HEALTH CONSULTATION

ZELLWOOD GROUNDWATER CONTAMINATION

ZELLWOOD, ORANGE COUNTY, FLORIDA

CERCLIS NO. FLD049985302

March 6, 1995

Prepared by

Florida Department of Health and Rehabilitative Services
Under Cooperative Agreement with the
Agency for Toxic Substances and Disease Registry

Background and Statement of Issues

This health consultation was prepared to examine the public health aspects of exposure to contaminants at the Zellwood Groundwater Contamination Superfund hazardous waste site. As noted in a Site Review and Update issued by the Florida Department of Health and Rehabilitative Services in 1992 (1), members of the nearby community may have been and may still be exposed to contaminants from this site. EPA has provided the Florida Department of Health and Rehabilitative Services (Florida HRS) with sampling data of the soil, surface water, sediment, and groundwater from the site and adjacent areas. Florida HRS has reviewed the environmental sampling data and the remediation alternatives outlined in the focused feasibility study (2) and Records of Decision (3, 4, 5) for the site to comment on the public health impact of the proposed remediation activities.

The Zellwood Groundwater Contamination site (Zellwood) is about one-half mile west of the town of Zellwood in the northwestern corner of Orange County, Florida (Figure 1). The 57-acre site consists of an area occupied by four industries and an open field with a marsh/wetlands area (Figures 2 and 3). The Zellwood site is bordered on the north by the Seaboard Coastline Railroad (beyond which lies a residential neighborhood), on the east by Laughlin Road, on the south by Jones Avenue, and on the west by a large, grassy field (6).

The Zellwood site is currently occupied by Zellwin Farms Company, Drum Service Company of Florida, Chemical Systems, Inc. and Coatings Application and Waterproofing Company. The Zellwin Farms Company is a vegetable washing and packing facility that began operating in 1960 and is still in business. Drum Service Company is a recycling facility for steel drums that began operating in 1963 and is also still in business. Chemical Systems began operations in 1982 producing cleaning products for the citrus concentrate industry. The property now occupied by Coatings Application and Waterproofing Company was originally owned by Southern Liquid Fertilizer Company which began operating in the early 1970's. The business operated until 1981 when the plant was purchased by Douglass Fertilizer and Chemical Company. Douglass Fertilizer sold the property in 1984 and the former fertilizer producton area is now occupied by the Waterproofing Company (6).

All four businesses occupying the Zellwood site are currently active. Zellwin Farms Company operates a vegetable washing and packing plant on the eastern end of the site. From 1960 to 1983, all waters from the washing process were discharged into the southern drainage ditch paralleling Jones Avenue. In 1983, some of the process water, and runoff from the parking lot area, were diverted to a drainage ditch south of their facility on the south

side of Jones Avenue. The remainder of the waste water is still discharged to the southern ditch (6). From 1963 until 1975, Drum Service Company discharged wastewaters from its drum cleaning and recycling operation into two on-site evaporation/percolation ponds. In 1975, the company redesigned its treatment system to reduce the use of the ponds. Further design changes in 1980 totally eliminated the use of the ponds for wastewater treatment. In 1981, the company began efforts to remove the waste ponds and contaminated sediments. During this operation, the company temporarily stored some of the sludge in a bermed area at the western edge of the drum storage area. In 1982, all sludge was removed to a landfill and the ponds and bermed area were filled in and used for parking and drum storage (7). Chemical Systems is a small facility that reportedly does not generate either solid or liquid wastes (6). The property currently occupied by the Coatings Application and Waterproofing Company was previously used by Douglass Fertilizer and Chemical Company which produced blended liquid fertilizers. Production wastewater was discharged to a series of three unlined evaporation/percolation ponds. The ponds are still present although they no longer receive wastewater. The two smaller ponds are usually dry while the bigger pond is always full of water (2).

There are about 300 residences within one mile of the site and the nearest are about 200 feet north of the site. The town of Zellwood is less than one-half mile east of the site and has about 1700 people (2). The population within one mile of the site is middle income and about 75.4% white, 21% black and 3% hispanic (8). A public school and two daycare centers are within one mile of the site.

Site investigations conducted in 1981 and 1982 by the Florida Department of Environmental Regulation (now the Florida Department of Environmental Protection (FDEP)) and the U.S. Environmental Protection Agency (EPA) indicated that soil, sediments, surface water, and groundwater at the Zellwood site were contaminated with metals, organic compounds and pesticides (7). EPA also sampled two off-site private wells in 1983 but found only low levels of zinc (9). Because of contamination found on the site, the Zellwood Groundwater Contamination site was placed on the National Priorities List of superfund sites on September 8, 1983. Cleanup at the site is being conducted in two separate actions. The first is intended to reduce or eliminate soil contamination at the site. This action was completed in early 1994 (2). The second addresses cleanup of the groundwater and remaining soil contamination at the site. EPA and contractors for the Potentially Responsible Parties have conducted several studies in addition to a Remedial Investigation and Feasibility Study of the site. These have included on-site sampling of the surface soil (< 6 inches), subsurface soil (> 6 inches), surface water, sediments, shallow groundwater (<40 feet), deep groundwater (> 40 feet), and waste materials, and

off-site sampling of soil, surface water, sediments, and groundwater (Tables 1-16, Figs. 3-5) (2, 6, 7, 8, 11, 12).

Contaminants at the Zellwood site fall into the following three categories: metals (antimony, arsenic, beryllium, cadmium, chromium, lead, manganese and zinc), pesticides (chlordane, DDE and dieldrin), and Polycyclic Aromatic Hydrocarbons/phthalates (benzo(a)pyrene and di(2-ethylhexyl)phthalate).

The major public health concerns at this site include exposure to contaminated surface soil, sediments, surface water, liquid waste, and solid waste sludge. Local drinking water wells may become contaminated in the future. Contaminated media in the industrial area of the site are not readily accessible to the general public, although workers may be exposed. The abandoned drum area, marsh, and open fields north and west of the industrialized part of the site, however, are not secured and are easily accessible to children and other trespassers. Exposure to contaminated media in these areas may have occurred in the past and may still be occurring. Although shallow groundwater under and southwest of the site is contaminated, local industrial supply and private drinking water wells are not.

Discussion

In the past, exposure may have occurred to contaminants in surface soil, sediments, surface water, liquid waste, solid waste, and groundwater. Currently, contamination has been measured only in surface soil, sediment, surface water and shallow groundwater. Liquid waste was present in five impoundments on the site. Two of these have been remediated. Another two contain intermittent standing water, the last one has contaminated sediment, and all three are no longer receiving liquid process wastes. Solid waste on the site was solidified and reemplaced as part of Operable Unit 1 remediation. Recent groundwater sampling (2) indicates cadmium and manganese are present above their comparison values in deep groundwater monitoring wells. However, no contamination is present in on-site production wells or off-site private drinking water wells at a level of concern. Shallow groundwater remains contaminated and contamination of the deeper aquifer in the future is a concern. However, current information indicates that shallow groundwater at the site is not used for any purpose.

Antimony

Surface soil, sediment, surface water, and waste sludge on the site, and off-site sediment contain antimony. The estimated daily dose of antimony from incidental ingestion of contaminated soil or sediment exceeds EPA's chronic oral RfD for children but

not for adults. The Reference Dose (RfD) is EPA's estimate of the daily exposure to a contaminant that is unlikely to cause adverse health effects. No ATSDR chronic oral MRL is available (13). The MRL is ATSDR's estimate of daily human exposure to a contaminant below which non-cancer, adverse health effects are unlikely to occur. Mild gastrointestinal irritation or diarrhea could result from incidental ingestion of on-site soil or sediment and off-site sediment contaminated with antimony.

Arsenic

Surface soil, sediment, surface water, liquid waste and solid waste on-site contain arsenic. The estimated daily dose of arsenic exceeds ATSDR's chronic oral MRL for children but not for adults (14). Irritation of the skin could result from dermal contact with arsenic-contaminated solid waste, sediment or surface soil. The appearance of "corns" or "warts" could result from incidental ingestion of on-site solid waste or sediment contaminated with arsenic. Arsenic is a known human carcinogen. However, lifetime exposure to arsenic in sediment or surface soil on the site would result in a no apparent increase in the risk of skin cancer.

Benzo(a)pyrene

Surface soil, sediment, surface water and production well water on-site, and sediment off-site contain benzo(a)pyrene. The estimated daily dose of benzo(a)pyrene is less than ATSDR's acute oral MRL. No chronic oral MRL is available (15). Therefore, we do not expect any adverse non-carcinogenic health effects from exposure to benzo(a)pyrene. Benzo(a)pyrene is a probable human carcinogen. However, there would be no apparent increase in the risk of cancer from exposure to benzo(a)pyrene at this site.

Beryllium

Surface soil, sediment, surface water, liquid waste, and solid waste on-site, and surface soil, sediment, and surface water off-site are contaminated with beryllium. The estimated daily dose of beryllium from incidental ingestion is less than EPA's chronic oral RfD. No ATSDR chronic oral MRL is available (16). Therefore, we do not expect any adverse non-carcinogenic health effects from exposure to beryllium. Beryllium is a probable human carcinogen. However, there would be no apparent increase in the risk of cancer from exposure to beryllium at this site.

Cadmium

Sediment, surface water, groundwater and liquid waste on-site, and groundwater off-site are contaminated with cadmium. The estimated daily dose of cadmium exceeds ATSDR's chronic oral MRL for children, but not for adults (17). Mild gastrointestinal

irritation and diarrhea could result in children from incidental ingestion of on-site sediments. Deep groundwater on and off of the site in the past contained cadmium at a level high enough to produce these effects in children if they ingested this water. However, recent groundwater sampling (2) has not found any cadmium in deep groundwater or private wells.

Chlordane

Surface soil, sediment, surface water, and solid waste on-site, and sediment off-site are contaminated with chlordane. The estimated daily dose of chlordane exceeds ATSDR's chronic oral MRL for children but not for adults (18). Incidental ingestion of on-site sediment could affect the liver of those exposed. Incidental ingestion of chlordane in on-site surface water is not likely to produce any adverse health effects. Chlordane is a probable human carcinogen based on animal studies. Lifetime exposure to chlordane at the highest level found in sediment on the site may slightly increase the risk of liver cancer in exposed individuals.

Chromium

Surface soil, sediment, surface water, liquid waste, and solid waste on-site, and groundwater off-site are contaminated with chromium. Since the analysis reports did not indicate whether chromium (III) or chromium (VI) was detected, we have assumed the presence of chromium (VI), the most toxic form. No ATSDR chronic oral MRL or EPA chronic oral RfD is available for chromium. However, the estimated daily dose of chromium is less than the No Observed Adverse Effect Level (NOAEL) for chromium (19). Therefore, we do not expect any adverse effects from exposure to chromium at this site.

DDE

Surface soil, sediment, surface water, and solid waste on-site are contaminated with DDE. No ATSDR chronic oral MRL or EPA chronic oral RfD is available for DDE. Therefore, we do not know if exposure to DDE on the site could result in any adverse health effects. DDE is a probable human carcinogen (20). However, exposure to DDE at the levels found on the site would result in no apparent increase in the risk of cancer.

Dieldrin

Surface soil and surface water on-site are contaminated with dieldrin. The estimated daily dose of dieldrin exceeds ATSDR's chronic oral MRL for children, but not for adults (21). Incidental ingestion of dieldrin in surface soil on the site may affect the kidneys and liver of children. Dieldrin is a probable human carcinogen. Lifetime exposure to dieldrin at the highest

level found in surface soil on the site may slightly increase the risk of liver cancer.

Di(2-ethylhexyl)phthalate

Surface soil, sediment, surface water, and solid waste on-site are contaminated with di(2-ethylhexyl)phthalate. The estimated daily dose of di(2-ethylhexyl)phthalate is less than ATSDR's intermediate oral MRL. No chronic oral MRL is available (22). Therefore, we do not expect any adverse health effects from exposure to di(2-ethylhexyl)phthalate at this site. Di(2-ethylhexyl)phthalate is a probable human carcinogen. However, there would be no apparent increase in the risk of cancer from exposure to di(2-ethylhexyl)phthalate at this site.

Lead

Lead has been found as a contaminant in all media examined. Although no ATSDR chronic oral MRL or EPA chronic oral RfD is available for lead, the level found in on-site solid waste in the past was high enough that exposure to it could have increased blood lead levels in children 16-40 µg/dL (23). Blood lead levels in this range may impair development of the nervous system and adversely affect the kidneys and blood-forming system. Industrial wells on-site, and one off-site private well contained lead levels exceeding the Florida Primary Drinking Water Standard. However, recent groundwater sampling (2) has not found lead in deep groundwater or private wells at a level of concern. Lead is a probable human carcinogen based on animal studies. However, the estimated daily dose of lead is at least 1,000 times less than the level at which cancer effects have been shown to occur in animals (23). Therefore, carcinogenic effects from incidental ingestion are unlikely.

Manganese

Surface soil, sediment, surface water, groundwater, liquid waste and solid waste on-site, and surface water and groundwater off-site are contaminated with manganese. The estimated daily dose of manganese from incidental ingestion of on-site sediment exceeds EPA's chronic oral RfD for children but not for adults. No ATSDR chronic oral MRL is available for manganese (24). Children exposed for longer than one year to manganese in sediments on the site may experience nervous system disturbances. In the past, on-site industrial production wells contained manganese at a level that could have produced these symptoms in children if they consumed this water. This contamination is not currently present in on-site production wells or off-site private drinking water wells.

Zinc

Surface water and solid waste on-site, and deep groundwater off-site are contaminated with zinc. The estimated daily dose of zinc from incidental ingestion of solid waste is less than ATSDR's intermediate oral MRL. No chronic oral MRL is available (25). Therefore, we do not expect any adverse health effects to have occurred from past exposure to zinc in on-site solid waste. In the past, deep groundwater off-site contained zinc at a level that could have caused adverse health effects in children if they consumed this water. However, this contamination has not reached off-site private wells.

Conclusions

Based upon our review of the environmental data and information contained in the Records of Decision for Operable Units 1 and 2, we conclude that EPA's cleanup acitivities to date and their proposed plan to remediate the groundwater at the site are protective of public health. Groundwater is not a current likely exposure pathway, although it could become so in the future if measures to remediate the shallow groundwater at the site are not implemented. Past exposure to contaminants in surface water and sediments in the holding pond and drainage ditches at the site may have resulted in adverse health effects. Exposure to sediments in the drainage ditches on-site may still result in adverse health effects.

Recommendations

Florida HRS recommends that EPA:

1. Monitor deep groundwater used as a source of drinking water until remediation of shallow groundwater has been completed.

2. Remove the source sediments from the remaining on-site holding pond to preclude further contamination of groundwater at the site.

3. Analyze samples of the sediments in the northern and middle ditches to determine if contamination is still present at a level of public health concern.

4. Conduct a well survey of the area within one-quarter mile of the site to ensure that shallow groundwater is not being used.

5. Post sufficient warning signs to comply with sections 403.704 and 403.7255, Florida Statutes and FDEP Rule 17-736 indicating the hazardous nature of this site.

References

1. Florida Department of Health and Rehabilitative Services. Site Review and Update, Zellwood Groundwater Contamination Site, September 2, 1992.

2. CDM Federal Programs Corporation. Supplemental Remedial Investigation and Focused Feasibility Study Report for the Zellwood Groundwater Contamination Site, Orange County, Florida. October 7, 1994.

3. EPA. Record of Decision for the Zellwood Groundwater Contamination NPL CERCLA Site - Orange County, Florida. December 1987.

4. EPA. Summary of the Remedial Alternative Selection, Zellwood Groundwater Contamination Site, Orange County, Florida. March 1990.

5. EPA. Draft Record of Decision, Summary of Remedial Alternative Selection, Zellwood Ground Water Contamination Site, Operable Unit 2, Zellwood, Orange County, Florida. February 1995.

6. NUS Corporation. Draft Remedial Investigation, Zellwood Groundwater Contamination Site, Orange County, Florida. December 1985.

7. NUS Corporation. Remedial Action Master Plan for the Zellwood Groundwater Contamination Site, Zellwood, Florida. June 1984.

8. Bureau of the Census. 1990 Census Data Files, U.S. Department of Commerce, Washington, DC.

9. EPA. Resampling of Two Private Wells at Zellwood, Florida; Memo: Hugh Vick to Bob Jordan. August 16, 1983.

10. EPA. Site Analysis, Zellwood Ground Water Contamination, Zellwood, Florida. June 1985.

11. Roy F. Weston, Inc. Information Management and Computer Mapping for Zellwood Groundwater Contamination NPL Site, Zellwood, Orange County, Florida. December 12, 1988.

12. Tetra Tech, Inc. Alternative Remedial Contracting Strategy (ARCS), Field Activities Report. September 1991.

13. Agency for Toxic Substances and Disease Registry. Toxicological Profile for Antimony. Atlanta: ATSDR, September 1992.

14. Agency for Toxic Substances and Disease Registry. Toxicological Profile for Arsenic. Atlanta: ATSDR, April 1993.

15. Agency for Toxic Substances and Disease Registry. Toxicological Profile for Benzo(a)pyrene. Atlanta: ATSDR, May 1990.

16. Agency for Toxic Substances and Disease Registry. Toxicological Profile for Beryllium . Atlanta: ATSDR, April 1993.

17. Agency for Toxic Substances and Disease Registry. Toxicological Profile for Cadmium. Atlanta: ATSDR, April 1993.

18. Agency for Toxic Substances and Disease Registry. Toxicological Profile for Chlordane, Update . Atlanta: ATSDR, May 1994.

19. Agency for Toxic Substances and Disease Registry. Toxicological Profile for Chromium. Atlanta: ATSDR, April 1993.

20. Agency for Toxic Substances and Disease Registry. Toxicological Profile for 4,4'-DDT, 4,4'-DDE, 4,4'-DDD, Update. Atlanta: ATSDR, May 1994.

21. Agency for Toxic Substances and Disease Registry. Toxicological Profile for Aldrin/Dieldrin. Atlanta: ATSDR, April 1993.

22. Agency for Toxic Substances and Disease Registry. Toxicological Profile for Di(2-ethylhexyl)phthalate. Atlanta: ATSDR, April 1993.

23. Agency for Toxic Substances and Disease Registry. Toxicological Profile for Lead. Atlanta: ATSDR, June 1990.

24. Agency for Toxic Substances and Disease Registry. Toxicological Profile for Manganese and Compounds. Atlanta: ATSDR, July 1992.

25. Agency for Toxic Substances and Disease Registry. Toxicological Profile for Zinc. Atlanta: ATSDR, October 1992.

Preparers of Report

Bruce J. Tuovila
Environmental Specialist
Office of Environmental Toxicology
Florida Department of Health and Rehabilitative Services

E. Randall Merchant
Biological Administrator
Office of Environmental Toxicology
Florida Department of Health and Rehabilitative Services

ATSDR Technical Project Officer:

Richard Kauffman
Remedial Programs Branch
Division of Health Assessment and Consultation

ATSDR Regional Representative:

Bob Safay
Regional Services
Office of the Assistant Administrator

Table 1. Maximum Concentrations in On-Site Surface Soil (<6 ")

Contaminants of Concern	Maximum Concentration (mg/kg)	Total # Exceeding Comparison Value/ Total # samples	Background Concentration (mg/kg)	Comparison Value	
				(mg/kg)	Source
Antimony	70	4/5	NA	20	RMEG
Arsenic	16	6/22	NA	0.4	CREG
Benzo(a) pyrene	7.6	6/19	NA	0.1	CREG
Beryllium	0.69	1/5	NA	0.2	CREG
Cadmium	16	0/28	NA	30	RMEG
Chlordane	33	11/19	NA	0.5	CREG
Chromium	360	2/28	NA	300	RMEG
DDE	5.6	6/19	NA	2.0	CREG
Dieldrin	5.9	5/17	NA	0.04	CREG
Di(2-ethylhexyl) phthalate	820	1/8	NA	50	CREG
Lead	1500	-/27	NA	NONE	CARCIN
Manganese	440	1/7	NA	300	RMEG
Zinc	560	0/7	NA	20000	RMEG

NA - not analyzed
CREG - Cancer Risk Evaluation Guide
RMEG - Reference Dose Media Evaluation Guide
CARCIN - Carcinogen
mg/kg- milligrams per kilogram
Sources: 6, 7, 11

Table 2. Maximum Concentrations in On-Site Subsurface Soil (> 6")

Contaminants of Concern	Maximum Concentration (mg/kg)	Total # Exceeding Comparison Value/ Total # samples	Background Concentration (mg/kg)	Comparison Value	
				(mg/kg)	Source
Antimony	45	1/33	NA	20	RMEG
Arsenic	41	16/55	NA	0.4	CREG
Benzo(a) pyrene	1.7	9/50	NA	0.1	CREG
Beryllium	ND	0/24	NA	0.2	CREG
Cadmium	3.5	0/60	NA	30	RMEG
Chlordane	44	25/57	NA	0.5	CREG
Chromium	200	0/66	NA	300	RMEG
DDE	12	4/57	NA	2.0	CREG
Dieldrin	0.8	9/48	NA	0.04	CREG
Di(2-ethylhexyl) phthalate	27	0/33	NA	50	CREG
Lead	800	-/67	NA	NONE	CARCIN
Manganese	110	0/45	NA	300	RMEG
Zinc	820	0/47	NA	20000	RMEG

NA - not analyzed
ND - not detected
CREG - Cancer Risk Evaluation Guide
RMEG - Reference Dose Media Evaluation Guide
µg/L- micrograms per liter
mg/kg- milligrams per kilogram
Sources: 2, 6, 7, 11, 12

Table 3. Maximum Concentrations in On-Site Sediment

Contaminants of Concern	Maximum Concentration (mg/kg)	Total # Exceeding Comparison Value/ Total # samples	Background Concentration (mg/kg)	Comparison Value	
				(mg/kg)	Source
Antimony	100	8/41	NA	20	RMEG
Arsenic	80	24/77	NA	0.4	CREG
Benzo(a) pyrene	2.8	16/54	NA	0.1	CREG
Beryllium	8.4	14/35	NA	0.2	CREG
Cadmium	62	3/81	NA	30	RMEG
Chlordane	470	25/69	NA	0.5	CREG
Chromium	720	3/81	NA	300	RMEG
DDE	20	8/69	NA	2.0	CREG
Dieldrin	ND	0/25	NA	0.04	CREG
Di(2-ethylhexyl) phthalate	2000	2/37	NA	50	CREG
Lead	2000	-/80	NA	NONE	CARCIN
Manganese	36000	6/47	NA	300	RMEG
Zinc	13000	0/47	NA	20000	RMEG

NA - not analyzed
ND - not detected
CREG - Cancer Risk Evaluation Guide
RMEG - Reference Dose Media Evaluation Guide
CARCIN - Carcinogen
mg/kg- milligrams per kilogram
Sources: 2, 6, 7, 10, 11

Table 4. Maximum Concentrations in On-Site Surface Water

Contaminants of Concern	Maximum Concentration (µg/L)	Total # Exceeding Comparison Value/ Total # samples	Background Concentration (µg/L)	Comparison Value	
				(µg/L)	Source
Antimony	57	5/24	NA	3	LTHA
Arsenic	140	6/25	NA	0.02	CREG
Benzo(a) pyrene	1	1/12	NA	0.005	CREG
Beryllium	20	3/29	NA	0.008	CREG
Cadmium	110	8/36	NA	5	RMEG
Chlordane	26	8/15	NA	0.03	CREG
Chromium	950	6/37	NA	50	RMEG
DDE	2.9	3/13	NA	0.1	CREG
Dieldrin	0.13	1/11	NA	0.002	CREG
Di(2-ethylhexyl) phthalate	84	8/26	NA	3	CREG
Lead	5700	12/37	NA	15	FLMCL
Manganese	20000	24/37	NA	50	RMEG
Zinc	21000	5/38	NA	2000	LTHA

NA - not analyzed
FLMCL - Florida Maximum Contaminant Level
CREG - Cancer Risk Evaluation Guide
RMEG - Reference Dose Media Evaluation Guide
LTHA - Lifetime Health Advisory for Drinking Water
µg/L- micrograms per liter
Sources: 2, 6, 7

Table 5. Maximum Concentrations in On-Site Shallow Groundwater (< 40')

Contaminants of Concern	Maximum Concentration (µg/L)	Total # Exceeding Comparison Value/ Total # samples	Background Concentration (µg/L)	Comparison Value	
				(µg/L)	Source
Antimony	72	1/25	NA	3	LTHA
Arsenic	1300	13/58	NA	0.02	CREG
Benzo(a) pyrene	ND	0/18	NA	0.005	CREG
Beryllium	4.2	4/41	NA	0.008	CREG
Cadmium	32	7/40	NA	5	RMEG
Chlordane	0.35	1/21	NA	0.03	CREG
Chromium	1500	23/70	NA	50	RMEG
DDE	0.09	0/23	NA	0.1	CREG
Dieldrin	ND	0/31	NA	0.002	CREG
Di(2-ethylhexyl) phthalate	60	3/26	NA	3	CREG
Lead	440	32/71	NA	15	FLMCL
Manganese	1400	19/53	NA	50	RMEG
Zinc	69000	6/53	NA	2000	LTHA

NA - not analyzed
ND - not detected
FLMCL - Florida Maximum Contaminant Level
CREG - Cancer Risk Evaluation Guide
RMEG - Reference Dose Media Evaluation Guide
LTHA - Lifetime Health Advisory for Drinking Water
µg/L- micrograms per liter
Sources: 2, 6, 7, 11, 12

Table 6. Maximum Concentrations in On-Site Deep Groundwater (> 40')

Contaminants of Concern	Maximum Concentration (µg/L)	Total # Exceeding Comparison Value/ Total # samples	Background Concentration (µg/L)	Comparison Value	
				(µg/L)	Source
Antimony	ND	0/5	NA	3	LTHA
Arsenic	ND	0/10	NA	0.02	CREG
Benzo(a) pyrene	ND	0/6	NA	0.005	CREG
Beryllium	ND	0/7	NA	0.008	CREG
Cadmium	11	1/12	NA	5	RMEG
Chlordane	ND	0/4	NA	0.03	CREG
Chromium	33	0/14	NA	50	RMEG
DDE	ND	0/2	NA	0.1	CREG
Dieldrin	ND	0/5	NA	0.002	CREG
Di(2-ethylhexyl) phthalate	ND	0/4	NA	3	CREG
Lead	150	2/14	NA	15	FLMCL
Manganese	90	1/10	NA	50	RMEG
Zinc	550	0/9	NA	2000	LTHA

NA - not analyzed
ND - not detected
FLMCL - Florida Maximum Contaminant Level
CREG - Cancer Risk Evaluation Guide
RMEG - Reference Dose Media Evaluation Guide
LTHA - Lifetime Health Advisory for Drinking Water
µg/L- micrograms per liter
Sources: 2, 6, 7

Table 7. Maximum Concentrations in On-Site Private Wells

Contaminants of Concern	Maximum Concentration (µg/L)	Total # Exceeding Comparison Value/ Total # samples	Background Concentration (µg/L)	Comparison Value	
				(µg/L)	Source
Antimony	ND	0/6	NA	3	LTHA
Arsenic	ND	0/13	NA	0.02	CREG
Benzo(a) pyrene	9.4	1/6	NA	0.005	CREG
Beryllium	ND	0/13	NA	0.008	CREG
Cadmium	15	1/16	NA	5	RMEG
Chlordane	ND	0/3	NA	0.03	CREG
Chromium	33	0/19	NA	50	RMEG
DDE	ND	0/3	NA	0.1	CREG
Dieldrin	ND	0/4	NA	0.002	CREG
Di(2-ethylhexyl) phthalate	ND	0/2	NA	3	CREG
Lead	30	2/19	NA	15	FLMCL
Manganese	100	1/13	NA	50	RMEG
Zinc	110	0/16	NA	2000	LTHA

NA - not analyzed
ND - not detected
FLMCL - Florida Maximum Contaminant Level
CREG - Cancer Risk Evaluation Guide
RMEG - Reference Dose Media Evaluation Guide
LTHA - Lifetime Health Advisory for Drinking Water
µg/L- micrograms per liter
Sources: 2, 6, 7, 10, 11

Table 8. Maximum Concentrations in On-Site Liquid Waste

Contaminants of Concern	Maximum Concentration (µg/L)	Total # Exceeding Comparison Value/ Total # samples	Background Concentration (µg/L)	Comparison Value	
				(µg/L)	Source
Antimony	ND	0/1	NA	3	LTHA
Arsenic	15	1/1	NA	0.02	CREG
Benzo(a) pyrene	NA	NA	NA	0.005	CREG
Beryllium	6	1/1	NA	0.008	CREG
Cadmium	18	5/5	NA	5	RMEG
Chlordane	ND	0/1	NA	0.03	CREG
Chromium	1980	5/5	NA	50	RMEG
DDE	NA	NA	NA	0.1	CREG
Dieldrin	NA	NA	NA	0.002	CREG
Di(2-ethylhexyl) phthalate	ND	0/1	NA	3	CREG
Lead	2710	4/5	NA	15	FLMCL
Manganese	1600	1/1	NA	50	RMEG
Zinc	6266	2/4	NA	2000	LTHA

NA - not analyzed
ND - not detected
FLMCL - Florida Maximum Contaminant Level
CREG - Cancer Risk Evaluation Guide
RMEG - Reference Dose Media Evaluation Guide
LTHA - Lifetime Health Advisory for Drinking Water
µg/L- micrograms per liter
Source: 7

Table 9. Maximum Concentrations in On-Site Solid Waste

Contaminants of Concern	Maximum Concentration (mg/kg)	Total # Exceeding Comparison Value/ Total # samples	Background Concentration (mg/kg)	Comparison Value	
				(mg/kg)	Source
Antimony	60	3/4	NA	20	RMEG
Arsenic	200	1/2	NA	0.4	CREG
Benzo(a) pyrene	NA	NA	NA	0.1	CREG
Beryllium	0.69	1/2	NA	0.2	CREG
Cadmium	28	0/4	NA	30	RMEG
Chlordane	18	2/4	NA	0.5	CREG
Chromium	1200	2/4	NA	300	RMEG
DDE	59	2/2	NA	2.0	CREG
Dieldrin	NA	NA	NA	0.04	CREG
Di(2-ethylhexyl) phthalate	1400	2/4	NA	50	CREG
Lead	5600	-/4	NA	NONE	CARCIN
Manganese	140	0/2	NA	300	RMEG
Zinc	1800	0/4	NA	20000	RMEG

NA - not analyzed
CREG - Cancer Risk Evaluation Guide
RMEG - Reference Dose Media Evaluation Guide
CARCIN - Carcinogen
mg/kg- milligrams per kilogram
Sources: 6, 7

Table 10. Maximum Concentrations in Off-Site Surface Soil (< 6")

Contaminants of Concern	Maximum Concentration (mg/kg)	Total # Exceeding Comparison Value/ Total # samples	Background Concentration (mg/kg)	Comparison Value	
				(mg/kg)	Source
Antimony	ND	0/2	ND	20	RMEG
Arsenic	ND	0/2	ND	0.4	CREG
Benzo(a) pyrene	ND	0/2	NA	0.1	CREG
Beryllium	0.51	1/1	NA	0.2	CREG
Cadmium	0.9	0/3	ND	30	RMEG
Chlordane	0.027	0/3	ND	0.5	CREG
Chromium	ND	0/3	2.8	300	RMEG
DDE	0.016	0/3	ND	2.0	CREG
Dieldrin	ND	0/1	NA	0.04	CREG
Di(2-ethylhexyl) phthalate	0.2	0/2	ND	50	CREG
Lead	13	-/3	7	NONE	CARCIN
Manganese	22	0/3	11	300	RMEG
Zinc	13	0/3	5.4	20000	RMEG

NA - not analyzed
ND - not detected
CREG - Cancer Risk Evaluation Guide
RMEG - Reference Dose Media Evaluation Guide
CARCIN - Carcinogen
mg/kg- milligrams per kilogram
Sources: 6, 7

Table 11. Maximum Concentrations in Off-Site Subsurface Soil (> 6")

Contaminants of Concern	Maximum Concentration (mg/kg)	Total # Exceeding Comparison Value/ Total # samples	Background Concentration (mg/kg)	Comparison Value	
				(mg/kg)	Source
Antimony	ND	0/1	NA	20	RMEG
Arsenic	ND	0/4	NA	0.4	CREG
Benzo(a) pyrene	0.0005	0/2	NA	0.1	CREG
Beryllium	NA	NA	NA	0.2	CREG
Cadmium	2.1	0/4	NA	30	RMEG
Chlordane	ND	0/2	NA	0.5	CREG
Chromium	3.3	0/4	NA	300	RMEG
DDE	ND	0/2	NA	2.0	CREG
Dieldrin	NA	NA	NA	0.04	CREG
Di(2-ethylhexyl) phthalate	ND	0/2	NA	50	CREG
Lead	20	-/4	NA	NONE	CARCIN
Manganese	24	0/4	NA	300	RMEG
Zinc	8	0/4	NA	20000	RMEG

NA - not analyzed
ND - not detected
CREG - Cancer Risk Evaluation Guide
RMEG - Reference Dose Media Evaluation Guide
CARCIN - Carcinogen
mg/kg- milligrams per kilogram
Source: 7

Table 12. Maximum Concentrations in Off-Site Sediment

Contaminants of Concern	Maximum Concentration (mg/kg)	Total # Exceeding Comparison Value/ Total # samples	Background Concentration (mg/kg)	Comparison Value	
				(mg/kg)	Source
Antimony	100	1/3	NA	20	RMEG
Arsenic	ND	0/4	NA	0.4	CREG
Benzo(a) pyrene	1.3	1/4	NA	0.1	CREG
Beryllium	2.5	1/3	NA	0.2	CREG
Cadmium	7.2	0/5	NA	30	RMEG
Chlordane	15	2/5	NA	0.5	CREG
Chromium	29	0/6	NA	300	RMEG
DDE	1.4	0/7	NA	2.0	CREG
Dieldrin	ND	0/2	NA	0.04	CREG
Di(2-ethylhexyl) phthalate	16	0/2	NA	50	CREG
Lead	40	-/6	NA	NONE	CARCIN
Manganese	46	0/5	NA	300	RMEG
Zinc	310	0/5	NA	20000	RMEG

NA - not analyzed
ND - not detected
CREG - Cancer Risk Evaluation Guide
RMEG - Reference Dose Media Evaluation Guide
CARCIN - Carcinogen
mg/kg- milligrams per kilogram
Sources: 6, 11

Table 13. Maximum Concentrations in Off-Site Surface Water

Contaminants of Concern	Maximum Concentration (µg/L)	Total # Exceeding Comparison Value/ Total # samples	Background Concentration (µg/L)	Comparison Value	
				(µg/L)	Source
Antimony	ND	0/3	NA	3	LTHA
Arsenic	ND	0/5	NA	0.02	CREG
Benzo(a) pyrene	ND	0/2	NA	0.005	CREG
Beryllium	2	1/5	NA	0.008	CREG
Cadmium	ND	0/5	NA	5	RMEG
Chlordane	ND	0/3	NA	0.03	CREG
Chromium	25	0/5	NA	50	RMEG
DDE	ND	0/4	NA	0.1	CREG
Dieldrin	NA	NA	NA	0.002	CREG
Di(2-ethylhexyl) phthalate	ND	0/3	NA	3	CREG
Lead	30	3/5	NA	15	FLMCL
Manganese	100	2/5	NA	50	RMEG
Zinc	160	0/5	NA	2000	LTHA

NA - not analyzed
ND - not detected
FLMCL - Florida Maximum Contaminant Level
CREG - Cancer Risk Evaluation Guide
RMEG - Reference Dose Media Evaluation Guide
LTHA - Lifetime Health Advisory for Drinking Water
µg/L- micrograms per liter
Source: 6

Table 14. Maximum Concentrations in Off-Site Shallow Groundwater (< 40')

Contaminants of Concern	Maximum Concentration (µg/L)	Total # Exceeding Comparison Value/ Total # samples	Background Concentration (µg/L)	Comparison Value	
				(µg/L)	Source
Antimony	46	1/13	NA	3	LTHA
Arsenic	24	5/36	NA	0.02	CREG
Benzo(a) pyrene	ND	0/15	NA	0.005	CREG
Beryllium	0.5	1/24	NA	0.008	CREG
Cadmium	22.1	8/37	NA	5	RMEG
Chlordane	ND	0/23	NA	0.03	CREG
Chromium	940	16/48	NA	50	RMEG
DDE	ND	0/23	NA	0.1	CREG
Dieldrin	0.15	2/28	NA	0.002	CREG
Di(2-ethylhexyl) phthalate	160	2/11	NA	3	CREG
Lead	350	16/47	NA	15	FLMCL
Manganese	220	13/28	NA	50	RMEG
Zinc	40000	5/28	NA	2000	LTHA

NA - not analyzed
ND - not detected
FLMCL - Florida Maximum Contaminant Level
CREG - Cancer Risk Evaluation Guide
RMEG - Reference Dose Media Evaluation Guide
LTHA - Lifetime Health Advisory for Drinking Water
µg/L- micrograms per liter
Sources: 2, 6, 7, 11, 12

Table 15. Maximum Concentrations in Off-Site Deep Groundwater (> 40')

Contaminants of Concern	Maximum Concentration (µg/L)	Total # Exceeding Comparison Value/ Total # samples	Background Concentration (µg/L)	Comparison Value	
				(µg/L)	Source
Antimony	ND	0/2	NA	3	LTHA
Arsenic	ND	0/4	NA	0.02	CREG
Benzo(a) pyrene	ND	0/1	NA	0.005	CREG
Beryllium	ND	0/4	NA	0.008	CREG
Cadmium	12	1/4	NA	5	RMEG
Chlordane	ND	0/3	NA	0.03	CREG
Chromium	96	1/3	NA	50	RMEG
DDE	ND	0/3	NA	0.1	CREG
Dieldrin	ND	0/5	NA	0.002	CREG
Di(2-ethylhexyl) phthalate	NA	NA	NA	3	CREG
Lead	50	2/5	NA	15	FLMCL
Manganese	66	1/5	NA	50	RMEG
Zinc	12000	1/3	NA	2000	LTHA

NA - not analyzed
ND - not detected
FLMCL - Florida Maximum Contaminant Level
CREG - Cancer Risk Evaluation Guide
RMEG - Reference Dose Media Evaluation Guide
LTHA - Lifetime Health Advisory for Drinking Water
µg/L- micrograms per liter
Sources: 2, 6, 7, 11

Table 16. Maximum Concentrations in Off-Site Private Wells

Contaminants of Concern	Maximum Concentration (µg/L)	Total # Exceeding Comparison Value/ Total # samples	Background Concentration (µg/L)	Comparison Value	
				(µg/L)	Source
Antimony	ND	0/8	NA	3	LTHA
Arsenic	ND	0/14	NA	0.02	CREG
Benzo(a) pyrene	ND	0/4	NA	0.005	CREG
Beryllium	ND	0/14	NA	0.008	CREG
Cadmium	13	1/15	NA	5	RMEG
Chlordane	ND	0/7	NA	0.03	CREG
Chromium	24	0/16	NA	50	RMEG
DDE	ND	0/7	NA	0.1	CREG
Dieldrin	ND	0/8	NA	0.002	CREG
Di(2-ethylhexyl) phthalate	ND	0/2	NA	3	CREG
Lead	20	2/22	NA	15	FLMCL
Manganese	24	0/14	NA	50	RMEG
Zinc	590	0/15	NA	2000	LTHA

NA - not analyzed
ND - not detected
FLMCL - Florida Maximum Contaminant Level
CREG - Cancer Risk Evaluation Guide
RMEG - Reference Dose Media Evaluation Guide
LTHA - Lifetime Health Advisory for Drinking Water
µg/L- micrograms per liter
Sources: 2, 6, 7, 9, 10, 11

Figure 1. State Map Showing Location of Orange County

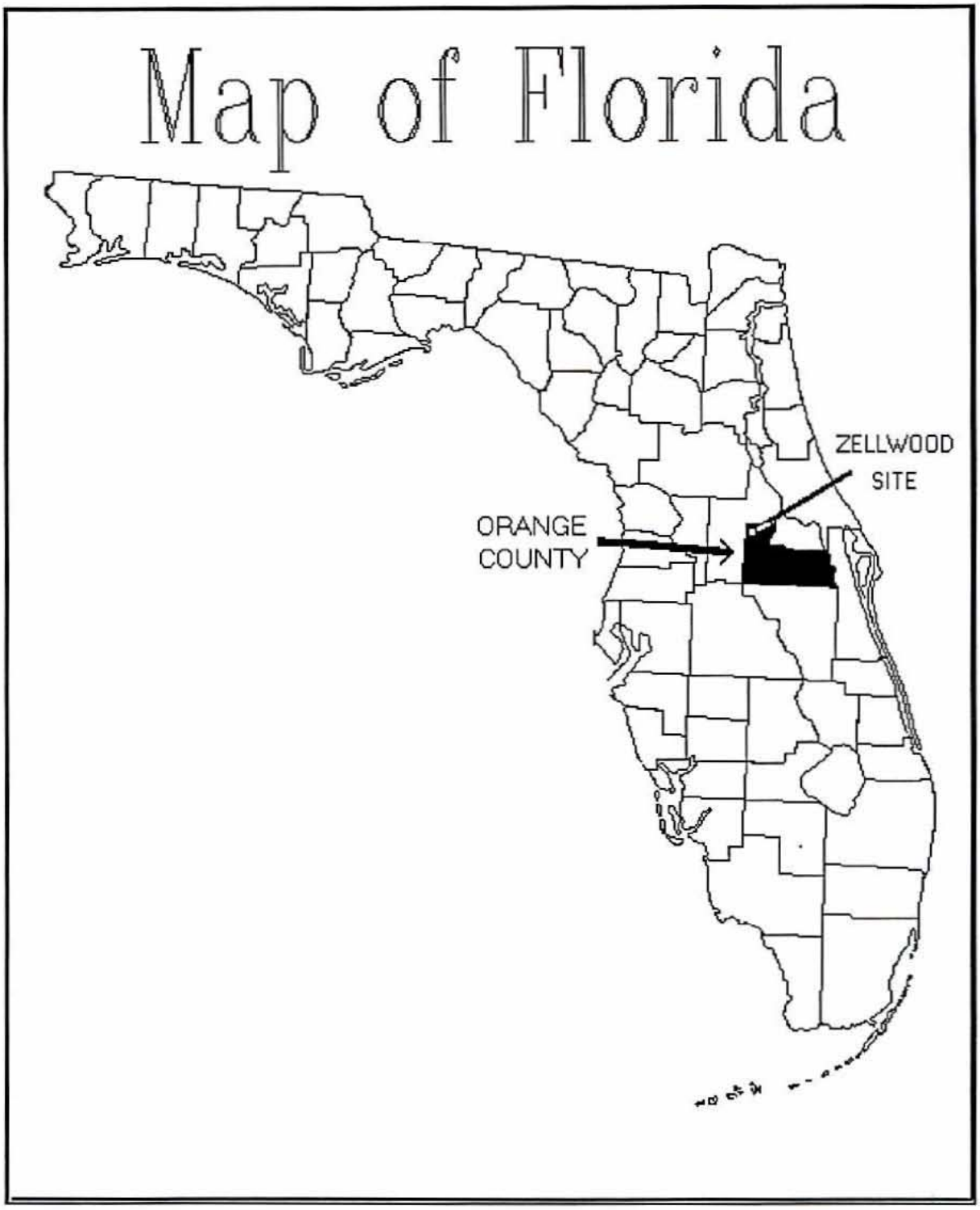

Figure 2. General Location of Zellwood Groundwater Contamination Site

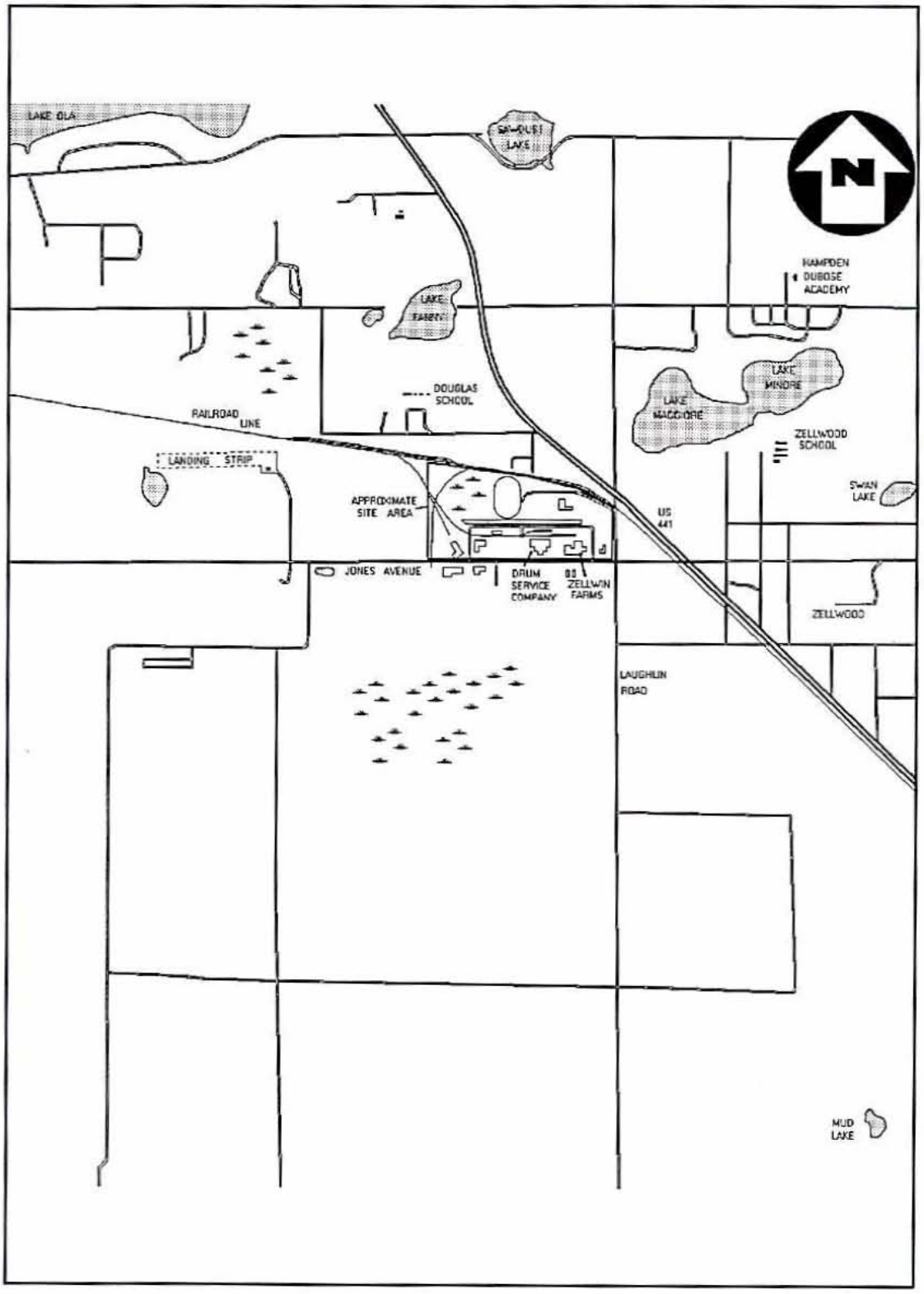

Figure 3. Surface Soil, Subsurface Soil, and Sediment Sample Locations

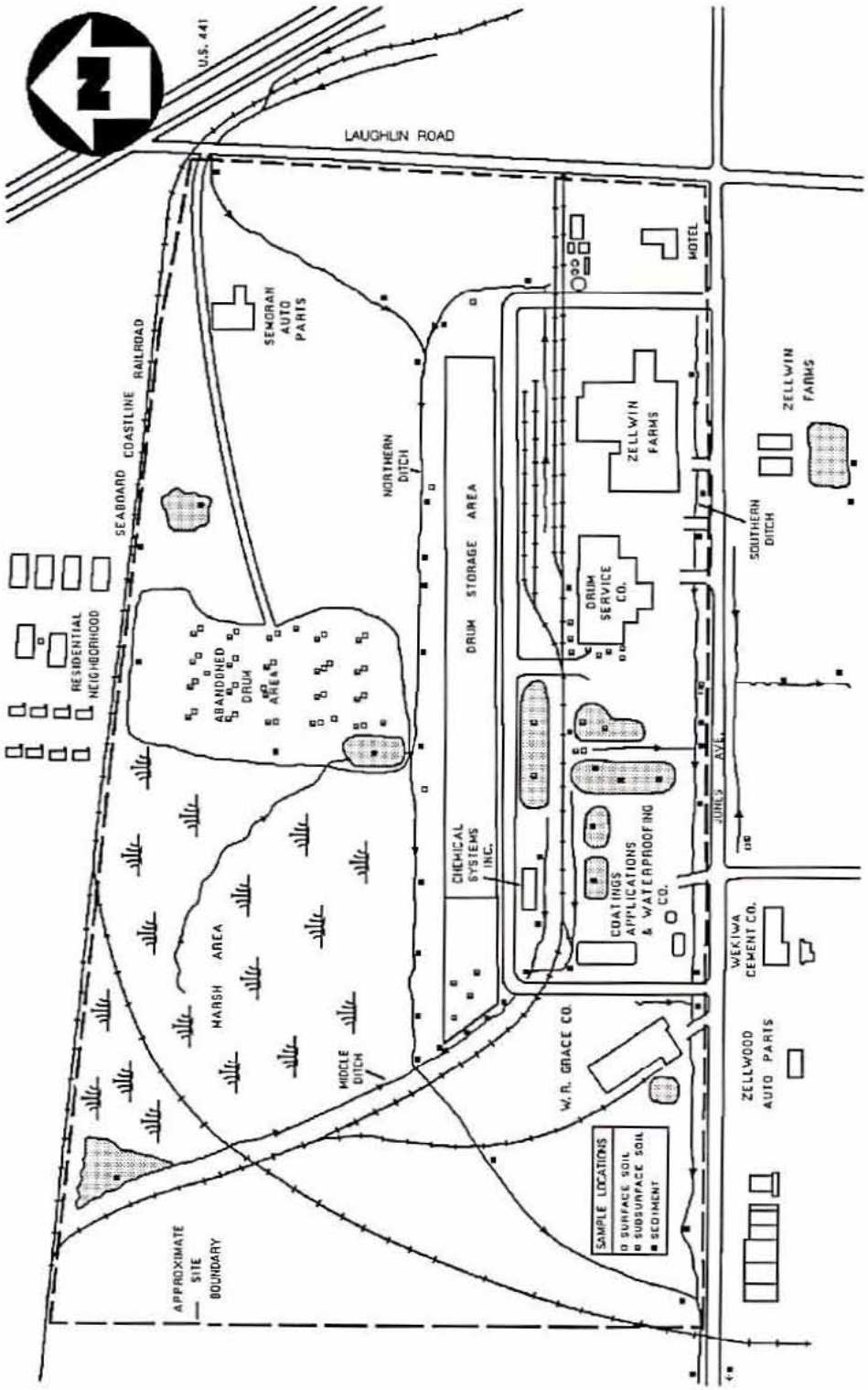

Figure 4. Shallow Groundwater, Deep Groundwater, and Private Well Sample Locations

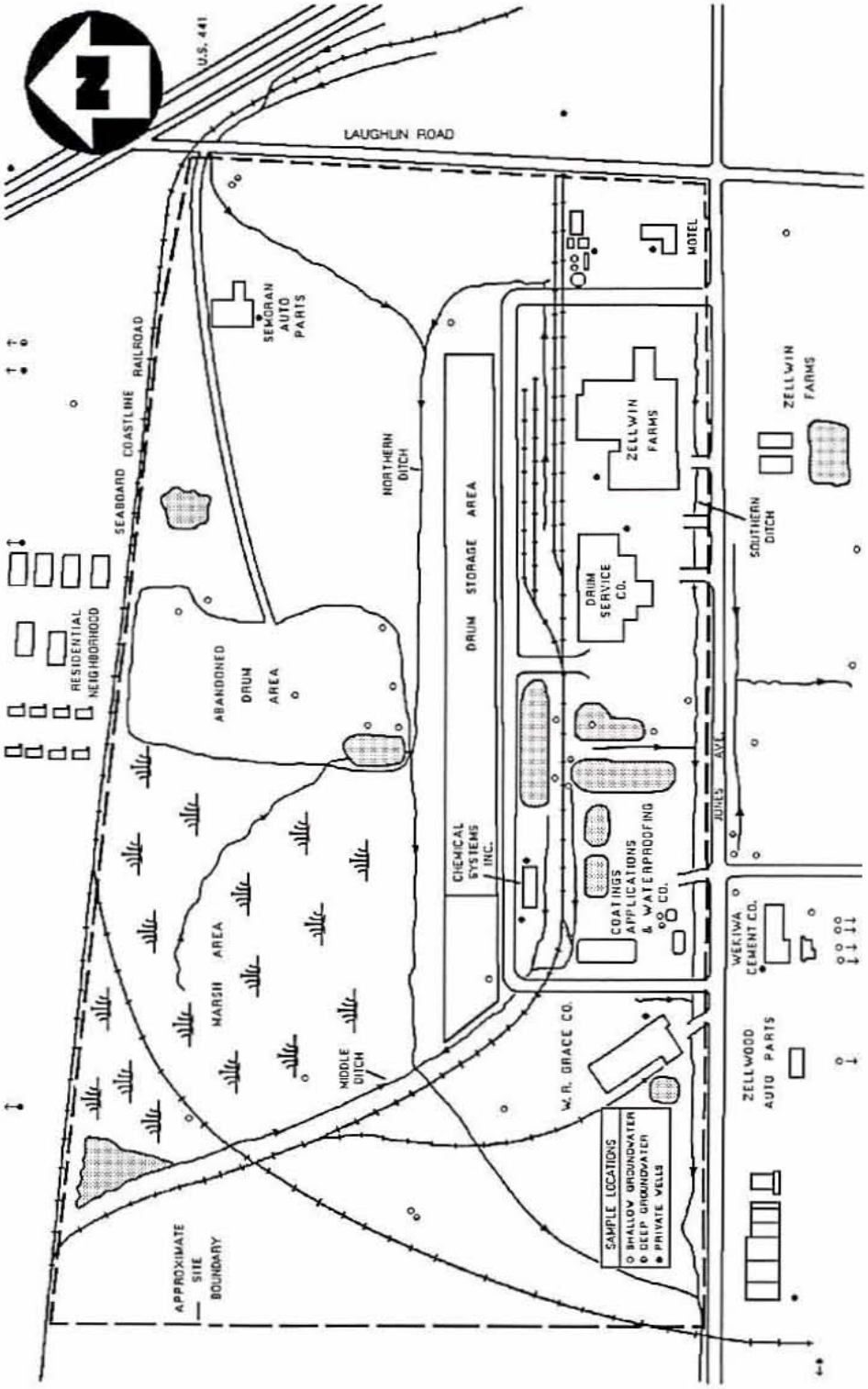

Figure 5. Surface Water, Liquid Waste, and Solid Waste Sample Locations