Public Health Assessment for

FORMER ST. JOE FOREST PRODUCTS SITE
(A/K/A ST. JOE PAPER MILL)
PORT ST. JOE, GULF COUNTY, FLORIDA
EPA FACILITY ID: FLD004056602
JANUARY 6, 2006

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
PUBLIC HEALTH SERVICE
Agency for Toxic Substances and Disease Registry

THE ATSDR PUBLIC HEALTH ASSESSMENT: A NOTE OF EXPLANATION

This Public Health Assessment was prepared by ATSDR pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA or Superfund) section 104 (i)(6) (42 U.S.C. 9604 (i)(6)), and in accordance with our implementing regulations (42 C.F.R. Part 90). In preparing this document, ATSDR has collected relevant health data, environmental data, and community health concerns from the Environmental Protection Agency (EPA), state and local health and environmental agencies, the community, and potentially responsible parties, where appropriate.

In addition, this document has previously been provided to EPA and the affected states in an initial release, as required by CERCLA section 104 (i)(6)(H) for their information and review. The revised document was released for a 30-day public comment period. Subsequent to the public comment period, ATSDR addressed all public comments and revised or appended the document as appropriate. The public health assessment has now been reissued. This concludes the public health assessment process for this site, unless additional information is obtained by ATSDR which, in the agency's opinion, indicates a need to revise or append the conclusions previously issued.

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Prepared by:

Florida Department of Health
Bureau of Community Environmental Health
Under Cooperative Agreement with the
Agency for Toxic Substances and Disease Registry

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Foreword

This document summarizes public health issues for the former St. Joe Forest Products site in Port St. Joe, Florida. Florida Department of Health (Florida DOH) developed this report using site evaluations prepared by contractors for the current site owners and DEP and their contractors. A number of steps are necessary to do such an evaluation:

- *Evaluating exposure*: Florida DOH scientists begin by reviewing available information about environmental conditions at the site. The first task is to find out how much contamination is present, where it is located, and how people might be exposed to it. Usually, Florida DOH does not collect its own environmental sampling data. We rely on information provided by the Florida Department of Environmental Protection (FDEP), the U.S. Environmental Protection Agency (EPA) and other government agencies, private businesses, and the public.
- *Evaluating health effects*: If there is evidence that people are being exposed—or could be exposed—to hazardous substances, Florida DOH scientists determine whether that exposure could be harmful to human health. This report focuses on public health; that is, the health effects on the community as a whole. It is based on existing scientific information.
- *Developing recommendations*: In the evaluation report, Florida DOH outlines its conclusions regarding any potential health threat posed by a site. It also offers recommendations for reducing or eliminating human exposure to contaminants. The role of Florida DOH in dealing with hazardous waste sites is primarily advisory. For that reason, the evaluation report will typically recommend actions EPA, FDEP, or the party responsible for site remediation should take. If, however, a health threat exists or is imminent, Florida DOH will issue a public health advisory warning people of the danger, and will work to resolve the problem.
- *Soliciting community input*: The evaluation process is interactive. Florida DOH starts by soliciting and evaluating information from various government agencies, individuals or organizations responsible for cleaning up the site, and those living in communities near the site. We share any conclusions about the site with the groups and organizations providing the information. Once an evaluation report has been prepared, Florida DOH seeks feedback from the public. *If you have questions or comments about this report, we encourage you to contact us*.

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Summary and Statement of Issues

The former St. Joe Forest Products site is at 600 West U.S. Highway 98 on St. Joe Bay in Port St. Joe, Gulf County, Florida. From 1938 to 1974, St. Joe Paper Company discharged mill wastewater into an unlined impoundment on the northern part of the site and into St. Joe Bay. After 1974, St. Joe Paper Company conveyed its mill wastewater to the Port St. Joe wastewater treatment plant. In 1996, St. Joe Paper Company sold the southern millworks to Florida Coast Paper. St. Joe Paper Company (now St. Joe Company) retains ownership of the northern part of the site.

Florida Coast Paper temporarily closed the mill in 1997 and then permanently closed it in 1998 due to financial difficulties. Stone Container Corporation took ownership in 2000 and later decided to dismantle the mill. Cleanup of the site is proceeding under Florida's Brownfields redevelopment program. Stone Container Corporation and St. Joe Company have formed a joint venture to develop the property and each company agreed to assess and remediate the portion of the site it owns.

In early 2003, Stone Container's contractors demolished all structures on the southern part of the site. In early 2004, their contractors completed removal of some of the contaminated soil from the site. This soil contained amounts of polychlorinated biphenyls (PCBs) that exceeded the FDEP Soil Cleanup Target Levels (SCTLs) for commercial or industrial land use areas.

Stone Container Corporation completed remediation to commercial and industrial standards in May 2005. Their contractors used engineering controls and institutional controls to prepare the contaminated portions of the southern parcel for future commercial or industrial use. Engineering controls included soil removal and capping. Their contractors installed a monitoring well down gradient of the area of capped soil and will continue to sample this well and other monitoring wells according to a schedule authorized by DEP in March 2005. Stone Container Corporation plans to prohibit future use of groundwater for potable or other uses through deed restrictions. Currently, access to the southern part of the site is restricted on the north, east, and south perimeters by gated chain-link fencing with "no trespassing" warning signs. The western boundary has a seawall and the contaminated soil remaining on the site has been capped with at least two feet of clean soil.

The St. Joe Company could carry out similar remediation plans for the northern part of the site. St. Joe Company's contractor stated "St. Joe Company does not intend to develop the subject property for residential purposes and is willing to record a Declaration of Restrictive Covenant for such property, preventing or limiting certain uses (e.g., residential) and activities (e.g., excavation) on the site" (Professional Service Industries, Inc. [PSI] 2004). FDEP requires such deed restrictions to allow the use of SCTLs it has set for commercial/industrial direct exposures or for leaching to groundwater (FDEP 1999). St. Joe Company plans additional soil testing to determine the extent of PAH contamination in the former wastewater impoundment. While chain-link fencing, the Gulf County Canal, and St. Joe Bay restrict access to the northern part of the site, Florida DOH personnel have seen people fishing from the northern bank of the property that borders Gulf County Canal. People can reach this part of the site from Highway 98 or by boat. Data have not shown this part of the property has contaminated soil, but St. Joe Company should post their property with signs warning people to avoid contact with the soil on the interior of site, especially where the former impoundment is located.

Florida Department of Health (Florida DOH) evaluated the available site analytical data in the context of Brownfields remediation. *Florida DOH recommends the owners prevent the use of groundwater for potable or other purposes and prevent future exposures to onsite soils that exceed the commercial and industrial SCTLs.* If land use changes, and the site is used for residential purposes, soil should be cleaned up to residential standards.

It is unlikely that contaminants from the site will affect groundwater used for drinking or other household purposes in offsite areas. DEP is requiring testing of on-site wells every 6 months to demonstrate contaminated groundwater will not affect the offsite water quality. The City of Port St. Joe supplies nearby residences with municipal water. Florida DOH asked the Gulf County Health Department if there were private wells near the site. Gulf County Health Department staff do not know of any nearby potable wells, but confirmed that a few people use shallow irrigation wells.

Other off-site contamination data are insufficient for evaluation of public health threat. The few sediment and surface water samples collected to date do not characterize chemicals in St. Joe Bay or Gulf County Canal. It is unknown if contaminated groundwater is entering St. Joe Bay. Florida DOH recommends that St. Joe Company should characterize the extent of contamination in sediments near the dock and throughout St. Joe Bay.

Florida DOH also recommends that St. Joe Company collect sheepshead, redfish, spotted sea trout, hardhead catfish, flounder, and southern quahog clams from the eastern part of St. Joe Bay near the site, Gulf County Canal, and the Port St. Joe Marina. These species are eaten by locals and visitors, or are harvested commercially. They should be analyzed for dioxin/furan toxicity equivalents (TEQs) and polychlorinated biphenyls (PCBs). In addition, the flounder and southern quahog clams should be analyzed for polycyclic aromatic hydrocarbons (PAHs).

Florida DOH put the Public Comment draft of the Public Health Assessment on our website

http://www.myfloridaeh.com/community/SUPERFUND/PHA.htm

in early June in anticipation of our Public Meeting on June 21, 2005. We handed out copies of the report to four of the people who attended the meeting to share with others who attended their churches. We gave copies to Gulf County Health Department staff and mailed a copy to the Port St. Joe Public Library.

Florida DOH will inform and educate nearby residents and local health care professionals about the public health threats associated with this site. Florida DOH, Bureau of Community Environmental Health staff will evaluate additional test results with respect to public health implications as they become available.

Purpose

The Florida Department of Health (Florida DOH) evaluates the public health significance of hazardous waste sites through a cooperative agreement with the federal Agency for Toxic Substances and Disease Registry (ATSDR) in Atlanta, Georgia. In 2002, the Florida Department of Environmental Protection (FDEP) asked Florida DOH to evaluate the public health threat from chemicals found in soil, sediments, groundwater, surface water, and seafood samples on and near the former St. Joe Forest Products site.

Background

The 168-acre, former St. Joe Forest Products site is at 600 West U.S. Highway 98 on St. Joe Bay, Port St. Joe, Gulf County, Florida (Figures 1 and 2). Gulf County Canal bounds the property on the north, Highway 98 (also know as County Road 30 and Butler Bay Road) is to the east, Howards Road is to the south, and St. Joe Bay is to the west. The southern (approximately) 120 acres, owned by Stone Container Corporation, includes the former mill area. A guardhouse, chain-link fences, gates, and the bay restrict access to this part of the site. Stone Container dismantled the mill in 2003, but ship-mooring facilities still exist along the western edge of the site. Before the demolition, security personnel guarded the southern part of the site 24 hours a day. St. Joe Company (formerly St. Joe Paper Company) owns the northern 48 acres of the site. The northern part of the site includes a buried impoundment where the St. Joe Paper Company had previously pumped wastewater to settle out solids before discharging it to the bay. Chain-link fences, gates, St. Joe Bay, and Gulf County Canal restrict access to the northern part of the site. Anglers can reach the northernmost part of the site from Highway 98 or from a boat. Sample data have not shown the shorelines of this part of the property has contaminated soil, but St. Joe Company should post their property warning people to avoid contact with the soil on the interior of site, especially where the former impoundment is located. St. Joe Company has not finalized their plans for future site uses, but their current remediation plans only address future commercial or industrial uses.

Site Description and History

The St. Joe Paper Company began paper mill operations at this site in 1938. The original kraft paper process involved the following steps:

- stripping the bark from pine logs,
- chipping the wood and screening the chunks,
- chemically separating the chips into cellulose, lignin, turpentine, and tall[†] oil,
- routing the cellulose through blower tanks, vibrating knotters, and stock washers to produce pulp, and
- making paper and paper products from the pulp.

Over time, the St. Joe Paper Company added a tank farm, a second warehouse, a box plant, a vehicle maintenance shop, a paint shop, a contractor shop, and a fiberglass shop (Figure 3).

[†]Tall oil is a resinous oily liquid composed of a mixture of rosin acids and fatty acids obtained as a byproduct in the treatment of pine pulp. Companies use tall oil in soaps, emulsions, and lubricants.

In the 1950s, the mill began disposing of leftover pine bark, "lime grits," and other waste in swampy areas east of the mill. From the 1950s to the 1980s, property owners built houses over these wastes. Residents referred to the area as Mill View or Millville. In 1966, the mill began bleaching some of the pulp cellulose in a four-stage bleaching plant. The mill bleached between 3% and 25% of the total pulp between 1970 and 1996. Stone Container Corporation did not have records for the period from 1966 to 1970 (FDEP 2002). Operators routed mill-process solids that could not be recycled to a waste bin where they mixed the solids with sand and dirt from the logs. St. Joe Paper Company used this material to surface forest roads and as agricultural lime (FDEP 2002). Before 1993, St. Joe Paper Company burned used solvent (methylene chloride), used oils, lacquer thinner, and xylene in the plant boiler. Other shop wastes included batteries and waste paint.

The paper mill produced 25–30 million gallons of wastewater per day (FDEP 2002). This water contained dilute sulfuric acid. Operators treated the water with alum (aluminum sulfate) to neutralize the acidity. Between 1938 and 1974, the St. Joe Paper Company mill discharged wastewater to an unlined surface impoundment on the northern part of the site. Although the impoundment was designed as an infiltration basin, St. Joe Paper Company did periodically empty wastewater overflow from the impoundment into St. Joe Bay through a ditch. In 1960, mill consultants reported an 11-foot-thick layer of soft plant waste and organic material along the bottom of St. Joe Bay near the mill (Stone Container Corporation 2001). Figure 4 shows the impoundment and ditch labeled on an aerial photo from October 1970. Figure 5 shows what the same area looked like in 1999. From 1966 to 1974, the wastewater discharge included bleach wastewater. The plant reportedly bleached as much as 23% of their daily pulp production during that time.

After 1974, St. Joe Paper Company conveyed its wastewaters via a ditch to the Port St. Joe wastewater treatment plant (WWTP) ½ mile north-northeast of the site (FDEP 2002; Figure 2). The wastewater treatment plant used a secondary treatment system that included chlorination, influent screening, grit removal, and clarifiers. Next, plant operators aerated the wastewater in a 70-acre unlined lagoon and then discharged treated effluent to the Gulf County canal, 2,600 feet upstream of St. Joe Bay. The U.S. Environmental Protection Agency (EPA) approved a National Pollution Discharge Elimination System (NPDES) permit for this discharge. This NPDES permit requires a 2.9-mile buffer zone in which people may not harvest oysters, mussels, or quahog clams. It does not restrict harvesting of crabs, scallops, shrimp, or finfish.

Quarterly, facility-specific NPDES monitoring requirements currently include dioxins and furans determined by toxic equivalents (TEQ) (FDEP 2002). Before August 1994, the effluent was analyzed for only the 2,3,7,8-TCDD and 2,3,7,8-TCDF congeners. From 1974 to October 1990, dioxin/furan discharge limitations were not part of the WWTP NPDES permit.

According to FDEP (2002), the Port St. Joe WWTP reported only three violations for the paper mill between 1994 and 1998. On July 7, 1998, the mill discharged turpentine and failed to report a sludge load. On August 19, 1998, the mill failed the pretreatment standard for iron (4,500 micrograms per liter [µg/L]).

Specific chemicals associated with paper mills include mercaptans, pinenes, limonene, methylphenols, dimethyl phenols, and chloroform. Resin acids and diterpene compounds occur naturally in softwoods. They may break down in wastewater aeration pond anaerobic zones to an alkyl-substituted phenanthrene, also known as retene. Other compounds often present in paper mill air and wastewater include volatile and semivolatile organic compounds (VOCs and SVOCs), extractable organics, and absorbable halides.

A 1988 study of five paper mills (including St. Joe Paper) by the National Council of the Paper Industry for Air and Stream Improvement, Inc. (NCASI) found that bleaching pulp with chlorine and hypochlorite produced dioxins and furans. As a follow up, St. Joe Paper participated in an EPA/Paper Industry cooperative study of 104 mills (EPA 1990). The study's purpose was to find process changes that might reduce effluent dioxins and furans. These process changes included pretreating lignin with hydrogen peroxide and using chlorine dioxide in the bleaching process.

In the early 1990s, the U.S. Fish and Wildlife Service (USFWS) and St. Joe Paper Company tested St. Joe Bay sediments, fish, and shellfish for dioxins and furans with inconclusive results (see the biota sampling section). The EPA also required testing of mill wastewater as a requirement of its NPDES surface water discharge permit.

In the 1990s, the FDEP identified several instances of improper waste handling at the mill. In 1992, FDEP found groundwater contamination between the vehicle maintenance and fiberglass shops. FDEP granted St. Joe Paper Company "no further action" groundwater remediation status in 1995. However, monitoring well groundwater samples analyzed in 2001 showed trichloroethene and vinyl chloride in shallow groundwater on the southern part of the site.

Florida Coast Paper (a joint venture of Stone Container Corporation and Box USA) purchased the mill and the southern part of the property from St. Joe Paper Company in 1996 (Appendix A, Photograph 1). The company temporarily closed the mill in 1997 and then permanently closed the mill in 1998 due to financial difficulties. In January 2000, Stone Container acquired the southern half of the property following Florida Coast Paper's bankruptcy settlement.

Stone Container Corporation completed most of the remediation activities for the southern portion of the site according to DEP's Brownfields regulations by May 2005. In 2002, contractors for Stone Container dismantled the mill and sold the building materials. The company's contractors removed 12,000 linear feet and 8,000 square-feet of friable (easily broken apart) asbestos-containing materials. They also removed 27.65 tons of hazardous materials and between 465 and 1,200 gallons of oil from 12 transformers containing polychlorinated biphenyls (PCBs). They returned the radioactive sources from 30 nuclear density gauges to their manufacturers. They transported the remaining tall oil to Arizona Chemical, and reclaimed and shipped other remaining liquids to other paper mills. The contractor cleaned and removed all aboveground storage tanks and process-chemical storage tanks, and shipped 3,500 tons of lime to Wittmer and Associates in Crestview, Florida, for agricultural use. Contractors removed sediments from the ditch that transferred wastewater from the site to the Port St. Joe WWTP and cleaned all U-drains and underground piping. Stone Container's contractors demolished the remaining buildings with explosives in January 2003 (Appendix A photographs).

FDEP approved the Brownfields Site Assessment Malcolm Pirnie prepared for the southern part of the site on April 9, 2004. Investigation activities addressed past operational practices at the mill site, recommendations from FDEP, and comments from former mill staff and other concerned citizens. Remediation activities included the following:

- excavation and removal of 104 cubic yards of PCB-impacted soil (> 50 ug/kg concentration from one location) to a landfill in Emelle Alabama,

- excavation and removal of 846 cubic yards of PCB-impacted soil (< 50 ug/kg concentration from five locations) to Springhill landfill in Campbellton, Florida,
- excavation and relocation of 222 cubic yards of PAH-impacted soil from ten locations to a location in the center of the property, where it was capped,
- excavation and relocation of 18 cubic yards of metals-impacted soil from two locations to a location in the center of the property, where it was capped,
- development of a restrictive covenant on the property deed for the consolidation areas,
- installation of a monitoring well down-gradient of the consolidation areas to verify the relocated impacted soils are not leaching PAHs or metals to groundwater,
- sampling and analysis of piezometers and monitoring wells after the consolidation activities were concluded (initial and confirmatory sample events),
- development of a restrictive covenant on the property deed for the use of groundwater from the shallow aquifer.

Figure 8 shows all soil excavation areas and monitoring well locations. Two areas of PAH-impacted soils, one area of PCB-impacted soil and one area of metals-impacted soil could not be excavated because they were below the water table (Figure 9). These areas were capped with at least three feet of clean soil. Post remedial activities will include testing groundwater every six months from five wells and four piezometers, for parameters specified by DEP (Figure 8 shows the well locations).

According to FDEP Northwest District personnel, future site use may include light commercial and residential operations. The St. Joe Port Authority may also use part of the property.

Demographics

In 2000, approximately 1,060 persons lived within a mile of the center of the site. Approximately 74% were black, 23% were white, about 1% were American Indian and Alaskan Native, Asian or Hispanic, and about 1.5% were two or more races. Closer to the site (within ¼ mile), of 730 total persons counted in the 2000 census, roughly 93% were black, 5% were white, about 2% were two or more races, and American Indians and Alaskan Natives were <1% (U.S. Census Bureau 2000, estimated using LandView 5 software).

After the mill closed in 1998, approximately 15 on-site employees were responsible for fire protection and other related duties. Between 1998 and 2004, 20 to 60 subcontractors demolished the buildings on the site. The Florida Brownfields Redevelopment program requires contractor certification.

Land Use

Land use around the site is residential, municipal, commercial, and industrial (Figure 2). North of Gulf County Canal is Highland View subdivision. East across Highway 98 are Arizona Chemical Company, the Port St. Joe well field and wastewater treatment plant, Mill View subdivision, and the Apalachicola Northern Railroad. The areas south and southwest of the site include a marina and the businesses and homes of Port St. Joe.

Natural Resource Use

Natural resource uses around the site include boating, swimming, fishing, and harvesting shellfish in St. Joe Bay and the Gulf of Mexico. St. Joe Peninsula State Park is across the bay from the site. A dredged shipping channel from the Gulf of Mexico leads to the site, and the Gulf County Canal north of the site connects to the Intracoastal Waterway. Because of its proximity to St. Joe Bay and the probability of groundwater withdrawal causing saltwater intrusion, shallow groundwater under the site and nearby areas is not a current source of drinking water.

Municipal water will be available for future site use. In 2007, the City of Port St. Joe and the North Florida Water Management District plan to shift the town's drinking water supply to surface water from the Chipley Canal. Currently, the city uses four municipal wells adjacent to city's wastewater treatment property that are about ½ mile east of the site (Figure 2). The city's well driller screened one municipal well at 150 feet in light gray, clayey sand with abundant mollusk shells; one in a clayey, fossil-rich limestone at 200 feet; and two in a sandy limestone at 400 feet. The wastewater treatment property has an unlined sludge lagoon about $^{1}/_{3}$-mile down gradient from the municipal wells.

Site Visit

On October 16, 2001, Florida DOH staff took pictures of the site in conjunction with their visit to the Mill View/Millville subdivision. Florida DOH staff visited the site for the following reasons:

- To become familiar with both sites, the surrounding community, and the town;
- To look for the best meeting place for any appropriate public meeting;
- To locate and/or meet with community leaders;
- To solicit the health concerns of the residents for inclusion in our research;
- To look for physical hazards associated with the site;
- To discover medical resources in the community;
- To meet with the head librarian to set up a repository and determine the library staff's preferred procedures for receiving submitted materials;
- To meet with Gulf County Health Department personnel connected with the site; and
- To gather information about elected officials and obtain city maps.

The Florida DOH specialists saw a "no trespassing" sign on the east gate of the southern part of the site. They saw a guardhouse west of this gate, and chain-link fencing enclosed the eastern, southern, and northern site perimeters. They also saw a chain-locked gate on the southern portion of the site over railroad tracks that entered the site. The west side of the site had a seawall. Florida DOH staff took pictures, but did not go on the site (Appendix A, Photograph 1). They did not see any evidence of trespass or hear any reports of trespass. While persons might access the site from St. Joe Bay or the Gulf County Canal, the site had guards in the past and the site is easily visible from Highway 98 and nearby neighborhoods. Townspeople know that the site owners do not permit trespassing on the site. The northern part of the site is readily accessible from the water, and visiting anglers probably would not know the site interior has contaminated soil, therefore DEP should require posting this interior area "no trespassing" (Photos 9 and 10).

Community Health Concerns

In September 2000, long-time residents told FDEP that they are concerned about Gulf County cancer rates and about possible health effects from past disposal of mill wastes. Florida DOH followed-up this concern about cancer rates for this public health assessment (see the Health Outcome Data section).

FDEP, in its 2002 Preliminary Site Assessment/Site Investigation, addressed many concerns voiced by six private citizens during a November 2, 2000 state and federal agency information-exchange hosted by USFWS. Citizens' concerns in part focused on disposal of materials from the site, including hazardous wastes, lime wastes, and demolition materials (FDEP 2002). FDEP did not address a few concerns that could present current or future exposure pathways. Stone Container Corporation has addressed citizens' questions about the burial of objects on the southern part of the site by including DEP and concerned citizens in their Community Advisory Board when planning and carrying out their remediation activities.

Florida DOH followed up on one of the concerns FDEP did not address in the preliminary assessment. A concerned citizen had asked what affect waste disposal could have had on nearby public and private potable wells, specifically St. Joe Paper and Arizona Chemical waste disposal in a landfill near the Port St. Joe Waste Water Treatment Plant and impoundment of sludge spray disposal at Jones Homestead, 4 miles east of the plant. Gulf County used to have a landfill near the canal and magnesium processing plant. The county closed the landfill and there are no private wells located near it. In addition, monitoring wells for detecting contaminants surround the Jones Homestead spray field (D. Kent, Gulf County Environmental Health Administrator, personal communication, [August 8, 2003]).

FDEP met with former site workers on December 11, 2001, *after* Stone Container Corporation and St. Joe Company submitted their voluntary site investigations (FDEP 2002). Therefore, although the data in these reports did not address spill and waste disposal issues brought up by former workers, Stone Container Corporation later provided a forum for addressing these items through their Community Advisory Board. The Community Advisory Board operated during the Brownfields remediation process. The issues workers mentioned included:

- Boiler ash dumped on the ground or into dumpsters near the cooling tower west of the boilers;
- Routinely leaking piping associated with the five lead-lined sulfuric acid tanks;
- Storage of lead-lining plates for the sulfuric acid tanks near the maintenance shop;
- Leaking piping and overflow of tanks associated with black and white liquors, caustics, and oil tanks, also recurring oil on the ground surface near the bulk storage tank area that workers were instructed to bury with clean soil;
- Leaking PCB transformers;
- A burst chlorine valve plate at the bleach plant, which, along with other spills from leaking pipes over the years, drained into the ground;
- Burial of crushed drums with residual liquids west of the bleach plant;
- Spills of diesel fuel, petroleum products, and degreasers during equipment cleaning, between the wood yard, millwright shop and the jack ladder, and
- Burial of pulp and lime wastes in the former barge basin, (this could theoretically present physical hazards if the land subsides under buildings at that location).

Workers told DEP about discharge of unknown liquids from boiler #4 to the bay. Stone Container's Community Advisory Board may not have addressed this discharge because it occurred off-site.

Stone Container also explained the 24-hour release of the contents of a caustic soda barge to the bay reported by workers as "not accompanied by toxic constituents" because FDEP does not consider the release of sodium hydroxide to seawater as an exposure hazard.

According to Florida DEP's Preliminary Assessment Report, a Stone Container Corporation representative refuted workers' reports that former site operators had buried a chemical railroad tank car, believed to have contained an acid product, and waste drums in the former wastewater impoundment pond. If St. Joe Company remediates their portion of the site under the Brownfields redevelopment program, they will be required to convene a Community Advisory Board, which could address such questions as part of the remediation of the northern part of the site.

Discussion

In this section, Florida DOH reviews the available site information (groundwater, soil, sediment, and surface-water data). Florida DOH looked for information on possible chemicals released to soil or water in the past and for the current levels of those chemicals at the site. Next, we review ways people might contact chemicals from past releases at the site. Finally, we evaluate whether or not these chemicals are likely to cause adverse health effects based on the site-specific opportunities for exposure.

We attempt to moderate the uncertainties associated with possible exposures when estimating or interpreting health risks by assuming adults and children will have daily exposures, over long periods, to the highest measured levels. Florida DOH intends to protect public health with the assumptions, interpretations, and recommendations made in this public health assessment.

Environmental Contamination

This section provides a review of environmental data collected at and near the site since 1988. We evaluate the sampling adequacy and identify the contaminants of concern at the site. This section refers to tables that list the maximum concentration and detection frequency (above the target cleanup level) for each contaminant of concern in the groundwater, surface water, sediment, and soil. No air data were available. We selected the contaminants of concern by considering the following factors:

1. Concentrations of contaminants found on and off the site. We only eliminate contaminants from further consideration if the typical concentrations at unpolluted sites in the area (background concentrations) and the on-site concentrations are both below standard ATSDR, FDEP, and EPA comparison values. However, background concentration levels are useful in determining whether contaminants are site-related. This process provides the assessment of the public health risk presented by all contaminants detected at or near a site, regardless of whether they are site-related.

2. Field-data quality, laboratory-data quality, and sample design.

3. Community health concerns expressed by members of the community about possible adverse health effects from exposure to site contaminants.

4. Comparisons of the maximum concentrations of contaminants identified at the site to published FDEP target cleanup values for contaminated environmental media for which a completed exposure pathway, or potential exposure pathway, is found to exist at the site. Target cleanup values are specific to the type of environmental media (water and soil) that is contaminated and were developed for use at sites being remediated under Florida's Brownfields Redevelopment Act and other Florida programs. Although these target cleanup values are not used to predict health effects, site contaminants that fall below the target cleanup values are unlikely to be associated with illness, and consequently are not evaluated further, unless the community has expressed a specific concern about the contaminant.

5. A few chemicals did not have target cleanup levels. Florida DOH compared these chemicals with ATSDR's *reference dose media evaluation guides* (RMEGs). An RMEG is the estimated daily human exposure level (for a period of 1 year or more) to a contaminant that is likely to be without an appreciable risk of noncancerous illnesses. RMEGs are derived, using standard exposure assumptions, from the EPA-established reference dose (RfD).

We selected the following contaminants of concern at the site for further evaluation using the above criteria: ammonia, antimony, arsenic, lead, manganese, polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), selenium, trichloroethene, vanadium, and vinyl chloride. St. Joe Company, Stone Container Corporation, EPA, USFWS, and FDEP (formerly the Department of Environmental Regulation) collected and analyzed these samples. In the following sections, the contamination found to exist *on* the site is discussed, followed by a discussion of the contamination found to exist outside the site boundaries, i.e., *off* the site.

On-Site Contamination

For this public health assessment, we define *on-site* as the area of the former paper mill and wastewater treatment impoundments ("Study Area" Appendix A, Figure 1—we delineate the north and south sections on Figure 2).

On-Site Soil

Northern Section

In 2001, contractors for St. Joe Company collected eight soil samples from three locations in the former wastewater impoundment. They also collected a background soil sample north of the impoundment. Four samples were from 0.5 to 1.5 feet below the land surface and four were from 14 to 16 feet below the land surface. They analyzed for VOCs, SVOCs, PCBs, PAHs, target analyte list (TAL) metals, dioxins, and furans (PSI 2002). TAL metals are aluminum, antimony, arsenic, barium, beryllium, cadmium, calcium, copper, iron, lead, magnesium, manganese, mercury, nickel, potassium, selenium, silver, sodium, thallium, tin, vanadium, and zinc. FDEP's contractor split samples with St. Joe Company's contractor and analyzed for the same chemical suites (E&E 2001).

In 2003, contractors for the St. Joe Company collected 10 additional soil samples from four locations. One location was in the wastewater impoundment. The other locations were literally above and below the impoundment, reportedly because the sample cores containing impounded material consisted of coarse bark material without soil matrix (PSI 2004). PSI analyzed the samples for VOCs, SVOCs, and retene, TEQ dioxins, PCBs, and TAL metals. They also sampled the top 6 inches of the discharge canal for TEQ dioxins (PSI 2004).

For the purpose of this public health assessment, the surface soil quality in the northern portion of the site has *not* been adequately characterized. Just two of the seven samples that St. Joe Company's contractor took inside the approximately 11-acre former impoundment contained impounded material. The remaining samples were comprised of material lying above and below the materials that settled out of the wastewater. The possible chemicals in the waste impoundment, especially the finer-grained ash and sediment material that does not contain bark, should be adequately characterized before remedial measures may appropriately address it. Not only are two samples insufficient to characterize an 11-acre area that is 15-feet deep in wastewater sediments, but Florida DOH is concerned these data will be used to narrow additional testing for PAHs alone. PAHs are the only chemicals that were detected above the industrial SCTLs in these two impoundment soil samples. Naphthalene, 1,2-dichloroethene, 4-methylphenol, and chromium were also detected in the wastewater impoundment soil samples above groundwater leachability standards. The three additional soil samples (15 feet west, 15 feet northwest, and 15 feet southwest of the Soil-3 location) PSI proposed may not help characterize wastes settled from the wastewater stream *if they are collected at locations that are not within the impoundment sediments*.

Southern Section

In 1992, contractors for St. Joe Paper Company collected seven soil samples from the area near the former fiberglass shop (Groundwater Technology 1993). Groundwater Technology staff collected a soil interval sample with the highest organic vapor analysis reading from the installation of each 16-foot monitoring well. They analyzed for VOCs. In 2001, FDEP's contractors collected five soil samples near monitoring wells on the southern portion of the site (E&E 2001). Stone Container's contractors analyzed one stained soil sample that had a petroleum odor taken near monitoring well SCC-4 (Malcolm Pirnie 2002). Both contractors' labs analyzed these soil samples for VOCs, total petroleum hydrocarbons (TPHs), PAHs/SVOCs, and TAL metals (E&E 2001, Malcolm Pirnie 2002). Stone Container's contractors later collected nine more soil samples near monitoring well SCC-4 and near two lead-lined tanks. Their lab analyzed the soil near this monitoring well for VOCs, TPHs, and PAHs, and the soil near the lead-lined tank for leachable lead and total lead (Malcolm Pirnie 2002). Malcolm Pirnie did not test for any of the dioxin or furan congeners as a part of either sampling event. Congeners are substances that are share chemical structures, and so behave in toxicologically similar ways.

Stone Container's contractor Malcolm Pirnie took soil samples from 113 additional locations as a part of site remediation under the Brownfields redevelopment program. Maps of the designated areas and sample locations are included as Figures 6 and 7, respectively. According to the work plan, different areas were sampled for different chemicals, as indicated in Table 1. Table 2 gives the soil contamination levels (for the whole site) before the remediation of the southern part of the site. Table 2a lists the highest measured values for the areas where the contractors could not excavate the soil because it was below the water table.

Table 1. 2003 Sample Locations on the Southern Parcel

Location	Analyses	# Samples 0–1 feet	# Locations > SCTL	# Samples 2–3 feet	# Locations > SCTL
Wood, Chip and Ash Storage Area (WS)	Metals, pH, and TPH, VOCs and SVOCs for 5 samples near ash collection area, 1 former ash area TEQ dioxins	16	5 > arsenic SCTL 2 > vanadium SCTL	3	
Former Barge Basin (FB)	Metals, pH, VOCs, SVOCs, PCBs, PAHs, and Cl	16	1 > antimony SCTL 5 > arsenic SCTL 1 > lead SCTL 7 > PAHs SCTL 4 > PCB SCTL 7 > vanadium SCTL	4	1 > vanadium SCTL
Transformer Area (TA and PCB)	PCBs	7 3 combined	2 > PCB SCTL	4	
Lime Kiln (LK)	Metals, pH, FL-Pro (to measure concentrations of petroleum hydrocarbons in soil in the Alkane range of C8-C40, and PAHs.	3	1 > PAHs SCTL	1	
Bleach Plant (BP)	Metals, pH, and Cl, 1 for TEQ dioxins, 2 for TPHs (strong petroleum odor)	6 2 combined	2 > arsenic SCTL 1 > vanadium SCTL	1	1 > vanadium SCTL
Liquor, Caustic and Turpentine Tanks (CA)	Metals, pH, and PAH, 2 sampled for TPH (strong petroleum odor)	21 2 combined	3 > arsenic SCTL 4 > PAHs SCTL	5	1 > PAHs SCTL
Power and Recovery Boiler Areas (BA)	TPH and PAHs	11	5 > PAHs SCTL	2	
Paper Machine and Turbine Building (PM)	Metals, VOCs, SVOCs, and PAHs	10 2 combined	2 > arsenic SCTL 3 > PAHs SCTL	2	
Effluent Channel (EC)	Metals, VOCs, SVOCs, PCBs, FL-Pro and PAHs	5	1 > arsenic SCTL 1 > PCB SCTL	1	
Fuel Oil Tank Farm (FS)	TPHs and PAHs	6 2 combined	2 > PAHs SCTL		
Maintenance and Fiberglass Shop (MS)	Metals, VOCs, SVOCs, TPHs and PAHs	7	2 > arsenic SCTL 5 > PAHs SCTL 1 > vanadium SCTL	1	
Paint and Electrical Shop (PE)	Metals, VOCs, SVOCs, TPHs and PAHs	9	4 > PAHs SCTL 1 > vanadium SCTL	2	
Box Plant (BX)	Metals, VOCs, SVOCs, pH and TPHs	1			
General Site (GS)	Metals, VOCs, SVOCs, pH, PAHs, and Cl		1 > vanadium SCTL		

Table 2. Soil Concentrations for Contaminants of Concern

Contaminants of Concern	Screening Value (mg/kg)	Highest Soil Concentration (mg/kg)	Location of Highest Concentration (Figure 3)	Number of Soil Samples Above Screening Value
Northern Part				
Ammonia	880,000*	ND/NA	—	—
Antimony	370*	ND/NA	—	—
Arsenic	12*	ND/NA	—	—
Lead	1,400*	NDASL	—	0/14
Manganese	43,000*	NDASL	—	0/17
PAHs (TEQ)	7*	**172.9**	Soil 3A	9/14
PCBs	2.6*	NDASL	—	0/17
Selenium	11,000*	NDASL	—	0/17
Trichloroethene	9.3*	NDASL	—	0/17
Vanadium	10,000*	NDASL	—	0/17
Vinyl Chloride	0.8*	NDASL	—	0/17
Southern Part				
Ammonia	880,000*	ND/NA	—	—
Antimony	370*	70.4	FB-SB-SS4-1.0	1/123
Arsenic	12*	**69.3**	FB-SB-SS4-1.0	25 or 10/123
Lead	1,410*	**1,410**	FB-SB-SS4-1.0	1/136
Manganese	43,000*	ND	—	0/123
PAHs (TEQ)	7*	**96.95TEQ**	MS-SB-SS12-1.0	4/11
PCBs	2.7*	**58**	EX4-B1-4	7/38
Selenium	11,000*	ND/NA	—	—
Trichloroethene	9.3*	ND/NA	—	—
Vanadium	10,000*	**97,700**	FB-SB-SS4-1.0	19/136
Vinyl Chloride	0.8*	ND/NA	—	—

***** FDEP Soil Cleanup Target Level for Commercial or Industrial Sites
mg/kg = milligrams per kilogram
PAHs (TEQ) = polycyclic aromatic hydrocarbons (toxic equivalents)**.**
PCBs = polychlorinated biphenyls
ND/NA = No values were reported for this analyte because it was either not analyzed for, or not detected.
NDASL = Not detected above screening level.

Based on their findings, Malcolm Pirnie prepared a Remedial Action Plan for the southern part of the site in 2004. They prepared additional DEP-requested addenda in 2004 and 2005. When removing or excavating soil, the remediation contractors sampled away from the hole edges to determine whether they had reached the edge of the soil contamination (as determined by the industrial/commercial SCTLs).

Remediation activities on the southern part of the site included:

- removal of 950 cubic yards of PCB-impacted soil from 6 locations to approved landfills,
- excavation and relocation of 222 cubic yards of PAH-impacted soil from 10 locations and 18 cubic yards of metals-impacted soil from 2 locations to the center of the southern part of the site, where it was capped (Photo 7) and will be placed under a restrictive covenant on the property deed.

Remediation contractors could not excavate two areas of PAH-impacted soils, one area of PCB-impacted soil, and one area of metals-impacted soil on the southern part of the site because they were below the water table (Figure 9). They capped these areas with at least 3 feet of clean soil. We list the highest measured levels of the contaminants of concern in Table 2a that follows.

Table 2a. Soil Concentrations for Contaminants of Concern below water table

Contaminants of Concern	Screening Value (mg/kg)	Highest Soil Concentration (mg/kg)	Location of Highest Concentration (Figure 9)
Southern Part			
Arsenic	2.1*	**13.7**	MET-EX2
PAHs (TEQ)	0.1*	**33.3 TEQ**	PAH-EX12
PCBs	0.5*	**6.15**	PCB-EX-4
Vanadium	67*	**14.3**	MET-EX2

Stone Container Corporation is negotiating a restrictive covenant for the property deed that will describe actions they will take to prevent future exposures to contaminated soil.

Groundwater

Northern Section

In 2001, St. Joe Company's contractor, Professional Services Industries, Inc. (PSI), collected groundwater samples from four monitoring wells (15–20 feet deep) at three locations in the former wastewater impoundment and at a background location north of the impoundment. Their lab analyzed for turbidity, ammonia, VOCs, SVOCs, extractable organics, PCBs, PAHs, TAL metals, and dioxins and furans (PSI 2002). FDEP's contractors split the samples and had them analyzed by a separate laboratory (E&E 2001).

In 2003, PSI installed two additional monitoring wells (MWs), one in the northern part and one in the southern part of the impoundment. They sampled for TAL metals and SVOCs, including retene. They also resampled the original monitoring wells. They analyzed groundwater from MW SJ-1 for thallium, MW SJ-2 for thallium (*the presence of thallium was not confirmed*) and TEQ dioxins, and SJ-3 for SVOCs including retene.

Southern Section

In 1993, St. Joe Paper Company's contractors collected 19 groundwater samples from seven monitoring wells (12–50 feet deep) near the former fiberglass shop (Groundwater Technology 1993). Their lab analyzed for VOCs. In 2001, Stone Container's contractors, Malcolm Pirnie, Inc., installed and sampled five new shallow on-site monitoring wells (16 feet deep) in the former millworks area. FDEP's contractors split groundwater samples from these wells. Both labs analyzed these samples for VOCs, SVOCs, PCBs, PAHs, metals, alkalinity, ammonia, chloride, nitrate, total dissolved solids, sulfate, total organic carbon and conductance (Malcolm Pirnie 2001, E&E 2001). As part of the remedial activities, Malcolm Pirnie installed eight temporary monitoring wells near the former boiler. Their lab analyzed these samples for total dissolved solids and VOCs. They found that groundwater in the former wastewater treatment impoundment area had high chloride, high sulfide, high total dissolved solid levels, and low pH.

Malcolm Pirnie reported the results of five episodes of sampling (for the five original monitoring wells on the southern part of the site) in the Site Rehabilitation Completion Report (Malcolm Pirnie 2005). Other groundwater remedial activities included the installation of a monitoring well down gradient of the consolidation areas to verify the relocated impacted soils are not leaching PAHs or metals to groundwater. Future continued monitoring activities will include the sampling and analysis of piezometers and monitoring wells on a repeated basis, every 6 months.

We list the highest measured levels of the contaminants of concern in groundwater (from data available by October 2005) in Table 3 that follows:

Table 3. Groundwater Concentrations for Contaminants of Concern

Contaminants of Concern	Screening Value (µg/L)	Highest Groundwater Concentration (µg/L)	Location of Highest Concentration	Number of Groundwater Samples Above Screening Value
Northern Part				
Ammonia	2,800 *	**35,800**	SJC-5	7/8
Antimony	6 P	NDASL	—	0/8
Arsenic	10 P	NDASL	—	0/8
Lead	15 P	ND	—	0/8
Manganese	500 ∂/2,000 †	**1,900**	SJC-2	2/8
PAHs (TEQ)	0.2 P	0.06	SJC-3	0/8
PCBs	0.5 P	**0.56**	SJC-3	1/10
Selenium	50 P	**210**	SJC-4	2/8
Trichloroethene	3 P	NDASL	—	0/8
Vanadium	53 *	NDASL	—	0/8
Vinyl Chloride	1 P	NDASL	—	0/8
Southern Part				
Ammonia	2,800 *	**3,660**	SCC-05	1/30
Antimony	6 P	**7.77**	SCC-05	1/30
Arsenic	10 P	**17.7**	SCC-05	1/30
Lead	15 P	NDASL	—	0/30
Manganese	500 ∂/2,000 †	**2,240**	SCC-05	5/30
PAHs (TEQ)	0.2 P	NDASL	—	0/30
PCBs	0.5 P	**0.57**	SCC-3	1/30
Selenium	50 P	ND/NA	—	—
Trichloroethene	3 P	**15**	SCC-04	3/30
Vanadium	53 *	**552**	SCC-04	3/30
Vinyl Chloride	1 P	**29.9**	SCC-04	5/30

P Florida Primary Drinking Water Standard,
S Florida Secondary Drinking water standard,
***** Florida Groundwater Cleanup Target Level
∂ Reference Dose Media Evaluation Guide, children (ATSDR 2003c)
† Reference Dose Media Evaluation Guide, adults (ATSDR 2003c)

PAHs (TEQ) = polycyclic aromatic hydrocarbons (toxic equivalents) toxicity equivalents to benzo(a)pyrene
ND/NA = No values were reported for this analyte either because it was not analyzed for or detected.
PCBs = polychlorinated biphenyls
µg/L = micrograms per liter.
NDASL = Not detected above screening level.

On-site groundwater has <u>not</u> been adequately characterized (for both the northern and southern portions of the site). Contractors have not demonstrated plume boundaries by showing areas without contamination down gradient of wells showing contamination. Nonetheless, the limited groundwater analyses contractors *have* carried out measures chemicals above levels associated with health effects for oral and inhalation exposures on the northern and southern parts of the site. Further testing would be important for this site **if shallow groundwater were used for any purposes other than monitoring**.

Scale in Pipes

Florida DOH Bureau of Radiation Control performed a radiation survey to evaluate possible contamination from *technologically enhanced naturally occurring radioactive materials* (TENORAM) in scale buildup (Florida DOH 2000). They determined that TENORAM levels did not pose a threat to human health or the environment.

Off-Site Contamination

Off-site refers to the area outside of the former paper mill and wastewater treatment impoundments (Appendix A, Figure 2).

Off-Site Sediment Samples

Between 1989 and 1990, St. Joe Paper Company's contractors took six sediment samples in St. Joe Bay and St. Vincent's Sound (Stone Container 2001). Their lab analyzed only for the 2,3,7,8-tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD) and 2,3,7,8-tetrachlorodibenzofuran (2,3,7,8-TCDF) dioxin/furan congeners. They did not analyze for the other dioxin and furan congeners necessary to calculate the TEQs listed in Table 13, Appendix B. Without the concentrations of the other dioxin/furan congeners, it is not possible to compare the results to the current guidelines.

Between 1991 and 1993, USFWS took nine deep water sediment samples (in 20 feet of water) from St. Joe Bay. They analyzed three sediment samples for organic pesticides, PCBs, PAHs, arsenic, mercury, 2,3,7,8-TCDD, and 2,3,7,8-TCDF. They analyzed six sediment samples for all the dioxin and furan congeners by the Total Equivalency Quotient method (Table 13, Appendix B) (Brim et al 2000). Arsenic was the only chemical occurring above health-based screening values. Three deep-water (20 feet) sediment samples contained arsenic above the ATSDR comparison value (0.5 mg/kg): 16, 17, and 7 mg/kg dry weight.

In 2001, St. Joe Company's contractors (PSI) took five sediment samples in St. Joe Bay within 200 feet of the site's northwestern boundary. They analyzed for SVOCs, dioxins, and furans. PAHs in one sample were the only chemicals occurring above health-based screening values. The sample from the impoundment ditch mouth contained PAHs slightly higher than the ATSDR comparison value (0.1 mg/kg): 0.135 mg/kg dry weight.

In 2003, St. Joe Company's contractors took two sediment samples in St. Joe Bay; they took one from 0.5 feet below land surface in the former bay discharge canal; they took the other in the discharge canal between the outflow and the bay. These were the only samples PSI (2004) analyzed for TEQ dioxins.

Of the 19 total St. Joe Bay sediment samples analyzed for dioxins and furans, 13 included all congeners. TEQ values from those 13 samples were below ATSDR's direct ingestion screening level (50 parts per trillion) for children.

For this public health assessment, sediment quality in St. Joe Bay has *not* been adequately characterized. Deep sediments in the shipping channel near the southern part of the site have not been tested. Additional sediment testing is also needed throughout the bay. Analyses should include all 17 dioxin/furan TEQ congeners.

Off-site Surface Water Samples

In the early 1990s, a St. Joe Paper Company contactor took two surface water samples from the Gulf County Canal and analyzed for the 2,3,7,8-TCDD and 2,3,7,8-TCDF dioxin and furan congeners (Stone Container 2001). Although the measured values were below detection levels, current screening values assume a measure of all the dioxin and furan congeners. They analyzed these samples for two of the 17 congeners; therefore, the concentration of all of the dioxin and furan congeners is unknown.

No other surface water samples were taken. For this public health assessment, surface water quality has <u>not</u> been adequately characterized.

Off-Site Wastewater Samples

Florida DOH considers mill wastewater "off-site" because, before 1974, it was discharged to the Gulf of Mexico via overflow from waste impoundments (Appendix A, Figure 4). After 1974, wastewater and sludge were disposed of at the Port St. Joe WWTP. Early analyses of waste were carried out to determine relative environmental impact and assess the efficacy of mill process controls; therefore, samples were only analyzed for the 2,3,7,8-TCDD and 2,3,7,8-TCDF dioxin and furan congeners.

- In June 1988, National Council for the Paper Industry for Air and Stream Improvement, Inc.'s (NCASI) contractors composited five mill effluent samples (wastewater and suspended sludge) from eight aliquots per day (as cited in the "104 Mill Study," NCASI 2000).
- Between June 1989 and March 1990, St. Joe Paper Company's contractors sampled 5-day effluent composites from St. Joe Forest Products, Arizona Chemical, and Port St. Joe WWTP effluent and influent. Each was sampled three times for 12 total samples (Stone Container 2001).
- In February 1993 and January 1994, St. Joe Paper Company's contractors sampled mill effluent, bleach pulp, effluent sludge, white linerboard, and Port St. Joe WWTP effluent (Stone Container 2001).

Although the measured 2,3,7,8-TCDD and 2,3,7,8-TCDF values for these liquid and solid samples were below human health-based screening values, these screening values are meant to be applied to toxicity equivalent totals calculated from the relative toxicities of all 17 dioxin and furan congeners (Appendix B, Table 13). These data are inadequate to evaluate public health concerns.

In 1996 and 1998, FDEP and the EPA analyzed surface water outfall from the Port St. Joe wastewater treatment plant effluent and only found one chemical of concern: 2,4,6-trichlorophenol, at 6.6 µg/l, slightly above its Florida surface water target cleanup level of 6.5 µg/l (EPA 2001).

Lime

The Florida Department of Agriculture and Consumer Services sampled a composite of the Port St. Joe Forest Products lime byproduct. The composite consisted of 30 cores collected from a 100-ton agricultural application lime stockpile (FDACS 2000). They analyzed for metals, however, no metals were found above their health-based screening values. They did not test for dioxin because effluent from the bleaching process that produces dioxins is not used in the lime process. In addition, firing the lime at high temperatures during reprocessing would likely destroy dioxins and other organics.

Biota

As with mill wastewater, early analyses of fish and shellfish only measured two dioxin and furan congeners: 2,3,7,8-TCDD and 2,3,7,8-TCDF. In June 1989 and 1990, St. Joe Paper Company's contractor collected 29 bottom-feeding fish, 23 top-feeding fish (analyzed as fillet and whole body composites), and six shellfish (southern quahog clams and oysters, analyzed as tissue samples) from five St. Joe Bay locations (Stone Container 2001). The measured 2,3,7,8-TCDD and 2,3,7,8-TCDF values in fish were acceptable for human consumption, using the standards of the day. The current standard, however, requires analysis for all 17 dioxin/furan TEQ congeners.

During the summers of 1990, 1991, and 1992, USFWS collected 10 spotted sea trout, and unspecified numbers of crabs and shrimp. They analyzed a composited tissue sample of skinless sea trout fillets and whole body composited tissue samples for crabs and shrimp for the 17 dioxin/furan TEQ congeners (Brim et al. 2000). Because community members indicated an interest in knowing what assessments had been done on St. Joe Bay fish and shellfish, Florida DOH included the following rough TEQ calculations for the USFWS's measured values. However, current EPA dioxin TEQ calculations call for adding in an equivalent for half the detection limit for all congeners if **any** congener is detected. Florida DOH was unable to add these in, as the detection limits were not reported.

Florida DOH multiplied the available data by toxicity coefficient and then added, to determine the following values:

USFWS	TEQ
➢ Sea trout, fillet composite	0.02 parts per trillion (ppt)
➢ Blue crab, whole-body composite	0.2–0.7 ppt
➢ Brown shrimp, whole-body composite	0.01 ppt

These rough TEQ calculations show sea trout, blue crab, and brown shrimp tissue dioxins levels may have been lower than levels different agencies have set as acceptable for human consumption:

7 ppt (EPA)
15 ppt (World Health Organization)
25 ppt (U.S. Food and Drug Administration) game fish
50 ppt (U.S. Food and Drug Administration) action level

From 1996 to 1998, EPA collected five bluefish, hardhead catfish, speckled seatrout, and gafftopsail catfish tissue samples from six locations in St. Joe Bay. As a part of this study, the City of Port St. Joe's contractor, ALA Environmental, also collected seven Spanish mackerel, largemouth bass, hardhead catfish, speckled sea trout, and redear sunfish tissue samples from four locations in St. Joe Bay (Stone Container 2001). The City of Port St. Joe's contractor calculated TEQ values for all 12 submitted tissue samples. These ranged from 0.005 ppt for the bluefish to 0.5 ppt for the hardhead catfish (Stone Container 2001). All, again, were much lower than levels different agencies have set as acceptable for human consumption.

For the purpose of this public health assessment, bioconcentration of contaminants in biota in St. Joe Bay has *not* been adequately characterized. Many of the tested species were mobile and short-lived. Dioxins and PCBs can accumulate to higher levels in longer living, sessile invertebrates living in deeper sediments or in long-lived, slow-growing, top predator fish (Brim et al. 2000) because these chemicals accumulate over time, and bioconcentrate up the food chain.

PAHs may accumulate to higher levels in clams than in fish, because of clams' inabilities to metabolize PAHs (whereas fish are able to break these down). Accumulation and transfer of PAHs to higher food-chain levels is primarily a function of the ability of the organism to metabolize PAHs by the mixed function oxygenase enzymes. Organisms with well-developed mixed function oxygenase (MFO) systems, such as fish, rapidly metabolize PAHs; those with poor MFO systems, such as bivalve mollusks, accumulate PAHs (Albers 1995, Elder and Dresler 1988). As most aquatic organisms at higher food chain levels have well-developed MFO systems, increases in accumulation through food-chain levels may not occur (Marwood 2001). However, the southern quahog clams may live more than 32 years, and therefore might accumulate relatively high PAH levels.

Florida DOH asked the Florida Fish and Wildlife Conservation Commission (FFWCC) about the species of fish that inhabit these waters. FWCC recommended collecting sheepshead, redfish, spotted sea trout, hardhead catfish, flounder, and southern quahog clams from the eastern part of St. Joe Bay near the site, Gulf County Canal, and the Port St. Joe Marina. These species are eaten by locals and visitors, or are harvested commercially. They should be analyzed for dioxin/furan toxicity equivalents (TEQs) and polychlorinated biphenyls (PCBs). In addition, flounder and southern quahog clams should be analyzed for polycyclic aromatic hydrocarbons (PAHs).

Quality Assurance and Quality Control

We use existing environmental data in this public health assessment. We assume these data are valid. Government consultants or consultants licensed and regulated by government agencies collected and analyzed the environmental samples. We also assume the personnel who collected and analyzed these samples followed adequate quality-assurance and quality control measures with regard to chain-of-custody, laboratory procedures, and data reporting. The completeness and reliability of the referenced environmental data determine the validity of the analyses and conclusions drawn for this public health assessment.

Physical Hazards

Bark and other organic materials are buried on both the northern and southern portions of the site. To avoid future structural problems in buildings, Florida DOH recommends foundations should be constructed only after engineering investigations of the subsurface materials have been carried out.

Because Stone Container's contractors removed all of the buildings from the southern portion of the site, covered the contaminated soil, and secured the site against trespass, physical hazards for trespassers are currently unlikely there.

The northern section of the site is not secure against trespassers, especially those that might enter from the water. While dense vegetation surrounds most of the known contamination there, St. Joe Company should post signs warning anglers against trespass and the potential for soil contamination exposure on the site's interior.

Pathways Analyses

Chemical contaminants in the environment can be harmful to public health, but only if people are exposed to them. It is essential to determine or estimate the frequency of contact people could have with hazardous substances in their environment in order to assess the public health significance of the contaminants.

To determine if people can be exposed to contaminants at or from a site, the human exposure pathways are examined. An exposure pathway has five parts:

1) A contaminant source,
2) An environmental medium like groundwater or soil that can hold or move the contamination,
3) A point at which people come into contact with a contaminated medium like a drinking water well or garden soil,
4) An exposure route like inhalation, ingestion, or skin contact.
5) A population which might come into contact with the contaminants,

An exposure pathway is *eliminated* from consideration if one or more of these five parts is not present and never will be present. Exposure pathways that are not eliminated in this way are either completed pathways or potential pathways. *Completed exposure pathways* have all five parts present, and exposure to a contaminant has occurred in the past, is occurring in the present, or will occur in the future. *Potential exposure pathways* have one or more of the five parts missing, but it is possible that a completed pathway does exits; potential pathways include exposure to a contaminant in the past, present, or future.

Completed Exposure Pathways

Former mill workers may have accidentally ingested, inhaled, or had skin contact with contaminants in on-site soil, sediments, or process chemicals (Appendix B, Table 6). Former workers and nearby residents may have inhaled mill emissions or contaminated dust. Worker's exposures may have come from contaminated on-site soil or sediments, or dust from contaminated soil and sediments. We are not able to address workers' potential health risks because we do not have information on either the types or the amounts of chemicals workers may have been exposed to, and worker exposures are outside the scope of this public health assessment. Workers' health and safety are the responsibility of the federal Occupational Safety and Health Administration and the National Institute for Occupational Safety and Health.

People may have eaten fish and shellfish from St. Joe Bay that contained contaminants from the mill. St. Joe Bay fish and shellfish may have accumulated contaminants from the mill via the food chain, surface water, or sediments. Data with which to evaluate such exposures is inadequate.

Potential Exposure Pathways

Because the property is close to the Gulf of Mexico, it is unlikely that anyone will install drinking water wells into the shallow, contaminated groundwater due to the potential for saltwater intrusion (Appendix B, Table 7). In other Florida coastal areas, shallow brackish groundwater has been used for aquaculture, for irrigation of salt-tolerant plants, and in light industrial business for nonpotable purposes (toilet flushing, hand washing, etc.). Florida DOH recommends deed restrictions prohibiting the use of shallow groundwater for drinking or other uses. We base this recommendation on an evaluation of people's potential exposures to contaminants in shallow groundwater via aeration, ingestion, and skin contact.

If deed restrictions and engineering controls required for Brownfields redevelopment were not in place, future changes in site use might allow:

- workers or residents on the northern part of the site to be exposed to ammonia and PAHs aerating from shallow groundwater,
- workers or residents on the northern part of the site to be exposed to contaminated surface soil or sediments from the former wastewater impoundments via soil ingestion, dust and vapor inhalation, or skin contact,
- workers or residents on the southern part of the site to be exposed to ammonia, trichloroethene, and vinyl chloride aerating from shallow groundwater, and
- workers or residents on the southern part of the site to be exposed to contaminated soil or sediments on their hands, on homegrown vegetables, via soil ingestion, dust and vapor inhalation, or other skin contact.

Eliminated Exposure Pathways

Stone Containers contractor's have excavated and capped contaminated soil on the southern section of the site. They drafted restrictive covenants to prohibit shallow groundwater use and limit soil contact on the southern portion of the site. While no exposure pathways have been ruled out for the northern part of the site, similar Brownfields remediation measures are available for use on this part of the site. Bay sediment, surface water, and biota data are inadequate for evaluation of public health effects.

Public Health Implications

The following sections discuss the chemicals by media, but we do not discuss chemicals measured at levels below their screening values. For example, if a chemical was measured in groundwater above its screening value and in soil below its screening value, only the possible health effects of exposure to groundwater are discussed.

Toxicological Evaluation

This subsection discusses exposure levels and possible health effects that might occur (or might have occurred) in people exposed to the highest measured levels of contaminants of concern at the site (if it became residential, and if those areas were not cleaned up or covered over [capped]). Also discussed are general ideas, such as risk of illness, dose response and thresholds, and uncertainty in public health assessments.

To evaluate exposure, we estimated daily doses for children and for adults for each contaminant of concern identified at the site. Kamrin (1988) explains the concept of "dose" in the following manner:

> . . . all chemicals, no matter what their characteristics, are toxic in large enough quantities. Thus, the amount of a chemical a person is exposed to is crucial in deciding the extent of toxicity that will occur. In attempting to place an exact number on the amount of a particular compound that is harmful, scientists recognize they must consider the size of an organism. It is unlikely, for example, that the same amount of a particular chemical that will cause toxic effects in a 1-pound rat will also cause toxicity in a 1-ton elephant.
>
> Thus instead of using the amount that is administered to or to which an organism is exposed, it is more realistic to use the amount per weight of the organism. Thus 1 ounce administered to a 1-pound rat is equivalent to 125 pounds (2,000 ounces) administered to a 2,000-pound (1-ton) elephant. In each case, the amount per weight is the same; i.e., 1 ounce for each pound of animal.
>
> The amount per weight is the *dose*. Dose is used in toxicology to compare the toxicity of different chemicals in different animals.

We express doses in units of milligrams (mg) of contaminant per kilogram (kg) of body weight (mg/kg/day) in this public health assessment.

To calculate the daily dose of each contaminant, standard assumptions are used about body weight, ingestion and inhalation rates, duration of exposure (time length), and other factors needed for dose calculation (ATSDR 1992a, EPA 1997a). In calculating the dose, we assume that people are exposed daily to the maximum concentration measured at the site for each contaminant in each environmental medium. ATSDR's toxicological profiles on contaminants separate exposures into three routes: inhalation, ingestion, and dermal (skin). For each of these exposure routes, ATSDR also groups health effects by duration (length of time) of exposure. *Acute exposures* are those that last less than 14 days; *intermediate exposures* are those that last 15–364 days; and *chronic exposures* are those that occur for 365 days or more (or an equivalent time length for animal exposures). ATSDR's toxicological profiles also provide information on the environmental transport and regulatory status of contaminants.

To estimate exposure from incidental ingestion of contaminated soil and groundwater, we made the following assumptions:

1) Children 1 to 4 years of age ingest an average of 200 mg of soil per day and 1 liter of water, and weigh an average of 15 kg;
2) Adults ingest an average of 100 mg of soil per day and 2 liters of water, and weigh an average of 70 kg;
3) Workers ingest an average of 50 mg of soil per day in and out of doors at work, 1 liter of water at work, weigh an average of 70 kg, and work 250 days a year. (**That is, a future worker's reasonable maximum exposure will be about half the dose we estimated for an adult resident**).

Florida DOH assumed daily exposure for 30 years for adults, daily exposure for 3 years for children, and exposure five times a week, 50 weeks a year, for 25 years for workers. Because we assume children ingest more soil and weigh less than adults do, the doses we calculate for children are greater than the doses we calculate for adults. Workers have the lowest calculated exposure levels.

Florida DOH used the highest values measured on the northern and southern parts of the site to calculate theoretical residential and commercial/industrial doses for all chemicals measured above their screening values. We list these doses in Tables 8a, 8b, 9, 10 and 11. We compare these calculated doses with the lowest doses known to have health effects in Table 14. Our assessment of the highest levels of chemicals measured on the site shows that the removal operations, deed restrictions, and the engineering controls FDEP requires for Brownfields redevelopment should prevent future chemical exposures. **DOH evaluated the theoretical long-term daily exposure outcomes for residents and workers to demonstrate the need for fulfilling these Brownfields requirement**s.

Because we evaluated 12 chemicals, in two media, on two parts of the site, for three receptor populations (child, adult, and worker), having two to three exposure routes (ingestion, inhalation, and sometimes dermal), **we limit the following toxicological discussions either to receptor doses that might have non-cancer health effects or receptor doses that might increase theoretical cancer risks**. If we do not discuss increases in cancer risk for a particular chemical, then it is not a known carcinogen. For this evaluation, child or adult receptors indicate a residential land use scenario, and a worker receptor indicates a commercial or industrial land use scenario. We direct readers with interests in the relationships between calculated doses for each chemical of concern (and receptor, and exposure pathway) and the chemical's lowest-known dose having adverse health effects to Table 14.

Northern Parcel Exposures

While sample data are inadequate to characterize either *the nature or the extent* of contamination on the northern part of the site, these limited data do indicate the presence of **PAHs in soil, and ammonia, manganese, PAHs, PCBs and selenium in groundwater. Some receptors (exposed persons) might experience non-cancer health effects or increased theoretical cancer risks with daily exposures to some of these chemicals**.

Ammonia

Children, adults, and workers inhaling ammonia released from shallow **groundwater** (in an enclosed space) could theoretically experience health effects in less than 14 days. These health effects could include eye, nose, and throat irritation. Health effects could include decreased lung function (measured by amount of air breathed in 1 minute and amount of air inhaled and exhaled with each breath). In addition, short-duration tests with pigs (at the same concentrations as those estimated to escape from the highest measured groundwater ammonia levels) found decreased weight gain, decreased food intake, decreased heart and lung immune response, and frequent coughing (ATSDR 2003a).

Manganese

Children and adults drinking manganese-contaminated shallow **groundwater** could theoretically experience mild neurological symptoms, including mental and emotional disturbances and slow or clumsy body movements with long-term exposure (ATSDR 2000c).

Polycyclic Aromatic Hydrocarbons (PAHs)

Children or adults inhaling PAHs released from shallow **groundwater** at the highest measured levels (in an enclosed space) could theoretically experience health effects in 6 months to 6 years. The dose we calculated is a little less (1.4 times less) than the dose associated with reduced lung function, abnormal chest x-ray, cough, bloody vomit, and throat/chest irritation in workers (ATSDR 1995). Daily, long-term inhalation of the highest measured PAH (TEQ) levels that aerated from groundwater (in an enclosed space) could theoretically cause an increased risk of 1 additional cancer case in 1,000 (a medium increased risk) for children and adults, and 1 in 10,000 (a low increased risk) for workers.

While the calculated **soil** doses are not high enough to predict noncancer health effects in exposed individuals, they might increase cancer risks. Daily, long-term ingestion and dust inhalation of PAH-contaminated soil could theoretically increase cancer risks by about 2 cases in 1,000 (a moderate increased risk) for children and adults and about 4 cases in 10,000 (a low increased risk) for workers.

Occupational studies of workers exposed to high levels of PAHs have shown skin, bladder, lung, and gastrointestinal cancers to be the most significant endpoints of PAH toxicity (ATSDR 1995).

Polychlorinated Biphenyls (PCBs)

Children drinking PCB-contaminated shallow **groundwater** could theoretically experience noncancer health effects in under a year. The child's dose exceeds the intermediate and chronic oral minimum risk level for adverse nail effects (separated and elevated nails) and immune system effects (reduced antibody responses) seen in studies of rhesus monkeys. Daily, long-term ingestion of the highest measured PCB levels in groundwater might only increase cancer risks slightly by 2 additional theoretical cancer cases in 100,000 for children, 1 in 100,000 for adults, and 2 in 1 million for workers. Studies have linked chronic oral PCB exposures with liver and thyroid cancers in rats (ATSDR 200b).

Selenium

Children drinking selenium-contaminated shallow **groundwater** could theoretically experience noncancer health effects in under a year. The child's dose is 5 times higher than the dose that damaged liver cells in an intermediate-length rat study. The child's dose exceeds the selenium dose that caused loss of nails and brittle hair in people ingesting organic selenium for longer than a year. The adult groundwater ingestion dose is 6 times greater higher than the "lowest-observed-adverse-effects level" (LOAEL) dose linked with a 49% reduction in testosterone in an intermediate rabbit ingestion study (equivalent to less than a year of exposure in humans). The worker's groundwater ingestion dose is 1.5 times lower than the dose linked with testosterone reduction in rabbits. Still, selenium is an essential nutrient for people and it is found in foods at very low levels. Selenium has not been associated with cancer in humans. Only selenium sulfide has been linked with liver and lung cancer in oral animal studies: this compound was tested on animals because it is used in dandruff shampoos; however, it is not known to be absorbed through the skin.

Southern Parcel Exposures

Ammonia

Children and adults inhaling ammonia released from shallow **groundwater** could theoretically experience health effects in less than 14 days. These health effects could include eye, nose, and throat irritation. Adverse health effects could include decreased lung function, measured by a decrease in: the amount of air a person can breathe in 1 minute, and the amount of air a person inhales and exhales with each breath. In addition, short-duration tests with pigs (at the same concentrations as those estimated to escape from the highest measured groundwater ammonia levels) found decreased weight gain, decreased food intake, decreased heart and lung immune response, and frequent coughing (ATSDR 2003a). If workers were to use this water extensively in an enclosed area, using plumbing fixtures that allowed aeration, they might also experience adverse health effects.

Antimony

Children ingesting antimony-contaminated **soil** might experience adverse health effects (ATSDR 1992b). While the child soil ingestion dose is 78 times lower than the LOAEL for three intermediate-length rat studies showing cardiologic and reproductive (decreased maternal weight gain) health effects, this LOAEL dose does not include safety factors to compensate for between--species and human variabilities. In addition to reproductive and heart effects, animal studies link low levels of ingested antimony with adverse blood system and liver affects. The dust inhalation doses for all three receptors are thousands of times lower than the dose causing respiratory and lymph health effects in a chronic rat study. Therefore, antimony in dust is unlikely to cause adverse health effects.

Arsenic

Children ingesting arsenic-contaminated **soil** or drinking arsenic-contaminated **groundwater** might experience gastrointestinal irritation, diarrhea, nausea, skin pigmentation changes, and hyperkeratosis (raised dark spots on the skin that are possibly precancerous (ATSDR 2000). Other receptor and pathway doses did not indicate risks for non-cancer illnesses.

Florida DOH calculated theoretical increased cancer risks for ingesting arsenic in **soil** or **groundwater**, or inhaling dust:

- for the incidental **soil** ingestion exposure route—an increase of 6 cases in 100,000 for children and adults, and an increase of 2 cases in 100,000 for workers,
- for the dust inhalation route of exposure—an increase of less than 1 theoretical case in 1,000,000 for children and workers, and an increase of 2 cases in 1,000,000 for adults,
- for the **groundwater** ingestion exposure route—an increase of 8 cases in 100,000 for children, 3 in 10,000 for adults, and 9 cases in 100,000 for workers.

From lowest to highest dose cancer effect levels, people's long-term arsenic exposures have been linked to lung, basal and squamous cell skin cancers, liver cancer (haemangioendothelioma), urinary tract cancers (bladder, kidney, prostate, ureter, and all urethral cancers), and intraepidermal cancers (ATSDR 2000a and Selene Chou, personal communications).

Lead

For lead, estimated blood levels more accurately predict health effects than traditional dose estimates. Florida DOH used a simple model to estimate blood lead levels and likely health effects for exposures to the highest measured levels of lead in soil (ATSDR 1999). **This model takes into account people's exposure to lead from sources other than the site.** ATSDR based the model on conservative assumptions and the model may not represent actual exposure. Tables 10–11 (Appendix B) list the assumptions used as a basis for the model. We assumed residential outdoor exposures to lead-contaminated soil, 8 hours per day, daily. The following table lists the values estimated for exposure to the highest measured lead level in on-site soil.

Table 4: Modeled Blood Lead Levels for Daily Ingestion of Soil with Highest Lead Levels *

Media	**Children Blood (µg/dL)**	**Adults Blood (µg/dL)**
Southern parcel surface soil	**3.72–10.71**	**3.06–10.35**

µg/dL - Micrograms per Deciliter

Lead interferes with the body's ability to make new red blood cells (ATSDR 1999). With too few red blood cells (anemia), the body's uptake of energy from food and oxygen from air are less efficient. The processes leading to anemia occur at all levels of lead exposure; there is no threshold for this effect. There also may be no threshold for adverse neurological effects of lead in children: intelligence, balance, hearing, and attention deficit hyperactivity disorder (ATSDR 2000d). We list health effects observed at measured blood-lead levels in the following table.

Table 5: Possible Health Effects at Blood Lead Levels Between 1 and 200 (µg/dL).

Children's Blood (µg/dL)	**Adult's Blood (µg/dL)**	Health Effects
No threshold	**3–56 µg/dL**	Decreased aminolevulinic acid dehydratase (ALAD) enzyme activity. ALAD is necessary for hemoglobin synthesis. A large decrease in ALAD activity can lead to anemia.
1–17 µg/dL		Alterations in visual evoked potentials (the electrical response of the brain's primary visual cortex to a visual stimulus).
6.5 µg/dL		(Average value at 24 months of age.) Lower cognitive function test scores in children 5–10 years of age.
6–200 µg/dL		Decreased neurobehavioral function; slightly decreased performance on IQ tests and other measures of neuro-psychological function.
≥ 9 µg/dL		Impaired motor developmental in 6-year-olds.
	5.5 µg/dL (avg.)	Decreased performance on neurobehavioral tests.
7–80 µg/dL	**80 µg/dL**	Decreased Pyrimidine 5' nucleotidase "Pyrimidines, along with purines, are the building blocks of DNA and RNA, the basic elements of cell programming machinery. In addition, they fulfill a variety of functions in the metabolism of the cell of which the most important are regulation or cell metabolism and function, energy conservation and transport, formation of coenzymes and of active intermediates of phospholipids and carbohydrate metabolism. Therefore in case a deficit exists, any system can be affected" (Van Gennip 1999).
10–15 µg/dL		Impaired mental and physical development.

Children's Blood (µg/dL)	Adult's Blood (µg/dL)	Health Effects
	≥10 µg/dL	Increased incidence of miscarriages and stillbirths.
	7–38 µg/dL	Increased blood pressure most prominent in middle-aged white men.

Based on inadequate evidence in humans and sufficient animal evidence, the EPA has classified inorganic lead as a probable human carcinogen. Because a dose-response relationship has not been established, a cancer slope is not available and we cannot predict increased cancer risks based on estimated doses. Worker epidemiological studies have suggested occupational lead exposure-cancer links (ATSDR 2005). Worker epidemiological studies have shown different probable links, including increases in all cancers, increases in gastrointestinal cancers (stomach, bladder, kidney, and rectal), increases in nerve cancers (glioma and brain), and increases in respiratory and lung cancers. High level, long-term exposures to lead acetate and lead phosphate are associated with kidney cancer in rats and mice.

<u>Manganese</u>

Children, adults and workers drinking manganese-contaminated shallow **groundwater** could experience mild neurological symptoms, including mental and emotional disturbances and slow/clumsy body movements (ATSDR 2000c).

<u>Polychlorinated Biphenyls (PCBs)</u>

Children ingesting PCB-contaminated **soil** or PCB-contaminated **groundwater** might be at risk for non-cancer health effects. Monkeys fed PCBs at low doses for long periods developed elevated and separated toenails and immune system effects (rhesus monkeys showed reduced IgM and IgG antibody responses to sheep red blood cells). Malcolm Pirnie has submitted restrictive-covenant documents to DEP to restrict access to shallow groundwater and PCB-contaminated soil that is below the water table (DEP will have to approve the covenants before they are accepted).

Daily, long-term ingestion exposures might theoretically increase cancer risks for all exposed receptor populations:

- for the incidental **soil** ingestion exposure route—an increase of 5 cases in 100,000 for children and adults, and an increase of 2 cases in 1,000,000 for workers,
- for the **groundwater** ingestion exposure route—an increase of 2 cases in 100,000 for children, 1 in 100,000 for adults, and 2 cases in 1,000,000 for workers.

Children and adults inhaling PCBs aerated or volatilized from shallow **groundwater** might be at risk for non-cancer health effects. Rats exposed at lower doses for periods equivalent to an intermediate human exposure (15 days to 1 year) had increased thyroid hormone levels and increases in the number of cells lining the urinary bladder (ATSDR, 2000b). In spite of this, studies have not shown PCBs to be carcinogenic from the inhalation route.

<u>Polycyclic Aromatic Hydrocarbons (PAHs)</u>

While persons exposed to PAHs in **soil** are unlikely to experience noncancer health effects (ATSDR 1995), long-term exposure might increase their cancer risks:

- for the incidental **soil** ingestion exposure route—an increase of 2 cases in 10,000 for children and adults, and an increase of 1 case in 10,000 for workers,
- for the dust inhalation route of exposure—an increase of 1 theoretical case in 100,000 for children, an increase of 2 cases in 1,000,000 for adults, and an increase of 3 cases in 1,000,000 for workers.

Worker exposures to high levels of PAHs show skin, bladder, lung and gastrointestinal cancers are the most significant endpoints of PAH toxicity. PAH inhalation doses were not linked with cancer in animal studies (ATSDR 1995).

<u>Vanadium</u>

Children, adults and workers accidentally ingesting vanadium-contaminated **soil** or drinking vanadium-contaminated shallow **groundwater** might experience non-cancer health effects in less than a year. For most of the receptors, the soil doses were slightly higher and the groundwater doses were slightly lower, than the doses showing kidney and respiratory health effects in an intermediate rat ingestion study (rats showed renal hemorrhagic foci and perivascular mononuclear cell infiltration). Only the worker dose for groundwater ingestion was below the minimum risk levels calculated from this study. While dust inhalation doses might not be high enough to cause non-cancer health effects, they would likely add to these incidental ingestion rates. The inhalation dose for the highest level of vanadium measured on the site is 7 times less than a dose causing bronchial irritation (in an acute human exposure). All other animal inhalation studies only showed health effects at much higher levels.

<u>Vinyl Chloride</u>

Children drinking vinyl chloride-contaminated **groundwater** might experience non-cancer liver effects, based on effects seen in a long-term rat study. While other receptor doses were below non-cancer health effect minimum risk levels, long-term groundwater exposures could theoretically increase cancer risks for all exposed receptor populations:

- for the ingestion exposure route—an increase of 3 cases in 1,000 for children, 6 cases in 1,000 for adults, and an increase of 2 case in 1,000 for workers;
- for the inhalation (of aerated or volatilized chemicals in an enclosed space) exposure route—an increase of 4 theoretical cases in 100,000 for children and adults, and an increase of 3 cases in 1,000,000 for workers,
- for the dermal exposure route—an increase of 4 cases in 100,000 for children and adults.

Vinyl chloride exposures have been linked to liver, brain, blood, and lung cancers in epidemiological studies of workers (ATSDR 1997b).

Current Activities

By May 2005, Stone Container's remediation contractors dug up all the contaminated soil above the water table on the southern part of the site. The contractors disposed of soil that contained PCBs in off-site landfills; and buried/capped the other soils that contained chemicals above their industrial SCTLs on the site. The contractors did not treat the groundwater. Florida DOH's assessment of the highest chemical levels remaining on the site shows:

- Workers or residents should avoid contacting the buried contaminated soil,

- Workers or residents should not use the contaminated shallow groundwater for potable or other purposes.

DEP is currently working with Stone Container Corporation on the draft for the restrictive covenant for the southern part of the site. Florida Statutes allow for different types of caps. A soil cap is generally placed when contaminants are not likely to leach to groundwater (usually demonstrated with leachability tests) and the soil cap’s purpose is to prevent exposure to the contaminants. A soil cap has to be a minimum of 2 feet thick. An impervious cap (such as asphalt or concrete) is generally used where soils may have a tendency to leach. Since parking lots and building foundations serve as a type of cap, they may be used even when the soils do not have the potential to leach, just because they are already planned on being used.

Either type of cap requires a restrictive covenant to be executed and recorded before a site can be closed. The covenant will spell out the site-specific conditions as applicable. Generally, excavation is not prohibited, but the covenant will require that any excavations in the contaminated areas (also spelled out and mapped in the covenant) be dealt with in accordance with all applicable federal, state, and local laws. The covenant also determines who maintains the cap and any special requirements. Restrictive covenants are recorded in the official records of the county and are tracked by DEP’s Institutional Controls Registry database.

The restrictive covenant DEP is working on for the former St. Joe mill site will prohibit the use of groundwater for any purpose other than monitoring. The areas where contaminated soil was capped will be included in the covenant along with a legal description of those areas (as surveyed by a licensed surveyor). Any future excavations in those areas, for things such as construction or utilities, will require proper disposal of any contaminated soils disturbed or provide for a new cap in accordance with Florida Statutes.

Data Needs

Existing data are inadequate to determine the public health risk from eating dioxin-contaminated fish and shellfish from St. Joe Bay. Of the fish and shellfish tested, few were analyzed for all 17 dioxin/furan TEQ congeners. The fish and shellfish that were analyzed for all 17 dioxin/furan TEQ congeners were too few to be statistically representative of the fish or shellfish population.

Existing data are inadequate to determine the public health risk from eating PAH-contaminated shellfish from St. Joe Bay. PAH levels could be higher in clams than in fish because their systems are less able to metabolize such chemicals. Bivalve mollusks accumulate PAHs from wastes more rapidly and retain them longer than other aquatic animals due to a lack of, or a low-PAH metabolizing ability. Accumulation and transfer of PAHs to higher food-chain levels is primarily a function of the ability of the organism to metabolize PAHs by the mixed function oxygenase enzymes. Organisms with well-developed mixed function oxygenase (MFO) systems, such as fish, rapidly metabolize PAHs; those with poor MFO systems, such as bivalve mollusks, accumulate PAHs (Albers 1995, Elder and Dresler 1988). As most aquatic organisms at higher food-chain levels have well developed MFO systems, increases in accumulation through food-chain levels do not occur (Marwood 2001). In fish and crustaceans, most PAHs accumulate in the liver, and the metabolites are stored in muscle and fat (Neff 1985).

Florida DOH recommends that sheepshead, redfish, spotted sea trout, hardhead catfish, flounder, and southern quahog clams should be collected from the eastern part of St. Joe Bay near the site, Gulf County Canal, and the Port St. Joe Marina. These species are eaten by locals and visitors, or are harvested commercially. They should be analyzed for dioxin/furan toxicity equivalents (TEQs) and polychlorinated biphenyls (PCBs). In addition, the flounder and southern quahog clams should be analyzed for polycyclic aromatic hydrocarbons (PAHs).

Other/Unknown Contaminants

This site is in an industrial part of Port St. Joe. In the past, workers and nearby residents may have been exposed to chemicals in the air from St. Joe Paper Company, St. Joe Forest Products, Arizona Chemical Company, and the Apalachicola Northern Railroad yard. Because there are no air quality data, Florida DOH is unable to estimate exposure levels or evaluate possible health effects from such exposures.

Risk of Illness, Dose Response/Threshold, and Uncertainty

In Appendix D, we discuss limitations on estimating the risk of illness, the theory of dose response, and the concept of thresholds. Also in Appendix D, we discuss the sources of uncertainty inherent in public health assessments.

Child Health Considerations

ATSDR and Florida DOH recognize that in communities faced with the contamination of their environment, the unique vulnerabilities of infants and children demand special attention. Children are at a greater risk than adults are for certain kinds of exposure to hazardous substances emitted from waste sites. Because they play outdoors and because they could carry food into contaminated areas, children are more likely to be exposed to contaminants in the environment. Children are shorter than adults are, and therefore they breathe dust, soil, and heavy vapors closer to the ground. They are also smaller, resulting in higher doses of chemical exposures per body weight. If toxic exposures occur during critical growth stages, the developing body systems of children can sustain permanent damage. Probably most important, however, is that children depend on adults for risk identification and risk management, housing, and access to medical care. Thus, adults should be aware of public health risks in their community, so they can guide their children accordingly.

In recognition of these concerns, ATSDR has developed screening values for the chemicals calculated specifically for children's exposures (ATSDR 1998). While there are no indications that children are more susceptible to the effects of ammonia, antimony, arsenic, selenium, and vanadium than adults (ATSDR 2003a, 1992b, 2000a, 1996, 1992d, respectively), the doses we calculated for children are generally higher than adults' doses because children weigh less and may accidentally eat more soil (or drink relatively more water). Nonetheless, children and/or fetuses are potentially more susceptible to lead, manganese, nickel, PCBs, PAHs, trichloroethene, and vinyl chloride found on the site, than adults.

Lead

Children's special susceptibility to lead includes impairment of nerve development, which results in slower learning, lowering of other neurobehavioral measures, slowed bone growth, and problems absorbing vitamin D. Absorption of lead appears to be higher in children who have low dietary iron or calcium intakes (ATSDR 1999).

Manganese
Children have neurological symptoms at lower manganese exposure levels than adults, but it is not known if they absorb more manganese or excrete less. Animal studies have shown the development of neurotoxic effects in children through maternal exposure to manganese (ATSDR 2000c).

Nickel
Fetuses and neonates may be more susceptible to nickel's toxic effects, according to animal studies that show reproductive affects and decreased survivability in pups (ATSDR 2003).

Polychlorinated Biphenyls
Babies born to mothers exposed to PCBs during pregnancy have slightly lower birth weights, problems with motor skills, and decreases in short-term memory. Mothers' PCBs exposures may affect babies' immune system functions. Because PCBs are fat-soluble, they may also be passed to babies through the mother's milk (ATSDR 2000b).

Polycyclic Aromatic Hydrocarbons (PAHs)
Developing fetuses are susceptible to the toxic effects produced by maternal exposure to PAHs. Chemicals pass more readily through children's blood-brain barrier than they would through an adult's blood-brain barrier. Their developing livers are also less able to metabolize chemicals (ATSDR 1995).

Trichloroethene
The association between birth defects and a mother's ingestion of water containing trichloroethene is not clear. Reported effects include higher incidence of childhood leukemia and heart valve defects. While the occurrence of heart valve defects is supported by animal studies, chemical stabilizers in the trichloroethene the animals were fed make the exact cause of these birth defects unclear. One epidemiologic study reported a higher number of children with rare respiratory system defects and eye defects, one reported neural tube defects and cleft palates, and another reported higher rates of hearing and speech impairment. There are many questions regarding these reports, including small numbers of children with defects and poorly defined exposure levels (ATSDR 1997a).

Vinyl Chloride
Studies of women who live near vinyl chloride manufacturing plants did not show that vinyl chloride caused birth defects. In animal studies, high level of vinyl chloride during pregnancy caused illness in the mother, increased the number of miscarriages, decreased fetal weight-gain, and delayed fetal skeletal development (ATSDR 1997b).

Other Unusually Susceptible Populations

A susceptible population has different or enhanced responses to a toxic chemical than most persons exposed to the same levels. Reasons include genetic makeup, age, health, nutritional status, and exposure to other toxic substances (like cigarette smoke or alcohol). These factors may limit an individual's ability to detoxify or excrete harmful chemicals or may increase the effects of damage to organs or systems in the body. Ammonia, antimony, arsenic, lead, manganese, nickel, PCBs, PAHs, selenium, trichloroethene, vanadium, and vinyl chloride measured on the site may affect the following specific susceptible populations listed in the following sections.

Ammonia
Persons who suffer from severe kidney or liver disease may be more susceptible to ammonia toxicity because these organs bio-transform and excrete ammonia. Persons with asthma, or who are hyper-reactive to other respiratory irritants may be more susceptible to ammonia's inhalation effects. Ammonia may worsen existing symptoms including cough, wheeze, nasal complaints, eye irritation, throat discomfort, and skin irritation (ATSDR 2003a).

Antimony
Persons with existing chronic respiratory, cardiovascular disease, or problems or kidney dysfunction may be more susceptible to antimony exposure (ATSDR1992).

Arsenic
Population subgroups more susceptible to arsenic's toxic effects might include those with reduced liver methylation capacity (a reduced liver-metabolic breakdown pathway) (ATSDR 2000a).

Lead
Population subgroups more susceptible to lead's toxic effects include pregnant women; the elderly; smokers; alcoholics; persons with malnutrition, kidney, or nerve problems; and persons with genetic diseases affecting red blood cell production (ATSDR 1999).

Manganese
The elderly are more susceptible to manganese toxicity, possibly because they metabolize metals more slowly and because they have a potential for adverse neurological effects, in addition to a normal decline in fine motor function with age (ATSDR 2000c).

Nickel
Population subgroups more susceptible to nickel's toxic effects may include those with kidney dysfunction, diabetics, and persons who are nickel-sensitive (ATSDR 2003).

Polychlorinated Biphenyls (PCBs)
People with liver disorders such as Gilbert's Syndrome, liver infection, liver cirrhosis, hepatitis B, or intermittent blood-developing system problems (porphyria) are potentially more susceptible to PCB exposure (ATSDR 2000b)

Polycyclic Aromatic Hydrocarbons (PAHs)
Persons with a history of excessive sun exposure and persons with liver and skin diseases may be more susceptible to the toxic effects of PAHs (ATSDR 1995).

Selenium
Individuals with vitamin E-deficient diets, diabetes, and iodine or thyroid deficiencies may be at greater risk of health effects from excess selenium exposure. The elderly may be less susceptible because they absorb less of what they ingest. Persons with already high exposure through foods grown in high selenium soil may be more susceptible to additional exposure (ATSDR 1996).

Trichloroethene
Elderly persons with weakening organ functions may show increased susceptibility to the toxic effects of trichloroethene (ATSDR 1997a).

Vanadium
Persons with pre-existing respiratory disorders, such as asthma, may be expected to have increased effects from breathing vanadium dusts (ATSDR 1992d).

Vinyl Chloride
Increased susceptibility to the toxic effects of vinyl chloride may occur in persons with liver disease, irregular heart rhythms, impaired peripheral circulation, or systemic sclerosis (a disease that causes progressive thickening of the skin). Persons with exposure to organochlorine pesticides, those consuming alcohol or "downers" (barbiturates), or taking Antabuse for alcoholism are also especially susceptible (ATSDR 1997b). Genetic predisposition for increased risk includes persons who possess the HLA-DR5, HLA-DR3, and B8 genes.

Health Outcome Data

In response to health concerns expressed by some in the community, Florida DOH compared Gulf County cancer rates with statewide rates. For the entire period cancer data are available (1981 to 2000), *both liver and total age-adjusted cancer rates were lower in Gulf County than in all Florida counties*.

Age-adjusted liver cancer rates were:

- 2.4 per 100,000 for Gulf County, and
- 2.9 per 100,000 for Florida.
- Age-adjusted rates for all cancers were:
- 436.7 per 100,000 for Gulf County, and
- 464.9 per 100,000 for Florida (Appendix C).

Trends for the 1981-1999 reported cancers show similar values.

- Age-adjusted liver cancer rates were:
- 1.8 per 100,000 for Gulf County, and
- 2.60 per 100,000 for Florida.

Age-adjusted rates for all cancers were:

- 429.82 per 100,000 for Gulf County, and
- 456.69 per 100,000 for Florida (Appendix C).

Again, these Florida Cancer Data System values indicate liver and total cancer age-adjusted rates are lower in Gulf County than all Florida counties, for the periods of 1981 to 2000, and 1981 to 1999.

Conclusions

FDEP is overseeing site remediation under Florida's Brownfields redevelopment program. Stone Container has completed cleaning up the southern part of the site to Florida Brownfields Redevelopment Act standards for commercial or industrial use. In November 2005, they were negotiating closure requirements with DEP. St. Joe Company likewise proposes cleaning up the northern part of the site to Florida Brownfields redevelopment standards for industrial use. Although there are currently no completed exposure pathways, if land use changed to allow residential or recreational development without prior remediation, the site would pose a **Public Health Hazard** due to contaminants in the soil and groundwater. However, Florida DOH found that the *removal operations, deed restrictions, and engineering controls FDEP requires for Brownfields remediation and development should* ***prevent*** *future exposures to soil and shallow groundwater at levels expected to affect health adversely*. **We evaluated the theoretical, long-term daily exposure outcomes to demonstrate the need for fulfilling these Brownfields redevelopment requirements and follow the restrictive covenants**. Our media specific conclusions follow.

1. Data are insufficient to characterize the contents of the former wastewater impoundment on the northern part of the site. This impoundment is 11 acres in area and approximately 15 feet deep. St. Joe Company's contractors have only taken two samples of the fine-grained wastes buried in the impoundment: both contained PAHs above the industrial soil cleanup target levels.

2. FDEP reported allegations that former operators buried waste drums and a ruptured tank car in the wastewater impoundment on the northern part of the site and bark in the former barge basin. The contractor's reports do not address these allegations. Buried hazardous material or buried organic material on either part of the site could adversely affect future site use.

3. Analyses of sediment near the dock area and throughout St. Joe Bay are insufficient to evaluate the indirect public health threat of site-related contaminants, which are environmentally persistent and may bioaccumulate in the St. Joe Bay food chain.

4. **Biota in St. Joe Bay are current indeterminate public health hazards** because analyses of St. Joe Bay fish and shellfish are insufficient to evaluate the public health threat of site-related contaminants they might have bioaccumulated. Some species are eaten by locals and visitors or are harvested commercially.

5. **On-site shallow groundwater poses a future public health hazard to anyone who might drink it or use it in an enclosed space**. **FDEP regulations allow site owners to develop restrictive covenants to prevent future use of shallow groundwater.** Contractors did not delineate or fully characterize shallow groundwater contamination; they only analyzed groundwater samples from 11 wells, (nine monitoring wells, plus two background wells) on this 168-acre site. Contractors did not analyze groundwater from under the southern half of the site for dioxins. Nonetheless, these data indicate people should not use on-site shallow groundwater for potable or other purposes. Contractors measured ammonia, manganese, PCBs, and selenium in groundwater from the northern part of the site; and ammonia, antimony, arsenic, manganese, PCBs, trichloroethene, vanadium, and vinyl chloride in groundwater from the southern part of the site above drinking water standards and other health-based screening values. Contractor's reports have not addressed what chemicals might be moving off-site into the St. Joe Bay via groundwater. Therefore, **off-site shallow groundwater poses a current indeterminate public health hazard**.

6. Surface water quality data from near the site are insufficient to assess the public health threat. Testing nearby surface water will be especially important if groundwater delineation reveals that contaminated shallow groundwater is discharging into St. Joe Bay.

7. The former St. Joe Forest Products site is **an indeterminate public health hazard for workers' past exposures** because existing personal exposure data are insufficient and worker exposure is outside the scope of the ATSDR public health assessment process.

Recommendations

The removal operations, deed restrictions, and engineering controls required for Brownfields redevelopment at this site should prevent future exposures to contaminated soil and shallow groundwater. Florida DOH recommends the following measures to prevent future exposures:

1. St. Joe Company should continue to restrict access to impoundment materials on the northern part of the site until they adequately characterize the chemical contents. They should post "No Trespassing" where people fish, to discourage them from possibly contacting contaminated soil on the interior of the site.

2. St. Joe Company should determine whether there are buried items on the northern part of the site using geophysical surveys. St. Joe Company and Stone Container should verify whether former operators buried bark or other organic materials. They should assure that no structures are erected over buried materials that may compact or decay and cause structural failure in these buildings, or the gas, sewer or potable water lines that will supply the buildings.

3. St. Joe Company should characterize the extent of contamination in sediments near the dock and in water shallower than 20 feet deep on the eastern side of St. Joe Bay.

4. Collect slow-growing, long-lived, top-predator or bottom feeding game fish and shellfish like sheepshead, redfish, spotted sea trout, hardhead catfish flounder and southern quahog clams from the eastern part of St. Joe Bay near the site, Gulf County Canal, and the port St. Joe Marina. Analyze these fish and shellfish for dioxin and furan TEQs and PCBs. Additionally; analyze flounder and southern quahog clams for PAHs.

5. Adopt deed restrictions that prohibit the use of shallow contaminated groundwater on both parts of the site. Stone Container is negotiating restrictive covenants with DEP that will prevent future exposures to shallow groundwater and soil that was capped on the site. As part of their remedial actions, Stone's contractor installed additional monitoring wells. However, they still have not delineated the contamination plume. Normally DEP will require the installation of monitoring wells until the extent of a groundwater plume is delineated for a Remedial Action Plan. Monitoring wells located outside a plume will not indicate contamination (i.e. they will only measure background concentrations, usually traces of metals). Because the Bay is located down gradient and contamination could have migrated into the bay, DEP should require groundwater modeling to show that the likely attenuation of the plume has not affected the surface water quality in the bay.

6. Test surface water near the site, especially if the completed groundwater delineation or modeling shows that contaminated groundwater is (or may be) entering St. Joe Bay.

7. People should consult their doctors if they do not feel well, especially if they have persistent symptoms. They should tell their doctors about any environmental exposures they have had, even if they do not know their exposure levels. This is especially

important for workers or others who may have been exposed to contaminants from the former St. Joe paper mill and other nearby industrial sources.

Public Health Action Plan

This section describes what ATSDR and Florida DOH plan to do at this site. The purpose of a Public Health Action Plan is to reduce any existing health hazards and to prevent any from occurring in the future. ATSDR and Florida DOH will do the following:

1. Florida DOH, Bureau of Community Environmental Health will inform and educate nearby residents about the public health threats associated with the former St. Joe Forest Products site.
2. Florida DOH, Bureau of Community Environmental Health will continue to work the Florida Department of Environmental Protection to protect public health.
3. Florida DOH will ask FDEP if the citizen review board adequately addressed (sample areas and sample depths) past concerns former workers had about spills and leaks they reported seeing on the site.
4. Florida DOH, Bureau of Community Environmental Health will evaluate additional test results for public health implications.

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Appendix A—Figures and Photographs

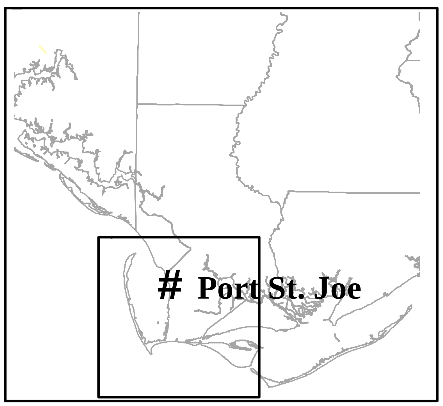
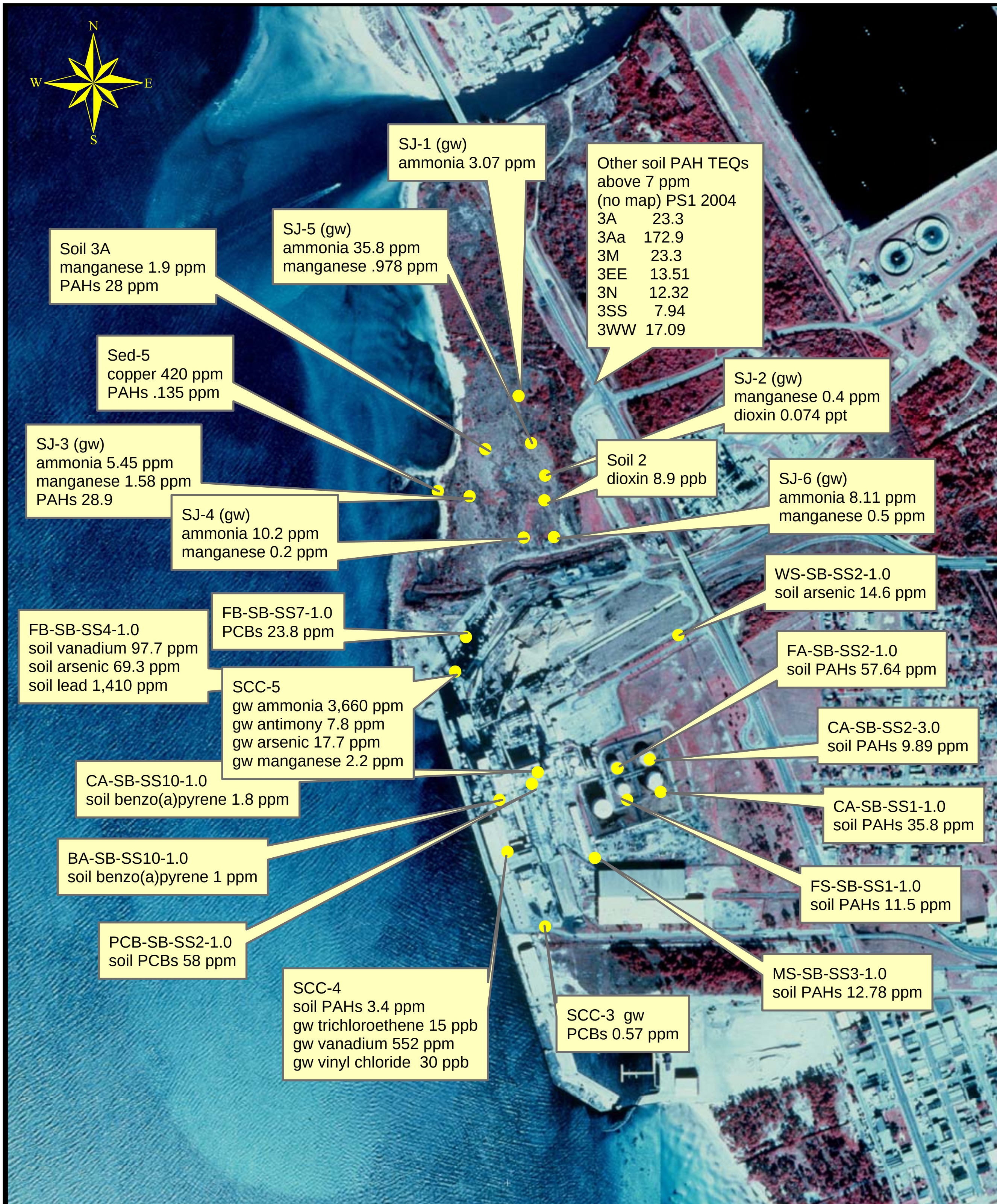


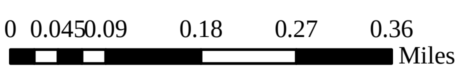
Figure 1: Former St. Joe Forest Products Location Map
Port St. Joe, Gulf County, Florida

N
W E
S

Figure 2: 1999 Aerial Photography, Locations Approximate

FLORIDA DEPARTMENT OF HEALTH





FLORIDA DEPARTMENT OF HEALTH

Figure 3: 1999 Aerial Photography, Locations Approximate.
Sample locations and chemicals exceeding target cleanup levels for industrial landuse (soil) and to protect the aquifer (groundwater). This map was prepared before the soil was excavated. The south parcel areas of soil with PCBs were removed and the other areas of contamination were excavated and buried on the central part of the site.

Figure 4: 1970 Aerial Photo from DEP 2002, Figure 9b

Figure 5: 1999 Aerial Photography, boundaries approximated

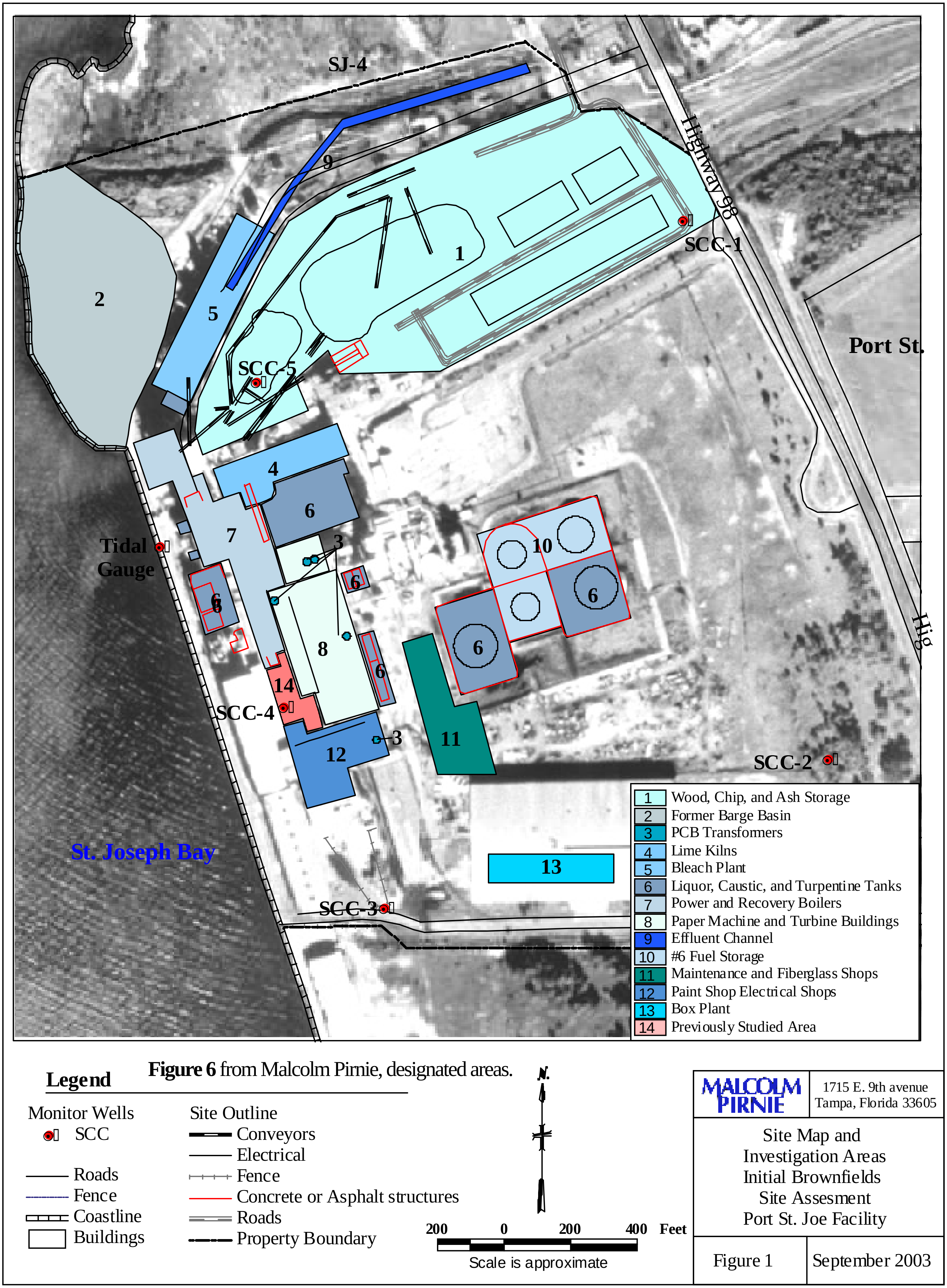


Figure 6 from Malcolm Pirnie, designated areas.

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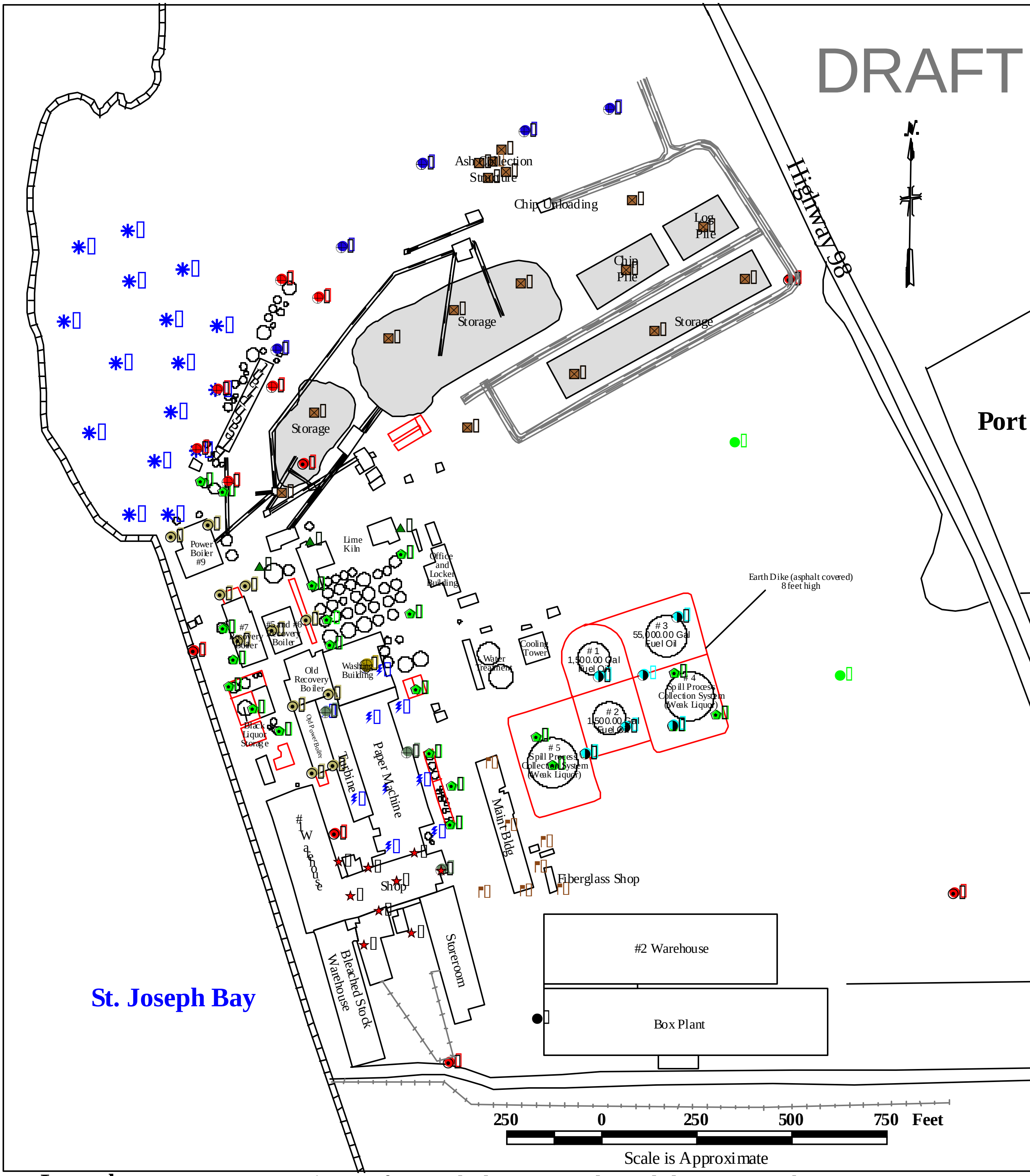

Figure 7 from Malcolm Pirnie, soil sample locations, southern section

Legend

- Barge Basin - FB
- Bleach Plant - BP
- Boilers - BA
- Box - BX
- Caustics - CA
- Effluent - EC
- Fuel Storage - FS
- General Site - GS
- Lime Kiln - LK
- Maintenance - MS
- PCB
- PCB -TA
- Paint - PE
- Turbine - PM
- Wood Storage - WS

MALCOLM PIRNIE
1715 E. 9th avenue
Tampa, Florida 33605

Soil Sample Locations
Initial
Brownfields Site Investigation
Port St. Joe Facility

Figure 2

September 2003

M:/4320006/GIS/projects_apr/Brownfield_soil_locations.apr

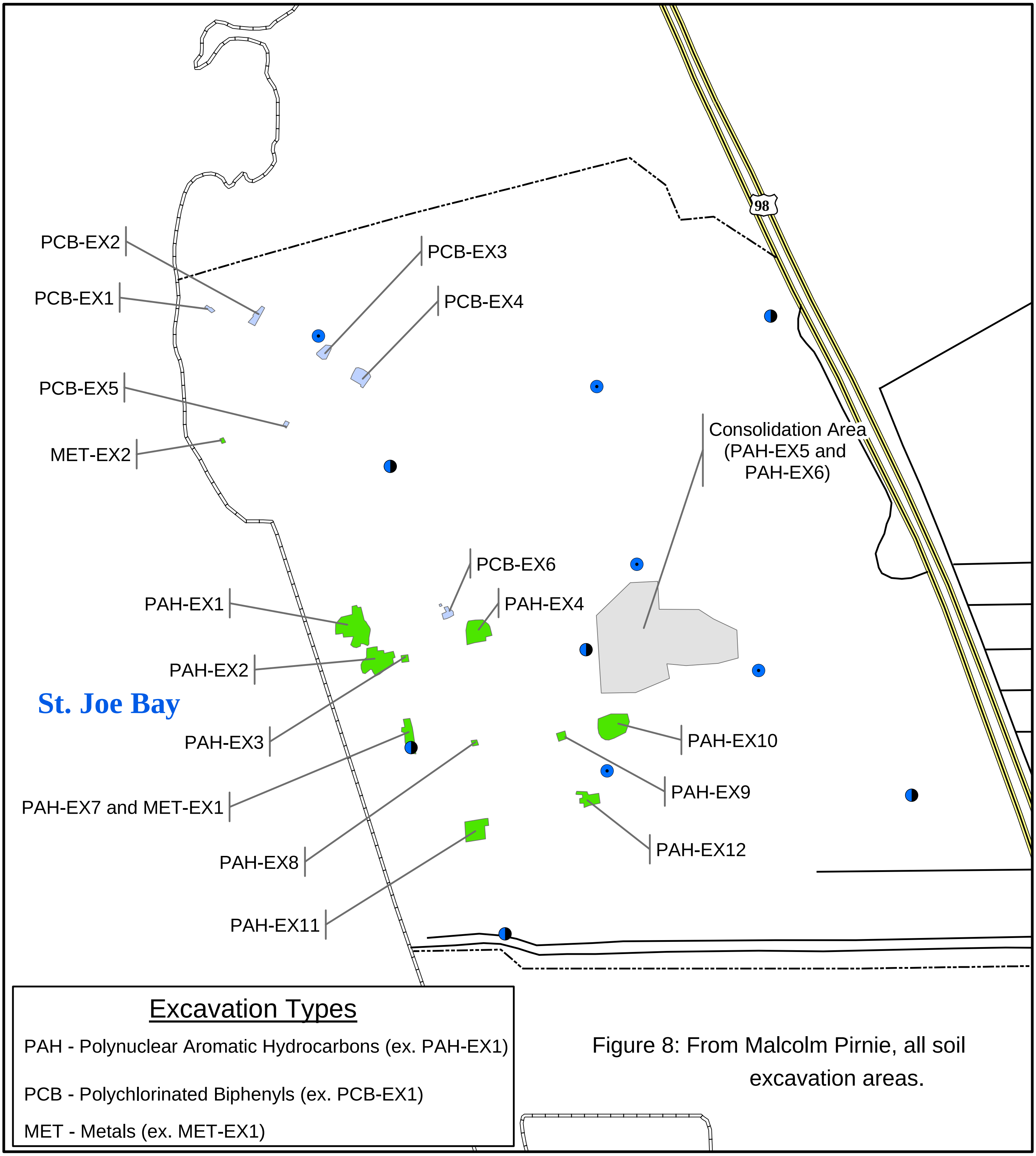

Figure 8: From Malcolm Pirnie, all soil excavation areas.

Legend

- Monitor Well
- Temporary Piezometer
- Coastline
- Property Boundary
- PCB Excavations
- PAH and Metals Excavations
- Consolidation Area

N

Feet

200 100 0 200 400 600

Scale is approximate

MALCOLM PIRNIE	1300 E. 8th avenue Tampa, Florida 33605
PCB, PAH, and Metals Excavation Areas Site Rehabilitation Completion Report Former Port St. Joe Paper Mill	
Figure 2	May 2005

4320006/GIS/Projects_MXD/SRCR_Figures/Figure 2-Excavations.mxd

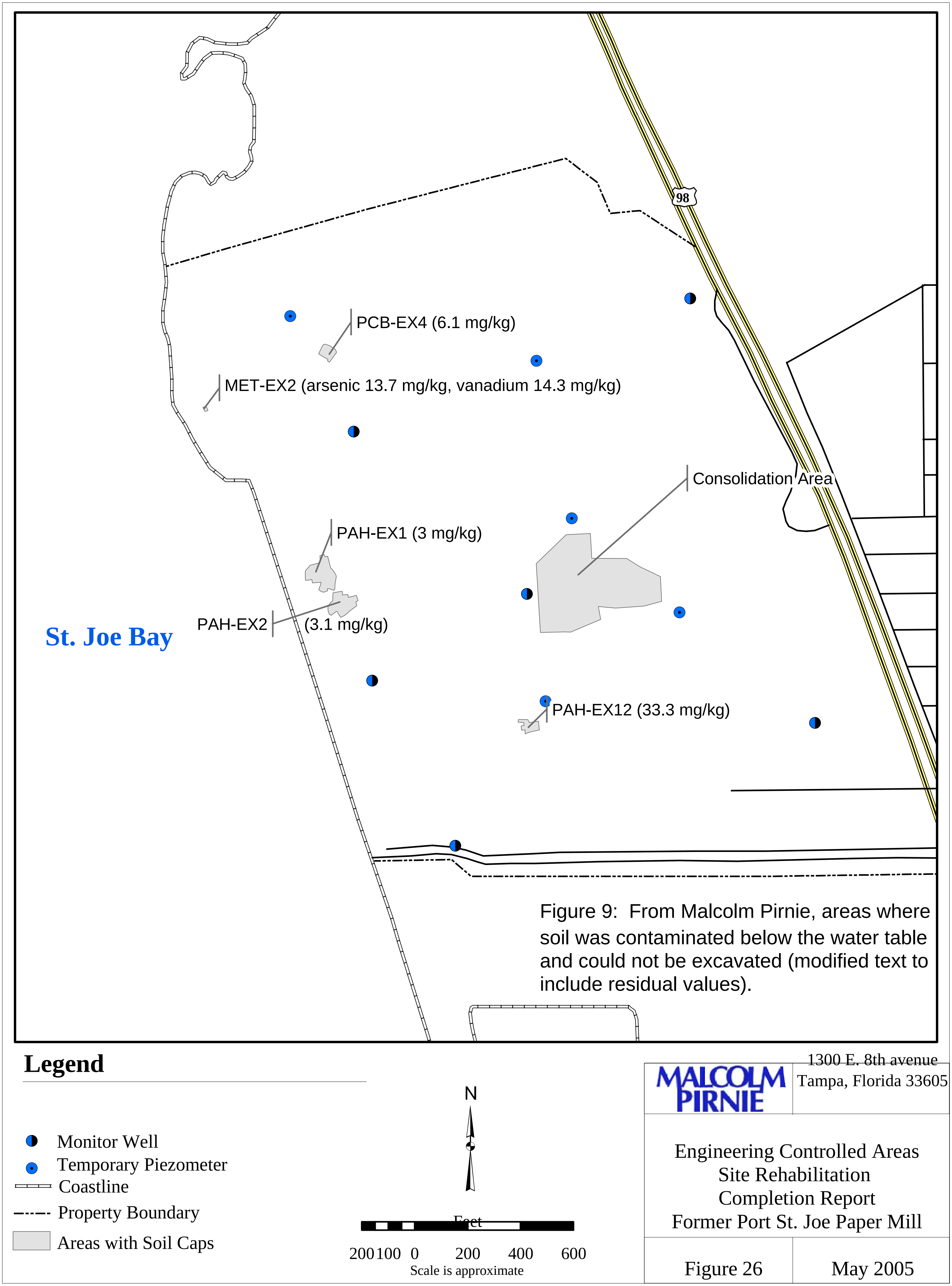

Figure 9: From Malcolm Pirnie, areas where soil was contaminated below the water table and could not be excavated (modified text to include residual values).

MALCOLM PIRNIE	1300 E. 8th avenue Tampa, Florida 33605
Engineering Controlled Areas Site Rehabilitation Completion Report Former Port St. Joe Paper Mill	
Figure 26	May 2005

Photograph 1: Closed St. Joe Millworks former St. Joe Forest Products site Port St. Joe, Gulf County, Florida

Photo 2: Gated entry on the western side of the southern parcel.

Photo 3: Metal debris and oxygen tanks on the southern parcel.

Photo 4: Bucket loader and dump truck, southern parcel.

Photo 5: Rubble pile and removal equipment on the the southern parcel.

Photo 6: Southern parcel, looking east through chain link fence, rubble pile and cleared land toward the bridge and Arizona Chemical.

Photo 7: Soil capping operations on the southern parcel.

Photo 8: View to the southwest from the bridge, remediation equipment on the southern parcel in the distance.

Photo 9: View to the northwest from the bridge, vegetated area forms the southern boundary with the northern part of the site.

Photo 10: Northern parcel on the opposite shore of Gulf County canal.


Bleach Plant Before and After


Pulp Stock Plant Before and During


Pulp Stock Plant During and After

Mill from Bridge

Appendix B—Tables

Table 6—Completed Exposure Pathways

PATHWAY NAME	EXPOSURE PATHWAY ELEMENTS					TIME
	SOURCE	ENVIRON-MENTAL MEDIA	POINT OF EXPOSURE	ROUTE OF EXPOSURE	EXPOSED POPULATION	
On-site surface soil (0–12 inches deep)	Paper mill wastes	Soil/sediments	On-site soil and former wastewater impoundment sediments.	Ingestion	Former workers	Past
Air	Paper mill emissions	Air	On- and off-site air	Inhalation	Former workers and nearby residents	Past
Dust	Contaminated surface soil and process chemicals	Dust	On- and off-site air	Inhalation	Former workers and nearby residents	Past
St. Joe Bay Seafood	Paper mill wastes	St. Joe Bay seafood	Seafood from bay	Ingestion	People consuming seafood from St. Joe Bay	Past, Present, and Future

Table 7—Potential Exposure Pathways

PATHWAY NAME	EXPOSURE PATHWAY ELEMENTS					TIME
	SOURCE	ENVIRON-MENTAL MEDIA	POINT OF EXPOSURE	ROUTE OF EXPOSURE	EXPOSED POPULATION	
Surface soil (0–12 inches deep)	Paper mill wastes	Soil and sediments	On-site soil and former waste impoundment sediments, home grown vegetable gardens	Ingestion	On-site workers or residents	Present and Future
Dust	Contaminated surface soil	Dust	On-site air	Inhalation	Residents and/or workers	Present and Future
Aquaculture [for example: farming mussels or soft-shelled crabs]	Paper mill wastes	Contaminated groundwater	Consumption of crabs and other seafood grown using contaminated groundwater	Ingestion	Consumers of crabs and other seafood grown using contaminated groundwater	Future

Table 8a—Calculated Doses for Exposure to Northern Parcel Soil

Contaminant of Concern (North)	Maximum Soil Concentration (mg/kg)	Oral MRL Guideline (mg/kg/day)	Estimated Soil Ingestion Dose (mg/kg/day)			Inhalation MRL Guideline TWA (mg/ m^3)	Estimated Dust Inhalation Dose (mg/m^3)	
			Child	Adult	Workers		Child & Adult	Worker
TEQ Poly-cyclic Hydrocarbons (PAHs)	172.9	None	0.002	0.0002	0.00009	0.2	0.000009	0.00002

The following information was used for both parts of Table 8 and Table 9:

Scenario Time frame: Future

Land Use Conditions: Residential for children and adults, commercial or industrial for workers

Exposure Medium: Soil and Dust
Exposure Point: Ingestion of Soil or Inhalation of Dust
Receptor Population: Residents
These doses were calculated using Risk Assistant Software Version 1.1 (Hampshire Research Institute) and standard values for groundwater consumption, shower inhalation exposure and dermal exposure parameters (EPA 1991).

MRL = Minimum Risk Level for noncancer illnesses
mg/kg/day = milligrams per kilogram per day
mg/kg = milligrams per kilogram
TWA = time weighted average
mg/m^3 = milligrams per cubic meter

The above doses were calculated using the following values:
Acute = exposure is 1–14 days
Intermediate = exposure is 15–364 days
Chronic = exposure is 365 days and longer
Adult and worker body weight is 70 kg
Adult soil consumption is 100 mg
Worker soil consumption is 3 mg outdoors
Residential Soil exposure is 365 events per year, 3 hours per event
Worker outdoor dust/soil exposures is 250 events per year 0.5 hours per event
Child body weight is 5 kg
Inhalation breathing rate is 0.5 cubic meters per hour.

Table 8b—Calculated Doses for Residential Exposure to Southern Parcel Soil

Contaminant of Concern (South)	Maximum Soil Concentration (mg/kg)	Oral MRL Guideline (mg/kg/day)	Estimated Soil Ingestion Dose (mg/kg/day)			Inhalation MRL Guideline TWA (mg/ m³)	Estimated Dust Inhalation Dose (mg/m³)	
			Child	Adult	Worker		Child & Adult	Worker
Antimony	70.4	None	0.0009	0.0001	0.00003	None	0.000004	0.000002
Arsenic	69.3	ϒ Acute 0.005 Chr. 0.0003	0.0009	0.0001	0.00003	None	0.000004	0.000006
Lead	1,410	None	3.7–10.7 µg/dL†	3.0–10.4 µg/dL		Inhalation is included in the model.		
TEQ PAHs	96.95	None	0.001	0.0001	0.00005	0.2	0.000005	0.000003
PCBs	6.15‡	Int. 0.00003 Chr. 0.00002	0.00008	0. 000009	0.000003	None	0.0000003	0.000003
Vanadium	97,700	Int. 0.003	1.3	0.1	0.05	Acute 0.0002	0.009	0.005

ϒ Provisional
† Tables 10 and 11 show the values used to estimated these blood concentrations in children and adults as discussed in the Lead Toxicological Profile (ATSDR, 1999)
‡ Most PCB above Industrial/Commercial CTLs were removed form the site, this level remains on the site at PCB-EX4. It was not removed because it was below the water table.

Table 9—Calculated Dose for Exposures to Groundwater

Contaminant of Concern	Maximum Groundwater Concentration (µg /L)	Oral MRL Guideline (mg/kg/day)	Estimated Groundwater Ingestion/Dermal Dose (mg/kg/day)			Inhalation MRL Guideline TWA (mg/ m^3)	Estimated Groundwater Vapor Inhalation Dose (mg/m^3)	
			Child	Adult	Worker		Child & Adult	Worker
North - Ammonia	35,800	Intermediate 0.3	2.4/0.01	1.02/0.007	0.35	Acute 1.7 ppm Chronic 0.1 ppm	564 ppm	50.05 ppm
North - Manganese	1,900	None	0.1/0.0002	0.05/0.0001	0.01	Chronic 0.00004	MD	MD
North - PAHs	0.06	None	0.000004/ 0.00007	0.000002/ 0.00005	0.000000 6	None	0.0007	0.00006
North - PCBs	0.56	See below	0.00004/0.0001	0.00002/0.0008	0.000005	None	0.006	0.0006
North - Selenium	210	Chr. 0.005	0.01/0.00002	0.006/0.00001	0.0007	None	MD	MD
South - Ammonia	3,600	Intermediate 0.3	0.24/0.001	0.1/0.0007	0.03	Acute 1.7 ppm Chronic 0.1 ppm	55 ppm	5.06 ppm
South - Arsenic	17.7	[ϒ]Acute 0.005 Chr. 0.0003	0.001/0.000002	0.0005/0.000001	0.0002	None	MD	MD
South - Antimony	7.77	None	0.0005 /0.0000008	0.00002/ 0.0000005	0.00008	None	MD	MD
South - Manganese	2240	None	0.14	0.06	0.02	None	MD	MD
South - PCBs (Arochlor-1260)	0.57	Int. 0.00003 Chr. 0.00002 Arochlor- 1254	0.00004/0.0001	0.00002/0.0008	0.000006	None	0.006	0.0006
South - Trichloroethene	15	None	0.001/0.0001	0.0004/0.00007	0.0001	None	0.04 ppm	0.002 ppm
South - Vanadium	552	Int. 0.003	0.03/0.00005	0.015/0.00004	0.005	Acute 0.0002	MD	MD
South - Vinyl Chloride	29.9	Chr. 0.00002	0.002/0.00006	0.0009/0.00004	0.0003	Acute 0.5 ppm Int. 0.03 ppm	0.12 ppm	0.012 ppm

[ϒ]Provisional

Table 10—Estimated Blood Lead Concentrations in Children Ingesting On-Site Surface Soil (micrograms per deciliter = µg/dL)

Media	Lead Conc.*		Time	Slope†		Blood lead levels	
	Low	High		Low	High	Low	High
Air (out)	0.1*	0.2*	0.8	2.46†	3.04†	0.08118	0.20064
Air (in)	0.3*	0.6*	0.8	2.46†	3.04†	0.24354	0.60192
Food	5*	5*	0.8	0.24†	0.24†	0.396	0.396
Water	4*	4*	0.8	0.16†	0.16†	0.2112	0.2112
Soil	1,410	1,410	0.8	0.002	0.016	0.9306	7.4448
Dust	1,410	1,410	0.8	0.004	0.004	1.8612	1.8612
Total						**3.72372**	**10.71576**

*Default value from ATSDR 1999, Appendix D.
†These slopes were for children from ATSDR 1999, Appendix D.
Source: ATSDR's Regression analysis with multiple-uptake parameters to estimate blood lead from environmental exposures (ATSDR 1999, Appendix D)

Table 11. Estimated Blood Lead Concentrations in Adults Ingesting On-Site Surface Soil (micrograms per deciliter - µg/dL)

Media	Conc.*		Time	Slope†		Low	High
	low	high		low	High		
Air (out)	0.1*	0.2*	0.8	1.59†	3.56†	0.05247	0.23496
Air (in)	0.3*	0.6*	0.8	1.53†	3.56†	0.15147	0.70488
Food	5*	5*	0.8	0.016†	0.0195†	0.0264	0.032175
Water	4*	4*	0.8	0.03†	0.06†	0.0396	0.0792
Soil	1,410	1,410	0.8	0.002	0.016†	0.9306	7.4448
Dust	1,410	1,410	0.8	0.004	0.004†	1.8612	1.8612
Total						**3.06174**	**10.35721**

*Default value from ATSDR 1999, Appendix D.
†Slopes for adults from ATSDR 1999, Appendix D.
ATSDR's Regression analysis with multiple-uptake parameters to estimate blood lead from environmental exposures (ATSDR 1999, Appendix D)

TEQs for PAHs and Dioxins/Furans

Table 12—TEQs for PAHs—Analytical results are multiplied by the following factors and then added together to obtain one number to be compared with the screening value for benzo[a]pyrene. EPA adds ½ the detection level for all carcinogenic PAHs, if any carcinogenic PAHs are detected.

PAH	*Toxicity Equivalency Factor*
Dibenz[a,h]anthracene	5
Benzo[a]pyrene	1
Benzo[a]anthracene	0.1
Benzo[b]fluoranthene	0.1
Benzo[k]fluoranthene	0.1
Indeno[1,2,3-c,d]pyrene	0.1
Anthracene	0.01
Benzo[g,h,i]perylene	0.01
Chrysene	0.01
Acenaphthene	0.001
Fluoranthene	0.001
Fluorene	0.001
Phenanthrene	0.001
Pyrene	0.001

Source: ATSDR 1995b.

Table 13—TEQs for Dioxins/Furans—Analytical results are multiplied by the following factors and then added together to obtain one number to be compared with the screening value for 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD). EPA adds ½ the detection level for all congeners, if any congeners are detected.

Dioxin/Furan	*Toxicity Equivalency Factor*
2,3,7,8-TCDD	1
1,2,3,7,8-PeCDD	1
1,2,3,4,7,8-HxCDD	0.1
1,2,3,6,7,8-HxCDD	0.1
1,2,3,7,8,9-HxCDD	0.1
1,2,3,4,6,7,8-HpCDD	0.01
OCDD	0.0001
2,3,7,8-TCDF	0.1
1,2,3,7,8-PeCDF	0.05
2,3,4,7,8-PeCDF	0.5
1,2,3,4,7,8-HxCDF	0.1
1,2,3,6,7,8-HxCDF	0.1
1,2,3,,7,8,9-HxCDF	0.1
2,3,4,6,7,8-HxCDF	0.1
1,2,3,4,6,7,8-HpCDF	0.01
1,2,3,4,7,8,9-HpCDF	0.01
OCDF	0.0001

Source: (WHO 1998).

Table 14. Comparison of doses calculated from highest measured values to most sensitive effects (effects occurring at the lowest doses in animal and human medical studies).

Chemical	Doses are in mg/kg/day unless listed as ppm (parts per million) in air: otherwise air levels are milligram s per cubic meter					
	children's dose	adult's dose	worker's dose	children's theoretical increased cancer risk	adult's theoretical increased cancer risk	worker's theoretical increased cancer risk
Ammonia groundwater north	Ing 2.4/Der 0.01 Inh 564 ppm	Ing 1.02/Der 0.01 Inh 564 ppm	Ing 0.35 Inh 50 ppm	No Slope	No Slope	No Slope
ATSDR 2003a (Update)	<u>Child ingestion dose gw north</u> (2.4) is 9 times less than the **No Observable Adverse Effect Level (NOAEL)** (22) in both acute and intermediate animal studies showing decreased weight gain and neurological effects. The child dose is 33 times less than the **Lowest Observable Adverse Effect Level (LOAEL)** dose (79) for decreased weight gain health effects in an intermediate rat study. <u>Adult ingestion dose gw north</u> (1.02) is 22 times less than the (NOAEL) dose (22) referenced for children, so we would not expect ingestion health effects for adults from ammonia in northern groundwater. The worker's dose is about 1/3 the adults dose. <u>Inhalation dose gw north</u> (564 ppm for children and adults) dose is 11.28 times greater; while the worker's dose (50 ppm) equals the dose (50 ppm) associated with frequent coughing, oral and nasal irritation and reduced weight gain and reduced food intake in pigs exposed for 1 to 2 weeks. Therefore exposure to ammonia aerated from groundwater in an enclosed space might elicit adverse health effects for these receptors. <u>Dermal exposure</u> the NOAEL dose for eye irritation in humans (10) is 1,000 times higher than the dermal dose for children (0.01).					
Ammonia groundwater south	Ing 0.24/Der 0.001 Inh 55 ppm	Ing 0.1/Der 0.0007 Inh 55 ppm	Ing 0.03 MD	No Slope	No Slope	No Slope
	<u>Child ingestion dose gw south</u> (0.24) is 90 times less than the NOAEL dose (22) in both acute and intermediate animal studies showing decreased weight gain and neurological effects. The child dose is 329 times less than the LOAEL dose (79) for decreased weight gain health effects in an intermediate rat study. <u>Adult ingestion dose gw south</u> (0.1) is 220 times less than the NOAEL dose (22) referenced for children, so we would not expect ingestion health effects for adults from ammonia in southern groundwater. The worker's dose is about 1/3 the adults dose. <u>Inhalation dose gw south</u> (55 ppm for children and adults) dose is 1.1 times greater than the dose (50 ppm) associated with frequent coughing, oral and nasal irritation and reduced weight gain and reduced food intake in pigs exposed for 1 to 2 weeks. The worker scenario did not involve showering, so they did not have an inhalation dose. Therefore exposure to ammonia aerated from groundwater in an enclosed space might elicit adverse health effects from these exposure scenarios. <u>Dermal exposure</u> the NOAEL dose for eye irritation in humans is 10,000 time higher than the dermal dose for children.					
Ammonia-associated cancers	Data to assess the carcinogenicity of ammonia are too few. The limited information indicates that ammonia may interfere with the normal protective reflexes of the nose and stomach lining resulting in the contact with other materials that may initiate or promote the neoplastic process.					

Chemical	Doses are in mg/kg/day unless listed as ppm (parts per million) in air: otherwise air levels are milligram s per cubic meter					
	children's dose	adult's dose	worker's dose	children's theoretical increased cancer risk	adult's theoretical increased cancer risk	worker's theoretical increased cancer risk
Antimony groundwater south	Ing 0.0005 Der 0.000002 Inh MD	Ing 0.00002 Der 0.0000005 Inh MD	Ing 0.00008 Inh MD	No Slope	No Slope	No Slope
ATSDR 1992	Child ingestion dose (0.0005) is 140 times less than the LOAEL dose (0.07) associated with heart birth defects in studies of rat pups and decreased maternal weight gains in studies of rat mothers. A dose 1000 times higher than this (0.5) caused vomiting in humans who ingested this level once. Adult ingestion dose is 3,500 times less than the LOAEL dose (0.07) associated with heart birth defects in rat pups and decreased maternal weight gains in rat mothers. The worker's dose is about 1/4 the adults dose. Inhalation dose MD means the model was missing the data necessary to calculate the amount of antimony that might aerate from water and be inhalable in an enclosed area. Dermal exposures are only known from very high levels of exposures (hundreds to thousands of mgs/kg doses) in animals which irritated the skin and eyes of the test animals. The highest reported dose (6,685) also caused neurological effects: unsteady gait in rabbits.					
Antimony soil south	Ing 0.0009 Inh 0.000004	Ing 0.0001 Inh 0.000004	Ing 0.00003 Inh 0.000002	No Slope	No Slope	No Slope
	Child ingestion dose (0.0009) is 78 times less than the LOAEL dose (0.07) associated with heart birth defects in studies of rat pups and decreased maternal weight gains in studies of rat mothers. Doses 556 times higher than this (0.5) caused vomiting in humans who ingested this level once. This dose (0.0009) puts the child antimony hazard quotient above one, meaning it might cause adverse health effects. At the lowest levels of effects, animal studies have shown ingested antimony adversely affects the heart and blood systems and the liver. Adult ingestion dose is 700 times less than the LOAEL dose (0.07) associated with heart birth defects in rat pups and decreased maternal weight gains in rat mothers. The worker's dose is about 1/3 the adults dose. The adult and worker antimony dose hazard quotients are less than one. Inhalation dose the child and adult doses (0.000004) are 329 times less than the LOAEL dose (0.07) showing respiratory effects, chronic inflammation and proliferation of macrophages[†] in a chronic rat study. The worker's dose (0.000002) is 35,000 times less than the LOAEL dose (0.07).					
Antimony-associated cancers:	Antimony has only been linked to cancer in rats breathing antimony trioxide and antimony trisulfide and may be related to deposition or clearance of antimony from the respiratory tract. Limited cancer epidemiology studies in workers did not show this effect. With ingestion exposures, only animal data is available and it does not show a link with cancer risk, no animal or human data are available for dermal exposures.					

† A macrophage is a type of 'scavenger' cell, key to the workings of the human immune system. Macrophages are produced by stem cells in the bone marrow and circulate through the blood. They settle in many tissues, especially in the spleen and lymph nodes and in the liver, serving as filters to trap microbes and other foreign particles that arrive through the blood.

Chemical	Doses are in mg/kg/day unless listed as ppm (parts per million) in air: otherwise air levels are milligram s per cubic meter					
	children's dose	adult's dose	worker's dose	children's theoretical increased cancer risk	adult's theoretical increased cancer risk	worker's theoretical increased cancer risk
Arsenic groundwater south	Ing 0.001 Inh MD Der 0.000002	Ing 0.0005 Inh MD Der0.000001	Ing 0.0002 Inh MD	Ing 8:100,000 Der < 1:1,000,000	Ing 3:10,000 Der < 1:1,000,000	Ing 9:100,000
ATSDR 2000 (Update)	Child ingestion dose (0.001) is 22 times less than the LOAEL dose (0.022) associated with gastrointestinal irritation, diarrhea, nausea, skin pigmentation changes, and hyperkeratosis (dark raised spots on the skin that are possibly precancerous); persons in this study continuously ingested arsenic in their drinking water. This level is, however, 2.5 times greater than the (0.0004) NOAEL and has a hazard quotient >1 , meaning it might cause adverse health effects with daily, long-term exposure. Adult ingestion dose (0.0005) is 44 times less than the LOAEL dose (0.022) associated with gastrointestinal irritation, diarrhea, nausea, skin pigmentation changes, and hyperkeratosis (dark raised spots on the skin that are possibly precancerous); persons in this study continuously ingested arsenic in their drinking water. This level is, however, 1.25 times above the NOAEL (0.0004), but it's below the hazard quotient of one, so would be unlikely to cause adverse health effects. The worker's dose is about 1/3 this adults dose. Inhalation dose MD means the model was missing the data necessary to calculate the amount of arsenic that might aerate from water and be inhalable in an enclosed area. Dermal exposure in workers (to dust of arsenic trioxide) causes contact dermatitis, redness and swelling with papules and vesicles in more severe cases. Another worker study noted itching, dry and hyper-pigmented skin, folliculitis, and superficial ulcerations with arsenic trioxide dust exposure. The LOAEL for skin irritation is 4 mg/kg/day, from a mouse study is two million times greater than the highest dose calculated (for children).					
Arsenic soil south	Ing 0.0009 Inh 0.000004	Ing 0.0001 Inh 0.000004	Ing 0.0003 Inh 0.000006	Ing 6:100,000 Inh < 1:1,000,000	Ing 6:100,000 Inh 2:1,000,000	Ing 2:100,000 Inh < 1:1,000,000
	Child ingestion dose (0.0009) is 24 times less than the LOAEL dose (0.022) associated with gastrointestinal irritation, diarrhea, nausea, skin pigmentation changes, and hyperkeratosis (dark raised spots on the skin that are possibly precancerous); persons in this study continuously ingested arsenic in their drinking water. This level is, however, 2.3 times greater than the (0.0004) NOAEL, for these health effects (same study) and it exceeds the hazard quotient of one, meaning daily long-term exposure to this dose might cause adverse health effects. Adult ingestion dose (0.0001) is 220 times less than the LOAEL dose (0.022) and 4 times less than the NOAEL dose. The worker's dose is 1/3rd the adults. Neither dose is likely to cause adverse health effects Inhalation dose (0.000004) is 175 times less than the amount associated with increased risk of stillbirth in humans (0.0007) and 1,750 times less than the dose (0.007) causing dermatitis (a skin inflammation that may cause redness, pain, and occasionally itching) in humans inhaling arsenic.					
Arsenic associated cancers:	From lowest to highest dose cancer effect levels, chronic arsenic exposures in people have been linked to lung cancer, basal and squamous cell skin cancers, liver cancer (haemangioendothelioma), urinary tract cancers (bladder, kidney, ureter, and all urethral cancers), and intraepidermal cancers. Intraepidermal is the name for the early pre-invasive form of squamous cell skin cancer. Pre-invasive means that the cancer cells are confined to the outermost layer of skin, the epidermis. At this stage, the cancer cells are unlikely to have spread to the lymph nodes, but they can spread along the skin surface. If left untreated, these cells can develop into an invasive cancer and spread into the lymphatic system.					
Lead ATSDR 1999a	3.72–10.71 µg/dl (modeled)	3.06–10.35 µg/dl (modeled)				

Chemical	Doses are in mg/kg/day unless listed as ppm (parts per million) in air: otherwise air levels are milligram s per cubic meter					
	children's dose	adult's dose	worker's dose	children's theoretical increased cancer risk	adult's theoretical increased cancer risk	worker's theoretical increased cancer risk
Manganese groundwater north	Ing 0.1 Inh MD Der0.0002	Ing 0.05 Inh MD Der0.0001	Ing 0.01 Inh MD	No Slope	No Slope	No Slope
ATSDR 2000 (Update)	Child ingestion dose (0.1) is 16 times greater than the LOAEL dose (0.059) associated with mild neurological signs in a woman who drank water containing manganese for 50 years. The results of oral animal studies suggest that other effects that occur at the lowest levels of manganese exposure (but at 40 to 60 times greater doses than the child dose) are enzymatic changes in the stomach and intestines that prevent the release of energy from cells and a 60% lack of weight gain in test animals. Adult ingestion dose (0.05) is .8 times less than the LOAEL dose (0.059). Inhalation of manganese effects are known from worker's studies. The lowest levels of exposure to manganese via inhalation show an inflammatory response in the lung, neurological effects (decreased reaction times, balance problems) and reproductive effects (sperm abnormalities). MD means the model was missing the data necessary to calculate the amount of manganese that might aerate from water and be inhalable in an enclosed area. Dermal exposure is not a typical pathway of exposure for inorganic manganese compounds because manganese does not penetrate the skin readily.					
Manganese groundwater south	Ing 0.14 Inh MD Der0.0002	Ing 0.06 Inh MD Der0.0001	Ing 0.02 Inh MD	No Slope	No Slope	No Slope
ATSDR 2000 (Update)	Child ingestion dose (0.14) is 2.4 times more than the LOAEL dose (0.059) associated with mild neurological signs in a woman who drank water containing manganese for 50 years. The results of oral animal studies suggest that other effects that occur at the lowest levels of manganese exposure (but at 28 to 42 times greater doses than the child dose) are enzymatic changes in the stomach and intestines that prevent the release of energy from cells and a 60% lack of weight gain in test animals. Adult ingestion dose (0.06) is roughly the same as the LOAEL dose (0.059) associated with mild neurological signs in a woman who drank water containing manganese for 50 years. The results of oral animal studies suggest that other effects that occur at the lowest levels of manganese exposure (but at 66 to 100 times greater doses than the adult dose) are enzymatic changes in the stomach and intestines that prevent the release of energy from cells and a 60% lack of weight gain in test animals. Worker levels are about 1/3 the adult residential dose. Inhalation of manganese effects are known from worker's studies. The lowest levels of exposure to manganese via inhalation show an inflammatory response in the lung, neurological effects (decreased reaction times, balance problems) and reproductive effects (sperm abnormalities). MD means the model was missing the data necessary to calculate the amount of manganese that might aerate from water and be inhalable in an enclosed area. Dermal exposure is not a typical pathway of exposure for inorganic manganese compounds because manganese does not penetrate the skin readily.					
Manganese-associated cancers	ATSDR did not find any studies linking inhalation or dermal manganese exposure to cancer. Oral manganese animal studies describe exposures having cancers with uncertain locations and uncertain doses, which nonetheless do not appear to be dose related.					

<table>
<tr><td rowspan="2">Chemical</td><td colspan="6">Doses are in mg/kg/day unless listed as ppm (parts per million) in air: otherwise air levels are milligram s per cubic meter</td></tr>
<tr><td>children’s dose</td><td>adult’s dose</td><td>worker’s dose</td><td>children’s theoretical increased cancer risk</td><td>adult’s theoretical increased cancer risk</td><td>worker’s theoretical increased cancer risk</td></tr>
<tr><td>PAHs TEQ
soil north</td><td>Ing 0.002
Inh 0.0000009 ppm</td><td>Ing 0.0002
Inh 0.0000009 ppm</td><td>Ing 0.00001
Inh 0.000002 ppm</td><td>Ing 7: 10,000
Inh 6 : 10,000</td><td>Ing 8:10,000
Inh 6:10,000</td><td>Ing 2:10,000
Inh 2:10,000</td></tr>
<tr><td>ATSDR 1995 (Update)</td><td colspan="6"><u>Child ingestion dose</u> (0.002) is 1,300 times less than the dose (2.6) associated with stomach cancer in mice exposed to benzo[a]pyrene ad lib in food for 30 to 197 days.
<u>Adult ingestion dose</u> (0.0002) is 13,000 times less than the (2.6) sensitive dose health effects described above for children. Worker’s commercial or industrial dose is 20 times less than adult’s residential exposure dose.
<u>Inhalation dose</u> (0.0000009) is 111 times less than the dose (0.0001) associated with reduced lung function, abnormal chest x-ray, cough, bloody vomit, and throat and chest irritation in persons exposed from 6 months to 6 years. Workers dose (0.000002) is 50 times less.</td></tr>
<tr><td>PAHs TEQ
groundwater north</td><td>Ing 0.000004
Dermal 0.00007
Inh 0.00007 ppm</td><td>Ing 0.000002
Dermal 0.00005
Inh 0.00007 ppm</td><td>Ing 0.0000006
Inh 0.000006 ppm</td><td>Ing 1:1,000,000
Dermal 2:100,000
Inh 1 : 1,000</td><td>Ing 5:1,000,000
Dermal 2:10,000
Inh 1: 1,000</td><td>Ing 2:1,000,000
Inh 1: 10,000</td></tr>
<tr><td></td><td colspan="6"><u>Child ingestion dose</u> (0.000004) is 65,000 times less than the dose (2.6) associated with stomach cancer in mice exposed to benzo[a]pyrene ad lib in food for 30 to 197 days.
<u>Adult ingestion dose</u> (0.000002) is 1,300,000 times less than the (2.6) sensitive dose health effects described above for children. Worker’s commercial or industrial dose is 3.3 times less than adult’s residential exposure dose.
<u>Inhalation dose</u> (0.00007) is 1.4 times less than the dose (0.0001) associated with reduced lung function, abnormal chest x-ray, cough, bloody vomit, and throat and chest irritation in persons exposed from 6 months to 6 years. Workers dose (0.000006) is about 16 times less than the sensitive dose, and assumes workers will be exposed inside their work facility.
<u>Dermal dose</u> for children (0.00007) is 178 times lower than the level causing malignant tumors in a chronic mouse study (0.0125); the adult’s dose is 250 times less.</td></tr>
</table>

Chemical	Doses are in mg/kg/day unless listed as ppm (parts per million) in air: otherwise air levels are milligram s per cubic meter					
	children's dose	adult's dose	worker's dose	children's theoretical increased cancer risk	adult's theoretical increased cancer risk	worker's theoretical increased cancer risk
PAHs TEQ soil south	Ing 0.001 Inh 0.0000005ppm	Ing 0.0001 Inh 0.0000005 ppm	Ing 0.00004 Inh 0.0000008ppm	Ing 2:10,000 Inh 1:100,000	Ing 2:10,000 Inh 2:1,000,000	Ing 1:10,000 Inh 3:1,000,000
ATSDR 1995 (Update)	Child ingestion dose (0.001) is 2,600 times less than the dose (2.6) associated with stomach cancer in mice exposed to benzo[a]pyrene ad lib in food for 30 to 197 days. Adult ingestion dose (0.0001) is 26,000 times less than the (2.6) sensitive dose health effects described above for children. Worker's commercial or industrial dose is 25 times less than adult's residential exposure dose. Inhalation dose (0.0000005) is 200 times less than the dose (0.0001) associated with reduced lung function, abnormal chest x-ray, cough, bloody vomit, and throat and chest irritation in persons exposed from 6 months to 6 years. Workers dose (0.0000008) is 125 times less, but this assumes they will be exposed to contaminated soil inside their work facility.					
PAH-associated cancers	Worker exposures to high levels of PAHs show cancers (skin, bladder, lung and gastrointestinal) are the most significant endpoint of PAH toxicity. Long-term worker PAH exposures have been linked with skin and eye irritation, photosensitivity, respiratory irritation (with cough and bronchitis), leukoplakia†, precancerous skin growths enhanced by exposure to sunlight, erythemaΔ, skin burns, acneiform lesions, mild hepatoxicity, and haematuria‡. Also several PAH compounds are immunotoxic, and some suppress selective compounds of the immune system. Workers' dermal exposure studies indicate that although direct contact may be of concern at high exposure levels, they do not suggest that lower levels are likely to cause significant irritation (Goodfellow et al. 2001).					
PCBs soil south	Ing 0.00008 Inh 0.0000003	Ing 0.00009 Inh 0.0000003	Ing 0.000003 Inh 0.0000005	Ing 5:100,000 Inh NCFTER★	Ing 5:100,000 Inh NCFTER	Ing 2:1,000,000 Inh NCFTER
ATSDR 2000b (Update) DOH calculated these doses from the highest PCB value still measured on the site: this soil is below the water	Child ingestion dose (0.00008) is 63 times less than the dose (0.005) associated with elevated and separated toenails, and immune system effects (reduced IgM and IgG antibody responses to sheep red blood cells) in studies of rhesus monkeys given Arochlor-1254 in capsules for longer than a year. Nonetheless this child ingestion dose is greater than the intermediate oral exposure minimum risk level (MRL) of 0.00003 set by dividing 0.0075 by an uncertainty factor of 300 (10 for extrapolation from a lowest observed adverse effect level to a no observed adverse effect level, 3 for extrapolation from animals to humans, and 10 for human variability). It is also higher than the chronic oral exposure MRL of 0.00002 set by dividing 0.005 by an uncertainty factor of 300 (10 for extrapolation from a lowest observed adverse effect level to a no observed adverse effect level, 3 for extrapolation from animals to humans, and 10 for human variability). Adult ingestion dose (0.00001) is 500 times less than the (0.005) sensitive dose health effects described above for children. The worker's dos is 1/3 the adult residential dose. Both the adult and worker doses are below the intermediate and chronic MRLs.					

† Leukoplakia is a common, potentially pre-cancerous disease of the mouth that involves the formation of white spots on the mucous membranes of the tongue and inside of the mouth. Despite the increased risk associated with having leukoplakia, many people with this condition never get oral cancer

Δ Erythema nodosum is an inflammation of subcutaneous fat tissue.

‡ Haematuria is passage of blood in the urine.

★ Not carcinogenic from this exposure route.

Chemical	Doses are in mg/kg/day unless listed as ppm (parts per million) in air: otherwise air levels are milligram s per cubic meter					
	children's dose	adult's dose	worker's dose	children's theoretical increased cancer risk	adult's theoretical increased cancer risk	worker's theoretical increased cancer risk
table and could not be removed.	Inhalation dose (0.000003) is 300,000 times less than the dose (0.009) associated with epithelial hyperplasia in the urinary bladder and endocrine symptoms (increased thyroid serum T3 and T4 hormones) in rats exposed 30 days, for 7 days a week 23 hours a day to Arochlor-1242.					
PCBs	Ing 0.00004/Der 0.0001 Inh 0.006	Ing 0.00002/Der 0.0008 Inh 0.006	Ing 0.000005 Inh 0.0008	Ing 2:100,000 Inh NCFTER★	Ing 1:100,000 Inh NCFTER	Ing 2:1,000,000 Inh NCFTER
ATSDR 2000b (Update) groundwater north and south had the same maximum level	Child ingestion dose (0.00004) is 125 times less than the dose (0.005) associated with elevated and separated toenails, and immune system effects (reduced IgM and IgG antibody responses to sheep red blood cells) in studies of rhesus monkeys given Arochlor-1254 in capsules for longer than a year. Nonetheless this child ingestion dose is greater than the intermediate oral exposure minimum risk level (MRL) of 0.00003 set by dividing 0.0075 by an uncertainty factor of 300 (10 for extrapolation from a lowest observed adverse effect level to a no observed adverse effect level, 3 for extrapolation from animals to humans, and 10 for human variability). It is also higher than the chronic oral exposure MRL of 0.00002 set by dividing 0.005 by an uncertainty factor of 300 (10 for extrapolation from a lowest observed adverse effect level to a no observed adverse effect level, 3 for extrapolation from animals to humans, and 10 for human variability). Adult ingestion dose (0.00002) is 250 times less than the (0.005) sensitive dose health effects described above for children. The worker's dos is 1/3 the adult residential dose. Both the adult and worker doses are below the intermediate and chronic MRLs. Inhalation dose Child and adult inhalation doses (0.006) are 1.5 times less than the dose (0.009) associated with epithelial hyperplasia in the urinary bladder and endocrine symptoms (increased thyroid serum T3 and T4 hormones) in rats exposed 30 days, for 7 days a week 23 hours a day to Arochlor-1242). Worker's inhalation dose is 11.25 times less than this sensitive dose. Dermal doses can be washed off the skin because PCBs are absorbed slowly, but DOH evaluated PCB dermal exposures like oral exposures because if the skin is not washed, absorption of PCBs via skin is nearly complete. The adult dermal dose is the highest and is only 6.25 times less than the sensitive dose for child ingestion, symptoms described above.					
PCB-associated cancers	Chronic oral PCB exposures have been linked with liver cancer in 6 rat studies and thyroid follicular cell adenoma in 3 other rat studies.					

★ Not carcinogenic from this exposure route.

Chemical	Doses are in mg/kg/day unless listed as ppm (parts per million) in air: otherwise air levels are milligram s per cubic meter					
	children's dose	adult's dose	worker's dose	children's theoretical increased cancer risk	adult's theoretical increased cancer risk	worker's theoretical increased cancer risk
Selenium groundwater north	Ing 0.01/Der0.00002 Inh MD	Ing 0.006/Der0.00001 Inh MD	Ing 0.0007 Inh MD	No Slope	No Slope	No Slope
ATSDR 2003 (Update)	Child ingestion dose (0.01) is 2 times less than the dose (0.023) associated with selenosis (loss of nails, brittle hair) in people ingesting organic selenium for a lifetime; this dose is 1.5 times greater than the NOAEL (0.015) for selenosis. ATSDR calculated a chronic MRL of 0.005 mg/kg-day by dividing the NOAEL (0.015) by an uncertainty factor of three for human variability, so this dose is twice the chronic MRL. Adult ingestion dose (0.006) is slightly above the chronic MRL for selenosis. The adult dose is 6 times greater than the LOAEL dose linked with a 49% reduction in testosterone in a rabbit study. The worker's dose is almost 7 times less than the MRL and 1.5 times less than the dose linked with testosterone reduction. Dermal dose: Selenium fumes and acute dermal exposures to selenium dioxide caused skin rashes, burns, contact dermatitis, eye pain, tearing, blurred vision, redness and dulled corneas, although a dose was not reported. Cancer: Only selenium sulfide has been linked with liver and lung cancer in oral animal studies, this compound was tested because it is used in dandruff shampoos.					
Trichloroethene groundwater south	Ing 0.001/Der 0.0002 Inh 0.04 ppm	Ing 0.0004/Der0.00007 Inh 0.04 ppm	Ing 0.0001 Inh 0.002 ppm	No Slope	No Slope	No Slope
ATSDR 1997 (Update)	Child ingestion dose (0.001) is 180 times less than the dose (0.18) in a developmental rat study associated with a 5% increase in fetal heart abnormalities. Adult ingestion dose (0.0004) is 450 times than the dose (0.18) in a developmental rat study associated with a 5% increase in fetal heart abnormalities. The worker dose is 4 times less than the adult residential dose or 1800 time less than the sensitive dose. Inhalation dose (0.04 ppm) is 1,500 times less than the dose (60 ppm) associated with size increase in large star-shaped nerve cells (astroglial hypertrophy) in an intermediate gerbil study. The worker dose was 20 times less than the residential exposure dose, or 30,000 times less than the sensitive dose. Dermal dose: Dermal exposures to trichloroethene cause skin whitening in humans due to fat extraction. Occupational skin exposures to high trichloroethene concentrations caused skin irritation, burns, rashes, jaundice and abnormal liver function. Some individuals develop hypersensitivity reactions that include skin and liver effects. Dermal absorption causes pain, and may result in other neurological effects, including dizziness, headache, insomnia, lethargy, forgetfulness and loss of feeling in the hands and feet. While ATSDR did not report doses for dermal exposure, DOH assumed these effects occurred at concentrated trichloroethene levels.. Cancer: Animal studies and human medical case studies are insufficient for evaluating the carcinogenicity of trichloroethene via inhalation or ingestion.					

Chemical	Doses are in mg/kg/day unless listed as ppm (parts per million) in air: otherwise air levels are milligram s per cubic meter					
	children's dose	adult's dose	worker's dose	children's theoretical increased cancer risk	adult's theoretical increased cancer risk	worker's theoretical increased cancer risk
Vanadium groundwater south	Ing 0.04/Dermal 0.00005 Inh MD	Ing 0.02/ Der 0.00004 Inh MD	Ing 0.005 Inh MD	No Slope	No Slope	No Slope
ATSDR 1992b TP-91/29	<u>Child ingestion dose</u> (0.04) is 7.5 times less than the no observed adverse effect level dose (0.3) causing mild bleeding in the kidneys of rats exposed to sodium metavanadate for 3 months. Nonetheless this child ingestion dose is 13.3 times greater than the intermediate oral exposure MRL of 0.003 set by dividing 0.3 by an uncertainty factor of 100 (10 for extrapolation from animals to humans, and 10 for human variability). <u>Adult ingestion dose</u> (0.02) is 15 times less than the (0.3) sensitive dose health effects and about 7 times greater than the MRL described above for children. The worker dose is 4 times less than the adult residential dose or 60 times less than the sensitive dose and about half the MRL. <u>Dermal dose:</u> ATSDR did not locate studies regarding adverse health effects in humans or animals after dermal exposures to vanadium.					
Vanadium soil south	Ing 1.3 Inh 0.009	Ing 0.1 Inh 0.009	Ing 0.05 Inh 0.005	No Slope	No Slope	No Slope
Vanadium-associated cancers	<u>Child ingestion dose</u> (1.3) is 4.3 times greater than the no observed adverse effect level dose (0.3) causing mild bleeding in the kidneys of rats exposed to sodium metavanadate for 3 months. Nonetheless this child ingestion dose is 433.3 times greater than the intermediate oral exposure MRL of 0.003 set by dividing 0.3 by an uncertainty factor of 100 (10 for extrapolation from animals to humans, and 10 for human variability). <u>Adult ingestion dose</u> (0.1) is 3 times less than the (0.3) sensitive dose health effects and about 33 times greater than the MRL described above for children. The worker dose is 20 times less than the adult residential dose and 6 times less than the sensitive dose but is still 16 times greater than the MRL. <u>Inhalation dose</u> (0.009) is 6.7 times less than the dose (0.06) associated with bronchial irritation (mucous formation and coughing) in two persons exposed for 8 hours to vanadium as vanadium pentoxide. The worker dose is about half the dose calculated for residential exposures. The onset of coughing and mucus formation was delayed 7 to 24 hours. Pulmonary function tests were normal. Other effects in workers chronically exposed to vanadium dusts included eye irritation, skin rashes, and weight loss. Animal studies and human medical case studies are insufficient for evaluating the carcinogenicity of vanadium via inhalation or ingestion.					

Chemical	Doses are in mg/kg/day unless listed as ppm (parts per million) in air: otherwise air levels are milligram s per cubic meter					
	children's dose	adult's dose	worker's dose	children's theoretical increased cancer risk	adult's theoretical increased cancer risk	worker's theoretical increased cancer risk
Vinyl Chloride groundwater south	Ing 0.002/Der 0.00006 Inh 0.12 ppm	Ing 0.0009/Der 0.00004 Inh 0.12 ppm	Ing 0.0003 Inh 0.012 ppm	Ing 1.3:1,000 Der 4:100,000 Inh 3.4:100,000	Ing 6 :1,000 Der 4:100,000 Inh 3.4:000,000	Ing 2:1,000 Inh 3.4:1,000,000
ATSDR 2004 (Update)	Child ingestion dose (0.002) is 85 times less than the NOAEL dose (0.17) associated with liver cell polymorphism (the original cells form new and different cells when they proliferate) in a chronic rat study. Nonetheless this child ingestion dose equals the chronic oral exposure minimum risk level of 0.002 ATSDR set by dividing 0.17 by an uncertainty factor of 100 (10 for extrapolation from animals to humans and 10 for human variability). Adult ingestion dose (0.0009) is 188 times less than the (0.17) sensitive dose and 2.2 times less then the MRL. The worker's dose is 1/3 the adult dose. Inhalation dose for residential exposures (0.12 ppm) is 83 times less than the dose (10) associated with liver cell centrilobular hypertrophy (growth of the liver cells through enlargement of the central parts of the lobes) in an intermediate rat study. ATSDR calculated an intermediate-duration MRL of 0.03 ppm from this study. The residential exposure level (for vinyl chloride aerated from groundwater used indoors) is 4 times the MRL. While the worker dose is 833 times the sensitive dose, it is only 2.5 times less than the intermediate MRL. Dermal dose: ATSDR did not locate studies regarding adverse health effects in humans or animals after dermal exposures to vinyl chloride. Associated cancer Results from worker studies have suggested that breathing air or drinking water containing moderate levels of vinyl chloride increases people's cancer risk. Liver, brain, lung and some blood cancers may be connected with breathing vinyl chloride for long periods. Long-term low-level inhalation exposures in animals showed increases in liver and mammary gland cancers. Low-level oral rat studies also showed associations with lung and liver cancer.					

Appendix C—Gulf County Florida Cancer Data Summary

Incidence Number, Age-Specific and Age-Adjusted Rates for Liver and All Cancers in Florida and Gulf County, 1981-1999

	Liver				All Cancers			
	Gulf		Florida		Gulf		Florida	
	Count	Rate	Count	Rate	Count	Rate	Count	Rate
Age 0 to 4	0	0	64	0.40	4	27.41	3,364	20.76
Age 5 to 9	0	0	15	0.10	2	12.87	1,784	11.65
Age 10 to 14	0	0	15	0.10	1	6.23	1,872	12.43
Age 15 to 19	0	0	18	0.12	3	18.05	2,866	18.40
Age 20 to 24	0	0	35	0.21	6	35.08	4,985	29.62
Age 25 to 29	0	0	47	0.27	6	33.37	9,571	54.03
Age 30 to 34	0	0	86	0.47	8	45.04	16,430	89.93
Age 35 to 39	0	0	149	0.84	11	69.62	24,089	136.08
Age 40 to 44	1	6.51	196	1.22	27	175.64	34,730	216.31
Age 45 to 49	0	0.00	354	2.51	48	356.14	49,093	348.67
Age 50 to 54	0	0.00	421	3.36	63	487.73	69,502	555.48
Age 55 to 59	0	0.00	519	4.32	94	725.70	2,572	854.68
Age 60 to 64	2	17.10	818	6.46	150	1,282.38	52,729	1,207.07
Age 65 to 69	2	17.65	1,222	9.34	193	1,703.29	26,923	1,734.96
Age 70 to 74	0	0	1,416	11.84	177	2,084.31	47,274	2,067.38
Age 75 to 79	0	0	1,226	13.20	135	2,156.55	11,647	2,279.02
Age 80 to 84	0	0	737	12.41	79	1,975.49	38,666	2,335.83
Age 85 & Up	0	0	521	12.45	69	2,470.46	94,668	2,261.36
Total Count	5		7,859		1,076		492,765	
Age-Adjusted Rate		**1.80**		**2.60**		**429.82**		**456.69**

jls 2/15/02

Liver Cancer Incidence Rates per 100,000 population, 1981-2000

	Gulf County		Florida	
Age Group	Number	Age-Specific Rate	Number	Age-Specific Rate
0 to 4	0	-	72	0.4
5 to 9	0	-	14	0.1
10 to 14	0	-	17	0.1
15 to 19	0	-	18	0.1
20 to 24	0	-	36	0.2
25 to 29	0	-	51	0.3
30 to 34	0	-	95	0.5
35 to 39	0	-	162	0.8
40 to 44	1	6.2	235	1.3
45 to 49	0	-	433	2.9
50 to 54	0	-	513	3.8
55 to 59	0	-	613	4.8
60 to 64	3	23.3	933	6.9
65 to 69	2	16.2	1,409	10.1
70 to 74	0	-	1,660	13.2
75 to 79	1	15.1	1,422	14.6
80 to 84	0	-	894	14.8
85 and Up	0	-	708	16.4
TOTAL	7		9,285	
Age-adj Rate		**2.4**		**2.92**

All Cancers Incidence Rates per 100,000 population, 1981-2000

	Gulf County		Florida	
Age Group	Number	Age-Specific Rate	Number	Age-Specific Rate
0 to 4	4	28.0	3,548	20.9
5 to 9	2	12.3	1,961	11.9
10 to 14	4	22.9	2,005	12.2
15 to 19	3	18.1	3,073	18.1
20 to 24	6	41.5	5,276	29.6
25 to 29	7	41.3	10,136	51.8
30 to 34	7	43.6	17,237	87.2
35 to 39	14	87.4	25,542	131.7
40 to 44	26	161.5	37,155	213.0
45 to 49	54	371.8	52,829	358.6
50 to 54	68	485.0	75,075	558.9
55 to 59	99	703.7	110,087	861.3
60 to 64	159	1,234.9	162,546	1,198.2
65 to 69	212	1,719.7	239,844	1,724.0
70 to 74	191	2,036.0	264,015	2,102.8
75 to 79	144	2,174.6	228,090	2,338.9
80 to 84	85	2,035.4	150,878	2,494.1
85 and Up	79	2,854.0	106,295	2,458.5
TOTAL	1,164		1,495,592	
Age-adj Rate		**436.7**		**464.87**

Source: Department of Health
Environmental Epidemiology
Florida Cancer Data System

Age-Adjusted to U.S. 2000 Standard Million

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Appendix D—Risk of Illness, Dose Response/Threshold, and Uncertainty in Public Health Assessments

Risk of Illness

In this health assessment, the risk of illness is the chance that exposure to a hazardous contaminant is associated with a harmful health effect or illness. The risk of illness is not a measure of cause and effect; only an in-depth health study can identify a cause and effect relationship. Instead, we use the risk of illness to decide if the site needs a follow-up health study and to identify possible associations.

The greater the exposure to a hazardous contaminant (dose), the greater the risk of illness. The amount of a substance required to harm a person's health (toxicity) also determines the risk of illness. Exposure to a hazardous contaminant above a minimum level increases everyone's risk of illness. Only in unusual circumstances, however, do many people become ill.

Information from human studies provides the strongest evidence that exposure to a hazardous contaminant is related to a particular illness. Some of this evidence comes from doctors reporting an unusual incidence of a specific illness in exposed individuals. Studies that are more formal compare illnesses in people with different levels of exposure. However, human information is very limited for most hazardous contaminants, and scientists must frequently depend upon data from animal studies. Hazardous contaminants associated with harmful health effects in humans are often associated with harmful health effects in other animal species. There are limits, however, in only relying on animal studies. For example, scientists have found some hazardous contaminants are associated with cancer in animals, but lack evidence of a similar association in humans. In addition, humans and animals have differing abilities to protect themselves against low levels of contaminants, and most animal studies test only the possible health effects of high exposure levels. Consequently, the possible effects on humans of low-level exposure to hazardous contaminants are uncertain when information is derived solely from animal experiments.

Dose Response/Thresholds

The focus of toxicological studies in humans or animals is identification of the relationship between exposure to different doses of a specific contaminant and the chance of having a health effect from each exposure level. This dose-response relationship provides a mathematical formula or graph that we use to estimate a person's risk of illness. The actual shape of the dose-response curve requires scientific knowledge of how a hazardous substance affects different cells in the human body. Dose-response curves used to estimate the risk of noncancer illnesses include a threshold dose while those used to estimate the risk of cancer do not. A threshold dose is the highest exposure dose at which there is no risk of illness. The dose-response curves for noncancer illnesses include a threshold dose that is greater than zero. Scientists include a threshold dose in these models because the human body can adjust to varying amounts of cell damage without illness. The threshold dose differs for different contaminants and different exposure routes, and we estimate it from information gathered in human and animal studies. In contrast, the dose-response curves used to estimate the risk of cancer assume there is no threshold dose (or, the cancer threshold dose is zero). This assumes a single contaminant molecule may be sufficient to cause a clinical case of cancer. This assumption is very conservative, and many scientists believe a threshold dose greater than zero also exists for the development of cancer.

Uncertainty

All risk assessments, to varying degrees, require the use of assumptions, judgments, and incomplete data. These contribute to the uncertainty of the final risk estimates. Some more important sources of uncertainty in this public health assessment include environmental sampling and analysis, exposure parameter estimates, use of modeled data, and present toxicological knowledge. These uncertainties may cause risk to be overestimated or underestimated. Because of the uncertainties described below, this public health assessment does not represent an absolute estimate of risk to persons exposed to chemicals at or near the former paper mill site.

Environmental chemistry analysis errors can arise from random errors in the sampling and analytical processes, resulting in either an over- or under-estimation of risk. We can control these errors to some extent by increasing the number of samples collected and analyzed and by sampling the same locations over several different periods. The above actions tend to minimize uncertainty contributed from random sampling errors.

There are two areas of uncertainty related to exposure parameter estimates. The first is the exposure-point concentration estimate. The second is the estimate of the total chemical exposures. In this assessment, we used maximum detected concentrations as the exposure point concentration. We believe using the maximum measured value to be appropriate because we cannot be certain of the peak contaminant concentrations, and we cannot statistically predict peak values. Nevertheless, this assumption introduces uncertainty into the risk assessment that may over- or under-estimate the actual risk of illness. When selecting parameter values to estimate exposure dose, we used default assumptions and values within the ranges recommended by the Agency for Toxic Substances and Disease Registry, DEP, or the U.S. Environmental Protection Agency. These default assumptions and values are conservative (health protective) and may contribute to the over-estimation of risk of illness. Similarly, we assumed the maximum exposure period occurred regularly for each selected pathway. Both assumptions are likely to contribute to the over-estimation of risk of illness.

We also see data gaps and uncertainties in the design, extrapolation, and interpretation of toxicological experimental studies. Data gaps contribute uncertainty because information is either not available or is addressed qualitatively. Moreover, the available information on the interaction among chemicals found at the site, when present, is qualitative (that is, a description instead of a number) and we cannot apply a mathematical formula to estimate the dose. These data gaps may tend to underestimate the actual risk of illness. In addition, we see great uncertainties in extrapolating from high-to-low doses, and from animal-to-human populations. Extrapolating from animals to humans is uncertain because of the differences in the uptake, metabolism, distribution, and body organ susceptibility between different species. Human populations are also variable because of differences in genetic constitution, diet, home and occupational environment, activity patterns, and other factors. These uncertainties can result in an over- or underestimation of risk of illness. Finally, we see great uncertainties in extrapolating from high doses to low doses, and controversy in interpreting these results. Because the models used to estimate dose-response relationships in experimental studies are conservative, they tend to overestimate the risk. Techniques used to derive acceptable exposure levels account for such variables by using safety factors. Currently, there is much debate in the scientific community about how much we overestimate the actual risks and what the risk estimates really mean.

Appendix E—Public Comments and Florida DOH Responses

Comment: DOH did not notify Stone Container Corporation about the Public Comment Meeting, they would have liked to have had a representative present.

Response: A Stone Container Corporation representative left DOH a voicemail about the meeting on the afternoon of the day we held the meeting (we were en route). Most of the questions the community had were about the Mill View Subdivision and were not about the former mill site. DOH mailed out fact sheets announcing the meeting to 200 of the approximately 339 residences within ¼ mile of the site. Of these, the Post Office returned 30 with undeliverable addresses. Florida DOH had sent Stone Container the completed Agency draft of this report.

Comment: The Public Comment version of this Public Health Assessment did not include information about site remediation that Stone Container Corporation's contractors completed in the last year.

Response: DEP provided DOH with a compact disk that contained the Site Rehabilitation Report for the southern part of the site after the June 2005 Public Meeting. We reviewed the additional information for this final version of the Public Health Assessment.

Comment: Using site evaluations prepared by the contractors employed by the current site owners is unacceptable.

Response: DEP performed a Preliminary Site Assessment for the former St. Joe Forest Products site. They split samples with the contractors for Stone Container Corporation and St. Joe Company. In response to this comment, DOH amended the Forward section of this report to include DEP's contractors in the list of data generators. Nonetheless, DOH had included data from DEP's Preliminary Site Assessment in the References and Discussion sections in the *Public Comment draft* of this report.

Comment: Why would DOH say that DEP *assumes* site development might include commercials properties and high-density residential properties such as condominiums when front-page pictures of the engineered plans of these condominiums and commercial properties appeared in the local paper over a year ago?

Response: Residential zoning status was just conferred to parts of the site. Before November 2005, zoning changes were necessary for Stone Container Corporation to build residential buildings on the site. To meet Brownfields residential development criteria, Stone Container Corporation may amend the restrictive covenant. DEP Brownfields staff indicated large portions of the 120-acre site already meet other residential criteria. Therefore, if Stone Container

Corporation chooses, they can build residences on those portions, now that the Gulf County Commission has granted the proper zoning status.

Comment: How does DOH know the municipal water supply wells meet potable standards? The commenter sites the close proximity of the Wastewater Treatment Lagoons, about ¼-mile down gradient from city wells and the former paper mill sites as sources of contaminants. The commenter asked about salt-water intrusion into one of the city wells.

Response: State and federal regulations require periodic testing of Public Wells Systems. The following website lists the groups of chemicals that are analyzed for http://www.dep.state.fl.us/water/drinkingwater/standard.htm.

DEP requires testing public supply water for inorganic contaminants (metals), volatile organic contaminants, synthetic organic contaminants, radionuclides, microbiological contaminants, miscellaneous contaminants, and various chemicals that affect color and taste (for which there are secondary drinking water standards).

> *Required Testing:* The Safe Drinking Water Act (SDWA) is a federal law, passed in 1974, which has been amended several times to expand both its breadth and the Environmental Protection Agency's (EPA) power to enforce it. The SDWA establishes primary and secondary drinking water quality standards for public water systems that serve at least 15 service connections, or 25 or more people 60 days or more out of the year. This law also mandates notification of the public when water quality maximum contaminant levels are exceeded by individual water systems. The SWDA further mandates enforcement action when drinking water is not treated properly, exceeds water quality standards, or imposes any undue risk to the public's health.
>
> In addition to these federal laws, the Florida Legislature has enacted several laws and rules to ensure that Florida's drinking waters are kept safe. Similar to the SDWA are Florida Statutes 403.850 - 403.864 that direct the Florida DEP to create and enforce rules regarding drinking water. These rules not only adhere to the federal government's national primary and secondary drinking water standards, but they also create additional rules to fulfill state requirements. These rules are contained in:

- **Chapter 62-550, F.A.C.—Drinking Water Standards, Monitoring, and Reporting**. Adopts EPA rules and regulates the water produced by public water systems. Municipal water systems are required to be sampled for volatile organic compounds, semivolatile organic compounds, and metals every three years. Requirements are set for more frequent sampling intervals (or the requirement of remediation systems) for water systems that do not meet these standards.
- **Chapter 62-555, F.A.C.—Permitting and Construction of Public Water Systems**. State rules which apply to water systems.
- **Chapter 62-560, F.A.C.—Requirements for Public Water Systems that are out of Compliance**. Adopts EPA rules on the actions a water system must take when it does not comply with established standards.

DOH contacted DEP to inquire about salt-water intrusion in the Port St. Joe municipal wells. ***DEP replied:***

> Salt-water intrusion is typically indicated by increased levels of chloride and sodium. We have not seen an increase in these two parameters in the Port St. Joe water wells. In the last 10 years, sodium (maximum contaminant level is 160 milligrams per liter (mg/l) has ranged from 15.3 to 20.5 mg/l; chloride (max. contaminant level is 250 mg/l) has ranged from 17 to 44.9 mg/l.

Another important piece of federal legislation is the Clean Water Act of 1972. The chief purpose of the Clean Water Act is the elimination of point source pollution to surface water.

Shallow groundwater movement: Very shallow groundwater flow can be similar to surface water flow because it often follows elevation. However, this premise generally only holds for the shallowest groundwater, as sediment or clay and stone beds may interrupt or influence groundwater flow direction in deeper sediments. For this reason, very shallow groundwater may flow toward surface water bodies, for example to the north near the Gulf County Canal on the northern part of the site, and to the west on the middle part of the site of the site. DEP's (2002) Combined Preliminary Assessment/Site Inspection, (page 95) states "Evidence of a groundwater divide, apparently caused by discharge from a broken water pipe, was documented between the Mill and the former surface impoundment during the current investigation. Groundwater flow at the Mill portion of the site appears to move south or southeast. Groundwater flows westward (toward the bay) on the former surface impoundment portion of the site." "The water table was encountered between 2 and 11 feet below the surface." These different groundwater flow directions are not contradictory when viewed in context of local site conditions.

Comment: What are the risks of the proposed Wastewater Treatment Plant spray field improvements?

Response: The DOH Health Assessment Team Staff has not been asked to evaluate information on the Wastewater Treatment Plant spray field, and we do not have information about these improvements.

Comment: Why did DOH describe what "is generally done" on Brownfield Cleanup sites when referring to St. Joe Company's plans for the northern portion of the site? What government agency will ensure that these recommendations are carried out?

Response: DEP Professional Engineers review and approve the Contamination Assessment Reports (describing what contaminants are on the site), the Remedial Action Plans (describing what actions will be taken to clean up contaminants on the site), and any required analytical results they may have asked for—after remedial actions are taken—to show the site has been remediated. DEP, not the DOH, determines if the terms of the Consent Order have been met. At this time, DEP has not approved the Contamination Assessment Report for the northern part of the site, meaning more information on the level and location of contaminants is needed. DOH's comments are therefore based on incomplete information. DOH and ATSDR will work with DEP to follow up on the recommendations made in this report.

Comment: St. Joe Bay and the Gulf County Canal may not be barriers to the northern part of the site because area visitors may enter this area by boat and may not know it is contaminated.

Response: The sand along the Gulf County Canal, where boaters may stop to fish, is not contaminated. To contact the contaminated sediments in the former lagoon, trespassers would have to get through thick scrubby vegetation and dig down into the former lagoon. Photos 9 and 10 show the northern and southern boundaries of the northern part of the site, respectively as quite vegetated. DOH recommends that this interior area be posted to prevent trespassing.

Comment: Who will follow up on DOH's Recommendations?

Response: DEP, DOH, and ATSDR will follow up on DOH's recommendations. As of November 2005, the entire southern portion of the site was remediated to DEP's specifications for industrial use, and portions are suitable for residences. Stone Container Corporation is negotiating a restrictive covenant to prevent future exposures to contaminated soil that was capped on the site and shallow contaminated groundwater.

Comment: Why did the state-established buffer zone for the former Wastewater Treatment Plant effluent of 2.9 miles only apply to oysters, mussels, and quahog clams, and not crabs, scallops, shrimp or other finfish? The commenter implies sediment chemicals would be a problem because sediments could be redistributed by shrimp nets.

Response: DOH asked the preparers of the DEP Preliminary Site Investigation about this question. DEP thought the permit program was based on EPA requirements, which were administered by the state of Florida. They thought EPA's buffer likely only applied to organisms that lived in sediments as filter feeders or attached to the bottom and did not readily move because they would constantly be exposed to this effluent.

Comment: Who had oversight of the remediation of the southern portion of the site?

Response: While DEP did, Remediation Contracting Companies such as Malcolm Pirnie employ licensed Professional Engineers and Professional Geologists who seal the site reports that are submitted to DEP. These seals indicate accountability for the report contents, including chain-of custody for laboratory work, oversight of sampling, and oversight of waste disposal. After these reports are submitted to DEP, Professional Engineers and Geologists employed by the state are accountable for assuring that the report contents meet state regulations and requirements. The Department of Business and Professional Regulation licenses Professional Engineers and Geologists. To become a "professional" and obtain a license, engineers and geologists must have taken the appropriate classes when obtaining their college degrees, they must work for a Professional Engineer or Geologist for six years, and they must pass two licensing examinations.

After fulfilling these requirements, they are then allowed to purchase a license to practice, and they must renew the license every two years in order to practice their discipline. Falsification of information in these reports could cause these professionals to lose their licenses.

Comment: Why was cement demolition debris from the mill used at boat landings, other water areas, and to build a road through Indian Swamp?

Response: DEP does not regulate material qualifying as clean debris as waste. DEP staff said there was no reason to suspect that the concrete debris from the site was contaminated. Persons suspecting the fill was used improperly can have DEP investigate.

Comment: DEP, in its 2002 Preliminary Site Assessment/Site Investigation, mentioned radioactive material in scale buildup along a short section of a sulfuric acid line pipe. What happened to it during the remediation activities?

Response: As mentioned in that report, DOH determined this scale was not dangerous to human health or the environment, so it could have been disposed of along with other building materials.

Comment: The new water plant using surface water from the Chipola canal is not scheduled to go on line until 2007 (not 2001). How can water that has fish advisories issued on it be used as a potable water source?

Response: DOH checked with DEP engineers and corrected this date to 2007. The water and canal sediments have very low levels of mercury. While these very low levels may be acceptable for drinking, bottom dwelling fish, and those that are slow growing but at the top of their food chains tend to bioconcentrate and even biomagnify these minute amounts of mercury. The fish advisories for the Chipola Canal suggest that sensitive subpopulations, women who are or may become pregnant, and children— should not eat largemouth bass, bowfin or gar. All others may eat these species of fish from the Chipola Canal once a month.

Comment: The cancer information in this document is not creditable.

Response: An epidemiologist from the Division of Environmental Health prepared the cancer analysis in Appendix C for this report using data from the Florida Cancer Data System. National lifetime estimates for developing cancer are between 1 in 3, and 1 in 4 for each person.

When asked to explain the limitations of these data, the epidemiologist explained that since Gulf County is rural, its population is very small in comparison to the rest of Florida. Because there will be very few cases of cancer when compared to the state as a whole she tried to look at as many years as possible. Our epidemiologist also age-adjusted the data. This is important because, for example, if the area being investigated had younger people than the rest of the state, you would expect to see fewer cases of cancer per capita. Conversely, in an area with older people than the rest of the state, you might expect to see greater numbers than you would see for the general population. Age-adjusting the data allows you to eliminate the effects of age to some extent and just compare the differences in rates.

Comment: Citizen's reports of buried materials and other environmental concerns have been discounted or ignored.

Response: DOH has included all the concerns they read about or heard, or have received during the public comment of this document. Stone Container Corporation has worked with a Community Advisory Board comprised of newspaper staff, the mayor, local business owners, and local residents, to keep them informed of all site activities and findings.

Members of the Brownfields Community Advisory Board met several times to receive updates on the Brownfields Site Assessment prior to site remediation. According to an article published by the Port St. Joe Star, 2/26/04, this committee talked with representatives of Malcolm Pirnie and PSI (contractors for St. Joe and Stone, respectively) about claims and rumors of contamination at the site. One category of concerns dealt with areas where buried containers were supposed to be located. According a representative of Stone Container, Malcolm Pirnie focused on this concern category during the testing period. This representative explained that DEP had actually gone on location and pointed out specific areas of concern, where, based on reports from unnamed individuals, problems might exist. These specific areas were tested for contamination as DEP requested.

Comment: Could the further testing DOH requested be done by DEP?

Response: DOH is negotiating with ATSDR about fish and shellfish testing. If DOH and ATSDR staff can work out funding and other issues, DOH will coordinate with the Florida Fish and Wildlife Commission to collect fish and shellfish and will have these samples analyzed. This testing would provide some much-needed data especially with regard to clams. Ingestion of fish and shellfish from the bay are much more likely human exposure pathways than soil or water ingestion, especially at this time.

Comment: Concerning off-site wastewater samples, in an 11/16/95 memo, a DEP employee had major concerns with the Port St. Joe Waste Water Treatment Plant's impact on surface water. He attached a spreadsheet for toxicity data starting in January 1991 that showed that the facility had not met the States' surface water standards in fifty percent of all valid tests performed.

Response: DOH does not have this information, and so cannot evaluate it. Florida DOH did recommend additional surface water testing, as we did not consider the available information adequate to characterize surface water quality.

Comment: A former Deputy Secretary of DEP asked EPA to allow the site owner's contractors to conduct testing of site media for the Preliminary Site Assessment**.**

Response: Although this request was made, DEP staff and their contractor accompanied the contractors for the site owners and split media samples with them. DEP's contractor sampled soil and groundwater for analyses to provide data for the Preliminary Site Assessment. An EPA-approved contract laboratory analyzed the DEP sample splits.

Comment: Little dioxin testing has been carried out for this site.

Response: Soil and sediments were sampled for dioxin, including splits collected by DEP's contractor. As these tests are expensive, and the initial samples did not show elevated levels, DEP did not require extensive follow up sampling for dioxin in these media. Dioxin tends not to partition into water.

Comment: Offsite groundwater needs to be considered as a potential exposure pathway**.**

Response: DOH does not consider offsite groundwater to be a potential exposure pathway, *as groundwater*. Because shallow groundwater should be flowing toward sea level, DOH's primary concern with shallow groundwater is discharge into nearby surface water bodies. Additional surface water sampling or groundwater modeling that demonstrates attenuation levels could provide data we could use to evaluate the public health concerns for surface water exposure that may contain shallow groundwater discharges.

Comment: The public meeting was not widely announced.

Response: DOH mailed out fact sheets announcing the meeting to 200 of the approximately 339 residences within ¼ mile of the site. Of these, the Post Office returned 30 with undeliverable addresses. DOH staff planned and set up this public meeting with the help of City Commissioner Rachel Crews who was unable to attend due to her attendance at another meeting. At the meeting, DOH discussed the findings of the third Millville Health Consult and the findings of the former St. Joe Forest site. Many of the questions asked at the meeting were about the Millville site. WJHG-TV, Channel 7, from Panama City sent a reporter to the meeting. This reporter filed a story about the meeting on Channel 7's web site, http://www.wjhg.com/. Florida DOH did not do a press release.

Comment: DOH requested public comments to be in by May 15, 2005, while they held the meeting on June 21, 2005.

Response: The three DOH health assessors worked on roughly 25 sites last year. DOH completed the Public Comment draft of this report in February 2005 but did not hold the Public Meeting as quickly as we had initially planned to. The author put this report on the DOH web site in anticipation of an earlier meeting, and the copy the commenter references apparently came from the web site. The commenter was at the public meeting but did not take a copy of the St. Joe Forest Products Public Health Assessment report distributed there, which did ask for comments by July 21, 2005. DOH generally provides more time if asked. DOH changed the comment due-date on our web site in response to this question.

Comment: The Public Health Assessment document for the mill site was not available to the public at the Public Library in Port St. Joe.

Response: DOH staff gave extra copies to the Gulf County Health Department representative and community members. DOH Community Involvement staff changed since DOH last held a public meeting in Port St. Joe. When DOH was reminded in August 2005 that a copy had not been sent to the repository established by the Community Involvement staff's predecessor, we sent one immediately.

Appendix F—Glossary of Environmental Health Terms

This glossary defines words used by the Agency for Toxic Substances and Disease Registry (ATSDR) in communications with the public. It is not a complete dictionary of environmental health terms. If you have questions or comments, call ATSDR's toll-free telephone number, 1-888-422-8737.

Absorption
The process of taking in. For a person or an animal, absorption is the process of a substance getting into the body through the eyes, skin, stomach, intestines, or lungs.

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

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

Additive effect
A biologic response to exposure to multiple substances that equals the sum of responses of all the individual substances added together [compare with antagonistic effect and synergistic effect].

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

Aerobic
Requiring oxygen [compare with anaerobic].

The Agency for Toxic Substances and Disease Registry (ATSDR)
The Agency for Toxic Substances and Disease Registry (ATSDR) is a federal public health agency with headquarters in Atlanta, Georgia, and 10 regional offices in the United States. ATSDR's mission is to serve the public by using the best science, taking responsive public health actions, and providing trusted health information to prevent harmful exposures and diseases related to toxic substances.

Ambient
Surrounding (for example, *ambient* air).

Anaerobic
Requiring the absence of oxygen [compare with aerobic].

Analyte
A substance measured in the laboratory. A chemical for which a sample (such as water, air, or blood) is tested in a laboratory. For example, if the analyte is mercury, the laboratory test will determine the amount of mercury in the sample.

Analytic epidemiologic study
A study that evaluates the association between exposure to hazardous substances and disease by testing scientific hypotheses.

Antagonistic effect
A biologic response to exposure to multiple substances that is **less** than would be expected if the known effects of the individual substances were added together [compare with additive effect and synergistic effect].

Background level
An average or expected amount of a substance or radioactive material in a specific environment, or typical amounts of substances that occur naturally in an environment.

Biodegradation
Decomposition or breakdown of a substance through the action of microorganisms (such as bacteria or fungi) or other natural physical processes (such as sunlight).

Biologic indicators of exposure study
A study that uses (a) biomedical testing or (b) the measurement of a substance [an analyte], its metabolite, or another marker of exposure in human body fluids or tissues to confirm human exposure to a hazardous substance [also see exposure investigation].

Biologic monitoring
Measuring hazardous substances in biologic materials (such as blood, hair, urine, or breath) to determine whether exposure has occurred. A blood test for lead is an example of biologic monitoring.

Biologic uptake
The transfer of substances from the environment to plants, animals, and humans.

Biota
Plants and animals in an environment. Some of these plants and animals might be sources of food, clothing, or medicines for people.

CAP [see Community Assistance Panel.]

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

Cancer risk
A theoretical risk for getting cancer if exposed to a substance every day for 70 years (a lifetime exposure). The true risk might be lower.

Carcinogen
A substance that causes cancer.

Case study
A medical or epidemiologic evaluation of one person or a small group of people to gather information about specific health conditions and past exposures.

Case-control study
A study that compares exposures of people who have a disease or condition (cases) with people who do not have the disease or condition (controls). Exposures that are more common among the cases may be considered as possible risk factors for the disease.

Central nervous system
The part of the nervous system that consists of the brain and the spinal cord.

CERCLA [see Comprehensive Environmental Response, Compensation, and Liability Act of 1980]

Chronic
Occurring over a long time [compare with acute].

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

Cluster investigation
A review of an unusual number, real or perceived, of health events (for example, reports of cancer) grouped together in time and location. Cluster investigations are designed to confirm case reports; determine whether they represent an unusual disease occurrence; and, if possible, explore possible causes and contributing environmental factors.

Community Assistance Panel (CAP)
A group of people from a community and from health and environmental agencies who work with ATSDR to resolve issues and problems related to hazardous substances in the community. CAP members work with ATSDR to gather and review community health concerns, provide information on how people might have been or might now be exposed to hazardous substances, and inform ATSDR on ways to involve the community in its activities.

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

Completed exposure pathway [see exposure pathway].

Comprehensive Environmental Response, Compensation, and Liability Act of 1980 CERCLA)
CERCLA, also known as Superfund, is the federal law that concerns the removal or cleanup of hazardous substances in the environment and at hazardous waste sites. ATSDR, which was created by CERCLA, is responsible for assessing health issues and supporting public health activities related to hazardous waste sites or other environmental releases of hazardous substances. This law was later amended by the Superfund Amendments and Reauthorization Act (SARA).

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

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

Delayed health effect
A disease or an injury that happens as a result of exposures that might have occurred in the past.

Dermal
Referring to the skin. For example, dermal absorption means passing through the skin.

Dermal contact
Contact with (touching) the skin [see route of exposure].

Descriptive epidemiology
The study of the amount and distribution of a disease in a specified population by person, place, and time.

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

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

Dose (for radioactive chemicals)
The radiation dose is the amount of energy from radiation that is actually absorbed by the body. This is not the same as measurements of the amount of radiation in the environment.

Dose-response relationship
The relationship between the amount of exposure [dose] to a substance and the resulting changes in body function or health (response).

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

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

EPA
United States Environmental Protection Agency.

Epidemiologic surveillance [see Public health surveillance].

Epidemiology
The study of the distribution and determinants of disease or health status in a population; the study of the occurrence and causes of health effects in humans.

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

Exposure assessment
The process of finding out how people come into contact with a hazardous substance, how often and for how long they are in contact with the substance, and how much of the substance they are in contact with.

Exposure-dose reconstruction
A method of estimating the amount of people's past exposure to hazardous substances. Computer and approximation methods are used when past information is limited, not available, or missing.

Exposure investigation
The collection and analysis of site-specific information and biologic tests (when appropriate) to determine whether people have been exposed to hazardous substances.

Exposure pathway

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

Exposure registry

A system of ongoing follow up of people who have had documented environmental exposures.

Feasibility study

A study by EPA to determine the best way to clean up environmental contamination. A number of factors are considered, including health risk, costs, and what methods will work well.

Groundwater

Water beneath the earth's surface in the spaces between soil particles and between rock surfaces [compare with surface water].

Hazard

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

Hazardous Substance Release and Health Effects Database (HazDat)

The scientific and administrative database system developed by ATSDR to manage data collection, retrieval, and analysis of site-specific information on hazardous substances, community health concerns, and public health activities.

Hazardous waste

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

Health investigation

The collection and evaluation of information about the health of community residents. This information is used to describe or count the occurrence of a disease, symptom, or clinical measure and to evaluate the possible association between the occurrence and exposure to hazardous substances.

Indeterminate public health hazard

The category used in ATSDR's public health assessment documents when a professional judgment about the level of health hazard cannot be made because information critical to such a decision is lacking.

Incidence

The number of new cases of disease in a defined population over a specific time period [contrast with prevalence].

Ingestion

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

Inhalation

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

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

In vitro
In an artificial environment outside a living organism or body. For example, some toxicity testing is done on cell cultures or slices of tissue grown in the laboratory, rather than on a living animal [compare with in vivo].

In vivo
Within a living organism or body. For example, some toxicity testing is done on whole animals, such as rats or mice [compare with in vitro].

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

Medical monitoring
A set of medical tests and physical exams specifically designed to evaluate whether an individual's exposure could negatively affect that person's health.

Metabolism
The conversion or breakdown of a substance from one form to another by a living organism.

Metabolite
Any product of metabolism.

mg/kg
Milligram per kilogram.

mg/cm^2
Milligram per square centimeter (of a surface).

mg/m^3
Milligram per cubic meter; a measure of the concentration of a chemical in a known volume (a cubic meter) of air, soil, or water.

Migration
Moving from one location to another.

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

National Priorities List for Uncontrolled Hazardous Waste Sites (National Priorities List or **NPL)**
EPA's list of the most serious uncontrolled or abandoned hazardous waste sites in the United States. The NPL is updated on a regular basis.

National Toxicology Program (NTP)
Part of the Department of Health and Human Services. NTP develops and carries out tests to predict whether a chemical will cause harm to humans.

No apparent public health hazard
A category used in ATSDR's public health assessments for sites where human exposure to contaminated media might be occurring, might have occurred in the past, or might occur in the future, but where the exposure is not expected to cause any harmful health effects.

No-observed-adverse-effect level (NOAEL)
The highest tested dose of a substance that has been reported to have no harmful (adverse) health effects on people or animals.

No public health hazard
A category used in ATSDR's public health assessment documents for sites where people have never and will never come into contact with harmful amounts of site-related substances.

NPL [see National Priorities List for Uncontrolled Hazardous Waste Sites]

Plume
A volume of a substance that moves from its source to places farther away from the source. Plumes can be described by the volume of air or water they occupy and the direction they move. For example, a plume can be a column of smoke from a chimney or a substance moving with groundwater.

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

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

Potentially responsible party (PRP)
A company, government, or person legally responsible for cleaning up the pollution at a hazardous waste site under Superfund. There may be more than one PRP for a particular site.

ppb
Parts per billion.

ppm
Parts per million.

Public availability session
An informal, drop-by meeting at which community members can meet one-on-one with ATSDR staff members to discuss health and site-related concerns.

Public comment period
An opportunity for the public to comment on agency findings or proposed activities contained in draft reports or documents. The public comment period is a limited time period during which comments will be accepted.

Public health action
A list of steps to protect public health.

Public health advisory
A statement made by ATSDR to EPA or a state regulatory agency that a release of hazardous substances poses an immediate threat to human health. The advisory includes recommended measures to reduce exposure and reduce the threat to human health.

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

Public health hazard
A category used in ATSDR's public health assessments for sites that pose a public health hazard because of long-term exposures (greater than 1 year) to sufficiently high levels of hazardous substances or radionuclides that could result in harmful health effects.

Public health hazard categories
Public health hazard categories are statements about whether people could be harmed by conditions present at the site in the past, present, or future. One or more hazard categories might be appropriate for each site. The five public health hazard categories are no public health hazard, no apparent public health hazard, indeterminate public health hazard, public health hazard, and urgent public health hazard.

Public health statement
The first chapter of an ATSDR toxicological profile. The public health statement is a summary written in words that are easy to understand. The public health statement explains how people might be exposed to a specific substance and describes the known health effects of that substance.

Public health surveillance
The ongoing, systematic collection, analysis, and interpretation of health data. This activity also involves timely dissemination of the data and use for public health programs.

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

Reference dose (RfD)
An EPA estimate, with uncertainty or safety factors built in, of the daily lifetime dose of a substance that is unlikely to cause harm in humans.

Remedial investigation
The CERCLA process of determining the type and extent of hazardous material contamination at a site.

RfD [see reference dose]

Risk
The probability that something will cause injury or harm.

Risk reduction
Actions that can decrease the likelihood that individuals, groups, or communities will experience disease or other health conditions.

Risk communication
The exchange of information to increase understanding of health risks.

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

Safety factor [see uncertainty factor]

SARA [see Superfund Amendments and Reauthorization Act]

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

Sample size
The number of units chosen from a population or an environment.

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

Special populations
People who might be more sensitive or susceptible to exposure to hazardous substances because of factors such as age, occupation, sex, or behaviors (for example, cigarette smoking). Children, pregnant women, and older people are often considered special populations.

Statistics
A branch of mathematics that deals with collecting, reviewing, summarizing, and interpreting data or information. Statistics are used to determine whether differences between study groups are meaningful.

Substance
A chemical.

Superfund [see Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) and Superfund Amendments and Reauthorization Act (SARA)

Superfund Amendments and Reauthorization Act (SARA)
In 1986, SARA amended the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) and expanded the health-related responsibilities of ATSDR. CERCLA and SARA direct ATSDR to look into the health effects from substance exposures at hazardous waste sites and to perform activities including health education, health studies, surveillance, health consultations, and toxicological profiles.

Surface water
Water on the surface of the earth, such as in lakes, rivers, streams, ponds, and springs [compare with groundwater].

Surveillance [see public health surveillance]

Survey
A systematic collection of information or data. A survey can be conducted to collect information from a group of people or from the environment. Surveys of a group of people can be conducted by telephone, by mail, or in person. Some surveys are done by interviewing a group of people [see prevalence survey].

Synergistic effect
A biologic response to multiple substances where one substance worsens the effect of another substance. The combined effect of the substances acting together is greater than the sum of the effects of the substances acting by themselves [see additive effect and antagonistic effect].

Teratogen
A substance that causes defects in development between conception and birth. A teratogen is a substance that causes a structural or functional birth defect.

Toxic agent
Chemical or physical (for example, radiation, heat, cold, microwaves) agents that, under certain circumstances of exposure, can cause harmful effects to living organisms.

Toxicological profile

An ATSDR document that examines, summarizes, and interprets information about a hazardous substance to determine harmful levels of exposure and associated health effects. A toxicological profile also identifies significant gaps in knowledge on the substance and describes areas where further research is needed.

Toxicology

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

Tumor

An abnormal mass of tissue that results from excessive cell division that is uncontrolled and progressive. Tumors perform no useful body function. Tumors can be either benign (not cancer) or malignant (cancer).

Uncertainty factor

Mathematical adjustments for reasons of safety when knowledge is incomplete. For example, factors used in the calculation of doses that are not harmful (adverse) to people. These factors are applied to the lowest-observed-adverse-effect-level (LOAEL) or the no-observed-adverse-effect-level (NOAEL) to derive a minimal risk level (MRL). Uncertainty factors are used to account for variations in people's sensitivity, for differences between animals and humans, and for differences between a LOAEL and a NOAEL. Scientists use uncertainty factors when they have some, but not all, the information from animal or human studies to decide whether an exposure will cause harm to people [also sometimes called a safety factor].

Urgent public health hazard

A category used in ATSDR's public health assessments for sites where short-term exposures (less than 1 year) to hazardous substances or conditions could result in harmful health effects that require rapid intervention.

Volatile organic compounds (VOCs)

Organic compounds that evaporate readily into the air. VOCs include substances such as benzene, toluene, methylene chloride, and methyl chloroform.

CERTIFICATION

This St. Joe Forest Products Public Health Assessment was prepared by the Florida Department of Health under a cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR). It is in accordance with approved methodology and procedures existing at the time the health assessment was begun. Editorial review was completed by the cooperative agreement partner.

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The Division of Health Assessment and Consultation, ATSDR, has reviewed this health consultation, and concurs with its findings.

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