HEALTH CONSULTATION

OUSTER CORPORATION

MIAMI, DADE COUNTY, FLORIDA

Prepared by:

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

Background and Statement of Issues

The Ouster Corporation stores soil-like materials from the yard processing operation at the Miami-Dade Resources Recovery Facility at 21001 SW 167th Avenue, Miami-Dade County, Florida (Figure 1). This soil-like material has been spread in the public right-of-way of a nearby street. In February 1998, Ouster tested soil-like material on the site and found arsenic, lead, hydrocarbons (components of petroleum and oil), and polychlorinated biphenyls (PCBs). Ouster also tested the shallow groundwater beneath the site and found elevated levels of arsenic in some monitoring wells (Figure 3). The Miami-Dade County Department of Environmental Resource Management (DERM) and the Miami-Dade County Health Department (CHD) tested 31 nearby private potable wells but did not find elevated arsenic levels (Figure 2). Ouster is considering additional groundwater monitoring (Figure 3).

Based on these results, Ouster agreed to limit the use of this soil-like material to nonresidential areas. In the Fall of 2001, Ouster removed the stockpiled material and provided it to Miami-Dade County as material for daily cover at lined-landfills. Due to their concerns that long-term storage of this material may have triggered groundwater contamination, DERM has required Ouster to perform an assessment of groundwater to determine the extent of contamination.

Nearby residents are concerned that they have been exposed to the soil-like material spread in the public right-of-way and to dust from the site. They are concerned this exposure may cause illness. Nearby residents are also concerned about the health of the Ouster workers.

The Miami-Dade CHD asked the Florida Department of Health (DOH) to review these data. DOH, through a cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR), evaluates the public health significance of hazardous waste sites in Florida. This is the first review of the Ouster site by either Florida DOH or ATSDR.

Demographics and Local Land Use

In 1990, about 815 people lived within one mile of the Ouster Corporation site. Twenty-nine percent were 19 years old or younger. Approximately 75 percent were white, 20 percent were white and nonwhite Hispanic, less than 2 percent were black, and less than 1 percent were America Indian, Asian, or Pacific Islander. The average per capita income was $16,724 and about 7 percent (60 people) were below the poverty level (US Bureau of Census, 1990).

The Ouster site is zoned for industrial use. An earthen berm and fence restrict public access. Although perimeter roads are lime-rock gravel, truck traffic across the site creates dust. Surrounding areas are zoned for agricultural use but also contain single-family homes. A recreational vehicle trailer park is approximately 1000 feet east of the site. The Sunrise School and Grant Center Hospital are about one mile southeast and northeast of the site, respectively.

Sampling and Test Results

On-site Soil-like Material

In February 1998, Ouster's contractor collected 26 composite samples from the seven on-site piles of the soil-like material. The samples were analyzed for RCRA (Resource Conservation and Recovery Act) metals, priority pollutant volatile organics, priority pollutant extractable organics, and non-priority pollutant organics. Between November 1998 and March 2001, the contractor collected 34 additional composite samples of the material and analyzed them for arsenic barium, selenium, silver, mercury, PCBs and lead.

Off-site Soil-like Material

In July 2001, four samples of the soil-like material in the right-of-way were collected (two by DERM and two by others) in the right-of-way along nearby Quail Roost Drive, west of SW 157th Avenue. DERM also collected one background soil sample. DERM analyzed these samples for metals, PCBs, and total recoverable petroleum hydrocarbons..

On- and Off-site Monitoring Wells

In the past three years, Ouster's consultants sampled ten on-site and six off-site monitoring wells. They analyzed the groundwater from these wells for metals, ammonia, nitrates, and polychlorinated biphenyls (PCBs).

Off-Site Private Drinking Water Wells

Since July 2000, DERM and the CHD have sampled 31 nearby private wells and tested for arsenic, ammonia-nitrate, and total nitrates. They have sampled the three closest down-gradient wells three times. They sampled six other private wells twice and the remaining 22 wells once.

Analytical Results and Data Evaluation

The DOH used health-based comparison values to narrow the focus to those contaminants most important to public health. Selection of a contaminant for further consideration does not necessarily mean that exposure to the contaminant will cause illness. Tables 1 through 4 summarize the results of testing the soil-like material and groundwater. Arsenic, lead, polychlorinated biphenyls (PCBs), and total petroleum hydrocarbons (TPHs) were above their respective comparison values. All were selected for further evaluation.

For each contaminant, DOH estimated a daily dose[1] that people might be exposed to. To estimate this dose we assume people are exposed to an average of the levels of chemicals measured in the soil-like material. We use the average of the measured values because the soil samples were taken as composites (mixtures of various parts of the piles), and the workers could be exposed to dust from this material every day. If we use an average of the measured values and assume daily exposure, this would exceed the amount a worker would be likely to be exposed to and provide information to help us determine if this material should be used in a residential setting. If the estimated doses do not seem to indicate causes for health concerns, then we can rule out expected health effects from daily exposure, and also exposure for workers which occurs less frequently than daily .

Tables 7 and 9 list the doses calculated using averages of the measured values. The doses for soil exposure include inhaling dust, exposing the skin, and eating material that might get on one's hands or food. Our dose estimates assume an adult will ingest material that weighs approximately the same as a postage stamp (and a child will ingest twice that amount), every day, for longer than one year. Our calculations indicate that most of this dose would be expected to come from ingestion (ingestion means accidentally eating material that gets on the hands or skin), not from dust inhalation or absorption through the skin. DERM reported that the workers at this site are moving the soil-like material with bulldozers, which makes direct hand or arm contact less likely and therefore makes ingestion a less likely route of exposure. Correspondingly, our calculated estimates probably over-estimate the actual amounts a worker (or nearby resident) would ingest.

For lead, we also estimated blood lead levels using a simple model developed by ATSDR (ATSDR 1999a, Appendix D) and the average measured soil values. We used exposure durations of 40-hour/week for workers and 19 hours daily for residents (people who might stay at home, such as small children and non-working adults). ATSDR developed this model for lead because they feel an estimated blood level is a more accurate predictor of effects than an estimated dose. This model ***adds in lead*** estimated to come from air, water, and food; sources ***other*** than the site.

When calculating doses for groundwater exposure (Tables 8 and 10) we used the highest amounts of arsenic measured in the on- and off-site monitoring wells. We used the highest values because the soil-like material is suspected as the source of the arsenic. Because the early arsenic values were below detection level but later the arsenic values increased, DOH assumes stockpiling this material could continue to contribute to groundwater contamination. Our assumption provides an incentive for having a regular schedule for removing this material to a safe, permanent location. Our dose calculations for groundwater exposures assume an adult will drink two liters and a child will drink one liter of well water daily, for a year or longer. For this

[1] A dose is an amount of toxin per body weight.

south Florida agricultural setting, such estimates may be accurate or excessive for some people but may be lower than what others actually drink due to outdoor work in climate that is hot, year-round.

Detection of total petroleum hydrocarbons (TPHs) is a simple measure of hydrocarbon contamination. FLAPRO, the method used by this laboratory, measures the heavier hydrocarbons, with between eight and forty carbons in their molecular structures. The heavier hydrocarbons often form oils, greases and waxes that are much less toxic than the lighter volatile hydrocarbon fractions like benzene and toluene. Because of unknown decay states and because these heavy hydrocarbons could have many sources in yard wastes, we did not attempt to guess the percentages of the chemicals that made up this mixture. Accordingly, we did not assess the public health threat of TPHs.

Discussion

We discuss the possibility of exposures to chemicals measured in soil and groundwater and the likelihood of associated health effects in the following sections. DOH evaluated direct ingestion, inhalation, and dermal contact exposure routes for soil–at an average of measured levels of contamination for lead, arsenic and PCBs–Tables 7 and 9. We evaluated ingestion and dermal exposures for the highest levels of arsenic found in groundwater on and off the site–Tables 8 and 10 (an inhalation route for arsenic in groundwater is unlikely).

Soil-like Material

Current on-site workers

The doses we calculated for arsenic and PCBs are lower than doses associated with illnesses and significant increases in cancer risks (compiled from medical reports and animal studies–ATSDR 2000a and 2000b). Therefore, daily, long-term exposure to the average arsenic and PCB concentrations measured in the on-site soil-like material are unlikely to cause illnesses, including cancer, in workers.

Daily long-term exposure to the average level of lead measured in the soil-like material on this site would also be unlikely to cause illness in workers. Table 11 shows a range of estimated blood lead levels for worker's exposure to 559.5 parts per million lead in soil (the average of the 59 composite samples). *ATSDR's model assumes that workers will have other exposures to lead from daily ingestion of food and water, and inhalation of air which may not be site-related (ATSDR 1999a, Appendix D).* The model estimate totals range from 0.6 to 1.5 micrograms lead per deciliter of blood (μg/dl). The highest estimated blood-lead level, 1.5μg/dl, is lower than the lowest blood lead level associated with an adverse health effect for adults–decreased activity of the enzyme aminolevulinic acid dehydratase (ALAD). Decreased ALAD can decrease heme synthesis in the blood and lead to anemia (from medical studies of people with known blood-lead levels, ATSDR, 1999a).

Current nearby residents

The doses we calculated for arsenic and PCBs are lower than doses associated with illnesses and significant increases in cancer risks (compiled from medical reports and animal studies–ATSDR 2000a and 2000b). Therefore, daily, long-term exposure to the dust from the average concentrations of arsenic and PCBs measured in the soil-like material stored on the site and spread in a street right-of-way near the Ouster site are unlikely to cause illness in residents.

As discussed in the section above on worker exposure, lead was measured in about half of the off-site soil-like material samples at levels between 400 and 500 mg/kg. The average amount measured in an off-site right-of-way was 437.75 mg/kg. Based on our inhalation dose calculations for on-site exposures, the amount that might be blown from the site in dust would not be likely to cause illness, even for children. Neither would occasional contact with this material in road right-of-ways. Again, the danger from lead would likely come from getting this material on the hands where it might be swallowed, on a daily basis. If for some reason the material were used in gardens, or put in an areas where children might come in contact with it daily and accidentally eat it, then it could have health effects. This possibility will be addressed in the next section on residential use of the site material.

Future residential soil use

If soil-like material from this site is used in a residential setting, daily, long-term exposure to an average of the measured levels of arsenic and PCBs would be unlikely to cause illnesses, including cancer. Again, this evaluation is based on the doses we calculated for arsenic and PCBs which are lower than doses associated with illnesses and significant increases in cancer risks (compiled from medical reports and animal studies–ATSDR 2000a and 2000b).

In a residential setting, it is possible that children or adults (staying at home) having daily contact with the soil-like material could experience health effects from lead. Children would be the most likely affected. Tables 12 and 13 show a range of estimated blood lead levels for children and adults exposed daily to 559.5 parts per million lead in soil (the average of the 59 composite samples). *Again, this model for estimation assumes that the children and adults will have other exposures to lead from daily ingestion of food and water, and inhalation of air which do not have to be site-related.* The estimate totals from this model are presented in a table on the following page with ranges of blood lead levels and associated health effects listed in columns below these ranges.

Estimates from the model"FRAMEWORK TO GUIDE PUBLIC HEALTH ASSESSMENT DECISIONS AT LEAD SITES - APPENDIX D (ATSDR 1999a)

4.3 to 11.2 micrograms lead per deciliter of blood (μg/dl)	***in Children (staying at home)***	**2.5 to 4.9** μg/dl blood lead	***in Adults(staying at home)***
General population studies and studies of children have shown:			
6 to 20 μg/dl blood lead levels have been associated with heart abnormalities (degenerative changes in myocardium and electrocardiogram abnormalities in children)			
no threshold in children for association between blood lead levels and decreased ALAD activity		3 to 56 μg/dl blood lead levels have been associated with decreased ALAD activity in adults	
7 to 80 μg/dl blood lead levels have been associated with decreased Py-5'-N[2] (in studies of children)			
1.4 to 17.4 μg/dl blood lead levels have been associated with alterations in visual evoked potentials[3] (children - environmental exposures)			
10 to 15 μg/dl blood lead levels have been associated with impaired mental development[4] in children			
≥ 9 μg/dl average lifetime blood lead levels have been associated with impaired motor developmental status[4] in 6-year-old children (Cincinnati cohort)			
6.5 μg/dl blood lead levels (mean at 24 months of age) have been associated with lower scores in tests of Cognitive Function[4] at 5 and 10 years of age			
These effects associated with low blood lead levels are reported from studies by many authors (ATSDR, 1999; pages 23-30, Table 2-1).			

[2] Py-5'-N is 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).

[3]The visual evoked potential (VEP) measures the electrical response of the brain's primary visual cortex to a visual stimulus. The VEP is measured with electrodes on the scalp. A graph of a typical VEP response comprises a well-defined peak of 3 to 20 microvolts at around 100 milliseconds. While the amplitudes of the VEPS can be quite variable, differing between people due to skull thickness, visual cortex morphology and electrode placement, any disorder of the optic nerve or primary visual cortex can affect the normal shape and timing of the graphed VEP response.

[4]These studies report deficits measured in expected mental and physical development in young children.

Groundwater

Although arsenic in the soil-like material may be contributing to on-site groundwater contamination, no one is known to be using the on-site limited-use well as a potable-water source, at this time. Therefore we do not consider it a current health threat. *In the future*, if people drink water with arsenic at the highest level measured in monitoring wells on the site, for long periods of time, they could have a low to moderately increased risk of skin cancer[5]. People with daily, long-term exposure to arsenic-contaminated groundwater at this level (and greater levels) could develop darkening of skin and darkening of corn-type growths on their palms and soles of their feet. Arsenic-induced skin changes can also include darker skin interspersed with lighter than normal skin patches on the face, neck, and back (hyper- and hypo-keratosis). These darker skin patches and corns can develop into skin cancer (multiple squamous cell carcinomas–ATSDR 2000a).

The highest level of arsenic measured in an off-site monitoring well is nearly ten times lower than the highest level measured on the site. Correspondingly the only associated health risk is a low increased risk of skin cancer[6] (at about ten times lower than the statistical values given in footnote 5) .

At this time, there is no health threat from using private drinking water wells near this site. However, nitrate levels measured in a few nearby private drinking water wells are just below the drinking water standard. We do not know if these nitrate levels in groundwater are site-related. But, because elevated nitrates can cause methemoglobinemia in infants and in some elderly people who's systems have difficulty breaking down nitrates, additional monitoring for nitrates is warranted. Methemoglobinemia prevents red blood cells from carrying sufficient oxygen and can be fatal.

Children's Health Initiative

ATSDR and DOH, through ATSDR's Child Health Initiative, 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 are adults for certain kinds of exposure to hazardous substances emitted from waste sites. Because they play outdoors and because they often carry food into contaminated areas, children are more likely to be exposed to contaminants in the environment. Children are shorter than adults, which means they breathe dust, soil, and heavy vapors close to the ground. They are also smaller, resulting in higher doses of chemical exposure per body weight. If toxic exposures occur during critical growth stages, the

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[5]A statistical increase of 9 in 10,000 for small children for 3 years of exposure and 4 in 1,000 for adults for 30 years of exposure.

[6]A statistical increase of 9 in 100,000 for small children for 3 years of exposure and 4 in 10,000 for adults for 30 years of exposure.

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 accordingly guide their children.

Although children's sensitivities to arsenic, lead, and PCBs are discussed in the following paragraphs, we would not expect to see increases in children's illnesses because the doses we calculated for off site exposures are minimal at this time.

Arsenic. Although there is no evidence for differences in absorption of arsenic in children and adults, at levels much higher than those measured at this site, inorganic arsenic is a developmental toxicant for fetuses. Also at much higher levels, arsenic may cause neural tube defects, miscarriages, and early neonatal deaths (ATSDR 2000a).

Lead. Children are more susceptible to lead toxicity than adults because they absorb a larger fraction of ingested lead and they exhibit more severe toxicity at lower levels. In addition, absorption of lead is higher in children who have low dietary iron, calcium, or zinc intake. Also, children's bones have a shorter retention time for lead than do adult's bones that are no longer growing (ATSDR 1999a).

PCBs - Children are more vulnerable to PCBs than adults because they are growing more rapidly and generally have fewer biotransforming enzymes (a mechanism for ridding the body of toxins) and less fat. Because PCBs are stored in fat, in children less of the total dose might be stored and therefore more might be present in the bloodstream (ATSDR, 2000b).

Other Sensitive Populations

Sensitive populations exhibit different or enhanced responses to chemicals than will most people exposed to the same chemical level in their environment. Reasons may include genetic makeup, age, health and nutritional status, and exposure to other toxic substances. Although subpopulations (other than children) sensitive to arsenic, lead, and PCBs are discussed in the following paragraphs, we would not expect to see increases in illness in exposed workers due to the relatively low doses we calculated for their exposure to these chemicals on the site. Currently, off site exposures would be minimal for workers or residents.

Arsenic - Subpopulations with reduced liver efficiency may have increased susceptibility to arsenic toxicity. Some medical reports indicate reduced liver methylation capacity could cause such inefficiency because methylation is one of the ways the liver transforms chemicals so they can be eliminated from the body. Reduced methylation capacity may result from dietary deficiencies in choline (a B-vitamin) or methionine (an amino acid) or may be part of a person's genetic makeup. Liver disease does not appear to decrease methylation capacity, at least not at levels that might be significant for low levels of arsenic exposure (ATSDR 2000a).

Lead - Subpopulations with increased susceptibility to lead toxicity include the elderly, smokers, alcoholics, and people with nutritional deficiencies, diseases affecting neurological or kidney function, and genetic diseases affecting heme (the iron-containing part of red blood cells) synthesis. Women experiencing mobilization of bone minerals due to pregnancy or osteoporosis will also be more susceptible since any new exposure is being added to the internal burden of lead previously stored in their bones (ATSDR 1999a).

PCBs - Subpopulations with reduced liver efficiency may have increased susceptibility to PCB toxicity. Some medical reports indicate incompletely developed glucuronide conjugation mechanisms (another way the liver transforms chemicals so they can be eliminated in the urine) may contribute to liver inefficiency. Other conditions that can also affect glucuronide conjugation mechanisms include liver infection, liver cirrhosis, or hepatitis B. PCB exposure could also enhance pre-existing genetic conditions that cause the body to dump porphyrins (bile, heme, cytochromes–ATSDR 2000b).

Conclusions

The Ouster Corporation site is categorized as "no apparent public health hazard" using current completed exposure pathways for workers on the site (40 hour/week) and for nearby residents exposed to dust, even for exposures which could continue for longer than one year. The highest blood-lead levels estimated for workers using the "FRAMEWORK TO GUIDE PUBLIC HEALTH ASSESSMENT DECISIONS AT LEAD SITES -APPENDIX D" (ATSDR, 1999a) was 1.5 μg/dl. This highest estimate is below any blood lead levels associated with adult health effects. For all other populations, either there is no exposure or estimated exposures levels are below any levels associated with adverse health effects.

DOH has assumed that no one is using, or will use, the arsenic-contaminated groundwater on and near the site as a long-term source of drinking water in making this "no apparent public health hazard" determination.

Based on our evaluation of the available data, DOH offers the following specific conclusions:

1. Arsenic in the soil-like material stored on the site probably contaminated the shallow groundwater. Elevated arsenic levels were measured in groundwater samples from monitoring wells near the eastern site boundary and just east of the site. If people were to drink this arsenic-contaminated groundwater daily, for long periods of time, the ingested arsenic could moderately increase their skin cancer risk. There is a limited-use well on the site; DOH has been told that this well is not used as a drinking water source.

2. In groundwater from private drinking water wells near the site, arsenic has only been found at levels below the Maximum Concentration Level (MCL), an enforceable, health-based standard. Because there are private and monitoring wells between the site and those with low-arsenic levels that do not show arsenic, it is unlikely these low levels are related

to the site at this time; but we are not ruling out future movement of arsenic in groundwater.

3. Nitrate levels measured in a few nearby private drinking water wells are just below the Florida drinking water standard. We do not know if groundwater nitrates are site-related. Elevated nitrates can cause methemoglobinemia in infants and in some elderly people whose bodies have difficulty breaking down nitrates. For infants to ingest this groundwater, it would have to be used in preparing formula, concentrated juices, or baby cereal; babies do not otherwise drink large quantities of water. Adults susceptible to methemoglobinemia would likewise have to drink daily quantities of nitrate-contaminated water or use it to prepare foods or beverages to be exposed. In these susceptible subpopulations, methemoglobinemia prevents red blood cells from carrying sufficient oxygen and can be fatal.

4. Estimates DOH calculated using ATSDR's "FRAMEWORK TO GUIDE PUBLIC HEALTH ASSESSMENT DECISIONS AT LEAD SITES - APPENDIX D" (Tables 11-13) show that use of the soil-like material in a residential setting could result in elevated blood lead in young children or adults who might come in contact with it daily in gardens or play areas. Each model calculation results in a high and low estimate, with an assumed range between the two. At the highest estimated blood lead levels, adults could experience decreased ALAD activity which could lead to anemia. Decreased ALAD activity has no blood lead level threshold in children, meaning an ALAD decrease is likely to be seen with any measured level of lead in children's blood. The estimated ranges of blood lead for children also overlapped blood lead levels associated with the following health effects (in studies of children): decreased Py-5'-N, alterations in visual evoked potentials, impaired mental development, impaired motor development, and lower scores in tests of cognitive function at five and ten years of age. The table in the section Future residential soil use has a more detailed explanation of these health effects in children.

5. Our dose calculations show that for anyone directly exposed to the soil-like material, accidentally eating (ingesting) it on a daily basis would give the highest exposure levels. The levels of chemicals DOH estimated for inhalation and dermal exposure only contributed a small fraction of the total estimated exposure. On-site workers handle the material with bulldozers and at this time no one else is known to have daily, direct contact with this material, so ingestion exposure in not likely. Exposure to dust generated from this material is unlikely to cause health effects in workers or nearby residents who might inhale it or get it on their skin; because the calculated levels of inhalation and dermal exposure are below any known to cause health effects.

Recommendations

1. To prevent future groundwater contamination, do not store soil-like material in uncovered piles on the site, especially for long periods of time. To prevent arsenic-contaminated groundwater under the site from being used as a drinking water source, determine if the

on-site limited-use well is used for drinking. If so, test it for arsenic and nitrates. Do not install any additional drinking water wells on the site.

2. Continue monitoring the movement of arsenic-contaminated groundwater to ensure nearby private drinking water wells do not become contaminated.

3. To prevent nitrate-groundwater exposures, continue to monitor the nearby private drinking water wells with elevated nitrates for exceedences of the nitrate Maximum Concentration Level (10 milligrams per liter). If an exceedence is found, DOH and DEP should be contacted. They administer and fund a program to supply filters for contaminated private wells.

4. To prevent daily ingestion exposure to the soil-like material, do not use it in gardens or residential areas where children are likely to play. DERM reported that the stockpiled material is now used at lined-landfills where it was used to cover refuse. The liners and leachate collection systems required for such landfills should prevent any future potential for groundwater contamination from this material.

This last recommendation is for anyone believing they have greater exposure or sensitivity than DOH considered in our evaluation of the site data.

5. To prevent exposure to the soil-like material, wash your hands before you use them in hand-to-mouth activities like eating, and wear a dust mask if conditions are dusty.

Public Health Action Plan

Florida DOH will continue to assist the Miami-Dade CHD and Miami-Dade DERM by reviewing new environmental data as needed. Therefore, if site conditions change or new data become available Florida and the ATSDR can/will re-evaluate this site.

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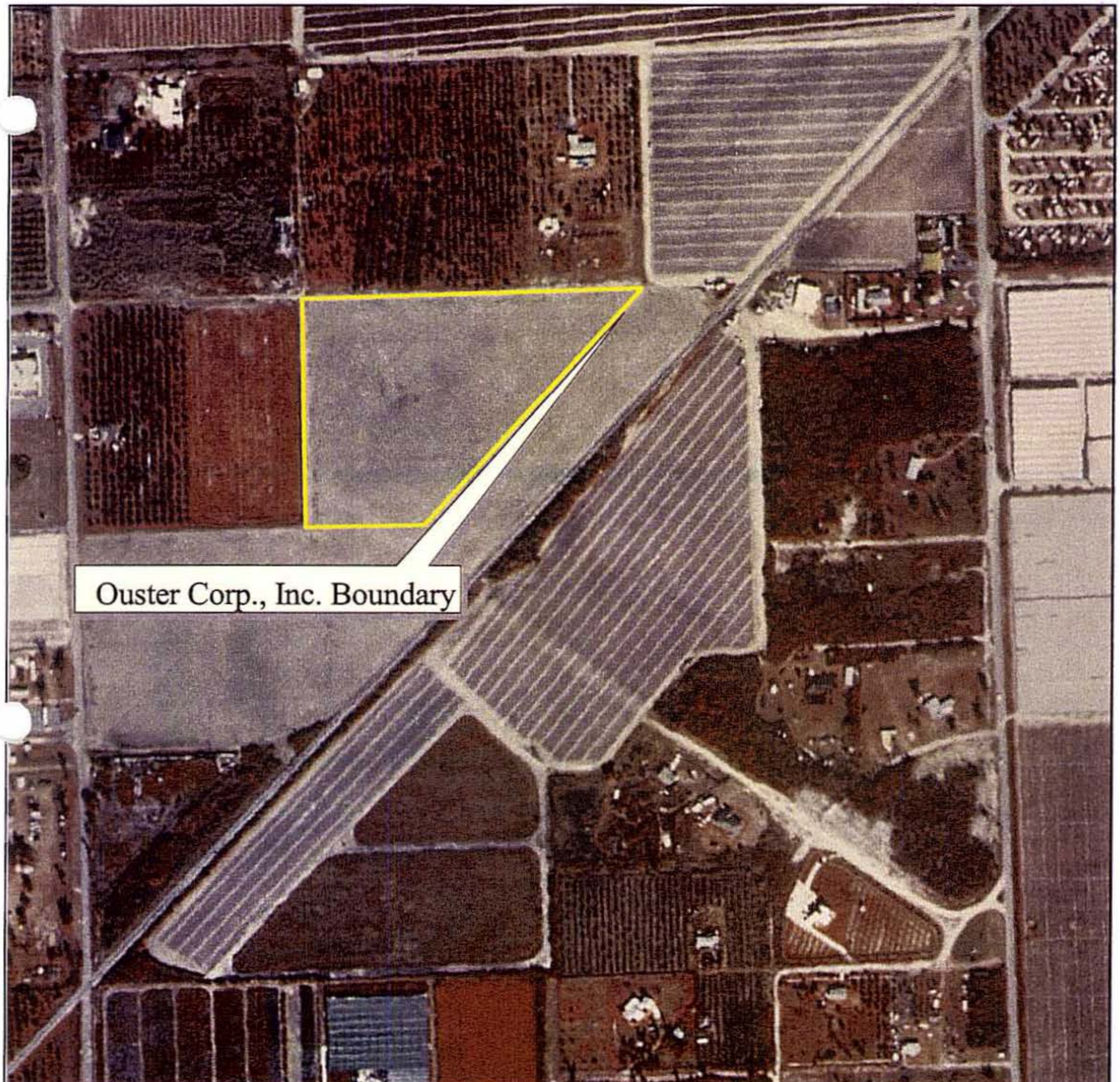

Ouster Corportion Site

Figure1

1995 Aerial Photograph

Site and Nearby Land Use

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Florida Department of Health

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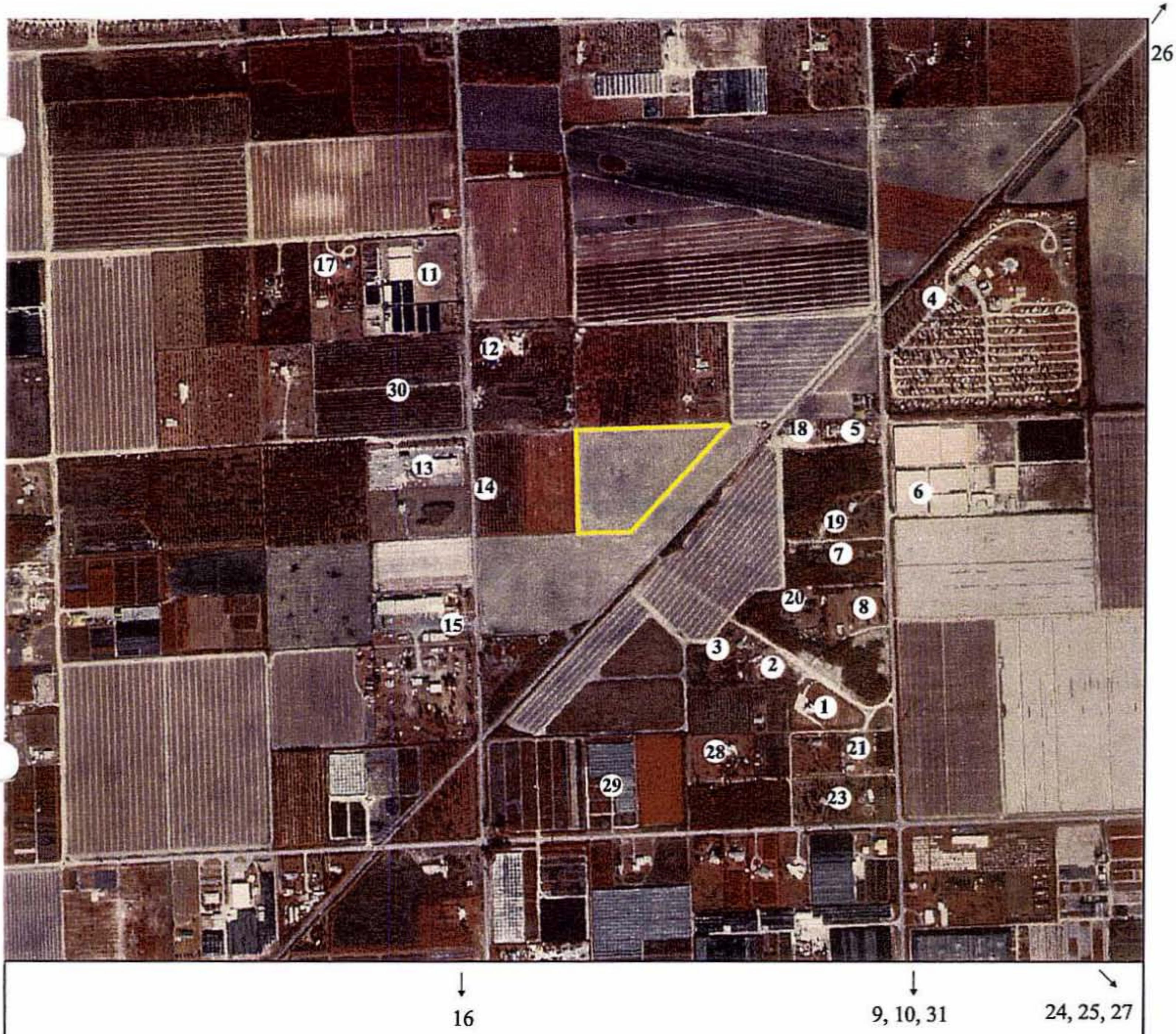

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Location of Private Wells Sampled Near the Ouster Site

Figure 2
1995 Aerial Photography

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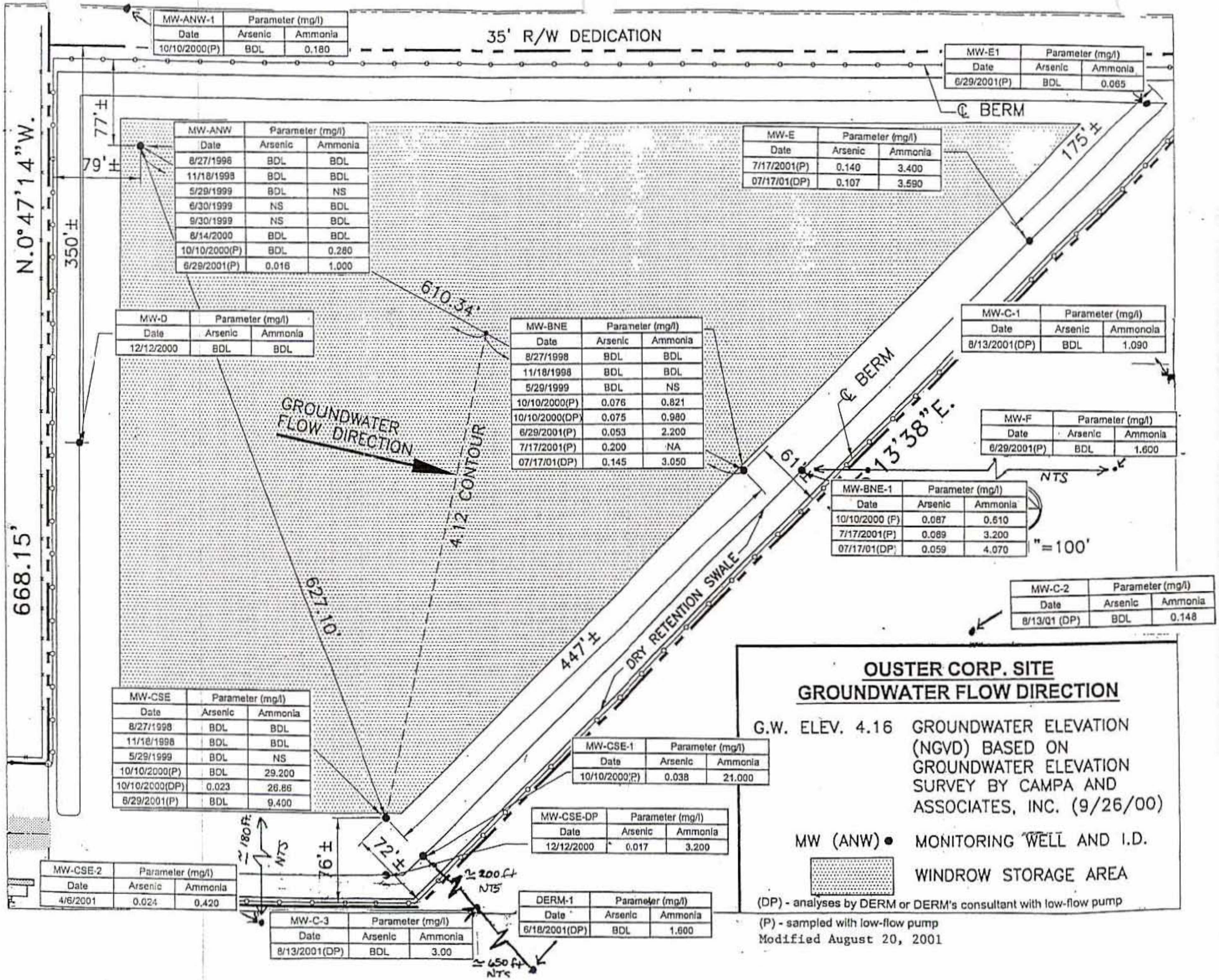

MW-ANW-1	Parameter (mg/l)	
Date	Arsenic	Ammonia
10/10/2000(P)	BDL	0.180

MW-E1	Parameter (mg/l)	
Date	Arsenic	Ammonia
6/29/2001(P)	BDL	0.065

MW-ANW	Parameter (mg/l)	
Date	Arsenic	Ammonia
8/27/1998	BDL	BDL
11/18/1998	BDL	BDL
5/29/1999	BDL	NS
6/30/1999	NS	BDL
9/30/1999	NS	BDL
8/14/2000	BDL	BDL
10/10/2000(P)	BDL	0.280
6/29/2001(P)	0.016	1.000

MW-E	Parameter (mg/l)	
Date	Arsenic	Ammonia
7/17/2001(P)	0.140	3.400
07/17/01(DP)	0.107	3.590

MW-D	Parameter (mg/l)	
Date	Arsenic	Ammonia
12/12/2000	BDL	BDL

MW-BNE	Parameter (mg/l)	
Date	Arsenic	Ammonia
8/27/1998	BDL	BDL
11/18/1998	BDL	BDL
5/29/1999	BDL	NS
10/10/2000(P)	0.076	0.821
10/10/2000(DP)	0.075	0.980
6/29/2001(P)	0.053	2.200
7/17/2001(P)	0.200	NA
07/17/01(DP)	0.145	3.050

MW-C-1	Parameter (mg/l)	
Date	Arsenic	Ammonola
8/13/2001(DP)	BDL	1.090

MW-F	Parameter (mg/l)	
Date	Arsenic	Ammonia
6/29/2001(P)	BDL	1.600

MW-BNE-1	Parameter (mg/l)	
Date	Arsenic	Ammonia
10/10/2000 (P)	0.087	0.610
7/17/2001(P)	0.089	3.200
07/17/01(DP)	0.059	4.070

MW-C-2	Parameter (mg/l)	
Date	Arsenic	Ammonia
8/13/01 (DP)	BDL	0.148

MW-CSE	Parameter (mg/l)	
Date	Arsenic	Ammonia
8/27/1998	BDL	BDL
11/18/1998	BDL	BDL
5/29/1999	BDL	NS
10/10/2000(P)	BDL	29.200
10/10/2000(DP)	0.023	26.86
6/29/2001(P)	BDL	9.400

MW-CSE-1	Parameter (mg/l)	
Date	Arsenic	Ammonia
10/10/2000(P)	0.038	21.000

MW-CSE-DP	Parameter (mg/l)	
Date	Arsenic	Ammonia
12/12/2000	0.017	3.200

MW-CSE-2	Parameter (mg/l)	
Date	Arsenic	Ammonia
4/6/2001	0.024	0.420

MW-C-3	Parameter (mg/l)	
Date	Arsenic	Ammonia
8/13/2001(DP)	BDL	3.00

DERM-1	Parameter (mg/l)	
Date	Arsenic	Ammonia
6/18/2001(DP)	BDL	1.600

Table 1. Contaminant Concentrations in On-Site Soil-Like Material

Contaminants	Maximum Conc. (mg/kg)	Location/ Date of Maximum Conc.	Average/ Number of Samples	# Greater Than Comparison Value/ Total # of Samples*	Comparison Value** (mg/kg)		Source	
arsenic	8.6	SV-1 2/98	4.34 avg. of 59 samples	0/59 51/59 43/59	20 0.8 3.7	(C_EMEG) (R_SCTL) (C/I_SCTL)	ATSDR FDEP	2000 1999
lead	9871	SP-2 3/99	559.51 avg. of 59 samples	27/59 1/59	400 920	(R_SCTL) (C/I_SCTL)	FDEP	1999
PCBs - polychlorinated biphenyls	5.19	SVI-3 2/98	3.7 avg. of 26 samples	20/26 11/26	0.5 2.1	(R_SCTL) (C/I_SCTL)	FDEP	1999
TPHs - total petroleum hydrocarbons	1500	SVI-3 2/98	495 avg. of 26 samples	15/26 0/26	340 2500	(R_SCTL) (C/I_SCTL)	FDEP	1999

Sources: Summary tables provided by DERM to Miami-Dade County Health Department

* This column gives the reader an idea how often the chemical was detected above the screening value out of the times for which it was analyzed The total number of analyses (denominator) can vary. Although this might suggest not all samples were analyzed for all chemicals, it could also mean this chemical was infrequently detected. The raw data are not available, and a chemical generally is included in the data summary table only if it is detected.

** Comparison values are used to select chemicals for further evaluation, not for determining the possibility of illness.

Abbreviations:
mg/kg = milligrams per kilogram
C_EMEG - ATSDR Environmental Media Evaluation Guide for Children
R_SCTL - Florida Residential Soil Cleanup Target Level
C/I_SCTL - Florida Commercial or Industrial Soil Cleanup Target Level

Table 2. Maximum Contaminant Concentrations in On-Site Groundwater (Monitoring Well data)

Contaminant	Maximum Concentration (µg/L)	Location/Date of Maximum Concentration	# Greater Than Comparison Value/ Total # of Samples*	Comparison Value	
				(µg/L)	Source
arsenic	200	MW-8NE 7/01†	8/33	50** (PDWS)	FDEP 1999

Source: Summary tables provided by Miami-Dade DERM

* Three of the 10 on-site monitoring wells exceeded the MCL for arsenic. These three wells were sampled more frequently than the other monitoring wells. In total, the MCL was exceeded in eight of 33 analyses, but some of the wells were sampled once and some were sampled eight times. The three monitoring wells containing elevated arsenic are all found along the eastern boundary of the site. The eastern boundary of the site is hydrologically down-gradient.

** This level is an enforceable drinking water standard in Florida (Maximum Concentration Level - MCL).
† MW8NE did not show arsenic until October 2000 and it had been sampled since June 1998–after which the arsenic levels got progressively higher until the last sample, which was taken in July 2001 (so an average value is probably not appropriate for assessing health risk).

µg/L = micrograms per liter

PDWS - Primary Drinking Water Standard - Enforceable Florida Standards

Table 3. Contaminant Concentrations in Off-Site Soil-Like Material (from road right-of-way)

Contaminants	Maximum Concentration (mg/kg)	Location/Date of Maximum Concentration	Average/ Number of Samples	# Greater Than Comparison Value/ Total # of Samples*	Comparison Value**	
					(mg/kg)	Source
arsenic	9.8	Other 2 7/01	8.6 avg. of 4 samples	0/4 4/4 4/4	20 (C_EMEG) 0.8 (R_SCTL) 3.7 (C/I_SCTL)	ATSDR 2000 Florida 1999
lead	446	Other 2 7/01	437.75 avg. of 4 samples	4/4 0/4	400 (R_SCTL) 920 (C/I_SCTL)	Florida 1999
PCBs - polychlorinated biphenyls	2.99	Other 1 7/01	1.79 avg. of 4 samples	4/4 0/4	0.5 (R_SCTL) 2.1 (C/I_SCTL)	Florida 1999
TPHs - total petroleum hydrocarbons	1534	Other 1 7/01	1158.75 avg. of 4 samples	4/4 0/4	340 (R_SCTL) 2500 (C/I_SCTL)	FDEP 1999

Sources: Summary tables provided by DERM to Miami-Dade County Health Department

* This column gives the reader an idea how often the chemical was detected above the screening value out of the times for which it was analyzed. The total number of analyses (denominator) can vary. Although this might suggest not all samples were analyzed for all chemicals, it could also mean this chemical was infrequently detected. The raw data is not available, and a chemical generally is included in the data summary table only if it is detected.

** Comparison values are used to select chemicals for further evaluation, not for determining the possibility of illness.

Abbreviations:
mg/kg = milligrams per kilogram
C_EMEG - ATSDR Environmental Media Evaluation Guide for Children
R_SCTL - Florida Residential Soil Cleanup Target Level
C/I_SCTL - Florida Commercial or Industrial Soil Cleanup Target Level

Table 4. Maximum Concentrations in Off-Site Groundwater (Four Monitoring Wells and 31Private Wells)

Contaminant	Maximum Concentration (µg/L)	Location/Date of Maximum Concentration	# Greater Than Comparison Value/ Total # of Samples*	Comparison Value	
				(µg/L)	Source
arsenic (monitoring wells)	24	MW-SE 6/01	0/6	50* (PDWS)	FDEP 1999
arsenic (private wells)	1.4	21 6/01	0/43	50* (PDWS)	FDEP 1999

Source: Summary tables provided by Miami-Dade DERM.

* This level is an enforceable drinking water standard in Florida (Maximum Concentration Level - MCL), but for purposes of adding filters to private wells, DEP is currently using 10 µg/L.

µg/L = micrograms per liter.

PDWS - Primary Drinking Water Standards are enforceable Florida standards.

Table 5. Completed Exposure Pathways

PATHWAY NAME	EXPOSURE PATHWAY ELEMENTS					TIME
	SOURCE	ENVIRONMENTAL MEDIA	POINT OF EXPOSURE	ROUTE OF EXPOSURE	EXPOSED POPULATION	
On-site surface soil-like material and contaminated dust	Soil-like material screened from yard trash	Soil-like material	On the site and off-site road right-of-way	Incidental ingestion and inhalation of dust	On-site workers and nearby residents	Current and future

Table 6. Potential Exposure Pathways

PATHWAY NAME	EXPOSURE PATHWAY ELEMENTS					TIME
	SOURCE	ENVIRONMENTAL MEDIA	POINT OF EXPOSURE	ROUTE OF EXPOSURE	EXPOSED POPULATION	
Private Wells	Soil-like material screened from yard trash	Groundwater	Nearby homes, if they use private wells that are contaminated	Ingestion of water and inhalation of volatilized contaminants	Residents of nearby homes east of the site with private drinking water wells	Future
Distribution of soil-like material	Soil-like material screened from yard trash	Soil-like material	Locations where soil-like material may be distributed	Incidental ingestion of soil-like material and inhalation of resulting dust	Limited; if use as landfill cover continues.	Future

Table 7 Calculated dose (mg/kg/day) from residential exposure to on-site soil-like material (Calculated using the average level of the on-site data)

Contaminants (average concentration) mg/kg		Chronic Oral MRL (mg/kg/day)	Dose from Soil Ingestion (mg/kg/day)			Inhalation MRL (ppm)	Dose from Inhalation of Dust (ppm except PCBs which were not converted from $\mu g/m^3$ due to unknown molecular weight)	
			Child	Adult	Worker		Child	Adult
arsenic	4.34	0.0003	0.00006	0.000006	0.0000002	none	0.0000003	0.0000003
lead	559.51	none	0.007	0.0008	0.00003	none	0.00003	0.00003
PCBs - polychlorinated biphenyls	3.7	Arochlor 1254 0.02	0.00005	0.000005	0.0000002	none	0.0000002	0.0000002

Scenario Time-frame: Future
Land Use Conditions: Residential
Exposure Medium- Soil and Dust
Exposure Point- Inhalation of Ingestion of Soil or Dust
Receptor Population- Residents

These doses were calculated using Risk Assistant Software (Hampshire Research Institute) and accepted values for groundwater consumption, shower inhalation exposure and dermal exposure parameters (EPA 1991).

MRL - Minimum Risk Level for non-cancer illnesses,
ppm = parts per million,
mg/m^3 = milligrams per cubic meter
$\mu g/L$ = micrograms per liter,
mg/kg/day = milligrams per kilogram per day

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 and longer
Inhalation breathing rate is 0.5 cubic meters per hour

Adult body weight- 70 kg
Child body weight- 15 kg
Adult soil consumption- 100mg
Child soil consumption 200 kg
Soil exposure is 365 events per year, 3 hours per event.
Lifetime is 70 years
Adult exposure is 30 years
Child exposure is 3 years

Table 8 Calculated dose (mg/kg/day) for potential residential use of on-site groundwater

Contaminant (maximum concentration) µg/L		Oral MRL (mg/kg/day)	Groundwater- Ingestion (mg/kg/day)		Groundwater- Dermal (mg/kg/day)	
			Child	Adult	Child	Adult
arsenic	200	(chr.) 0.0003	0.01	0.006	model ltd.†	0.00001

†Model calculates for showers, not baths; most small children don't take showers.

Scenario Time-frame: Future
Land Use Conditions: Residential
Exposure Medium- Groundwater
Exposure Point- On-site tap water
Receptor Population- Residents

These doses were calculated using Risk Assistant Software (Hampshire Research Institute) and accepted values for groundwater consumption, shower inhalation exposure and dermal exposure parameters (EPA 1991).

MRL - Minimum Risk Level
µg/L = micrograms per liter
mg/kg/day = milligrams per kilogram per day
Oral MRL values are presented as an oral dose (mg/kg/day)

N.D.- Not detected
N.A.- Not applicable
N.S.- Not significant
omb - outside model boundary

acute = exposure is 1- 14 days
intermediate = exposure is 15-364 days
chronic = exposure is 365 and longer

The above doses were calculated using the following values:

Adult body weight- 70 kg
Adult water consumption- 2 liters/day
Adult skin surface area- 23,000cm^2
Adult exposure is 30 years
Lifetime is 70 years

Child body weight- 15 kg
Child water consumption- 1 liter/day
Child skin surface area- 7,200cm^2
Child exposure is 3 years

Table 9 Calculated dose (mg/kg/day) from residential exposure to off-site soil-like material (Calculated using the average level at the off-site location)

Contaminants (average concentration) mg/kg		Chronic Oral MRL (mg/kg/day)	Dose from Soil Ingestion (mg/kg/day)			Inhalation MRL (ppm)	Dose from Inhalation of Dust (ppm except PCBs which were not converted from $\mu g/m^3$ due to unknown molecular weight)(ppm)	
			Child	Adult	Worker		Child	Adult
arsenic	8.6	0.0003	0.0001	0.00001	0.0000002	none	0.0000003	0.0000003
lead	437.75	none	0.006	0.0006	0.00003	none	0.00003	0.00003
PCBs - polychlorinated biphenyls	1.79	Arochlor 1254 0.02	0.0002	0.000003	0.0000002	none	0.0000002	0.0000002

Scenario Time-frame: Future
Land Use Conditions: Residential
Exposure Medium- Soil and Dust
Exposure Point- Inhalation of Ingestion of Soil or Dust
Receptor Population- Residents

These doses were calculated using Risk Assistant Software (Hampshire Research Institute) and accepted values for groundwater consumption, shower inhalation exposure and dermal exposure parameters (EPA 1991).

MRL - Minimum Risk Level for non-cancer illnesses,
ppm = parts per million,
mg/m^3 = milligrams per cubic meter
$\mu g/L$ = micrograms per liter,
mg/kg/day = milligrams per kilogram per day

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 and longer
Inhalation breathing rate is 0.5 cubic meters per hour

Adult body weight- 70 kg
Child body weight- 15 kg
Adult soil consumption- 100mg
Child soil consumption 200 kg
Soil exposure is 365 events per year, 3 hours per event.
Adult exposure is 30 years
Child exposure is 3 years
Lifetime is 70 years
Adult exposure is 30 years
Child exposure is 3 years

Table 10 Calculated dose (mg/kg/day) for potential residential use of off-site groundwater

Contaminant (maximum concentration) µg/L		Oral MRL (mg/kg/day)	Groundwater- Ingestion (mg/kg/day)		Groundwater- Dermal (mg/kg/day)	
			Child	Adult	Child	Adult
arsenic	24	(chr.) 0.0003	0.0016	0.0007	model ltd.†	0.000002

†Model calculates for showers, not baths; most small children don't take showers.

Scenario Time-frame: Future
Land Use Conditions: Residential
Exposure Medium- Groundwater
Exposure Point- On-site tap water
Receptor Population- Residents

These doses were calculated using Risk Assistant Software (Hampshire Research Institute) and accepted values for groundwater consumption, shower inhalation exposure and dermal exposure parameters (EPA 1991).

MRL - Minimum Risk Level
µg/L = micrograms per liter
mg/kg/day = milligrams per kilogram per day
Oral MRL values are presented as an oral dose (mg/kg/day)

N.D.- Not detected
N.A.- Not applicable
N.S.- Not significant
omb - outside model boundary

acute = exposure is 1- 14 days
intermediate = exposure is 15-364 days
chronic = exposure is 365 and longer

The above doses were calculated using the following values:

Adult body weight-	70 kg	Child body weight-	15 kg
Adult water consumption-	2 liters/day	Child water consumption-	1 liter/day
Adult skin surface area-	23,000cm^2	Child skin surface area-	7,200cm^2
Adult exposure is 30 years		Child exposure is 3 years	
Lifetime is 70 years			

Lead at On-site Average (559.5 mg/kg)

Matrices Using ATSDR's Regression Analysis with Multiple-uptake Parameters to Estimate Blood Lead from Environmental Exposures (ATSDR 1999a, Appendix D)

Table 11- On-Site Workers, working a 40-hour week

Media	Conc. *		Time	Slope†		Low	High
	low	high		low	high		
Air (out)	0.1*	0.2*	0.23	1.43	2.00	0.0329	0.046
Air (in)	0.3*	0.6*	0.23	1.43	2.00	0.0987	0.138
Food	5*		0.23	0.018	0.022	0.0207	0.0311
Water	4*		0.23	0.06		0.0552	0.0552
Soil	559.5		0.23	0.001	0.003	0.12869	0.38606
Dust	559.5		0.23	0.0021	0.0067	0.27024	0.86219
Total‡						0.60638	1.51854

*Used Default Value from ATSDR 1999a, Appendix D.
†These slopes were for adult men or adults from ATSDR 1999a, Appendix D.
‡Estimates of blood lead levels, high and low, for the matrix, in microgram per deciliter.

Table 12-Young Children Living On-site or in Daily Contact With Soil-Like Material

Media	Conc. *		Time	Slope§		Low	High
	low	high		low	high		
Air (out)	0.1*	0.2*	0.8	2.46	3.04	0.1968	0.2432
Air (in)	0.3*	0.6*	0.8	2.46	3.04	0.5904	0.7296
Food	5*		0.8	0.24		0.96	0.0311
Water	4*		0.8	0.16		0.512	0.0552
Soil	559.5		0.8	0.0025	0.016	1.119	7.1616
Dust	559.5		0.8	0.0021	0.0067	0.93996	2.99892
Total‡						4.31816	11.21962

*Used Default Value from ATSDR 1999a, Appendix D.
§These slopes were for children from ATSDR 1999a, Appendix D.
‡Estimates of blood lead levels, high and low, for the matrix, in microgram per deciliter..

Lead at 500 mg/kg

Table 13 - Adults (staying in the home), living on-site or in daily contact with soil-like material

Media	Conc. *		Time	Slope†		Low	High
	low	high		low	high		
Air (out)	0.1*	0.2*	0.8	1.59	3.56	0.1272	0.2848
Air (in)	0.3*	0.6*	0.8	1.53	3.56	0.3672	0.8544
Food	5*		0.8	0.016	0.0195	0.064	0.0311
Water	4*		0.8	0.03	0.06	0.096	0.0552
Soil	559.5		0.8	0.002	0.0016	0.8952	0.71616
Dust	559.5		0.8	0.0021	0.0067	0.93996	2.99892
Total‡						2.48956	4.94058

*Used Default Value from ATSDR 1999a, Appendix D.
†These slopes were for adult men and women or adults from ATSDR 1999a, Appendix D.
‡Estimates of blood lead levels, high and low, for the matrix, in microgram per deciliter.

Certification

The Florida Department of Health, Bureau of Environmental Epidemiology prepared the Ouster Corporation Health Consultation under a cooperative agreement with the Agency for Toxic Substances and Disease Registry. It followed approved methodology and procedures existing at the time it began.

Debra Gable
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ATSDR

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

Roberta Erlwein for
Richard Gillig
Branch Chief,
SSAB, DHAC,
ATSDR