Hanley is currently the ATSDR site lead for Oak Ridge, and he was recently appointed the co-project manager, along with Dr. William Cibulas. Dr. William Taylor is the Oak Ridge Field Office Manager. Jerry Pereira was the Project Manager, but has recently retired. A new Project Manager has not been appointed. The Health Assessors for these projects are: iodine-131 (Dr. Paul Charp, ATSDR), Y-12 uranium (Dr. Paul Charp, ATSDR), K-25 releases (Dr. Mark Evans, ATSDR), PCBs (Dr. Jo Ann Freedman, ATSDR), mercury (Dr. William Taylor, ATSDR), White Oak Creek Radionuclides (Dr. Paul Charp, ATSDR), groundwater (Trent LeCoultre, ATSDR), TSCA Incinerator (John Wilhelmi, ERG Inc.), and screening of environmental data (Dr. Karl Markiewicz, ATSDR). The summary document has not yet been assigned to a Health Assessor.

- In June 2001, ATSDR had each of the Phase II ORDR documents reviewed by a group of technical experts to evaluate the quality and completeness of the studies and to determine if the studies provided a foundation for follow-up public health actions or studies. The reviewer comments were compiled into a summary document by an ATSDR contractor in June 2001. The following are selected technical reviewer's comments on the Dose Reconstruction report on uranium (Vol. 5, the report of Project Task 6, which also is referred to as the Task 6

[64] All completed PHAs will be assessable via the Internet at www.atsdr.cdc.gov/HAC/PHA/.

[65] www.atsdr.cdc.gov/HAC/oakridge/

[66] ORRHES, which first met in November 2000, is part of the Citizens Advisory Committee on Public Health Service Activities and Research at DOE Sites. Federal Advisory Committee Act (FACA) chartered Subcommittees such as ORRHES were established to provide advice and recommendations to the Director of CDC and the Administrator of ATSDR pertaining to CDC's and ATSDR's public health activities and research at the Oak Ridge sites. ORRHES provides a forum for community, American Indian Tribal, and labor interaction, and serves as a vehicle for communities, American Indian Tribes, and labor to express concerns and provide advice and recommendations to CDC and ATSDR.

[67] See *EPA Controversy Case Study* (Appendix 1-4)

document). All reviewer comments can be found in Appendix G of ATSDR's PHA on Y-12 uranium release. [Note that bolding is by ITSPA.] [68]

> "Three reviewers agreed that the report met basic methodological standards and that, while it was not a complete analysis of possible uranium exposure near ORR, it was 'a good first pass.'" (page G-9) "One reviewer noted that although the lack of uncertainty analysis in the uranium report made it difficult to evaluate the reliability of the report's conclusions, he would guess that the report's exposure and dose estimates are accurate to within an order of magnitude." (p.G-14) "The three reviewers who spoke to the issue of the uranium report's public health application agreed that the report is adequate for public health decision-making; however, it does not, at present, provide a reliable reconstruction of past uranium doses in the Oak Ridge area. The reviewers, however, affirmed the study's value as a suitable foundation for follow-up studies. One reviewer considered the report useful only as a first-order approximation of actual doses, but suggested that it could be used in cautious **preliminary** public health work—along with the caveat that it may have underestimated the degree of uncertainty inherent in its estimates." (p.G-15) **"The evaluation of uranium concentrations in soil was not covered in depth; one reviewer noted that it almost seemed incidental to the rest of the report."** (p.G-9) "The report is overly weighted toward gauging the radiological effects of uranium exposure. It should have placed more focus on the **chemical toxicity** of uranium." (p.G-10) "Two reviewers felt that the uranium report's use of sediment samples as a surrogate for uranium soil sampling data was unacceptable. A third reviewer stated that the analogy between soil and sediment data *might* be acceptable, but nevertheless praised the actual soil data collected by FAMU as clearly preferable to this analogy. **Other reviewers called for further soil sampling in the Oak Ridge area, particularly subsurface soil core sampling.** All four reviewers expressed confidence in the soil sampling data collected by researchers from FAMU. One reviewer considered them clearly superior to the uranium report's sediment data for use in public health decision-making. Three reviewers called for additional uranium monitoring in strategic locations where one might expect past releases of uranium to have accumulated: in sediments behind dams, on flood plains, and around lakes and swamps. **Two reviewers also called for soil core samples at depths of up to 1 meter, noting that one would not expect to find significant uranium accumulation near the soil surface (*where FAMU collected its samples*).** One reviewer concluded that the reference locations selected seemed appropriate, but **another questioned the report's degree of emphasis on the town of Scarboro as an area of primary public health**

[68] "Public Health Assessment for Y-12 Uranium Releases," Agency for Toxic Substances and Disease Registry, Appendix G, 1/30/04. http://www.atsdr.cdc.gov/HAC/PHA/oakridgey12/y12a.pdf (Note: This web site does not provide the appendices.)

concern.[69] The reviewer indicated that Scarboro seems to have been chosen as a primary public health concern for the Y-12 uranium releases simply because it is the closest community to the facility. This conclusion, the reviewer stated, is premature and might be modified by further analysis of population distribution, wind patterns, and surface water features in the Oak Ridge area. The reviewer noted that, even if it were determined that uranium exposure was higher in Scarboro than in any other community, **overall risk to the public health might still be greater in another town with lower exposure levels but a larger population**." (p.G-8) "One reviewer noted that the report, despite its lack of uncertainty analysis, **does support the conclusion that ORR uranium exposure has had no *detectable* health effect on persons living in Scarboro**. **This is not the same as saying that there has been no health effect: the same reviewer said there was a reasonable likelihood that a few cases of cancer in Scarboro were caused by uranium exposure. Even if this were the case, however, there would probably be no statistically valid way to distinguish those cases caused by ORR emissions from those which were not**." (.G-15) The reviewers made these three major recommendations: (1) Add/improve uncertainty and sensitivity analyses. (2) Develop dynamic models to further characterize the fate of past uranium releases. (3) Continue searching for site-specific historical information. (p.G-16)

- In 2001, EPA's Science and Ecosystem Division Enforcement Investigation Branch performed the *Scarboro Community Environmental Sampling Validation Study*. EPA collected soil, sediment, and surface water samples from the Scarboro community to respond to community concerns, identify data gaps, and validate the sampling performed by FAMU in 1998 (FAMU 1998) (see Figure 6 in that report for sample locations). All samples were subjected to a full analytical scan, including inorganic metals, volatile organic compounds, semi-volatile organic compounds, radiochemicals, organochlorine pesticides, and PCBs. In addition, EPA collected uranium core samples from two locations in Scarboro and conducted a radiation walkover of the areas selected for sampling to determine whether radiation existed above background level.

- On January 30, 2004, ATSDR released its first Public Health Assessment (i.e., Y-12 Uranium Releases).

- In June 2004, EPA headquarters (EPA-HQ) came to an ORRHES meeting in Oak Ridge to discuss their concerns regarding the Y-12 PHA on uranium releases. [Note: It took a small group of ORRHES members over a year, working outside

[69] This issue was a major source of the controversy surrounding ATSDR's PHA on Y-12 uranium, which was issued in January 2004. EPA did not accept ATSDR's findings of no health impacts in the past and challenged the use of Scarboro to represent all of Oak Ridge.

of the ORHESS process, to finally get ATSDR to agree to the meeting with EPA-HQ. See *EPA Controversy Case Study* in Appendix 1-4 for more information.]

- At the September 2004 ORRHES meeting, ATSDR announced it was not going to complete the CHNA.

- In October 2004, it was announced that a grant was awarded to the Community-based Hazard Management Program (CBHM), which is part of Clark University's George Perkins Marsh Institute (Worcester, MA). The funded project is *Redressing the Shortcomings of Science by Assessing Public Health Studies*. Issues raised by Clark University have been a matter of great controversy within ORRHES. In particular, ATSDR's plan to use 5,000 mrem over 70 years as a screening level for radiation in the community has been a hotly debated and contentious issue (see Footnotes 79-83). This issue was part of the EPA controversy that is addressed in the "*EPA Controversy Case Study*" found in Appendix 1-4. Hopefully, this newly funded CMTA-funded project will help ORRHES be better equipped to deal with this very important issue. The following information is from Clark University's proposal to the Citizen's Monitoring and Technical Assessment (CMTA) Fund (i.e., the same organization that funded this ITSPA study):

  > "There is a vast literature on the human health effects caused by low levels of ionizing radiation. This literature is used for assessing health risks from historical exposures and the need for follow-up public health activities and the setting of risk-based clean-up standards (e.g., soil action levels, waste acceptance criteria) and goals (e.g., allowable future site uses) around DOE facilities. Unfortunately, the literature has often been used selectively in reports by responsible government agencies, including DOE and ATSDR, and there are inconsistencies among these reports. For example, in our recent review of an ATSDR Public Health Assessment for tritium contamination at Lawrence Livermore National Laboratory, LLNL (ATSDR 2002a; review by Goble and Russ can be found at http://www.trivalleycares.org/), we found that the agency's treatment of risks from radiation exposure contradicts standard practice as described in the National Academy of Sciences BEIR V report (NRC 1990), in international commissions (ICRP 1991, UNSCEAR 2000), and in ATSDR's own Toxicological Profile for Ionizing Radiation (ATSDR 1999).
  >
  > Specifically, despite a scientific consensus that cancer risk should be considered proportional to dose even at very small doses (known as the 'linear, no-threshold' model of risk) the authors operate under the assumption that there is a threshold for radiation-induced cancer. The threshold that they propose is higher than their dose estimate for a maximally exposed individual; thus they estimate zero risk. The authors did not acknowledge that they are advocating a minority position and

provide only a biased review of the available literature that ignores evidence of effects below their proposed threshold.

In contrast, using standard methods we found that within the range of uncertainty there was potential for cancer mortality risks that are considered 'significant' in common regulatory practice. Most disturbing was that the report (and it is not a unique example) directly subverts the two key risk management concepts – ALARA (as low as reasonably achievable) and the setting of "risk-based standards" that have served as cornerstones for the social compact on managing radiological hazards.

Without an understanding of the evidence about health effects from low-level ionizing radiation, community groups are often in a weak position to deal with inconsistencies, to criticize the agencies' selective use of current scientific knowledge, and to respond to policy changes like the abandonment of ALARA. In fact, this literature is often not very accessible to community members. It is found in widely dispersed highly technical academic journals and reports. It is written in dense, complex technical jargon, which is useful for experts in the field but builds barriers for transferring that knowledge to lay people. Finally, there are few widely availably critical summaries of the extant literature.

The understandings and capabilities of communities exposed to contamination from the national laboratories are further exacerbated in economically and socially disadvantaged communities. Communities around ORR and Los Alamos National Laboratory fit the operational definition of vulnerability that is comprised of three elements: 1) characteristics of the sub-population can lead to higher exposures, 2) the sub-population has more susceptibility to the potential harm caused by the exposures than the general population, and 3) the relatively weak ability of the exposed and susceptible sub-population to cope with the harm puts them at greater risk."

- At the March 2005 ORRHES meeting, ATSDR announced it was considering beginning work again on the CHNA.

4.2 ATSDR STATEMENT OF MERCURY ISSUES

The following is a summary statement of mercury-related issues compiled from ATSDR's health consultations on EFPC (1993 and 1995).

- In April 1993, ATSDR issued a health consultation on mercury contamination in the EFPC flood plain. The finding of the consultation was that mercury contamination in soil ***did*** exist at levels that could pose a health risk to residents in the area.[70]
- In January 1994, DOE released a report that provided more sampling data and also suggested a clean-up level of 50 milligram per kilogram (mg/kg, also equals ppm) mercury in soil. This cleanup level was based on the U.S. EPA reference dose for mercury and conservative assumptions about the potential exposure pathway and exposure doses that might occur through that pathway.
- In June 1994, DOE released an addendum to their original report. They presented additional sampling data, which suggested that the predominant forms of mercury found in the area were *mercuric sulfide* and *metallic mercury* and cited new studies concerning the lower absorption rates of these forms of inorganic mercury. Based on this new information, DOE recommended a higher clean-up level of 180 mg/kg.
- Some members of the community questioned DOE's shift in clean-up levels, and, in particular, they questioned DOE's assumptions concerning mercury speciation and absorption. Because of these concerns, community members requested a consultation from ATSDR on whether the modified clean-up level would be protective of public health.
- In order to evaluate whether the new clean-up level will be protective, ATSDR analyzed the proposed level using a worst case scenario that bypasses the scientific issues of speciation and absorption.
- In the January 1995 consultation, ATSDR found the proposed 180 mg/kg clean-up level protective of public health.
- As a result of public comments, DOE revisited the assumptions used to develop the 180 mg/kg mercury cleanup level. Based on this review, DOE decided to adopt a new cleanup level of 400 mg/kg mercury for the floodplain soil.
- At the request of members of the public and the City of Oak Ridge, ATSDR evaluated the public health impact of the new cleanup level of 400 mg/kg mercury in soil. In the June 1995 consultation, ATSDR analyzed the cleanup level using a worst-case exposure scenario and the most likely exposure scenario of a small child in a residential setting (similar to those used in the February 1995 consultation). ATSDR concluded the 400 mg/kg cleanup level of mercury in the floodplain soil was protective of public health. (June 1995)
- ATSDR recommended the following interim actions to reduce exposures until the EFPC flood plain was remediated: 1) post signs and restrict public access to areas with elevated mercury concentrations and 2) continue the EFPC fish advisory.

In its health consultations, ATSDR did not directly answer the question, "What is a safe level of mercury in the soil?" The agency believes that such an answer would interfere with EPA's role of setting cleanup levels and, therefore is outside of ATSDR's scope. ATSDR indicates their "customers" must propose a cleanup level and ask them the question, "Is this level protective of the public's health?" ATSDR also claims it does not provide maximum cleanup levels because their calculations are based on site-specific

[70] Based on a review of soil, sediment, surface water, air, and groundwater summary data from the *EFPC Remedial Investigation Report Phase 1A* and summary fish data from the DOE Biological Monitoring and Abatement Program (BMAP), http://www.esd.ornl.gov/ BMAP/.

assumptions. As a result, ATSDR may agree it is safe to clean up one site to a particular level, but may agree to another level for the same contaminant at another site. ATSDR indicates their calculations do not provide standards that are transferable to all situations.

4.3 HEALTH HAZARDS OF Y-12 CONTAMINANTS

While mercury is probably the major contaminant of concern (COC) for the Y-12 Plant, other COCs are uranium, PCBs, and beryllium. The following information was obtained from ATSDR's ToxFaq, (http://www.atsdr.cdc.gov/toxpro2.html) and from the ATSDR Health Consultations (1993 and 1995).

4.3.1 Mercury

This section provides information on the forms of mercury that can exist in the environment, results of animal studies, and the specific hazards from forms of mercury thought to exist in the EFPC floodplain. Note that ATSDR's toxicological profile for mercury can be found at the web site: http://atsdr1.atsdr.cdc.gov/toxprofiles/tp46-c2.pdf.

4.3.1.1 Possible Forms in the Environment

Mercury has three valence states and is found in the environment in various forms, i.e., inorganic (e.g., mercuric chloride, mercuric nitrate, mercuric sulfide), organic (e.g., methylmercury), and elemental mercury (i.e., metallic). The state and form in which mercury is found in the environment depend on a number of factors. Volatile forms are expected to evaporate to the atmosphere; solid forms partition to soil and to the water column. The severity and type of toxic effect resulting from exposure differs for each form of mercury. (1993 Health Consultation)

It is widely assumed that the form of mercury in the Oak Ridge soils is primarily mercuric sulfide, a highly insoluble form of mercury. However, this is a very controversial assumption. ATSDR attempted to bypass this controversy by assuming mercuric chloride in its worst case calculations (see Section 4.3.1.6).

4.3.1.2 Animal Study Results

The hazard from ingesting inorganic mercury is primarily based on absorption into the bloodstream (internal dose). Different forms of inorganic mercury compounds have different absorption rates. (1995 Health Consultation) Most of ATSDR information on absorption of inorganic mercury after ingestion is from animal studies that used mercuric chloride, a highly soluble form of mercury. ATSDR has no direct measures of the amount of mercury that children would absorb. No laboratory studies are available on the percent absorption of inorganic mercury from the gastrointestinal tract in humans. However, ATSDR knows mercury can be absorbed by this route because mercury has been detected in humans who have ingested inorganic mercury compounds (mercuric nitrate, mercuric chloride, mercuric sulfide).

Detailed animal studies indicate absorption of inorganic mercury across the gut is limited and is influenced by the form of mercury and by an animal's age and diet, as well as its species. For example, young rats may absorb much more mercury than old mice. Mercuric chloride, the compound ATSDR used for its estimate in Oak Ridge, is used in many animal studies because it is very soluble in water and is believed to have the highest absorption rate of inorganic mercury. The absorption for mercuric chloride by this route ranges from as little as one percent to as much as 38 percent in mice and rats. Studies suggest that some forms of mercury, for example mercuric sulfide, have lower absorption rates or "bioavailability" through the gut than mercuric chloride. However, the relative bioavailability of mercuric sulfide versus mercuric chloride has not been specifically studied in animals nor has it been examined in humans. [See August 1995 entry in the timeline in Section 4.1.]

ATSDR is reasonably certain that absorption is much lower (approximately 0.1%) for liquid metallic mercury. For this reason, ingestion of metallic mercury is much less hazardous than ingestion of mercuric chloride. In contrast, metallic mercury is dangerous if its vapor is inhaled, because metallic mercury vapor is easily absorbed through the lungs.

4.3.1.3 Known Human Health Effects

The health effects of mercury vary dramatically depending on the form of mercury. Human health effects of regular consumption of methylmercury are vision and hearing loss, slurred speech, tremors, muscle weakness, and neurological damage. Methylmercury poisoning also can be fatal. Babies can have birth defects (i.e., brain damage and gnarled limbs) if pregnant women eat mercury-contaminated fish often.

Mercury poisoning can be cumulative and may take weeks, months, or years to produce a recognizable clinical effect. Adverse health effects of long-term exposure to low levels of organic and inorganic mercury are primarily kidney damage and central nervous system effects. The kidney is the organ most sensitive to the effects of ingestion of inorganic mercury salts and inhalation of elemental mercury. Renal effects have been seen in people following chronic oral exposure to inorganic mercury salts and in rats and mice following acute (less than 14 days), intermediate (15 to 365 days), and chronic (greater than 365 days) oral exposure to inorganic mercury salts. Severe effects on the kidney have been seen in people following chronic and acute occupational inhalation exposure to elemental mercury vapors. Effects on the kidney include increased urine protein levels and, in more severe cases, a reduction in the glomerular filtration rate, which is a sign of decreased blood-filtering capacity.

The central and peripheral nervous systems are also target organs for elemental, organic, and inorganic mercury. Neurologic and behavioral disorders in people have been seen following long-term ingestion and dermal application of inorganic mercury-containing compounds, such as teething powders, ointments, and laxatives, as well as pesticides containing organic mercury. Limited human and animal data are available on dermal exposure to mercury. However, acrodynia (pink disease) occurs in children

dermally exposed to inorganic mercury compounds. Acrodynia is a complex neurologic syndrome characterized by fine postural or action tremor of the face or extremities, lack of muscle tone, sensitivity to light, general rash, and hypertrichosis. Information on neurotoxicity in people following oral exposure to organic mercury comes from reports of people who have ingested contaminated fish and fungicide-treated grains.

Organic forms of mercury are known neurodevelopmental toxins. Human and animal studies indicate that organic mercury (particularly methylmercury) and elemental mercury vapor cross the placenta to the fetus. Although maternal milk may contain only five percent of the mercury concentration of maternal blood, neonatal exposure to mercury may be greatly increased by nursing. Severe brain damage has been seen in infants following prenatal exposure via maternal ingestion of methylmercury in bread and fish. No abnormal reproductive or anatomic effects have been seen in infants exposed prenatally.

The central nervous system is likely to be the most critical target organ for elemental mercury vapor. Acute, intermediate, and chronic exposure to mercury vapor may elicit consistent and pronounced neurologic effects. The neurologic syndrome commonly seen as a result of chronic mercury toxicity is characterized by common central nervous system symptoms, including irritability; fatigue; anorexia; tremors; dementia; memory loss; impaired peripheral vision, hearing, taste, and smell; sleeping disorders; and unsteadiness of gait and limbs. (1993 Health Consultation)

4.3.1.4 Hazards of Forms Found in the EFPC Floodplain

The following information on the forms of mercury found in the EFPC floodplain was obtained from the 1993 and 1995 ATSDR Health Consultations.

4.3.1.4.1 *1993 ATSDR Health Consultation*

The 1993 ATSDR Health Consultation indicates the inorganic form of mercury, i.e., mercuric sulfide, makes up 84 to 98 percent of the mercury in the contaminated EFPC soil. This form is insoluble in water and strongly adsorbs to soil. The primary route by which people might be exposed to mercuric sulfide at the creek is ingestion of contaminated soil. Following ingestion, absorption of inorganic mercury compounds across the gastrointestinal tract is low in both people and animals. Oral absorption of a dose of inorganic mercury salts has been estimated to be less than seven percent. Absorption of inorganic mercury via inhalation and dermal exposures can occur; however, no quantitative data are available. Inorganic mercury salts accumulate primarily in the kidney, but are distributed to the liver, erythrocytes, bone marrow, intestine, and skin.

The mercury in the contaminated EFPC soil consists of up to eight percent elemental mercury. Elemental mercury is a liquid, but readily vaporizes with increases in temperature. At EFPC, volatile chemicals such as elemental mercury are expected to evaporate to the atmosphere during excavation. Once inhaled, 80 to 100 percent of

elemental mercury vapors are absorbed through the lungs into the systemic circulation. However, elemental mercury is poorly absorbed through dermal and oral routes.

Depending on their solubility, organic forms of mercury adsorb to particulates or are transported in the water column. ATSDR reports the mercury in EFPC soil is less than 0.01 percent organic mercury. The most common organic form of mercury (i.e., methylmercury) is soluble, mobile, and quickly enters the aquatic food chain. Methyl mercury biomagnifies in fish on the order of 10,000 to 100,000 times the concentration found in ambient waters. The primary routes of exposure to organic mercury at EFPC would probably be ingestion of contaminated fish and, to a lesser extent, soil. Organic mercury is readily absorbed orally. Retention and excretion studies have shown that approximately 95 percent of an oral dose of aqueous methylmercuric nitrate is absorbed across the gastrointestinal tract. Exposure to a number of forms of mercury in the soil, sediment, and fish by multiple routes (i.e., ingestion, inhalation, and dermal contact) would result in an increased exposure dose and an increased risk of non-cancer health effects.

4.3.1.4.2 *1995 ATSDR Health Consultation*

In June, 1994, DOE released an addendum to the remedial investigation, which presented the results of additional studies of mercury in the EFPC flood plain soil. In the addendum, DOE stated that several different analytical methods indicated that mercuric sulfide and metallic mercury are likely to be the dominant inorganic mercury forms present and that mercuric chloride (the most easily absorbed and the most toxic inorganic form of mercury) is a minor component of the total mercury in the EFPC floodplain soils. DOE also stated the weight of evidence supports their hypothesis that these predominant forms of mercury in the floodplain soil are less soluble, less bioavailable (not as easily absorbed into the bloodstream), and less toxic than the highly soluble mercuric chloride used to develop the preliminary cleanup level. Based on this evidence, DOE recommended a higher clean-up level of 180 mg/kg mercury in soil by reducing the bioavailability factor in their calculations from 100 to 30 percent.

Some local residents who were concerned about the new recommended clean-up level requested an ATSDR Health Consultation. In January 1995, ATSDR issued a document stating the 180 mg/kg clean-up level is protective of public health. To evaluate whether the recommended level is protective, ATSDR bypassed the areas of scientific debate about speciation and bioavailability of mercury in the floodplain soil and analyzed the 180 mg/kg mercury cleanup level using a worst-case scenario, which is discussed in Section 4.3.1.6.

4.3.1.5 Exposure Pathways

Potential sources of exposure to contaminants in EFPC are the soil and sediment, fish consumption, and consumption of other sources in the food chain. These pathways are discussed in the following sections.

4.3.1.5.1 *Soil and Sediment*

According to the 1993 ATSDR Health Consultation on Y-12, the primary routes of exposure to contaminated soil and sediment are unintentional ingestion and excessive dermal exposures. However, exposure also can occur when contaminated soils are excavated. People, particularly children, who fish, play, or walk along EFPC and the flood plain may be exposed to mercury through ingestion of soil from inadvertent hand-to-mouth activities and by dermal contact with soil. Exposure to mercury in the sediments would occur primarily through dermal contact, possibly by ingestion.

In the 1995 Health Consultation, ATSDR indicated that the residential land use scenario provides the maximum opportunity for chronic exposure to the mercury in the EFPC floodplain soil. Young children in the residential areas have the greatest risk of exposure to mercury because they are likely to have the most frequent and longest duration exposure to the EFPC soils since they play in the dirt and engage in frequent hand-to-mouth activity, often placing objects in their mouth. A medical condition exists, referred to as pica, which is the persistent craving and compulsive eating of non-food substances, including soils. Children with this condition are most at risk from the EFPC soils and sediments.[71]

The frequency and duration of exposure to EFPC floodplain soil is likely to be much less for older children and adults in general and particularly for people who do not live on the floodplain. Within the commercial, DOE, and recreational (e.g., sportsman club and golf course) areas, access to the floodplain is either difficult or restricted. Within the agricultural areas, people intermittently enter the floodplain. Consequently, people would more probably have infrequent and short-duration exposures to mercury via ingestion of inorganic mercury in soil or inhalation of mercury vapors in the air.

Excavation of soil and sediments along EFPC may result in the release of mercury vapor from the soils, especially as the ambient air temperature increases. Such releases may increase ambient air levels of mercury vapor, which could pose a health risk to unprotected workers and the public. Exposure to mercury vapor may cause pronounced neurologic effects.

4.3.1.5.2 *Fish Consumption*

Fish from EFPC also contain elevated levels of PCBs, but mercury and PCB concentrations found in fish fillet samples were below levels that cause acute adverse health effects by ingestion. However, frequent and long-term ingestion of contaminated

---

[71] Pica in humans has many different subgroups, defined by the substance that is ingested. Some of the most commonly described types of pica are eating earth, soil or clay (geophagia), ice (pagophagia) and starch (amylophagia). However, pica involving dozens of other substances, including cigarette butts and ashes, hair, paint chips, and paper have also been reported. Although pica can occur in individuals of any background, a higher incidence of pica is associated with pregnancy, developmental delay and mental retardation, psychiatric disease and autism, early childhood, poor nutrition or low blood levels of iron and other minerals, and certain cultural or religious traditions. (Source: http://webess16.micromedex.com/content/DiseaseDex/002141.htm)

fish from the creek could result in an increased risk of adverse effects on the central nervous system and kidneys and a moderate increased risk of developing cancer. (1993 ATSDR Health Consultation)

ORNL scientist Dr. Jim Loar indicated in his 1993 and 1994 *State of the Creek* addresses that levels of methylmercury found in fish further downstream of Y-12 have *increased for unexplained reasons*. He indicated in the *1994 State of the Creek* address that statistical tests showed the increase is not an artifact of fish size, gender, or season and that ecological changes (in trophic status, bioenergetic efficiency) do not account for the increase. Loar also indicated that aqueous methylmercury concentrations have increased in LEFPC over the past two decades, but mechanism driving the change in bioaccumulation remains unknown and under investigation. See Section v for an overview by year of these addresses.

4.3.1.5.3 *Food Chain*

Another potential exposure pathway associated with the contaminated soil at the EFPC is the food chain. Cattle and wildlife grazing in the creek's floodplain may bioaccumulate contaminants through ingestion of soil, plants, or animals that bioconcentrate contaminants. Furthermore, it is possible that contaminants in the soil may bioaccumulate in and accumulate on vegetables, especially root vegetables, grown in the creek's contaminated soil. However, in the 1993 Health Consultation, ATSDR indicated the public health implications of exposure to contaminants in the soil via the food chain could not be evaluated without additional information about the cattle, wildlife, and vegetable crops in the EFPC flood plain.

4.3.1.6 Exposure Scenarios and Expected Risk

The three exposure scenarios evaluated by ATSDR in their Health Consultations were (1) a child playing in the EFPC floodplain soil, (2) an individual eating fish caught from the creek, and (3) inhalation of mercury vapor from the floodplain soil.

4.3.1.6.1 *Playing in the Floodplain*

To date, two health consultations have been performed by ATSDR. A PHA on mercury currently is underway and should be published soon.

1993 Health Consultation: It was reported in the 1993 ATSDR Health Consultation that long-term exposure to soil at this site containing mercury at concentrations of 1,010 ppm could result in body burdens of mercury that result in adverse health effects. ATSDR gave as an example a 30-kilogram child playing four days a week for 10 years in the EFPC floodplain soil containing the maximum concentration of contaminants reported, i.e., 1,010 ppm for soil and 2,240 ppm for sediment.[72] ATSDR indicated that only the estimated ingested exposure dose for inorganic mercury exceeds

[72] Maximum concentrations were provided by Dr. William Taylor of ATSDR.

the ATSDR oral minimal risk level (MRL) of 0.002 mg/kg/day. (The MRL is an estimate of daily human exposure to a contaminant below which non-cancer health effects are considered unlikely.) ATSDR reported that no apparent increases in carcinogenic risk or in non-cancer health effects are expected from oral exposure to other contaminants in the soil.

1995 Health Consultation: In the 1995 Health Consultation, ATSDR used a worst-case scenario to determine if the 180 mg/kg mercury cleanup level was protective of the most sensitive population. This population was assumed to be young children who live close to EFPC and play in the floodplain soils during the early years of life. They were assumed to be exposed to the most highly absorbable form of inorganic mercury (i.e., mercuric chloride and metallic mercury) by the most probable exposure routes. By making this assumption, ATSDR bypassed the areas of scientific debate about speciation and bioavailability of mercury in the floodplain soil.

ATSDR estimated a child would receive 0.001 mg/kg/day (milligrams of mercury for every kilogram of the child's body weight everyday) during the early years of life if the child daily swallowed a small amount of dirt from mouthing toys or fingers with dust on them containing 180 mg/kg mercuric chloride. ATSDR used mercuric chloride in their calculations because studies have shown it is highly soluble, and more of it will be absorbed across the stomach and walls of the intestine than other forms of inorganic mercury. To determine if this "worst case" dose poses a health hazard, ATSDR then examined recent U.S. Public Health Service studies of animals fed mercuric chloride.

Animal studies have been used to define a no-observed-adverse-effect level (NOAEL) of 0.23 mg/kg/day for intermediate exposure (more than fourteen days, but less than one year) to inorganic mercury and a lowest-observed-adverse effect level (LOAEL) of 1.9 mg/kg/day for chronic exposure (more than one year) to inorganic mercury. The NOAEL is the amount of mercury animals ingested five days a week for six months without any adverse health effect. The LOAEL is the smallest amount of mercury animals ingested over a lifetime (i.e., five days a week for two years) that did produce an adverse health effect.

For inorganic mercury, the adverse effects first observed in the animals were minor changes in the kidneys and weight loss. More serious kidney effects were seen at a higher dose of mercury. ATSDR's calculated chronic oral exposure dose of 0.001 mg/kg/day for children was approximately 1,900 times *less than* the chronic LOAEL of 1.9 mg/kg/day and 230 times *less than* the intermediate NOAEL of 0.23 mg/kg/day. Thus, ATSDR estimated in 1995 that the chronic oral exposure dose for the worst case scenario was much lower than the LOAEL and NOAEL.

4.3.1.6.2 *Eating Fish*

Fish fillet samples collected from the EFPC contain mercury and PCBs. ATSDR indicated there was no acute health threat to people who eat the fish. However, if people frequently ingested contaminated fish from the creek over a prolonged period, there was a

moderate increased risk of adverse effects to the central nervous system and kidneys, and of developing cancer. (1993 ATSDR Health Consultation)

4.3.1.6.3 *Inhalation of Vapor from Soil*

In ATSDR's evaluation of the danger of inhaling mercury vapor from the floodplain soil (1995 Health Consultation), the agency considered the air concentrations of mercury vapor measured over floodplain areas with the maximum mercury concentrations in soil. Long-term air monitoring (not performed by ATSDR) indicated the concentration of mercury vapor ranged from 0.0000031 to 0.0000124 mg/m^3 (milligrams of mercury per cubic meter of air) in air over soil containing up to 3,000 mg/kg mercury. To determine the health hazard of inhaling mercury vapor, ATSDR examined studies of people occupationally exposed to metallic mercury vapor (the most toxic form for inhalation).

A chronic occupational human study was used to define the lowest-observed-adverse-effect level (LOAEL) of 0.026 mg/m^3 for chronic exposure to mercury vapor in air. In that study, the adverse effect observed was an increase in the fine tremors that all people have normally. There was also some indication from other studies that some memory loss and mild kidney effects may occur at this LOAEL. The maximum concentration of mercury vapor measured in air over the floodplain (0.0000124 mg/m^3) is 2,000 times *less than* the LOAEL of 0.026 mg/m^3. Thus, air concentrations of mercury vapor over floodplain soil at its present level of contamination are *much lower* than the LOAEL. The air concentrations of mercury vapor over soil with only 180 mg/kg mercury will be even lower.

4.3.1.7 Dose Calculation Equations

The following equation and variables are used by ATSDR to calculate exposure dose in parts per million per day (ppm/d):

$$D = C \times IR \times AF \times EF / BW$$ where:

D = exposure dose	mg Hg / kg BW /d = ppm / d
C = contaminant concentration	mg Hg / kg soil = ppm
IR = intake rate of contaminant medium	kg soil / d
AF = bioavailability factor	(unitless)
EF = exposure factor *	(unitless)
BW = body weight	kg BW

* For acute exposures, EF = 1. For long-term exposures EF < 1 because it is assumed that children do not play in the soil every day.

The soil intake rate for typical children is 200 mg/d and as high as 5,000 mg/d for children who exhibit soil-pica behavior. [Note: The intake rate units in the equation above are kg/d, not mg/d as indicated here.] The doses used for public health mercury assessments are the ATSDR MRLs: (1) oral inorganic mercury MRLs: 0.002 mg/kg/d (i.e., ppm/d) for intermediate exposures and 0.007 mg/kg/d for acute exposures, (2): oral methylmercury: 0.0003 mg/kg/d for chronic exposures, and (3) inhalation of elemental or metallic mercury: 0.0002 mg/m^3 for chronic inhalation.

4.3.2 Uranium

The following is from ATSDR's ToxFaq for uranium (http://www.atsdr.cdc.gov/tfacts150.html). Uranium is a naturally occurring chemical substance that is mildly radioactive. It is naturally found in soil where it may stay for billions of years. Everyone is exposed to low amounts of uranium through food, air, and water. All uranium mixtures (natural, depleted, and enriched) have the same chemical effect on the body and exposure to high levels of uranium can cause kidney disease. It is not known to cause cancer, but can decay into other radioactive materials that may. In particular, uranium can decay into radium, which can cause cancer if exposed to enough of it for a long enough period of time. Studies have reported lung and other cancers in uranium miners; however, the miners also smoked and were exposed to other substances that cause cancer, such as radon and silica dust.

Like adults, children are exposed to small amounts of uranium in air, food, and drinking water. If children were exposed to very large amounts of uranium, it is possible that they might have kidney damage like that seen in adults. ATSDR reports it does not know if children differ from adults in their susceptibility to the health effects of uranium exposure.

It is not known if exposure to uranium can affect the developing human fetus. In laboratory animals, high doses of uranium in drinking water resulted in birth defects and an increase in fetal deaths. Measurements of uranium have not been made in pregnant women, and ATSDR reports it does not know if uranium can cross the placenta and enter the fetus. In an experiment with pregnant animals, only a small amount of the injected uranium reached the fetus.

Because uranium is in a normal diet, there will always be some level of uranium in all parts of a person's body. Uranium is normally measured in a sample of urine collected and sent to a laboratory. Blood, feces, and tissue samples are rarely used. Because most uranium leaves the body within a few days, higher than normal amounts in urine show if someone has been exposed to larger-than-normal amounts within the last week or so. Some highly sensitive radiation methods can measure uranium levels for a long time after a large amount is taken in. Also, some radiation equipment can tell if uranium is on the skin.

4.3.2 Polychlorinated Biphenyls

The following is from ATSDR's ToxFaq for polychlorinated biphenyls (PCBs): http://www.atsdr.cdc.gov/tfacts17.html. PCBs are a mixture of individual chemicals that are no longer produced in the United States, but are still found in the environment. Polychlorinated biphenyls are mixtures of up to 209 individual chlorinated compounds (known as congeners). There are no known natural sources of PCBs. They are either oily liquids or solids that are colorless to light yellow. Some PCBs can exist as a vapor in air and have no known smell or taste. Many commercial PCB mixtures are known in the U.S. by the trade name Aroclor.

PCBs have been used as coolants and lubricants in transformers, capacitors, and other electrical equipment because they don't burn easily and are good insulators. The manufacture of PCBs was stopped in the U.S. in 1977 because of evidence they build up in the environment and can cause harmful health effects. Products made before 1977 that may contain PCBs include old fluorescent lighting fixtures and electrical devices containing PCB capacitors, and old microscope and hydraulic oils.

PCBs are taken up by small organisms and fish in water. They are also taken up by other animals that eat these aquatic animals as food. PCBs accumulate in fish and marine mammals, reaching levels that may be many thousands of times higher than in water. Animals that ate food containing large amounts of PCBs for short periods of time had mild liver damage and some died. Animals that ate smaller amounts of PCBs in food over several weeks or months developed various kinds of health effects, including anemia; acne-like skin conditions; and liver, stomach, and thyroid gland injuries. Other effects of PCBs in animals include changes in the immune system, behavioral alterations, and impaired reproduction. PCBs are not known to cause birth defects.

Human health effects that have been associated with exposure to PCBs include acne-like skin conditions in adults and neurobehavioral and immunological changes in children. PCBs are known to cause cancer in animals. The most commonly observed health effects in people exposed to large amounts of PCBs are skin conditions such as acne and rashes. Studies in exposed workers have shown changes in blood and urine that may indicate liver damage. PCB exposures in the general population are not likely to result in skin and liver effects. Most of the studies of health effects of PCBs in the general population examined children of mothers who were exposed to PCBs.

Few studies of workers indicate that PCBs were associated with certain kinds of cancer in humans, such as cancer of the liver and biliary tract. Rats that ate food containing high levels of PCBs for two years developed liver cancer. The Department of Health and Human Services (DHHS) has concluded that PCBs may reasonably be anticipated to be carcinogens. The EPA and the International Agency for Research on Cancer (IARC) have determined that PCBs are probably carcinogenic to humans.

Women who were exposed to relatively high levels of PCBs in the workplace or ate large amounts of fish contaminated with PCBs had babies that weighed slightly less

than babies from women who did not have these exposures. Babies born to women who ate PCB-contaminated fish also showed abnormal responses in tests of infant behavior. Some of these behaviors, such as problems with motor skills and a decrease in short-term memory, lasted for several years. Other studies suggest that the immune system was affected in children born to and nursed by mothers exposed to increased levels of PCBs. There are no reports of structural birth defects caused by exposure to PCBs or of health effects of PCBs in older children. The most likely way infants will be exposed to PCBs is from breast milk. Transplacental transfers of PCBs were also reported In most cases, the benefits of breast-feeding outweigh any risks from exposure to PCBs in mother's milk.

4.3.4 Beryllium

The following is from ATSDR's ToxFaq for beryllium: http://www.atsdr.cdc.gov/tfacts4.html. Beryllium is a hard, grayish metal naturally found in mineral rocks, coal, soil, and volcanic dust. People working in industries where beryllium is mined, processed, machined, or converted into metal, alloys, and other chemicals may be exposed to high levels of beryllium. This metal is a contaminant widely found at the Y-12 Plant.

The general population is usually exposed to low levels of beryllium in air, food, and water. Therefore, the acute or chronic beryllium disease is unlikely in the general population because ambient air levels of beryllium are normally very low (0.00003-0.0002 $\mu g/m^3$). However, people living near industries involved with beryllium may be exposed to higher than normal levels of beryllium in air.

The effects of beryllium depend on the level and time of exposure. The Occupational Safety and Health Administration (OSHA) sets a limit of 2 $\mu g/m^3$ of workroom air for an 8-hour work shift. The EPA restricts the amount of beryllium that industries may release into the air to 0.01 $\mu g/m^3$ averaged over a 30-day period. If beryllium air levels are high enough (greater than 1,000 g/m^3), an acute condition can result. This condition resembles pneumonia and is called acute beryllium disease. However, ATSDR indicates that occupational and community air standards are effective in preventing most acute lung damage.

Lung damage has been observed in people exposed to high levels of beryllium in the air. The people who become sensitive to beryllium may develop an inflammatory reaction in the respiratory system. About 1 to 15 percent of all people occupationally-exposed to beryllium in air become sensitive to beryllium and may develop chronic beryllium disease (CBD), an irreversible and sometimes fatal scarring of the lungs. CBD may be completely asymptomatic or begin with coughing, chest pain, shortness of breath, weakness, and/or fatigue**.** It can also result in anorexia, weight loss, and may also lead to right side heart enlargement and heart disease in advanced cases. CBD can occur many years after exposure to higher than normal levels of beryllium (greater than 0.5 g/m^3). Some people who are sensitized to beryllium may not have any symptoms.

Swallowing beryllium has not been reported to cause effects in humans because very little beryllium is absorbed from the stomach and intestines. Ulcers have been seen in dogs ingesting beryllium in the diet. Beryllium contact with skin that has been scraped or cut may cause rashes or ulcers.

Long term exposure to beryllium can increase the risk of developing lung cancer in people. The DHHS and the IARC have determined that beryllium is a human carcinogen. The EPA has determined that beryllium is a probable human carcinogen. EPA has estimated that lifetime exposure to 0.04 $\mu g/m^3$ beryllium can result in a one in a thousand chance of developing cancer.

ATSDR indicates it does not know if children differ from adults in their susceptibility as there are no studies on the health effects of children exposed to the metal. It is likely that the health effects seen in children exposed to beryllium will be similar to the effects seen in adults. ATSDR also does not know if exposure will result in birth defects or other developmental effects in people. The studies on developmental effects in animals are not conclusive.

4.4 SAMPLING BASIS (MERCURY/PCBs)

In all of its Oak Ridge health consultations, ATSDR has made its public health decisions without additional environmental sampling being done to verify the data provided by DOE. They do so because it is not in ATSDR's scope to do environmental sampling, but the Agency can make recommendations to EPA, DOE, and other agencies when it is required.

Prior to ATSDR becoming involved, some human sampling was conducted in Oak Ridge. In 1985, the TDHE and the CDC conducted a pilot survey of mercury levels in Oak Ridge and performed human sampling (i.e., hair and urine). In 1997, the *Watts Bar Reservoir Exposure Investigation* was conducted to measure actual PCBs and mercury levels in people consuming moderate to large amounts of fish and turtles from the Watts Bar Reservoir.[73]

4.4.1 1985 Household Survey and Human Sampling

In "Pilot Survey of Mercury Levels in Oak Ridge, Tennessee" (October 1985),[74] which was conducted by the TDHE and the CDC, the agencies studied the EFPC floodplain areas, the Scarboro neighborhood, and sewer lines. The purpose of the survey was to determine whether people had been recently exposed to mercury-contaminated soil and fish, and if any clinical health effects from mercury should be expected. After conducting this two-phase study, the agencies concluded that residents and workers of

[73] The reader also may be interested in a survey of anglers along the Clinch River and Poplar conducted by Cadmus Group, which is summarized in Sections 5.6.1 and 5.6.2.

[74] ITSPA could not locate this study through the web sites of ATSDR, CDC, TDEC, or Tennessee Dept. of Health.

Oak Ridge were not likely to be at increased risk for having significantly high mercury levels, and that urinary and hair mercury concentrations were below levels associated with adverse health effects.

4.4.1.1 Phase I

TDHE conducted a household census to gather information on Oak Ridge residents' and city workers' exposure-related activities (i.e., gardening, eating locally-caught fish, maintaining the sewer line). A potentially exposed group was identified that included residents along the EFPC floodplain and the newer sewer lines with soil mercury concentrations greater than or equal to 12 ppm. Residents of Scarboro (the residential area closest to the Y-12 settling pond) and seventeen Oak Ridge storm drain workers and outdoor maintenance personnel were also included in this group. Individuals in the potentially-exposed group must have resided, gardened, played, mowed grass, or worked in areas with mercury soil levels greater than or equal to 12 ppm for at least one month before the survey, or consumed locally caught fish (from the EFPC or downstream as far as Watts Bar Reservoir on the Clinch River), during the three months prior to the survey.

The TDHE completed interviews at 952 households, which was 51 percent of the total number of households contacted. Interviews were completed with 2,627 individuals, representing 10.7 percent of the Oak Ridge population. The most common exposure-related activities cited by participants were recreation in a contaminated area and ingestion of local fish and game (336 and 281 participants, respectively).

4.4.1.2 Phase II

The TDHE collected urine and hair samples from a subset of study participants and analyzed them for their mercury content. The TDHE used the results of the household survey to select the individuals for biologic sampling. Urinary mercury levels ranged from 0 to 22.6 nanograms per milliliter. All values were within the normal range reported in populations with no occupational, therapeutic, or demonstrable exposure to mercury. No evidence of excess organic mercury levels was found in hair samples. Hair mercury concentrations ranged from 2.15 to 8.88 microgram per gram.

4.4.2 1997 Watts Bar Reservoir and Clinch River Turtle Sampling Survey

For several years, TDEC fish consumption advisories warning of PCB contamination in fish were issued for the Watts Bar Reservoir. Such advisories also have been issued for many other reservoirs nationally. Because of the concern regarding PCBs in fish and the recognition that turtles from the reservoirs were also being consumed, this survey was undertaken by TDEC to sample the turtles in the area. Many agencies were consulted and were involved in the project, including ATSDR, DOE, TDH, TVA[75], and

[75] See Appendix 1-5 for TVA's *2001 Annual Monitoring Results* for area waterways.

the Tennessee Wildlife Resources Agency (TWRA).

The Watts Bar Reservoir and Clinch River Turtle sampling survey was undertaken to determine body burdens of contaminants in snapping turtles in the Watts Bar Reservoir and Clinch River. The results of the survey, which was published in May 1997, indicated that turtles in the Watts Bar Reservoir and Clinch River accumulate PCBs and other contaminants. The concentrations of PCBs in turtle tissue were found at levels of concern for human consumption based on data from the fish consumption advisories for the area. Most of the PCB contamination, however, was found to be in fat tissue, as it is with fish. Methods of food preparation, therefore, especially tissue selection, can greatly affect the amount of PCBs consumed with the turtle meat. Note the ATSDR reference used to obtain this information did not provide the specific findings of this survey. [76]

4.4.3 1997 Watts Bar Exposure Investigation

To follow up on the findings of studies and investigations of the Watts Bar Reservoir, ATSDR conducted an exposure investigation with cooperation from the TDH and the Roane County Health Department. This investigation was begun because previous studies by state and federal agencies had concluded that consumption of PCB-contaminated fish and turtles was the only current source of exposure of public health concern. These studies estimated that people who eat moderate to large amounts of certain fish or turtles may have higher than average PCB levels. However, these studies did not have actual evidence of elevated exposure to PCBs among consumers of large amounts of Watts Bar Reservoir fish or turtles. Therefore, the purpose of the exposure investigation was to measure actual PCBs and mercury levels in people consuming moderate to large amounts of fish and turtles from the Watts Bar Reservoir and to determine if they are being exposed to high levels of PCBs and mercury. [77]

In September 1997, ATSDR screened more than 500 individuals and obtained blood samples from 116 individuals who met the criteria and volunteered, including 13 individuals from the Scarboro community. These participants were interviewed and blood was drawn for analyses of serum PCB and blood mercury. In November 1997, ATSDR sent all participants written notification and interpretation of their individual results. In December 1997, an ATSDR physician conducted follow-up interviews with those participants who had been identified as having elevated values. Between March 16 and 19 of 1998, ATSDR held public meetings in Oak Ridge (Scarboro community), Kingston, and Spring City to discuss the results of the exposure investigation. The investigation found:

- The exposure investigation participants' serum PCB levels and blood mercury levels are very similar to levels found in the general population.

[76] http://www.atsdr.cdc.gov/HAC/oakridge/phact/c_4.html

[77] http://www.atsdr.cdc.gov/HAC/oakridge/phact/c_4.html

- Only 5 of the 116 people tested (4%) had PCB levels that were higher than 20 micrograms per liter or parts per billion, which is considered to be an elevated level of total PCBs. Of the five participants who exceeded 20 micrograms per liter, four had levels of 20-30 micrograms per liter. One participant had a serum PCB level of 103.8 micrograms per liter, which is higher than the general population distribution.

- One participant in the exposure investigation had a total blood mercury level higher than 10 micrograms per liter, which is considered to be elevated. The remaining participants had mercury blood levels that ranged up to 10 micrograms per liter, as might be expected to be found in the general population.

4.4.4 DOE-funded Monitoring and Sampling

Through its subcontractors, DOE funds all of the monitoring and sampling that is relied upon by the state of Tennessee, CDC, and ATSDR in their evaluations. Although this arrangement may make sense to Congress in terms of funding decisions, it creates the appearance of conflict of interest. Not only do DOE-funded subcontractors do the monitoring and sampling, but DOE also provides funding through grants and other financial arrangements to the state and federal governmental agencies that are responsible for performing work associated with the ORR, as well as for the groups that provide oversight of these activities.

DOE is required to publish its monitoring results annually in a "Remediation Effectiveness Report." DOE also publishes an Annual Site Environmental Report (ASER). In addition, there is an annual *State of the Creek* address where EFPC monitoring results are presented to the public by Dr. Jim Loar, an ORNL scientist. The following sections provide ATSDR's assumptions (as reported in the Health Consultations) regarding DOE's sampling results.

4.4.4.1 Soil and Sediment

According to the 1993 ATSDR Health Consultation on Y-12 chemical releases into EFPC, soil samples were taken from three transects across the creek in the NOAA and Bruner sites known to be contaminated with mercury. This information is based on the EFPC Remedial Investigation.[78] Six locations (three on each side of the creek), were sampled at 20-meter intervals along each transect. Composite soil samples (also referred to as homogenized samples throughout this report) were collected from 0- to 12-inch depths (Phase I only) at each location along the transects. Nine sediment samples were collected along the EFPC bottom from Y-12 to the confluence of Poplar Creek. Elevated levels of mercury were found in a few soil and sediment samples from all three areas. The concentration ranges of contaminants in sediment and soil from all three locations are provided in the ATSDR Health Consultation. According to ATSDR, a mercury

[78] "East Fork Poplar Creek – Sewer Line Beltway Remedial Investigation Report," Prepared by SAIC for Radian Corp. and submitted to the DOE, April 1993.

speciation study of the EFPC flood plain soil showed the distribution of mercury to be 84-98 percent inorganic (mercuric), 3-8 percent elemental, and 0.003-0.01 percent organic (methylmercury).

4.4.4.2 Groundwater and Surface Water

ATSDR reported in the 1993 ATSDR Health Consultation on Y-12 chemical releases into EFPC that *groundwater* at twenty-two shallow monitoring wells (5-15 feet deep) along EFPC was sampled quarterly until remediation at EFPC was completed. ATSDR also provided in its report the concentration ranges of contaminants in the shallow groundwater along EFPC. ATSDR indicated that information on the geologic and hydrogeologic characteristics of the creek, survey data on groundwater use along the creek, and private well water sampling data were not provided to them. Nevertheless, ATSDR concluded there was no apparent health risk for residents because there was no evidence that groundwater from shallow aquifers along the creek is used for domestic purposes. Most Oak Ridge residents use the municipal water system, which receives raw water from the Clinch River (Melton Reservoir) upstream of the DOE reservation. Five grab *surface water* samples were collected from EFPC and contaminants found were not at levels of public health concern.

4.4.4.3 Air

In the 1993 ATSDR Health Consultation on Y-12 chemical releases into EFPC, ATSDR indicated it evaluated a summary of ambient air data from the EFPC Remedial Investigation. The data reviewed was comprised of air samples taken from three flood plain locations (i.e., NOAA, Lysimeter, and Minit Chek) with known mercury soil contamination of up to 3,000 milligrams per kilogram. The ATSDR Health Consultation reports the data as not being at levels of public health concern. ATSDR also referenced the document, “Mercury in Ambient Air Over Flood Plain of East Fork Poplar Creek” (1992 DOE).

4.5 EPA CONCERNS AND COMMENTS (Y-12 URANIUM PHA)

EPA operates under approximately 12 major statutory authorities. Its mandates and mission requires them to assume a leading national role in all areas relating to radiation and chemical exposures and potential health effects. One of the most important authorities of EPA’s Office of Radiation and Indoor Air (ORIA)—often referred to in this report as EPA-HQ—is to advise the President and other federal agencies on all matters relating to radiation protection. This includes issuing Federal Guidance, signed by the President, regarding radiation dose limits that other federal agencies must consider when setting up their radiation protection guidelines or regulations. ORIA also gives technical assistance upon request to the Regional offices such as EPA Region IV.

ORIA reviewed the ATSDR PHA on Y-12 uranium releases. The principle reviewers of that ATSDR document were: Lowell Ralston (Ph.D.), Neal Nelson (Ph.D., DVM), Jerome Puskin (Ph.D.), Anthony Wolbarst (Ph.D.), and David Pawel (Ph.D.). The

information in the following sections was obtained by the author of this report, Susan Arnold Kaplan, from communications with Ralston prior to the June 2004 ORRHES meeting. Ralston generated detailed responses to a list of questions generated by Kaplan and others, which were provided to EPA (both Region IV and ORIA) and ATSDR in preparation for that meeting. However, despite repeated requests by Kaplan and other ORRHES members, these detailed responses were never distributed to the entire Subcommittee. ATSDR only distributed to ORRHES members the parts below that are in italics, which were provided by Region IV.

4.5.1 Current and Past Exposures

Question: "Does EPA accept ATSDR's written responses to their comments as published in the final Y-12 PHA on uranium?"

EPA Region IV Response: Yes, EPA believes that ATSDR's responses adequately address issues raised in the comments and explain the differences between EPA risk assessment and the ATSDR screening health assessments. EPA's ORIA office would have preferred a more rigorous assessment of past exposures, using **quantitative** uncertainty analysis, but agrees the final doses do not constitute an apparent public health hazard.

ORIA Response: With respect to **current** exposures in Scarboro only, ORIA indicated in written communications with Kaplan that it agrees with EPA Region IV and ATSDR that present day concentrations of uranium isotopes in soil and air samples are within the range of normal background levels and as such, pose no current health hazard (concern) to Scarboro residents, regardless of how well ATSDR's responded or not to our detailed comments on this subject.

With respect to **past** exposures in Scarboro and in other communities comprising the city of Oak Ridge, ORIA does not believe that ATSDR's responses to their concerns adequately address the key issues raised. Specifically, ORIA does not accept the following ATSDR assumptions:

(1) ORIA does not accept that Scarboro is a suitable reference location for assessing past exposures to all Oak Ridge residents (i.e., ATSDR assumes that Scarboro represents the worst case, and that all other Oak Ridge communities were less impacted).

ATSDR considered health effects for Scarboro residents only, and provided no additional data or information to support conclusions about past uranium exposures or potential health effects for residents in other Oak Ridge communities or neighboring communities. ORIA believes this is a major gap in ATSDR's analysis. In the Oak Ridge Health Studies (1991-1999), investigators performing dose reconstructions for I-131 releases from X-10, mercury releases from Y-12, and PCB releases from Y-12 evaluated exposures and estimated health risks to residents in several city locations (e.g., Scarboro, EFPC floodplain) and in Wolf Valley. In addition, historical environmental survey data (1959-1971) for off-site

releases of ORR contaminants indicate that uranium concentrations in air, soil, biota, and surface water may have been higher in other Oak Ridge communities compared to Scarboro. For these reasons, ORIA believes that ATSDR should include other Oak Ridge communities in its assessment of past uranium releases from the Y-12 Plant.

(2) ORIA does not accept that the screening-level assessment performed by the Dose Reconstruction Task 6 team and adopted by ATSDR to produce a single point estimate of total past dose (i.e., 155 mrem/70 years) is sufficiently rigorous to support conclusions about past exposures and long-term health effects (cancer risks and kidney toxicities) for Scarboro residents or for any other Oak Ridge residents.

The Task 6 Level II screening analysis, which ATSDR adopted for its assessment of past uranium releases in the PHA, was based on exposure assumptions for a typically exposed adult and was intended solely as a method to decide if uranium releases from Y-12 required further detailed evaluation, i.e., a dose reconstruction. It was never intended to be used or interpreted as a comprehensive, definitive estimate of health risks in Scarboro or any other Oak Ridge community. Because the result of the Task 6 Level II screening analysis (cancer risk – $8x10^{-5}$) was only slightly below the ORHASP decision guide of $1x10^{-4}$, the Task 6 team and ORHASP provided several recommendations (such as quantitative uncertainty analyses, additional soil sampling, and atmospheric tracer studies) to improve the quality and scope of the uranium screening analysis **before** it could be used to estimate past exposure and health risks. For these reasons, ORIA believes that ATSDR used the Task 6 Level II screening analysis improperly. Therefore, ORIA believes ATSDR should implement the Task 6 and ORHASP recommendations and provide a more comprehensive assessment (with uncertainty bounds[79]) of the health risks from past uranium releases from the Y-12 Plant (i.e., a dose reconstruction). In its final report, ORHASP stated that dose reconstruction was necessary because it believed that no single estimate of dose or risk was adequate enough to account for the complexities associated with

[79] ATSDR appears to be avoiding the use of uncertainty analysis in Oak Ridge despite the fact that the use of quantitative uncertainty analysis to express the limits of credibility in any exposure or risk value is endorsed by EPA's Science Advisory Board and the National Academy of Sciences (NAS). The use of such an analysis in the face of uncertainty makes decisions based on the upper confidence limit, not a single central value (or average) that ignores uncertainty—as ATSDR has proposed to do in Oak Ridge. The use of the upper confidence limit shows how bad things could have been, but because ATSDR focuses instead on the limits of epidemiological detection, the agency makes decisions at the lower bound of the confidence interval. [Note that nowhere other than with radiation at Federal facilities does ATSDR use the limit of epidemiological detection in human populations as a surrogate for a limit of public health concern.] The use of uncertainty analysis is described in the National Council on Radiation Protection and Measurements (NCRP) Commentary No. 14 (1996), NCRP Report No. 26 (1997), EPA's Guidance Document on Probabilistic Risk Analysis (2002), International Atomic Energy Agency (IAEA) Safety Series No. 100 (1989), and many other texts and articles. The use of Monte Carlo procedures to propagate state of knowledge probability distributions into a 90% or 95% credibility interval for the final result (exposure, dose, and risk) is now standard procedure. Uncertainty analysis using this approach has been conducted in dose reconstruction at Hanford, Fernald, Rocky Flats, Savannah River, Idaho Falls, Oak Ridge, and LBNL. Uncertainty in radiogenic cancer risk has been quantified using this approach by the National Cancer Institute (NCI), EPA, NCRP, SENES Oak Ridge, Inc. Risk Analysis Corp. at Rocky Flats and Savannah River. Uncertainty analysis using statistical and subjectively derived probability distributions is the basis for probability of causation estimation in the Interactive Radioepidemiological Program (IREP). This program has been legally mandated by Congress for use in determining the eligibility for compensation of radiation worker claims for DOE and the Atomic Veterans. In this case, the upper 99th credibility limit of the distribution of the probability of causation is used for decision making, not the central value. ATSDR rejects IREP, stating that it is used mainly for compensation of claims, which shows they have not yet realized that it is at the present the most advanced methodology for quantifying the uncertainty in radiogenic cancer risk.

reconstructing past releases and exposures, and the uncertainties in estimating health effects. ORIA agrees with ORHASP.

(3) ORIA does not accept that the screening level assessment was based on conservatively biased assumptions.

ATSDR claims that the Dose Reconstruction Task 6 team repeatedly used overly conservative exposure assumptions in its screening-level assessment, and for this reason, ATSDR dose estimate is biased conservatively. ORIA disagrees. In their written comments, ORIA provided several examples where specific exposure assumptions for inhalation rates, exposure times, indoor/outdoor concentration ratios, and plant and fish consumption rates are at or below average values cited in the literature. In other words, many of the values are not conservative. The Task 6 team identified only one conservative assumption in its Level II screening analysis for uranium: the use of the average total uranium concentration measured in EFPC sediment in 1980 (i.e., 26 picocurie per gram, pCi/g) as a surrogate for the average uranium concentration in soil at Scarboro which, at that time, had not been measured. ATSDR contends that, based on current measurements of total uranium concentration in Scarboro soil (i.e., ~2 pCi/g), the past exposures have been substantially overestimated. While ORIA agrees the use of the 1980 EFPC sediment data was a conservative assumption, ORIA disagrees with ATSDR's contention that past exposures have been substantially overestimated for two reasons. First, the Task 6 team performed a sensitivity analysis which showed that, when they reduced the total uranium soil concentration from 20 pCi/g to 2 pCi/g (i.e., by a factor of 10 or ~100%) and recalculated their results, the screening index for all exposure pathways dropped by only ~40%, i.e., from a cancer risk of $8x10^{-5}$ to $5.1x10^{-5}$. They attributed this disproportionate decrease to the fact that the soil exposure pathways account for only about ~40% of the overall risk. Second, ORIA believes that the current Scarboro soil concentrations represent historical concentrations, which were likely to have been higher in the past when peak releases from Y-12 occurred. For these reasons, ORIA believes that ATSDR should provide a better estimate of historical uranium concentrations in Scarboro and provide ranges of values (i.e., probability distribution functions (PDFs)) for all uncertain parameter values. ORIA believes ATSDR should use the revised soil estimates and PDFs in quantitative uncertainty analyses to capture the full range of past exposures and health risks. (See Footnote 80.)

(4) ORIA does not accept that quantitative uncertainty is unnecessary, based on ATSDR's interpretation of the guidance provided in National Council on Radiation Protection and Measurements (NCRP) Commentary No. 14.

ATSDR contends that, based on their interpretation of NCRP Commentary No. 14 guidance, they are not required to perform uncertainty analyses, citing two reasons, namely, that their screening analysis was biased conservatively and that their resultant total dose estimate was far below their evaluation criteria. ORIA disagrees with ATSDR's contention because: (1) ORIA does not believe that the

screening analysis was biased conservatively (see Item 3 above), (2) ORIA does not believe that ATSDR's evaluation criteria are protective (see Item 5 below), and (3) ORIA does not believe that the NCRP "guidance" mandates that ATSDR not perform uncertainty analyses. Rather, ORIA believes that ATSDR's assessment of past exposures from Y-12 uranium releases, with all of its data gaps, uncertainties, and incomplete analyses, is a good example of when the NCRP guidance should not be followed. In fact, ORIA believes that ATSDR *should* conduct quantitative uncertainty analyses, consider all Oak Ridge communities, and present central estimates and 95% confidence intervals for cancer risks and Hazard Index scores for non-cancer effects. (See Footnote 80.)

(5) ORIA does not accept that ATSDR's radiation cancer risk policy and their evaluation criteria are appropriate and protective.

ORIA disagrees with ATSDR's policy not to calculate cancer risks for radionuclide intakes. Not only is it inconsistent with current EPA and ATSDR policies for chemical carcinogens, but is also inconsistent with current national and international radiation protection policies that are based on a linear, no-threshold (LNT) extrapolation of radiation doses and risks below epidemiological detection limits. All EPA, DOE, and Nuclear Regulatory Commission (NRC) radiation protection regulations derive from the LNT hypothesis. ORIA also disagrees with ATSDR's MRL of 100 mrem/year for radiation-induced, non-cancer effects and with its 5,000 mrem 70-year lifetime effective dose limit for cancer risks. The former is an ad hoc value which is unsupported by the scientific literature and is inapplicable for chronic, low-dose exposures such as those from present or past Y-12 uranium releases. It *should not* be used. The latter criterion, 5,000 mrem/70 years, is another ad hoc value which represents ATSDR's judgment regarding "observable" or statistically significant cancer risks caused by total body radiation exposures. [80,81]

---

[80] The use of 5,000 mrem (i.e., 5 rem) over 70 years has been a highly controversial issue within ORRHES, especially as it pertains to internal emitters that primarily affect single organs. For example, according to SENES Oak Ridge Inc. Center for Risk Analysis, at an effective dose of 5 rem, the thyroid would receive 100 rem if exposures were due to the ingestion or inhalation of I-131. The skin would receive 500 rem if exposure were received primarily from external beta irradiation. Such doses are clearly above levels known to induce excess cancers in exposed populations, especially if such exposures were to occur to children. Note there is no other known carcinogen for which ATSDR uses the limits of epidemiological detection as a surrogate for a safe level of human exposure. For chemical carcinogens, ATSDR uses the EPA risk estimates for initial screening, which are based on upper confidence limits of the dose response. Therefore, many are perplexed as to why such exceptions are being made by ATSDR for radiation, other than the fact that the annual exposure from background radiation is on the order of a few hundred millirem effective—and most of this is from radon, the second leading cause of lung cancer. The health risk associated with inhalation of uranium oxide at a level that would give an effective lifetime dose of 5,000 mrem was independently examined by SENES Oak Ridge, Inc., which estimated the upper bound of a 90% credibility interval would exceed 1 chance in 100 of lung cancer if uranium oxide were to be inhaled at a rate that would produce 42 rem to the lung. This lung dose would translate into a lifetime effective dose of 5,000 mrem, using the appropriate ICRP tissue weighting factor of 0.12. That risk estimate, however, is based on the absorbed dose to the lung (i.e., 2.1 cGy) as opposed to the tissue equivalent dose for high linear energy transfer (LET) radiation (i.e., 42 rem). The SENES risk estimate was calculated using algorithms in IREP for alpha radiation inhaled chronically at low doses and multiplying the Excess Relative Risk by the cumulative background incidence rate for an unexposed population. Note that Dr. Charles Meinhold provided an independent review of the ATSDR radiogenic cancer screening criterion of 5,000 mrem effective dose (averaged over a 70-year lifetime). His comments are provided in Appendix 1-6.

[81] The Health Physics Society (HPS) has proposed a controversial recommendation that risk below 5 rem in 1 year, or 10 rem per lifetime, only be discussed in "qualitative terms." However, some believe the HPS is proposing to essentially censor quantitative information that would reveal the large discrepancy between cancer risk levels assumed to be acceptable for radiation and those assumed acceptable for all other known chemical carcinogens. Many believe there is no reason why risk cannot be quantified at any

Since this limit is based on committed effective dose, individual organ doses would be several times higher, depending on their radiation weighting factors. This criterion corresponds to a lifetime excess cancer incidence risk of approximately four chances in 1,000 or $4x10^{-3}$, which is slightly over 10 times higher than EPA's upper-limit for acceptable cancer risks, and 40 times higher than the decision guide ORHASP used in the Oak Ridge Health Studies. Moreover, ORIA objects to ATSDR's inaccurate comparison of its criterion—presented in another form as 71 mrem/year (i.e., = 5,000/70)—with the International Commission on Radiological Protection (ICRP) and NCRP limit of 100 mrem/year for exposures of members of the general public. Contrary to ATSDR's claims, the 100 mrem/year limit applies to all radiation sources (except background and medical) and all pathways—not just to a single source—like uranium releases from Y-12. Moreover, it requires that all exposures be justified and kept as low as is reasonably achievable (ALARA) below the limit. In other words, 70-year lifetime exposures at the limit (i.e., 100 mrem/year x 70 years = 7,000 mrem lifetime) are unacceptable. With this in mind, all federal environmental standards for individual radiation sources or practices are set at a level that is a fraction of the 100 mrem/year limit, e.g., NRC's 25 mrem/year limit for site decommissioning and EPA's 10 mrem/year limit for radionuclide airborne releases under the Clean Air Act. For these reasons, ORIA believes that ATSDR's radionuclide risk policy and evaluation criteria are *not protective* and *should not* be used to evaluate past exposure from Y-12 uranium releases.

Cancer and kidney toxicity are the only long-term health effects anticipated for chronic exposures to uranium isotopes. Therefore, with respect to radiation carcinogenesis, ORIA believes that estimates of potential health effects from uranium exposures should be expressed in appropriate terms, i.e., *lifetime risk* of excess fatal or total cancer (i.e., cancer mortality or incidence). For regulatory purposes, EPA, NRC, and DOE use committed effective dose or total effective dose (which employ risk-weighted values) to demonstrate compliance with dose-based standards. However, dose standards must be "translated" from dose to cancer risk using a single dose-to-risk conversion factor. Such an approach does not provide a good estimate of cancer risks for many internally deposited radionuclides. While dose limits and dose conversion factors work generally well for regulating occupational exposures, they are not EPA's preferred approach for estimating cancer risks associated with environmental exposures. [82]

---

dose, provided that uncertainties are also disclosed. If the recommendations of this new HPS position statement were abided by, many former DOE and contractor workers diagnosed with cancer who were exposed during their period of occupational work history would be ineligible for compensation and medical care as quantitative risk estimates that lead to an estimate of the probability of causation would not be produced.

[82] ATSDR chose to present the data in the Y-12 PHA on uranium in terms of dose rather than risk despite a majority vote by ORRHES to approve making a recommendation to ATSDR to present the data in terms of risk as well. However, the highly controversial requirement for a 2/3 majority for major ORRHES votes resulted in this recommendation being "defeated." Note that ORRHES is the only Health Effects Subcommittee that operates (or has operated) under this 2/3 majority requirement.

(6) ORIA does not accept that exposures of Oak Ridge residents to other ORR contaminants (i.e., I-131, mercury, PCBs, and radionuclides released to White Oak Creek) should be addressed individually in separate evaluations or not considered at all.

ORIA believes that ATSDR should present the cancer risks and non-cancer health effects from past uranium exposures in context with the health risks from concurrent exposures to I-131, mercury, PCBs, and radionuclides released to White Oak Creek, as was done in Oak Ridge Health Studies. Since 1944, residents of the city of Oak Ridge and surrounding communities have been exposed simultaneously to multiple contaminants released from ORR. Long-term health risk can only be put into perspective if these exposures are addressed collectively and not individually.

(7) ORIA does not accept how ATSDR ruled out uranium contamination from airborne releases from Y-12 based on previous aerial radiation surveys.

ORIA believes that ATSDR should account for the bulk of airborne uranium released from Y-12 in the past. Aerial radiation surveys are incapable of detecting environmental concentrations of depleted or enriched uranium, because the X- and gamma ray photons emitted by U-235 and U-238 are not abundant and are of low energies. Moreover, detection of the primary U-235 photo-peak is complicated by interference by a similar photon from Ra-226. For these reasons, ORIA believes that additional soil sampling in and around Oak Ridge and nearby communities is necessary to determine the fate and transport of the bulk of uranium released from Y-12.

4.5.2 Emphasis on Scarboro Alone

Question: "What are EPA's feelings on the emphasis on Scarboro alone in the Y-12 PHA as opposed to other areas of the community that could have been impacted by airborne plumes from Y-12?"

EPA Region IV's Response: EPA believes any uncertainty on the appropriateness of using Scarboro to represent off-site uranium releases from Y-12 can be addressed with the Preliminary Assessment/Site Investigation [PA/SI] for the City of Oak Ridge and Surrounding Communities, scheduled for 2006, and included in DOE's milestone commitments listed in the Federal Facilities Agreement (FFA). See FFA Appendix E page E-7: http://www.bechteljacobs.com/ettp_ffa_appendices.shtml).

ORIA's Response: See #1 of the previous section.

4.5.3 Technical Rigor

Question: Is the technical rigor of the ATSDR PHA on Y-12 sufficient?

EPA Region IV's Response: It is recognized that the purpose of a screening Health Assessment is more qualitative than a quantitative risk assessment. ATSDR's Y-12 PHA is a screening health assessment, and by design, addresses uncertainties qualitatively.

ORIA's Response: The rigor with respect to the assessment of *current* exposures is sufficient. However, it is not for *past* exposures. ORIA believes that ATSDR should conduct quantitative uncertainty analyses, consider all Oak Ridge communities, and present central estimates and 95 percent confidence intervals for cancer risks and Hazard Index scores for non-cancer effects.

4.5.4 Need for Additional Community Sampling

Question: "Does EPA believe additional sampling is needed in Oak Ridge? If so, discuss the need for a sampling program that includes other contaminants of concern besides uranium and that includes not only the areas potentially impacted by Y-12 (e.g., Woodland, Union Valley, etc.), but also areas potentially impacted by X-10 and K-25?

Region IV's Response: Data needs will be determined during the planning of the PA/SI, between DOE, EPA, and the State. The FFA PA/SI milestone commitment includes surrounding communities.

ORIA's Response: Yes, additional sampling is needed. However, at this time, ORIA believes that it would be premature for us to comment on a detailed sampling plan. Such a plan requires additional information (such as complex air dispersion modeling and historical environmental sampling data) to identify target sampling locations, contaminants of concern, sampling and analysis protocols, detection limits, etc., which does not currently exist. It would also have to be fully reviewed, vetted, and approved before being implemented. That said, ORIA would suggest that any new sampling plan should consider overcoming the limitations of previous sampling activities in Scarboro (DOE/FAMU 1998, EPA 2001). These limitations included surface soil samples only, lack of sufficiently sensitive techniques for quantifying uranium isotopes, and lack of appropriate background locations for comparison to natural levels. All areas within range of Y-12 and K-25/S-50 uranium airborne releases should be considered in this plan.

One-meter-deep core sampling coupled with ICP-mass spectrometry (or equivalent/superior methods) should be sufficient to answer questions about current and historical levels of uranium isotopes (and several other priority contaminants released from Y-12, e.g., mercury, Tc-99, arsenic) in soils. These data, in turn, may be used to estimate current and past exposures.

4.5.5 EPA's Presentation to ORRHES

ORRHES members attempted to get EPA ORIA to the table to publicly discuss their concerns regarding the Y-12 PHA on uranium releases for practically a year before they succeeded in getting ATSDR to agree to allow the agency to speak to the advisory panel. This group had to work outside the ORRHES process to finally get EPA-HQ's participation. EPA ORIA scientist Dr. Lowell Ralston and other ORIA staff were allowed to attend the June 8, 2004, ORRHES meeting. This meeting was the first time EPA's technical concerns regarding the PHA had been publicly discussed. The minutes of this highly controversial meeting are available at www.atsdr.cdc.gov/HAC/oakridge/. and a video tape of this meeting is available from ATSDR.

However, ATSDR did not place Ralston (or any other ORIA reviewer) on the agenda to speak despite the fact he was the expert the group most wished to hear. Although not on the agenda, Ralston fielded practically all of the technical questions. Ralston had come prepared to give a detailed presentation, but was not allowed to formally present, and ORRHES was not provided hardcopies of his overheads. However, because of pressure from some ORRHES members, Ralston was later allowed to provide an electronic copy of his overheads.

The information in the following sections was taken from Ralston's overheads, which he provided electronically to ORRHES soon after the June meeting. The author of this report also requested that detailed written responses to the list of the questions provided in advance to EPA be provided to ORRHES members, but those responses had not been received as of November 24, 2004. However, permission was granted by EPA to use those responses in this report (see Section 4.5).

4.5.5.1 General Comments

- To improve estimates of historical uranium releases from Y-12, the Dose Reconstruction Task 6 team recommended:

  ⇒ Additional searching for and review of effluent monitoring data for Y-12 electromagnetic enrichment operations from 1944 to 1947 and data relating to releases from unmonitored depleted uranium operations in the 1950s through the 1990s (Rec. #2),

  ⇒ Uncertainty analysis of the Y-12 uranium release estimates. (Rec. #3)

- The Dose Reconstruction reviewers had three principal recommendations for improving the quality of the uranium report in preparation for using it in public health decision-making:

  ⇒ *Add/improve uncertainty and sensitivity analyses.* Three reviewers indicated that more work needs to be done to characterize the extent and significance of the lack of knowledge pertaining to past uranium exposures in the Oak Ridge

area. As a guide, one reviewer suggested that future investigators develop probability distribution functions, develop reasonable estimates to fill in gaps in release data, and perform a sensitivity analysis to evaluate how uncertainty in the study's input data creates uncertainty in the study's output. One reviewer also recommended that uncertainty calculations be done separately for systematic and random errors.

⇒ *Develop dynamic models to further characterize the fate of past uranium releases.* Two reviewers emphasized the need to measure uranium concentrations in *core* samples of soil from the Oak Ridge area. These measurements should be part of a broader research effort aimed at identifying how uranium has moved through the Oak Ridge environment after its release. For example, one reviewer asked future investigators to determine where and by what means past releases of uranium have accumulated. Another reviewer emphasized that most such analyses would have to make use of *dynamic* (as opposed to equilibrium) models. This is because ORR uranium releases prior to 1974 varied significantly from year to year and cannot be properly modeled with equilibrium models.

⇒ *Continue searching for site-specific historical information.* One reviewer suggested that investigators collect additional site-specific information about the Oak Ridge area, such as information about the agricultural practices common there during the period in question. The reviewer also suggested that investigators continue to attempt to uncover additional archival information relating to uranium releases from ORR.

- ORIA concurred with all Task 6 and ORHASP recommendations and also recommended that,

  ⇒ Assessments of past uranium exposures, doses, and risks be expanded to include all residents of all City of Oak Ridge and nearby communities.

  ⇒ The cancer and non-cancer health risks from past uranium exposures be present along with the health risks due to concurrent past exposures to I-131, mercury, PCBs, and radionuclides from White Oak Creek.

4.5.5.2 Air Pathway

- ATSDR's assessment is not a comprehensive analysis of all uncertainties associated with past intakes, doses, and health risks for the air exposure pathways due to historical airborne releases of uranium from Y-12.

- ATSDR's estimation of historical uranium air concentrations:

  ⇒ Excludes the U-238 measurement and release data (1986-1995) which are more uncertain than the U-234/U-235 data;

⇒ Ignores the error terms in the measurement data and the uncertainties and data gaps in the release data for all uranium isotopes;

⇒ Is based only on 10 years of available air monitoring data from Scarboro,1986-1995, during which time the releases from Y-12 were considerably lower and more uncertain than in earlier years (1944-1985);

⇒ Does not account for the fact that past airborne releases of uranium occurred in different buildings and locations at the Y-12 facility—in other words, reconstructed historical air concentrations in Scarboro based on current data may not be valid;

⇒ Has not been validated using alternative methods, e.g., complex-terrain air dispersion modeling, atmospheric tracer studies, and comparisons with historical environmental survey data from other air stations); and

⇒ Does not provide estimates of uranium air concentrations from Y-12 airborne releases in other City of Oak Ridge or neighboring communities.

- ATSDR's (and the Task 6 Level II) assessment of past uranium intakes, doses, and risks for the air exposure pathways:

⇒ Applies to adults only;

⇒ Uses single values (without uncertainty bounds) for U-234+U-235 and U-238 air concentrations, which are averages of the *reconstructed* air concentrations over the 52-year exposure interval;

⇒ Does not address higher exposures during the years of peak releases (1954-1964);

⇒ Underestimates intakes, doses and risks for the inhalation pathway for a "typical" adult by a factor of 3.5:

  - The Task 6/ATSDR assessment assumes a daily on-site exposure time of 9.6 hours (indoors only) and an indoor-to-outdoor shielding factor of 0.3 for brick houses (i.e., indoor uranium air concentration is assumed to be only one-third as much as outdoor concentrations).

  - For residential exposures, EPA's *Exposure Factors Handbook* recommends 50th percentile values of 16.4 hr per day indoors and 2 hr per day outdoors (EPA/600/P-95/002Fc, August 1997, p.15-17).

  - Using EPA's average exposure times, an indoor shielding factor of 0.5 for wooden houses, and no shielding factor for outdoor exposures, ORIA

recalculated an inhalation pathway dose (122 mrem) that was 3.5 times higher than ATSDR's estimate (35 mrem).

- Does not provide estimates of uranium intakes, doses and risks for other residents of the City of Oak Ridge or neighboring communities.

- The Task 6 team recommended improving estimates of historical uranium air concentrations:

  ⇒ Evaluating the effects of the ridges and valleys that dominate the local terrain surrounding Y-12 and Scarboro and investigation of alternative approaches to estimate air concentrations at Scarboro with an emphasis on identifying additional monitoring data.

  ⇒ Evaluating the uncertainty associated with air concentrations would provide upper and lower bounds of confidence in the estimates. (Rec. #6)

- ORHASP recommended that:

  ⇒ DOE should undertake a program of measurements of atmospheric dispersion of controlled tracer releases from representative stacks and vents at Y-12. The primary goal of these measurements would be to define the transport of a non-depositing tracer from Y-12 to populated areas of Oak Ridge, including the Scarboro and Woodland communities that are both relatively close to the plant. (Rec. #4)

- The Task 6 team recommended improvements for the assessments of past uranium intakes, doses, and risks for the air exposure pathways:

  ⇒ Improve the exposure assessment to include region-specific consumption habits and assessments, and inclusion of uncertainty analysis to provide statistical bounds for the evaluations of risk. (Rec. #8)

  ⇒ Refine the chemical toxicity evaluation, possibly to include other approaches/models and an uncertainty analysis. (Rec. #9)

4.5.5.3 Soil/Sediment Pathway

- EPA ORIA agreed with ATSDR that the use of the 1980 EFPC sediment data is a conservative assumption for Scarboro assessments, but disagreed that past exposures to Oak Ridge residents have been substantially overestimated, for three reasons:

  ⇒ The Task 6 team performed a sensitivity analysis which showed that, when they reduced the total uranium soil concentration from 26 pCi/g to 2 pCi/g (i.e., by a factor of 10) and recalculated their results, their Level II screening

index for all exposure pathways dropped by only ~40%, i.e., from a cancer risk of 8×10^{-5} to 5.1×10^{-5}. They attributed this disproportionate decrease to the fact that the soil exposure pathways account for only ~40% of the overall risk.

⇒ Current Scarboro soil concentrations do not represent historical concentrations or U-234 and U-235 enrichment levels, which were likely to have been higher in the past when peak releases from Y-12 occurred.

⇒ The 1980 EFPC uranium sediment data may be appropriate for assessing past exposures to residents of other City of Oak communities, such as EFPC farm families, as was done for the Oak Ridge Dose Reconstruction analyses for mercury and PCBs.

- ATSDR's (and the Task 6 Level II) assessment of past uranium intakes, doses, and risks for the soil exposure pathways:

⇒ Applies to adults only;

⇒ Does not address higher exposures during the years of peak releases (1954-1964);

⇒ Uses several non-conservative parameter values, for example:

  - The assumed Level II consumption rate, 0.2 kg/d, is for vegetables only, not for vegetables and fruit, and is at the lower bound of the range of average values listed in EPA's *Exposure Factors Handbook*. Moreover, for the air pathway-component of the vegetable pathway, the actual daily intake of uranium-contaminated vegetables is actually far less, i.e., ~0.01 kg/d, when adjusted for the fraction of consumed vegetables assumed to be contaminated (0.2) and the fraction of contamination remaining on vegetables after washing (0.2), calculated as 0.2 kg/d * 0.2 * 0.2 = 0.008 or ~0.01 kg/d. Likewise, for the soil pathway-component of the vegetable pathway, the actual daily intake of uranium-contaminated vegetables is 0.04 kg/d, when adjusted for the fraction of assumed contaminated vegetables (0.2), calculated as 0.2 kg/d * 0.2 = 0.04 kg/d. The combined, adjusted rate (i.e., 0.01 + 0.04 = 0.05 kg/d) for home-grown vegetable consumption is small and probably underestimates historical intake rates for residents of Scarboro and other Oak Ridge communities who most likely consumed both home- and locally-grown vegetables and fruits contaminated with uranium during the years of peak releases from Y-12.

  - Meat and milk pathways are almost completely eliminated due to the use of non-conservative transfer factors and intake rates.

⇒ Does not provide estimates of uranium intakes, doses and risks for other residents of the City of Oak Ridge or neighboring communities.

- To improve estimates of historical uranium soil concentrations, the Task 6 team recommended:

⇒ Refinement of the approach used to evaluate surface water and soil-based exposure concentrations. This refined analysis could possibly involve shifting to a source term-based approach rather than one based on environmental measurements. This would include review of release estimates to assure that the release estimates used in the screening assessments were appropriate (Rec. #5)

- ORHASP recommended for:

⇒ DOE, EPA, the State (and perhaps other agencies) to undertake a coordinated program to obtain needed information and satisfy stakeholder concerns. A soil sampling program was deemed vital to gaining information relevant to the historic contamination levels in residential areas closest to the ORR plants. Detailed sampling was recommended in all of the most closely situated neighborhoods and also in a few residential areas at greater distances. ORHASP believed that decisions about additional dose reconstruction studies should be deferred until the results of the recommended soil sampling program were obtained and carefully interpreted. (Rec. #3)

- To improve assessments of past uranium intakes, doses, and risks for the soil exposure pathways, the Task 6 team recommended:

⇒ Improvement of the exposure assessment to include region-specific consumption habits and assessments, and inclusion of uncertainty analysis to provide statistical bounds for the evaluations of risk. (Rec. #8)

  - Refinement of the chemical toxicity evaluation, possibly to include other approaches/models and an uncertainty analysis. (Rec. #9)

4.5.5.4 Fish/Surface Water Pathway

- EPA ORIA agreed with ATSDR that the fish consumption rate may be a conservative assumption for Scarboro assessments, but disagreed that past exposures to Oak Ridge residents have been overestimated, for three reasons:

⇒ The assumed daily intake rate for fish caught in EFPC (4 g/d for both Level I and Level II assessments) is slightly less than the lower-bound of the range of mean daily intake values given in Table 10-84 of the *Exposure Factors Handbook (EFH)* for freshwater anglers (i.e., 5 - 17 g/d). Assuming a mean fish serving size of 129 g (*EFH*, Table 10-82) and an exposure frequency of

350 d/y (ChemRisk 1999, Table K-1), the Level II daily intake rate corresponds to ~11 servings per year of contaminated fish (i.e., 4 g/d * 350 d/y *129 g/serving), or about one meal of contaminated fish a month. Depending on the edible portion of the fish caught, it is conceivable that all 11 servings could come from only a few fish.

⇒ Higher fish consumption rates may be appropriate for assessing past exposures to residents of other City of Oak communities, such as EFPC farm families, as was done for the Oak Ridge Dose Reconstruction analyses for mercury and PCBs.

⇒ The Oak Ridge Dose Reconstruction analyses for mercury and PCBs included a range of higher intake rates for residents of Oak Ridge (including Scarboro) who consumed contaminated fish from Popular creek, White Oak Creek, and the Clinch River.

- ATSDR's (and the Task 6 Level II) assessment of past uranium intakes, doses, and risks for the surface water exposure pathways:

  ⇒ Applies to adults only;

  ⇒ Is based on a reconstructed, 52-year average uranium surface water concentration, without uncertainty bounds, that assumes natural isotopic abundances;

  ⇒ Uses several non-conservative parameter values for exposure times and intake rates;

  ⇒ Does not provide estimates of uranium intakes, doses and risks for other residents of the City of Oak Ridge or neighboring communities.

- To improve assessments of past uranium intakes, doses, and risks for the surface water exposure pathways, the Task 6 team recommended:

  ⇒ Improvement of the exposure assessment to include region-specific consumption habits and assessments, and inclusion of uncertainty analysis to provide statistical bounds for the evaluations of risk. (Rec. #8)

  ⇒ Refinement of the chemical toxicity evaluation, possibly to include other approaches/models and an uncertainty analysis. (Rec. #9)

4.6 ATSDR'S STATED POSITION

ATSDR's stated position[83] (for uranium only) has been to date that **no** further sampling or modeling data are required for the agency to make its decisions on public health implications of contaminants released from the ORR,

- Despite the recommendations made before ATSDR began its PHA process in Oak Ridge by the Dose Reconstruction Task 6 team, the Dose Reconstruction reviewers, and ORHASP,
- Despite repeated requests from area residents and ORRHES members, and
- Despite the recent recommendations by EPA ORIA, which are described in Section 4.5.

However, ATSDR has indicated they will be recommending further sampling for iodine. ATSDR's report on mercury is still in progress, so ITSPA does not know what recommendations will be made in this PHA.

4.7 DOE'S STATED POSITION

David Adler, Lead Environmental Scientist for DOE, indicated to ITSPA in January, 2005, that the agency will not simply rely on ATSDR recommendations. He indicated DOE will even listen to a single member of the public in regards to its future sampling plans for the community of Oak Ridge. Such sampling is specified in the Federal Facilities Agreement Appendix E – Other milestone. Note that this milestone was referenced by Region IV in its responses to ORRHES' questions regarding sampling.

[83] This position has been stated numerous times at ORRHES meetings, but was stated most definitively at the ORRHES Exposure Evaluation Work Group meeting on 11/15/04 by Public Health Assessors, Jack Hanley and Paul Charp, in response to a question by ORRHES member Susan Kaplan, the principle investigator for this study.

CHAPTER 5. IMPORTANT RELATED ISSUES

A number of important issues related to EFPC, Oak Ridge, and the region in general are discussed in this chapter. These issues are: (1) the meaning of "free use" of the creek (2) on-going releases to the creek, (3) a discussion of the confusion over what is considered contaminated and what is considered hazardous, (4) conflicts of interest, (5) questionable, censored, "classified"/reclassified, or the lack of data, (6) the lack of public knowledge, and (7) the lack of public trust.

1.1 WHAT'S THE MEANING OF "FREE USE" OF EFPC?

DOE officials indicate the creek has been remediated with the intent of "free use."[84] However, the creek remains posted by the state. Because of these contradictions of government positions, ITSPA believes the concept of "free" and "unlimited" use needs to be clarified for the public.

At the 2001 *State of the Creek* Address, the author of this report asked the presenter, Dr. James Loar, if it was acceptable to "swish" plants in the water before planting them as at least one property owner has been known to do.[85] His response was that all contact with the water is forbidden and this use of the creek is not allowable. At the 2002 *State of the Creek* Address, he affirmed his position that, because the signs say no water contact, the public should not come into contact with the water in any way.

However, this position makes it very difficult, if not impossible, for property owners to perform the tasks the city (i.e., Public Works Director, Gary Cinder) indicates they are responsible for performing[86] (see Section 1.3.1.1 for the question and answer). Fulfilling these responsibilities would put property owners in direct contact with the water and creek bank sediments unless proper safety precautions are taken and, unfortunately, Cinder did not inform the public how they could learn about performing such tasks safely in his response.

The ROD for LEFPC, which was signed by TDEC and the EPA in August 1995 and which initiated a 15-month timetable for initiation of remediation, states: "This remedy will result in remediation of hazardous substances that allows for *unlimited use of*, and *unrestricted exposure to*, the LEFPC Operating Unit."

---

[84] Personal conversations between ITSPA and Jason Darby (Water Restoration Manager) on 12/3/00 and David Page (former DOE Team Leader of the floodplain remediation project) on 8/21/02. Darby and Page both indicated to ITSPA the remediation of EFPC was intended to allow "free-" and "unrestricted-use" of the Creek. This is also stated in the ROD.

[85] Dr. James Loar of the Environmental Sciences Division (ESD) at ORNL gave the 2001 *State of the Creek* address (the first held in a public forum) at a meeting of the Oak Ridge Reservation Local Oversight Committee Citizens' Advisory Panel (LOC-CAP) on October 9, 2001. He gave the 2002 address to the public on Oct. 16, 2002, the 2003 *State of the Creek* address on 10/28/03, and the 2004 State of the Creek address took place on November 8, 2004.

[86] Ask Inky, *The Oak Ridger*, 5/24/02.

The ROD also states: "Remediation of the surface water in LEFPC can best be accomplished through the DOE Y-12 Environmental Restoration Program, and the continuing mercury releases will be regulated under the NPDES permit for the Y-12 Plant. Therefore, the *LEFPC surface water is not within the scope of this ROD*, but is discussed for informational purposes only."

Regarding groundwater, the ROD says: "Groundwater does not present an unacceptable risk to human health and the environment." However, it goes further to say: "If sufficient quantities of groundwater could be extracted from the shallow soil horizon (0-20 ft) for residential use, such groundwater *could pose an unacceptable risk*. However, because residential use of the shallow soil horizon (shallow) groundwater is not realistic, groundwater is not considered an unacceptable risk. DOE will monitor to detect any future residential use of the shallow groundwater."

5.2 ON-GOING RELEASES TO EFPC

During the *State of the Creek* addresses, Dr. Jim Loar of ORNL has consistently pointed out that future remedial actions and modernization activities at Y-12 could have short-term adverse effects on the health of EFPC. It also is important to note that accidental releases from Y-12 to EFPF still occur, although they are said to be small compared to past releases and, therefore, supposedly do not pose a public health concern.

One of the major reasons given by TDEC as the cause for no concern regarding such releases is the dilution factor introduced by the seven to eight million gallons per day flow rate of the EFPC (four million gallons of which come from diversion of water from the Clinch River), which DOE must maintain. However, during a tour of the creek (discussed in Section 7.1), ITSPA noted there did not appear to be much flow in the creek and asked TDEC the following question:[87]

> If a reasonable-sized, non-planned-for release occurred, could puddles of contaminants be left in areas of the creek bed that the normal day-to-day flow wouldn't normally reach? During ITSPA's tour, we noticed areas where creek bed was exposed because the flow was so low. So, if they have a spill, does DOE increase the flow to make sure they rinse away these puddles?
>
> *TDEC's Response:*
>
> "Flow is not increased to flush the creek of anything. The idea is to maintain as steady a flow as possible. In order for an unplanned release to create puddles that are then stranded from the normal flow would require an enormous quantity of liquid to be added to the creek, likely on the order of several hundred thousands of gallons in a very short period of time, probably a few minutes. A release of this magnitude would constitute an emergency and would be reported immediately. In addition, Lake Reality serves as a catch basin for just such a situation. If this

[87] All of ITSPA's questions and TDEC's answers can be found in Section 7.4.1.

much material is released then the creek would be diverted into Lake Reality and the water held there until the creek water returned to a fairly normal state. The NPDES permit for Y-12 requires that they maintain a flow rate of at least seven million gallons per day. With rain and other inputs, they usually exceed this and achieve between seven and eight million gallons per day. This may sound like a lot, but when you do the math it comes out to around 90 gallons per second. To visualize this, imagine two 55 gallon drums of water per second. In a creek the size of EFPC this will not appear to be very much."

One example of such an accidental release occurred on February 4, 2000, when wastewater exceeding the DOE Derived Concentration Guide (DCG)[88] values for uranium-238 and -234 was released from the Central Pollution Control Facility. The effluent, about 14,032 gallons of "mop water," was discharged through NPDES Outfalls 501 and 201 to the creek. The discharge was 1,400 picocuries/liter (pCi/l) for uranium-238 and 5,500 pCi/l for U-234.[89] The suspected cause was failure of the lime silo, which led to sodium hydroxide being substituted for the normally used lime slurry to control pH. However, the removal efficiency and difficulty in controlling pH was not recognized prior to the substitution and the process change resulted in significantly lower uranium removal. One of the contributing causes of the incident was reported to be inattention to detail because no analyses were performed to ensure the chemical being substituted would perform the same as lime.[90]

TDEC officials indicated to ITSPA (see Section 7.4.1) that sufficient dilution would have occurred in the creek to render this release harmless. TDEC also indicated that if a release was of sufficient magnitude that it was harmful, the Tennessee Emergency Management Agency (TEMA) would be immediately notified and emergency response procedures would go into effect.

Nevertheless, ITSPA remains concerned about the potential exposure to children who might be playing in the creek, and to property owners who might be performing the tasks required by the city, when discharges occur—even if they are not sufficient to be considered an "emergency." Because no system is in place for immediately and directly notifying property owners when releases to EFPC occur, these individuals cannot choose to avoid contact with the contaminants. ITSPA also is concerned about the potential for spreading contamination to their homes and other areas of the community as a result of releases.

---

[88] DOE uses DCG values as references for radiological environmental protection in accordance with DOE Order 5400.5, *Radiation Protection of the Public and Environment*. For water, DCG is the concentration of a radionuclide that, if consumed at a standard rate for one year, would result in an effective dose equivalent of 100 mrem. Sometimes a value lower than the DCG is used for radiological screening purposes. The screening value is equivalent to 4 percent of the DCG, which is the EPA accepted drinking water standard for radionuclides. Values exceeding this level warrant consideration for additional future monitoring and surveillance to ensure that releases are consistent with ALARA requirements of DOE Order 5400.5.

[89] The DCG limit for U-238 is 600 pCi/l and is 500 pCi /l for U-234.

[90] This is just one example of a more recent release. However, ITSPA does not have the resources to track all such releases, which are posted on a bulletin board at the local Tennessee Department of Environment and Conservation office. Unfortunately, this information is not made electronically available via the Internet.

5.3 WHAT'S HAZARDOUS?/WHAT'S CONTAMINATED?

The ill-defined issue of exactly what is considered hazardous and what is considered contaminated is illustrated in the pine-beetle incident described in Section 3.5.1). This incident was related in 2000 to ITSPA by an EFPC property owner and it shows one specific instance of an economic impact on a property owner. This incident prompted ITSPA to apply for the CMTA Fund grant to conduct this study.

5.4 CONFLICTS OF INTEREST

ITSPA and others are concerned about the inherent conflict of interest in having DOE—the entity responsible for the off-site pollution—as the source of funding for sampling and monitoring of this pollution by its contractors and TDEC. DOE also is the source of funds for the assessments of health impacts from its off-site releases, which are being performed by ATSDR through its PHA process.

As a result, questions have been raised about the credibility of existing data due to the conflicts of interest of the federal government and its contractors. In particular, it is at the managerial level of responsibility that ITSPA believes the conflict of interest becomes a most serious concern. Although the local scientists conducting studies are certainly highly capable and generally are thought to have a high level of scientific credibility and integrity, ITSPA has concerns about the managers and other decision-makers who oversee these scientists' work and/or who influence what information is passed on to higher levels of management and to the public. ITSPA is concerned about their influence both directly in what is published or indirectly through the classification or withholding of work considered to be politically sensitive. This is illustrated in Section 5.5.2.

ITSPA also is concerned that the conflict of interest issue carries over to the federal advisory panels, such as ORRHES, the Oak Ridge Reservation Environmental Management Site Specific Advisory Board (ORREMSSAB, also referred to as SSAB), and oversight groups such as the TDEC Oversight Division and the ORR Local Oversight Committee. ITSPA is particularly concerned about the participation of former contractor senior managers serving as voting members on advisory panels. They must consistently choose between defending the government's or contractor's position and representing the interests of the community.

Because of the reliance on DOE-generated and controlled data and the government's apparent reluctance to conduct a widespread sampling effort in the community, some members of the public believe the government must be afraid of what such a sampling program would reveal. Unfortunately, the U.S. government's conflict-of-interest in this matter fuels much of this distrust. Therefore, ITSPA believes a widespread soil core sampling and surface smear program having appropriate independent oversight is needed to win the public's trust again.

5.5 DATA: QUESTIONABLE, CENSORED, OR "CLASSIFIED"/RECLASSIFIED, OR LACK OF

Some of the existing Oak Ridge data is questionable and not credible with the public because of conflict of interest reasons or for technical reasons. If existing data becomes politically sensitive, it can be censored or "classified." However, in many cases, data simply does not exist or it is not being made available to the public. For example: (1) soil core sampling in off-site areas downwind of the DOE facilities and surface smear data throughout the community, (2) disease and birth defects registry data by census tract, and (3) community health needs regarding environmental exposures.

5.5.1 Lack of or Questionable Data

The lack of credible soil sampling and surface smear data throughout the Oak Ridge community and other downwind/downstream off-site areas affected by the three DOE facilities is an issue of major concern to a number of community members. ITSPA believes the lack of credible data greatly affects the quality of decisions now being made by ATSDR's public health officials regarding the impacts of releases from the ORR on residents in both the past and the present. It appears that fear of economic impacts on the city drive this absence of community-wide sampling.

ITSPA believes home owners' and city and DOE officials' fears of the economic impacts of the findings will likely prevent these kinds of sampling from ever occurring—unless some catastrophe occurs that makes it necessary. In 1984, Terry Cothran of the Tennessee Dept. of Health and Environment pointed out that a large part of residents' concern was not over health, but over economics, since housing sales were nearly at a standstill since the mercury revelations. Howard Zeller, then head of the Atlanta EPA office, agreed that the cleanup delay might hamper economic development, but could see no solution to it.[91]

Today, ITSPA believes that little has changed regarding the community members' feelings, except that they are even more averse to having bad news raised by community members and the media. Most community members simply wish for all the negative publicity to end so their housing values can rebound. In addition, many of the stakeholders who participated in the past or who participate today have grown old and have become tired of fighting, attending public meetings on their own time, etc. As a result, much of the city's institutional knowledge is being lost or not used.

Despite discussions regarding the need for community-wide credible data, the EPA, TDEC, and ATSDR are all relying on the extremely limited off-site soil data generated and/or funded by the government agency responsible for causing the problem. These agencies also are relying on modeling results thought by some to be insufficiently rigorous to effectively answer the questions that have been raised. This is important to understand, because the PHAs, which are now being performed by ATSDR and overseen

[91] "EPA Unhappy With Method Used In Environmental Sampling," *The Oak Ridger*, 11/2/84

by ORRHES, are underway and are expected to be issued next year without the additional sampling recommended by ORHASP and the reviewers of the dose reconstruction. In a decision that seems questionable to ITSPA, DOE is waiting for ATSDR to issue all of its PHAs before deciding if any additional sampling and modeling will be done. Unfortunately, because of these concerns, ITSPA believes it is likely that any ATSDR findings of no impact will not dispel the public's fear of living in Oak Ridge.

5.5.1.1 Lack of Soil Core Sampling and Surface Smear Data

Soil Core Sampling: The Oak Ridge real estate market has been particularly impacted by the public's negative perception of historical and current releases in the community. This negative perception continues despite the fact that a number of active Oak Ridge supporters and city officials strongly promote the position that the public's negative perceptions are based on false beliefs—i.e., that contamination is widespread throughout the community and at levels that represent a concern. See Section 3.2 for a discussion of the "Citizens Guide to Oak Ridge," which was written in 2002 by a group of Oak Ridge citizens.

ITSPA believes this negative perception is fueled by the lack of community-wide soil sampling and surface smear data. Most of the off-site sampling, in fact, has been done in the Scarboro community, and that sampling was only for surface soil (i.e., no core samples or surface smears). There are concerns that the off-site sampling in Scarboro was not representative of the community because that neighborhood was not the most affected area regarding exposures in the past. (See Section 4.5.2 for more information.) Unfortunately, no area-wide soil sampling has been done to confirm this assumption and, particularly, no sampling data of the areas downwind of Y-12 have yet been presented to the community. In ORRHES discussions, some references have been made to sampling data being generated at some point in the near future, but no sampling plan has been presented to the Subcommittee.[92]

Part of the concern about the residential areas of Oak Ridge arises from the gap in Pine Ridge, which runs between the Y-12 Site and most of the residential areas in Oak Ridge. In addition, some members of ORRHES have expressed concern about the lack of sufficient analysis and modeling of meteorological conditions on days of known high historical releases that could have affected how past releases traveled throughout the community. The following statement is from a summary of reviewers' comments on the Oak Ridge Dose Reconstruction for uranium: "The reviewer was somewhat puzzled by the report's use of meteorological conditions from 1987 to represent "average" weather.

[92] Because of the confusion on this matter, ITSPA attempted to get clarification from both TDEC and DOE. According to TDEC, CERCLA applies to all off-site decisions and DOE must submit a site investigation by 9/30/06. TDEC indicated the first step in the process is a Preliminary Assessment/Site Investigation, which they indicated will include some sampling. However, TDEC also indicated that DOE could determine that in-depth sampling is not required. In addition, TDEC pointed out there is no legal requirement for public input on this process, although they indicated that DOE likely will seek public input through the Site Specific Advisory Board. However, according to a recent communication with DOE (i.e., Pat Halsey, Environmental Management), DOE currently assumes that no further sampling will be required. She indicated this decision ultimately hinges on the report from ATSDR, which is called for in the Federal Facilities Agreement Appendix E - Other.

The reviewer suggested the report could be improved if 5-year meteorological averages were used instead."[93]

Surface Smear Data: Another concern regarding contamination in the residential parts of Oak Ridge pertains to *take-home contamination*. However, it appears there has been no widespread effort to check the region for take-home contamination of radioactive materials, chemicals, or other hazards such as beryllium. This is true despite the fact there are documented cases of materials being taken off the ORR, for example take-home contamination by workers, spills from rail cars (e.g., CSX Railroad), public auctions of surplus materials (e.g., Roscoe Fields and the David Witherspoon Superfund sites), releases from trucks to public roads, etc.[94]

Take-home contamination was the subject of a 1995 CDC study, which looks at possible take-home contaminants by industry.[95] See Appendix Table 1-7-1 for a summary of contaminants by industry, which is based on information from the CDC study. Appendix Table 1-7-2 summarizes potential illnesses and symptoms for various contaminants that were evaluated in the CDC study.

Unfortunately, records are inadequate to determine the extent of off-site contamination that has been taken home by local workers on shoes, clothing, or in cars. In 1990, when ORNL expanded its use of walk-through monitors to control contamination, three employees were found to be contaminated with radioactive phosphorus-32. One employee had contamination on his hands, pants, shirt and shoes. Further investigation revealed that the worker had taken home contamination on a lunch bag. Newspaper reports noted that increased use of monitors had turned up numerous incidents of contamination. Since 1943, thousands of workers have been in the presence of hazardous and radioactive materials on the Oak Ridge reservation. Daily, these workers would return home to families. Undoubtedly, some of them carried with them radioactive and other hazardous contaminants in clothing, on skin, and in lungs.[96]

---

[93] "Public Health Assessment for Y-12 Uranium Releases," Agency for Toxic Substances and Disease Registry, Appendix G, p. G-13, 1/30/04. (http://www.atsdr.cdc.gov/HAC/PHA/oakridgey12/y12a.pdf. Note: This web site does not provide the appendices. It is necessary to refer to the hard copy or the CD provided to ORRHES by ATSDR to access the Appendices.)

[94] "Accidents Bring $450,000 'Fine'," *The Oak Ridger*, 9/1/04. "The company that oversees environmental cleanup projects for the Department of Energy in Tennessee and Kentucky will lose about $450,000 due to safety problems - including two incidents that shut down public roadways. DOE's Oak Ridge Operations office is essentially fining Bechtel Jacobs Co. $250,000 for safety concerns associated with local cleanup work."

[95] "Report to Congress on Workers' Home Contamination Study," U.S. Dept. of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, September 1995.

[96] http://www.stopthebombs.org/y12/offsitecontamination.html

5.5.1.2 Questionable EFPC Core Sampling Data

The soil core sampling procedure used for EFPC sampling (i.e., Phase 1B sampling) used a controversial methodology to "homogenize" the sediment and soil samples. Unfortunately, this problem threatens the credibility of this massive effort. The preliminary sampling of EFPC and the potentially mercury-contaminated areas of the community was conducted by the Oak Ridge Associated Universities (ORAU) in the mid-1980s. The soil sampling conducted by ORAU was generally shallow surface sampling, although a few deep core samples were later taken and the fractions analyzed. However, fractionating a deep core sample and analyzing those fractions is much more expensive than analyzing a single "homogenized" sample. This is considered to be one of the main reasons that DOE decided to use the homogenization procedure.

ORAU did not perform the bulk of the EFPC sampling and analysis, which occurred during what is referred to as Phase 1A and 1B Sampling. These phases of work were conducted by SAIC, and the results are reported in the April 1993 document, "East Fork Poplar Creek —Sewer Line Beltway Remedial Investigation Report." There was some public discussion of sampling technique in 1984. "David Hopkins of EPA said that he was not suggesting that any agency involved in the investigation was conducting it improperly, just that not all agencies—there are seven agencies involved in the task force—are conducting it in the same way." [97]

Phase 1A activities, initiated in October 1990 and scheduled for completion early in 1992, explored the types of contaminants present in surface water, groundwater, soils and sediment in the area affected by EFPC. Researchers also installed monitoring wells along the creek and its floodplain to conduct extensive sampling of groundwater. Samples (114 12-inch core samples)[98] were also collected from 20 tributaries to the creek to determine if contamination was coming from sources other than the Y-12 Plant.

Phase 1B sampling consisted of taking 2,694 16-inch core samples (see Footnote 99) throughout the EFPC floodplain. Sampling was accomplished by establishing locations on a systematic pattern at 65 to 300 foot intervals and taking soil samples at those locations. The pattern was to extend to the edge of the floodplain that usually ranged from 100 to 400 feet from the creek, depending upon the exact location and scope of the land. The soil samples were taken by driving a tube into the ground and extracting a 16-inch section of soil. This left a 1-inch-diameter hole, which was to be filled in with replacement soil to remove any trace of disturbance. Sampling teams expected to recover 100 to 200 samples per day; therefore their presence was to be short-term in any particular part of the creek. Sediments within the creek were also collected for analysis. Ecological effects were assessed by sampling the flora and fauna associated with the floodplain.[99]

---

[97] "EPA Unhappy With Method Used In Environmental Sampling," *The Oak Ridger*, 11/2/84

[98] Provided in an email to the author (2/15/05) from Dr. Timothy Joseph, Senior Scientist DOE Oak Ridge Operations.

[99] *DOE* Fact Sheet "The Environmental Restoration Program for East Fork Poplar Creek", Summer 1991.

Phase IB sampling used a process referred to by DOE as "homogenization" whereby, after retrieving a subsurface core sample, technicians would place the soil or sediment into a metal bowl and mix or "homogenize" the material before placing it in sample bottles for shipment to the laboratory.[100] Therefore, instead of analyzing several small samples to determine the maximum level of contaminant present, a single blended sample was analyzed, which resulted in an average reading.

Homogenization threatens the credibility of this sampling effort. In fact, EFPC property owners wrote letters in June 1995 to DOE and other government officials protesting the use of this procedure, because it did not reflect the maximum mercury level found in the core samples. The following is a quote obtained by ITSPA during a personal interview of an EFPC property owner (see Personal Interview #4 in Section 7.3.3):

> "I felt that an end user, if they ever had a grievance, would not accept the 400 ppm because it was an average. And you don't live with averages." "If you're going to build a sidewalk or a road, you don't take 18 inches of soil and homogenize it. You dig down and say this is the level that I want my residential sidewalk going to my house. The soil there is black…you didn't have to test…you could cut a profile and see the black layer and it was usually 3 to 5 inches in depth. If the average was 1,600 ppm, how high was it really in that black layer? However, the government agents …said, "that's the protocol… that's the way it's written…that's the way you take samples."

The method preferred by ITSPA would have been an analysis of the soil strata that appeared visually to contain the highest levels of mercury—which was readily apparent from the appearance of the soil. A DOE official indicated to an EFPC property owner in 1995 that he had become experienced enough to estimate within 200 or 300 ppm the mercury concentration that would be revealed in the lab work simply by looking at the density of the black zone. This black substance was known to be associated with high levels of mercury in sediment as early as 1984. At that time it was unknown whether the "mysterious black substance" was "holding the mercury hostage and preventing it from spreading" and apparently research was underway to evaluate the substance. [101]

Unfortunately, the homogenization method selected by DOE significantly diluted the mercury and resulted in a much lower test result, which significantly reduced the amount of dirt to be removed. This, in turn, will have left in place soil with mercury at levels significantly greater than 400 ppm. ATSDR indicated in the 1993 Health Consultation that "long-term exposure to soil at this site containing mercury at concentrations of 1,010 ppm may result in body burdens of mercury that could result in

---

[100] "Second Sampling Phase Begins at EFPC," *DOE Environmental Update,* Fall 1991.

[101] "EPA Unhappy With Method Used In Environmental Sampling," *The Oak Ridger*, 11/2/84.

adverse health effects." [102] However, these calculations are currently being reevaluated by ATSDR. (See Section 4.3.1.7 for the equations and variables used in these calculations.)

5.5.1.3 Lack of Disease and Birth Defects Registry Data

Not only is there an absence of credible off-site soil core sampling and surface smear data, but there also is a disconcerting absence of disease and birth defects registry data for the state of Tennessee. The following is an attempt to show the progression of effort in this area in the state and Oak Ridge over the last decade.

In 1992, Congress established the National Program of Cancer Registries (NPCR) by enacting the Cancer Registries Amendment Act, Public Law 102-515. Public Law (1998 Code) was a Congressional mandate that reauthorized the National Program of Cancer Registries. It authorized the CDC to provide funds to states and territories to improve existing cancer registries and to plan and implement registries where they do not exist. It also provided CDC funds to help establish a computerized reporting and data-processing system.[103]

In December 1999, ORHASP issued its summary report recommending that the state continue to seek funding for a statewide birth defects registry.

Since the establishment of ORRHES in November 2000, disease incidence has been a major topic of interest for its members. ORRHES' ad hoc Cancer Incidence Work Group (recently made permanent as the Health Outcome Data Work Group) has consistently pointed out the need for a high quality disease incidence and birth defects registry that makes the data available to the community by census tract. However, in 2001 when ORRHES expressed interest in establishing a local disease registry, the group was told by ATSDR that the Hanford Health Effects Subcommittee had once passed a recommendation for ATSDR to establish a local disease registry, but that Congress passed legislation specifically prohibiting them from doing so.

In 2002 an article was published in a local newspaper regarding efforts to develop a nationwide system to track diseases as a result of the September 11, 2001, and other terrorist attacks.[104]

In 2003, Tennessee's cancer registry received a "D" and was ranked in the bottom three in a comparison of state registries performed by the non-profit organization, *Trust*

[102] http://www.atsdr.cdc.gov/HAC/PHA/efork1/y12_toc.html

[103] www.cdc.gov/cancer/npcr/amendmentact.htm

[104] "System to Track U.S. Disease Would be a Bargain," The Oak Ridger (reprinted from the St. Petersburg (Fla) Times), 8/27/92. This editorial pointed out that the U.S. has no nationwide tracking system for illnesses. It indicated the recent terrorist attacks on the U.S. have heightened the urgency of putting a nationwide tracking system into place. As a result, Congress has allocated $17.5 million for pilot projects in the 50 states, but estimates are it will take $300 million and many years to build a nationwide network.

for America's Health.[105] However, the group commended Tennessee for making strides in their efforts to track cancer. According to *The Nashville Tennessean*,[106] the only F was given to Mississippi. The disease-tracking report looked at the quality of information gathered by states on cancer cases, its application to other data, and the state's outreach to the public on the issue of cancer rates. Although the report notes that Tennessee has made strides in cancer tracking, it faulted Tennessee for failing to combine its data on cancer cases with other information on lifestyle, cancer screening and the environment. *The Tennessean* indicated that Tennessee's cancer registry is in its infancy compared with other states, but that it had implemented an enhanced cancer registry to spot trends and patterns in cancer cases in 2002. The registry does not effectively compare cancer rates with environmental and demographic data. *The Tennessean* indicated that properly linking information would allow the state to better target its cancer prevention efforts to at-risk populations and to help determine the causes of clusters of cancer cases that might have a common environmental source.

5.5.1.4 Lack of Community Health Needs and Concerns Documentation

An unresolved issue in Oak Ridge is documentation of community health needs and concerns regarding environmental exposures. ATSDR had originally planned to document them, but the agency has indicated to ORRHES it no longer plans to do so. Documenting community health needs and concerns is part of the ATSDR PHA process. In fact, according to the ATSDR *Guidance Manual*, documentation of the community's health needs and concerns is a prerequisite for follow-on epidemiology studies and other work related to community-specific health outcome studies, health education of doctors, etc. Therefore, ATSDR's commitment to Oak Ridge to conduct a Community Health Needs Assessment, in addition to a number of PHAs, before making any recommendations regarding the community is of great interest and importance to the Subcommittee and the community.

George Washington University (GWU) was hired by ATSDR in 2001 to produce the CHNA, which was to include a telephone survey of an eight-county region, to develop a list of "key informants and relevant local agencies, and to conduct a number of focus groups to determine the community's perception of its health needs as pertaining to environmental exposures from the Reservation. ORRHES became concerned about the progress on this project due to a lack of communication between the advisory group and GWU. Unfortunately, this concern proved to be valid. The advertisement below (which was run only once on 8/28/02) was placed in local newspapers to solicit participants for the focus groups. A number of ORRHES members felt this advertisement was too generic to turn up anything useful for the environmental exposure-related assessment. The focus of the assessment was to be illnesses resulting from DOE releases in the community rather than general health issues such as diabetes and heart disease.

---

[105] See http://healthyamericans.org/reports/healthtrack/ and http://healthyamericans.org/state/cancergrade/display.php?StateID=TN

[106] "Advocacy Group Gives State's Cancer Tracking System a 'D'," *The Nashville Tennessean*, 9/29/03.
"Tracking Cancer Cases is Vital to Public Health." *The Nashville Tennessean*, 10/6/03.

8/28/02

Health Concerns?

Do you have concerns about your health?
If you are 21 years old or older,
we would like to hear from you!

Study Purpose:
To understand the health concerns and needs of residents in your area.

Adult residents in areas of **Anderson, Blount, Knox, Loudon, Meigs, Morgan, Rhea, and Roane Counties** are eligible.	We will hold several 1-1½ hour discussions with up to 12 people in a group. Groups will be held at different times of day or evening and in several places in the study area.

Light refreshments will be served.
Each participant will receive a **Wal-Mart gift card.**

If you would like to learn more about this project or **volunteer,**
please call Dr. Rebecca Parkin or Ms. Lisa Ragain at

1-800-693-9291

To reach us directly, the best time to call is between 8:30 a.m. and 4:30 p.m. Monday through Friday. You may leave a message anytime and we'll call you back at your convenience.
We will be pleased to answer your questions and to advise you of your eligibility for a discussion group.

We look forward to hearing from you!

The George Washington University
WASHINGTON DC

In fact, very few community members responded to the ad. As a result of this ineffective outreach effort, only one focus group was held—and it was composed of a single worker. However, workers are outside of ORRHES' scope, which is only on residents. So, in fact, the entire effort failed. Because of the failure of GWU and ATSDR to deliver what they committed, ORRHES rejected the CHNA as submitted and developed and recommended a reduced-scope recovery plan. However, ATSDR decided against expending any more resources on this effort, which was officially announced at the September 14, 2004, ORRHES meeting. Therefore, despite a cost of almost $165,000 to the taxpayers, [107] the concerns of the Oak Ridge community remain undocumented by ATSDR.

Some members of ORRHES and the public are now concerned about the government's intent to conduct the follow-on work necessary to answer questions regarding health impacts in likely-affected communities, such as Dillis, Happy Valley, Bradbury, etc. These concerns have been exacerbated by the fact that ATSDR has avoided requests by ORRHES to provide cancer statistics by census tract so that disease incidence in these communities can be evaluated by the Subcommittee.

[107] Letter from Elizaabeth H. Howze, Director of the ATSDR Division of Health Education and Promotion dated 8/4/03

5.5.2 Censored or Classified/Reclassified Data

Another extremely important issue is DOE's tendency to classify or reclassify data in what appears to be attempts to keep or remove politically sensitive information from the public domain. ATSDR also appears to withhold information requested by ORRHES. ITSPA discovered two examples of this regarding mercury data and two examples with ORRHES.

5.5.2.1 Steve Gough Incident

The actions of former ORNL researcher Steve Gough of ESD are credited with sparking the investigation that led to the closing of EFPC to fishing and swimming.[108,109] In December 1981, Gough, along with his brother from the U.S. Geological Survey (USGS) in Denver, Colorado, took unofficial samples along EFPC and embarked on what became a controversial project. They collected six samples of moss, liverwort, and sycamore roots from the floodplain near the banks of EFPC and Bear Creek. The USGS found that the EFPC samples contained high levels of mercury. However, Because Gough took unauthorized samples, worked with another agency without permission, and unknowingly violated national security regulations because of the classified nature of mercury losses from the Y-12 Plant, ORNL officials reprimanded him for insubordination. DOE and its contractor (Union Carbide) forced Gough to stop his investigation of mercury pollution around the Y-12 Plant, ordering the return of all his data and samples. Gough left ORNL in June 1982.[110,111]

Gough disagreed with the reasons for the reprimand. He pointed out that mercury loss figures were not classified in the 1977 *Mercury Inventory* report and the mercury levels found in the moss samples could not be used to back-calculate the Y-12 Plant's inventory of mercury or the amount of lithium-6 separated for nuclear weapons production. In 1986, one year after the Office of the Inspector General investigated Gough's complaints (report issued July 9, 1985), DOE Oak Ridge Operations (ORO) manager Joe La Grone intervened and ordered Union Carbide to expunge its negative comments from Gough's file. [112]

---

[108] "Behind Mercury, Museum Probes: Inspector General," *The Oak Ridger*, 7/27/83.

[109] "No Prosecution In DOE Mercury 'Cover-Up' Investigation," *The Oak Ridger*, 5/29/85

[110] "Mercury Two Years Later (Part 1)," The Oak Ridger, 5/16/85

[111] "When newspapers reported a former ORNL scientist's accounts of mercury pollution and called him a whistleblower, Dr. Postma mocked the disclosures by handing out whistles to lab researchers he thought had done the real legwork on mercury in the environment." "Remembering Dr. (Herman) Postma," 11/10/04, *The Oak Ridger*.

[112] "ORNL, Mercury, and the Environment" (unpublished 3/13/95 report written by Caroline Hay Krause on personal time; used with permission).

5.5.2.2 Reclassified Soil Sampling Data

Another example of a questionable classification of data is illustrated by the following incident, which was related to ITSPA by an EFPC property owner. On 5/8/95, the property owner called a DOE official he had been working with to inquire about the type of soil samples taken in 1985 on his land. However, the official informed him that he no longer had his files on the 1984/85 soil sampling as other DOE personnel had recently picked up his files and told him they were now "classified." This official indicated he was opposed to this action because the information had been open and available from 1985 until then, a decade later.

5.5.2.3 Census Track and EPA Data

ATSDR was asked in 2003 to provide ORRHES a PHA for the Army Depot in Memphis that included cancer data by census tract. The group was told by ATSDR that the state would no longer release data by census tract because of anonymity concerns. However, ATSDR had to retract that statement when an ORRHES member discovered another report underway on a Memphis creek polluted by Velsicol Chemical where the state is planning to provide data by census tract.[113]

In addition to this example, ATSDR has failed to provide to ORRHES EPA ORIA's detailed responses to the questions that were provided to EPA and ATSDR in advance of the June meeting. To date, these responses have not yet been released to the full Subcommittee by ATSDR despite several requests.

5.6 LACK OF KNOWLEDGE

One of the reasons ITSPA decided to undertake this study is the public's lack of knowledge and understanding regarding environmental issues such as those affecting the use of EFPC and other local waterways. A journal article by The Cadmus Group[114] specifically addresses the issue of the public's lack of knowledge of the hazards of posted waterways.

5.6.1 The Cadmus Group Survey

The article describes The Cadmus Group's survey of 202 people actively fishing either on land or by boat along the Clinch River arm of Watts Bar Reservoir adjacent to the ORR from Melton Hill Dam to the Poplar Creek confluence or on Poplar Creek within ORR boundaries to obtain information about the demographics, fishing behavior, knowledge, fish consumption, and risk perception of anglers. The group interviewed fishermen on land along the 1.6-km reach of the Clinch River immediately below Melton

[113] "Cancer Rates Scrutinized for Creek-side Residents" (Memphis, TN), *Knoxville News Sentinel*, 6/12/04.

[114] K. Rouse Campbell et al., "Fishing Along the Clinch River Arm of Watts Bar Reservoir Adjacent to the Oak Ridge Reservation, Tennessee: Behavior, Knowledge, and Risk Perception," *The Science of the Total Environment*, Volume 299, Issues 1-3, 1 November 2002, Pages 145-161.

Hill Dam (Melton Hill Dam tailwaters) and along the upper portions of Poplar Creek, where it was accessible from shore along Blair Creek Road. People were consistently found fishing from the shore along Melton Hill Dam tailwaters (84% of surveys).

Of the 202 people interviewed, 95 percent of the anglers were found fishing in the Clinch River portion of the study area. Only 10 people (5% of the total) were fishing in Poplar Creek when interviewed. Approximately 10 percent of the anglers approached refused to be interviewed, mainly because they were in a hurry or were busy navigating their boat in the dangerous area just below the dam or in the high current.

Even though 81 percent of the people interviewed knew about the fish consumption advisories for the study area, 48 percent of them thought the fish were safe to eat, while 38 percent ate the fish that they caught from the study area. Thirty percent (of the 10 Poplar Creek anglers) ate fish from the study area, while 70 percent did not eat fish at all. Nine out of the ten had heard about the fish consumption warnings. In general, more people who made less than $20,000 a year, did not graduate from high school, or were 50 years of age or older ate fish from the study area than those who made more money, had more education, or were younger.

Approximately 36 percent of anglers who had knowledge of the fish consumption warnings ate fish from the study area. The majority of anglers interviewed knew about the fish consumption advisories because of the signs posted by the boat ramps and parking areas in the study area and the Tennessee Wildlife Resources Agency pamphlet of fishing regulations that is given to people when they purchase fishing licenses. However, few people knew the correct fish advisories and none mentioned that pregnant and nursing women and children should limit how much fish they eat. Significantly fewer blacks had knowledge of the fish consumption warnings than whites. The anglers also were asked if they had heard any warnings about eating turtles or turtle eggs. No one had heard about the warnings regarding eating turtles and turtle eggs.[115]

5.6.2 University of Tennessee Report

UT documented in a 1994 report that, despite the fact the potential threat to public health by the EFPC and Watts Bar Lake has been the focus of considerable attention in the news media,

> "less than half of the respondents (40%) report having heard of EFPC. Of those who have heard of the Creek, about one-quarter (27%) feel it poses a major threat to the health of people living nearby, compared to those who feel it poses only a minor threat (21%) or no threat (21%), and 31% are not sure.

[115] Note the Cadmus Group mentioned a brochure developed by LOC-CAP members (i.e., Alfred Brooks and Susan Kaplan (ITSPA's principal investigator)), who worked in conjunction with ATSDR and TWRA to develop it. Cadmus indicated it was an "excellent brochure" that clearly explains the fish consumption advisories for the Watts Bar Reservoir and includes many ways to minimize risks related to the fish consumption advisories. However, not one person interviewed by Cadmus mentioned the brochure as a source of knowledge. Therefore, The Cadmus Group concluded that, even though this brochure had been developed and circulated in the last five years, there is a need to provide such information to the people who may be most at risk from eating fish caught from the Clinch River arm of the Watts Bar Reservoir.

Awareness of the Creek is more widespread in Oak Ridge and in Anderson and Roane counties, where substantial majorities have heard of it. Yet, in both Oak Ridge and in Anderson County, a larger than average percentage of respondents feel that the Creek does not pose a threat to the health of people living nearby. Even though only a relatively small percentage of the respondents located in Meigs and Union County have heard of EFPC, those who have are notably more likely to believe it is a threat to health.

Watts Bar Lake is more familiar to the general public. Almost nine out of ten respondents (88%) reported having heard of this body of water. A majority of those who know about the lake think that it poses only a minor threat (22%) or no threat (33%) to the health of people living nearby, but 19 percent think that it poses a major health threat. The rest (26%) are not sure if the lake poses a health threat. However, even though only 19 percent think the lake poses a major health threat to nearby residents, it is clear the public has reservations about the safety of the lake. A sizable minority (43%) report they are reluctant to engage in recreational activities on Watts Bar due to concerns about the lake's water quality, and a substantial majority (67%) are reluctant to eat fish from the lake because of concerns about water quality." [116]

5.7 LACK OF TRUST

Many members of the public lack trust in those with authority over EFPC and the other contaminated areas in the region, not to mention the DOE facilities that were responsible for creating the contaminated areas. For example, DOE lost public trust when it took a FOIA request to get the agency to publicly acknowledge it had released tons of mercury to the environment, with hundreds of thousands of pounds going into EFPC. DOE lost public trust when it conveniently did not include high mercury result in a major report and it took the landowner fighting to get one of the most highly contaminated privately owned pieces of EFPC property remediated. DOE lost trust when it did not indemnify private landowners and the city of Oak Ridge from liability from the release of mercury and other contaminants.

ITSPA believes ATSDR lost credibility and public trust with the decision to proceed with the Oak Ridge PHAs without additional sampling having been performed in areas other than the Scarboro community, as was recommended by reviewers of the Dose Reconstruction. Scarboro is an African-American community that is located closest to the Y-12 Plant. It was selected by ATSDR to be the "sentinel" community for its Public Health Assessment on uranium releases from Y-12, i.e., to represent all of Oak Ridge. However, EPA has indicated this community likely does not represent the highest exposed community in Oak Ridge. ITSPA is concerned that ATSDR believes it can make

[116] "*Report of Knowledge, Attitudes and Beliefs Survey of Residents of an Eight-county Area Surrounding Oak Ridge, Tennessee*," Dr. Michael Benson, Dept. of Sociology; and Dr. William Lyons and Dr. John Scheb, Social Science Research Institute. The UT document was published on August 12, 1994, for the Tennessee Dept. of Health Division of Environmental Epidemiology, the ORHASP, and the LOC.

these important health calls regarding public exposures without additional sampling data being available to help it evaluate past and current exposures to contaminants of concern (COCs) and without sufficient health and birth defects registry data being available. The non-profit group, *Trust for America's Health*, indicated in a 2/26/01 report that environmental factors now account for 72 percent of cancers.[117]

Regarding trust of DOE on current releases and incidents at the plants, the following is from a recent article [118] written by Frank Munger, a Knoxville newspaper reporter who regularly covers DOE:

> "In the wake of two Oak Ridge emergencies this past spring, each of which required the closure of public roads, the U.S. Dept. of Energy and its contractors vowed to make amends and repair any damage to the public's trust." "A lot has been said about fixing mistakes and holding folks accountable for safety on every project, big and small. A lot also has been said about communications and regaining the public's trust. But some of those words didn't seem to mean much. In separate interviews in late August and early September, Boyd (Gerald, DOE's Oak Ridge manager) and Mike Hughes (the president of Bechtel Jacobs, DOE's environmental manager in Oak Ridge) promised to communicate issues promptly and thoroughly. Yet, even as they talked about lessons learned from the May emergencies, they failed to mention another accident that had occurred Aug. 10 (2004) at ORNL. Four workers received significant internal exposures to radioactivity during cleanup operations…" "The first public information came when DOE released an Aug. 31 (2004) letter from Boyd to Hughes. That's when the DOE manager informed the top contractor that it was being fined $250,000. *Do Oak Ridge officials respond only when roads have to be closed or sirens are sounded to evacuate local residents*?" [Note: Italics added.]

In addition to the examples given above regarding lack of public trust, two studies attempted to quantify the extent of public distrust of the government, i.e., one study by The Cadmus Group and one by the University of Tennessee.

5.7.1 The Cadmus Group Survey

The Cadmus Group found that anglers often do not trust the government in general or government agencies that issue advisories, an attitude that was prevalent among the people interviewed for that study. This was especially true for those individuals who had lived in the local area for many years, due to releases, spills and discharges of contaminants resulting from DOE operations on the ORR.

---

[117] http://healthyamericans.org/reports/healthtrack/

[118] "DOE's Problem Solving: The Good, Bad, and Tardy," *Knoxville News Sentinel*, 10/13/04, p.5.

5.7.2 University of Tennessee Report

Distrust was quantified by UT in a report that states the following:

> "The least trustworthy information source appears to be local government officials. Only 10 percent of the respondents rated them as very trustworthy, while 26 percent rated them as not trustworthy at all." "The U.S. Dept. of Energy was rated as slightly more trustworthy than local officials, but less trustworthy than state agencies and environmental groups. It is important to note, though, that most people regard all of these organizations as only somewhat trustworthy on the effect of the ORR on the local environment." The report also states: "Although they are not as important as television, radio, and newspapers, local environmental groups are an important source of information about environmental concerns."

Another factor adding to the distrust is the government's unwillingness to look at disease incidence. One of the recommendations in the 1994 UT report was:

> "Address the widespread perception that environmental contamination from the plants has caused health problems for those who work at or live in close proximity to the ORR. A relatively small percentage of the respondents reported that they had experienced health problems they believed were caused by environmental contamination released from the plants. Nevertheless, a majority of respondents said that they thought the plants had created health problems for those who work at or live nearby them. One way of addressing this issue would be to conduct a study of the actual incidence of disease and other health-related conditions among people living in the vicinity of the ORR. An overwhelming majority of respondents thought that such a study was very important."

(See Sections 5.5.1.3 and 5.5.1.4)

CHAPTER 6.0. OVERVIEW OF IMPACTED/POTENTIALLY IMPACTED AREAS

This chapter compiles information intended to give the reader a good perspective of the magnitude of the DOE contaminant-release problem. Although containing a broad overview of the releases of contaminants to the region in general, this report's scope is focused primarily on determining impacts on property owners along the EFPC.

6.1 OVERVIEW OF RELEASES

This section discusses contaminant releases in Oak Ridge; downstream areas such as the city of Kingston, Poplar Creek, and the Clinch River; and Knox County. The following data are included in Appendix 1-9:

- Surface water releases of uranium and thorium from Y-12 from 1944 to 1999 (Appendix Tables 1-9-1 and 1-9-2),
- Results of Y-12 plant sediment monitoring for 1997 and 1998 (Appendix Table 1-9-3),
- Radionuclide concentrations in surface waters above ORNL for 1997 and 1998 (Appendix Table 1-9-4),
- Data for area-wide radiological survey points (Appendix Table 1-9-5),
- Test results of mercury testing of Scarboro soils for 1983 (Appendix Table 1-9-6),
- Results of mercury testing of Oak Ridge soils for 1983 (Appendix Table 1-9-7).
- Test results for city and privately owned properties for 1987 (Appendix Table 1-9-8).
- Oak Ridge aerial flyover regions of interest (Appendix Table 1-9-9 and 1-9-10),

Locations not having obvious pathways of exposure also have been affected. Such areas have been contaminated through the public auctions that have taken place for decades, railway and truck spills, and take-home contamination by workers at the facilities. The public has always been assured that these off-site releases have been cleaned up and that they pose no health hazard.

6.1.1 Oak Ridge

In the past 20 years since the announcements that mercury and other contaminants had been released in Oak Ridge as a result of DOE operations, Y-12 mercury release estimates provided to the public have varied. The first estimate was the 2.2 million pound material-unaccounted-for (MUF) figure released by DOE in 1983, which came

from the 1977 mercury inventory report[119] prepared by the Union Carbide Corporation Nuclear Division (UCCND). Another was the estimate of actual creek losses in the range of 800,000 pounds, which also could be derived from the 1977 UCCND report. In the 1983 Mercury Task Force report, the best estimate was that roughly 160,000 pounds of mercury, or 70 to 80 tons, were in the EFPC floodplain and about the same amount was thought to be in Watts Bar Reservoir sediments—i.e., about 320,000 pounds of mercury present in local soils and sediments beyond the Y-12 Plant fence. A 240,000- pound estimate was formulated in DOE's Lower East Fork Poplar Creek CERCLA project Feasibility Study. However, as recently as 2003 it was reported in the local newspaper that the quantity lost to EFPC was 280,000 pounds. [120]

In addition to the contamination spread to Oak Ridge by surface waters, sediments, floodplains, groundwater, and air, contamination was spread to numerous locations via miscellaneous pathways. Mercury and other contaminants were spread around the city when property owners used EFPC sediments and floodplain soil, as well as K-25 sewage sludge, in their gardens and other areas, and when the city used EFPC sediment and soil for projects such as the Oak Ridge Civic Center, the Sewerline Beltway, and school ball fields. Contaminated soil was used on ball fields at Robertsville and Jefferson Junior High Schools, and soil was used at numerous residential areas. Advertisements in the local newspaper offered free sampling to concerned residents. Table 2 (Section 3.1) provides the results of 1984/85 mercury testing of miscellaneous Oak Ridge locations, some of which are not identified because the property owner requested confidentiality. Appendix Tables 1-9-6, 1-9-7, and 1-9-8 also provide test results.

Other miscellaneous pathways for off-site contamination are wartime operations, the sale of surplus material by DOE to the public, workers carrying it to their homes, and spills from trucks and railway cars. Examples include the Elza Gate site (Oak Ridge railroad loading zone for uranium ore during World War II), CSX Railway site (leakage of contamination from railcar outside of the Y-12 Plant), the Atomic Auto Parts site (Oak Ridge site contaminated as a result of public auction), the Roscoe Fields site (Knox County site contaminated as a result of public auction), the David Witherspoon site (Knox County site contaminated as a result of public auction), and the Freels Bend site (irradiated livestock burial site located on Melton Hill Lake and adjacent to Knox County),

Residential areas in the city of Oak Ridge that have been most impacted by Y-12 surface water emissions are those located on LEFPC. Groundwater is not generally considered to be a problem because Oak Ridge residents use municipal water, although wells are used in some rural areas outside the city. Residential areas generally considered to have been most affected by Y-12 air emissions of mercury, uranium, and other

[119] This document, which was at the heart of the mercury controversy in Oak Ridge, has a very interesting history. It was originally released as an unclassified document in 1977, but was later classified and then unclassified again. This document was involved in the Steve Gough incident, which is discussed in Section 5.5.2.1.

[120] "Creek Cleanup Takes Step Forward," The Oak Ridger, 10/8/02.

contaminants are Scarboro and, perhaps, Woodland and Union Valley. Woodland has been raised as a concern because of the gap in Pine Ridge, which was thought to protect Oak Ridge residents from Y-12 air releases. According to the Oak Ridge Dose Reconstruction, although Scarboro is the residential area closest to Y-12, there are farm locations closer to the EFPC. The dose reconstruction team estimated that from 6,000 to 10,000 people lived in Scarboro between 1950 and 1990 and that from 40 to 200 people lived on farms along EFPC. This was the period of greatest exposure to members of the public.

Studies of the Scarboro community to date have failed to demonstrate significant residual uranium contamination, although this conclusion is controversial because primarily surface samples—as opposed to fractionated core samples, which are needed to determine past levels of exposure—were taken. Another source of controversy is the fact that studies have not been conducted in Woodland, Union Valley, or any other area besides Scarboro. As a result, insufficient sampling has been done to answer the questions regarding off-site contamination that have been raised by the public.

The following information is from *The Oak Ridger* regarding an EPA report on Scarboro issued in 2002:

> "It is believed that the residents of the sampled properties in the Scarboro community are not currently being exposed to substances from the DOE Y-12 facility at these sample locations in quantities that pose an unreasonable risk to health or the environment."… "This general conclusion, however, cannot be made concerning all of Scarboro since all areas were not sampled. Therefore, EPA does not propose any future action for the Scarboro community." [121]

Regarding this statement, a member of the LOC-CAP said "the conclusions the EPA drew could be drawn on "any set of samples," and noted the report, like its many predecessors, only raised more questions rather than provided answers."

On the subject of the impact of an underground plume that has migrated off-site from Y-12, Al Brooks, an EFPC property owner and also a member of the LOC-CAP, had this to say in a :

> "The Y-12 East End deep plume of volatile organics (VOC) extends east under the commercial area of Union Valley which is served by city water. After surfacing into Scarboro Creek the VOCs evaporate long before they reach the Clinch River. The Y-12 West End plume (nitrates, etc.) enters Bear Creek, which also receives low levels of uranium from the Bear Creek waste areas. The creek, intermixing with ground water, shows a decreasing level of contamination and meets requirements long before it reaches the LEFPC, which itself shows slightly

[121] "Frustration Surfaces With Scarboro Study," The Oak Ridger, 10/9/02.

elevated levels of mercury just below Y-12, but is contaminated by city sewage in its lower reaches…." [122]

6.1.2 Other

Although the primary focus of this study is on the city of Oak Ridge, the three DOE facilities located on the ORR have had a great impact on communities outside of Oak Ridge as well. For example, the city of Kingston is located on a waterway downstream of Y-12 and the other DOE facilities. Knox County also has been impacted, particularly by air emissions from ORNL and by contaminants sold through public auction to businesses and individuals located within that county. See Figure 1 for a regional map of the ORR and selected off-site areas.

6.1.2.1 Downstream Areas

Figure 2 is a map showing the ORR and impacted waterways. Figure 3 shows the location of the DOE facilities, area waterways, the Oak Ridge Sewerline Beltway, and other Oak Ridge landmarks. Figure 4 is a map showing the Y-12 facility and the closest downstream/downwind Oak Ridge residential areas. Figure 5 is a map showing only the waterways impacted by ORR releases. For a hydrogeological tour of the EFPC Watershed, see http://www.esd.ornl.gov/ BMAP/efpc_int.htm.

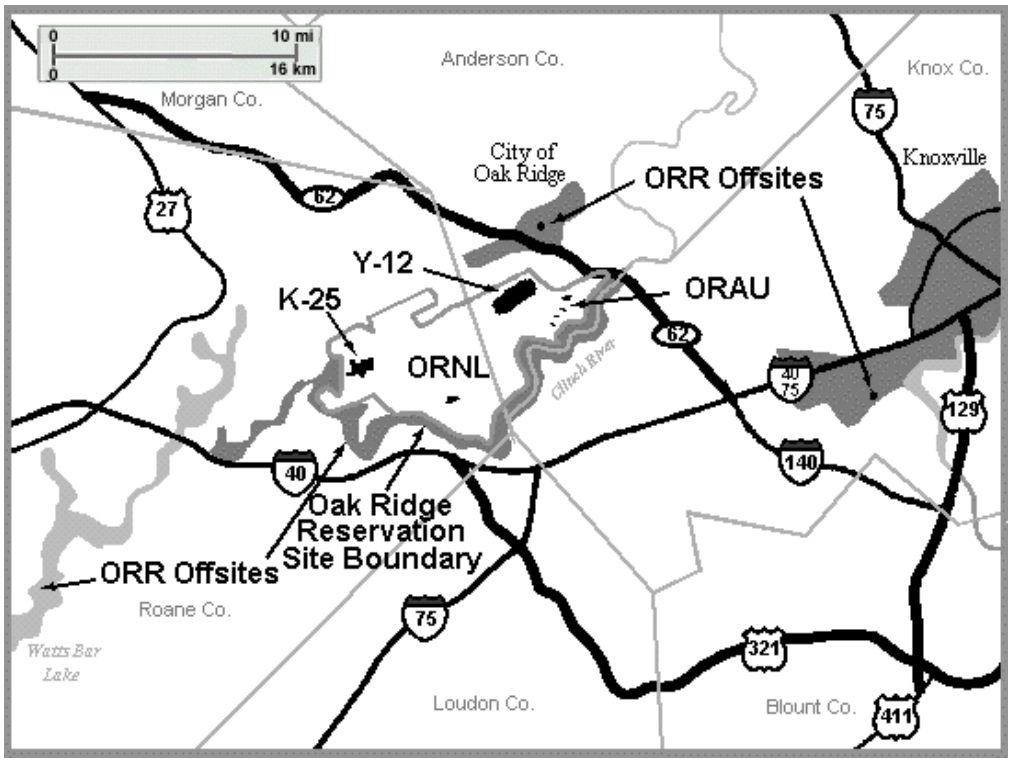


Figure 1. Regional Map of the Oak Ridge Reservation (ORR) and Selected Off-site Areas

[122] "Your Views: Says Risk Statements Don't Help Public Understand." Letter to the Editor by Al Brooks, *The Oak Ridger*, 4/7/04.

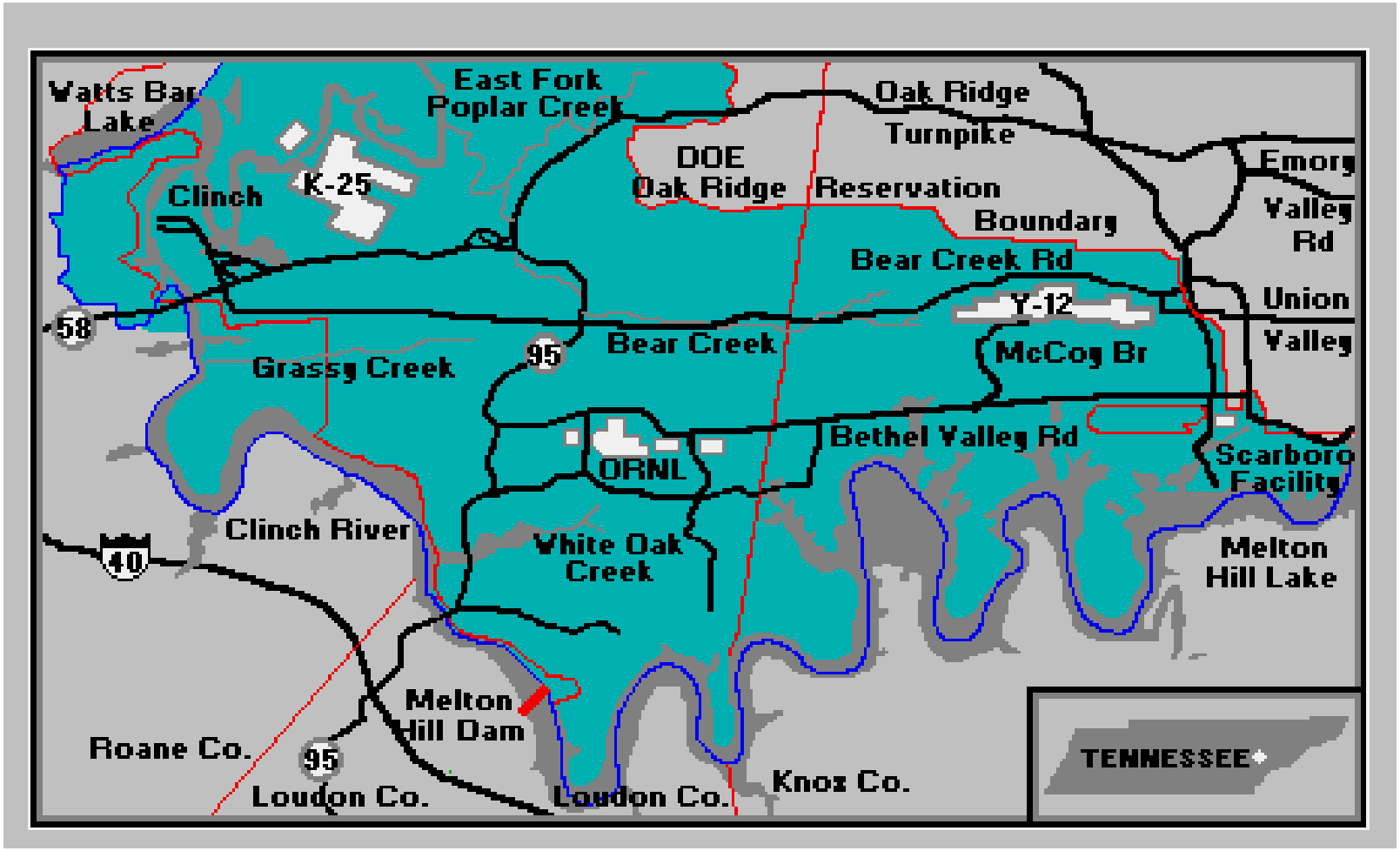


Figure 2. Regional Map of the Oak Ridge Reservation and Impacted Waterways

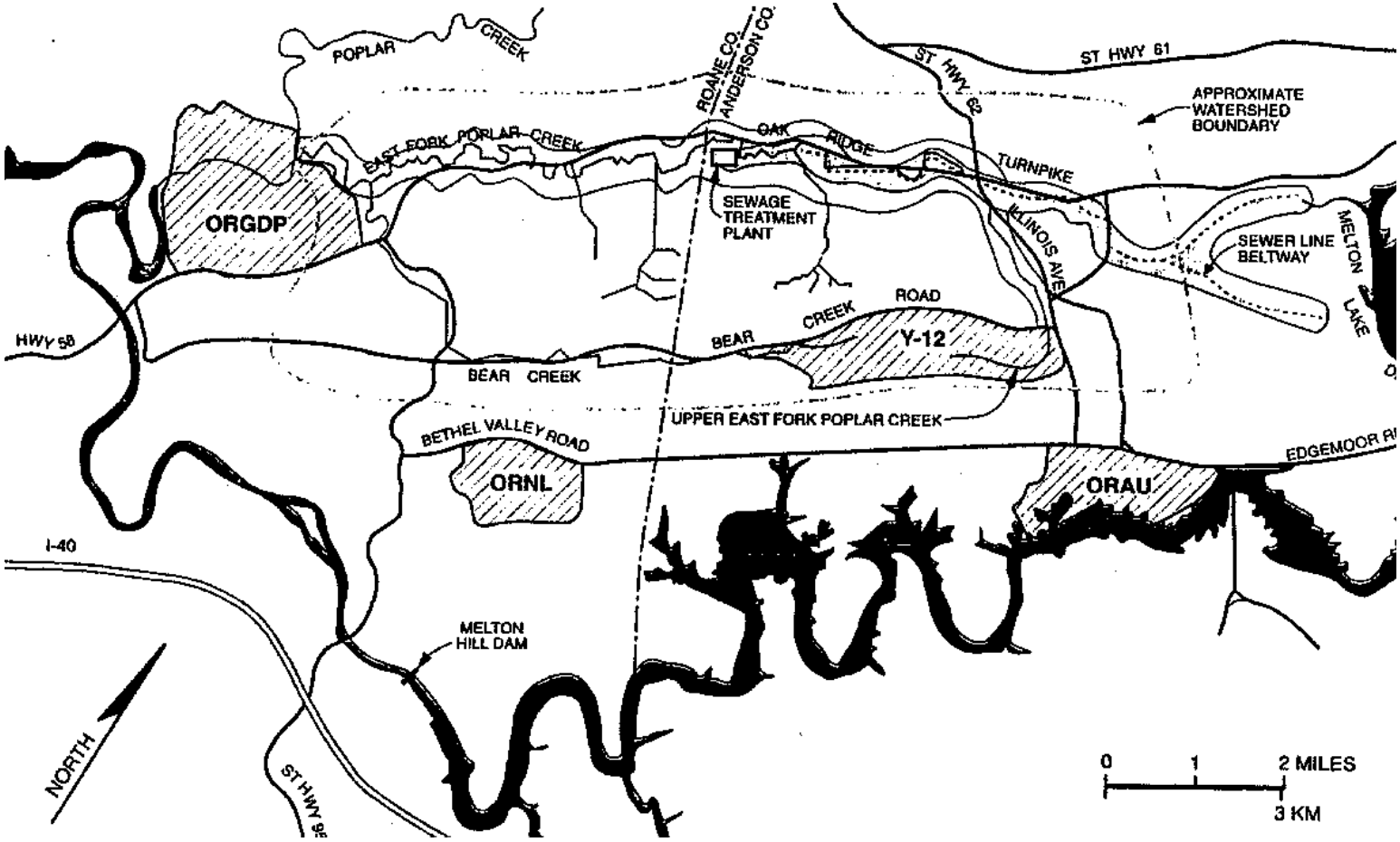
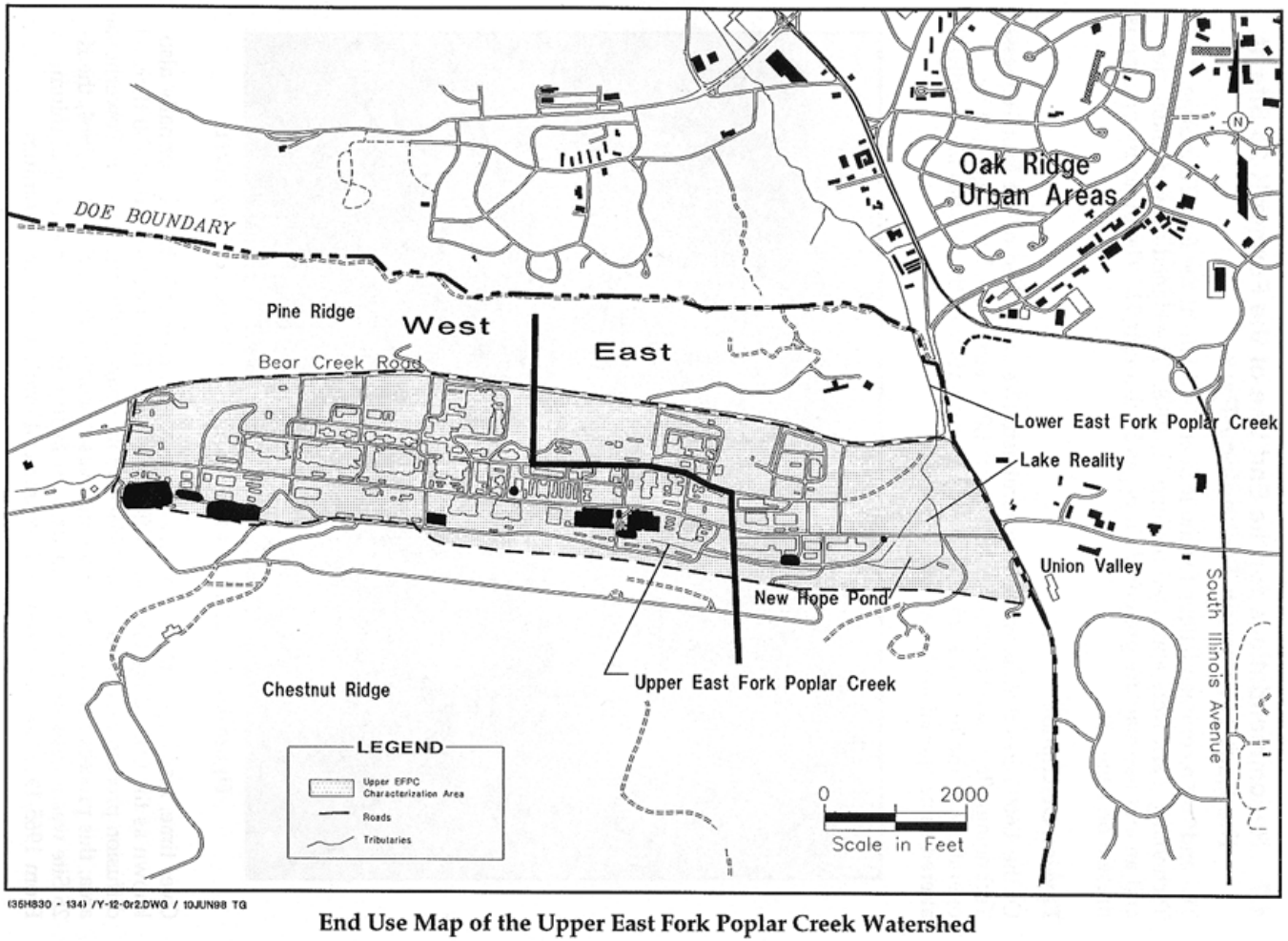


Figure 3. Location of DOE Facilities, Area Waterways, Sewerline Beltway, and Other Oak Ridge Landmarks



End Use Map of the Upper East Fork Poplar Creek Watershed

Figure 4. Map Showing Y-12 Facility and the Closest Oak Ridge Areas

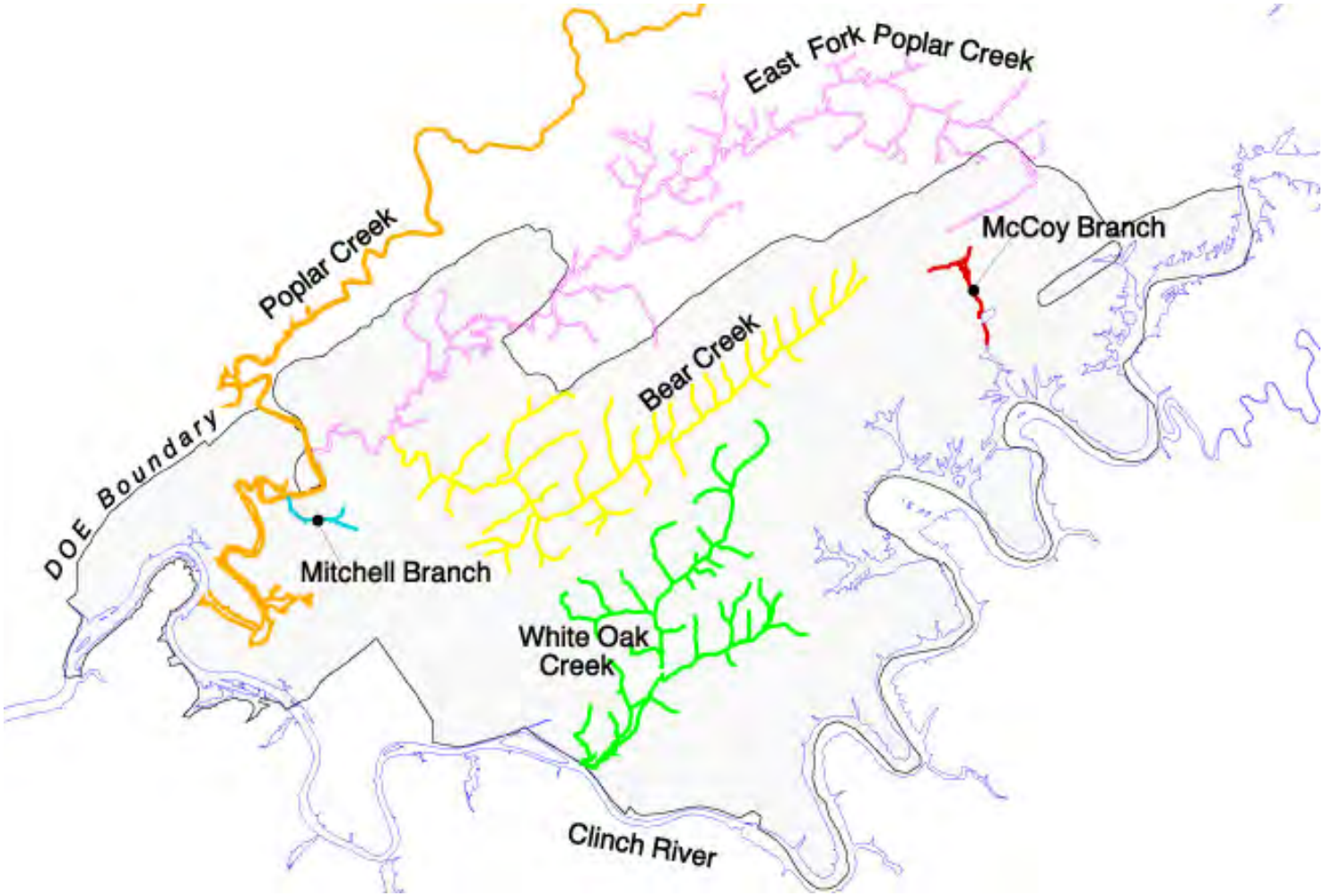


Figure 5. All Waterways Impacted by Releases from the Three DOE Facilities on the Oak Ridge Reservation

6.1.2.1.1 *Kingston*

In addition to being affected by Y-12, the city of Kingston and other communities located along the waterways that flow downstream of the former K-25 Site and ORNL have been significantly impacted by these two facilities as well. Appendix 1-8 provides comments by the ORREMSSAB to the Oak Ridge Environment Quality Advisory Board (4/1/97) on DOE's Proposed Plan for Clinch River/Poplar Creek Operable Unit dated October 16, 1996. Of particular interest are ORREMSSAB's comments regarding near-shore sediments at a lake in Kingston. Selected comments are included in Section 6.3.6.

In its health consultation, ATSDR evaluated surface sediments in shallow areas of the Watts Bar reservoir using maximum concentrations of contaminants and worst-case scenarios (Feb. 1996 Health Consultation). These scenarios assumed children would be exposed to radionuclides in surface sediments while swimming or fishing in the reservoir and to radionuclides in soil if surface sediments were dredged and used for surface soil at residential properties. ATSDR determined that the maximum chemical and radioactive contaminant concentrations reported in the recent surface sediments data (mercury, Co-60, Sr-89/90, and Cs-137) would not present a public health hazard. The estimated dose from radioactive contaminants was less than 15 mrem/yr or 0.15 mSv/yr.

6.1.2.1.2 *Poplar Creek*

Poplar Creek, which joins the Clinch River about 10 miles upstream of Kingston, is adversely impacted by industrial, municipal, and agricultural sources. Lower Poplar Creek is part of the Watts Bar Reservoir flow regime. Under certain conditions at Melton Hill Dam, Poplar Creek can actually flow upstream. Factors that affect accumulation of contaminants in fish from Poplar Creek include: (1) inputs from East Fork Poplar Creek, (2) Mitchell Branch, (3) ponds at the former K-25 Site, (4) the Clinch River, (5) historical in-stream sediment contamination, and (6) fish movement within the system coinciding with the changing flow patterns. For ORNL biological monitoring data on Poplar Creek, see the following web site: http://www.esd.ornl.gov/BMAP/index.html.

6.1.2.1.3 *Clinch River*

The Clinch River is a large river and reservoir system that is adversely impacted throughout its 140-mile length by industrial, municipal, and agricultural sources.[123] The river flows downstream of all three DOE facilities in Oak Ridge. The ORR is located along the Clinch River arm of Watts Bar Reservoir beginning at Clinch River Kilometer (CRK) 17.7 [Clinch River Mile (CRM) 11] and extending upstream of Melton Hill Dam to CRK 69 (CRM 43).[124]

---

[123] "Reservoir Monitoring Results," Tennessee Valley Authority, 2001 Annual Update.

[124] K. Rouse Campbell et al., "Fishing Along the Clinch River Arm of Watts Bar Reservoir Adjacent to the Oak Ridge Reservation, Tennessee: Behavior, Knowledge, and Risk Perception," *The Science of the Total Environment*, Volume 299, Issues 1-3, 1 November 2002, Pages 145-161.

Bioaccumulation monitoring for the Biological and Abatement Program (BMAP) has been conducted in the Clinch River (or Watts Bar Reservoir) since 1987. For ORNL biological monitoring data on the Clinch River, see the following web site (http://www.esd.ornl.gov/BMAP/index.html). BMAP monitoring has been conducted in the Clinch River/Watts Bar Reservoir below inputs from the DOE facilities in Oak Ridge, as well as at Clinch River sites upstream from those sources (primarily in Melton Hill Reservoir). Upstream Clinch River sites serve as reference sites. Monitoring of fish from the Clinch River clearly show that DOE sources contribute to the contaminant body burdens in fish, but also clearly show that sources upstream of DOE inputs are also important contributors to that burden.

6.1.2.2. Knox County

The dose reconstruction team reported other areas that have been affected by historical Reservation air emissions (e.g., radioactive iodine exposures in the Buttermilk Road area in Knox County). Other known Knox County areas that have been contaminated as a result of DOE operations are the Roscoe Fields Site, the David Witherspoon site, and Freels Bend (adjacent to the Knox County line, but actually located in Anderson County). Freels Bend is part of the ORAU site in Figures 1 and 3.

6.2 REMEDIATED SITES

Relatively few sites have been remediated as a result of the DOE releases from Y-12 to the EFPC. Remediation decisions were based on a combination of economic drivers and the determinations of possible health impacts by ATSDR. The remediated sites are the former Bruner site (which includes the Clark and Sturm sites) and the NOAA site. Areas that were remediated prior to the EFPC remediation include the Oak Ridge Civic Center, Robertsville and Jefferson Junior High Schools, and the Girls Club. In addition several residential and commercial areas were tested for contamination, although it appears few were in the most likely affected downwind areas (i.e., Woodland and Union Valley). While the main concern appears to have been mercury, several sites have been remediated due to radiation and other contamination (i.e., CSX Railway, Atomic City Auto Parts, Elza Gate, Roscoe Field Site, David Witherspoon)

ATSDR's official policy upon coming into a community is only to answer the specific question posed to them, which in this case was "Is this particular cleanup level safe?," i.e., 180 ppm mercury and later 400 ppm mercury. In this case, however, an important question that should have been raised with ATSDR but was not, is the appropriateness of the use of the homogenized sampling technique.

In 1995 (EFPC cleanup started in 1996), property owners sent letters and met with DOE and other officials questioning this procedure, which as one property owner indicated "very seriously masks the potential real level of contamination within the bands that were probably deposited during major rain/flood events."[125] The following is from

[125] July 6, 1995, letter from an EFPC property owner to Nelson Lingle, Chief of DOE's Oak Ridge Remediation Branch.

personal notes taken by an EFPC property owner regarding a telephone conversation on 4/4/95 with David Page, DOE Team Leader of the EFPC floodplain remediation project. In this conversation, the property owner expressed concern about homogenized soil samples:

> "As a real life situation, a worker or other individual on the site doesn't deal in homogenized soil, but in layers. If they work in the black layer, they could encounter contamination of 600 to 1600 ppm (or more) even though DOE testing with homogenized samples said the contamination level was less than 400 ppm."

In June 1995, another EFPC property owner requested from the Jacobs Engineering EFPC Task Manager a copy of the procedure they were using for taking soil samples. He was told by the manager that he did not have one and reported that their procedure is a little different than that used before. He said the new procedure would be included in a report due out in July (1995). A DOE official, who also was part of the joint conversation, indicated the procedure followed the protocol that he wrote up, submitted to EPA, and was approved by EPA. He indicated his approved plan is known as "Sampling and Analysis Plan Phase 1B." The property owner inquired of the method and asked if it was true that they took a core sample of from 0" to 16" and homogenized it before taking the sample for mercury analysis. Both the DOE and the Jacobs official said yes. The property owner then posed the question of what happens if while preparing a building foundation he exposed a layer whose mercury concentration far exceeds the so-called cleanup limit of 400 ppm. The following comments were made in hindsight by an EFPC property owner during a 2003 interview with ITSPA (see Personal Interview #4 in Section 7.3.3):

> "I felt that an end user, if they ever had a grievance, would not accept the 400 ppm because 400 ppm was an average. And you don't live with averages."

6.2.1 EFPC Properties (i.e., Bruner Site, Including Clark and Sturm Sites) and NOAA

A ROD documenting the remedial action of LEFPC was approved in September 1995 and DOE completed Phase I in September 1996. Phase I involved excavating approximately 4,300 cubic yards of soil with a mercury concentration above 400 ppm at the NOAA site located west of South Illinois Avenue in Oak Ridge. These contaminated soils were disposed of in a Y-12 landfill and the NOAA site was backfilled with clean soil and the excavated area was restored with grass, trees, and shrubs. Monitoring was to continue indefinitely to ensure the effectiveness of the remediation. Phase II (completed in October 1997 and signed off by the state on 9/30/98) removed approximately 22,700 cubic yards of soil above 400 ppm at the NOAA and Bruner sites. These sites were excavated, the soil disposed, and the sites backfilled, restored, and reportedly monitored.[126]

---

[126] "Environmental Restoration Program for Lower East Fork Poplar Creek, DOE Fact Sheet, Spring 1995.

Prior to this remediation occurring, soil samples were taken during *Phase IA* from three transects across the creek in the NOAA and Bruner sites known to be contaminated with mercury. Six locations (three on each side of the creek), were sampled at 20-meter intervals along each transect. ATSDR indicated that composite soil samples were collected from 0- to 12-inch depths at each location along the transects.[127] Nine sediment samples were collected along the EFPC bottom from Y-12 to the confluence of Poplar Creek. Elevated levels of mercury were found in a few soil and sediment samples from all three areas.

The concentration ranges of contaminants in the sediment and in soil from all three locations are provided in the 1993 ATSDR Health Consultation (based on the EFPC Remedial Investigation[128]). According to ATSDR, a mercury speciation study of the EFPC flood plain soil showed the distribution of mercury to be 84-98 percent inorganic (mercuric), 3-8 percent elemental, and 0.003-0.01 percent organic (methylmercury).

6.2.2 City and Other Properties

Contaminated soil and sediments from the EFPC were once used as fill dirt for community areas and projects, such as the Sewer Line Beltway (see Figure 3) the Civic Center, the Robertsville and Jefferson Middle Schools, and home gardens. Mercury was the primary contaminant of concern, but other heavy metals, radionuclides, and some organic compounds also were present in smaller quantities. In addition to Table 2 in Section 3.1, Appendix Tables 1-9-6, 1-9-7, and 1-9-8 provide mercury test results.

6.2.2.1 Sewer Line Beltway

The Sewer Line Beltway was constructed by the City of Oak Ridge during 1982 and 1983 and contains over 10 miles of sanitary interceptor sewers and force mains. In certain instances, EFPC floodplain soils were used for topsoil for the project; however, no records were kept to document the backfill procedures and locations. Accessible areas were sampled in a grid pattern along the beltway. Mercury testing was conducted on 821 samples and testing was performed on 75 samples for gross alpha, gross beta, uranium, thorium, barium, chromium, arsenic, selenium, cadmium, silver, and lead.[129]

6.2.2.2 Civic Center and Schools

On 8/19/83, the *Knoxville News Sentinel* reported that officials announced that mercury-contaminated areas at Jefferson and Robertsville Junior High Schools would be

---

[127] The Phase IB sampling procedure used by DOE was a 16-inch core sample.

[128] "East Fork Poplar Creek – Sewer Line Beltway Remedial Investigation Report," Prepared by SAIC for Radian Corp. and submitted to the DOE, April 1993.

[129] Pre-remediation data found in the 1984 document, "Removal of Topsoil from the Oak Ridge Civic Center Greenbelt Sewer Line," Y/TS-61, by C.C. Hill, L.S. Jones, and M.A. Manuel.

covered with fresh dirt. On 5/16/85, *The Oak Ridger* reported: "There has been some cleanup. Soil that had been taken from the EFPC area for use as fill dirt along sewer line construction in front of Jefferson Junior High School was removed and replaced, along with similar fill dirt on the softball field at Robertsville Junior High. About 3,000 cubic yards of mercury-contaminated dirt was removed from the Civic Center, at a cost of about $41 million."[130]

6.2.2.3 Girls Club

The Girls Club site was remediated at the request of that organization despite having relatively low levels of mercury. "Levels of 55 ppm were found on the Girls Club site as the result of surveys DOE performed last year (i.e., 1992) at the request of the Club. Although the level of mercury contamination does not present a human health risk, (DOE spokesman) Frank Juan said, DOE decided that the placement of a soil cover up to one foot thick should be taken because of the nature of the land use. This could involve people sliding and grinding in the dirt." [131]

6.2.2.4 Atomic City Auto Parts

The Atomic City Auto Parts (formerly known as the Dupont Smith scrap yard and is located on Melton Lake Drive in Oak Ridge) is one of the most notable off-site commercial locations where contamination likely derived from Y-12 operations has been found. Atomic City Auto Parts is an active automobile salvage facility that had chemicals of concern on-site originating from either the present operations or the storage of salvage materials purchased via public auction from DOE. Note the Dupont Smith operation had been granted Atomic Energy Commission (AEC) or Tennessee "agreement state" licenses to be in possession of radiologically contaminated items.

Typical mercury levels in the soil of less than 630 ppm were measured, but one sample actually measured 6,700 ppm. Other pollutants at the site include: VOCs, semivolatile organic compounds, metals, PCBs, dioxin/furans, and uranium. However, the principal risk comes from PCBs. The remedial investigation determined the risks were unacceptable based on the pathways evaluated, and concluded remedial action was warranted. According to TDEC, the cleanup of this Superfund site by the state began in 2004.

6.2.2.5 CSX Railway Tracks

Two sections of CSX Transportation Group railroad tracks in Oak Ridge were contaminated in the early 1960s. An investigation team detected cesium-137 along sections of the track along Warehouse Road. ORNL coordinated a more extensive survey of the railroad tracks to decide the nature and extent of contamination. It was determined

[130] The cleanup level for the Civic Center was 10 ppm of mercury as opposed to the 400 ppm cleanup level for the EFPC properties.

[131] "DOE Begins Work on Girls Inc. Field, Plans to Put Cover Over Contamination," *The Oak Ridger*, 4/7/93.

the contaminant came from dead irradiated cows, which had been shipped to Oak Ridge from out west. The decaying animals dripped onto the tracks.[132]

Sampling was confined to a five-meter corridor on each side of the railroad bed and elevated levels of cesium-137 were detected, ranging from 1.05 to 21,870 pCi/g. Uranium and strontium levels were near background. The preliminary assessment concluded that the present levels of human exposure were within acceptable limits.[133] However, a TDEC document list/summary indicated the contaminated areas were remediated.

A radiological survey was performed on the railroad in July of 1997. This action was initiated due to public concerns in the Emory Heights area of Oak Ridge. The 1997 survey started behind Warehouse Row and went along Warehouse Road (across from Atomic City Auto Parts Site) and ended on Scarboro Road behind the Oak Ridge Utility District and the east side of Y-12. Measurements were taken along the track approximately two feet from ground level and monitoring was performed continuously along the railroad track. Three one-minute counts were taken periodically for recording purposes and were located on the map with the use of a Ground Positioning System accurate to within 10 meters with post processing. Any location found to be twice background (2X) was documented. A portable gamma spectrometer was used to identify isotopes and calculate dose rates and a meter was used to determine dose equivalent to tissue. Background was established at approximately 7,000 counts per minute.

During the survey, 42 locations were established for recording purposes. Three areas of concern due to elevated counts per minute were identified. Areas specified in a CSX Railway Survey table (dated July 1997) that were less than 2X were: junction of Midway and Lafayette (0.73X), behind ACM Auto Parts near Lafayette (0.83X), Midland Road near Y-12 Credit Union (0.97X), junction of Illinois and Lafayette (1.12X), CSX Railway perpendicular to guard shack (1.12X), prior to Scarboro Road crossover (1.03X), Y-12 Plant gate along CSX Railway (0.92X), railway heading SW near confined space box (0.87X), and behind Oak Ridge Utility District (0.74X). The entrance to Jaycor off Scarboro Road was 2.55X, but was determined to be inconclusive due to natural decay products.

One area, which showed evidence of previous track removal, ranged from 22,000-43,000 counts per minute (cpm) for cesium-137. The high counts were centralized in small pockets and not spread throughout the area. Levels of soil samples taken from approximately 18 inches below the surface (due to railway ballast or gravel) were 98 and 36 pCi/g.

A second area of contamination, which began at point 24 and peaked at the fence line of American Ecology (now Toxco), had readings ranging from 60,000-70,000 cpm.

---

[132] See TDEC responses to ITSPA's questions in Section 7.4.1.

[133] Information Resources Center Fact Sheet, 920501.0047, May 1992.

Environmental thermoluminiscent dosimeters (TLDs) were found on the fence. According to the information provided by TDEC, the building is monitored and inspected by the State Division of Radiological Health. According to records, the operation was in compliance and well maintained. It was determined the readings were related to "shine" (i.e., radiation field) from operations and was not a contamination problem. Note that limits associated with radiation exposures to the public are based on measurements taken at the fence and do not necessarily protect the public from higher exposures, which can occur at locations beyond the fence line due to "shine" from radioactive materials at the site.

The third area of greater than twice background readings was found to be at the entrance to 601 Scarboro Road. Readings were close to18,000 cpm, with the area of concern on either side of the driveway within the railroad tracks boundary. However, it was decided the increase was due to natural thorium decay products and possibly potassium-40. The levels were determined low enough to be of no concern.

The 1994 cleanup of the CSX Railway from Warehouse Road to Scarboro and the east side of the Y-12 spur (Radian Corp RIWP) had a cleanup target level of 50 pCi/g. However, soil samples taken from the area near Warehouse Road during the 1997 survey revealed numbers above this level (i.e., the previously mentioned 36 and 98 pCi/g of Cs-137). According to the information provided by TDEC (which they obtained from a conversation with the State laboratory), these numbers are lower than real values due to some gravel being included in the soil weight calculations.

The contamination was not spread out, but localized in two or three small areas. Signs of previous remedial activity were evident. The calculated dose rate for a human who spent every day of a year exposed to the soil in area four (within two feet) would be about 250 mrem per year. Adjusting for background, the extra dose that could be received from this area would be about 200 mrem per year. DOE has established an effective dose equivalent of 25 mrem per year to the public from DOE Low Level Waste sites (DOE Order 5820.2A). Based on the numbers calculated here in a conservative manner, the dose to the public could exceed these limits by a factor of eight.

It should be noted that the area of track near Jefferson Middle School, Emory Heights Subdivision, the old Girls Club, and the Retirement Center were all near background. The exception to this was that area of track that runs behind the former American Ecology facility, which was exposed to shine from Area 27 of that facility. The calculated dose rate for a person who spent every day of a year along the tracks at that location would have been approximately 100 mrem per year.

According to State Regulation 1200-2-5-60, 100 mrems is the dose limit for individual members of the public to receive from a licensed or registered operation. Regulation 1200-2-5-61 allows for practical applications to be applied for dose assessment. The track along Warehouse Row exceeded this limit and needed further attention to obtain DOE's initial goal, meet State action limits, and remove contamination. This cleanup was completed in 1998.

6.2.2.6 Elza Gate

Another private property location where contamination indirectly associated with some of the earliest Y-12 operations was found is the Elza Gate site located at the extreme eastern end of Oak Ridge. Elza Gate was the site where several warehouses were established under the wartime authority of the Manhattan Engineering District (MED) of the Corps. of Engineers to store pitchblende ore brought to the U.S. from the Belgian Congo shortly after the outbreak of World War II. (Note: MED was the governmental agency precursor to the Atomic Energy Commission.) This ore was high in uranium content but, unlike the uranium ores later derived from U.S. deposits, it also had a very high radium concentration. Years later, many of the retired Calutron machine components were brought from Y-12 to this site for salvage "stripping." PCB soil contamination at Elza Gate was caused, at least in part, by leaks of pyranol fluid from capacitors taken from the Calutron components.

In a memorandum dated December 13, 1990, DOE official David Adler recommended maximum uranium-238 residual concentrations in soil of 59 to 2,000 pCi/g, depending on future land use. He provided a bar chart that showed the effect of lowering the uranium cleanup standard on the resulting volume of contaminated soil and recommended a uranium guideline of 35 pCi/g. On February 25, 1991, Adler requested TDEC's comment on the planned cleanup levels for contamination at the site: 5 pCi/g for radium-226 and thorium-230, 35 pCi/g for uranium-238, and 25 ppm for PCBs. [Wagoner, DOE FUSRAP Director, noted the recommended value of 35 pCi/g for uranium-238 was below DOE's dose guideline of 100 mrem per year.]

In September 1991, the DOE's proposed removal action involved removal of 7,000 cubic yards of radioactively contaminated soils and concrete, which was to be disposed at the UNC site. The PCB-contaminated materials were to be shipped to an existing commercial facility for disposal. According to information obtained from the Information Resource Center, this proposed action was categorically excluded from further NEPA review and documentation.

6.2.2.7 Freels Bend

The accidental irradiation of cattle in New Mexico during the testing of the first atomic bomb in 1945 provided an opportunity to study the long-range biological effects of irradiation on animals. The government purchased the cattle and shipped them to Oak Ridge, which began the research program to investigate the effects of fallout radiation. TDEC indicated to ITSPA that the Freels Bend site is not contaminated from a health standpoint. This issue is addressed in "Environmental Restoration Footprint Reduction Process Evaluation of Freels Bend Area" (DOE Document available through the reading room).

The ORAU Program and the Oak Ridge Institute for Science and Education (ORISE) now consists of two primary sites, the South Campus Facility and the Freels

Bend Area, located within the ORR.[134] The Freels Bend Area is located approximately two miles southwest of the South Campus Facility. This area is also located within the ORR and is bounded on three sides by the Clinch River. [135] Because of past operations at the ORAU facilities, various buildings and areas were contaminated with hazardous and radioactive waste. Environmental restoration of those sites was a part of the DOE Environmental Management (EM) program.

The Freels Bend Area was used to support field research from the South Campus facility. It was a holding area for test animals being used to investigate the effects of irradiation at low dose rates and at variable dose rates. At the Freels Bend Area, animals were irradiated at the Low-Dose-Rate Irradiation Facility and the Variable-Dose-Rate Irradiation Facility and then observed over a period of time to determine the effects of radiation. The animal carcasses were disposed of at three landfills at the site. The three Animal Burial Sites are designated as I, II, and III.

Surveys conducted at various research facilities in the Oak Ridge area indicated that some degree of both radionuclide and chemical contamination is present at the South Campus Facility and the Freels Bend Area. In 1989, the EPA placed these facilities on the NPL. Environmental Restoration program activities have been performed in accordance with the requirements and processes specified by the January 1992 Federal Facilities Agreement (FFA) between DOE, EPA Region IV, and TDEC.

In 1993, DOE performed a Site Investigation at the area. The regions investigated included those associated with the irradiation facilities, animal burial locations, and three small surface impoundments used in the care of control herds. The initial survey indicated that contaminants of concern are radionuclides, organic chemicals, and metals. However, the magnitude and extent of contamination was limited and localized. DOE assumes that the source of the organic and trace metal contaminants is the decayed animal carcasses. The source for radionuclides, to the extent they are present, has not been determined. The findings of the investigation indicated No Further Action was needed, and a petition to the regulatory agencies proposing No Further Action at Animal Burial Sites I, II, and III and the Variable-Dose-Rate Irradiation Facility was submitted and approved in FY 1995.

Access to the 70 acres of the Freels Bend Area is restricted and not open to the general public. Although no fences or barriers surround the property, there is a locked gate at the access road. Because of the suspected presence of radionuclides, organic chemicals, and metals, the Department performed a preliminary assessment at Freels Bend. A radiological survey of the burro barn was reported in Feb. 1991 by A.T. Payne of ORAU. At a 5/9/01 Site Specific Advisory Board (i.e., ORREMSSAB) meeting, a

[134] ORAU was established in 1946. It is a private not-for-profit consortium of 82 colleges and universities whose mission is to provide and develop capabilities critical to the nation's technology infrastructure, particularly in the areas of energy, education, health, and the environment. The consortium provides its university members with access to federal research facilities and conducts research involving the use of various radionuclides and chemicals for the Department of Energy and other member institutions. ORAU is also the managing and operating contractor for ORISE.

[135] http://64.233.161.104/search?q=cache:Z_Lx0bQ0gFYJ:web.em.doe.gov/bemr96/orau.html+Freels+Bend+contamination&hl=en

TDEC representative (Doug McCoy) indicated that some characterization work on Freels Bend had been done, including a "no further investigation" (NFI) determination on soils. According to ORAU, a 1993 assessment determined that no further investigation of the Freels Bend Area was required.

The facilities are currently under DOE control, but ORAU assumes that the ultimate use of the South Campus Facility will be Industrial. The city of Oak Ridge has requested that the Freels Bend Area parcel be put under "self sufficiency;" however, the DOE has not yet declared it as excess. ORAU assumes the Department will ultimately release the Freels Bend Area for Open Space/Wildlife Management. A five-year agreement between DOE and TWRA was signed and is effective through 2006.

6.2.2.7 Roscoe Field Site

Approximately 200 abandoned drums were discovered in 1994 on property owned by Roscoe W. Fields in Solway, which is located just outside of Oak Ridge along Highway 62. Some of the drums and other material on the site appeared to have been generated by DOE and likely were obtained through public auction.

The site reconnaissance determined they were in varying stages of degradation. The drums were located on top of a hill in a semi-densely wooded area, approximately 150 yards from the road. Drums also were found to be leaking a thick black oily substance and were marked as containing petroleum products, such as Pyroquel (a threading oil and ethylene glycol). A radiological survey found that approximately four to five drums had radiation detections above the background levels for the area, but many of the drums were not accessible for scanning. This area became a Superfund site, which has been remediated.

6.2.2.8 David Witherspoon Site

The David Witherspoon salvage operation site in south Knoxville is one of the most notable of the off-site commercial locations where contamination deriving from Y-12 has been found. However, the fundamental nature of the “loosely” regulated salvage businesses conducted at these locations suggest that significant chemical contamination could also have originated from any number of other commercial clients. This notwithstanding, the nominal presence of uranium and elemental mercury at these locations has generally been accepted as “prima-facie” evidence of a Y-12 connection. Witherspoon operations had been granted AEC or Tennessee “agreement state” licenses to be in possession of radiologically contaminated items.

A 1981 NRC investigation found that DOE sold to David Witherspoon more than 200,000 pounds of steel contaminated with uranium-235. Witherspoon never reported the shipment; the metal was then resold to the Knoxville Iron Company. The NRC was unable to determine what happened to the metal after that point. In 1990, the state of Tennessee named the Witherspoon scrap metal yard a priority for clean-up. Subsequently, the state ordered DOE to fund clean-up operations. However, DOE

invoked the doctrine of sovereign immunity, exempting itself from state authority. Nevertheless, in January of 1992, DOE entered into cleanup negotiations with the state.[136]

6.3 NON-REMEDIATED SITES

As discussed in the previous section, there have been a number of areas in Oak Ridge that necessitated remediation due to having mercury levels greater than 400 ppm or due to the spread of radioactive materials to off-site locations. However, some areas have potentially been impacted by DOE operations, but have never been sampled despite repeated requests by community members and activists. Despite calls for community-wide sampling, the only area in Oak Ridge that has been sampled—other than the properties discussed previously in the remediation section—is the Scarboro community. Specific areas where soil sampling has been requested are Woodland, Union Valley, and Country Club Estates. In addition to soil sampling, a surface smear sampling effort would help allay the public's fears that contamination has been spread throughout the community in public places. [An examination of area maps shows that Country Club Estates is not located near any of the DOE facilities and the neighborhood is not likely to have been contaminated by DOE activities under routine wind conditions. Impacts by water runoff were not evaluated.]

6.3.1 EFPC and Floodplain Properties

ITSPA has identified almost 300 residential and commercial properties that are impacted directly or indirectly by the EFPC. "Impacted" is defined by ITSPA to be that a property contains, is adjacent to, or is up to 1,000 feet from the creek. ITSPA's real estate analysis can be found in Section 7.2. Compared to large commercial property owners, residential and small business property owners potentially face more of a personal economic burden due to their proximity to the creek, and these burdens are greatly affected by negative media coverage. Residential properties also carry an additional burden caused by potential exposure of resident and other children who regularly play in the creek. The risk of economic and other impacts is particularly acute for non-local buyers who move to the community and unknowingly buy properties without knowing the history of the creek and the floodplain.

6.3.2 Scarboro

The Scarboro community is a predominantly African-American neighborhood that is the residential area closest to the Y-12 Plant (i.e., located about one-half mile away). Scarboro is perceived by the public and was assumed by ATSDR to have been impacted most severely by releases from the Y-12 Plant. However, Scarboro residents are quick to point out the EFPC does not run through the residential areas, but lies approximately one-half mile from the nearest residence. A number of residents believe

[136] www.stopthebombs.org/y12/offsitecontamination.html

that the public does not understand this, which they believe has further hurt the marketability of their property.

Information Resources Center (IRC) Document 980301.0114 (undated), *Scarboro Community Study Comments and Responses*, contains public comments on the *Scarboro Community Study* and DOE's responses. IRC Document 990101.0031 presents the analytical results obtained from the environmental study of soil sediment and surface waters within Scarboro. It provides a comparison of the results obtained in this effort with results from previous environmental studies conducted in the Oak Ridge area. However, the Scarboro studies did not include thorium, beryllium, cyanide, acetonitrile, tungsten, and other materials that could have been released from the Y-12 Plant.

There was no air sampling station in Scarboro during the years when releases from Y-12 were highest, although one was installed during the fourth quarter of 1986 near the Scarboro Community Center. Recent air sampling data collected between 1986 and 1995 by DOE showed an elevated ratio of uranium-235 to -238, although the amount detected was still within background levels. The Dose Reconstruction indicated that the presence of those radionuclides in excess of their natural abundance is a clear indication that at least some enriched uranium releases from Y-12 were carried to Scarboro by air during those years. Natural and depleted uranium were also released from Y-12, but those releases are more difficult to distinguish from uranium that is naturally present in air.

The efforts made in recent years by EPA and Florida A&M to sample and test the soil in Scarboro have been fraught with controversy and confusion. As a result of the controversy surrounding their community, some Scarboro residents believe they have been disproportionately impacted in comparison to other neighborhoods likely to have been similarly impacted (e.g., Woodland and Union Valley).

Soil sampling data in Scarboro from the environmental monitoring program in recent years and from the 1998 *Scarboro Community Environmental Study* also show the presence of small amounts of enriched uranium. Releases of depleted uranium from Y-12 have reduced the observed enrichment of uranium in soil samples and add to the problem of interpreting results. The dose reconstruction screening calculations for uranium uptake from soil in the Scarboro community illustrate the difficulties encountered in making such determinations. Unfortunately, no historic soil samples were available from the Scarboro area for the time period of greatest interest (1950 to 1970). Sampling was performed recently (DOE, 1998. *Scarboro Community Environmental Study*), but the results are not representative of earlier years because only surface soil was sampled. [137]

[137] DOE Reading Room Document 990101.0031 presents the analytical results obtained from the environmental study of soil sediment and surface waters within Scarboro. It provides a comparison of the results obtained in this effort with results from previous environmental studies conducted in the Oak Ridge area. Document 980301.0114 (*Scarboro Community Study Comments and Responses*) contains public comments on the Scarboro community study that was performed, as well as DOE's responses to those comments.

In 1992, a focused area aerial survey (discussed in #7 in Section 4.5.1 and Appendix 1-9.5), did not include two-thirds of Scarboro (nor any of Country Club Estates). This exclusion from the flyover caused a public controversy and residents expressed concerns about a cover-up to hide severe contamination. DOE published an explanatory report around 1998 and held two public meetings.

The following is a quote by Jack Hanley, ATSDR's lead for the public health assessment process in Oak Ridge, at the December 2, 2003, ORRHES meeting regarding the use of Scarboro to represent all of Oak Ridge:

> "The question was why did we choose Scarboro as a reference location and so we acknowledge in the document that the prevailing winds go up and down the valley, most of the uranium would have fallen out in this valley, Union Valley and Bear Creek Valley. However, no one lives in those valleys and no one has lived in those valleys since the plants were there. So you look for in a health assessment a community that's likely to have been exposed and, based on the state's evaluation, their modeling…they estimated that Scarboro would have been an established community that would have likely been exposed at the highest levels. So that's why Scarboro was chosen. We acknowledge the City of Oak Ridge is likely to be the community that would have been exposed, the population that would have been exposed. Scarboro is being used to represent the whole Oak Ridge, so this area that we acknowledge is likely not to have been exposed to levels of health concern and the rest of the city wouldn't have. "

6.3.3 Woodland

Woodland is the neighborhood that is the next closest to the Y-12 Plant. Despite the gap in Pine Ridge, which could allow contaminants to blow towards Woodland, little sampling (as far as the public knows) has been done in this community, although Table 2 contains a single data point (i.e., 420 ppm mercury at N. Purdue and Rutgers where the Sewerline Beltway crosses). As a result, community members have called for inclusion of Woodland in any future sampling effort. The following is a quote by ATSDR's Jack Hanley from the minutes of the December 2, 2003, ORRHES meeting regarding Woodland:[138]

> "…these are the air monitoring stations that were used and also many of these monitors we have data from the mid 1980's through the 1990's and the operation slowed down. I think, in the early 1990's and then picked up again later. But during the 1980's we do have monitoring data and that's the data that we used and focused on when we made that assumption about the Woodland community…"
>
> "In addition, we did some additional analysis because some people were concerned about the gap here in the, along Scarboro Rd. here, and they were concerned about the Woodland community. And so, to evaluate that analysis

[138] It is possible to view the videotape of this meeting, which is available at the ATSDR Oak Ridge Field Office (865-220-0295)

there's a monitoring station right here in Bear Creek Valley right at the end. This monitoring station had on average, over ten years or so, a twenty percent higher exposure than Scarboro, but it's in the valley right near the site. With one year being almost twice the exposure as the monitoring station here. So, we made the assumption that if you took the exposures here that they would have received and assumed they were here, we took the dose twice as much as Scarboro, and we added that for this dose here and it still would not have been a public health problem. So, these are points that EPA brought up and we discussed them with EPA Region IV. In addition to that, we have fly-over data…"[139,140]

6.3.4 Union Valley

As a result of many years of small spills and incidental releases in chemical process areas, a plume of *groundwater* contaminated with various chlorinated hydrocarbon organic solvents has been created at the east end of Y-12. The extent of the plume was mapped in off-site areas in the early 1990s and is now slowly moving down gradient to the east into private property areas in Union Valley. According to a 1995 report,[141] the organic concentrations in the groundwater remain relatively low and there is currently no active use of groundwater within the contaminated plume because the area is served by city water.

Union Valley also receives *air emissions* from Y-12. The prevailing winds go up and down the valley and, therefore, blow towards Union Valley much of the time. The following is a discussion by ORRHES regarding historical exposures to Union Valley from air emissions. The following are quotes from the minutes of the December 2, 2003:

Jack Hanley, the ATSDR public health assessor for Oak Ridge (talking about EPA)
"…I don't know if they know about Union Valley, but Union Valley has commercial

[139] Surveys have been made of the ORR and the surrounding area using the Aerial Radiological Measuring System (ARMS). These surveys consist of airborne gamma radiation measurements from both natural- and man-made isotopes on or in the terrain surface. The purpose was to identify gamma-emitting radioactive contaminants, including their concentrations and spatial distribution, particularly those attributable to DOE operations. Note that these flyovers would not detect releases of an alpha-only emitter like plutonium. Airborne radiological surveys were conducted in 1959, 1973, 1974, 1980, and 1989. The 1959 and 1973 data were collected by fixed-wing surveys. The 1974 survey was made by helicopter in order to survey at lower altitudes and slower speeds. (Source: Burson, Z.G., "Aerial Radiological Surveys of ERDA's Oak Ridge Facilities and Vicinity (Survey Period: 1973-1974)" EG&G, Inc. for the U.S. Energy Research and Development Administration (ERDA), 1976)

[140] ORRHES has raised questions regarding whether fly-over data would show uranium. It is primarily an alpha emitter, but ATSDR has indicated to ORRHES that the daughter products would show up in aerial surveys. According to EPA ORIA, however, fly-over gamma spectrometry surveys are not sensitive enough to pick up depleted or enriched uranium (i.e., U-238, U-234 and U-235) without any of the decay products present. According to EPA, uranium can be measured with fly-overs, but it does not cue in on the uranium isotopes. It cues in on radium-226 and the following isotopes that have higher gamma abundance and are in secular equilibrium with their parents, so there is really no measurement of uranium; it is inferred from their decay products. Aerial radiation surveys are incapable of detecting environmental concentrations of depleted or enriched uranium, because the X- and gamma ray photons emitted by U-235 and U-238 are not abundant and of low energies. Detection of the primary U-235 photo-peak is complicated by interference by a similar photon from Ra-226. For these reasons, EPA ORIA believes that additional soil sampling in and around Oak Ridge and nearby communities is necessary to determine the fate and transport of the bulk of uranium released from Y-12. EPA ORIA has indicated it believes that ATSDR should account for the bulk of airborne uranium released from Y-12 in the past. See Section 4.5 for discussion of the differences of opinion between EPA ORIA and ATSDR.

[141] "Health and Ecological Risks at the U.S. Department of Energy's Nuclear Weapons Complex: A Qualitative Evaluation," Tulane/Xavier Consortium for Environmental Risk Evaluation (CERE) Interim Risk Report, March 1995.

development all up and down the valley, there's no one lives there, what other community they would recommend, especially in the fifties, when you didn't have this other portion of Oak Ridge up here; there was no one that lived out there. We have the maps from the fifties…. They didn't say."

ORRHES member Susan Kaplan: "You mentioned that the wind blows down the valley, has anyone gone in and pulled soil samples down the valley to see what those levels are as a comparison to test your hypothesis [Note: The hypothesis is that uranium, because it is heavy, fell close to Y-12, but in the Union Valley direction rather than Scarboro.]?" The answer was no.

ORRHES member Charles Washington: "…The one I'm concerned about is do the air monitors pre-date the Clean Air Act. When did we put those monitors out there and the exact time that we went from 100 percent production of uranium hexafluoride (UF_6) to roughly 10, 15, or 20 percent production? If it is twice, if what we find is twice as much now when we're operating at 10, 15, or 20 percent, what was it when we were operating at 80, 90, and some time 100 percent to the full capacity? You have to take into consideration too that a temperature inversion appears in the valley about most nights at 2:00 when you go out there you can't even see in that valley…."

Paul Charp of ATSDR: "The wind directions for the valley are up and down the valley. If you look at the distribution patterns, maybe five percent of the time the wind would go across the ridge and deposit into the Scarboro area, but it did pick up something….If it is a temperature inversion, most of that will stay inside the valley."

ORRHES member Charles Washington: "When there were emissions that were unplanned they know about them. They did that quite a few times and tried to put some of the blame on TVA. Well, TVA turned around and said, ok, we'll go out there when you're operating at 100 percent, which was in May. They went out at night and soon Y-12 stopped looking at the emissions from the TVA stacks."

6.3.5 Country Club Estates

Country Club Estates is located in the western-most part of Oak Ridge and is located west of the boundary of the western end of the ORR on the northern side of Pine Ridge. EFPC feeder streams flow throughout this neighborhood, which is located south of the Oak Ridge Country Club and Golf Course. The EFPC crosses the northern part of this neighborhood, crossing Gum Hollow Rd. and flowing along the north end of the golf course.

The 1992 focused area aerial survey did not include Country Club Estates (or two-thirds of Scarboro), which caused a public controversy and claims that it was an attempt to cover-up severe contamination in these two neighborhoods. DOE published an explanatory report around 1998 and held two public meetings. However, no sampling has been done in this community.

Note that ITSPA used a Geographic Information System (GIS) system and other maps to pinpoint the location of this neighborhood in relation to the DOE facilities. It appears very unlikely that Country Club Estates would be impacted by air emissions from the facilities because the prevailing wind direction does not blow toward the neighborhood. The area is located a significant distance from any of the plants. Of course, an accident that occurs on a day the wind is blowing in a non-standard direction has the potential to impact this area. ITSPA did not evaluate the potential for impacts from water runoff.

6.3.6 Downstream Areas

A radiological survey was performed on the Clinch River and downstream areas during December 1996 and January 1997 by TDEC and DOE-ORO.[142] Major sites of concern were those areas of the Watts Bar Reservoir used for public swimming and/or recreational activities. (See Figure 5 for a map of the water system.) A primary list of sites to survey was established from a map showing gamma radiation levels taken during a 1994 fly-over of the area and a map showing cesium-137 concentrations from a 1994 report.[143] Table 79 of that report provides the radiological survey data for the sites screened for radioactivity.

Readings of 6,500-8,500 cpm (based on high energy gamma) were obtained at the Solway Park near the Solway Bridge to be used as background readings (see Appendix Table 1-9-5). Two areas were screened at Clark Park (located on Melton Hill Lake portion of the Clinch River). A high reading of approximately 14,000 cpm was detected in the Clark Park picnic area. However, this was determined to be due to a shale outcrop, which is naturally high in gamma-emitting radionuclides.

The Grassy Creek area along the shoreline of the Clinch River was the only site surveyed that had levels greater than twice background. The area had a high of approximately 50,000 cpm and the results for cesium-137 were 7.324 ± 0.088 and 7.462 ± 0.088 pCi/g. [Note that 15 pCi/g for Cs-137 results in a 1×10^{-4} cancer risk, the cut-off level for acceptable risk.] The calculated dose rate for a human who spent every day of a year exposed to the sediments in this area would be 237.4 mrem/year (in addition to the normal annual dose for background of around 360 mrem/year), approximately 10 times the DOE effective dose equivalent limit of 25 mrem/year to the public (DOE Order 5820.2A). These sediments are often under water, which decreases the likelihood of exposure.

Jones Island was surveyed extensively along its bank. However, the levels were unexpectedly low considering its proximity to White Oak Creek discharge into the Clinch

[142] "Radiological Survey of Clinch River Public parks and Recreational Areas from Melton Hill Dam to Kingston," Tennessee Dept. of Environment and Conservation/DOE-Oversight, Robert Storms and Dale Rector, March 20, 1997.

[143] "Data Summary for the Near-shore Sediment Characterization Task of the Clinch River Environmental Restoration Program," D. A. Levine, W. W. Hargrove, K. R. Campbell, M. A. Wood, C. D. Rash, Environmental Sciences Division, Oak Ridge National Laboratory, ESD Publication 4318, October 1994.

River. This may be explained by the coffer dam on White Oak Creek, which inhibits sediment migration. Another explanation could be erosional (as opposed to depositional) processes along the island's banks.

One area of interest that was not surveyed was the Campbells Bend area near the K-25 Plant. It was to be surveyed as part of Parcel 1 of the Footprint Reduction Project. There was no visible sediment deposition in this area and a preliminary walkover did not detect any elevated levels of radionuclides.

No areas of concern were observed at the Gallaher Boat Ramp (off Route 95), 58 landing in Kingston, the Kingston Apartments beach area, the area underneath the I-40 bridge in Kingston (downriver from the TVA Kingston Steam Plant), Kingston City Park, north of Brashear Island, Brashear Island, Johnsons Creek, and three areas located on Jones Island.

Although contaminants were found in the Watts Bar Reservoir, the decision was made by the government to leave the deposit of pollutants in place, because they are located a couple of feet down in the sediment.[144] There was an out-of-court-settled lawsuit by the owners of several resorts in Kingston, who claimed their businesses had been damaged by the disclosure of the releases. This suit was filed in 1991 and was settled in 1994.[145, 146]

A source of information on the Watts Bar Reservoir is "The Utility of Existing Data Sets for Conducting a CERCLA Baseline Risk Assessment for Lower Watts Bar Reservoir: An Analysis of Quantitation Limits."[147] This document focuses on contaminants in water, sediment, and wildlife, and it indicated the minimum quantitation limits for two inorganics, beryllium and thallium, exceeded the human risk reference criteria (RC).

Another document of interest (see Appendix 1-8) for the downstream areas is the recommendations submitted by a local federal advisory committee (Oak Ridge Reservation Environmental Management Site Specific Advisory Board, ORREMSSAB) to the Oak Ridge Environment Quality Advisory Board (4/1/97) on DOE's *Proposed Plan for Clinch River/Poplar Creek Operable Unit* (October 16, 1996). The following are excerpts from that document. Of particular interest are comments regarding near-shore sediments and the assumptions regarding children. Note that ITSPA did not contact the ORREMSSAB, EQAB, or DOE to determine if the recommendations in this document were followed by DOE. The Federal Advisory Committee Act (FACA) only requires

---

[144] "Cold War Fears Added To Pollution Of Streams (Uranium Pollution—Our Nuclear Legacy," *Knoxville News Sentinel*, 6/28/85

[145] "Watts Bar Lake Resorts Sue Over Contamination," *The Oak Ridger*, 9/1/91.

[146] "Resort Owners at Watts Bar Settle Out of Court With MMES," *The Oak Ridger*, 8/5/94

[147] "The Utility of Existing Data Sets for Conducting a CERCLA Baseline Risk Assessment for Lower Watts Bar Reservoir: An Analysis of Quantitation Limits," ORNL/ER-233, Martin Marietta, July 1994.

DOE to consider a recommendation. The agency is not required to follow any recommendation submitted by a FACA-chartered committee.

> "In the plan, only sediments in the main channel of the Clinch River or main creek bed of the Poplar Creek are noted to present potential risk to human health. Nothing is said in the Plan about how the preferred alternative protects the public from contamination of near-shore sediments. A reader could conclude that no significant levels of contaminants were found to be present in near-shore sediments. For instance, Tables E-35 through E-37 (Appendix E, RI/FS) clearly show that a number of contaminants exceed the acceptable non-carcinogenic hazard index of 1.0 for several reaches of the Clinch River and the Poplar Creek. The carcinogenic risk level of 10^{-4} (1 part in 10,000) is also exceeded when risks are added across pathways for some subreaches. There is no indication in the Plan why these risk levels are acceptable"
>
> "Also, some of the Clinch River reaches with unacceptable risk levels are outside the ORR and the ORREMSSAB is concerned that risks from exposure to contaminants in near-shore sediment in recreational areas are not well characterized. In the RI/FS, the data for near-shore sediment were analyzed by subreach and the presence of recreational areas was not emphasized. Samples collected were surface "grab" samples that extended only to about 10 cm in depth."
>
> "For instance, the Kingston City Park is located in subreach 4.04. This subreach begins at the Park and extends for 1.5 miles to the mouth of the Clinch River. According to Table C-1 (Appendix C of the RI/FS), 25 near-shore samples were collected in subreach 4.04. These data were used to obtain one representative concentration that was used to calculate risk for subreach 4.04. However, only two samples were collected from the Kingston City Park area and it is not clear whether any samples were taken from the swimming area. Risks were not calculated for the Kingston City Park itself. Therefore, the ORREMSSAB recommends that core samples be collected at 50 ft. to 100 ft. intervals at known recreation areas along the Clinch River prior to the Record of Decision….."
>
> "On p.5-19 of the RI/FS it is stated that only adults were considered for exposure to carcinogens in the risk assessment because the end result would not be substantially different than if children were considered. It is generally accepted in the health sciences community that children may be more susceptible to the effects of carcinogens than adults. Therefore, the ORREMSSAB recommends that risk calculation for child exposures to carcinogens be conducted and the RI/FS amended to include them….."

CHAPTER 7.0 ITSPA RESEARCH ACTIVITIES AND FINDINGS

This chapter discusses the primary research conducted by ITSPA during this project and presents the findings. In establishing the focus of its efforts, ITSPA worked towards meeting the goals stated in the project proposal (listed in Chapter 2). However, in addition to meeting these original goals, there were many other accomplishments that resulted from ITSPA's primary and secondary research. These accomplishments also are listed in Chapter 2.

In addition to the secondary research that went into writing this report, the following are the primary research activities that ITSPA conducted in order to meet the project goals: (1) conducting a driving tour of EFPC properties, (2) performing a real estate analysis using GIS data available on-line and public records available at the county courthouse, (3) obtaining input from residents and property owners along the creek via a short-form survey and personal interviews, and (4) getting input from governmental entities (i.e., the city, state, and DOE)

7.1 DRIVING TOUR OF EFPC PROPERTIES

Over the period from May 30 to June 5, 2002, ITSPA's project team, consisting of the author of this report and the SENES technical advisor (Dr. Gordon Blaylock), took a driving tour of the Oak Ridge streets potentially impacted by the release of contaminants from the Y-12 Site via the EFPC (referred to here as the primary stream). The team also investigated feeder streams (referred to as secondary streams) flowing into the EFPC.

Table 3 lists the streets that were part of the driving tour whose purpose was: (1) to identify properties directly and indirectly impacted by the creek and its floodplain, (2) to identify appropriate streets to target in a future survey, (3) to examine the accessibility of the creek by the public, and (4) to assess the current state of government efforts to warn the public and property owners against use of the creek and the floodplain.

The areas toured were captured via digital photographs, which were assembled at the beginning of this project (i.e., 2002) into a narrated slideshow. Unfortunately, the software used is no longer supported by the company and further work is required to convert it to another program to make it readily available to the public.

7.1.1 Assumptions

The level of risk to the public from contaminants in the primary and secondary streams is a matter of some confusion and controversy in Oak Ridge. However, for the purposes of this tour, the *primary stream* was assumed to have contaminated water and sediments, as well as contaminated fish, turtles, and other biota. This assumption was made because the EFPC is posted by the State of Tennessee and, in addition to the ban on eating fish and turtles from the creek, signs along some portions of EFPC indicate contact with water or sediment is not allowed. The team assumed the major concern in

secondary streams is contaminated fish and turtles moving upstream from EFPC, as opposed to contaminated water and sediments. Note, however, in flood conditions, contaminated water and sediment could potentially back up into the feeder streams.

Fish, turtles, and other biota exposed to the waters and sediment from the EFPC generally have both internal and external contamination. However, internal contamination is the main concern and the team assumed external contamination generally is of little concern. Primary contaminants of concern in the fish and turtles are mercury and PCBs, but others could include radionuclides. The main issue of concern with these contaminants is that, even though the concentrations of contaminants in the water are generally low today, certain contaminants accumulate and concentrate in fish, turtles, and aquatic organisms. For example, methylmercury (which makes up approximately 95 percent of the mercury found in fish) concentrates to high levels, as does cesium-137. The concentration factor for cesium-137 is approximately 2,000 (i.e., concentration of contaminant in the fish divided by the concentration of the contaminant in the water). The concentration factor in fish for metallic mercury and several other forms of mercury is much lower than the concentration factor for methylmercury. The 1993 ATSDR Health Consultation indicates methylmercury biomagnifies in fish on the order of 10,000 to 100,000 times the concentration found in ambient waters.

TABLE 3
GUIDE TO FINDINGS OF DRIVING TOUR BY ITSPA

POTENTIALLY IMPACTED ROADS/SITES*	TOURED?	ACCESS TO CREEK*	OBSERVATION REFERENCE (SECTION 7.1.2)
AmVets	Y	P	See Number 13
Arbor Place Apartments	Y	P	See Number 2
Auburn Hills	Y	P	See Number 4
Badger Ave.	N	S	See Number 22
Big Turtle Park	Y	P	See Number 21
Bobby Gray Ball Field	Y	S/P	See Number 3
Burnham Woods Subdivision	Y	P	See Number 4, 5
Cappiello Office Complex	Y	P	See Number 6
Carden Apartments	Y	P	See Number 2
Continuum Courtyard	Y	S	See Number 16
Dean Stallings Ford	Y	P	See Number 2
Dental Complex	Y	P	See Number 6
Fairview Apartments	Y	P	See Number 4
First Wesleyan Church	Y	P	See Number 12
Gates Dr.	Y	P	See Number 18, 19
Girls, Inc.	Y	P	See Number 13
Goldenview Ln.	Y	P	See Number 17
Golfcrest Ln.	Y	P	See Number 17
Graceland Rd.	N	S	See Number 16, 22
Grandcove Ln.	Y	P	See Number 17
Greenwood Ln.	Y	P	See Number 17
Greystone Dr.	N	S	See Number 16, 22
Greywood Pl.	Y	S	See Number 22
Gum Hollow Rd.	Y	S/P	See Number 16
Heritage Fellowship and Pre-school	Y	P	See Number 10
Hermitage Blvd.	Y	P	See Number 21
Hopkins/Strang Field	Y	S/P	See Number 3
Illinois Ave., S.	Y	P	See Number 1, 2, 5, 6, 7
Illinois Ave., N.	Y	P	See Number 10, 11
Ingrahm Ln.	Y	P	See Number 10, 11
Jackson Crossing	Y	P	See Number 21
Jefferson Cir.	Y	P	See Number 12
Jefferson Ct.	Y	P	See Number 12
Jefferson Terminal Rd.	Y	P	See Number 12
Kroger	Y	P	See Number 2, 3
La Petite Academy	Y	P	See Number 6

Continued…

TABLE 3 (CONT.)
GUIDE TO FINDINGS OF DRIVING TOUR BY ITSPA

POTENTIALLY IMPACTED ROADS/ SITES*	TOURED?	ACCESS TO CREEK*	OBSERVATION REFERENCE (SECTION 7.1.2)
Lincoln Mercury	Y	P	See Number 2
Monterey Rd.	Y	P	See Number 21
Mullins Performance Car Wash	Y	P	See Number 2
Naples Ln.	N	S	See Number 22
National Guard Armory	Y	P	See Number 13
National Oceanographic and Atmospheric Administration	Y	P	See Number 2
Nebraska Ave.	N	S	See Number 22
New Haven	N	S	See Number 22
Normandy Rd.	N	S	See Number 22
Oak Ridge Country Club	Y	S/P	See Number 16
Oak Ridge Inn and Suites	Y	P	See Number 2
Oak Ridge Storage	Y	P	See Number 2
Oak Ridge Suites	Y	P	See Number 4
Oak Ridge Turnpike	Y	P	See Number 9, 10, 14, 17
Oklahoma Ave.	N	S	See Number 22
Public Housing Authority	Y	P	See Number 9
Racoon Ave.	N	S	See Number 22
Ramada Inn (former site)	Y	P	See Number 2
Robertsville Middle School	Y	P	See Number 9, 10, 11
Robertsville Rd.	Y	P	See Number 12
Ronald Wright, DDS	Y	P	See Number 6
Royce Cir.	Y	P	See Number 12
Scarboro Community	Y	S/P	See Number 3, 4
Scarboro Rd.	Y	P	See Number 1
Southwood Ln., W. & E.	Y	P	See Number 14, 20
State Highway 95	Y	P	See Number 14, 17
Steve Hammons DDS	Y	P	See Number 2
Sunrise Apartments	Y	P	See Number 4
Sweetgum Ln.	Y	P	See Number 19
Tamara Ln.	Y	P	See Number 4
Tansi Ln.	Y	P	See Number 4
Targa Ln.	Y	P	See Number 4
Telemann Ln.	Y	P	See Number 4
Tempura Dr.	Y	P	See Number 4
Terri Ln.	Y	P	See Number 4
Therapy Center	Y	P	See Number 2

Continued…

TABLE 3 (CONT.)
GUIDE TO FINDINGS OF DRIVING TOUR BY ITSPA

POTENTIALLY IMPACTED ROADS/ SITES*	TOURED?	ACCESS TO CREEK*	OBSERVATION REFERENCE (SECTION 7.1.2)
Tidewater Ln.	Y	P	See Number 4
Tiffin Dr.	Y	P	See Number 4, 5
Tiffany Pl.	Y	P	See Number 4
Tracy Ln.	Y	P	See Number 4
Trenton Dr.	Y	P	See Number 4
Trevecca Ln.	Y	P	See Number 4
Tulsa Rd.	Y	P	See Number 4, 6
Tulsa Rd., E.	Y	P	See Number 3, 4
Tusculum Dr.	Y	P	See Number 4
Tuskegee Dr.	Y	P	See Number 4
Utica Circle	Y	P	See Number 4
Valley Forge Dr.	Y	P	See Number 7
Valpariso Rd.	Y	NA	See Number 8
Van Hicks Pl.	Y	P	See Number 9
Van Hicks Rd.	Y	P	See Number 9
Vanderbilt, East	Y	P	See Number 5, 7, 8
Village Apartments	Y	P	See Number 12
Villanova Rd.	Y	NA	See Number 8
West Gate Apartments	Y	P	See Number 18
Wilberforce Rd.	Y	S/P	See Number 3
Wilderness Trace Condominiums	Y	P	See Number 7
William G. Harris, DDS	Y	P	See Number 6
Wiltshire Dr.	Y	P	See Number 15
Wiltshire Estates	Y	P	See Number 15
Woodbury Ln.	Y	S/P	See Number 3
Y-12 Site	Y	P	See Number 1
YWCA	Y	P	See Number 13

* P = Primary waterway — A site that provides direct access (i.e., adjoins the creek and/or its floodplain) or indirect access (i.e., within relatively easy walking distance) to the primary waterway, EFPC.

S = Secondary waterway — A site that provides access to a secondary waterway (or feeder stream) that feeds local runoff into EFPC. A secondary waterway may contain contaminated fish and turtles and may periodically receive backed up floodwaters and sediments from the primary waterway.

Y = Yes N = No NA = Not accessible

Source: ITSPA

7.1.2 Observations

In the following observations, a portion of the stream described by the team to be "easily accessible and inviting" has flowing, non-stagnant water, few fallen trees and debris littering the creek bed, and easy access from an area that is generally unblocked by foliage, fallen trees, and debris. See Table 3 for a guide to the findings by location/road.

1. The tour began at the beginning of the creek at the Y-12 Site and proceeded along Scarboro Rd. to S. Illinois Ave. TDEC warning signs are posted in very obvious locations along Scarboro Rd. just outside of the Y-12 Site. Access to the creek at this location is impeded by a barbed wire fence. [Note, however, that barbed wire was not observed by the team in any other location along the creek.]

2. The team then proceeded north on S. Illinois to the back of the Kroger grocery store. They concluded the potential exists for the public to easily access the creek along this route. However, much of the land along the creek is commercial property (e.g., Mullins Performance Car Wash, Steve Hammons DDS, Lincoln Mercury, Oak Ridge Storage, Therapy Center, Dean Stallings Ford, National Oceanographic Atmospheric Administration, Carden Apartments, Oak Ridge Inn and Suites (i.e., formerly Ramada Inn), Kroger, Arbor Place Apartments). An inspection of the creek at the Hammons DDS and Lincoln Mercury properties revealed it was easily accessible and inviting and there was no barbed wire fence present. However, a warning sign was posted in a conspicuous place at the Hammons DDS property.[148] The creek appeared similarly accessible and inviting to children at the other commercial properties.

3. From Kroger, the team proceeded to E. Tulsa, Wilberforce Ave., and Woodbury Ln. (located beside Hopkins/Strang Field), which are located in the Scarboro community. There are no private residences on or near the EFPC in this area, but the team found the creek easily accessible to the public and generally secluded along Woodbury Ln., which it essentially parallels. The team concluded this seclusion might attract children, who also would likely ignore any signs warning against contact with the water or sediments. However, the team could not determine if signs were present along Woodbury Ln. due to the vegetation blocking the view of the creek. A sign was obvious at the intersection of EFPC and E. Tulsa. A secondary waterway crosses Woodbury Lane and the driveway to the Bobby Gray Ball Field, which is located on Wilberforce Ave.

4. From Scarboro, the team followed E. Tulsa Rd. to Tulsa Rd., Tuskegee Dr., and Tusculum Dr. The areas of concern here are the Fairview Apartments (located at the intersection of Tulsa Rd. and Utica Circle) and the Burnham Woods Subdivision. These areas are located near an easily accessible part of the creek that could attract children, and no warning signs were apparent on the southwest

[148] ITSPA revisited this property on 9/26/02 and this sign, which had been previously captured in a photo, had been removed. See Section 7.4.1 (questions #1 through #4) for a discussion of signs and property owner rights.

side. On the northeast side of the street, a sign appeared to be obscured by vegetation. In Burnham Woods, access is of particular concern for residents along Tusculum Dr., Tiffin Dr., and Trenton Dr., which are located a very short walking distance from the creek. Roads in this subdivision that are located farther away, but still within walking distance, are Tamara Ln., Tansi Ln., Targa Ln., Telemann Ln., Tempura Dr., Terri Ln., Tidewater Ln., Tiffany Place, Tracy Ln., and Trevecca Ln. In addition to single-family dwellings, the neighborhood has three multi-family complexes: a retirement complex (i.e., Auburn Hills), and two apartment complexes (i.e., Oak Ridge Suites and Sunrise Apartments).

5. The team observed the creek along the northern portion of S. Illinois Ave. from the Burnham Woods area that overlooks Illinois (i.e., intersection of Tiffin and E. Vanderbilt). They concluded this portion of the creek is not easily accessible due to a steep, rocky embankment and the fact it runs parallel to S. Illinois Ave. in a high traffic density area that offers little privacy.

6. Following Tulsa Rd. towards S. Illinois Ave., the team inspected the grounds of the Dental Complex, which houses Drs. William G. Harris and Ronald Wright. This site has a very nice, relatively secluded picnic area along the creek. However, warning signs are conspicuously posted. The daycare, La Petite Academy, is located on one side of the Dental Complex and the Cappiello Office Complex is on the other side. The creek runs behind these buildings as well.

7. The team then went to E. Vanderbilt Dr. (left turn off S. Illinois Ave.) and Wilderness Trace Condominiums (Valley Forge Dr.). They concluded the condominium site provides relatively easy access to an inviting portion of the creek, as well as seclusion. Note this area did have one sign (located near the E. Vanderbilt bridge just off S. Illinois) warning against contact with the water and eating the fish.

8. The team proceeded up E. Vanderbilt Dr. to Valpariso Rd. and Villanova Rd. The downhill descent required to access the creek from these streets appeared to serve as a sufficient deterrent to access by the public. In addition, the creek along this area is located in a very public area with high traffic density.

9. Next, the team went west on Oak Ridge Turnpike and then north on Van Hicks, which is the site of a public housing unit operated by the Public Housing Authority. This site poses a concern in regards to easy access to an inviting part of the creek. However, there are two warning signs posted in very noticeable locations on the south bank of the creek. There also is a sign posted on the opposite (i.e., north) side of the creek, which can be accessed via a bridge apparently used by school children walking to Robertsville Middle School. However, the sign on the north (i.e., school) side is less obvious than the signs on the south (i.e., Housing Authority) side.

10. The team then went east on Oak Ridge Turnpike, north onto N. Illinois Ave., and west onto Ingrahm Ln., which is the site of a church and pre-school (Heritage Fellowship and Pre-school). This facility is located beside Robertsville Middle School. However, the team concluded that a fence, the distance to the creek, and the level of adult supervision likely to be provided by the church staff, members, and parents should be sufficient to prevent children from accessing the creek from this facility. Nevertheless, an educational program might still be appropriate.

11. Robertsville Middle School is located just north of Ingrahm Ln. on N. Illinois Ave. The team concluded an educational effort for the school and the community in general may be justified because of easy access to the creek for the students and neighbors, and the fact that children likely play unsupervised on the school grounds. (See Numbers 9 and 10 above.)

12. The team went west on Robertsville Rd. to Royce Circle (location of First Wesleyan Church and Village Apartments), Jefferson Circle, Jefferson Ct., and Jefferson Terminal Rd. All of these areas appear to provide relatively easy access to a nice portion of the creek, as well as a private environment that might entice neighborhood children. (See Number 13 below.)

13. Other sites located near the Jefferson/Robertsville leg of the creek that may pose concern because of easy access for children are the Girls, Inc., the YWCA, the National Guard Armory, and the AmVets facilities. The part of the creek located behind AmVets and the Armory has a very nice and secluded walking trail beside it. See the report cover for a picture of this site. Warning signs are not visible, although this would be a good place to post one. Note a bicycle is submerged in the water and trash is present, indicating some use by the public. This portion of the creek appears accessible from the areas mentioned in Numbers 9, 11, and 12 above.

14. Next, the team went west on Oak Ridge Turnpike/State Highway 95, which the creek essentially follows westward. The land surrounding the creek and the roadway is flat and provides easy access and seclusion for the length of the road to Southwood Lane, E. and W. (where the tour ended).

15. The team went south on Wiltshire Dr. (off the Oak Ridge Turnpike), which crosses the creek at one location. EFPC is very accessible at this location, particularly from the properties near the road because they have level terrain. The creek directly adjoins a number of other properties in Wiltshire Estates, but the terrain appeared to be quite hilly. However, despite the hills, a motivated child could probably hike to the creek.

16. Gum Hollow Rd. intersects the creek at one location, i.e., near the northern boundary of the Oak Ridge Golf and Country Club. There are no residences on the portion of this road near the creek. However, there is a fairly extensive feeder stream that could contain contaminated fish and turtles that migrate from the

creek. Continuum Courtyard is located along the feeder stream closest to EFPC. Homes on Graceland Rd. and the northern leg of Greystone Dr. also are on a feeder stream, but are located far from the creek.

17. The tour continued west on Oak Ridge Turnpike/State Highway 95 to the neighborhood made up of Goldenview Ln., Golfcrest Ln., Grandcove Ln., and Greenwood Ln. These areas provide easy access to the creek.

18. The West Gate Apartment complex is located further west on Gates Dr. (south turn off the Highway). This complex is located near the creek and provides easy access.

19. Sweetgum Ln. is located west of Gates Dr. The subdivision consists of approximately 12 houses, with those on the south side adjoining the floodplain and providing easy access to the creek.

20. E. Southwood Ln. is in a subdivision that appeard to be made up of several spec houses, a number of which were unoccupied. However, some were occupied—one of which had a swingset located quite near the creek, likely in the floodplain. W. Southwood Ln. has lots for sale, but no homes were built at that time, although this is not the case now. The team walked some lots located at the end of W. Southwood, which are located quite near the creek and adjoin the floodplain. There were no warning signs posted along the creek and the lots appeared to have the potential for being sold as prime real estate because of their status as creek-side lots. This is particularly true for the south-most lots, which are located on a very inviting part of the stream.

21. Jackson Crossing is a relatively new subdivision comprised primarily of Monterey Rd. (the road beside Big Turtle Park) and Hermitage Blvd. (off Monterey Rd.). This neighborhood is located near a part of EFPC that appeared to be a very inviting place for children to play. From the road, no warning signs were visible along the creek.

22. The following roads (located in the western part of Oak Ridge) were determined (via touring or map) to not provide access to EFPC, but are located near feeder streams: Graceland Rd., Greystone Dr., Greywood Pl., Naples Ln., Nebraska Ave., New Haven, Normandy Rd., Oklahoma Ave. Badger Ave. and Racoon Ave. are located near a feeder stream, which runs behind the Civic Center.

7.2 REAL ESTATE ANALYSIS

A real estate analysis was undertaken to identify landowners that have been impacted by EFPC, both directly and indirectly. Note that quantifying impacts on owners of property along and near the EFPC in terms of dollars collectively and on an individual landowner basis, as well as documenting the vacancy rate of these properties compared to other Oak Ridge areas, proved extremely difficult. Not only was information needed to quantify economic impact on specific properties scanty and difficult to obtain from government records, but a number of property owners seemed reluctant to discuss this issue with ITSPA. See Section 3.5 for quantitative examples of economic impacts on property owners.

Geographic Information Service (GIS) data have recently become available on-line, and these data served as the basis for ITSPA's real estate analysis. Roane County data only became available in recent months, but the Anderson County data has been available for some time. [149] These data can be found on-line at http://gis.cortn.org. Prior to this information being available on-line, ITSPA had to search databases physically located at the Anderson County and Roane County Courthouses and the Oak Ridge City Municipal Center.

ITSPA gathered property value information, but did not include it in this report to limit the size of this already lengthy report. ITSPA also attempted to gather sales history data, which would have enabled ITSPA to determine the number of times a property had been sold since the mid-1980s when the mercury scare took place. Although such an analysis was done for some of the properties, information was scanty, difficult to obtain, and of questionable completeness. Therefore, that effort was abandoned and the information that was gathered is not included in this report.

ITSPA decided to base the impact analysis on an evaluation of the properties' *distance from the creek*, i.e., the closer to the creek the greater the impact. Note, the distances reported by ITSPA are extremely rough approximations based on measurements taken from the GIS maps, which also could have errors. Also note that ITSPA found several errors in the GPS property data reports, so care should be taken in its use. Note the estimations did not take into account topological characteristics of the land, such as very steep hills and valleys, which could make it very difficult for an individual to gain access to the creek from a particular property. *Because of these limitations of the data, readers of this report should take great care in using these data.*

ITSPA attempted to identify all properties adjacent to or in very close proximity to the EFPC and located in the city of Oak Ridge (both Roane and Anderson Counties). Therefore, the closer the proximity to the creek, the greater the likelihood of a property's being identified and included in this study, although a few properties at significant distances from the creek (i.e., greater than 1,000 feet) were selected for inclusion in Table

[149] ITSPA was told by Oak Ridge City employee Mark Skiles the entire state is now on-line.

6 simply for comparison. However, they are not included in the analysis presented in Tables 4 and 5.

ITSPA identified 293 properties through the driving tour (see Section 7.1) and the analysis of the GIS data, 17 of which are located at greater than 1,000 feet from the creek. Those properties that are directly impacted by the EFPC are indicated by an asterisk (*) in Table 6. This indicates the creek runs through or touches the property at any location. Distances are provided for those properties that are not directly impacted. *Note, however, it is very likely that ITSPA did not succeed in identifying all of the impacted properties along the creek. Therefore, again, readers of this report should take great care in using these data.*

ITSPA assumed that indirect impacts are influenced greatly by the property's distance from the creek (i.e., the closer the greater the impact). Although ITSPA acknowledges that impact is greatly influenced by a property's topological characteristics (i.e., a steep embankment or hill likely decreases the potential impact), topology was not taken into account. The distances provided reflect the closest approximate distance to the creek estimated by ITSPA using the best available map from the web site http://gis.cotrn.org.

Tables 4 and 5 summarize the results of ITSPA's analysis of the distances of the identified properties to the creek. Table 4 provides an analysis of the number of properties while Table 5 provides an analysis based on percentage. For these analyses, ITSPA grouped the properties into three use categories: (1) Education/Children (eight properties), (2) Business Zoning/Adult Oriented (81 properties), and (3) Residential (187 properties). Note that properties greater than 1,000 feet are not included in this discussion. The reason is that only a few selected properties at greater than 1,000 feet were evaluated because the focus of this study was on identifying properties close to the creek, not those far away.

For the eight Education/Children Application properties, four are adjacent to the creek (50%); two (25 %) are within one to 100 feet, zero (0 %) are within 101 to 300 feet; and two (25 %) are within 301 to 1,000 feet. For the 81 Business Zoning/Adult Oriented Application properties, 32 (39.5%) are adjacent to the creek; 12 (14.8 %) are within one to 100 feet; 24 (29.6 %) are within 101 to 300 feet; and 13 (16.0 %) are within 301 to 1,000 feet. For the 187 Residential Application properties, 52 (27.8%) are adjacent to the creek; 81 (43.3 %) are within one to 100 feet; 25 (13.4 %) are within 101 to 300 feet; and 29 (15.5 %) are within 301 to 1,000 feet.

When analyzed as a whole (i.e., all 276 properties ungrouped), 88 (31.9%) are adjacent to the creek; 95 (34.4 %) are within one to 100 feet; 49 (17.8 %) are within 101 to 300 feet; 44 (15.9 %) are within 301 to 1,000 feet.

TABLE 4
ANALYSIS SUMMARY FOR OAK RIDGE PROPERTIES IN CLOSE PROXIMITY TO EAST FORK POPLAR CREEK
(NUMBER OF PROPERTIES)

		PROXIMITY TO CREEK (FEET)*			
LAND USE APPLICATIONS	**TOTAL NUMBER OF PROPERTIES**	**ADJACENT**	**1-100**	**101-300**	**301-1,000**
Education/Children	8	4	2	0	2
Business Zoning/Adult Oriented	81	32	12	24	13
Residential	187**	52	81	25	29
TOTAL	276	88	95	49	44

* There are many more properties at a distance greater than 1,000 feet than were identified in Table 6. Therefore, properties greater than 1,000 feet are not included in this analysis.

** Condominiums and apartments, which have numerous tenants in residence, are counted in this analysis only once.

TABLE 5
ANALYSIS SUMMARY FOR OAK RIDGE PROPERTIES IN CLOSE PROXIMITY TO EAST FORK POPLAR CREEK
(PERCENTAGE)

		PROXIMITY TO CREEK (%)			
LAND USE APPLICATIONS	**TOTAL PERCENTAGE**	**ADJACENT**	**1-100**	**101-300**	**301-1,000**
Education/Children	100	50	25	0	25
Business Zoning/Adult Oriented	100	39.5	14.8	29.6	16.0
Residential	100	27.8	43.3	13.4	15.5
TOTAL	100	31.9	34.4	17.8	15.9

TABLE 6
ANALYSIS OF OAK RIDGE PROPERTIES IN CLOSE PROXIMITY TO EAST FORK POPLAR CREEK

GEOGRAPHIC INFORMATION SYSTEM NUMBER (OLD MAP NUMBER)	CURRENT PROPERTY OWNER+	ADDRESS	PROPERTY ZONING	NUMBER OF ACRES	ESTIMATED DISTANCE FROM CREEK (FEET) *
Business Zoning / Adult Oriented Applications (See 1-85)					
1. 001099M A 01000 (19 CA 004)	Lendon E. Hart	S. Illinois Ave.	B2 General Business Districts	3.5	*
2. 001099M A 01200 (20 CA 007)	A.P. Cappiello Jr.	216 S. Illinois Ave.	B2 General Business Districts	4.79	*
3. 001099M A 02000 (20 CA 11)	A&M Enterprises (Oak Ridge Putt Putt)	Tuskeegee Dr.	B2 General Business Districts	2	*
4. 001099M A 02200 (20 BZ 001)	A&M Enterprises—C&H Carwash	133 Tulsa Rd.	B2 General Business Districts	6.96	*
5. 001099M A 02300 (19 BZ 40705)	U. Patel Etux Vasant	0 Tulsa Rd.	B2 General Business Districts	2.25	*
6. 001099N A 00200 (18 BZ 001)	Davco Restaurants, Inc.	108 S. Illinois Ave.	UB2 Unified Business Districts	1.9	*
7. 001099N A 01100 (18 BZ 003)	Creekside Investors Ltd.	136 S. Illinois Ave.	O2 Office/UB2 Unified General Business	1.21	*
8. 001099O A 00400 (17 BY 342)	Fraternal Order of Eagles	1650 Oak Ridge Turnpike	O2 Office Districts	2.94	*
9. 001099O A 00900 (16 BX 533.01)	City of Oak Ridge	NA	O2 Office Districts	1.98	*
10. 001099O A 01000 (16 BX 005)	American Veterans	190 Adams Ln.	O2 Office Districts	1.46	*
11. 001099O A 01300 (17 BX 535)	National Guard Armory	1790 Oak Ridge Turnpike	O2 Office Districts	8.29	*

Continued…

TABLE 6 (CONT.)
ANALYSIS OF OAK RIDGE PROPERTIES IN CLOSE PROXIMITY TO EAST FORK POPLAR CREEK

GEOGRAPHIC INFORMATION SYSTEM NUMBER (OLD MAP NUMBER)	CURRENT PROPERTY OWNER+	ADDRESS	PROPERTY ZONING	NUMBER OF ACRES	ESTIMATED DISTANCE FROM CREEK (FEET) *
Business Zoning / Adult Oriented Applications (See 1-85)					
12. 001099O A 01500 (16 BX 464.03)	Rocky Top Properties	30 Jefferson Ave.	B2 General Business Districts (Commercial-Retail)	1.27	*
13. 001099O A 01600 (16 BX 464.02)	Carrol Retux Greene c/o Green's Cycle Shop	38 Jefferson Ave.	B2 General Business Districts (Commercial-Retail)	66	*
14. 001099O A 01700 (16 BX 464.01)	Carrol R. & Shirley Greene	40 Jefferson Ave.	B2 General Business Districts	82	*
15. 001099O A 01800 (16 BX 464.00)	Jerry D. & Phyllis L. Greene	50 Jefferson Ave.	B2 General Business Districts	140	*
16. 001099O A 01900 (16 BX 465.00)	David H. & Pamela Tate	68 Jefferson Ave.	B2 General Business Districts	165	*
17. 001099O A 02000 (16 BX 466.01)	David H. & Pamela Tate	100 Jefferson Terminal	B2 General Business Districts	2.35	*
18. 001104N A 00201 (16 BQ 559)	Nancy Stanley	Oak Ridge Turnpike	UB2 Unified Business Districts	20.56	*
19. 001104N A 00202 (16 BQ 559)	Jackson Crossing LLC	Hermitage Blvd.	UB2 Unified Business Districts	5.6	*
20. 011105C A 00200 (18 BZ 606)	CGSOR Inc.	Tulsa Rd.	O2 Office Districts	1.43	*
21. 001105C A 00700 (19 BZ 606.04)	Oak Ridge FM Inc.	114 Tulsa Rd.	O2 Office Districts	3.49	*
22. 001105D A 00900 (21 CA 460.02)	Ray Carden	106 Inn Ln.	B2 General Business Districts	5.15	*

Continued…

TABLE 6 (CONT.)
ANALYSIS OF OAK RIDGE PROPERTIES IN CLOSE PROXIMITY TO EAST FORK POPLAR CREEK

GEOGRAPHIC INFORMATION SYSTEM NUMBER (OLD MAP NUMBER)	CURRENT PROPERTY OWNER+	ADDRESS	PROPERTY ZONING	NUMBER OF ACRES	ESTIMATED DISTANCE FROM CREEK (FEET) *
Business Zoning / Adult Oriented Applications (See 1-85)					
23. 001105D A 01000 (21 CA 460.01)	Ray & Joan Carden	107 Inn Ln.	B2 General Business Districts	2.06	*
24. 001105D A 01600 (22 CB 058)	Dean & Emma Bea Stallings	480 Illinois Ave.	UB2 Unified General Business Districts	4.01	*
25. 001105D A 01800 (22 CB 057)	Dennis J. Wheeler	500 Scarboro Ln.	UB2 Unified General Business Districts	2.69	*
26. 001105D A 01900 (22 CB 059)	Dennis J. Wheeler	502 Scarboro Rd.	UB2 Unified General Business Districts	1.6	*
27. 001105D A 02000 (23 CB 001)	Group Bremfour LLC or Lincoln Mercury	504 Scarboro Ln.	UB2 Unified General Business Districts	1.41	*
28. 001105D A 02100 (23 CB 002)	Steven & Rebecca Hammons	508 Scarboro Ln.	UB2 Unified General Business Districts	1	*
29. 001105D A 02200 (23 CB 003)	Eastern Racing Corp.	510 Scarboro Ln.	UB2 Unified General Business Districts	1	*
30. 001105D A 02300 (22 CB 571)	Robert Monday Realty Co.	Lafayette Dr.	UB2 Unified General Business Districts	43.66	*
31. 001105D A 03400 (21 CA 458)	Cooper Lane Trustee (Whittenburg Children Trust)	Wilberforce Ave.	B2 General Business Districts	1.24	*
32. 001106 005 (25 CB 300)	DOE Reservation	Scarboro Rd. + Union Valley Rd.	FIR Federal Industry and Research (Railroad)	7.34	*
33. 001105D A 03500 (21 CA 463)	Robert W. Monday	Tuskeegee Dr.	B2 General Business Districts	4.01	10

Continued…

TABLE 6 (CONT.)
ANALYSIS OF OAK RIDGE PROPERTIES IN CLOSE PROXIMITY TO EAST FORK POPLAR CREEK

GEOGRAPHIC INFORMATION SYSTEM NUMBER (OLD MAP NUMBER)	CURRENT PROPERTY OWNER+	ADDRESS	PROPERTY ZONING	NUMBER OF ACRES	ESTIMATED DISTANCE FROM CREEK (FEET) *
Business Zoning / Adult Oriented Applications (See 1-85)					
34. 001099M A 02400 (19 BZ 407.04)	Vansant U. and Tarulata V. Patel	Tulsa Rd.	O2 Office Districts	1.19	30
35. 001099N A 00300 (18 BZ 009)	Walter E. Culbreth III	108 S. Illinois Ave.	UB2 Unified Business Districts	99.64	40
36. 001099N A 00900 (18 BZ 005)	Donald C. Maddox	S. Illinois Ave.	O2 Office/UB2 Unified General Business	100	40
37. 001099N A 01000 (18 BZ 005.01)	Michael J. Patterson	122 S. Illinois Ave.	O2 Office/UB2 Unified General Business	85	40
38. 001099N A 00400 (18 BZ 008)	Ambulatory Care Assoc. LP	110 Illinois Ave. S.	UB2 Unified Business Districts	100	45
39. 001099N A 00500 (18 BZ 004)	Thomas G. Jr. & Jacqueline S. Johnson	112 S. Illinois Ave	UB2 Unified Business Districts	50	50
40. 001099N A 00600 (18 BZ 002)	Thomas G. Jr. & Jacqueline S. Johnson	114 S. Illinois Ave.	UB2 Unified Business Districts	187	50
41. 001099N A 00700 (18 BZ 006)	RTM Winners LP C/O Carmen Hernanbez	116 S. Illinois Ave.	UB2 Unified Business Districts	133	50
42. 001099N A 00800 (18 BZ 007)	CNL Income Fund IV LTD & Shoney's Inc.	118 S. Illinois Ave.	UB2 Unified Business Districts	117	50
43. 001104N A 00300 (16 BR 559.02)	Lynn B. Weigel	2385 Oak Ridge Turnpike	UB2 Unified General Business Districts	5.2	100
44. 001105C A 00600 (19 BZ 606.03)	Oak Ridge FM Inc.	114 Tulsa Rd.	O2 Office Districts	1	100

Continued…

TABLE 6 (CONT.)
ANALYSIS OF OAK RIDGE PROPERTIES IN CLOSE PROXIMITY TO EAST FORK POPLAR CREEK

GEOGRAPHIC INFORMATION SYSTEM NUMBER (OLD MAP NUMBER)	CURRENT PROPERTY OWNER+	ADDRESS	PROPERTY ZONING	NUMBER OF ACRES	ESTIMATED DISTANCE FROM CREEK (FEET) *
Business Zoning / Adult Oriented Applications (See 1-85)					
45. 001099O A 01100 (17 BX 533.03)	Charles Robert Etux Crane, Cathy, & Sunshine Playschool	103 Adams Ln.	O2 Office Districts	1	125
46. 001105H A 00600 (16 BU 00201)	John M. Anderson	2079 Oak Ridge Turnpike	B2 General Business Districts	1	130
47. 001105H A 00700 (16 BU 563.02)	William E. Lindsey	Oak Ridge Turnpike	UB2 Unified General Business Districts	1	150
48. 001099N B 01000 (18 BZ 478.00)	Lane Family XX LLC	101 S. Illinois Ave.	B2 General Business Districts	9.41	155
49. 001099N B 01100 (17 BZ 474)	Oak Ridge Imports Inc. C/O Harry Lane / Herb J. Newton	101 S. Illinois Ave.	B3 Roadside Business Districts	2.26	155
50. 001099O A 02100 (16 BX 466)	David H. Tate	102 Jefferson Terminal	B2 General Business Districts	0.75	160
51. 001105H A 00500	John M. Anderson	2081 Oak Ridge Turnpike	B2 General Business Districts	1	190
52. 001105D A 01700 (22 CB 056)	The Josephine LLC	490 S. Illinois Ave.	UB2 Unified General Business Districts	1.36	200
53. 001105D A 03700 (20 CA 463.03)	Robert W. Monday	0 Tulsa	B2 General Business Districts	0.43	200
54. 001106G A 00200 (24 CC 709)	Scientific & Technical Resources, Inc.	S. Illinois	IND2 Industrial Districts	71.33	200
55. 001105D A 03600 (21 CA 459.00)	Kmart Corp. C/O Burr Wolfe L.P.	39 S. Illinois Ave.	B2 General Business Districts	9.92	205

Continued…

TABLE 6 (CONT.)
ANALYSIS OF OAK RIDGE PROPERTIES IN CLOSE PROXIMITY TO EAST FORK POPLAR CREEK

GEOGRAPHIC INFORMATION SYSTEM NUMBER (OLD MAP NUMBER)	CURRENT PROPERTY OWNER+	ADDRESS	PROPERTY ZONING	NUMBER OF ACRES	ESTIMATED DISTANCE FROM CREEK (FEET) *
Business Zoning / Adult Oriented Applications (See 1-85)					
56. 001099O A 00800 (17 BX 533.04)	William H. Skelton	100 Adams Lane	O2 Office Districts	1	210
57. 001099M A 01500	A&M Enterprises Inc. C/O Cypress JJC Oak Ridge	302 S. Illinois Ave.	B2 General Business Districts	6.65	230
58. 001105H A 00400 (16 BU 00101)	Wayne Willis	0 Oak Ridge Turnpike	B1 Neighborhood Business District	1	235
59. 001099M A 00500 (19 BZ 407.06)	Vasant U. & Tarulata V. Patel	208 S. Illinois Ave.	B2 General Business Districts	1.3	245
60. 001105H A 00300 (16 BU 001)	Richard L. Powers and Timothy & Mike Pickens	2093 Oak Ridge Turnpike	B1 Neighborhood Business District	1	250
61. 001099M A 00100 (19 BZ 002)	A. P. & Lois Cappiello	200 S. Illinois	B2 General Business Districts	0.42	255
62. 001099M A 00400 (19 BZ 407.01)	Vasant U. & Tarulata V. Patel	206 S. Illinois Ave.	B2 General Business Districts	2.35	260
63. 001099M A 00600 (19 BZ 407.02)	Peoples Development	210 S. Illinois Ave.	B2 General Business Districts	1.84	260
64. 001099M A 02100 (20 BZ 409.01)	Hardy Investment Assoc. LTD	481 Tulsa Rd.	B2 General Business Districts	2.98	270
65. 001105D A 00300 (21 CA 463.02)	Roy Knox Etux Pemberton, C/O Jim Harrison	Illinois Ave.	B2 General Business Districts	8.64	280

Continued…

TABLE 6 (CONT.)
ANALYSIS OF OAK RIDGE PROPERTIES IN CLOSE PROXIMITY TO EAST FORK POPLAR CREEK

GEOGRAPHIC INFORMATION SYSTEM NUMBER (OLD MAP NUMBER)	CURRENT PROPERTY OWNER+	ADDRESS	PROPERTY ZONING	NUMBER OF ACRES	ESTIMATED DISTANCE FROM CREEK (FEET) *
Business Zoning / Adult Oriented Applications (See 1-85)					
66. 001099M A 00900 (19 CA 00401)	Lendon E. Hart	240 S. Illinois Ave.	B2 General Business Districts	1.19	290
67. 001099M A 01900 (20 CA 009)	A&M Enterprises & Books a Million	310 S. Illinois Ave.	B2 General Business Districts	0.84	300
68. 001105D A 00600 (21 CB 097)	Carden Rentals LP	422 S. Illinois Ave.	B2 General Business Districts	125	300
69. 001099O A 02200 (16 BX 347)	J.W. Gibson	0 Jefferson Ave.	B2 General Business Districts	1.34	325
70. 001099M A 00200 (19 BZ 004)	A. P. & Lois Cappiello	202 S. Illinois	B2 General Business Districts	0.35	340
71. 001099O A 00300 (17 BY 469)	All American Property Corp.	1612 Oak Ridge Turnpike	B3 Roadside Business Districts	2.79	370
72. 001099M A 00300 (19 BZ 407.00)	Shoney's of Knoxville	204 S. Illinois Ave.	B2 General Business Districts	1.84	400
73. 001099M A 01300 (20 CA 00701)	Koplan Living Trust	214 S. Illinois Ave.	NA from GIS	1	505
74. 001099M A 00700	A.P. Cappiello Jr.	212 S. Illinois Ave.	B2 General Business Districts	150	520
75. 001105C A 01100 (19 BZ 606.05)	J.W. Gibson Co.	Tiffin Dr.	NA from GIS	1	550
76. 001099M A 00800 (19 CA 001)	A.P. Cappiello Jr.	214 S. Illinois Ave.	B2 General Business Districts	0.46	560
77. 001099M A 01700 (20 CA 013)	A&M Enterprises	326 S. Illinois Ave.	B2 General Business Districts	0.26	650

Continued…

TABLE 6 (CONT.)
ANALYSIS OF OAK RIDGE PROPERTIES IN CLOSE PROXIMITY TO EAST FORK POPLAR CREEK

GEOGRAPHIC INFORMATION SYSTEM NUMBER (OLD MAP NUMBER)	CURRENT PROPERTY OWNER+	ADDRESS	PROPERTY ZONING	NUMBER OF ACRES	ESTIMATED DISTANCE FROM CREEK (FEET) *
Business Zoning / Adult Oriented Applications (See 1-85)					
78. 001099M A 01800 (20 CA 008)	A&M Enterprises & Buddy's Bar-B-Q/Baskin Robbins	328 S. Illinois Ave.	B2 General Business Districts	0.87	650
79. 001099M A 01400 (20 CA 006)	A&M Enterprises Inc.	220 S. Illinois Ave.	B2 General Business Districts	0.45	730
80. 001105D A 00100 (20 CA 463.04)	Robert Monday	0 Illinois Ave.	B2 General Business Districts	0.28	800
81. 001105D A 03800 (20 CA 463.01?)	Robert W. Monday	320 S. Illinois	B2 General Business Districts	205	860
82. 001099L A 02900 (20 CB 485.21)	Morrison Restaurants Inc. C/O Marvin Poer & Co.	S. Illinois Ave.	B2 General Business Districts	6.54	>1,000
83. 001105D A 00400 (21 CA 459.01)	McDonalds Corp Litton T. Cochran	Illinois Ave.	B2 General Business Districts	1.31	>1,000
84. 001105D A 02400 (23 CA 462)	Robert W. Monday	Scarboro Rd.	UB2 Unified General Business Districts	4.88	>1,000
85. 073015K B 00700	Continum Care Corp.	209 Gum Hollow Rd.	B1 Neighborhood Business Districts	1.51	>5,000

Continued…

TABLE 6 (CONT.)
ANALYSIS OF OAK RIDGE PROPERTIES IN CLOSE PROXIMITY TO EAST FORK POPLAR CREEK

GEOGRAPHIC INFORMATION SYSTEM NUMBER (OLD MAP NUMBER)	CURRENT PROPERTY OWNER+	ADDRESS	PROPERTY ZONING	NUMBER OF ACRES	ESTIMATED DISTANCE FROM CREEK (FEET) *
Education & Children Applications (See 86-93)					
86. 001099O A 00100 (16 BY 273)	Robertsville Jr. High	245 Robertsville Rd.	E Education and Research Districts	35.82	*
87. 001105C A 00300 (19 BZ 606.02)	Ronald & Cheryl Wright (Dentist)	106 Tulsa Rd.	O2 Office Districts	0.5	*
88. 001105C A 00400 (19 BZ 606.08)	William S. Harris (Pediatric Dentist)	108 Tulsa Rd	O2 Office Districts	1	*
89. 001105C A 00500 (19 BZ 606.07)	La Petite Academy	112 Tulsa Ave.	O2 Office Districts	1	*
90. 001099O A 01400 (17 BX 410)	Girls Inc.	1660 Oak Ridge Turnpike	O2 Office Districts (Note: children present)	3.52	35
91. 001099O A 00700 (17 BX 533.02)	YWCA	1660 Oak Ridge Turnpike	O2 Office Districts (Note: children present)	4.06	40
92. 001099O A 00200 (17 BY 471)	Oak Ridge Church of God	142 Ingraham Rd.	RG1 Residential/Open Space & Reserved Districts (Institutional Public)	5.05	370
93. 001099O A 03000 (16 BX 050)	First Wesleyan Church	280 Royce Circle	R3 Multiple Family/ Residential/Hotel Districts	1.7	410

Continued…

TABLE 6 (CONT.)
ANALYSIS OF OAK RIDGE PROPERTIES IN CLOSE PROXIMITY TO EAST FORK POPLAR CREEK

GEOGRAPHIC INFORMATION SYSTEM NUMBER (OLD MAP NUMBER)	CURRENT PROPERTY OWNER+	ADDRESS	PROPERTY ZONING	NUMBER OF ACRES	ESTIMATED DISTANCE FROM CREEK (FEET) *
Residential Applications (See 94-293)					
94. 001099N A 00100 (17 BY 619)	Oak Ridge city Electric Substation	Oak Ridge Turnpike	RG1 Residential/Open Space & Reserved Districts (Institutional Public)	3.95	*
95. 001099N A 01500 (18 BX 352)	Oak Ridge Coronado LLP	100 Vanderbilt Dr.	R3 Multiple Family/ Residential/Hotel Districts	24.08	*
96. 001099N A 01700 (17 BY 351)	Oak Ridge Coronado LLP	101 Valparaiso Rd.	R3 Multiple Family/ Residential/Hotel Districts	4.34	*
97. 001099O A 00500 (17 BY 531)	Oak Ridge Housing Authority	Oak Ridge Turnpike	O2 Office Districts (Multi-Family Apartments)	4.67	*
98. 001099O A 00600 (17 BY 532)	Oak Ridge Housing Authority	Oak Ridge Turnpike	O2 Office Districts (Multi-Family Apartments)	3.81	*
99. 001104E B 00100 (17 BS 561)	Robert Jett & Francis S. Shannon	2291 Oak Ridge Turnpike	RG1 Residential/Open Space & Reserved Districts	115.2	*
100.001104E B 00300 (16 BT 005)	Arlene & Alfred (Jr.) Brooks (Rev. Trust)	100 Wiltshire Dr.	RG1 Residential/Open Space & Reserved Districts	6.86	*
101.001104E B 00400 (16 BT 006)	Patricia C. Green	102 Wiltshire Dr.	RG1 Residential/Open Space & Reserved Districts	6.82	*
102.001104E B 00700 (17 BT 007)	Walter and Linda Brown (N/A)	108 Wiltshire Rd.	RG1 Residential/Open Space & Reserved Districts	9.51	*
103.001104E B 00800 (17 BT 008.01)	Walter & Linda Brown	108 Wiltshire Rd.	RG1 Residential/Open Space & Reserved Districts	2.25	*
104.001104E B 01300 (17 BT 002)	Thomas & Annette Southard	109 Wiltshire Dr.	RG1 Residential/Open Space & Reserved Districts	5.2	*

Continued…

TABLE 6 (CONT.)
ANALYSIS OF OAK RIDGE PROPERTIES IN CLOSE PROXIMITY TO EAST FORK POPLAR CREEK

GEOGRAPHIC INFORMATION SYSTEM NUMBER (OLD MAP NUMBER)	CURRENT PROPERTY OWNER+	ADDRESS	PROPERTY ZONING	NUMBER OF ACRES	ESTIMATED DISTANCE FROM CREEK (FEET) *
Residential Applications (See 94-293)					
105.001104E B 01400 (16 BT 004)	Allen B. & Betty Marsh	107 Wiltshire Dr.	RG1 Residential/Open Space & Reserved Districts	5.13	*
106.001104E B 01500 (16 BT 010)	Harry & Lillian Savage	105 Wiltshire Dr.	RG1 Residential/Open Space & Reserved Districts	5.04	*
107.001104E B 01600 (16 BT 009)	Kathleen Glasstone	103 Wiltshire Dr.	RG1 Residential/Open Space & Reserved Districts	5.06	*
108.001104E B 01700 (16 BT 001)	Robert F. Hibben C/O Deborah Green	101 Wiltshire Dr.	RG1 Residential/Open Space & Reserved Districts	6.71	*
109.001104N A 00100 (16 BR 559.01)	Russell Dean & Judy S. Jackson	2387 Oak Ridge Turnpike	RG1 Residential/Open Space & Reserved Districts	5.02	*
110.001104N A 00200 (16 BR 559)	Jackson Crossing LLC	2383 Oak Ridge Turnpike	R2 Two/Three/Four Family Residential Districts	33.5	*
111.001104N A 00400 (15 BQ 348)	City of Oak Ridge Sewer Plant	Oak Ridge Turnpike	RG1 Residential/Open Space & Reserved Districts (Institutional Public)	47.18	*
112.001104N A 02300 (16 BR 559.03)	Morningside of Tenn LP	0 Hermitage Blvd.	R2 Two/Three/Four Family Residential Districts	6.72	*
113.001104N A 03500 (16 BQ 559.04)	Jackson Crossing LLC	Creek front buffer	R2 Two/Three/Four Family Residential Districts (Parks/Rec/Open Space)	0.87	*

Continued…

TABLE 6 (CONT.)
ANALYSIS OF OAK RIDGE PROPERTIES IN CLOSE PROXIMITY TO EAST FORK POPLAR CREEK

GEOGRAPHIC INFORMATION SYSTEM NUMBER (OLD MAP NUMBER)	CURRENT PROPERTY OWNER+	ADDRESS	PROPERTY ZONING	NUMBER OF ACRES	ESTIMATED DISTANCE FROM CREEK (FEET) *
Residential Applications (See 94-293)					
114.011105C A 00800 (19 BZ 015)	Aspen Homes for Elderly	Tiffin Dr.	R4B Multiple Family Residential Districts	6.48	*
115.001105C A 00100 (19 BZ 606)	Joanne C. Asher & many other tenants	Valley Forge Dr.	R4C Multiple Family Residential Districts	1	*
116.001105C A 01800 (19 BZ 027)	J.W. Gibson Co.	0 Tiffany Pl.	R4C Multiple Family Residential Districts (PUD)	0.28	*
117.001105D A 03200 (CA 21 408.01)	Oak Ridge City	Woodbury Lane	RG1 Residential/Open Space & Reserved Districts	6.17	*
118.001105D A 03300 (21 CA 458)	Cooper Lane Trustee (Whittenburg Children Trust)	Wilburforce Ave.	RG1 Residential/Open Space & Reserved Districts	1.41	*
119.001105H A 01800 (17 BU 012)	George and Karen Fann	Wiltshire Dr.	RG1 Residential/Open Space & Reserved Districts	5.53	*
120.001105H A 01900 (17 BU 009)	C.W. and Wanda Craven and Linda and Walter Brown	Wiltshire Dr.	RG1 Residential/Open Space & Reserved Districts	6.01	*
121.001105H A 02000 (17 BU 007)	C.W. and Wanda Craven and Linda and Walter Brown	Wiltshire Dr.	RG1 Residential/Open Space & Reserved Districts	5.45	*
122.001105H A 02100 (17 BU 005)	Roger & Rebecca Brown	Wiltshire Dr.	RG1 Residential/Open Space & Reserved Districts	5.25	*
123.001105H A 02200 (17 BU 003)	C.W. and Wanda Craven and Linda and Walter Brown	Wiltshire Dr.	RG1 Residential/Open Space & Reserved Districts	4.58	*

Continued…

TABLE 6 (CONT.)
ANALYSIS OF OAK RIDGE PROPERTIES IN CLOSE PROXIMITY TO EAST FORK POPLAR CREEK

GEOGRAPHIC INFORMATION SYSTEM NUMBER (OLD MAP NUMBER)	CURRENT PROPERTY OWNER+	ADDRESS	PROPERTY ZONING	NUMBER OF ACRES	ESTIMATED DISTANCE FROM CREEK (FEET) *
Residential Applications (See 94-293)					
124.001105H A 02300 (17 BU 001)	C.W. and Wanda Craven	113 Wiltshire Dr.	RG1 Residential/Open Space & Reserved Districts	5.47	*
125.001105D A 01500 (22 CB 461)	DOE Training Bldg.	610 S. Illinois Ave.	RG1 Residential/Open Space & Reserved Districts	10.51	*
126.001105H A 00100 (17 BT 563.00)	Melvin Sturm	Oak Ridge Turnpike	RG1 Residential/Open Space & Reserved Districts	14.59	*
127.001105H A 00800 (17 BW 564)	Wayne & Patricia Clark	Oak Ridge Turnpike	RG1 Residential/Open Space & Reserved Districts	92.9	*
128.073009 04100 (17 BP 560.00)	Oak Ridge Sportsmans Club (Anderson Co. portion)	2501 Oak Ridge Turnpike	RG1 Residential/Open Space & Reserved Districts (Parks/Rec/Open Space)	323.2	*
129.073015 00100 (16 BM 595.01)	Oak Ridge Golf & Country Club	150 Gum Hollow Rd.	RG1 Residential/Open Space & Reserved Districts (Parks/Rec/Open Space)	10	*
130.073015 00105 (17 BK 595.05)	Oak Ridge Golf & Country Club	Oak Ridge Turnpike Off	RG1 Residential/Open Space & Reserved Districts	172.1	*
131.073015 00700 (17 BK 597)	J.W. Gibson	Gum Hollow Rd.	RG1 Residential/Open Space & Reserved Districts	217	*
132.073015A C 00400 (16 BL 021)	M. Elizabeth Kittrell	132 Grandcove Ln.	R2 Two/Three/Four Family Residential Districts	1	*
133.073015A C 00500 (16 BL 020)	William M. & Kneece Barbara K. Hogle	134 Grandcove Ln.	R2 Two/Three/Four Family Residential Districts	1	*

Continued…

TABLE 6 (CONT.)
ANALYSIS OF OAK RIDGE PROPERTIES IN CLOSE PROXIMITY TO EAST FORK POPLAR CREEK

GEOGRAPHIC INFORMATION SYSTEM NUMBER (OLD MAP NUMBER)	CURRENT PROPERTY OWNER+	ADDRESS	PROPERTY ZONING	NUMBER OF ACRES	ESTIMATED DISTANCE FROM CREEK (FEET) *
Residential Applications (See 94-293)					
134.073015A C 00800 (16 BL 017)	George F. & Ardis O. Leichsenring	140 Grandcove Ln.	R2 Two/Three/Four Family Residential Districts	1	*
135.073015B C 00800 (16 BM 051)	Burl E. & Phyllis A. Cloninger	113 Goldenview Ln.	R2 Two/Three/Four Family Residential Districts	1	*
136.073015B C 00900 (16 BM 052)	Burl E. & Phyllis A. Cloninger	115 Goldenview Ln.	R2 Two/Three/Four Family Residential Districts	1	*
137.073015B C 01200 (16 BM 056)	Suzanne S. Asher	152 Golfcrest Ln.	R2 Two/Three/Four Family Residential Districts	1	*
138.073015B D 00500 (16 BM 085)	Earl C. & Nettie C. Smith	116 Greenwood Ln.	R2 Two/Three/Four Family Residential Districts	1	*
139.073015B E 00400 (16 BL 029)	Gerald C. & Joanne B. Walker	155 Grandcove Ln.	R2 Two/Three/Four Family Residential Districts	1	*
140.073015B E 01303 (16 BL 041)	H.D. & Joyce D. Trust Hickman	0 Grandcove Ln.	R2 Two/Three/Four Family Residential Districts	1	*
141.073015H A 00100 (16 BL 595.03)	Thomas L. & Annette J. Southard	101, 105, 107 Gates Dr.	R4B Multiple Family Residential Districts	4.02	*

Continued…

TABLE 6 (CONT.)
ANALYSIS OF OAK RIDGE PROPERTIES IN CLOSE PROXIMITY TO EAST FORK POPLAR CREEK

GEOGRAPHIC INFORMATION SYSTEM NUMBER (OLD MAP NUMBER)	CURRENT PROPERTY OWNER+	ADDRESS	PROPERTY ZONING	NUMBER OF ACRES	ESTIMATED DISTANCE FROM CREEK (FEET) *
Residential Applications (See 94-293)					
142.073015H B 00200 (16 BL 595.04)	J.W. Gibson	Sweet Gum Off	R4B Multiple Family Residential Districts (PUD) Open Space (Greenway)	1.99	*
143.073015H B 00500 (17 BJ59504)	J.W. Gibson	9999 Oak Ridge Highway	R-2 2-4 Family Residential Districts (PUD)	4.42	*
144.073015I A 00100 (16 BL 595.04)	J.W. Gibson	Southwood Ln. E Off	R2 Two/Three/Four Family Residential Districts (PUD) Open Space (Greenway)	3.87	*
145.073015I B 00600 (16 BL 595.04)	J.W. Gibson	Oak Ridge Turnpike	R2 Two/Three/Four Family Residential Districts (PUD) Open Space (Greenway)	5.19	*
146.073015A C 00105 (16 BL 032)	Bradley Allen Jenkins	126 Grandcove Ln.	R2 Two/Three/Four Family Residential Districts	1	5
147.073015B B 00500 (16 BM 037)	John W. & Mary Daugherty	108 Goldenview Ln.	R2 Two/Three/Four Family Residential Districts	1	5
148.073015B B 00600 (16 BM 038)	David G. Walker	110 Goldenview Ln.	R2 Two/Three/Four Family Residential Districts	1	5

Continued…

TABLE 6 (CONT.)
ANALYSIS OF OAK RIDGE PROPERTIES IN CLOSE PROXIMITY TO EAST FORK POPLAR CREEK

GEOGRAPHIC INFORMATION SYSTEM NUMBER (OLD MAP NUMBER)	CURRENT PROPERTY OWNER+	ADDRESS	PROPERTY ZONING	NUMBER OF ACRES	ESTIMATED DISTANCE FROM CREEK (FEET) *
Residential Applications (See 94-293)					
149.073015B B 00800 (16 BM 040)	Kay L. Lamuno	114 Goldenview Ln.	R2 Two/Three/Four Family Residential Districts	1	5
150.073015B C 01100 (16 BM 055)	David G. Walker	150 Golfcrest Ln.	R2 Two/Three/Four Family Residential Districts	1	5
151.073015B E 01301 (16 BL 043)	Sylvia Wayne Lovelace	0 Grandcove Ln.	R2 Two/Three/Four Family Residential Districts	1	5
152.073015I B 00800	Judith Raman	211 Southwood Ln.	R-2 2-4 Family Residential Districts (PUD)	1.15	5
153.073015I B 00900 (17BJ 020)	J.W. Gibson	209 Southwood Ln.	R-2 2-4 Family Residential Districts (PUD)	1	5
154.001099N A 02000 (17 BY 003)	Billy R. & Sandra Mothershed	301 Valparaiso Rd.	R1A One Family Residential Districts	0.63	10
155.001099N A 02100 (17 BY 004)	Fred L. Hannon & Levina O. /rev. trust	305 Valparaiso Rd.	R1A One Family Residential Districts	2.1	10
156.073015A C 00101 (16 BL 035)	Norbert R. & Margre Grant	120 Grandcove Ln.	R2 Two/Three/Four Family Residential Districts	1	10
157.073015A C 00104 (16 BL 033)	Ruby L. Trust Fourney	124 Grandcove Ln.	R2 Two/Three/Four Family Residential Districts	1	10

Continued…

TABLE 6 (CONT.)
ANALYSIS OF OAK RIDGE PROPERTIES IN CLOSE PROXIMITY TO EAST FORK POPLAR CREEK

GEOGRAPHIC INFORMATION SYSTEM NUMBER (OLD MAP NUMBER)	CURRENT PROPERTY OWNER+	ADDRESS	PROPERTY ZONING	NUMBER OF ACRES	ESTIMATED DISTANCE FROM CREEK (FEET) *
Residential Applications (See 94-293)					
158.073015A C 00900 (16 BL 016)	Douglas & Travis Ann J. MacDonald	142 Grandcove Ln.	R2 Two/Three/Four Family Residential Districts	1	10
159.073015B B 00700 (16 BM 039)	Arthur B. & Carolyn S. Miller	112 Goldenview Ln.	R2 Two/Three/Four Family Residential Districts	1	10
160.073015B C 00700 (16 BM 050)	Burl E. & Phyllis A. Cloninger	111 Goldenview Ln.	R2 Two/Three/Four Family Residential Districts	1	10
161.073015B D 00600 (16 BM 080)	W S C Inc.	115 Greenwood Ln.	R2 Two/Three/Four Family Residential Districts	1	10
162.073015B E 00500 (16 BL 025)	H.D. & Joyce D. Trust Hickman	147 Grandcove Ln.	R2 Two/Three/Four Family Residential Districts	1	10
163.073015A C 00300 (16 BL 030)	Jonathan & Lisa Rael	130 Grandcove Ln.	R2 Two/Three/Four Family Residential Districts	1	15
164.073015B C 00600 (16 BM 049)	Burl E. & Phyllis A. Cloninger	109 Goldenview Ln.	R2 Two/Three/Four Family Residential Districts	1	15
165.073015B D 00501 (16 BM 086)	Nancy B. Stanley & Paul Busteed	118 Greenwood Ln.	R2 Two/Three/Four Family Residential Districts	1	15

Continued…

TABLE 6 (CONT.)
ANALYSIS OF OAK RIDGE PROPERTIES IN CLOSE PROXIMITY TO EAST FORK POPLAR CREEK

GEOGRAPHIC INFORMATION SYSTEM NUMBER (OLD MAP NUMBER)	CURRENT PROPERTY OWNER+	ADDRESS	PROPERTY ZONING	NUMBER OF ACRES	ESTIMATED DISTANCE FROM CREEK (FEET) *
Residential Applications (See 94-293)					
166.001099O A 02500 (16 BX 468.00)	Charles E. Thompson ($30,000)	289 Royce Circle	R3 Multiple Family/ Residential/Hotel Districts	2.14	20
167.001099O A 03200 (16 BX 011)	Virginia Power c/o Chris Power	151 Royce Circle	R3 Multiple Family/ Residential/Hotel Districts	0.69	20
168.073015A C 00100 (16 BL 046)	Carolyn V. Cornett	114 Grandcove Ln	R2 Two/Three/Four Family Residential Districts	1	20
169.073015A C 00200 (16 BL 031)	Philip J. & Frances M. Marlino	128 Grandcove Ln.	R2 Two/Three/Four Family Residential Districts	1	20
170.073015B C 0100 (16 BM 054)	Gerald & Jo Anne Walker	148 Golfcrest Ln.	R2 Two/Three/Four Family Residential Districts	1	20
171.073015B E 01200 (16 BL 015)	Ross H. & Catherine W. Compton	139 Grandcove Ln.	R2 Two/Three/Four Family Residential Districts	1.04	20
172.073015H B 00403 (16 BK 054)	J.W. Gibson	206 Sweetgum Ln.	R4B Multiple Family Residential Districts	1	20
173.073015I A 00900 (17 BJ 009)	Glenn Douglas Jr. & Christina Holyfield Crater	112 Southwood Ln.	R-2 2-4 Family Residential Districts (PUD)	1	20
174.073015I A 01000 (17 BK 001)	Tracey J. & Sandra L. Hilton	114 Southwood Ln.	R-2 2-4 Family Residential Districts (PUD)	1	20

Continued…

TABLE 6 (CONT.)
ANALYSIS OF OAK RIDGE PROPERTIES IN CLOSE PROXIMITY TO EAST FORK POPLAR CREEK

GEOGRAPHIC INFORMATION SYSTEM NUMBER (OLD MAP NUMBER)	CURRENT PROPERTY OWNER+	ADDRESS	PROPERTY ZONING	NUMBER OF ACRES	ESTIMATED DISTANCE FROM CREEK (FEET) *
Residential Applications (See 94-293)					
175.073015I A 01700 (17 BK 008)	J.W. Gibson	123 Southwood Ln.	R-2 2-4 Family Residential Districts (PUD)	1	20
176.001099O A 03100 (16 BX 010)	Virginia Power c/o Chris Power	153 Royce Circle	R3 Multiple Family/ Residential/Hotel Districts	0.67	25
177.073015A C 00600 (16 BL 019)	Harry Jones Evans	136 Grandcove Ln.	R2 Two/Three/Four Family Residential Districts	1	25
178.073015H B 00400 (16 BK 051)	J.W. Gibson	200 Sweetgum Ln.	R4B Multiple Family Residential Districts	1	25
179.073015I A 00800 (17 BJ 010)	Glenn Douglas Jr. & Christina Holyfield Crater	110 Southwood Ln.	R-2 2-4 Family Residential Districts (PUD)	1	25
180.073015I A 01800 (17 BK 009)	J.W. Gibson	121 Southwood Ln.	R-2 2-4 Family Residential Districts (PUD)	1	25
181.073015I B 00500 (17BJ 024)	J.W. Gibson	208 Southwood Ln. W	R-2 2-4 Family Residential Districts (PUD)	3.12	25
182.073015I B 01000 (17BJ 019)	J.W. Gibson	207 Southwood Ln.	R-2 2-4 Family Residential Districts (PUD)	1	25
183.001099N A 01900 (17 BY 002)	H.H. and Mary E. Williams	299 Valparaiso Rd.	R1A One Family Residential Districts	0.55	30
184.001104N A 03100 (16 BQ 004)	Jackson Crossing LLC	202 Hermitage Blvd.	R2 Two/Three/Four Family Residential Districts	0.36	30

Continued…

TABLE 6 (CONT.)
ANALYSIS OF OAK RIDGE PROPERTIES IN CLOSE PROXIMITY TO EAST FORK POPLAR CREEK

GEOGRAPHIC INFORMATION SYSTEM NUMBER (OLD MAP NUMBER)	CURRENT PROPERTY OWNER+	ADDRESS	PROPERTY ZONING	NUMBER OF ACRES	ESTIMATED DISTANCE FROM CREEK (FEET) *
Residential Applications (See 94-293)					
185.073015B C 00500 (16 BM 053)	Barbara L. White	146 Golfcrest Ln.	R2 Two/Three/Four Family Residential Districts	1	30
186.073015B C 01300 (16 BM 057)	James W. & Mary E. Jackson	154 Golfcrest Ln.	R2 Two/Three/Four Family Residential Districts	1	30
187.073015H B 00301 (16 BK 072)	J.W. Gibson	Sweetgum Ln.	R4B Multiple Family Residential Districts (PUD)	1	30
188.073015H B 00404 (16 BK 055)	J.W. Gibson	208 Sweetgum Ln.	R4B Multiple Family Residential Districts	1	30
189.073015H B 00408 (16 BL 059)	Mary Frances Bailey	216 Sweetgum Ln.	R4B Multiple Family Residential Districts	1	30
190.073015I A 00600 (17 BJ 012)	J.W. Gibson	106 Southwood Ln.	R-2 2-4 Family Residential Districts (PUD)	1	30
191.073015I A 01100 (17 BK 002)	Robert A. & Nancy J. Cordani	116 Southwood Ln.	R-2 2-4 Family Residential Districts (PUD)	1	30
192.073015I A 01500 (17 BK 006)	J.W. Gibson	124 Southwood Ln.	R-2 2-4 Family Residential Districts (PUD)	1	30
193.001099N A 01800 (17 BY 001)	M.L. and Mary E. Gilreath	297 Valparaiso Rd.	R1A One Family Residential Districts	0.62	35
194.001104N A 03200 (16 BQ 003)	David Whisnant	200 Hermitage Blvd.	R2 Two/Three/Four Family Residential Districts	0.41	35

Continued…

TABLE 6 (CONT.)
ANALYSIS OF OAK RIDGE PROPERTIES IN CLOSE PROXIMITY TO EAST FORK POPLAR CREEK

GEOGRAPHIC INFORMATION SYSTEM NUMBER (OLD MAP NUMBER)	CURRENT PROPERTY OWNER+	ADDRESS	PROPERTY ZONING	NUMBER OF ACRES	ESTIMATED DISTANCE FROM CREEK (FEET) *
Residential Applications (See 94-293)					
195.073015H B 00100 (16 BK 001)	J.W. Gibson	100 Sweetgum Ln.	R4B Multiple Family Residential Districts	1	35
196.073015H B 00101 (16 BK 068)	Utl & Kang Munye Roh	170 Sweetgum Ln.	R4B Multiple Family Residential Districts (PUD)	1	35
197.073015H B 00407 (16 BL 058)	George & Kpeli Irene Y. Darko	214 Sweetgum Ln.	R4B Multiple Family Residential Districts	1	35
198.073015H B 00409 (16 BL 060)	Bernard C. & Leisha H. Cundy	218 Sweetgum Ln.	R4B Multiple Family Residential Districts	1	35
199.073015I A 00500 (17 BJ 013)	J.W. Gibson	104 Southwood Ln.	R-2 2-4 Family Residential Districts (PUD)	1	35
200.073015I A 01600 (17 BK 007)	J.W. Gibson	126 Southwood Ln.	R-2 2-4 Family Residential Districts (PUD)	1	35
201.001099O A 02800 (16 BX 009)	Virginia Power c/o Chris Power	155 Royce Circle	R3 Multiple Family/ Residential/Hotel Districts	0.58	40
202.001104N A 03000 (16 BQ 005)	Jackson Crossing LLC	204 Hermitage Blvd.	R2 Two/Three/Four Family Residential Districts	0.33	40
203.073015A C 00106 (16 BL 045)	Irene L. Kendall	116 Grandcove Ln.	R2 Two/Three/Four Family Residential Districts	1	40
204.073015A C 00700 (16 BL 018)	Robert Lyles Love	138 Grandcove Ln.	R2 Two/Three/Four Family Residential Districts	1	40

Continued…

TABLE 6 (CONT.)
ANALYSIS OF OAK RIDGE PROPERTIES IN CLOSE PROXIMITY TO EAST FORK POPLAR CREEK

GEOGRAPHIC INFORMATION SYSTEM NUMBER (OLD MAP NUMBER)	CURRENT PROPERTY OWNER+	ADDRESS	PROPERTY ZONING	NUMBER OF ACRES	ESTIMATED DISTANCE FROM CREEK (FEET) *
Residential Applications (See 94-293)					
205.073015H B 00300 (16 BK 002)	J.W. Gibson	102 Sweetgum Ln.	R4B Multiple Family Residential Districts	1	40
206.073015I A 01200 (17 BK 003)	J.W. Gibson	118 Southwood Ln.	R-2 2-4 Family Residential Districts (PUD)	1	40
207.073015I A 01400 (17 BK 005)	J.W. Gibson	122 Southwood Ln.	R-2 2-4 Family Residential Districts (PUD)	1	40
208.001099O A 02600 (16 BX 007)	Virginia Power c/o Chris Power	159 Royce Circle	R3 Multiple Family/ Residential/Hotel Districts	0.6	45
209.073015B C 01400 (16 BM 058)	David M. Carrington	156 Golfcrest Ln.	R2 Two/Three/Four Family Residential Districts	1	45
210.073015I A 00300 (17 BJ 015)	J.W. Gibson	100 Southwood Ln.	R-2 2-4 Family Residential Districts (PUD)	1	45
211.073015I A 00400 (17 BJ 014)	J.W. Gibson	102 Southwood Ln.	R-2 2-4 Family Residential Districts (PUD)	1	45
212.073015I B 01100 (17BJ 018)	J.W. Gibson	205 Southwood Ln.	R-2 2-4 Family Residential Districts (PUD)	1	45
213.001099O A 02700 (16 BX 008)	Virginia Power c/o Chris Power	157 Royce Circle	R3 Multiple Family/ Residential/Hotel Districts	0.54	50
214.001104E B 00200 (16 BS 561.01)	Oak Ridge City Electric Substation	Oak Ridge Turnpike	RG1 Residential/Open Space & Reserved Districts (Institutional Public)	1	50

Continued…

TABLE 6 (CONT.)
ANALYSIS OF OAK RIDGE PROPERTIES IN CLOSE PROXIMITY TO EAST FORK POPLAR CREEK

GEOGRAPHIC INFORMATION SYSTEM NUMBER (OLD MAP NUMBER)	CURRENT PROPERTY OWNER+	ADDRESS	PROPERTY ZONING	NUMBER OF ACRES	ESTIMATED DISTANCE FROM CREEK (FEET) *
Residential Applications (See 94-293)					
215.001104N A 03300 (16 BQ 002)	Carol J. & Bill R. Leffew	198 Hermitage Blvd.	R2 Two/Three/Four Family Residential Districts	0.28	50
216.001104N A 03400 (16 BQ 001)	Jackson Crossing LLC	196 Hermitage Blvd.	R2 Two/Three/Four Family Residential Districts	0.44	50
217.073015H B 00102 (16 BK 070)	David A. & Cathy M. Van Oosterwuk	Sweet Gum Ln.	R4B Multiple Family Residential Districts (PUD)	1	50
218.073015I A 01300 (17 BK 004)	David R. & Merle Clark	120 Southwood Ln.	R-2 2-4 Family Residential Districts (PUD)	1	50
219.073015I B 01200 (17BJ 017)	J.W. Gibson	203 Southwood Ln.	R-2 2-4 Family Residential Districts (PUD)	1	50
220.073015I A 00200 (17 BJ 016)	J.W. Gibson	201 Southwood Ln.	R-2 2-4 Family Residential Districts (PUD)	1	60
221.073015I B 00700 (17BJ 022)	Margaret M. Trustee Hanrahan	210 Southwood Ln.	R-2 2-4 Family Residential Districts (PUD)	1	60
222.001099O A 02400 (16 BX 467.00)	Wayne & Patricia Clark	Jefferson Terminal	R3 Multiple Family/ Residential/Hotel Districts	2	65
223.073015I A 00700 (17 BJ 011)	John M. & Pamela L. Zisman	108 Southwood Ln.	R2 Two/Three/Four Family Residential Districts (PUD)	1	65
224.073015B C 01500 (16 BM 059)	Thomas E. Sr. & Marilyn J.McCreight	158 Golfcrest Ln.	R2 Two/Three/Four Family Residential Districts	1	80

Continued…

TABLE 6 (CONT.)
ANALYSIS OF OAK RIDGE PROPERTIES IN CLOSE PROXIMITY TO EAST FORK POPLAR CREEK

GEOGRAPHIC INFORMATION SYSTEM NUMBER (OLD MAP NUMBER)	CURRENT PROPERTY OWNER+	ADDRESS	PROPERTY ZONING	NUMBER OF ACRES	ESTIMATED DISTANCE FROM CREEK (FEET) *
Residential Applications (See 94-293)					
225.001104N A 02900 (16 BQ 006)	Jackson Crossing LLC	206 Hermitage Blvd.	R2 Two/Three/Four Family Residential Districts	0.63	90
226.001105C B 00100 (19 BZ 010)	C&S Land Co.	191 Tusculum Dr.	R4B Multiple Family Residential Districts	4.43	100
227.073015B C 01600 (16 BM 060)	Arta Jo Newton	160 Golfcrest Ln.	R2 Two/Three/Four Family Residential Districts	1	110
228.001105C B 04500 (19 BZ 009)	Ying Fung & Ming Ching Yu * ($25,694)	193 Tusculum Dr. (1 acre)	R4B Multiple Family Residential Districts	1	115
229.073015B D 00400 (16 BM 081)	Terry N. Sharpe	114 Greenwood Ln.	R2 Two/Three/Four Family Residential Districts	1	115
230.073015B D 00800 (16 BM 078)	W S C Inc.	111 Greenwood Ln.	R2 Two/Three/Four Family Residential Districts	1	120
231.073015B D 00900 (16 BM 077)	W S C Inc.	109 Greenwood Ln.	R2 Two/Three/Four Family Residential Districts	1	130
232.073015B E 01400 (16 BL 010)	Sylvia M. Lovelace	123 Grandcove Ln.	R2 Two/Three/Four Family Residential Districts	1	140

Continued…

TABLE 6 (CONT.)
ANALYSIS OF OAK RIDGE PROPERTIES IN CLOSE PROXIMITY TO EAST FORK POPLAR CREEK

GEOGRAPHIC INFORMATION SYSTEM NUMBER (OLD MAP NUMBER)	CURRENT PROPERTY OWNER+	ADDRESS	PROPERTY ZONING	NUMBER OF ACRES	ESTIMATED DISTANCE FROM CREEK (FEET) *
Residential Applications (See 94-293)					
233.001105C B 04400 (19 BZ 009)	Ying Fung & Ming Ching Yu	195 Tusculum Dr.	R4B Multiple Family Residential Districts	1	170
234.073015I B 00100 (17 BJ 028)	J.W. Gibson	Southwood Ln. W	R2 Two/Three/Four Family Residential Districts (PUD)	1	175
235.001099O A 03300 (16 BY 536)	Carden Rentals LP	Royce Cir.	R3 Multiple Family/ Residential/Hotel Districts	2.14	185
236.001105D A 02700 (21 CA 408)	City of Oak Ridge Ball Park	Wilberforce Ave.	RG1 Residential/Open Space & Reserved Districts	57.95	200
237.001105D A 03100 (21 BZ 456.00)	Frances Sturm	Tuskegee Dr.	RG1 Residential/Open Space & Reserved Districts	1	200
238.073015I B 00200 (17 BJ 027)	J.W. Gibson	Southwood Ln. W	R2 Two/Three/Four Family Residential Districts (PUD)	1	215
239.073015I A 03600 (17 BJ 001)	J.W. & Edna Gibson	101 Southwood Ln.	R-2 2-4 Family Residential Districts (PUD)	1	230
240.073015I A 01900 (17 BK 010)	J.W. Gibson	119 Southwood Ln.	R-2 2-4 Family Residential Districts (PUD)	1	245
241.073015I A 03500 (17 BJ 002)	J.W. Gibson	103 Southwood Ln.	R-2 2-4 Family Residential Districts (PUD)	1	255
242.001104N A 02800 (16 BQ 007)	Larry G. Byars	208 Hermitage Blvd.	R2 Two/Three/Four Family Residential Districts	0.37	260

Continued…

TABLE 6 (CONT.)
ANALYSIS OF OAK RIDGE PROPERTIES IN CLOSE PROXIMITY TO EAST FORK POPLAR CREEK

GEOGRAPHIC INFORMATION SYSTEM NUMBER (OLD MAP NUMBER)	CURRENT PROPERTY OWNER+	ADDRESS	PROPERTY ZONING	NUMBER OF ACRES	ESTIMATED DISTANCE FROM CREEK (FEET) *
Residential Applications (See 94-293)					
243.073015I B 00300 (17BJ 026)	J.W. Gibson	204 Southwood Ln.	R-2 2-4 Family Residential Districts (PUD)	1	260
244.001099N A 01200 (18 BZ 473.01)	J.W. Gibson	100 S. Illinois Ave.	RG1 Residential/Open Space & Reserved Districts	5.89	270
245.073015I B 00400 (17BJ 025)	J.W. Gibson	206 Southwood Ln.	R-2 2-4 Family Residential Districts (PUD)	1.24	270
246.073015I A 02100 (17 BK 012)	Charles E. & Phyllis H. Green	115 Southwood Ln.	R-2 2-4 Family Residential Districts (PUD)	1	280
247.073015B D 00300 (16 BM 082)	Terry N. Sharpe	112 Greenwood Ln.	R2 Two/Three/Four Family Residential Districts	1	290
248.073015I A 02000 (17 BK 011)	J.W. Gibson	117 Southwood Ln.	R-2 2-4 Family Residential Districts (PUD)	1	290
249.001099N A 02200 (18 BY 354)	Oak Ridge Coronado LLP	101 Vanderbilt Dr.	R3 Multiple Family/ Residential/Hotel Districts	16.55	300
250.001104N A 00500 (16 BQ 021)	Oak Ridge Sportsman Assoc.	201 Hermitage Blvd.	R2 Two/Three/Four Family Residential Districts	0.47	300
251.001106A B 05200 (22 CB 060)	Richard A. & Shirley Chinn	515 S. Illinois Ave.	R1C One Family Residential Districts	1	300
252.073015I A 03400 (17 BJ 003)	J.W. Gibson	105 Southwood Ln.	R-2 2-4 Family Residential Districts (PUD)	1	305

Continued…

TABLE 6 (CONT.)
ANALYSIS OF OAK RIDGE PROPERTIES IN CLOSE PROXIMITY TO EAST FORK POPLAR CREEK

GEOGRAPHIC INFORMATION SYSTEM NUMBER (OLD MAP NUMBER)	CURRENT PROPERTY OWNER+	ADDRESS	PROPERTY ZONING	NUMBER OF ACRES	ESTIMATED DISTANCE FROM CREEK (FEET) *
Residential Applications (See 94-293)					
253.001104E B 00500 (16 BT 007)	Robert & Patricia Green	104 Wiltshire Dr.	RG1 Residential/Open Space & Reserved Districts (Single Family-Detached)	5.63	310
254.073015B D 00200 (16 BM 083)	Terry N. Sharpe	114 Greenwood Ln.	R2 Two/Three/Four Family Residential Districts	1	325
255.073015I A 02200 (17 BK 013)	Connie & Ricky G. Phillips	113 Southwood Ln.	R-2 2-4 Family Residential Districts (PUD)	1	340
256.073015B D 00100 (16 BM 084)	Terry N. Sharpe	108 Greenwood Ln.	R2 Two/Three/Four Family Residential Districts	1	345
257.073015I A 02300 (17 BK 014)	J.W. Gibson	111 Southwood Ln.	R-2 2-4 Family Residential Districts (PUD)	1	370
258.073015I A 02400 (17 BK 015)	J.W. Gibson	109 Southwood Ln.	R-2 2-4 Family Residential Districts (PUD)	1	370
259.073015I A 02500 (17 BJ 008)	Steven Wade & Sara Lee Diana Wiley	107 Southwood Ln.	R-2 2-4 Family Residential Districts (PUD)	1	370
260.001105C B 04300 (19 BZ 008)	Sunrise Apartments c/o Stephen H. Moore	197 Tusculum Dr.	R4B Multiple Family Residential Districts	1.01	390
261.001104N A 02700 (16 BR 008)	David Whisnant	210 Hermitage Blvd.	R2 Two/Three/Four Family Residential Districts	0.31	395

Continued…

TABLE 6 (CONT.)
ANALYSIS OF OAK RIDGE PROPERTIES IN CLOSE PROXIMITY TO EAST FORK POPLAR CREEK

GEOGRAPHIC INFORMATION SYSTEM NUMBER (OLD MAP NUMBER)	CURRENT PROPERTY OWNER+	ADDRESS	PROPERTY ZONING	NUMBER OF ACRES	ESTIMATED DISTANCE FROM CREEK (FEET) *
Residential Applications (See 94-293)					
262.001104N A 01300 (16 BQ 020)	Jackson Crossing LLC	203 Hermitage Blvd.	R2 Two/Three/Four Family Residential Districts	0.28	500
263.001104N A 02600 (17 BR 009)	Les P. & Natalia A. Beard	212 Hermitage Blvd.	R2 Two/Three/Four Family Residential Districts	0.28	500
264.001105H A 01300 (17 BU 004)	C.W. & Wanda Craven & Walt & Linda Brown	Wiltshire Dr.	RG1 Residential/Open Space & Reserved Districts	9.78	500
265.001105H A 01500 (17 BU 008)	C.W. & Wanda Craven & Walt & Linda Brown	Wiltshire Dr.	RG1 Residential/Open Space & Reserved Districts	6.95	535
266.001104N A 01400 (16 BQ 019)	Jackson Crossing LLC	205 Hermitage Blvd.	R2 Two/Three/Four Family Residential Districts	0.25	540
267.001105H A 01700 (17 BV 011)	Jason T. & Christine P. Cheny ($115,600)	Wiltshire Dr.	RG1 Residential/Open Space & Reserved Districts	5.78	550
268.001099N A 01300 (18 BY 355)	Oak Ridge Coronado LLP	0 Vanderbilt Dr.	R3 Multiple Family/ Residential/Hotel Districts	2.84	570
269.001104N A 02500 (17 BR 010)	David Whisnant	214 Hermitage Blvd.	R2 Two/Three/Four Family Residential Districts	0.28	580
270.001104E B 00600 (16 BT 008)	Robert H. McNabb	106 Wiltshire Dr.	R1A One Family Residential Districts	5.14	590

Continued…

TABLE 6 (CONT.)
ANALYSIS OF OAK RIDGE PROPERTIES IN CLOSE PROXIMITY TO EAST FORK POPLAR CREEK

GEOGRAPHIC INFORMATION SYSTEM NUMBER (OLD MAP NUMBER)	CURRENT PROPERTY OWNER+	ADDRESS	PROPERTY ZONING	NUMBER OF ACRES	ESTIMATED DISTANCE FROM CREEK (FEET) *
Residential Applications (See 94-293)					
271.001104N A 01500 (16 BQ 018)	Jackson Crossing LLC	207 Hermitage Blvd.	R2 Two/Three/Four Family Residential Districts	0.24	600
272.001104N A 01600 (17 BQ 017)	Michael Agamaliam	209 Hermitage Blvd.	R2 Two/Three/Four Family Residential Districts	0.26	610
273.001105C B 042.00 (20 BZ 003)	City of Oak Ridge	Tusculum Dr.	R1C One Family Residential Districts	4..36	610
274.001105H A 01600 (17 BU 010)	C.W. & Wanda Craven & Walt & Linda Brown	Wiltshire Dr.	RG1 Residential/Open Space & Reserved Districts	4.7	660
275.001104N A 01700 (17 BQ 016)	Yink Fung & Ming Ching Yu	211 Hermitage Blvd.	R2 Two/Three/Four Family Residential Districts	0.29	665
276.001105H A 01200 (17 BU 002)	William Keys II & Melanie Chitwood Fillauer	Tuskeegee Dr.	RG1 Residential/Open Space & Reserved Districts	6	700
277.001104N A 02200 (17 BR 054)	Joseph W. Cletcher	221 Hermitage Blvd.	R2 Two/Three/Four Family Residential Districts	0.34	750
278.001105H A 01400 (17 BU 006)	C.W. & Wanda Craven & Walt & Linda Brown	Wiltshire Dr.	RG1 Residential/Open Space & Reserved Districts	5.85	775

Continued…

TABLE 6 (CONT.)
ANALYSIS OF OAK RIDGE PROPERTIES IN CLOSE PROXIMITY TO EAST FORK POPLAR CREEK

GEOGRAPHIC INFORMATION SYSTEM NUMBER (OLD MAP NUMBER)	CURRENT PROPERTY OWNER+	ADDRESS	PROPERTY ZONING	NUMBER OF ACRES	ESTIMATED DISTANCE FROM CREEK (FEET) *
Residential Applications (See 94-293)					
279.001105C A 01000 (19 BY 014)	Tiffin Home Development	111 Tiffin Dr.	R1C One Family Residential Districts	1	800
280.001105C B 04100 (20 BZ 023)	Brady & Debbie Nathan	199 Tusculum Dr.	R1C One Family Residential Districts	0.62	930
281.001105C B 04000 (20 BY 024)	Walter W. Etux Wimes	201 Tusculum Dr.	R1C One Family Residential Districts (Single Family-Detached)	0.44	1,100
282.001105H A 01100 (18 BU 563.03)	Mel Sturm	Tuskeegee Dr.	RG1 Residential/Open Space & Reserved Districts	9.83	1260
283.001105H A 00900 (20 BV 567)	Wayne & Patricia Clark	0 Tuskeegee Dr.	R1A One Family Residential Districts	353.4	1,550
284.001105C B 03500 (20 BY 029)	Virginia & Bryan Hamby	211 Tusculum Dr.	R1C One Family Residential Districts (Single Family-Detached)	0.38	1,660
285.001105C B 03400 (20 BY 030)	John Crawford	213 Tusculum Dr.	R1C One Family Residential Districts (Single Family-Detached)	0.42	1,775
286.073015J C 03900 (19 BK 597.03)	J.W. Gibson	Glassboro Dr.	R1B One Family Residential Districts (Reserved for Park Site)	6.74	~2,000
287.073015J C 01600 (19 BM 004)	Marshall A. & Vicki Lenne	188 Gum Hollow Rd.	R2 Two/Three/Four Family Residential Districts	1	~3,000

Continued…

TABLE 6 (CONT.)
ANALYSIS OF OAK RIDGE PROPERTIES IN CLOSE PROXIMITY TO EAST FORK POPLAR CREEK

GEOGRAPHIC INFORMATION SYSTEM NUMBER (OLD MAP NUMBER)	CURRENT PROPERTY OWNER+	ADDRESS	PROPERTY ZONING	NUMBER OF ACRES	ESTIMATED DISTANCE FROM CREEK (FEET) *
Residential Applications (See 94-293)					
288.073015K B 00800 (19 BM 001)	Carden Rentals LLP	201 Gum Hollow Rd.	R4A Multiple Family Residential Districts	1.13	~3,800
289.073015K B 00300 (20 BM 003)	Viatcheslav & Ekat Erina Danilov	221 Gum Hollow Rd.	R1B One Family Residential Districts	1	>5,000
290.073015K B 00400 (20 BM 002)	J.W. Gibson	219 Gum Hollow Rd.	R1B One Family Residential Districts	1	>5,000
291.073015K B 00500 (20 BM 001)	J.W. Gibson	217 Gum Hollow Rd.	R1B One Family Residential Districts	1	>5,000
292.073015K B 00600 (19 BM 003)	Cole Properties Enterprise	211 Gum Hollow Rd.	R4A Multiple Family Residential Districts	2.07	>5,000
293.001105H A 01000 (21 BX 567.01)	Teller Village Apts. c/o Steve Tuskerman	100 Tee Jay Dr.	R4B Multiple Family Residential Districts (PUD)	8.55	6,100

Note: Although ITSPA made the best possible effort to report accurate data, ITSPA acknowledges that some of the numbers reported in this table may be incorrect either due to ITSPA's errors or errors in the GIS database itself. Therefore, users of these numbers are responsible for verifying the accuracy of these data. The distances provided in this table reflect the closest approximate distance to the creek as estimated by ITSPA using the best available map from the web site http://gis.cotrn.org.

PUD = Planned Unit Development District. See www.cortn.org (Departments/Community Development) for more detailed definitions of the abbreviations used in this table.

7.3 INPUT FROM SELECTED RESIDENTS AND/OR PROPERTY OWNERS

ITSPA conducted a short-form survey and personal interviews with a variety of individuals in order to gain the perspective of land owners, condo and home owners, and tenants in order to meet Goal 1, 2, and 4 (see Table 1). Note, however, a number of property owners seemed reluctant to discuss this issue with ITSPA, perhaps out of fear of stigmatizing their property and hindering its future sale.

7.3.1 Survey Participant Selection Process

The driving tour was used to select the streets and facilities to target for delivery of the short-form survey. The streets selected are generally on or near the primary EFPC stream rather than secondary feeder streams. (See Table 3)

7.3.2 Short-form Survey

The ITSPA project team delivered 460 surveys to the majority of the streets listed in Table 3. There were 22 surveys returned (return rate of 4.8%) and Table 7 summarizes the responses. Figure 6 provides the survey form used.

INSTITUTE FOR TECHNOLOGY, SOCIAL, AND POLICY AWARENESS, INC.

SHORT-FORM SURVEY OF RESIDENTS ALONG EAST FORK POPLAR CREEK (EFPC) AND ITS TRIBUTARIES (DELIVERED 8/30/02 – 9/26/02)

Please check all that apply:

1. Property owner on or near EFPC	2. Renter on or near EFPC	3. Played in EFPC as a child	4. Have observed children playing in or along EFPC in recent years
5. Have asked children to stop playing in EFPC	6. Did not realize the EFPC posed any concern		
7. Have caught fish in EFPC	8. Have eaten fish from EFPC		
9. Have caught turtles in EFPC	10. Have eaten turtles from EFPC		
11. Have caught fish in streams feeding into EFPC	12. Have eaten fish in streams feeding into EFPC		
13. Have caught turtles in streams feeding into EFPC	14. Have eaten turtles from streams feeding into EFPC		
15. EFPC floodwaters have come onto my property	16. Believe EFPC has impacted me financially or other ways		
17. Willing to share additional information describing how I've been impacted*	18. Was informed about the EFPC before purchasing or leasing property, apartment, etc.		
19. Want more information about EFPC			

Optional:

Name:_____

Address: _____

_____

Telephone:_____

Email:_____

Date moved on or near EFPC:_____

Comments:

_____

_____

_____

_____

_____

_____

* If interested in providing additional information for this project, call Susan Kaplan (865-927-3784) to arrange an interview. (Note: You are in no way obligated to fill out this form or to participate in any other way. However, if you are interested in providing additional information, a signed "Informed Consent" form is required.)

Figure 6. Short Form Survey of Residents Along East Fork Poplar Creek

TABLE 7
SHORT-FORM SURVEY RESPONSE SUMMARY

SHORT-FORM SURVEY STATEMENT	PERCENT RESPONDING, %	COMMENTS
1. Property owner on or near EFPC	60	
2. Renter on or near EFPC	33	Two respondents did not indicate if renter or property owner.
3. Played in EFPC as a child	7	
4. Have observed children playing in or along EFPC in recent years	53	
5. Have asked children to stop playing in EFPC	20	
6. Did not realize the EFPC posed any concern	47	
7. Have caught fish in EFPC	0	One respondent indicated they have seen large fish in the creek.
8. Have eaten fish from EFPC	7	
9. Have caught turtles in EFPC	7	
10. Have eaten turtles from EFPC	0	
11. Have caught fish in streams feeding into EFPC	7	
12. Have eaten fish from streams feeding into EFPC	0	
13. Have caught turtles in streams feeding into EFPC	7	
14. Have eaten turtles from streams feeding into EFPC	0	
15. EFPC floodwaters have come onto my property	47	
16. Believe EFPC has impacted me financially or other ways	40	
17. Willing to share additional information describing how I've been impacted	13	
18. Was informed about the EFPC before purchasing or leasing property, apartment, etc.	13	
19. Want more information about EFPC	47	

SOURCE: ITSPA

Table 8 provides an analysis of the short-form survey responses, sorted by the number of years each respondent has lived on the creek. The following statements are an overview of this analysis.

Fifty nine percent (13) of the 22 respondents are property owners along EFPC. Nine percent (2) of the respondents played in the creek as a child and 41 percent (9) have observed children playing in or along the EFPC in recent years. Eighteen percent (4) of

the respondents have asked children to stop playing in the creek. Thirty six percent (8) indicated they did not realize the EFPC posed any concern. None of the respondents have personally caught fish from the creek, but five percent (1) indicated they had eaten fish from EFPC. Five percent (1) indicated they had caught turtles in the creek, but none have eaten them. Five percent (1) of the respondents indicated they had caught fish in streams feeding into EFPC, but none indicated they had eaten them. Five percent (1) indicated they had caught turtles in streams feeding into EFPC, but none indicated they had eaten them. Forty five percent (10) of the respondents indicated that EFPC floodwaters have come onto their property. Thirty two percent (7) indicated they believe the EFPC has impacted them financially or in other ways. Eighteen percent (4) of the respondents indicated they were willing to share additional information describing how they have been impacted. Nine percent (2) indicated they were informed about the EFPC before purchasing or leasing. Thirty six percent (8) of the respondents indicated they want more information on EFPC.

7.3.3 Personal Interviews

Tables 9 through 12 summarize the information obtained by ITSPA's through personal interviews. Interviews 1 (Table 9) and 4 (Table 12) were of large property owners. Interview 2 (Table 10) was of a condominium owner, and Interview 3 (Table 11) was of a tenant.

TABLE 8
ANALYSIS OF SHORT-FORM SURVEY RESPONSES

YEARS SURVEY RESPONDENT HAS LIVED ON EFPC	SURVEY STATEMENTS CHECKED*	RESPONSE BY SURVEY STATEMENT NUMBER*																	
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**
1. 40 years	1,2,4,9,15,16,17	x	x		x					x						x	x	x		
2. 12 years	None																			
3. 3 years	1,4,15,16,18,19	x			x											x	x		x	x
4. 9 years	1,4,6,13,15,16,19	x			x		x							x		x	x			x
5. 2 years	1,6,15	x					x									x				
6. 14 year	1,4,5,15,16,17,19	x			x	x										x	x	x		x
7. <1 year	2,6,19		x				x													x
8. 1 year	1,4,6,15,19	x			x		x									x				x
9. 25 years	1,4,15,16(?),19	x			x											x	?			x
10. 2 years	2,3		x	x																
11. 1 year	1,6,15,19																			
12. 4 years	1,4,5,11	x			x	x						x								
13. 9 years	1,4,5,16,18	x			x	x											x		x	
14. Not provided	6						x													
15. Not provided	1,15	x														x				
16. <1 year	2,6		x				x													
17. Not provided	1,6.19	x					x													x
18. 5 years (1971-76)	2,6,15		x				x									x				
19. 54 years	1	x																		
20. 1 years	2,4,5,19		x		x	x														
21. 2 years	2,3,8,16,17		x	x					x								x	x		x
22. Not provided	1,15,16,17	x														x	x	x		
Number responding		13	7	2	9	4	8	0	1	1	0	1	0	1	0	10	7	4	2	8
Percent responding, %		59	32	9	41	18	36	0	5	5	0	5	0	5	0	45	32	18	9	36
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**

* See Table 7 or Figure 6 for survey statements.

SOURCE: ITSPA

TABLE 9
PERSONAL INTERVIEW #1
(LARGE PROPERTY OWNER)

QUESTION	RESPONSE SUMMARY
1. Are you a property owner along the EFPC or one of its tributaries? Tenant? Developer? Other? EFPC or tributary?	Owns (1) 93 acres with 2,000 frontage feet along the creek up to the top of the ridge, which is across from Four Oakes Center and (2) A parcel containing 357 acres not affected by the creek, located on the other side of ridge about one mile from the creek (perpendicular distance). He originally owned all 357 acres, but recently sold 8.5 acres to an apartment developer. [150]
2. For how many years? Date?	Bought the creek-front property from the U.S. government in 1959 and the 357 acres in 1972.
3. Do you have children?	No
4. What activities do you and/or your children currently do in, or near, the EFPC? One of its tributaries?	Cuts trees to enable commercialization of creek frontage, plants bushes along creek edge, mows, and works cattle. He plans to move a section of the creek in the future[151] and to plant bushes along the creek again. In the past, he carried water directly from the creek in a bucket to allow him to plant trees when the ground too dry. This property owner has tried to give the trees he's cut to people to burn in their fireplaces, but no one has wanted the wood. He also indicated that anyone is invited to play on his property along the creek.
5. What activities have you and/or your children done in the past? Years?	Regarding children, he indicated there was very little use except for a lady doing home schooling who used to bring her child there. They went up and down the creek looking at birds, etc., but he doesn't think they were playing in the soil. They may have "dug up a snail or something like that," but did not significantly mess with the soil.
6. What do you know about the contamination of the creek and its tributaries, both historically and today?	He followed the discussion and the debate over the years and, at the time he thought he was fairly well informed. He thought he knew what was going on and so is not really concerned about the mercury. He believes it has had a chance to react and combine as mercuric sulfide or other non-hazardous substances. He does not see it as a problem, but thinks society sees it as a problem. He has no real knowledge of present contamination, but believes Y-12 releases of mercury are very, very small, so he has had no concern at all—until recently. He does not see fish now like he once did, which makes him suspicious. He has commonly seen 10"-12" Carp in EFPC.

Continued…

[150] "There was some conversation regarding the apartments (now known as Teller Village) in the early days of the negotiation as to whether the land was in any way contaminated from Y-12. I put them into contact with the government agency that was just coming out with a report with regard to Scarboro Village and the sampling. Apparently, the report said that Scarboro is not contaminated. I told the Regency people that such a report existed. Whether they looked it up or not, I don't know. They offered me a price for the land that surprised me and I did not negotiate or debate that price. The per-acre-price was in the range of $21,000 per acre. But more than that, the State of TN, when it did Tuskeegee Drive upgrade, they paid me approx. $35,000 per acre. Frontage on an approved road I think should have cost that much, but frontage on an unimproved road, I was surprised that they paid that much for it."

[151] "I decided where I wanted to move the creek and drew a rough drawing and took it to the Corp. of Engineers in Loudon County because I thought they were in charge of the creek. The nice lady who was the senior officer in that office listened patiently while I told her that I wanted to use farming techniques (a sincere but innocent terminology on my part) to use farming equipment to relocate the creek, i.e., to shove it south back up against the foot of the hill in the flood plain, and thus be able to commercially use the frontage along the Turnpike, which then would be north of the creek. She smiled and said if I used farming techniques, she could not stop me. I then went to the City who said that I could not do this until I get clearance from DOE because of the mercury question, and that I had to go to TDEC because they really control the creek as far as the city knows. Then I learned that EPA was involved, and different other agencies…in the end I think there were five agencies that I was supposed to get clearance before undertaking this project. I still want to do it, but it has drifted to zero because I'm developing some other land. But I will most likely bring it to the front of my activities late this summer or this winter (2003). But it is something that I have to deal with soon."

TABLE 9 (CONT.)
PERSONAL INTERVIEW #1
(LARGE PROPERTY OWNER)

QUESTION	RESPONSE SUMMARY
7. How did you learn this information?	At first, by "scuttlebutt." The people were accusing the government of mercury contamination before the news hit the papers around 1983. He more or less followed the public discussion and participated in panels regarding the study. While EFPC was being cleaned up, he spent a fair amount of time, both with the people doing the cleanup and the management, just watching what was going on to satisfy himself they were cleaning it up. The land was filled in around 1999 and was essentially returned to him as being cleaned up. He has not had any serious discussions recently about the mercury contamination or any current effects of it. Note the City of Oak Ridge was very aloof about the mercury issue and would not even come to the public meetings that 50-75 people would attend. Also note that, when Jefferson businesses flooded in 1950s and 60s and water was in the buildings, the City did not seem to care.
8. Are you aware that varying levels of contaminants have historically been, and are currently being, released to the EFPC from the Y-12 Plant?	Know they were in the past, but the government is monitoring now so believes there is no problem today.
9. Do you know what contaminants were released to the EFPC in the past? What is your understanding of how the levels released have changed over time?	Mercury, hydrocarbons, inorganic acids & salts. Levels have significantly decreased over time.
10. Do you know what contaminants are released to the EFPC today? If Yes, what do you know about their levels of release?	No.
11. Do the Y-12 releases of the past concern you? If yes, what concerns you most?	Not anymore. The public's impression is the bad part now…truth doesn't matter.
12. Do the Y-12 releases of the present concern you? If yes, what concerns you most?	No. What concerns him most is the large amount of retraining of plant personnel (and resulting human error) causing accidents, e.g., the recent burning of Jerry Scruggs at Y-12 with uranium metal.
13. Are you interested in learning more about the releases of the past? The present?	No. He lives in the future.
14. Would you need help in interpreting the data you are provided?	No. Scientist by training.

Continued…

TABLE 9 (CONT.)
PERSONAL INTERVIEW #1
(LARGE PROPERTY OWNER)

QUESTION	RESPONSE SUMMARY
15. Do you believe you have been personally impacted by the release of contaminants to the EFPC? If so, how?	Despite his intimate contact with the contaminants, he believes there have been no health impacts. However, the government hindered his use of the land and stigmatized it, leading to non-use of both the land along EFPC and the land over the ridge along Tuskeegee Dr. that is not directly impacted by the creek.[152] He indicated that Oak Ridge is definitely not growing now and has not grown in 40 years. He thinks that implies the outside public has some concern about contamination in Oak Ridge.
16. Do you know about the Oak Ridge Reservation Health Effects Subcommittee (ORRHES) activities and reports?	Aware of, but do not follow activities.
17. Comments	"My wife believes that from the very early days our land essentially had been damned. That was made very real when the *Knoxville News Sentinel* carried a story—and I'll have to make it up now: "Laboratory Researchers' Yard Found to Have Contained Mercury."[153] Then the story goes on talking about my property along the Turnpike. Well, my front yard is not there. I live a mile and a half up the hill from there. That set my wife's view that the land along the creek possibly would not be developed in our lifetime. And it's approaching that. I'm 80." Regarding the signs posted by the State of Tennessee along EFPC (in response to the interviewer's comment that she was told by the State that they check the signs annually, but she had noticed one had been removed from an easily accessible commercial property since she started this project): "I say that is bull----. I have one as a souvenir they haven't told me is no longer there. I do not believe with any sincerity that they check those signs."

Continued…

[152] "The state of TN refused to let Roane State Community College be located on the Tuskeegee Dr. property because there was a chance the land could have been contaminated from Y-12. The land was given twice, the first time 25 years ago and 15 years ago the second time. We gave the land to the State, the deed was transferred, and it was rejected by Gov. Alexander the first time on an argument that the community college (now Pellissippi State located on Pellissippi Parkway) should be located on the Parkway in order to fill a region that was scheduled to grow and he wanted the school to be a part of that growth. So contamination was not a discussion. Then time went by and we organized a committee called Oak Ridge Committee for Higher Education (ORCHE) and ORCHE worked five years. My wife and I offered 50 acres and the city offered 52 (old landfill and land reserved for a landfill) and that was accepted by the State and transferred, and they even had a preliminary design of the building. That went all the way to the conceptual drawings when political (some local) maneuvering associated with that all of a sudden came up that there was a possibility of contamination and things thrown on the property that they did not know about. We paid an engineering firm to do a study to come on the property to do a report. The firm found a barrel that at an earlier time had TCE (i.e., trichloroethylene) in it and in their report the firm claimed that it exceeded the limit of allowed contamination based on state data, and that gave them the basis to bring in a health physicist group from Brentwood, TN. They looked over the property and a very nice lady told me she thought it was a shame, but the way they worded the question she had to answer it truthfully. The question was "Is there a possibility of contamination from Y-12." She said, "I do not believe there was contamination from Y-12, but yes, there is a possibility. That was the basis of their shutting down the program. Ten years later, the engineering firm happened to be reviewing their records, and they wrote the city that they had made a mistake in looking in the state of TN listing of contamination limits. They read it as ppm (parts per million) and it was really ppb (parts per billion). They were a thousand parts off in their report. They were embarrassed by that. The city thought it was humorous because they still owned the land and it removed the cloud from them for now. But at that time, that was the basis for the second rejection and the land was transferred back to my estate."

[153] The article he was referring to could, perhaps, be "Mercury Problem Pains Landowners," Knoxville News Sentinel, 8/19/91.

TABLE 9 (CONT.)
PERSONAL INTERVIEW #1
(LARGE PROPERTY OWNER)

QUESTION	RESPONSE
INTERVIEWEE'S ANSWERS TO SURVEY (PROPERTY OWNERS', DEVELOPERS', AND LANDLORDS')	
18. Do you believe the property you own or manage along the EFPC and/or its tributaries has been impacted by Y-12 releases to the creek? If so, how?	See #15 in previous section.
19. Has your soil been tested for contaminants such as mercury? If yes, what was the level?	Yes. It was originally 2,300 ppm near the area he used a lot and had routine contact with for many years while working cattle, mowing, cutting trees, etc. However, since the samples were homogenized, he believes they could easily have cut the contamination reading by a third or by a half or more, i.e., the level could actually have been 4,600 to 6,000 ppm.[154] Any soil with less than 400 ppm (homogenized value) was left in place, and fresh clay was put over areas where soil contaminated more than 400 ppm was removed. Note, that mercury-contaminated soil from this property was used by the city for projects throughout the city.[155, 156]

Continued…

[154] "I purchased the Turnpike property in 1959. Almost immediately, I wanted to have some cattle. I grew up being near farms, but was a city boy. This frontage is where I wanted to start. So, in the early 1960s, I fenced off probably 20 acres of bramble and could-be pasture land along the Turnpike (including EFPC), which came through my property. Across from Bruners, I developed a ramp where I could turn my car or trailer down the ramp, and from there I created a path down to the creek and put a power-pole footbridge across the creek and had to wade through an area that was lower than that around it. I had to wade across 100-150 feet to where I got back to high ground. All through this area there were about six channels of EFPC. To solve this problem, I decided to take two plastic paint buckets, and each time I went in (essentially every day), I would carry in two 5-gallon buckets of rocks and dump them in this low flooded area and then mess with the cattle, and then bring the empty buckets back out. I would pick up some more convenient rock and have it ready for the next day. In nothing flat, like two years, I had a comfortable causeway where I did not have to wade any longer to get to my barn/shed and to work with my cattle. Later on, when they started digging out and sampling for mercury, immediately below (downstream) from this causeway that I had created, is where they discovered the highest mercury contamination (2,300 ppm) which at that time was known as the largest contamination in the private sector. By the time they took the sample that land had filled in with silt. So that for the sampling process, if they took a deep core, say 18" or so, and homogenized it with the soil silt that was from the top surface, they could easily have cut the contamination reading by a third or by a half. It could easily have been 4,600 ppm or 6,000 ppm or some other number down at the bottom of this wet area where the mercury could easily have settled. That was part of the explanation that they concluded was the reason that the high contamination was there was this low area where the water would be last to evaporate off and any mercury that came downstream would tend to be caught in that area and concentrated."

[155] "Back when the mercury question was actively being discussed, the city had put in a library and recreation facility and they were landscaping around it. The city also was relocating the main sewer line to the west of Oak Ridge and across my property they had moved it with my agreement back further from the Turnpike. So they had some familiarity with my land. One Saturday morning I was working at my business, and my wife came hurrying down in her little VW all upset because she saw construction equipment loading & hauling soil from our property located across from Four Oaks next to Louisiana Ave. (near the area where the flooding and mercury conversation had just begun to be discussed, but was not studied at all, and which was eventually remediated). I got in the car and hurried back to the property and, sure enough, there was a front-end loader and trucks on my property waiting to be loaded with soil to haul out. They'd cut the fence where my cattle had been in there. I blocked their exit with my VW and told them they had no right to be on my property. A contractor for the City even chased me around with the front-end loader, but it moved so slow that I could easily move out of its way. He was trying to frighten me to get out so they could continue doing what they were doing, but I wasn't afraid of him! It was ridiculous behavior. After two hours, the supervisor came, and then the city people came, and they agreed they had no right to be there. But by that time, they had already hauled out a number of loads and had spread the soil up around the new civic center. Later on, it turned out they had significant contamination at the civic center because they had hauled earth from the floodplain on my property without my permission."

[156] Table 1 provides 1984/85 data for Oak Ridge properties that were tested for contamination.

TABLE 9 (CONT.)
PERSONAL INTERVIEW #1
(LARGE PROPERTY OWNER)

QUESTION	RESPONSE SUMMARY
20. Do you believe the creek and/or its tributaries have affected the final outcome of a proposed sale, lease, or project? If yes, how many times?	Yes. There was a possible sale in 1959. However, no one has approached him since then to demonstrate financial interest in any way. (But this land has never been officially advertised as being for sale.)
21. If you answered yes to number 3, what is your estimate (in dollars) of the impact of the EFPC and/or its tributaries on the sale, development, and use of your property? Do you have any specific examples you can share?	(1) He believes the land value of the west EFPC property currently is 1/3 to 1/2 the value of non-impacted areas in the city. However, the property owner received a $175,000 settlement from the government due to a lawsuit.[157] At that time, he estimated the government actually owed him around $1.5 million in rent for the land. He believed rent was owed because the government controlled his property and, in fact, threatened that he would be co-liable with the government. (2) Around the year 2000, he incurred a $40,000 loss due to the inability to get a logging contract to salvage wood damaged by Pine Beetles. The logger was unwilling to cross the creek with his equipment because there was no access to clean water to rinse the potentially contaminated water and soil off with.
22. Do you believe that potential buyers, tenants, or co-developers must be informed of past environmental releases to the EFPC from the Y-12 Plant? Current releases?	This property owner believes he should inform them as a business courtesy, but would be conservative in this discussion because he believes the land is safe for humans.

Continued…

[157] "Real early in the discussions of the mercury and I think actually before DOE openly confessed (range of 1983), some parties alluded to another property owner and me, that we could not, should not, use our property, because we would be co-liable with DOE. We then started having occasional discussions with various people in the AEC/DOE/ERDA operation as to when they were willing to tell us what this was all about…what was this thing called mercury…how bad was it…Repeatedly we were told it was premature. We went from engineers (Wayne something) to trying to talk to the attorneys. When we couldn't make comfortable conversation with some very southern gentlemanly they had at they time, we tried to go to the senior attorneys that were here (one had a complicated name and a lady who may still be here). They pretty well roughed us up verbally—brow-beating us—telling us it was premature and don't bother them. They succeeded in delaying all this until we suddenly learned about and realized that we were beyond the legal date that you could file a court proceeding. We believe that they intentionally did that. I do not consider that they were honorable, forthright citizens in their behavior…I think they were, frankly, devious. And I felt that when they had exceeded that statute of limitations they almost changed their behavior and talked to us with more sincerity, feeling that they were safer. We decided that we were going to do something about it. But we made a mistake. We sought around and picked out a legal firm in New York State that had a reasonable reputation in this kind of litigation. It turns out they were a more gentle type of attorney firm than what we needed because by now DOE had gotten the Dept. of Justice attorneys (I have no idea in hell why they were there), but they were kind of rough and tumble tough guys (i.e., the Dept. of Justice). So we filed our brief and, after a time, they made contact through our attorneys and proposed that we have a hearing and not a court proceeding. At that time, I hadn't gotten as tough as I am now. I do not feel that AEC/ERDA/DOE has been honorable in all of this. At an earlier time, I thoroughly respected that organization, so I had to make a transition from respecting to disrespecting—or not even considering them honorable. So they proposed and we unwisely agreed to have a hearing and that a judge would have the authority in that hearing as if it were a regular court case. A long time had passed. Actually, 15 years had stalled by. They sent down a rather senior judge of some court in the Washington area, his clerk, some assistants, and AEC/ERDA/DOE attorneys, and a contingent of Dept. of Justice attorneys (abusive, brow-beating type willing to make exaggerated claims). When the judge called them on it, they would claim they were innocent and inexperienced in this area and depended on other people's word. It turned out to be a ridiculous hearing and the judge advised the other property owner and me that we had allowed the statute of limitation to seriously pass, but the judge also concluded that DOE had not handled the situation even reasonably well and, therefore, we would receive a settlement. I think I finally received $175,000. When we finally did the arithmetic in terms of their tying up the land and threatening us that we could not use the land or we would be co-liable, they probably should have had to pay a rent equivalent to $1.5 million. I could be ridiculous, but it appears the judge did 10% of our claim."

TABLE 9 (CONT.)
PERSONAL INTERVIEW #1
(LARGE PROPERTY OWNER)

QUESTION	RESPONSE SUMMARY
23. Do you believe that potential buyers, tenants, or co-developers must be informed about specific contaminants that may remain in the creek and the floodplain?	They should be advised that contamination occurred, but it is up to them to get specifics.
24. Do you have sufficient information about the EFPC to provide to potential buyers, tenants, co-developers? If not, what do you need?	He does not think so. Although he has some reports, he would refer individuals to government offices rather than dig through his files. He believes it's their burden to do due diligence.
INTERVIEWEES ANSWERS TO SURVEY (TENANTS)	
25. Was the creek discussed with you before signing a lease? Who initiated the discussion? What were you told?	Not a tenant.
26. If discussed afterward, how long after signing was it discussed? Who initiated the discussion on EFPC? What were you told?	Not a tenant.

SOURCE: ITSPA

TABLE 10
PERSONAL INTERVIEW #2
(CONDOMINIUM OWNER)

QUESTION	RESPONSE
1. Are you a property owner along the EFPC or one of its tributaries? Tenant? Developer? Other? EFPC or tributary?	Owns a condo along EFPC and resides there.
2. For how many years? Date?	Since 1988 or 89.
3. Do you have children?	They are grown and never lived there.
4. What activities do you and/or your children currently do in, or near, the EFPC? One of its tributaries?	Now retired so he doesn't work around the creek anymore. However, it is part of the property where he lives…the condo association land crosses EFPC and goes up the center of the creek towards Illinois and Vanderbilt, but he has little activity associated with the creek itself.
5. What activities have you and/or your children done in the past? Years?	In the early- to mid-1970s when WOKI radio station was constructed, he worked on a construction project in the creek without protective gear. He believes the station is located in the floodplain of EFPC. At that time, Johnny Pirkle, who owned and originated WOKI radio station, had him build the first building associated with the station off Tulsa Rd. He poured concrete for a transmission tower on the opposite side of the creek from Tulsa Rd. They poured concrete and waded in EFPC behind the radio station. They weren't familiar at that time with the pollution hazards of EFPC so they did not wear any protective clothing. The construction next to the creek occurred over 3-4 months. They dug soil and crossed the creek by wading. They poured the base for the transmission tower, and then they poured concrete over the cables in the creek itself. They dug the soil with a backhoe and then did a lot of cleaning up by hand of the footings, etc.. So, they were in direct contact with the soil.
6. What do you know about the contamination of the creek and its tributaries, both historically and today?	He knew mainly about the mercury contamination and that they used vast quantities at Y-12. He talked to a lot of people who worked with vast quantities of mercury and they told him about the conditions they functioned in.
7. How did you learn this information?	He's been a resident of Oak Ridge since 1988 or 89 and read the Oak Ridger over the years. He used to be an investigator for the old Civil Service Commission, which did security clearances for the plants. So he was associated a lot with people physically at the plant, so he was pretty aware of what was going on in the community as far as common knowledge. Otherwise mostly from news releases and newspapers. He had very little firsthand knowledge of what was going on as far as contaminants, except for what was generally known and through interviews with employees, but nothing really specific about spills or contaminants.
8. Are you aware that varying levels of contaminants have historically been, and are currently being, released to the EFPC from the Y-12 Plant?	Yes

Continued…

TABLE 10 (CONT.)
PERSONAL INTERVIEW #2
(CONDOMINIUM OWNER)

QUESTION	RESPONSE
9. Do you know what contaminants were released to the EFPC in the past? What is your understanding of how the levels released have changed over time?	He assumes fewer contaminants are being released because he doesn't think they use mercury in the quantities they used to. So he believes the contaminant level of mercury presently being introduced is drastically less than it was.
10. Do you know what contaminants are released to the EFPC today? If Yes, what do you know about their levels of release?	No.
11. Do the Y-12 releases of the past concern you? If yes, what concerns you most?	Yes. EFPC covers a big area of southern Oak Ridge. He thinks the awareness that contaminants are there has harmed Oak Ridge from the standpoint of getting new residents. He is a fisherman and a hunter, and he dislikes the fact that EFPC is basically off-limits from the standpoint of wading or using the creek. He has fished part of Poplar Creek near K-25 and he just doesn't like the fact that contaminants have spoiled the creek from the standpoint of recreational activities.
12. Do the Y-12 releases of the present concern you? If yes, what concerns you most?	He's not knowledgeable about the releases so he doesn't know whether to be concerned or not. He is concerned if there are releases.
13. Are you interested in learning more about the releases of the past? The present?	Both, but only to a certain degree. He's not very "rabid" on most social issues. He's interested, but "life goes on."
14. Would you need help in interpreting the data you are provided?	No.
15. Do you believe you have been personally impacted by the release of contaminants to the EFPC? If so, how?	Other than reduced recreational use of public lands and the negative effect on the city in general caused by the notoriety due to the contamination, he doesn't think so. But he's not sure now that he's been diagnosed with cancer. Over the last 6 or 7 years, he's eaten a few of the fish he caught from Poplar Creek near K-25 and the embayments/reservoirs that Poplar Creek feeds into. He estimates he eats two pounds per month on average. Regarding property values, he believes it hasn't affected them in his condo complex. He thinks most residents feel the government has reduced the contaminants and they're not close enough to be directly impacted. He assumes they don't get involved in any recreation in the creek that runs through the property. So he doesn't think they worry too much about it.
16. Do you know about the Oak Ridge Reservation Health Effects Subcommittee (ORRHES) activities and reports?	No.

Continued…

TABLE 10 (CONT.)
PERSONAL INTERVIEW #2
(CONDOMINIUM OWNER)

QUESTION	RESPONSE
17. Comments	"I'm a Missourian…you know, from the Ozarks. We pretty much trusted the government, I mean were raised to trust the government. I never thought I'd work for the government and, of course, I never thought I'd work around any nuclear plants. So it's second nature to me to want to trust the government even though I've been so involved with the government over the years that I know in the name of national security it can get carried away. But it's a joy to meet somebody that I think, on the surface anyway, isn't down to bring down the government as a whole and has a moral feeling about what she's involved in doing. It's been kind of a pleasure to talk to you, really. Because most of these rabid people… not…now that's throwing it out that you're rabid…Most people that I've even been around that wanted to talk about pollution were off the wall…they had some big personal ax to grind and were either down here ringing the Liberty Bell or demonstrating at Y-12…I'm rather an anti-demonstrator and a big believer in nuclear weapons.
INTERVIEWEE'S ANSWERS TO SURVEY (PROPERTY OWNERS', DEVELOPERS', AND LANDLORDS')	
18. Do you believe the property you own or manage along the EFPC and/or its tributaries has been impacted by Y-12 releases to the creek? If so, how?	The city as a whole probably has, but not him personally.
19. Has your soil been tested for contaminants such as mercury? If yes, what was the level?	He's not aware of it, but part of the property is the creek itself, so he's sure it has.
20. Do you believe the creek and/or its tributaries have affected the final outcome of a proposed sale, lease, or project? If yes, how many times?	No.
21. If you answered yes to number 3, what is your estimate (in dollars) of the impact of the EFPC and/or its tributaries on the sale, development, and use of your property? Do you have any specific examples you can share?	None

Continued…

TABLE 10 (CONT.)
PERSONAL INTERVIEW #2
(CONDOMINIUM OWNER)

QUESTION	RESPONSE
22. Do you believe that potential buyers, tenants, or co-developers must be informed of past environmental releases to the EFPC from the Y-12 Plant? Current releases?	Yes.
23. Do you believe that potential buyers, tenants, or co-developers must be informed about specific contaminants that may remain in the creek and the floodplain?	Yes, but he doesn't think it should be mandatory that we look up every visitor that comes to Oak Ridge to tell them they're in a bad place. But people who live here should be made aware of it somehow.
24. Do you have sufficient information about the EFPC to provide to potential buyers, tenants, co-developers? If not, what do you need?	No.
INTERVIEWEES ANSWERS TO SURVEY (TENANTS)	
25. Was the creek discussed with you before signing a lease? Who initiated the discussion? What were you told?	Not a tenant.
26. If discussed afterward, how long after signing was it discussed? Who initiated the discussion on EFPC? What were you told?	Not a tenant.

SOURCE: ITSPA

TABLE 11
PERSONAL INTERVIEW #3
(TENANT)

QUESTION	RESPONSE
1. Are you a property owner along the EFPC or one of its tributaries? Tenant? Developer? Other? EFPC or tributary?	Tenant
2. For how many years? Date?	Three years Oct. 2003
3. Do you have children?	No
4. What activities do you and/or your children currently do in, or near, the EFPC? One of its tributaries?	Since moving into this rental, he's seen kids around the creek and cautioned them because the area is so steep. He's noticed the creek is pretty deep in that area, around 5 feet deep. He was down there two years ago walking in the mud with his nephew. He didn't see any tadpoles or fish, which surprised him because, when he was a child, this property owner and his sister played in the creek and saw lots of tadpoles and frogs.
5. What activities have you and/or your children done in the past? Years?	Played in the creek with his sister when they lived in the Dillis community.
6. What do you know about the contamination of the creek and its tributaries, both historically and today?	He knew about the pollution (both chemical and radiation), but believes the contamination is mainly mercury-related pollution from New Hope Pond at Y-12.
7. How did you learn this information?	He saw the information in his department at Y-12 where he has worked for 27 years.
8. Are you aware that varying levels of contaminants have historically been, and are currently being, released to the EFPC from the Y-12 Plant?	Not really aware of today.
9. Do you know what contaminants were released to the EFPC in the past? What is your understanding of how the levels released have changed over time?	Mainly mercury.
10. Do you know what contaminants are released to the EFPC today? If Yes, what do you know about their levels of release?	No.
11. Do the Y-12 releases of the past concern you? If yes, what concerns you most?	Yes because he and sister played in the creek as kids near the west end guard shack.

Continued…

TABLE 11 (CONT.)
PERSONAL INTERVIEW #3
(TENANT)

QUESTION	RESPONSE
12. Do the Y-12 releases of the present concern you? If yes, what concerns you most?	He's done some posters at work at Y-12 where they highlighted cleanup efforts and monitoring. He knows they have a type of little fish that they watch and they can tell if there's been any releases because there will be a fish kill. As far as he knows, Y-12 has not had any recent fish kills. He thinks recently there was one around ORNL.
13. Are you interested in learning more about the releases of the past? The present?	Yes
14. Would you need help in interpreting the data you are provided?	No
15. Do you believe you have been personally impacted by the release of contaminants to the EFPC? If so, how?	Possibly his health, but not economically. He's curious if playing in the creek might have caused his narcolepsy. He's not sure what causes it, but it's a neurological problem. He's not sure if the doctors today know what actually causes it, if it can be caused by contaminants, or if it is just hereditary. No one else in his family has it. Also, his mother had an unusual occurrence with her death. She died of a non-cancerous tumor that grew inside of her heart till it reached the point where it cut off the blood flow to the lower half of her body. She died in February 1962 at the age of 34.
16. Do you know about the Oak Ridge Reservation Health Effects Subcommittee (ORRHES) activities and reports?	No.
17. Comments	He discussed flooding in his neighborhood, which is not a problem for him because they're a little higher than some of the other people that live in the area. Where his townhouse is located, the bank goes up a lot higher. It's probably 20-25 feet from the water if it's not flooded. If it's flooded, it may be 15 feet. The flooding spreads out and looks like a small lake when it covers part of the Country Club Estates golf course that's behind his house. There's some townhouses to the right (if you're looking out the front door of his house). They're lower down than he is on the bank and so the flooding comes up almost to the back of the parking area. He's never seen it come into the parking area, but it does come up pretty close. (Note that photos of the flooding were provided.) He also indicated he wanted to see the creek area cleaned up and checked further. "If some of this land is eventually going to be used for private use such as subdivisions, recreation, or parks, then it really needs to be checked to make sure there's not any contaminants that there is not a historical record of. There may be burial grounds where they put contaminants that there is no record of the burial." During the time when Union Carbide was here, it was his understanding that the records weren't kept well.

Continued…

TABLE 11 (CONT.)
PERSONAL INTERVIEW #3
(TENANT)

QUESTION	RESPONSE
INTERVIEWEE'S ANSWERS TO SURVEY (PROPERTY OWNERS', DEVELOPERS', AND LANDLORDS')	
18. Do you believe the property you own or manage along the EFPC and/or its tributaries has been impacted by Y-12 releases to the creek? If so, how?	Not a property owner.
19. Has your soil been tested for contaminants such as mercury? If yes, what was the level?	--
20. Do you believe the creek and/or its tributaries have affected the final outcome of a proposed sale, lease, or project? If yes, how many times?	Not a property owner.
21. If you answered yes to number 3, what is your estimate (in dollars) of the impact of the EFPC and/or its tributaries on the sale, development, and use of your property? Do you have any specific examples you can share?	Not applicable
22. Do you believe that potential buyers, tenants, or co-developers must be informed of past environmental releases to the EFPC from the Y-12 Plant? Current releases?	Not a property owner
23. Do you believe that potential buyers, tenants, or co-developers must be informed about specific contaminants that may remain in the creek and the floodplain?	Not a property owner.
24. Do you have sufficient information about the EFPC to provide to potential buyers, tenants, co-developers? If not, what do you need?	Not a property owner.

Continued…

TABLE 11 (CONT.)
PERSONAL INTERVIEW #3
(TENANT)

QUESTION	INTERVIEWEES ANSWERS TO SURVEY (TENANTS)
25. Was the creek discussed with you before signing a lease? Who initiated the discussion? What were you told?	No, but he knew about the creek and that it had been contaminated and may still be.
26. If discussed afterward, how long after signing was it discussed? Who initiated the discussion on EFPC? What were you told?	Not discussed.

SOURCE: ITSPA

TABLE 12
PERSONAL INTERVIEW #4
(LARGE PROPERTY OWNER)

QUESTION	RESPONSE
1. Are you a property owner along the EFPC or one of its tributaries? Tenant? Developer? Other? EFPC or tributary?	Once owned 112 acres of creek-front property located on the south side of West Oak Ridge Turnpike going to the top of the ridge. The land stretches west probably 1/3 of a mile starting at Louisiana Ave. About 70 acres was sold around 1995.
2. For how many years? Date?	Since 1959 when he bought the 112 acres of creek-front property by competitive sealed bid from the U.S. government sales agents.
3. Do you have children?	Three children who are all grown and no longer live in Oak Ridge. They were all born in Oak Ridge and went through high school in Oak Ridge, but never lived on the creek-front property.
4. What activities do you and/or your children currently do in, or near, the EFPC? One of its tributaries?	None.
5. What activities have you and/or your children done in the past? Years?	His family's only involvement was that occasionally they would walk, but not along the creek. It was along the hillsides. While they didn't camp, other people did. People have hunted and recreated on the property. One time in a clearing he found a large recliner chair where someone had carried it up there even though there's no road. There's another incident he felt he should mention. He had a friend who raised livestock and at one time he asked if it was ok to keep his cattle there and to let them graze on the land. The property owner agreed to that, but there was no exchange of funds. However, when the friend slaughtered one of the cattle, he gave the landowner a side of beef. That happened one time, and his family consumed that beef.
6. What do you know about the contamination of the creek and its tributaries, both historically and today?	He said he "knew too much," because he spent hours and hours reading reports, going to meetings, and following the problems that were being encountered along EFPC. So he knows a great deal and has charts that show contamination samplings. He followed the process all the way through and ultimately litigated with the U.S. government for an involuntarily holding of his property. This effort required a great deal of research and he paid a personal price for being so outspoken in the government-dominated community.
7. How did you learn this information?	He spent hours and hours at the Information Resource Center. He estimated that the stack of documents he had read and the charts he had looked at and all the technical information that was involved was easily much taller than he is. He's six feet and he guesses he read a stack of 8 or 9 feet of technical reports and it just took endless amounts of time.
8. Are you aware that varying levels of contaminants have historically been, and are currently being, released to the EFPC from the Y-12 Plant?	Yes

Continued…

TABLE 12 (CONT.)
PERSONAL INTERVIEW #4
(LARGE PROPERTY OWNER)

QUESTION	RESPONSE
9. Do you know what contaminants were released to the EFPC in the past? What is your understanding of how the levels released have changed over time?	His reports show the main contaminant was mercury, but there were also radioactive particles and a variety of things. It seemed as if the flooding caused it to be in strata—it washed down in flood stages. The contamination basically wasn't and isn't in the creek. It is on the shores on each side of the creek. The main contaminants were not in the creek bed itself. Flooding would wash the contaminants into the low-lying areas and then the water would recede and leave the contaminants there.
10. Do you know what contaminants are released to the EFPC today? If Yes, what do you know about their levels of release?	He moved from Oak Ridge almost seven years ago. His awareness, or continuing to follow the progress of the story, is limited to what he reads in the papers (either the *Knoxville News Sentinel* or *The Oak Ridger*), which he continues to take. For several years, he was on the EFPC Citizens Working Group, a citizens group kept informed by DOE.
11. Do the Y-12 releases of the past concern you? If yes, what concerns you most?	Yes. Mainly the loss of use of his land and some concern about consumption of cattle raised on the land.
12. Do the Y-12 releases of the present concern you? If yes, what concerns you most?	No. They are far less than before.
13. Are you interested in learning more about the releases of the past? The present?	Nothing other than newspaper reports. He knows way too much already.
14. Would you need help in interpreting the data you are provided?	No. He's an engineer by training.
15. Do you believe you have been personally impacted by the release of contaminants to the EFPC? If so, how?	Yes. No question about it. He spent too many years reading reports and thinking about it and then ultimately suing government for an involuntary taking of his land for a number of years and not receiving any rent. The government held his property and made it part of a Superfund Site. He could not develop it, couldn't use it, and was at high risk of being sued if he turned it over to someone else to use it and they proved that their health was damaged or they were economically damaged. However, as part of the terms of the legal settlement, the government is now responsible if someone buys the land and finds a highly contaminated spot. Note the government originally refused to give him legal indemnity and he had to sue to get it. However, this applies only for the land involved in this specific lawsuit. It does not apply to any other creek-side properties. [158]
16. Do you know about the Oak Ridge Reservation Health Effects Subcommittee (ORRHES) activities and reports?	Yes.

Continued…

[158] This property owner pointed out that it was really sad how the property owners were run around in circles by the Dept. of Energy. And that was not his business. He was a businessman in the community of Oak Ridge. He was a retailer and when property was sold by the government, he placed bids. Most people had no faith in the future of Oak Ridge and he was a businessman there. He grew up in East Tennessee and thought that Oak Ridge would be a viable community for a long period of time. And so when the government finally started disposing of tracts of land and individual properties, he placed sealed bids and was successful.

TABLE 12 (CONT.)
PERSONAL INTERVIEW #4
(LARGE PROPERTY OWNER)

QUESTION	RESPONSE
17. Comments	The litigation against the government about his EFPC property was a terrible experience. When the suit was filed by an environmental attorney, DOE's local legal staff turned it over to the Dept. of Justice. They ended up with an arbitration judge coming down from Washington with the attorneys from the Dept. of Justice and the moderator. This person told his attorneys and him that they didn't have a case and it would be immediately thrown out because it exceeded the statute of limitations. He did that privately with them, but then privately with the Dept. of Justice attorneys he told them the litigants have a good case, all the facts are there, but there is a question of statute of limitations. However, he told them he thought that might be overlooked by the Judge. He told each party that they would probably lose the case, which caused them to agree on a settlement. This was not satisfactory in his mind considering the years the government had held his property, but he didn't want to spend more years of his life thinking about this issue. He recalls getting around $120,000 as compensation for the 12 to 13 years the property had been held. The amount was lower than what the other litigant involved received in the settlement because (he believes) of the acreage or maybe because of the higher level of contamination. I felt that an end user, if they ever had a grievance, would not accept the 400 ppm because it was an average. And you don't live with averages. If you're going to build a sidewalk or a road, you don't take 18 inches of soil and homogenize it. You dig down and say this is the level that I want my residential sidewalk going to my house. The soil there is black…you didn't have to test…you could cut a profile and see the black layer and it was usually 3 to 5 inches in depth. If the average was 1,600 ppm, how high was it really in that black layer? However, the government agents …said, "that's the protocol… that's the way it's written…that's the way you take samples.
INTERVIEWEE'S ANSWERS TO SURVEY (PROPERTY OWNERS', DEVELOPERS', AND LANDLORDS')	
18. Do you believe the property you own or manage along the EFPC and/or its tributaries has been impacted by Y-12 releases to the creek? How?	See #15 in previous section.

Continued…

TABLE 12 (CONT.)
PERSONAL INTERVIEW #4
(LARGE PROPERTY OWNER)

QUESTION	RESPONSE
19. Has your soil been tested for contaminants such as mercury? If yes, what was the level?	Even averaged (which is essentially what the EPA protocol did), this landowner had one location that was 1600 ppm. [159] Even though the owner raised the issue of dilution with the government, they said the protocol was to take a 16-inch sample. They did not take samples every 4 inches, for example. Each sample tested was made up of 16-inches of soil. From the surface, they pulled maybe a 3- or 4-foot sample, which was divided into 16-inch sample segments. When the government first started, they talked about cleanup to 50 ppm. They changed the level upward and upward until the final cleanup level of 400 ppm was decided upon. The owner believed the 400 ppm level was quite confusing because it was based on a 16-inch sample, but everyone knew that the mercury was lying in strata of generally 3 to 4 to 5 inches. So, you might have in a particular soil level (e.g., 12" or 24" down) contaminations of 2,000 ppm. But when you mixed it with the soil above and below it, brought the reported level of contamination down, effectively averaging the contamination level. This property owner's opinion is you don't deal in averages in a case like this…you should deal in maximum values. But that is not what the government did in the EFPC cleanup.
20. Do you believe the creek and/or its tributaries have affected the final outcome of a proposed sale, lease, or project? If yes, how many times?	About seven or eight years ago, the property owner was approached to sell the hillside property along EFPC. The property goes from the Turnpike back to the creek, and then continues south of the creek to the top of the ridge. The property south of the creek, which runs basically east and west and goes up the hillside some 70 acres or so, was sold to two investors who wanted to develop baby farms, which they have done. They added a road and put in water and sewer. The road is about a third of the way up the hillside and some lots (maybe six or seven or eight) border on the creek up to the road, while some lots border the road and go up the hillside.

Continued…

[159] This property owner discovered that one transect of soil samples, six cores, had been omitted on Map 6, sheet 2 or 3, of the SAIC report dated 4/13/93 containing ORAU Historical Data (EFPC—Sewer Line Beltway Remedial Investigation Report, Volume V, Maps 1-7). By coincidence, this transect contained soil sample 85-0487, which showed 1,600 ppm on his parcel. DOE said this was probably just an oversight.

TABLE 12 (CONT.)
PERSONAL INTERVIEW #4
(LARGE PROPERTY OWNER)

QUESTION	RESPONSE
21. If you answered yes to number 3, what is your estimate (in dollars) of the impact of the EFPC and/or its tributaries on the sale, development, and use of your property? Do you have any specific examples you can share?	This property owner settled his lawsuit with the government for $120,000, far less than the value of rent he calculated for the period of the involuntarily holding by the government. He calculated a value by assuming it was not contaminated and assuming the frontage along the creek near the Turnpike was zoned commercial. He assumed the property south of the creek, which was zoned greenbelt, could be rezoned for apartments or some other use (e.g., at one time an office park was proposed for the site). He also assumed that a reasonable rent might give an 8-10% return per year on its economic value. Using these assumptions, he computed what would be a reasonable lease value for the land. For example, if the government held land for one year whose economic value $1 million, then a reasonable rent would be anywhere from $80-100,000 per year. In his situation, the government held the land for 13 years. And it wasn't until after the cleanup and it had been officially released could you safely market the property. At one time, he had a person who wanted to buy 100 feet along the Turnpike to put their business on it. They had a business on the east end of town and wanted to add a second one on the west end of town. He informed the potential buyer there was a cloud on the property, and he told him the history of the property and that there had been cleanup. The owner offered to sell 100 feet at (he believes) $1,000 to $1,100 per front foot, so it was basically a $100,000-plus transaction for land only. That was only for 100 feet of frontage and he had around 2000 front-feet of land that could be zoned commercially, which would have a value of $2 million at that sales price. The property owner sold the 70 acres of greenbelt property to investors at about $7,000 per acre for land with no water, sewer, or roads. This was a transaction of around $460,000. [160]
22. Do you believe that potential buyers, tenants, or co-developers must be informed of past environmental releases to the EFPC from the Y-12 Plant? Current releases?	Yes. He has informed a potential buyer in the past and plans to inform any potential buyers in the future that there was once a cloud on the property. He will tell them the history of the property and about the cleanup. However, theoretically, the property has been cleared by the government and he is technically free to use the property as he wishes without any restrictions. In addition, the lawsuit gives him indemnity against lawsuits from future owners. However, this is not the case for the other landowners who were not involved in his litigation against the government and the resulting settlement.
23. Do you believe that potential buyers, tenants, or co-developers must be informed about specific contaminants that may remain in the creek and the floodplain?	See Question #6.

Continued…

[160] This property owner related another example of economic impact from the contamination. Before it was public knowledge, his friend built some housing units down near Country Club Road along the Turnpike near the old gates. This development backs up directly to the creek and a couple of developers invested quite a bit of money at that time on condominiums or rental units. They were built and ready to be occupied, leased, or sold when the news broke about the EFPC contamination. As a result, nothing sold…no one would live there. People eventually started to live there and currently still live there. However, he knew for sure that the EFPC revelations bankrupted these builders.

TABLE 12 (CONT.)
PERSONAL INTERVIEW #4
(LARGE PROPERTY OWNER)

QUESTION	RESPONSE
24. Do you have sufficient information about the EFPC to provide to potential buyers, tenants, co-developers? If not, what do you need?	Yes
INTERVIEWEES ANSWERS TO SURVEY (TENANTS)	
25. Was the creek discussed with you before signing a lease? Who initiated the discussion? What were you told?	Not a tenant.
26. If discussed afterward, how long after signing was it discussed? Who initiated the discussion on EFPC? What were you told?	Not a tenant.

SOURCE: ITSPA

7.4 INPUT FROM GOVERNMENTAL ENTITIES

ITSPA spoke with representatives from several governmental entities regarding this project. The most extensive information was provided by tDEC, which met in person with the author of this report. TDEC officials provided written responses to ITSPA's questions, which were discussed during this meeting. These questions and TDEC's responses are provided below.

7.4.1 Tennessee Department Of Environment And Conservation

On September 30, 2004, ITSPA met with TDEC to discuss issues associated with the EFPC and other local areas known to have DOE contamination. ITSPA's questions, background information, and TDEC's responses are provided below.

TENNESSEE DEPARTMENT OF ENVIRONMENT AND CONSERVATION RESPONSES TO QUESTIONS BY SUSAN KAPLAN REGARDING EFPC AND OTHER CONTAMINATED AREAS (SEPT. 30, 2004)

Note: Written responses provided by the state are in quotation marks. Information provided verbally to ITSPA during the meeting is not in quotes.

Attendees:

Susan Kaplan, ITSPA
Doug McCoy, Manager, Environmental Restoration
Chudi Nwangwa, Manager, Special Projects
Roger Petrie, Supervisor, Environmental Monitoring
Don Gilmore, Asst Manager, Environmental Monitoring
Kristoff Czartoryski, Manager, Waste Management

1. Who is responsible for maintaining signs along EFPC?

"TDEC Water Pollution Control is responsible by agreement DOE-Oversight maintains the signs along EFPC."

Individuals responsible: Greg Denton (Nashville TDEC), Natley Harris (Knoxville TDEC), Doug McCoy (Oak Ridge TDEC)

2. How often are the signs checked and replaced if missing or covered by foliage?

"The signs are checked once each year in the spring. The signs are replaced if necessary."

3. What is the penalty for removing a sign?

"For those on public property, it could be vandalism, TCA 39-14-108. I don't see a specific provision in the water quality act." [Note: TCA is Tennessee Code Annotated.]

A property owner can legally remove signs, and the state must get permission to go onto private land to put up or check signs.

4. Why are no signs posted along the creek in the Southwood development? Was a method of disclosure ever put in place to notify potential buyers, which is even more important for the out-of-towners buyers Mr Hart was referring to? If not, why? Do you realize exclusion applies regarding notification for developers such as Hart and Gibson, but this puts the person buying the property at risk as soon as they become aware of a problem? Then it becomes possible that they are subject to the disclosure law despite the fact they were not notified themselves.[161]

See response to Questions 2 and 3.

"Private Property, Postings are published annually by TWRA and provided on TDEC's website."

5. Are there any building restrictions on EFPC property? Were any put in place?[162]

"The CERCLA ROD does not identify any building restrictions. Locations identified to have contamination above the action level were excavated by DOE. The city may have building restrictions. I believe there are restrictions about development (fill) within the 100 year flood plain based on Clean Water Act requirements (sect. 404) and possibly TVA Act sect. 26A. There certainly are restrictions based upon wetland protection requirements of both the Federal Clean Water Act and the State Water Quality Control Act."

[161] In the Planning Commission meeting reported on 9/16/93 it was said: "In a telephone conversation, Hart said "What it seems to me like is they are trying to keep us from developing it," he said." "The letter (from EQAB Chairman Jay Pride addressed to Terry Domm, chairman of the Planning Commission) also states that the Planning Commission and other government agencies should consider notification of contamination along the creek." "Some method of disclosure (such as notification on the subdivision plat that contamination has been discovered on adjacent property) should be considered," the letter states. "Warning signs required by regulators should be maintained along the creek floodplain." Hart said he wasn't pleased with this notion. "Those are things that I told Mr. Issel that I didn't like period," he said, "for the simple reason that you would never sell the property. Why, if somebody came in from out of town it would scare them to death." When asked what he considered the health hazard of the property to be, he said, "It is no health hazard."

[162] At the Planning Commission meeting reported on 8/19/91, Wayne Clark said that he had "modest concerns" about the mercury contamination, but that some type of covering and building restrictions should eliminate any threat.

6. **Who took the samples for the developers of Southwood? Were there any independent observers? Who decided where the samples would be taken? Who paid for the sampling?** [163]

   "We are unable to locate or identify the October 1992 study within our files. Having a document name and/or control number would help. If it was not a CERCLA study, but one commissioned by the property owner, we may not have any record of such data. If it were a CERCLA study, then DOE's contractor (probably SAIC) took the samples. Independent observers could have potentially included DOE, EPA, TDEC and/or other contractors that DOE may have hired to oversee the sampling. If CERCLA, the sampling point decision would have been made collectively between DOE and its contractors, EPA, and TDEC by review of the RIWP or other Sampling and Analysis plan. There were thousands of samples taken within the EFPC floodplain and creek during the CERCLA RI process. If a CERCLA study, then DOE paid."

7. **Who owns the floodplain? Who owns the creek (i.e., the sediments and the biota)? If private, and these owners were not told about the issues, are they obligated to inform the next buyer? Has DOE given these buyers legal indemnity for legal actions resulting from the creek?**[164]

   The State owns the water and the biota. The property owner owns the creek bed itself unless TVA controls it based on flood control elevation. However, a property owner is not allowed to dam up the creek. The EFPC is a tributary to a navigable waterway and, therefore, restrictions apply.

8. Statement from the Planning Commission meeting reported on 8/30/93: "Because of the proximity, those residents may spend more time in the floodplain increasing their exposure to the contaminated soils." **Are buyers told this?**

   "Not by the CERCLA process directly. Certainly the entire process was reviewed by the public through not only the documents but through numerous meetings of the EFPC public working group. Also, the CERCLA risk analysis process took into consideration the time projected for a resident (home owner) to spend on their property, which included the floodplain. The analysis did not predict a problem when contaminant levels were below the clean up action level." (i.e., 400 ppm)

---

[163] At the Planning Commission meeting reported on 8/30/93, developer J.W. Gibson, who along with Len Hart Sr. is developing Southwood, presented an October 1992 study by SAIC that sampled the creek at Southwood and found 10 to 50 ppm of mercury." However, on 4/7/95, an EFPC property owner recorded in his notes that an SAIC employee indicated you could go out in the EFPC area and get almost any reading you want (either low or high).

[164] Statement from the Planning Commission meeting reported on 8/30/93: "Hart reconfigured the lots in such a way that none of them is located in the creek's floodplain, and submitted the new plan to the EPA, the DOE, and the DOE Oversight Div. of the state Dept. of the Environment and Conservation."

9. Statement from the Planning Commission meeting reported on 8/30/93: "Asked about placing barriers between the homes and the linear parcel, Issel said he would ask EQAB what the options were. "It may be necessary to put a fence up along there," he said. "That would be ugly, but it may be necessary." **This was not done. Why?**

> "Barriers such as fences were considered early in the CERCLA screening process. This was true for those alternatives that relied upon institutional and engineered controls to provide protection. However, the final decision was not based upon such controls but instead was based upon the excavation and removal of contaminants that were above the risk action level. Also a major consideration is that most of this property is privately owned and such institutional decisions would have to include property owner permission or purchase (condemnation) of the property by the government. The decision was made to excavate instead."

10. Have educational materials been developed for property owners along the creek to tell them how to safely perform tasks the city requires them to do?

> No proactive program has been developed as far as Doug McCoy knows.

11. Did the EFPC remediation that took place only apply to the EFPC floodplain and not the water or creek bank sediments, which is my impression from the ROD?

> "The ROD and follow up remedial action did cover the floodplain and creek banks that were found to be contaminated above the action level. The ROD did not make a decision on the water or creek bottom sediments, even though the RI did collect much data on both locations. The rational was based on the concept that the water and stream bed sediments were directly tied to the upstream sources, i.e., Y-12 plant site. It was therefore determined that the water and sediments would be covered in the future RODs for the UEFPC area (Y-12). Even though most sources of release from the Y-12 site are greatly diminished and controlled, it seemed prudent to not make the downstream final decision until all upstream work was complete."

12. ITSPA is concerned about the potential for exposure to inadvertent releases from the Reservation via EFPC of children who might be playing in the creek and to property owners who might be performing the tasks required by the city when the discharges occur. ITSPA is also concerned about individuals who happen to be in the creek when the contamination is present spreading contamination to their homes and other areas of the community. **Is a system in place for immediately notifying these property owners when releases to EFPC have occurred? Do educational materials exist that tell these individuals what to do if they believe they have been exposed?**

"TDEC has no system for immediate notification of the public and is unaware of any such system. Likewise, we know of no public education materials specific to releases to EFPC."

Since there is no law, the state cannot legally mandate such notification. However, if a law is in place, then TEMA, DOE, and City would be most likely to develop.

13. Are DOE's releases still posted on the bulletin board in the hallway at TDEC? Is there an on-line, computerized system to make it easier for the public to track releases? Could/should a system be implemented that automatically places a telephone call to residents along EFPC immediately following a release?

"Yes, they are still posted on the wall. TDEC is unaware of any on-line system that makes tracking of releases easier for the public. A call system to residents might be possible, but would require considerable effort even to determine contact information for all landowners. Since the threats to human health associated with DOE releases are chronic rather than acute in nature, such a system might do little to minimize health risks to the public."

14. One example of such an accidental release occurred on February 4, 2000, when wastewater exceeding the DOE DCG values for uranium-238 and -234 was released from the Central Pollution Control Facility. The effluent, about 14,032 gallons of "mop water," was discharged through NPDES Outfalls 501 and 201 to the creek. The discharge was 1,400 picocuries/ liter (pCi) for uranium-238 and 5,500 pCi/liter for U-234.

"The EFPC flow rate is generally 8 million gallons/day, so this kind of release would be harmless as soon as it hit the creek because of dilution."

15. If a reasonable-sized, non-planned-for release occurred, couldn't puddles of contaminants be left in areas of the creek bed that the normal day-to-day flow wouldn't normally reach? During my tour, I noticed areas where creek bed was exposed because the flow was so low. So, if they have a spill, do they increase the flow to make sure they rinse away these puddles?

"Flow is not increased to flush the creek of anything. The idea is to maintain as steady a flow as possible. In order for an unplanned release to create puddles that are then stranded from the normal flow would require an enormous quantity of liquid to be added to the creek, likely on the order of several hundred thousands of gallons in a very short period of time, probably a few minutes. A release of this magnitude would constitute an emergency and would be reported immediately. In addition, Lake Reality serves as a catch basin for just such a situation. If this much material is released then the creek would be diverted into Lake Reality and the water held there until the creek water returned to a fairly normal state."

"The NPDES permit for Y-12 requires that they maintain a flow rate of at least 7 million gallons per day. With rain and other inputs, they usually exceed this and achieve between 7 and 8 million gallons per day. This may sound like a lot, but when you do the math it comes out to around 90 gallons per second. To visualize this, imagine two 55 gallon drums of water per second. In a creek the size of EFPC this will not appear to be very much."

16. **What is the status of the 5-year follow-up report to evaluate the remediation of EFPC?**

CERCLA requirement for a 5-year review only applies when contaminants are known to be left in place. Since nothing greater than the risk range was supposedly left in place at EFPC, a 5-year review is not legally mandated. However, because the State and EPA are interested in the floodplain, the state requires sampling by DOE. Sampling results are reported annually by DOE in the RER, which can be obtained through the DOE reading room.

17. **At a recent ORRHES meeting, EPA indicated they had an enforceable milestone coming up regarding sampling. What is this milestone?**

"CERCLA applies to all off-site decisions. DOE must submit a site investigation by 9/30/06. Responsible TDEC person: Robert Storms. The first step in the process is a Preliminary Assessment/Site Investigation, which will include some sampling. However, they may determine in-depth sampling is not required. There is no legal requirement for public input on this process although DOE likely will. DOE EM is responsible for this, i.e., Steve McCracken, David Adler, Pat Halsey, maybe Sissy Perkins." [Note: CERCLA does not have the same strong mandate for cleanup as RCRA.)

18. **What was the source of mercury at Atomic City Auto Parts? [**Mercury levels in the soil of 630 ppm were measured, while one sample actually measured 6,700 ppm. Levels of other samples ranged from 13 ppm to 480 ppm. Other pollutants at the site include VOCs, semivolatile organic compounds, metals, PCBs, dioxin/furans, and uranium. However, the majority of risk comes from PCBs. The remedial investigation determined the risks were unacceptable based on the pathways evaluated, and concluded remedial action is warranted. However, no ROD has yet been signed. **]**

"The State Superfund project has been underway for the last 6-8 months. (Dan Hawkins, TDEC Knoxville)"

19. **What was the outcome of the CSX Railroad survey? What was the source of the contamination? What is the reference for the report issued?** [A radiological survey was performed on the railroad in July of 1997. This action was initiated due to public concerns in the Emory Heights area of Oak Ridge. The 1997 survey started behind Warehouse Row, along Warehouse Road (across from Atomic City Auto Parts

Site) and ended on Scarboro Road behind the Oak Ridge Utility District and the east side of Y-12.]

"Cleanup was completed in 1998. Source of contamination was from dead irradiated cows, which had been shipped here from out west. Decaying animals dripped onto tracks."

20. **Was this remediation done?** [According to State Regulation 1200-2-5-60, 100 mrems is the dose limit for individual members of the public to receive from a licensed or registered operation. Regulation 1200-2-5-61 allows for practical applications to be applied for dose assessment. The track along Warehouse Row exceeds this and will need further attention to obtain DOE's initial goal, meet State action limits, and remove contamination.]

    See answer above.

21. Freels Bend

    "This subject is addressed in "Environmental Restoration Footprint Reduction Process Evaluation of Freels Bend Area" (DOE Document available through the reading room) Freels Bend is not contaminated from a health standpoint. 5-year agreement between DOE and TWRA was signed and is effective through 2006. (Robert Storm, TDEC OR)"

22. Other knowledgeable people regarding EFPC:

    Wayne Tolbert (SAIC); Kathy Elliot (Army Corp of Engineers, Lenoir City); EPA experts in Athens & Triangle Park

23. Statutes guiding EFPC

    Federal: Clean Water Act, Wetlands (all floodplain is probably wetland)
    State: Water Quality Control Act (Rules & Regs 1200-4)
    TVA: Navigable waters and their tributaries
    100-year floodplain

24. Roscoe Fields site:

    "The answers to your questions can be fully updated by DOE. The program manager on this project was Andrea B. Perkins. 865-576-2552. or by the state DSF..The manager is Dan Hawkins at 865-594-6035."

    From 3/4/94 Consent Agreement and Order:

    "The TDEC's Div. of Superfund responded to an incident report from the Tennessee Emergency Management Agency on Thursday, 2/24/94, regarding the

discovery of miscellaneous abandoned drums located on property owned by Mr. Roscoe W. Fields. This property is in the area of the intersection of Solway School Rd. and Guinn Rd., Knoxville TN. The Div. of Superfund subsequently requested the DOE to participate in a site reconnaissance on Friday, 2/25/94, because some of the drums and other material on the site appear to have been generated by DOE. The site reconnaissance identified approximately 200 drums in varying stages of degradation located on top of a hill in a semi-densely wooded area approximately 150 yards from the road. The majority of the drums are similar to type 17E drums with a bung top that are used for the storage of liquids. Most of the drums are upright situated in an oval configuration, however, many of the drums are covered with fallen leaves and branches so the tops of the drums were not readily visible. Several drums had rusted tops and appear to have collected rain water. Several drums were breached by puncture or rust. A few drums appeared to be expanded.

Leaking drums were observed in the area as well as stained soil in the areas of the leaking drums. The appearance of the leaking drums and material was a thick black oily substance. Several of the drums were marked as petroleum products, such as Pyroquel (a threading oil). Also observed were drums identified as ethylene glycol.

A radiological survey of the assessable drums was conducted. This survey was primarily intended to be used as a screening tool to determine if there were any elevated levels of radioactivity in the area. Approximately, 4 to 5 drums had radiation detections above the background levels for the area. Many of the drums were not accessible for scanning.

TDEC agreed to develop the necessary documents required to accomplish the characterization/removal/disposition of the approximately 200 abandoned drums described above and conduct the removal action."

7.4.2 Department of Energy

ITSPA spoke to David Adler, Lead Environmental Scientist for DOE, by telephone in January 2005 regarding community-wide sampling. In this conversation, Adler indicated that DOE will not simply rely on ATSDR recommendations regarding community sampling. He indicated DOE will even listen to a single member of the public in regards to its future sampling plans for the community of Oak Ridge. Note that determining if such sampling is needed is an upcoming milestone scheduled for 2006 in the Federal Facilities Agreement Appendix E – Other. This milestone specifically states that this decision is pending ATSDR's recommendation. (See http://www.bechteljacobs.com/ettp_ffa_appendices.shtml). See Appendix 2-16 for a letter to the Editor of the *Oak Ridge Observer* on the subject of community sampling, which was written by the author of this report.

ITSPA attempted to speak and/or meet with David Page, the DOE Team Leader of the EFPC floodplain remediation project. However, Page would not return telephone calls and, at a meeting that he and the author of this report both attended, Page indicated he was not at liberty to speak about the project since he was no longer assigned to it.

7.4.3. City of Oak Ridge

ITSPA spoke with Gary Cinder, Oak Ridge Public Works Director, on 2/28/05 to determine if the city now provides any additional guidance to property owners along the posted creek. He indicated that to his knowledge there is no information on this subject available through the city. Cinder indicated that because the creek has been remediated and is no longer considered to be a problem, he and his staff treat the creek and floodplain sediments just like any other dirt in town. He knows of no restrictions on property owners in terms of coming into contact with the waters, sediments, and soils of the creek and the floodplain.

ITSPA also spoke with city planner Kayla Gentry, who helped fill some gaps in ITSPA's real estate analysis.

CHAPTER 8. TECHNICAL EXPERT'S ASSESSMENT

[ITSPA retained SENES Oak Ridge, Inc. Center for Risk Analysis to provide technical guidance for this project. Dr. Gordon Blaylock, environmental scientist, served as the technical expert for this project and is the author of this chapter.]

The release of mercury from the Y-12 Plant of the Oak Ridge Facilities occurred between 1950 and 1963. The Colex process (Column-based exchange process) was responsible for the release of many tons of mercury into the environment. Mercury was released to air, soil, and water as a result of the process of the enrichment of lithium-6 for use in thermonuclear weapons. Mercury was also released from other processes and facilities on the Oak Ridge Reservation. Most of these releases are documented in the appendices of the Dose Reconstruction Project for Task 2 (Mercury Releases from Lithium Enrichment at the Oak Ridge Y-12 Plant - a Reconstruction of Historical Releases and Off-Site Doses and Health Risks).[165] By far, the greatest amount of mercury was released to the environment as a result of the Colex process.

The estimate by the Dose Reconstruction Task Korce of the release of mercury to East Fork Poplar Creek was 280,000 pounds between 1950 and 1993. Most of the mercury was released between 1954 and 1962 (Figure 7). More than 70,000 pounds of mercury were estimated to have been released in 1958. It was during these large releases of 1956-1960 that the largest recorded floods since the establishment of Oak Ridge occurred on EFPC.

As a result of flood conditions on EFPC, high concentrations of mercury could have been deposited on the floodplain. These areas were covered by deposition during later floods. Such conditions would also account for the layers of sediments with high concentration of mercury that can be observed in the flood plain soils.

[165] Tennessee Department of Health, 1999, "Mercury Releases from Lithium Enrichment at the Oak Ridge Y-12 Plant-A Reconstruction of Historical Releases and Off-Site Doses and Health Risk." Report of the Oak Ridge Dose Reconstruction, Vol. 2. Submitted to the Tennessee Department of Health by ChemRisk.

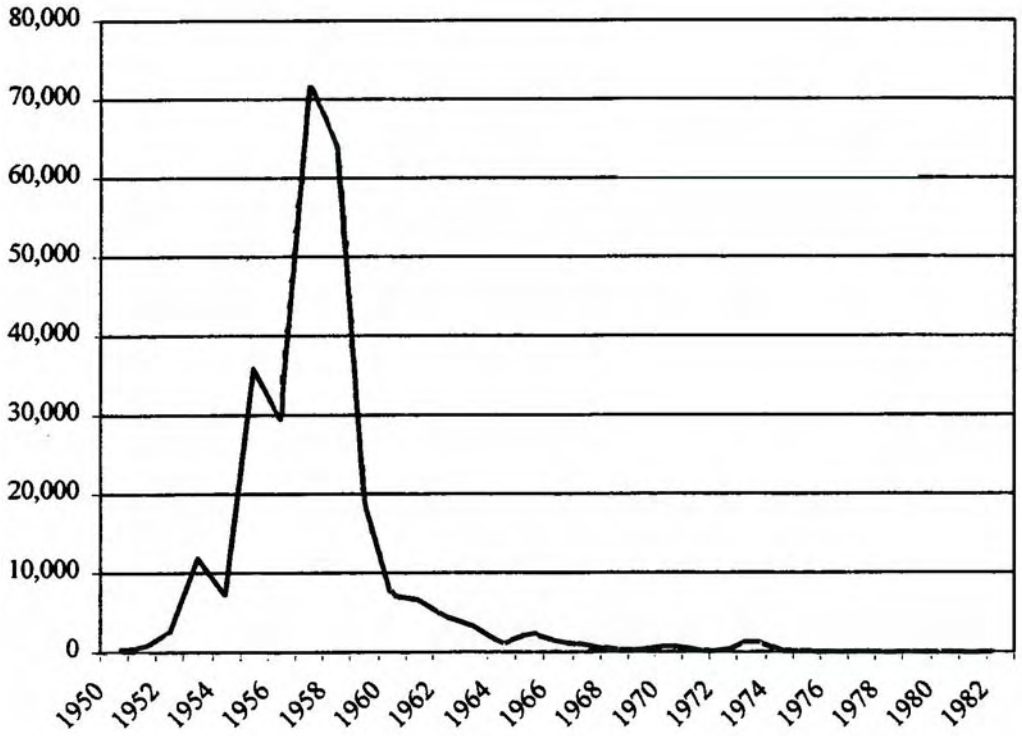


Figure 7. Annual estimated releases of mercury (pounds) from the Y-12 plant to East Fork Poplar Creek by the Task 2 Team of the Oak Ridge Dose Reconstruction Project.

8.1 FLOODING EAST FORK OF POPLAR CREEK

Norris Dam, which was closed in 1936, is located at Clinch River Mile 79.8. The closure of the dam had a dramatic effect on the flooding of the Clinch River below its outfall (Tennessee Valley Authority 1959).[166] Regulation by Norris Reservoir has produced a substantial reduction in flood crest flows and elevations in the Oak Ridge Reach of the river. In spite of Norris Reservoir regulations, large floods could still occur in the Oak Ridge Reach as a result of heavy rainfall over the Clinch River watershed below Norris Dam. The impoundment of Melton Hill Dam in 1963 at Clinch River Mile 23.1 changed the flood situation along the upper 31 miles of the Oak Ridge reach.

[166] Tennessee Valley Authority, 1959. "Floods on Clinch River & East Fork Poplar Creek in the Vicinity of Oak Ridge," Tennessee. Report No. 0-5922, p. 66. Tennessee Valley Authority, 1959.

Flooding on EFPC, which is located in both Roane and Anderson Counties, usually occurs annually. The watershed of 29.8 square miles lies entirely within the Oak Ridge city limits. The Creek has its origin on Chestnut Ridge south of the residential area of Oak Ridge. It joins a tributary that drains the west portion of Oak Ridge. From there the stream flows approximately 12.5 miles southwest to enter Popular Creek, about 5.5 miles above its mouth at Clinch River Mile 12.0, which is in Watts Bar Reservoir Backwater. Only the lower one or two miles of East Fork Poplar Creek are affected by floods on the Clinch River and Poplar Creek.

The greatest known flood on EFPC since Oak Ridge was established in 1942 occurred September 29, 1944. The crest of this flood was 2.5 feet above the floor of the control building at the West Sewage Disposal Plant. The second-greatest known flood in Oak Ridge history occurred January 15, 1954, and was 1.2 feet below the 1944 flood. Other major floods occurred on April 15, 1956, and in December of 1956. Based on crest markers recorded since January 15, 1954, on nearby Poplar Creek, floods have occurred at a frequency of about 4 per year on EFPC. The Creek is subject to flooding during any month of the year.

Flood damage in Oak Ridge has been small. Damage includes the loss of the use of the tennis courts at Mile 11.46 and of the lower fairway at the Oak Ridge golf course. The Robertsville Junior High football field has also been flooded by the creek. The Robertsville Junior High School's football field extends to Mile 12.12, between the Anco Supply Company and EFPC. The overflow of the April 1956 flood covered the end zone to a depth of approximately one foot. Several other facilities were reached by the floodwaters during the April 1956 flood.

8.2 MERCURY IN THE ENVIRONMENT

This brief review of information on mercury in EFPC will concentrate primarily on mercury in the sediment and floodplain soils of EFPC, but will also mention other contaminants. Many investigations have been conducted on the concentration of mercury in the sediment, water, and biota in EFPC, Poplar Creek, and the Clinch River. The Phase lb Sampling and Analysis Plan for Soil, Sediment and Water (DOE 1992)[167] contains Table 2.1, "Historical studies of contamination in EFPC." In addition, the dose reconstruction report on mercury (Oak Ridge Health Studies, Task 2 Report)[168] contains a bibliography that references some historical studies.

It was the opinion of the 1983 Mercury Task Force that mercuric nitrate, produced when mercury is washed with nitric acid, is very soluble in water. However, neutralizing

---

[167] U.S. Department of Energy, 1992. "Environmental Restoration Program East Fork Poplar Creek Sewer Line Beltway integrated RCRA/CERCLA/NEPA. Phase Ib, Sampling and Analysis Plan for Soil, Sediment, and Water." DOE/OR-983, OKR/91-051, Prepared by Radian Corporation for the U. S. Department of Energy.

[168] Tennessee Department of Health, 1999, "Mercury Releases from Lithium Enrichment at the Oak Ridge Y-12 Plant-A Reconstruction of Historical Releases and Off-Site Doses and Health Risk." Report of the Oak Ridge Dose Reconstruction, Vol. 2. Submitted to the Tennessee Department of Health by ChemRisk.

the waste stream forms mercuric oxide, which is only slightly soluble. Mercuric oxide formed in this manner does not settle readily, and flowing water would likely have kept it in suspension. Thus, flood conditions on East Fork Poplar Creek could have deposited high concentrations of mercury in the floodplain areas that were covered by deposition. Such conditions would also account for the layers of sediments with high concentration of mercury that can be observed in the floodplain soils.

8.3 LITERATURE REVIEW

The following are reviews and summaries of several important documents and issues discussed in this section: (1) Record of Decision for LEFPC (2) ORAU Survey, (3) TVA Survey, (4) Phase Ib Sampling and Analysis Plan, (5) remedial alternative actions, (6) ATSDR panel results, and (7) Baseline Post-remediation Monitoring Program Plan.

8.3.1 Record of Decision

The geographic area included in the "Record Of Decision For Lower East Fork Poplar Creek, Oak Ridge, Tennessee" (DOE/OR/02-1370&D2) begins at the outfall of Lake Reality at EFPC creek kilometer 23.3 (creek mile 14.5) and extends to the confluence with Poplar Creek.[169] The Upper East Fork operational unit (OU) begins at Lake Reality and extends into the Y-12 Plant. The Lower EFPC ROD includes soil, sediment, and groundwater in the 100-year floodplain of EFPC. In addition, floodplain soils, which served as backfill material for construction of the Sewer Line Beltway through the city of Oak Ridge, were included as part of the investigation along with commercial, residential, agricultural, and miscellaneous areas within the city of Oak Ridge. The Lower EFPC surface water is not within the scope of this ROD.

The sewer line beltway consists of 16 kilometers (km) or 10 miles of sewer lines. Part of the sewer line is in the floodplain and two sections are in the city of Oak Ridge. The CERCLA risk assessment process and RI report concluded that the soils of the Sewer Line Beltway soils presented no significant risk and the beltway was not discussed further.

Results of the soil, sediment, groundwater, and surface water sampling showed detectable levels of 13 heavy metals, 9 polycyclic aromatic hydrocarbons (PAHs), and 11 radionuclides. Mercury was the most significant contributor (greater than 85 percent) to the total non-carcinogenic risk. The organic compounds did not present a significant risk to human health. Total uranium accounted for 98 percent of the total activity of radionuclides, and risk associated with exposure to radionuclides fell within the EPA acceptable target range in all cases.

---

[169] U.S. Department of Energy, 1995. "Record of Decision for Lower East Fork Poplar Creek Oak Ridge, Tennessee." DOE/OR/02-1370&D2. Prepared by Jacobs ER Team Oak. Ridge, Tennessee, under contract DE-ACO5-03OR22028. Prepared for U.S. Department of Energy Office of Environmental Restoration And Waste Management.

8.3.2 ORAU Survey

The ORAU survey provided a spatial distribution of mercury contamination along EFPC from the Y-12 Plant boundary to creek kilometer 7.8 at the western edge of the city of Oak Ridge. The total mercury concentration of the surface soil (top 3 in.) was measured at sampling points across the floodplain on transacts every 100 meters (m) along the creek. Mercury concentrations were highest close to Y-12 and nearest the creek. However, mercury concentrations did not decline gradually with distance from the source or distance from the stream. Instead, there were "hot spots" of high mercury concentrations found along the stream. These "hot spots" of mercury were found in depositional areas of sediments with intervening areas of relatively low concentrations. One section of the floodplain near the Y-12 Plant was sampled by ORAU on a finer grid. The data showed large differences between adjacent sampling points. Samples taken 0.5 m apart varied in mercury concentrations by order of magnitude.

8.3.3 TVA Survey

The TVA survey[170] examined the vertical distribution of mercury along the EFPC and found that generally the highest mercury concentrations were found in the first or second layer sampled (top 18 in). Concentrations of greater than 100 ppm were found as deep as 36 inches. TVA's analysis of in-stream sediment found concentrations of mercury ranging from 10 to 150 ppm. In the water of EFPC, mercury concentrations were slightly above the detection limit of 0.4 micrograms per liter (µg/L). However, during storm events the mercury concentration in water increased as much as tenfold primarily because of mercury associated with particles.

8.3.4 Phase Ib Sampling and Analysis Plan for Soil, Sediment, and Water

The Phase Ia sampling plan addressed the nature of contamination, identified the affected media, and screened the contaminants of concern. The Phase Ib sampling plan[171] focused on determining the extent of contamination. The initial stage of the sampling program consisted of surface and subsurface soil sampling along transacts every 100 m from the confluence of EFPC with Poplar Creek, upstream to 23 km to the mouth of Lake Reality. The purpose of the sampling was to provide a deeper integration of sampled materials for surface values and assess contamination at depth. The sampling scanned the entire floodplain to determine which areas required further sampling of contaminants and which could be excluded from further investigation.

Surface sampling was defined as taking a representative sample from an homogenized section of the uppermost 16 inches of soil. The sample would integrate not

---

[170] Tennessee Valley Authority. 1985. "Sediment Characterization. Task 2 Instream Contaminant Study. " Prepared for U. S. Department of Energy Oak Ridge, Tennessee. Office of Natural Resources and Economic Development Tennessee Valley Authority.

[171] U.S. Department of Energy, 1992. "Environmental Restoration Program East Fork Poplar Creek Sewer Line Beltway integrated RCRA/CERCLA/NEPA. Phase Ib Sampling and Analysis Plan for Soil, Sediment, and Water." DOE/OR-983, OKR/91-051, Prepared by Radian Corporation for the U. S. Department of Energy.

only the shallow surface concentration but also deeper strata, such as the black strata containing 1,000 to 2,000 ppm mercury. Deeper samples were taken at every other transact (200 m) to determine contaminated soil volume. Samples were to be taken at 0 to 16, 16 to 32, and 32 to 48 inches. Approximately 2500 samples were taken over 159 transacts. An additional soil-sampling task was performed at the Bruner and the NOAA sites to determine a contamination profile at 1-inch layers.

8.3.4.1 Soil Sampling

The method used for taking core samples and for analyzing the samples for mercury was negotiated with the Environmental Protection Agency. Core samples of 16 inches in depth and 1 inch in diameter would be taken. At certain locations, and when deemed necessary, the sampling depth would be increased to 32 and 48 inches. Samples would be taken at the locations describe in the Phase 1b sampling and Analysis Plan for soil, sediment, and water.[172]

The 16-inch core sample would be extruded into a mixing bowl and homogenized and then analyzed for mercury. If the result was 400 ppm or greater, the area from which the sample was taken would be considered for remediation. By mixing the 16-inch core sample, higher concentrations of mercury, which were usually in a 3 to 6 inch black band of soil, would be diluted. Usually the black band of soil was located about 8 inches below the surface of the soil. Therefore, a 16-inch core sample, which had a four-inch band of soil containing 1,500 ppm of mercury, could still have a homogenized concentration of less than 400 ppm.

In the second public comment period of June 14,1995 -July 13, 1995 (Record for Decision for Lower East Fork Poplar Creek Oak Ridge, Tennessee)[173], the methodology was questioned concerning the mixing of the topsoil, which would essentially dilute the concentration of the mercury in the floodplain sample. This methodology would result in a lower than true concentration of mercury in the contaminated layer. The response by representative of DOE was that a conservative scenario would be used in estimating the contaminant concentration for the surface soil exposure pathway. That is, mercury concentrations in the homogenized 16-inch core sample were assumed to be surface contamination. Since surface contamination was considered the most critical pathway, the 400 ppm cleanup level was established to protect human health. Thus, an informed decision was made to incorporate the highest concentration of mercury in surface soils data in order to develop a conservative evaluation.

---

[172] U.S. Department of Energy, 1992. "Environmental Restoration Program East Fork Poplar Creek Sewer Line Beltway integrated RCRA/CERCLA/NEPA. Phase Ib Sampling and Analysis Plan for Soil, Sediment, and Water." DOE/OR-983, OKR/91-051, Prepared by Radian Corporation for the U. S. Department of Energy.

[173] U.S. Department of Energy, 1995, "Record of Decision for Lower East Fork Poplar Creek Oak Ridge, Tennessee." DOE/OR/02-1370&D2. Prepared by Jacobs ER Team Oak. Ridge, Tennessee, under contract DE-ACO5-03OR22028. Prepared for U.S. Department of Energy Office of Environmental Restoration And Waste Management.

The decision appears to be conservative for exposure to surface soils; however, it would not be conservative if there were direct exposure to the black layer of soil containing the highest concentration of mercury. This layer, which is usually located approximately 8 inches below the surface of the soil, could be exposed in many ways during the construction of homes and other activities. Such activities could result in direct exposure to mercury levels much higher than 400 ppm.

Ecological resources potentially impacted by remedial activities include aquatic and terrestrial habitats, animals and plants. Surface water and sediment are the primary abiotic components of aquatic habitats and are the major exposure pathways for contaminants. Riparian habitats include the stream channel, banks, and floodplain that span the transition from aquatic to terrestrial habitats. These habitats occupied about 52 acres of the area to be remediated. In general, surveys showed that the number of fish species and terrestrial plants and animals increased with distance from the Y-12 Plant, indicating that pollution decreases with distance from the plant.

8.3.4.2 Human Health Risk Assessment

Results of the baseline human health risk assessment indicate unacceptable risk to human health may result from exposure to the Lower EFPC floodplain soils.[174] Two exposure pathways of concern were identified: (1) inadvertent ingestion of soils and (2) ingestion of ground water as drinking water source. Risk estimates based on reasonable maximum exposure indicated potential adverse health effects associated with long-term exposure to ERPC soils for children ages 3 to 12 years of age. Mercury was identified as the predominant contaminant of concern. Remaining toxicity due to other contaminants would also be reduced by remedial action. It should be noted, that the human health risk assessment was based on toxicity testing using soluble mercury species (mercuric chloride) in laboratory animals, not the less soluble forms (mercuric sulfide and elemental mercury) that were considered to predominate in EFPC flood plain soils. In other words, the risk assessment conservatively assumed that all mercury in EFPC is present in the most bioavailable form.

8.3.4.3 Change of Cleanup Goals from 180 ppm to 400ppm

DOE had originally recommended a remediation goal of 180 ppm of mercury for Lower EFPC. After further study and interaction with members of the community, the remediation goal was raised to 400 ppm of mercury. This increase from 180 to 400 ppm was justified by the use of a bioavailability factor of 10 percent instead of the more conservative 30 percent, which is used at mercury mining sites**.** The change to 10 percent availability was justified by the following studies that found the species of mercury in the floodplain were not bioavailable - primarily mercuric sulfide, elemental mercury and other insoluble species of mercury.

---

[174] U. S. Department of Energy. 1996. "Baselines and Post-remediation Monitoring Program Plan for the Lower East Fork Poplar Creek Remedial Action Project Oak Ridge, Tennessee." Y/ER-262/R1, Prepared by Science Applications International Corporation Oak Ridge, Tennessee under subcontract 43B-99069C.Y05, for The U.S. Department of Energy under contract DE-AC05-84OR21400.

8.3.4.3.1 *Species of Mercury in EFPC Floodplain Soils*

A controversy, which has not been resolved, concerns the predominant forms of mercury found in floodplain soils. Revis et al. (1989)[175], using a sequential extraction technique he himself had developed, determined that the mercury in soils in the floodplain was approximately 85 percent mercuric sulfide. Later, EPA using a sequential extraction procedure they developed (Miller, 1993)[176] determined the mercury in a different set of soils was predominantly elemental mercury (Dobb et al. 1994).[177] To resolve this discrepancy, ORNL-ESD compared the results of the two techniques as well as a third procedure (Sakamoto et al. 1992)[178] on the same set of five soils. Results of this comparison indicated the mean percentages of mercuric sulfide were 46 percent, 25 percent, and 83 percent, respectively. The biggest discrepancy between the results of the Revis and EPA procedures was the abundance of elemental mercury: averages of 28 and 72 percent, respectively. Discussion between the researchers of ORNL and EPA did not resolve the issue.

Sequential methods are common methods for the speciation of metals in soil and sediments (Tessier et al. 1979)[179]; however, there are problems in using sequential extraction procedures for quantitative analysis (Pickering 1981). Nevertheless, all three techniques indicated that mercury in Lower EFPC soils was not organic, was not water soluble, and was resistant to extraction except by aggressive means.

By increasing the remediation goal to 400 ppm, the cost would be reduced from $36-78 million to $22-28 million, the volume extracted from 41,300 to 7,646 cubic meters (m^3), area impacted from 7.3 to 2.5 hectares, time to complete from 82 to 26 weeks, dump truck loads 6,750 to 1,000. All of these impacts were considered by the public, especially the number of truck loads that would move through Oak Ridge to the Y-12 disposal site. The revised alternative was to include appropriate monitoring of Lower EFPC media to ensure effectiveness of the remedial action.

---

[175] Revis, N.W., T.R. Osborne, G. Holdsworth, and C. Hadden. 1989. "Distribution of mercury species in soils from a mercury-contaminated site." *Water. Air and Soil Pollution*.

[176] Miller, E.L. 1993. "Speciation of Mercury in Soils." U.S. Environmental Protection Agency, Environmental Monitoring Systems Laboratory, Las Vegas, NV.

[177] Dobb, D., E. Miller, D. Cardenas, and K. Brown. 1994. "Determination of Mercury, with Speciation, in Poplar Creek Soil Samples," internal report. U.S. Environmental Protection Agency, Environmental Monitoring Systems Laboratory. Las Vegas, NV.

[178] Sakamoto, H., T. Tomiyasu, and N. Yonehara. 1992. "Differential determination of organic mercury, mercury (II) oxide and mercury (II) sulfide in sediments by cold vapor atomic absorption spectrometry." *Analytical Sciences*.

[179] Tessier, A., P.G.C. Campbell, and M. Bisson. 1979. "Sequential extraction procedure for the speciation of particulate trace metals," *Analytical Chemistry*.

8.3.4.3.2 *Remedial Alternative Actions*

Seven remedial alternative actions were evaluated in the feasibility study (DOE 1994b)[180] for cleanup of lower EFPC. Alternative 3 was selected as the one most suited for lower EFPC. Floodplain soil with mercury concentrations greater than the remediation goal of 400 ppm would be excavated and disposed of in a permitted landfill at the Y-12 Plant. A small area of wetland would be remediated and restored. Clean barrow soil would be used to fill the excavation.

The remediation occurred in two phases. Phase I occurred at the NOAA facility in the spring of 1996, and the full-scale remediation Phase II in the spring of 1997. Phase I was used to confirm and verify processes and test assumptions of the remediation plan. The anticipated daily average excavation depth was 16 inches. At the NOAA site, the mercury contamination extended to a depth of 16 in., while at the Bruner site the depth of contamination exceeding 400 ppm extended to a depth of 32 in. at isolated locations.

8.3.5 ATSDR Panel Results

Questions regarding the speciation of mercury and its bioavailability in the floodplain have continued to be controversial because of the lack of general agreement among experts about fundamental issues. As a result, in August 1995 the ATSDR convened a panel of experts to discuss the bioavailability of mercury in contaminated soils with emphasis on the conditions in EFPC.

Three papers resulting from this panel meeting were published in the journal *Risk Analysis*[181]: "The Environmental Geochemistry and Bioaccessibility of Mercury in Soils and Sediment" (Davis et al.)[182], "Evaluation of Methods for Assessing the Oral Bioavailability of Inorganic Mercury in Soils," (Schoof and Nielsen)[183], "Current Views on the Oral Bioavailability of Inorganic Mercury in Soil: Implications for Health Risk Assessments," (Paustenbach et. al.).[184] Results of these papers and the panel findings are

[180] U.S. Department of Energy, 1992. "Environmental Restoration Program East Fork Poplar Creek Sewer Line Beltway integrated RCRA/CERCLA/NEPA. Phase Ib, Sampling and Analysis Plan for Soil, Sediment, and Water." DOE/OR-983, OKR/91-051, Prepared by Radian Corporation for the U. S. Department of Energy.

[181] U.S. Department of Energy, 1995. "Record of Decision for Lower East Fork Poplar Creek Oak Ridge, Tennessee." DOE/OR/02-1370&D2. Prepared by Jacobs ER Team Oak. Ridge, Tennessee, under contract DE-ACO5-03OR22028. Prepared for U.S. Department of Energy Office of Environmental Restoration And Waste Management.

[182] Davis A.A., S. Nicolas, S. Bloom, and S.S. Que Hee.. 1997. "The Environmental Geochemistry and Bioaccessibility of Mercury in Soils and Sediment." *Risk Analysis* 17:5; 557-569.

[183] Schoof, R.A. and J.B. Nielsen, 1997. "Evaluation of Methods for Assessing the Oral Bioavailability of Inorganic Mercury in Soil." *Risk Analysis* 17:5; 545-555.

[184] Paustenbach D.J., G.M. Bruce, and P. Chrostowski. 1997. "Current Views on the Oral Bioavailability of Inorganic Mercury in Soils: Implications for Health Risk Assessments," *Risk Analysis* 17:5; 533-544.

summarized in a paper by Canady et al.[185], "ATSDR Science Panel on the Bioavailability of Mercury in Soils: Lessons Learned."

In summary, the health hazards posed by mercury-contaminated soils are strongly influenced by estimates of the bioavailability of mercury in the soils. The default assumption of 100 percent for mercury-contaminated soils is excessively conservative. Analysis of the literature led to the conclusion that the default value of 100 percent relative bioavailability for soil-mercury should be used only when performing a screening-level assessment.

One of the main objectives of the ATSDR panel was to analyze the current literature concerning the bioavailability of mercury in soils. The panel's recommendation, which is a standard recommendation for most panels, was that additional research is needed to estimate a value (default value) that is more realistic, but is still protective of public health. The panel concluded that current knowledge does not allow the development of default assumptions or guidelines for soil-mercury. Thus, the most practical method for defining soil-mercury bioavailability appears to be site-specific assays using *in vivo* and *in vitro* approaches that were discussed at the panel meeting.

8.3.6 Baseline Post-remediation Monitoring Program Plan

The purpose of the "Baseline Post-remediation Monitoring Program Plan (PMP)[186] for the Lower East Fork Poplar Creek Remedial Action Project Oak Ridge," Tennessee (Y/ER-262/R1)[187] was to confirm that remedial actions comply with the EFPC ROD. The ROD specifies that the actions produced by fulfilling the requirements of the ROD will be protective of human health (removal of soil with concentrations of mercury greater than 400 mg/kg) and the environment, i.e., plant and animal populations. The PMP did not include sampling during remedial activities, but dealt with sampling before (baseline) and after (post-remediation monitoring) activities were completed.

The PMP uses data from the Y-12 Plant Biological and Abatement Program (BMAP)[188] to evaluate compliance with the ROD. The ROD states that the remediation is protective of human health and the environment; however, there is uncertainty about the extended risk to plants and animals after excavation and site restoration has been completed. Therefore, the ROD calls for post-remediation monitoring of EFPC flood-

[185] Canady, R.A., J.E. Hanley, and A.S. Susten. 1997. "ATSDR Science Panel on the Bioavailability of Mercury in Soils: Lessons Learned." *Risk Analysis* 17:5; 527-532.

[186] Loar et al. 1989. "The Oak Ridge Y-12 Plant Biological Monitoring and Abatement Program for East Fork Poplar Creek." ORNLTM-10265. Environmental Sciences Division, Oak Ridge National Laboratory, Oak Ridge, Tenn.

[187] U. S. Department of Energy. 1996. "Baseline and Post-remediation Monitoring Program Plan for the Lower East Fork Poplar Creek Remedial Action Project Oak Ridge, Tennessee." Y/ER-262/R1, Prepared by Science Applications International Corporation Oak Ridge, Tennessee under subcontract 43B-99069C.Y05. For The U.S. Department of Energy under contract DE-AC05-84OR21400.

[188] U. S. Department of Energy. 1998. "Post-remediation Monitoring Program Baseline Assessment Report, Lower East Fork Poplar Creek, Oak Ridge Y-12 Plant, Oak Ridge, Tennessee," Y/ER-319. Prepared for the U. S. Department of Energy Office of Environmental Management.

plain soils and associated biota and EFPC surface water, sediment and associated biota. The monitoring will provide data to evaluate whether ecological populations are protected when concentrations of mercury in the soil remain above the ecological soil Remedial Goal Objective (RGO) of 200 mg/kg.

The ROD states that no contamination will remain in the EFPC floodplain at levels that will prevent unrestricted use. However, there was uncertainty about the protectiveness of the planned remediation for ecological receptors. Data will be reported in a five-year review. If the monitoring data indicates that there has been an increase in the exposure and effects on monitoring endpoints due to mercury in the EFPC environment, then the risk to ecological receptors would need to be evaluated in accordance with EFPC Baseline Ecological Risk Assessment.

According to the Post-remediation Monitoring Program (1998)[189] concentration of total mercury in surface water was highest in samples collected from the uppermost sites in EFPC and declined with distance downstream. In contrast, concentration of methylmercury tended to increase with distance downstream. The exception was at EFPC 21.9 km, immediately downstream of NOAA, where the methylmercury concentration in surface water was 1.5 times higher than at the sites immediately upstream (EFPC 22.8 km) and downstream (EFPC 18.2 km). Biota downstream of the remediation site contained higher concentrations of mercury than at upstream sites.

8.3.6.1 Concentration Of Mercury In Water And Fish

According to Bechtel Jacobs' 2002 Remedial Effectiveness Report[190], the concentration of mercury in redbreast sunfish in EFPC has increased at stations downstream of the Y-12 facilities, below the NOAA and Bruner sites. The concentration of methylmercury in water has also increased. Since the releases of mercury from the Y-12 facilities have supposedly decreased, the reason for the increases in fish and water is unknown.

One supposition is that the increased concentration of mercury in fish at downstream locations is the result of the stream recovery. As the stream recovers, the food chain becomes more complex with the number of species increasing. This increase in species at the lower trophic level provides a more complex food chain, with mercury concentrations in the lower trophic levels being concentrated in one of the top predators, the redbreast sunfish. Another supposition is that the remedial action at the NOAA and Bruner sites had resulted in environmental changes in the soil that increased the production of methylmercury.

---

[189] Loar, J.M. 2004. "The State of East Fork Poplar Creek: Status of Ecological Recovery." Environmental Sciences Division. Oak Ridge National Laboratory.

[190] Loar, J.M. 2004. "The State of East Fork Poplar Creek: Status of Ecological Recovery." Environmental Sciences Division. Oak Ridge National Laboratory.

Loar, in his address on the State of East Fork Poplar Creek: Status of Ecological Recovery (November 8, 2004, Environmental Sciences Division)[191], showed that the ecology of EFPC continues to improve by the increased number of species of biota that are found in the lower reaches of EFPC. However, the level of mercury in fish species below the remediation sites are still higher than those further upstream. It should also be pointed out that DOE facilities pump about two million gallons of water from the Clinch River into EFPC. Although this is not a large amount by stream standards (about 3 cubic feet/second stream flow), it dilutes the contaminants in the stream.

8.4 SUMMARY AND CONCLUSIONS

The NOAA and the Bruner sites have been remediated to less than 400 ppm for mercury in a 16-inch core sample.

Core samples were homogenized in the 16-inch core sample, which diluted the black band of soil that contained high levels of mercury of 2,000 ppm or more with less contaminated soils. If the homogenized sample exceeded 400 ppm, the site was to be remediated.

A weakness of EPA-approved methodology of homogenizing core samples was that a core sample with a 4-inch band of soil containing a concentration of 1,500 ppm could have a homogenized concentration of less than 400 ppm; therefore, the area would not be remediated. However, if the band was 2-inches thick, the concentration would be 3,000 ppm.

The level of remediation was increased from an EPA recommended level of 180 ppm mercury to 400 ppm after a public meeting with local residents. These residents believed that 400 ppm was a safe level, they did not want their land disturbed, and they were concerned about the truck traffic going to the Y-12 landfill.

The level of remediation was increased to 400 ppm, because studies by Revis and others indicated that the species of mercury in the floodplain was in an insoluble form that would not be readily mobilized.

According to the ROD, after remediation was complete, no contamination will remain in the EFPC floodplain at levels that will prevent unrestricted use. However, unrestricted use could include construction and other activities that would uncover the black layer of soil that could contain concentrations of mercury higher than 400 ppm. In such conditions, the direct exposure pathways may not be safe for the public.

Because of the controversy concerning the species of mercury in EFPC, in 1995 ATSDR convened a panel to examine the species of mercury primarily in EFPC. The

---

[191] Loar, J.M. 2004. "The State of East Fork Poplar Creek: Status of Ecological Recovery." Environmental Sciences Division. Oak Ridge National Laboratory.

panel concluded that the mercury in EFPC floodplain was in a form that was not readily mobilized. The panel also concluded that additional research was needed and that specific *in vivo and in vitro* studies were needed to determine the mobility of mercury in the floodplain. Thus, the composition of mercury species in the floodplain soil is still not completely understood.

After remediation of the NOAA and Bruner sites, methylmercury in water and in biota in the lower reaches had increased above the levels located upstream. This condition has persisted through 2004. Since the releases of mercury from Y-12 have decreased, there is a question as to whether the remediation at the NOAA and Bruner sites produced environmental conditions that were favorable for the production of methylmercury.

8.5 LITERATURE

Canady, R.A., J.E. Hanley, and A.S. Susten. 1997. "ATSDR Science Panel on the Bioavailability of Mercury in Soils: Lessons Learned." *Risk Analysis* 17:5; 527-532.

Davis A.A., S. Nicolas, S. Bloom, and S.S. Que Hee.. 1997. "The Environmental Geochemistry and Bioaccessibility of Mercury in Soils and Sediment." *Risk Analysis* 17:5; 557-569.

Dobb, D., E. Miller, D. Cardenas, and K. Brown. 1994. "Determination of Mercury, with Speciation, in Poplar Creek Soil Samples, internal report." U.S. Environmental Protection Agency, Environmental Monitoring Systems Laboratory. Las Vegas, NV.

Loar et al. 1989. "The Oak Ridge Y-12 Plant Biological Monitoring and Abatement Program for East Fork Poplar Creek." ORNLTM-10265. Environmental Sciences Division, Oak Ridge National Laboratory, Oak Ridge, Tenn.

Loar, J.M. 2004. "The State of East Fork Poplar Creek: Status of Ecological Recovery." Environmental Sciences Division. Oak Ridge National Laboratory.

Miller, E.L. 1993. "Speciation of Mercury in Soils." U.S. Environmental Protection Agency, Environmental Monitoring Systems Laboratory, Las Vegas, NV.

Paustenbach D.J., G.M. Bruce, and P. Chrostowski. 1997. "Current Views on the Oral Bioavailability of Inorganic Mercury in Soils: Implications for Health Risk Assessments," *Risk Analysis* 17:5; 533-544.

Revis, N.W., T.R. Osborne, G. Holdsworth, and C. Hadden. 1989. "Distribution of mercury species in soils from a mercury-contaminated site." *Water. Air and Soil Pollution*.

Sakamoto, H., T. Tomiyasu, and N. Yonehara. 1992. "Differential determination of organic mercury, mercury (II) oxide and mercury (II) sulfide in sediments by cold vapor atomic absorption spectrometry." *Analytical Sciences*.

Schoof, R.A. and J.B. Nielsen. 1997. "Evaluation of Methods for Assessing the Oral Bioavailability of Inorganic Mercury in Soil." *Risk Analysis* 17:5; 545-555.

Tennessee Department of Health. 1999. "Mercury Releases from Lithium Enrichment at the Oak Ridge Y-12 Plant-A Reconstruction of Historical Releases and Off-Site Doses and Health Risk." Report of the Oak Ridge Dose Reconstruction, Vol. 2. Submitted to the Tennessee Department of Health by ChemRisk.

Tennessee Valley Authority. 1959. "Floods on Clinch River & East Fork Poplar Creek in the Vicinity of Oak Ridge, Tennessee." Report No. 0-5922, p. 66. Tennessee Valley Authority, 1959.

Tennessee Valley Authority. 1985. "Sediment Characterization. Task 2 Instream Contaminant Study." Prepared for U. S. Department of Energy Oak Ridge, Tennessee. Office of Natural Resources and Economic Development Tennessee Valley Authority.

Tessier, A., P.G.C. Campbell, and M. Bisson. 1979. "Sequential extraction procedure for the speciation of particulate trace metals," *Analytical Chemistry*.

U.S. Department of Energy. 1992. "Environmental Restoration Program East Fork Poplar Creek Sewer Line Beltway integrated RCRA/CERCLA/NEPA. Phase Ib, Sampling and Analysis Plan for Soil, Sediment, and Water." DOE/OR-983, OKR/91-051, Prepared by Radian Corporation for the U. S. Department of Energy.

U.S. Department of Energy. 1995. "Record of Decision for Lower East Fork Poplar Creek Oak Ridge, Tennessee." DOE/OR/02-1370&D2. Prepared by Jacobs ER Team Oak. Ridge, Tennessee, under contract DE-ACO5-03OR22028. Prepared for U.S. Department of Energy Office of Environmental Restoration And Waste Management.

U.S. Department of Energy. 1996. "Baselines and Post-remediation Monitoring Program Plan for the Lower East Fork Poplar Creek Remedial Action Project Oak Ridge, Tennessee." Y/ER-262/R1, Prepared by Science Applications International Corporation, Oak Ridge, Tennessee, under subcontract 43B-99069C.Y05, for The U.S. Department of Energy under contract DE-AC05-84OR21400.

U.S. Department of Energy. 1996. "Confirmatory Sampling and Analysis Plan for the Lower East Fork Poplar Creek Operable Unit, Oak Ridge, Tennessee." Y/ER-258. Prepared by Science Applications International Corporation Oak Ridge, Tennessee under subcontract43B-99089C, Y05, for the U.S. Department of Energy under contract DE-AC)-84OR21400.

U.S. Department of Energy. 1996. "Phase II Remedial Design Report on the Lower East Fork Poplar Creek Remedial Action Project, Oak Ridge, Tennessee." DOE/OR/01-1449&D2, Prepared by Foster Wheeler Environmental Corporation, Oak Ridge, Tennessee, under subcontract 32M-03542C for The U.S. Department of Energy,

U.S. Department of Energy. 1996. "Remedial Action Work Plan for Phase II of the Lower East Fork Poplar Creek Remedial Action Project, Oak Ridge, Tennessee." DOE/OR/01-1480&D1. Prepared by Foster Wheeler Environmental Corporation Oak Ridge, Tennessee under subcontract 32M-03542C, for the U.S. Department of Energy under contract DE-AC05-840R21400.

U.S. Department of Energy. 1998. "Post-remediation Monitoring Program Baseline Assessment Report, Lower East Fork Poplar Creek, Oak Ridge Y-12 Plant, Oak Ridge, Tennessee," Y/ER-319.

U. S. Environmental Protection Agency. January 2001. Water Quality Criterion for the Protection of Human Health: EPA-R-01-001.

U. S. Environmental Protection Agency. October 2000. Reference Dose for Methylmercury. NCEA-S-0930, pp 66.

CHAPTER 9. CONCLUSIONS

From the perspective of the many local, national, and international scientists studying Oak Ridge releases, the EFPC and other off-site contamination must be a fascinating problem. However, from the property owner's and community member's perspectives, it is confusing, frustrating, and often costly. There are numerous questions remaining unanswered despite the many public meetings and workshops that have been held in the name of "public participation." The sections to follow provide discussions of (1) ethical issues associated with real estate sales along the creek, (2) what the public should be told, and (3) specific recommendations.

9.1 LEGAL AND ETHICAL ISSUES

The fact that the EFPC winds its way through much of Oak Ridge raises both legal and ethical concerns, particularly regarding the sale and lease of real estate along the creek. Does the fact that in past health consultations[192] ATSDR has found the 400 ppm cleanup level acceptable absolve a property owner of having to disclose that the property lies on or near a stream impacted by the Y-12 Plant and may be located on or near a mercury-contaminated floodplain? What about the feeder streams that back up during floods and have fish and turtles that likely have contaminant levels of concern? Should these feeder streams be posted by the state? Must (or should) property owners inform potential buyers that the stream is posted despite the fact that there is no sign on the creek bank adjacent to the property? What if the developer maintains a buffer area separating the property from the creek? What is the property owner's obligation to disclose the property's close proximity to EFPC? What should individuals do when they see children playing in the creek or along its banks? Does the ATSDR position of "no threat to human health" apply to the creek itself and its banks, as opposed to the floodplain soils, which are specified in the Health Consultations? (See Section 9.2 for an extensive list of questions such as these.)

ITSPA believes this situation should be covered by existing state real estate protection laws, particularly since the people buying these properties are possibly not from this area and are unaware about the history of the land they are purchasing.[193] According to local attorney David Flitcroft,[194] one of the obligations of a real estate professional, regardless of whom he or she represents, is to disclose any adverse facts about a property that would significantly affect its value. In addition, they must provide timely and accurate information (upon request) of market conditions.

---

[192] Note that ATSDR's Public Health Assessment on mercury has not yet been completed, so ITSPA does not know what ATSDR's future position on this issue will be. Dr. William Taylor is the lead health assessor on this project (865-220-0295).

[193] In fact, the author of this report witnessed a person involved with the new Rarity Ridge development (located across the river from the former K-25 Plant) saying at an Oak Ridge Planning Commission meeting the target market for the development is retirees from Ohio and other mid-western states.

[194] Partner in the Oak Ridge law firm of Joyce, Meridith, Flitcroft, & Normand and author of a series of articles published in *The Oak Ridger* in 2002 regarding real estate disclosures. These articles are included in Appendix 2.

However, upon examination of the Tennessee statute[195] covering real estate disclosure, ITSPA discovered a number of exclusions in Tennessee's real estate disclosure law. Quite relevant to potential EFPC property buyers is the exclusion of disclosures concerning the purchase of a new home from a developer that offers a one-year warranty. The problem is that environmental problems are long-term in nature and a one-year warranty and a one-year statute of limitations does little to protect buyers.

The following are examples of other exclusions, which were obtained from "Part Two: Residental Property Disclosure" by attorney David Flitcroft (*The Oak Ridger*, 7/26/02): "…the disclosure only applies to residential property. So, if you are buying farm property, industrial or commercial property or raw land, it does not apply. It is appropriate to work with your real estate professional to fashion a disclosure to apply. Certain sellers are exempt from the disclosure law: court-ordered sales, foreclosure sales, bankruptcy sales, sale by a fiduciary…, transfer termination a tenancy in common, certain family transfers, transfer pursuant to divorce, tax sales, property sold at auction, first-time sale of a dwelling provided the builder offers a written warranty, transfers in which the owner has not resided on the property within three years from the date of transfer. In my practice, if the sale is exempt from the residential disclosure, I would recommend that a professional home inspection be done."

9.2 WHAT THE PUBLIC SHOULD BE TOLD

It is likely that many members of the public do not understand the scientific information presented at the annual *State of the Creek Address*. In fact, many probably do not know that these addresses are held. Of even more concern to ITSPA are the results of the short-form survey of EFPC residents, which indicate that some do not even know the creek could pose a risk at all.

The following are questions that ITSPA believes have not been effectively answered by the government agencies responsible for the environment and the health, safety, and welfare of the public:

- What are the public health implications of the use of "homogenized" samples during Phase IB sampling of the EFPC and its floodplain?

- What safeguards are in place to prevent the spread of mercury-containing soil at greater than 400 ppm during future city and construction projects?

- How much mercury is reintroduced to the floodplain during floods today and where are the problem areas?

- Can property owners safely perform maintenance operations on their creek-front property (e.g., bank stabilization and vegetation removal), which the city has

[195] Title 66 Property law, Chapter 5 Conveyances of Property: www.state.tn.us/commerce/boards/trec/rulesandlaws.html/t66/t_66_ch_5.htm

indicated is expected of them? This appears to put the property owners in a Catch 22 situation because of the postings.

- If someone comes into contact with the posted water, what decontamination steps should they take?

- Does everything that comes into contact with the creek water and sediments have to be packaged, handled, and disposed of as hazardous waste, as one property owner indicated to ITSPA he was told in 2000, and which resulted in the loss of tens of thousands of dollars?

- Spills still occur periodically at Y-12. Should property owners be warned immediately so they can take extra precautions to keep humans and pets out of the creek as the contaminant plume passes? Does a mechanism exist to immediately notify residents along the EFPC of a spill other than the general siren?

- Should residents place a grill in the floodplain near the creek and use it as a picnic area? How are residents educated about this use of the floodplain?

- Should parents place a swing-set in the floodplain and allow their child to play and dig there? How are residents educated about this use of the floodplain?

- What should a parent do if a child wanders into the creek, digs in the sediments, and becomes covered with that sediment? Are the children who are regularly exposed to the water and/or sediments at risk for future health problems? Has this risk been quantified and communicated to residents?

- Since little human health data are available, particularly on environmental exposures, is a system in place to track the actual long-term health impacts on children who currently play in the creek and have played there in the past?

- Has any work been done to generate or gather data regarding absorption of inorganic mercury salts via inhalation and dermal exposures? ATSDR indicated in the 1993 Health Consultation that no quantitative data were available.

- Does the fact that in past health consultations ATSDR has found the 400 ppm cleanup level acceptable for use absolve a property owner of having to disclose that the property lies on or near a stream impacted by the Y-12 Plant and may be located on or near a potentially mercury-contaminated floodplain?

- What about the feeder streams that back up during floods and have fish and turtles that likely have contaminant levels of concern? Are these feeder streams posted by the state?

- Must (or should) the property owner inform potential buyers the stream is posted despite the fact there are no signs on the creek bank adjacent to the property?

- What if the developer maintains a buffer area separating the property from the creek? What is the property owner's obligation to disclose the property's close proximity to EFPC?

- Does the ATSDR position of "no threat to human health" apply to the creek itself and its banks, as opposed to the floodplain soils, which are specified in the Health Consultations?

9.3 RECOMMENDATIONS

EFPC property owners deserve relief from the dilemma they face—perhaps unknowingly. In particular, property owners should be provided guidance on exactly how they can safely and legally use their property along the creek and the buffers that have been established by neighborhood developers.

9.3.1 Buyer Notification and Real Estate Disclosure Laws

Unfortunately, because of the homogenized sampling method used in Phase IB sampling of the EFPC, it is very likely that bands of soil contaminated to a level much greater than 400 ppm has been left in place (perhaps in the range of thousands of ppm). *Therefore, ITSPA recommends the buyer of property near and on the creek be informed of this possibility both by the realtor/seller and by deed restrictions.* However, because the government's position is that no contamination has been left in place, it appears no disclosure or deed restrictions are currently required.

In addition, ITSPA believes there are an alarming number of exclusions to the Tennessee real estate disclosure law. *Therefore, ITSPA believes law should be amended to eliminate these exclusions.*

One of ITSPA's major concerns is for non-locals who come to Oak Ridge for a job opportunity or retirement. These individuals are very likely to be uninformed about the issues surrounding this beautiful creek and creekside properties, which would otherwise be considered prime acreage. This issue is discussed in detail in Section 3.4.

9.3.2 Property Use Guidelines

Government agencies need to better understand the financial impacts of their decisions on these property owners, and should *develop a set of consistent guidelines that property owners can follow in the use and care of their creek-front and/or flood-impacted property*. The example regarding pine beetle damaged trees on EFPC property (see Section 3.5.1) dramatically illustrates why such guidelines are needed.

9.3.3 Community Sampling

There is a disconcerting absence of soil sampling and surface smear data in Oak Ridge, which greatly impacts the public's trust of DOE as well as the quality of decisions made by public health officials regarding the impacts of releases from the ORR on residents in both the past and the present. The credibility of the data that does exist has been called into question because of the use of "homogenized" samples, as well as the serious conflict of interest that exists because DOE is the funding source for all of these activities. *Therefore, a widespread Oak Ridge sampling program (deep soil cores and surface smears)—having appropriate community input and independent oversight—should be developed as part of the upcoming FFA milestone.*

However, such a plan for soil sampling requires additional information (such as complex air dispersion modeling and historical environmental sampling data) to identify target sampling locations, contaminants of concern, sampling and analysis protocols, detection limits, etc. Sampling to determine what people may have been exposed to years ago requires sophisticated sampling for isotope ratios, deeper soil samples in undisturbed areas, and perhaps novel approaches, such as looking for isotope ratios in tree rings and retrospectively modeling past air concentrations. Sampling should be extended to areas that today may be far below levels of concern for present day contamination. Limits of detection need to be pushed to very low levels, which also drives the cost of sampling up considerably.

A sampling plan would also have to be fully reviewed, vetted, and approved before being implemented. Any new sampling plan should consider overcoming the limitations of previous sampling activities in Scarboro (DOE/FAMU 1998, EPA 2001). These limitations include surface soil samples only, lack of sufficiently sensitive techniques for quantifying uranium isotopes, and lack of appropriate background locations for comparison to natural levels. All areas within range of Y-12, K-25/S-50, and ORNL releases should be considered in the plan.

The following is required not just to evaluate present day contamination and exposure, but also to confirm estimates of past exposures: One-meter-deep core sampling coupled with ICP-mass spectrometry (or equivalent/superior methods) should be sufficient to answer questions about current and historical levels of several priority contaminants in soils released from Y-12 (e.g., mercury, uranium isotopes, technicium-99, and arsenic). These data, in turn, may be used to estimate current and past exposures.

Although the EFPC sampling effort was quite extensive, ITSPA believes there was a serious problem with the sampling protocol, i.e., the decision to "homogenize" samples, in the Phase 1B sampling effort. The following is DOE's description of homogenization:

> "After retrieving the subsurface soil, technicians would place the samples into a metal bowl, where samples are homogenized before being placed in sample bottles for shipment to the laboratory." [196]

The following is a quote from an EFPC property owner regarding this procedure, which was obtained by ITSPA during a personal interview:

> "I felt that an end user, if they ever had a grievance, would not accept the 400 ppm because it was an average. And you don't live with averages." "If you're going to build a sidewalk or a road, you don't take 18 inches of soil and homogenize it. You dig down and say this is the level that I want my residential sidewalk going to my house. The soil there is black…you didn't have to test…you could cut a profile and see the black layer and it was usually 3 to 5 inches in depth. If the average was 1,600 ppm, how high was it really in that black layer? However, the government agents …said, "that's the protocol… that's the way it's written…that's the way you take samples.""

This and at least one other property owner wrote numerous letters to government officials within DOE and other agencies protesting the use of this procedure. However, they could not convince the government to change the questionable procedure.

In addition to the absence of sufficient and credible off-site environmental sampling data, there is a disconcerting absence of disease and birth defects registry data, which should have been collected by the state over the last decade. Unfortunately, Tennessee is ranked in the bottom three in a comparison of state registries performed by Trust for America's Health (discussed in Section 5.5.1.3). *Therefore, pressure should be placed on the state to establish credible disease and birth defects registries.*

9.3.4 Signs Along The Creek

TDEC must be more diligent in its efforts to ensure that signs are posted and visible along the EFPC, particularly in the summer months when children are more likely to play in the creek. However, summer is the time when vegetation grows that blocks visibility of some of the signs. During its tour of the creek, ITSPA noticed some were totally obscured by vegetation. In addition*, the agency needs to ensure that signs are in place along the creek in the new subdivisions in the west end of Oak Ridge*. For example, during the tour of the creek, ITSPA did not see a single sign in the Southwood Subdivision. Unfortunately, the ITSPA team was unable to inspect the creek-front in other subdivisions in this area. However, ITSPA suspects there are no signs there as well. (Section 7.1 summarizes ITSPA's driving tour and discusses where signs were present and absent.)

---

[196] DOE Environmental Update, Fall 1991.

9.3.5 EFPC Resident Education Program

Because of unanswered questions regarding the EFPC and its use, ITSPA recommends *development of an educational program geared towards residents near the waterway*. Information should be disseminated via pamphlet, web site, local science museum, public library, school outreach effort, churches, daycares, etc. The program should answer questions such as the ones raised by ITSPA and provide a web site, as well as a point of contact where the public can get accurate and consistent answers to their questions.