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CHEVRON CHEMICAL COMPANY (ORTHO DIVISION)
ORLANDO, ORANGE COUNTY, FLORIDA
CERCLIS NO. FLD004064242
MAY 3, 1995

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PUBLIC HEALTH ASSESSMENT

CHEVRON CHEMICAL COMPANY (ORTHO DIVISION)

ORLANDO, ORANGE COUNTY, FLORIDA

CERCLIS NO. FLD004064242

Prepared by

The Florida Department of Health and Rehabilitative Services
Environmental Toxicology
Under a Cooperative Agreement with
The Agency for Toxic Substances and Disease Registry

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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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FOREWARD

The Agency for Toxic Substances and Disease Registry, ATSDR, is an agency of the U.S. Public Health Service. It was established by Congress in 1980 under the Comprehensive Environmental Response, Compensation, and Liability Act, also known as the *Superfund* law. This law set up a fund to identify and clean up our country's hazardous waste sites. The Environmental Protection Agency, EPA, and the individual states regulate the investigation and clean up of the sites.

Since 1986, ATSDR has been required by law to conduct a public health assessment at each of the sites on the EPA National Priorities List. The aim of these evaluations is to find out if people are being exposed to hazardous substances and, if so, whether that exposure is harmful and should be stopped or reduced. (The legal definition of a health assessment is included on the inside front cover.) If appropriate, ATSDR also conducts public health assessments when petitioned by concerned individuals. Public health assessments are carried out by environmental and health scientists from ATSDR and from the states with which ATSDR has cooperataive agreements.

Exposure: As the first step in the evaluation, ATSDR scientists review environmental data to see how much contamination is at a site, where it is, and how people might come into contact with it. Generally, ATSDR does not collect its own environmental sampling data but reviews information provided by EPA, other government agencies, businesses, and the public. When there is not enough environmental information available, the report will indicate what further sampling data is needed.

Health Effects: If the review of the environmental data shows that people have or could come into contact with hazardous substances, ATSDR scientists then evaluate whether or not there will be any harmful effects from these exposures. The report focuses on public health, or the health impact on the community as a whole, rather than on individual risks. Again, ATSDR generally makes use of existing scientific information, which can include the results of medical, toxicologic and epidemiologic studies and the data collected in disease registries. The science of environmental health is still developing, and sometimes scientific information on the health effects of certain substances is not available. When this is so, the report will suggest what further research studies are needed.

Conclusions: The report presents conclusions about the level of health threat, if any, posed by a site and recommends ways to stop or reduce exposure in its public health action plan. ATSDR is primarily an advisory agency, so usually these reports

identify what actions are appropriate to be undertaken by EPA, other responsible parties, or the research or education divisions of ATSDR. However, if there is an urgent health threat, ATSDR can issue a public health advisory warning people of the danger. ATSDR can also authorize health education or pilot studies of health effects, full-scale epidemiology studies, disease registries, surveillance studies or research on specific hazardous substances.

Interactive Process: The health assessment is an interactive process. ATSDR solicits and evaluates information from numerous city, state and federal agencies, the companies responsible for cleaning up the site, and the community. It then shares its conclusions with them. Agencies are asked to respond to an early version of the report to make sure that the data they have provided is accurate and current. When infomed of ATSDR's conclusions and recommendations, sometimes the agencies will begin to act on them before the final release of the report.

Community: ATSDR also needs to learn what people in the area know about the site and what concerns they may have about its impact on their health. Consequently, throughout the evaluation process, ATSDR actively gathers information and comments from the people who live or work near a site, including residents of the area, civic leaders, health professionals and community groups. To ensure that the report responds to the community's health concerns, an early version is also distributed to the public for their comments. All the comments received from the public are responded to in the final version of the report.

Comments: If, after reading this report, you have questions or comments, we encourage you to send them to us.

Letters should be addressed as follows:

Attention: Chief, Program Evaluation, Records, and Information Services Branch, Agency for Toxic Substances and Disease Registry, 1600 Clifton Road (E-56), Atlanta, GA 30333.

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SUMMARY

The Chevron Chemical Co. (Ortho Division) Superfund site is a former pesticide formulation plant and truck repair facility in Orlando, Florida. This site is a public health hazard because some residents of the adjacent Armstrong Trailer Park may have unknowingly eaten small amounts soil contaminated with the pesticide chlordane. As a result, we estimate these residents have a moderately increased risk of liver cancer. Since Chevron cleaned up the chlordane-contaminated soil at this trailer park in 1994, we estimate that the remaining cancer risk is insignificant. Some nearby residents are concerned that exposure to contaminated dust, ground water, and surface water has affected their health.

In this public health assessment we evaluated the health threat of contact with the pesticides chlordane, DDD, DDT, dieldrin, and heptachlor epoxide. We selected these pesticides based on the likelihood of breathing contaminated dust and eating contaminated soil. We also evaluated the potential public health threat from drinking contaminated ground water and using nearby Lake Fairview.

Since we do not have any air monitoring data prior to 1992, we do not know the public health threat from breathing pesticide-contaminated air before that time. The concentrations of pesticides in the air during the 1992 site cleanup, however, were unlikely to cause any illness. We estimate that people who have lived along the western boundary of the Armstrong Trailer Park for more than 20 years may have a moderately increased risk of liver cancer. This increased risk is due to unknowingly eaten very small amounts of chlordane-contaminated soil. Since Chevron cleaned up the chlordane-contaminated soil in 1994, we estimate the increased cancer risk from exposure since then is insignificant. Although we estimate that drinking the contaminated ground water under the Armstrong Trailer Park is unlikely to cause any illness, we do not recommend drinking it. We did not assess the public health threat from using Lake Fairview since ground water monitoring data show that contamination has not traveled that far.

We recommend that Chevron maintain the grass cover or suppress dust to prevent any additional pesticide exposure. We recommend the Southwest Florida Water Management District prohibit any new private wells near this site or prohibit domestic use of the contaminated ground water. We will tell the long-term residents of the Armstrong Trailer Park about their risk of liver cancer and about the other conclusions of this public health assessment.

BACKGROUND

In this public health assessment, the Florida Department of Health and Rehabilitative Services (Florida HRS), in cooperation with the Agency for Toxic Substances and Disease Registry (ATSDR), evaluates the public health significance of the Chevron Chemical Co. (Ortho Division). Specifically, Florida HRS decides whether health effects are possible and recommends actions to reduce or prevent them. The Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA or Superfund) authorizes the ATSDR to conduct public health assessments at hazardous waste sites. The ATSDR, located in Atlanta, Georgia, is a federal agency within the U.S. Department of Health and Human Services.

There are uncertainties inherent in the public health assessment process. These uncertainties fall into four categories: 1) science is never 100% certain), 2) the inexactness of the risk assessment process, 3) the incompleteness of the information collected thus far, and 4) differences in opinion as to the implications of the information (NJDEP 1990). Scientists and public health officials incorporate uncertainties into risk assessments by using worst-case assumptions when estimating or interpreting health risks. They also incorporate uncertainties by using wide safety margins when setting health-related threshold values. Because of these actions, risk assessments tend to err on the side of protecting public health. Therefore, the assumptions, interpretations, and recommendations we make throughout this public health assessment err in the direction of protecting public health.

A. Site Description and History

The Chevron Chemical Co. (Ortho Division) Superfund hazardous waste site is in Orlando, Florida (Figure 1). This 4-acre site is in a mixed industrial/commercial/residential area at 3100 Orange Blossom Trail (Highway 441), three miles northwest of downtown Orlando (Figure 2). It is bounded on the north by the Armstrong Trailer Park and the 441 Trailer Park. It is bounded on the east by Orange Blossom Trail and Lake Fairview Commerce Center. Areas south and west of the site are light industrial (Figure 3). The site is level and contains no buildings or other structures. Grass covers the site and a 6-foot high chain-link fence with a locked gate surrounds it.

The Chevron Chemical Company, Ortho Division (Chevron) blended pesticides at this site between 1950 and 1976. The site included an office, a formulation (blending) building, storage tanks, a water tower, and rinsate ponds (Figure 4). Chevron blended chlordane, lindane, dieldrin, aldrin, parathion, and other pesticides with xylene, kerosene, mineral oil, mineral spirits, ethyl benzene, and aromatic naphtha. Before 1970 Chevron discharged contaminated rinse water to unlined ponds on site. As a result, they contaminated soil and ground water with pesticides. After 1970 they collected their rinse water and shipped it off site.

Aerial photographs from 1952 show a trailer park next to the north side of the site (EPA 1991). The Orange County Public Health Unit has records of this trailer park dating back to 1956 (Orange CPHU 1994).

In 1978 Robert Uttal purchased the property from Chevron and operated Central Florida Mack Truck until 1986. Central Florida Mack Truck serviced diesel engine trucks and disposed of waste oil, diesel fuel, paint, and cleaning solvents in the on-site rinsate ponds. In 1983, a Chevron consultant found pesticides in on-site soil and ground water (Dames & Moore 1983). Four years later in 1987, an investment-firm consultant found petroleum contamination in the ground water (Jammal & Associates 1987). Mr. Uttal leased the parking area for vehicle storage from 1987 to 1988 and leased the pesticide-blending building as a public-storage facility from 1989 to 1990. In 1989 an Environmental Protection Agency (EPA) consultant found extensive pesticide and petroleum contamination in both the soil and ground water (NUS 1990).

In January 1990, the Agency for Toxic Substances and Disease Registry (ATSDR) concluded that contact with contaminated surface soil was a public-health threat and recommended that the EPA restrict site access (ATSDR 1990). Three months later, Chevron built a fence around the site. In September 1990, Chevron consultants further defined the extent of soil and ground-water contamination (Brown and Caldwell 1990a). In a 1992 emergency removal action, contractors for Chevron demolished the buildings and excavated and shipped 23,000 tons of contaminated soil. They also treated 126,000 gallons of contaminated ground water and backfilled the site with clean fill (Brown and Caldwell 1992). The ATSDR concurred with the EPA's soil clean up goal of <5 mg/kg chlordane (ATSDR 1991).

In August of 1992, the EPA selected this site as a pilot for their Superfund Accelerated Cleanup Model program (SACM). In 1993 and 1994, Chevron purchased the property from the First Union Bank and the Resolution Trust Corporation following foreclosure. On January 18, 1994, the EPA proposed adding this site to the Superfund National Priorities List (NPL). The EPA based its proposed listing on remaining ground-water contamination. Between March and April of 1994, contractors for Chevron removed approximately 200 cubic yards of pesticide-contaminated surface soil from the southwest corner of the Armstrong Trailer Park (Task 1994a). The EPA finalized the listing of this site on the Superfund NPL on May 31, 1994. Also on May 31, 1994, contractors for Chevron completed their remedial investigation report (Task 1994a). To evaluate additional cleanup options, EPA contractors drafted a baseline risk assessment (B&V 1994) and Chevron contractors drafted a feasibility study (Task 1994b). The EPA hopes to select a final cleanup plan (Record of Decision) early in 1995. We prepared this public health assessment in response to the EPA's proposal to add this site to the Superfund list.

B. Site Visit

On July 29, 1993, Randy Merchant with the Florida Department of Health and Rehabilitative Services (HRS), Office of Environmental Toxicology (Tallahassee) visited the site.

Representatives of the Orange County Public Health Unit, Environmental Health Section, accompanied him on this site visit. They drove around the site and through the Armstrong Trailer Park and the 441 Trailer Park. Grass covered the site and a 6-foot chain-link fence with a locked gate completely enclosed it. There were no structures on the site and no evidence of trespass. Some trailers in the Armstrong Trailer Park were within a few feet of the site boundary. They observed that the residents of both the Armstrong and 441 trailer parks were low income and predominantly white. On the evening of July 29, 1993, Mr. Merchant attended an EPA sponsored public meeting.

Mr. Merchant visited the site again on August 5, 1994. He observed that the site fence was in good repair and that there was no evidence of trespass. From the Armstrong Trailer Park, he noted about 0.2 acre of standing water (0-3 inches deep) in the northwest corner of the site. He noticed that Chevron contractors had placed sandbags along the northwest site boundary to contain site run-off. Mr. Merchant also toured the Armstrong Trailer Park and observed the southwest corner where Chevron contractors had excavated contaminated surface soil. He observed that, although the area was damp from recent rains, sod covered it and there was no bare soil. Mr. Merchant did not collect any environmental samples during either of these site visits.

From 4:00 to 7:00 PM on March 9, 1995, Mr. Merchant held a public meeting in the laundry room of the Armstrong Trailer Park. The purpose of this meeting was to solicit comment on the draft public health assessment report. Julia Winter, also with Florida HRS Office of Environmental Toxicology in Tallahassee, accompanied Mr. Merchant. The EPA Region IV community relations coordinator, the EPA site remedial project manager, two representatives from the Environmental Health section of the Orange County Health Department, and a representative from TASK Environmental, a Chevron contractor also attended this meeting.

The manager/owner of the trailer park along with 15 to 20 residents attended this meeting and expressed a wide range of concerns. They were concerned they were exposure to contaminated dust during the 1992 site cleanup. They complained of strong odors, skin rashes, burning eyes and noses, nausea, sore throats, and chest pains during that time. One residents complained that her children continue to suffer from skin rashes, runny noses, fever, bronchitis, and other flu-like symptoms. Some were concerned that fruits and vegetables grown at the trailer park were no longer safe to eat.

C. Demographics, Land Use, and Natural Resource Use

Demographics

We estimate that in 1990, about 4,000 people lived within one mile of this site. We base our estimate on 1990 census data for Orange County census tract #126 (BOC 1990). Although

the site is in census tract #124, most of the people within a one-mile radius of the site reside in tract #126. Tract #126 encompasses most of the College Park area and extends about 1.5 miles southeast of the site. Residents in this census tract are almost exclusively white (98%). The population is mostly middle age: the median age is 41. Seventy-five percent of the 1,910 housing units in this tract are owner occupied. Median yearly family income in this tract is about $41,000 (BOC 1990). Based on our observations, we estimate about 300 people live in the Armstrong and 441 Trailer Parks north of the site. Residents of these two trailer parks have low income and are predominately white.

Land Use

Land use within one mile of the site is a mix of industrial, commercial, and residential. The areas north and east of the site are mainly residential. Lake Fairview is about 1,000 feet to the northeast. The areas south and west of the site are light industrial with few homes. Commercial development lines Orange Blossom Trail (US 441) northwest and southeast of the site.

Natural Resource Use

Ground water below the site is contained in two aquifers: the surficial aquifer and the Floridan aquifer. Ground water in the surficial aquifer starts about 10 feet deep and extends to about 25 or 30 feet deep. Ground-water flow in the surficial aquifer is northeast toward Lake Fairview (Task 1994a). The surficial aquifer is separated from the Floridan aquifer by about 50 feet of clay (the Hawthorne formation). The Floridan aquifer under the site starts at about 80 feet deep. Regional ground water flow in the Floridan aquifer is to the east and northeast (Task 1994a). Flow direction in the Floridan aquifer is influenced locally by the effects of pumping wells and drainage wells.

Beginning in 1948, the City of Orlando supplied water to all of the residents of the Armstrong and 441 Trailer Parks (the area over the contaminated ground water) (Orange CPHU 1993). Since the City of Orlando supplies water to homes and business immediately adjacent to the site, ground water is not a source of drinking water for nearby residents. In 1990 Chevron consultants identified eight wells within 1 mile of the site (Brown and Caldwell 1990b). This report, however, did not identify if these wells were used for drinking water. None of these wells are northeast of the site (in the direction of the surficial-aquifer ground-water flow).

Area residents use Lake Fairview, northeast of the site, for swimming, fishing, water skiing, and boating. There is no evidence of hunting in this area. We did not observe any home gardens in either the Armstrong or 441 Trailer Parks.

D. Health Outcome Data

We did not evaluate health outcome data for the Chevron Chemical Co. (Ortho Division). See the Public Health Implications, Community Health Concerns Evaluation section later in this report for details.

COMMUNITY HEALTH CONCERNS

Nearby residents have expressed some health concerns. We compiled these concerns from public meeting summaries, newspaper articles, and EPA reports.

1. A few residents of the Armstrong Trailer Park north of the site were concerned that breathing pesticide-contaminated dust during the 1992 soil removal would affect their health. Specifically, they complained of strong odors, skin rashes, burning eyes and noses, nausea, sore throats, and chest pains during that time.

2. A few nearby residents are concerned that contaminated ground water will reach their private wells and affect their health.

3. A few nearby residents are concerned that contaminated ground water will reach Lake Fairview and affect their health via consumption of fish, incidental ingestion of water, or skin absorption.

4. One nearby resident was concerned that their health had been affected by living near this site. This resident did not specify what illnesses they thought were site related. This resident was also concerned that the stress of living near a hazardous waste site had affected their health.

5. One nearby resident was concerned that their emphysema was aggravated by breathing contaminated dust from the site.

6. Some nearby residents were concerned that home-grown fruits and vegetables were no longer safe to eat.

7. One residents is concerned that her children continue to suffer from skin rashes, runny noses, fever, bronchitis, and other flu-like symptoms.

ENVIRONMENTAL CONTAMINATION AND OTHER HAZARDS

In this section, we review the environmental data collected at the site, evaluate sampling adequacy, and select contaminants of concern. Also in this section, we list the maximum concentration and detection frequency for the contaminants of concern in the various media (that is, water, soil, and air). We select contaminants of concern based on the following factors:

1. Concentrations of contaminants on and off the site: although background concentrations are useful in determining if contaminants are site-related, we only eliminate contaminants from further consideration if both the background and on-site concentrations are below standard comparison values. This is necessary to assess the public health risk to all contaminants detected, whether site related or not.

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

3. Community health concerns.

4. For complete and potential exposure pathways, comparison of maximum concentrations with published ATSDR standard comparison values: in selecting contaminants of concern, we did not consider contaminant concentrations in eliminated pathways such as on-site soil and ground water. The ATSDR's published standard comparison values are media-specific concentrations used to select contaminants for further evaluation. They are not used to predict health effects or to set clean-up levels. Contaminants with media concentrations above an ATSDR standard comparison value do not necessarily represent a health threat, but are selected for further evaluation. Contaminants with media concentrations below an ATSDR standard comparison value are unlikely to be associated with illness and are not evaluated further, unless there is a specific community concern about the contaminant.

5. For complete and potential exposure pathways, comparison of maximum concentrations with toxicological information published in documents called ATSDR toxicological profiles. These profiles are chemical specific and summarize toxicological information found in the scientific literature.

We used the following ATSDR standard comparison values (ATSDR 1994), in order of priority, to select contaminants of concern:

1. EMEG--Environmental Media Evaluation Guide--is derived from the ATSDR's Minimal Risk Level (MRL) using standard exposure assumptions, such as ingestion of two liters of water per day and body weight of 70 kg for adults. MRLs are estimates

of daily human exposure to a chemical likely to be without an appreciable risk of noncancerous illnesses, generally for a year or longer.

2. CREG--Cancer Risk Evaluation Guide--is calculated from the EPA's cancer slope factors, is the contaminant concentration that is estimated to result in no more than one excess cancer per one million persons exposed over a lifetime.

3. RMEG--Reference Dose Media Evaluation Guide--is derived from the EPA's Reference Dose (RfD) using standard exposure assumptions. RfDs are estimates of daily human exposure to a chemical likely to be without an appreciable risk of noncancerous illnesses, generally for a year or longer.

4. LTHA--Lifetime Health Advisory for Drinking Water--is the EPA's estimate of the concentration of a drinking-water contaminant at which illnesses are not expected to occur over lifetime exposure. LTHAs provide a safety margin to protect sensitive members of the population.

Using the methodology described above, we selected the pesticides chlordane, DDT, DDE, dieldrin, and heptachlor epoxide as contaminants of concern at this site. We only use the ATSDR standard comparison values to select contaminants of concern for further consideration. Identification of a contaminant of concern in this section does not necessarily mean that exposure will be associated with illnesses. Identification serves to narrow the focus of the public health assessment to those contaminants most important to public health. When we selected a contaminant of concern in one medium, we also reported that contaminant in all other media. We evaluate the contaminants of concern in subsequent sections and decide whether exposure has public health significance.

In Tables 1 through 10, Appendix B, we summarize the environmental sampling data for five selected contaminants of concern.

To identify industrial facilities that could contribute to the contamination near this site, we searched the 1987 to 1992 EPA Toxic Chemical Release Inventory (TRI) data bases. The EPA developed TRI from the chemical release information (air, water, and soil) provided by certain industries. The Chevron Chemical Superfund site is in the 32804 and 32808 zip code areas. Between 1987 and 1992 six facilities in these two zip codes areas reported chemical releases. These releases included hydrochloric acid, sodium hydroxide, nitric acid, phosphoric acid, ammonia, glycol ethers, and isopropyl alcohol. Citrus Central Orlando Can Division at 1900 W. Hampshire Avenue reported the release of approximately 72,000 pounds of toluene into the air between 1988 and 1990. None of these releases, however, are likely to affect the residents near the Chevron Chemical site.

In this public health assessment, we first discuss the contamination that exists **on** the site and then the contamination that occurs **off** the site.

A. On-site Contamination

For this public health assessment, we define "on-site" as the property boundary as shown in Figure 4. We divide on-site surface soil, subsurface soil, and ground-water samples into those collected before and after the 1992 cleanup. We characterize the on-site air quality based on measurements taken at the site boundary during the 1992 cleanup.

On-Site Surface Soil (0-1 Foot) Before 1992 Cleanup

In 1989 EPA contractors collected two surface soil samples (depth not specified) from the site (Figure 5, Appendix A). They found pesticides and petroleum solvents (NUS 1990). In October 1990 Chevron contractors collected 10 more on-site surface soil samples (0 to 6 inches deep) (Figures 6 and 7, Appendix A). They found pesticides and petroleum solvents (Brown and Caldwell 1990a).

Table 1 (Appendix B) lists the maximum concentrations of the five contaminants of concern found in the surface soil before the 1992 site cleanup. We consider surface soil sample CC-SS-01 representative of the background surface-soil quality. EPA contractors collected this sample 85 feet southwest of the site (NUS 1990). For this public health assessment, Chevron and EPA adequately characterized the on-site surface soil quality before the 1992 cleanup.

On-Site Surface Soil (0-1 Foot) After 1992 Cleanup

Since the 1992 cleanup, neither Chevron nor EPA has collected any surface soil samples. In 1992, after removing the contaminated soil but before replacing with clean fill, Chevron contractors collected and analyzed between 200 and 300 confirmation soil samples (depth not specified). Since they collected these samples during the soil excavation but before adding clean fill, we assume these samples were subsurface (> 1 foot deep). Chevron filled the excavated areas with clean soil and covered them with sod. Because a fence surrounds the site and grass covers it, we do not recommend additional surface soil samples. Additional surface soil samples may be necessary in the future, however, if the site use changes.

On-Site Subsurface Soil (> 1 Foot) Before 1992 Cleanup

In 1981 Chevron contractors collected three 10.5 feet deep subsurface soil samples (Figure 8, Appendix A) and found pesticides (Dames & Moore 1983). We did not include these results in our assessment, however, since they reported the pesticide concentrations in terms of weight per volume of soil extract (mg/L). Since the report did not detail the extraction procedure, we cannot determine the actual soil concentrations.

In 1989 EPA contractors collected five subsurface soil samples (depth not specified) from the site (Figure 5, Appendix A). They found pesticides and petroleum solvents (NUS 1990). In October 1990 Chevron contractors collected 28 on-site subsurface soil samples (1.5 to 8 feet

deep) (Figures 6 and 7, Appendix A). They found pesticides and petroleum solvents (Brown and Caldwell 1990a).

During the 1992 site cleanup, Chevron contractors collected and analyzed between 200 and 400 samples (depth not specified) of the soil they excavated and removed (Figure 9, Appendix A)(Brown and Caldwell 1992). Since these samples were collected during the soil excavation, we assume that most were subsurface (>1 foot deep). We used summary data from the Removal Action Report (Brown and Caldwell 1992) since we were unable to obtain the raw data.

In Table 2 (Appendix B) we list the maximum concentrations of the five contaminants of concern found in the subsurface soil before the 1992 site cleanup. We consider subsurface soil sample CC-SB-01 representative of the background subsurface-soil quality. EPA contractors collected this sample 85 feet southwest of the site (NUS 1990). For this public health assessment, Chevron and EPA adequately characterized the on-site subsurface soil quality before the 1992 cleanup.

On-Site Subsurface Soil (> 1 Foot) After 1992 Cleanup

In 1992, after removing the contaminated soil but before replacing with clean fill, Chevron contractors collected and analyzed between 200 and 300 confirmation subsurface-soil samples (depth not specified) (Figure 10, Appendix A). They found reduced concentrations of pesticides and petroleum solvents (Brown and Caldwell 1992; Task 1994a).

In Table 3 (Appendix B) we list the maximum concentrations of the five contaminants of concern remaining in the subsurface soil after the 1992 site cleanup. We consider subsurface soil sample CC-SB-01 representative of the background subsurface-soil quality. EPA contractors collected this sample 85 feet southwest of the site (NUS 1990). For this public health assessment, Chevron and EPA adequately characterized the on-site subsurface soil quality after the 1992 cleanup.

On-Site Surficial-Aquifer Ground Water Before 1992 Cleanup

In 1981 and 1982, Chevron contractors collected and analyzed ground-water samples from eight surficial-aquifer monitor wells (Figure 8, Appendix A). They found elevated pesticide levels (Dames & Moore 1983). Five years later in 1987, contractors for Southeast Investment Properties collected ground-water samples from seven temporary surficial-aquifer monitor wells (Figure 11, Appendix A). They found petroleum solvent contamination. They did not analyze these samples for pesticides or other contaminants (Jammal & Associates 1987). In 1989, contractors for the EPA collected and analyzed ground-water samples from five temporary surficial-aquifer monitor wells on site and one temporary background surficial-aquifer monitor well (Figure 5, Appendix A). These contractors found elevated levels of pesticides and petroleum solvents (NUS 1990). In September 1990, contractors for Chevron collected and analyzed ground-water samples from 14 surficial-aquifer monitor

wells (Figure 12, Appendix A). They found elevated concentrations of pesticides and petroleum solvents (Brown and Caldwell 1990a). In September 1991 Chevron contractors collected 17 ground-water samples from the surficial aquifer on site using a Hydropunch® (locations not specified). One month later, they resampled the existing 14 on-site surficial-aquifer monitor wells and one newly installed well cluster (Figure 12, Appendix A). They found elevated levels of pesticides and petroleum solvents (Brown and Caldwell 1992).

In Table 4 (Appendix B) we list the maximum concentrations of the five contaminants of concern found in the surficial aquifer before the 1992 site cleanup. We consider ground-water samples from monitor wells MW-A and MW-D (in the southeast and southwest corners of the site) and CC-TW-01 (85 feet southwest of the site) as representative of the background quality in the surficial aquifer (NUS 1990). We assume monitor wells less than 35-feet-deep to be in the surficial aquifer. For this public health assessment, Chevron and EPA have adequately characterized the on-site surficial-aquifer ground-water quality before the 1992 cleanup.

On-Site Surficial-Aquifer Ground Water After 1992 Cleanup

As part of the 1992 site clean-up, Chevron contractors collected and treated about 126,000 gallons of contaminated ground water from the surficial aquifer on site. In April 1993, Chevron contractors collected and analyzed ground-water samples from the five remaining on-site monitor wells (Chevron 1993b). In September 1993, Chevron contractors collected and analyzed ground-water samples from the five existing and ten new on-site surficial-aquifer monitor wells (PTI 1993). Figure 13 (Appendix A) shows the locations of these on-site surficial-aquifer monitor wells.

Table 5 (Appendix B) lists the maximum concentrations of the five contaminants of concerns found in the surficial aquifer since the 1992 site cleanup. We consider ground-water samples from monitor wells MW-A and MW-D (in the southeast and southwest corners of the site) and CC-TW-01 (85 feet southwest of the site) as representative of the background quality in the surficial aquifer (NUS 1990). In this assessment, we assume monitor wells less than 35-feet-deep to be in the surficial aquifer. For this public health assessment, Chevron and EPA have adequately characterized the quality of the on-site surficial aquifer ground water remaining after the 1992 cleanup.

On-Site Air

There are no on-site air monitoring data before 1992. During the 1992 site cleanup, Chevron contractors monitored air quality at two places along the northern site boundary near the Armstrong Trailer Park. From February 2, 1992 to April 9, 1992 they collected and analyzed 57 air samples for organochlorine pesticides and PCBs (Brown and Caldwell 1992). They only detected chlordane and DDD. Both pesticides were above their comparison values (Table 6, Appendix B).

B. Off-site Contamination

For this public health assessment, we define "off-site" as the area outside the property boundary shown in Figure 4. We divide off-site surface soil contamination into samples collected before and after the 1994 surface soil removal from the Armstrong Trailer Park. We assume off-site air quality to be similar to that at the site boundary during the 1992 site cleanup. Neither the EPA nor Chevron has collected or analyzed water samples from nearby Lake Fairview. Ground-water monitoring data show that contamination has not reached Lake Fairview.

Off-Site Surface Soil (0-1 Foot) Before 1994 Removal

From September 22 to 28, and again on November 17, 1993, Chevron contractors collected 50 surface-soil samples from the Armstrong Trailer Park north of the site (Figure 14, Appendix A). Chevron contractors collected most of these soil samples from the low area in the back (west end) of the trailer park. They analyzed these samples for organochlorine pesticides (PTI 1994). Most of these soil samples were from the ground surface (0-3 inches deep) although some were one foot deep. Chevron found elevated levels of chlordane (Table 7, Appendix B). For comparison, the maximum concentration of chlordane in the trailer park soil--370 mg/kg--is less than the recommended soil concentration for termite control--512 mg/kg--(Chevron 1993a). We consider sample #1 (September 1993) taken from the front (east side) of the trailer park to represent background surface-soil quality. For this public health assessment, these samples are adequate to characterize the off-site surface-soil quality before the 1994 removal.

Off-Site Surface Soil (0-1 Foot) After 1994 Removal

In March and April 1994, Chevron contractors removed about 200 square yards of pesticide-contaminated soil from the Armstrong Trailer Park. Most of the contaminated soil was in the southwest corner of the trailer park but there were localized pockets in other areas. Following this removal, Chevron contractors collected confirmation soil samples (Table 8, Appendix B) (Chevron 1994a and 1994b). For this public health assessment, these samples adequately characterize the remaining off-site surface soil quality.

Off-Site Surficial Aquifer Ground Water (5-32 Feet Deep)

Since the City of Orlando supplies water to homes and business in the area, ground water is not a source of drinking water. Specifically, the City of Orlando supplies water to all of the residents of the Armstrong and 441 Trailer Parks (the area over the contaminated ground water) (Orange CPHU 1993).

In October 1991 and again in April 1993, Chevron contractors collected and analyzed ground-water samples from two monitor well clusters in the Armstrong Trailer Park north of the site (Brown and Caldwell 1992, Chevron 1993b). In September 1993, Chevron

contractors collected and analyzed ground-water samples from these two monitor well clusters. They also sampled five monitor wells north and east of the site (PTI 1993). Figure 13 (Appendix A) shows the locations of these off-site surficial-aquifer monitor wells. They found elevated levels of chlordane and DDD in one monitor well in the Armstrong Trailer Park (Table 9, Appendix B).

We consider ground-water samples from monitor wells MW-A and MW-D (in the southeast and southwest corners of the site) and CC-TW-01 (85 feet southwest of the site) representative of the background quality in the surficial aquifer (NUS 1990). We assume monitor wells less than 35 feet deep are in the surficial aquifer. For this public health assessment, Chevron and EPA have adequately characterized the surficial-aquifer ground-water quality off site.

Off-Site Air

There is no off-site air monitoring data before 1992. Therefore, we cannot assess the public health threat from inhalation of site-related contaminated dust before 1992. From February 2 to April 9, 1992 Chevron contractors collected 57 air samples from the northern site boundary near the Armstrong Trailer Park. They analyzed these samples for organochlorine pesticides and PCBs (Brown and Caldwell 1992). We used these site-boundary air-quality data as representative of the off-site air quality. They only detected chlordane and DDD. Both pesticides, however, were above their comparison values (Table 10, Appendix B).

C. Quality Assurance and Quality Control

We assume the environmental data used in our assessment are valid since governmental contractors or contractors overseen by governmental agencies collected and analyzed the environmental samples. In preparing this public health assessment, we relied on the existing environmental data. We assumed consultants who collected and analyzed these samples followed adequate quality assurance and quality control measures concerning chain-of-custody, laboratory procedures, and data reporting. The completeness and reliability of the referenced information determines the validity of the analyses and conclusions drawn for this public health assessment.

In each of the preceding On- and Off-Site Contamination subsections, we evaluated the adequacy of the data to estimate exposures. We assumed that estimated data (J) and presumptive data (N) were valid. This second assumption errs on the side of public health by assuming that a contaminant exists when it may not exist.

D. Physical and Other Hazards

The site is level, covered with grass, completely fenced, and contains neither buildings nor equipment. We did not observe physical or other types of hazards.

PATHWAYS ANALYSES

To decide whether nearby residents have contacted contaminants migrating from the site, we evaluated the environmental and human components of exposure pathways. Exposure pathways consist of five elements: a source of contamination, transport through an environmental medium, a point of exposure, a route of human exposure, and an exposed population.

We eliminate an exposure pathway if at least one of five elements is missing and will never be present. Exposure pathways that we do not eliminate are either completed or potential. For completed pathways, all five elements exist and exposure to a contaminant has occurred, is occurring, or will occur. At least one of five elements is missing, but could exist for potential pathways. For potential pathways, exposure to a contaminant could have occurred, could be occurring, or could occur in the future.

A. Completed Exposure Pathways

We categorized incidental soil ingestion and inhalation of contaminated dust as completed exposure pathways. Refer to Table 11, Appendix B for a summary of these completed exposure pathways.

Off-Site Incidental Soil Ingestion Pathway

Incidental ingestion of off-site contaminated soil is a completed exposure pathway. Residents of the Armstrong Trailer Park were exposed to site-related contaminants via incidental ingestion of contaminated soil. Stormwater was the likely transport mechanism of contaminated soil from the site to the trailer park. Contaminated soil in the Armstrong Trailer Park is the point of exposure. Incidental ingestion is the route of exposure. The approximately 150 residents of the Armstrong Trailer Park are the receptor population.

We estimate residents of the Armstrong were exposed to contaminated soil via incidental ingestion from 1952 to 1994. Aerial photographs first showed nearby trailers in 1952. Chevron removed the contaminated soil in 1994. We err on the side of protecting public health by assuming that any one person lived in this trailer park for 42 years (1952-1994).

Off-Site Inhalation Pathway

Inhalation of contaminated dust is a completed exposure pathway. Residents of the Armstrong and 441 Trailer Parks were exposed to site-related contaminants via inhalation of contaminated dust. Contaminated soil on the site is the source of the contaminants. Strong winds blew contaminated dust to the Armstrong and 441 Trailer Parks during dry periods.

Contaminated air in these two trailers parks is the point of exposure. Inhalation is the route of exposure. The approximately 300 residents of the Armstrong and 441 Trailer Parks are the receptor population.

We estimate residents of the Armstrong and 441 Trailer Parks were exposed to contaminated dust from 1952 to 1976. Aerial photographs first showed nearby trailers in 1952. Chevron ceased operations in 1976. We estimate they were not exposed from 1976 to 1992. From 1976 to 1992 vegetation covered the unpaved portion of the site and significant wind blown dust was unlikely. These residents were again exposed during the 1992 site cleanup. Since 1992 grass has covered the site and wind-blown dust is unlikely.

B. Potential Exposure Pathways

We categorize off-site ground water and off-site surface water as potential exposure pathways. Refer to Table 12, Appendix B, for a summary of these potential exposure pathways.

Off-Site Ground-Water Pathway

Off-site ground water is a potential exposure pathway. Ground water under the Armstrong Trailer Park north of the site is contaminated. Currently, the City of Orlando supplies water to all of the residents of the Armstrong and 441 Trailer Parks (the area over the contaminated ground water) (Orange CPHU 1993). Although no one currently uses this ground water, if it was ingested, the trailer park residents would be exposed to site-related contaminants. Contaminated soil on the site is the source and ground-water flow is the transport mechanism. If this contaminated ground water is ever used, private wells would be the point of exposure. Ingestion would be the predominant route of exposure. Assuming they all began using the contaminated ground water, the approximately 300 residents of the Armstrong and 441 Trailer Parks would be the receptor population.

Off-Site Surface Water Pathway

Off-site surface water is a potential exposure pathway. Although contaminated ground water has not reached Lake Fairview, if it does, recreational users would be exposed to site-related contaminants via incidental ingestion and skin absorption during swimming, boating, etc. Contaminated soil on the site is the source and ground-water flow is the transport mechanism. The water of Lake Fairview would be the point of exposure. Incidental ingestion and skin absorption would be the routes of exposure. We estimate that 500 recreational users per year would be the receptor population.

C. Eliminated Pathways

We eliminated on-site surface water as an exposure pathway since the soil is too porous and the terrain too flat for any significant accumulation of water above ground surface. Since

there is no surface water on site, we also eliminated contact with sediment as an exposure pathway. Transport of contaminated soil via stormwater run-off is considered above under the Completed Exposure Pathways section. Since there is no significant hunting or gardening in this area, we eliminated consumption of plants and animals as an exposure pathway.

We also eliminated incidental ingestion of, and skin absorption from, on-site soil as an exposure pathway. Chevron and Central Florida Mack Truck occupied the site from 1950 to 1986 and thus limited public access to the contaminated soil. Although Mr Uttal leased the warehouse for public storage between 1987 and 1990, vegetation covered the rest of the site and contact with the contaminated soil was unlikely. A fence has limited public access since April 1990. As long as the site remains undisturbed, exposure to the contaminated soil and ground water is unlikely.

PUBLIC HEALTH IMPLICATIONS

In this section we will discuss possible health effects for persons exposed to specific contaminants, evaluate state and local health databases, and address specific community health concerns.

A. Toxicological Evaluation

Introduction

In this subsection, we discuss exposure levels and possible health effects that might occur in people exposed to the contaminants of concern at the site. Also in this subsection, we discuss general concepts such as the risk of illness, dose response and thresholds, and uncertainty in public health assessments.

To evaluate exposure, we estimated the daily dose of each contaminant of concern found at the site. Kamrin (1988) explains a dose in this 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 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 2000 ounces to a 2000-pound (1-

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

This amount per weight is the dose. We use it to decide the amount of a drug to prescribe to patients of differing weights. We use dose in toxicology to compare the toxicity of different chemicals in different animals."

In expressing the daily dose, we used the units of milligrams of contaminant per kilogram of body weight per day (mg/kg/day).

To calculate the daily dose of each contaminant, we used standard assumptions about body weight, ingestion and inhalation rates, exposure time length, and other factors needed for dose calculation (ATSDR 1992d, 1993c; EPA 1990). In calculating the dose, we assumed residents were exposed to the maximum concentration measured for each contaminant in each medium.

To evaluate health effects, the ATSDR has developed Minimal Risk Levels (MRLs) for contaminants commonly found at hazardous waste sites. An MRL is an estimate of daily human exposure to a contaminant below which non-cancer, adverse health effects are unlikely to occur. The ATSDR developed MRLs for each route of exposure, such as ingestion and inhalation. The ATSDR also developed MRLs for the length of exposure, such as acute (less than 14 days), intermediate (15 to 364 days), and chromic (greater than 365 days). The ATSDR presents these MRLs in Toxicological Profiles. These chemical-specific profiles provide information on health effects, environmental transport, human exposure, and regulatory status.

In this section, we used standard assumptions to estimate human exposure from incidental ingestion of soil, from inhalation of contaminated dust, and from drinking ground water.

To estimate exposure from incidental ingestion of contaminated soil, we made the following assumptions: 1) children between the ages of one and six ingest an average of 200 milligrams (mg) of soil per day, 2) these children weigh about 10 kilograms (kg), 3) these children were exposed for six years (period when children are most likely to ingest soil), and 4) they ingested soil at the maximum concentration measured for each contaminant.

To estimate exposure from inhalation of pesticide-contaminated dust, we made the following assumptions: 1) nearby adults inhale about 1 cubic meter (m^3) of air per hour, or 24 m^3 of air per day, 2) these adults weigh 70 kilograms (kg), 3) these adults have been exposed for 25 years, and 4) these adults were exposed to the maximum air concentrations measured for each contaminant. Since Chevron monitored the air at the boundary between the site and the trailer park, we assumed nearby residents inhaled the maximum measured concentration. We did not include any factor for dilution.

To estimate the potential exposure from drinking contaminated ground water, we assumed: 1) adults ingest an average of 2 liters of water per day, 2) these adults weigh about 70 kilograms, 3) in the future, these adults may be exposed for five years, and 4) for each contaminant measured in the ground water, they will ingest the maximum measured concentration. We selected a five-year exposure period based on the average time between household moves in the U.S. We also base this exposure period on our estimate of the average time between private well testing in a mixed residential/commercial/industrial area.

We did not estimate potential exposure from incidental ingestion and skin absorption of contaminants during swimming, boating, etc. in Lake Fairview. Ground-water monitoring data show that contamination has not reached Lake Fairview. Dilution, physical retardation, and biodegradation in the ground water make it impractical to predict future concentrations in this nearby lake. Without an estimate of contaminant concentration in the lake, we cannot estimate exposure or likely health effects.

Chlordane

Some adults and children living in the Armstrong Trailer Park north of the site were exposed to chlordane via breathing contaminated dust and incidental ingestion of contaminated soil. They could also be exposed to chlordane via drinking if they ever use the contaminated ground water below the trailer park.

Since there is no air monitoring data before 1992, we do not know the public health threat from breathing chlordane-contaminated dust before then. The maximum concentration of chlordane in the air during the 1992 site cleanup, however, was below the ATSDR intermediate Minimal Risk Level (ATSDR 1989a, 1992b). Therefore, we do not expect any health effects from exposure to chlordane-contaminated dust during the 1992 site cleanup. Since clean soil and grass now cover the site, we do not expect any future exposure to chlordane-contaminated dust.

Our estimate of a child's chlordane exposure via incidental ingestion of Armstrong Trailer Park contaminated soil before 1994 is slightly above the ATSDR intermediate and chronic Minimal Risk Levels (ATSDR 1989a, 1992b). ATSDR MRLs are screening levels. Exposures below an MRL are unlikely to cause illness. Exposures above an MRL may or may not cause an illness, depending on how much above the MRL and for how long. Although our estimate of a child's exposure to chlordane from Chevron is slightly above the ATSDR MRL, we do not expect any health effects. Our estimate of a child's exposure is 40 times less than the lowest exposure (dose) that did not cause liver damage in rats or mice (Vesicol 1983a, 1983b; Khasawinah and Grutsch 1989a, 1989b).

Our estimate of an adult's chlordane exposure via incidental ingestion of Armstrong Trailer Park contaminated soil before 1994 is below the ATSDR acute, intermediate, and chronic Minimal Risk Levels (ATSDR 1989a, 1992b). Therefore, we do not expect any non-cancer health effects from this exposure. Although there is no evidence of chlordane causing cancer

in humans, the EPA has classified it as a probable human carcinogen based on limited animal testing. Chlordane has caused liver cancer in both rats and mice (Vesicol 1983a, 1983b; Khasawinah and Grutsch 1989a, 1989b). We estimate that some adults in the Armstrong Trailer Park are at a moderately increased risk of liver cancer from incidental ingestion of chlordane-contaminated soil before 1994. Following the 1994 soil removal from the Armstrong Trailer Park, we estimate the increased cancer risk from incidental ingestion of chlordane-contaminated soil in the future is insignificant.

Currently, we do not know of anyone drinking contaminated ground water at or near this site. Our estimate of a child's chlordane exposure via ingestion of contaminated ground water below the Armstrong Trailer Park is slightly above the ATSDR intermediate and chronic MRL. This estimate, however, is 20 times less than the lowest exposure (dose) that did not cause liver damage in rats or mice (ATSDR 1989a, 1992b). Our estimate of an adult's chlordane exposure via ingestion of contaminated ground water under the Armstrong Trailer Park is less than the ATSDR acute, intermediate, and chronic MRL. Therefore, we do not expect any non-cancer health effects in children or adults if they drank this contaminated ground water.

Although there is no evidence of chlordane causing cancer in humans, the EPA has classified it as a probable human carcinogen based on limited animal testing. Chlordane has caused liver cancer in both rats and mice (Vesicol 1983a, 1983b; Khasawinah and Grutsch 1989a, 1989b). We estimate that some adults in the Armstrong Trailer Park would be at a low increased risk of liver cancer if they drank the chlordane-contaminated ground water over a lifetime. We recommend the Southwest Florida Water Management District prohibit any new private wells in this area. Or, we recommend they prohibit domestic use of the contaminated ground water until it meets all state and federal drinking water standards.

DDD

Some adults and children living in the Armstrong Trailer Park north of the site were exposed to DDD via breathing contaminated dust and incidental ingestion of contaminated soil. They could also be exposed to DDD via drinking if they ever use the contaminated ground water below the trailer park.

Since there is no air-monitoring data before 1992, we do not know the public health threat from breathing DDD-contaminated dust before then. Although there is no ATSDR Minimal Risk Level for DDD, the maximum concentration of DDD in the air during the 1992 site cleanup was 250 times less than the EPA air unit risk for the closely related pesticide DDT (ATSDR 1989b, 1992c). Therefore, we do not expect any health effects from exposure to DDD-contaminated dust during the 1992 site cleanup. Since clean soil and grass now cover the site, we do not expect any future exposure to DDD-contaminated dust.

Our estimate of a child's DDD exposure via incidental ingestion of Armstrong Trailer Park soil before 1994 is slightly above the ATSDR intermediate Minimal Risk Levels (ATSDR

1989b, 1992c). This estimate, however, is 10,000 times less than the lowest exposure (dose) that did not cause heart, blood, or liver damage in humans (Hayes et al. 1956). Therefore, we do not expect any health effects in children from ingesting DDD-contaminated soil at the Armstrong Trailer Park.

Our estimate of an adult's DDD exposure via incidental ingestion of Armstrong Trailer Park soil before 1994 is below the ATSDR acute and intermediate Minimal Risk Levels (ATSDR 1989b, 1992c). Although there is no evidence of DDD causing cancer in humans, The EPA has classified it as a probable human carcinogen based on limited animal testing. Our estimate of an adult's DDD exposure via incidental ingestion of Armstrong Trailer Park soil, however, is below the EPA upper-bound 10^{-6} excess cancer-risk estimate. Therefore, we do not expect any health effects in adults from this exposure.

Currently, we do not know of anyone drinking contaminated ground water at or near this site. Our estimate of a child's DDD exposure via ingestion of contaminated ground water below the Armstrong Trailer Park is above the ATSDR acute and intermediate MRL (ATSDR 1989b, 1992c). This estimate, however, is 750 times less than the lowest exposure (dose) that did not cause heart, blood, or liver damage in humans (Hayes et al. 1956). Our estimate of an adult's DDD exposure via ingestion of contaminated ground water below the Armstrong Trailer Park is slightly below the ATSDR acute MRL but above the intermediate MRL. Our estimate, however, is three thousand (3,000) times less than the lowest exposure (dose) that did not cause heart, blood, or liver damage in humans (Hayes et al. 1956). Although there is no evidence of DDD causing cancer in humans, the EPA has classified it as a probable human carcinogen based on limited animal testing. Our estimate of an adult's DDD exposure via incidental ingestion of contaminated ground water below the Armstrong Trailer Park, however, is less than the EPA upper-bound 10^{-6} excess cancer-risk estimate. Therefore, we do not expect any health effects in children or adults if they drank DDD-contaminated ground water below the Armstrong Trailer Park.

Although we do not expect any health effects from drinking DDD in the ground water, we do not recommend anyone drink this water. We recommend the Southwest Florida Water Management District prohibit any private wells in this area. Or we recommend they prohibit domestic use of the contaminated ground water until it meets all state and federal drinking-water standards.

DDT

Some adults and children living in the Armstrong Trailer Park north of the site were exposed to DDT via incidental ingestion of contaminated soil. Neither Chevron nor EPA has detected DDT in the air or ground water off site.

Our estimate of a child's DDT exposure via incidental ingestion of Armstrong Trailer Park soil before 1994 is less than the ATSDR acute Minimal Risk Level but slightly above the intermediate MRL (ATSDR 1989b, 1992c). This estimate, however, is eight thousand five

hundred (8,500) times less than the lowest exposure (dose) that did not cause heart, blood, or liver damage in humans (Hayes et al. 1956). Therefore, we do not expect any health effects in children from ingesting DDT-contaminated soil at the Armstrong Trailer Park.

Our estimate of an adult's DDT exposure via incidental ingestion of Armstrong Trailer Park soil before 1994 is below both the ATSDR acute and intermediate Minimal Risk Levels (ATSDR 1989b, 1992c). Although there is no evidence of DDT causing cancer in humans, the EPA has classified it as a probable human carcinogen based on limited animal testing. This estimate of an adult's DDT exposure via incidental ingestion of Armstrong Trailer Park soil, however, is below the EPA upper-bound 10^{-6} excess cancer-risk estimate. Therefore, we do not expect any health effects in adults from this exposure.

Dieldrin

Some adults and children living in the Armstrong Trailer Park north of the site were exposed to dieldrin via incidental ingestion of contaminated soil. Neither Chevron nor EPA has detected dieldrin in the air or ground water off site.

Our estimate of both a child and adult's dieldrin exposure via incidental ingestion of Armstrong Trailer Park soil before 1994 is less than both the ATSDR acute and chronic Minimal Risk Level (ATSDR 1993a). Although there is no evidence of dieldrin causing cancer in humans, the EPA has classified it as a probable human carcinogen based on limited animal testing. This estimate of an adult's dieldrin exposure via incidental ingestion of Armstrong Trailer Park soil, however, is below the EPA upper-bound 10^{-6} excess cancer-risk estimate. Therefore, we do not expect any health effects (including cancer) in children or adults from ingesting dieldrin-contaminated soil at the Armstrong Trailer Park.

Heptachlor Epoxide

Some adults and children living in the Armstrong Trailer Park north of the site were exposed to heptachlor epoxide via incidental ingestion of contaminated soil. Neither Chevron nor EPA has detected heptachlor epoxide in the air or ground water off site.

Our estimate of both a child and adult's heptachlor exposure epoxide via incidental ingestion of Armstrong Trailer Park soil before 1994 is less than the ATSDR chronic Minimal Risk Level (ATSDR 1989c, 1993b). Although there is no evidence of heptachlor epoxide causing cancer in humans, the EPA has classified it as a probable human carcinogen based on limited animal testing. This estimate of an adult's heptachlor epoxide exposure via incidental ingestion of Armstrong Trailer Park soil, however, is below the EPA upper-bound 10^{-6} excess cancer-risk estimate. Therefore, we do not expect any health effects in children or adults from ingesting heptachlor epoxide-contaminated soil at the Armstrong Trailer Park.

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 determine if the nearby community 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. We usually measure and report individual risks of illness as an expression of chance. Consequently, scientists discuss the likelihood of becoming ill, and may express the chance of becoming ill as a fraction. For example, some workers exposed to very high levels of asbestos had an estimated cancer risk of one chance in one hundred (1 in 100). However, the estimated cancer risk from exposure to the lower asbestos levels in outside air was one chance in ten thousand (1 in 10,000). Sometimes, scientists compare the severity of different risks by looking at the expected occurrences of an illness for the total exposed population. For example, in 100,000 workers exposed to high levels of asbestos in the 1930s and 1940s, scientists would expect to see 1,000 (= 100,000 x 1/100) extra cancer cases. If 100,000 people were exposed only to low levels of asbestos, scientists would expect to see 10 (= 100,000 x 1/10,000) extra cases of cancer (EPA 1990).

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 unusual incidence of a specific illness in exposed individuals. More formal studies compare illnesses in people with different levels of exposure. However, human information is very limited for most hazardous contaminants, and scientists frequently must depend upon data from animal studies. We use animal studies to estimate risk of illness in humans. 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 mammals, 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 a hazardous contaminant are uncertain when information is derived solely from animal experiments (EPA 1990).

Dose-Response and Threshold Ideas

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. There is one important difference between the dose-response curves used to estimate the risk of noncancer illnesses and those used to estimate the risk of cancer: the existence of a threshold dose. 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 (EPA 1990). This assumption is very conservative, and many scientists believe a threshold dose greater than zero also exists for the development of cancer.

Uncertainty in Risk Assessments

All risk assessments require the use of assumptions, judgements, and incomplete data to varying degrees. 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 to a different extent (ICF Kaiser 1993). 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 Chevron 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 (ICF Kaiser 1993).

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 (ICF Kaiser 1993). 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 ATSDR or the EPA. 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.

There are also data gaps and uncertainties in the design, extrapolation, and interpretation of toxicological experimental studies (ICF Kaiser 1993). 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, there are 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 under-estimation of risk of illness. Finally, there are great uncertainties in extrapolating from high 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 over estimate the risk. Techniques used to derive acceptable exposure levels account for such variables through the use of safety factors. Currently, there is much debate in the scientific community about how much we over estimate the actual risks and what the risk estimates really mean.

B. Health Outcome Data Evaluation

We did not evaluate health outcome data for the community around this site. It is unlikely a search of statewide health-outcome data would detect an effect in such a small group. Therefore, there is little justification or community demand for an evaluation of health outcome data at this time. If future environmental investigations find other contaminants, we will evaluate health outcome data as considered appropriate.

C. Community Health Concerns Evaluation

In this subsection, we address the community health concerns in terms of our findings presented in the Toxicological Evaluation subsection above.

Although we interpret the health concerns in terms of our toxicological findings, it is important to remember that many individual symptoms, conditions, and illnesses reported by the community have more than one cause. Similarly, any one reported symptom may suggest many different illnesses. To distinguish between illnesses caused by substances found at the site and those caused by other agents requires an in-depth health study. Therefore, our findings in this subsection suggest health problems that are possible, instead of health problems that are likely.

Conversely, it is also important to remember that our not finding an association between a contaminant and an illness in the toxicological literature does not necessarily mean the association does not exist. There are two possible explanations for this insufficiency in the literature. On one hand, there truly may be no association between a contaminant and a specific illness, or between a contaminant at the estimated concentration and a specific illness. Consequently, we will not find certain health effects regardless of the number of studies we conduct. On the other hand, there may not be enough reliable studies to identify an existing association between a contaminant and an illness. Therefore, the associations could be found if there were more studies. Without more research, we cannot tell which alternative correctly describes the literature insufficiency.

We address community health concerns as follows:

1. A few residents of the Armstrong Trailer Park north of the site were concerned that breathing pesticide-contaminated dust during the 1992 soil removal would affect their health. Specifically, they complained of strong odors, skin rashes, burning eyes and noses, nausea, sore throats, and chest pains during that time.

During the 1992 soil removal, Chevron measured both chlordane and DDD in the airborne dust along the boundary between the site and the Armstrong Trailer Park. The maximum concentration of chlordane in the air during the 1992 site cleanup, however, was below the ATSDR intermediate Minimal Risk Level (ATSDR 1989a, 1992b). Although there is no ATSDR Minimal Risk Level for DDD, the maximum concentration of DDD in the air during the 1992 site cleanup was 250 times less than the EPA air unit risk for the closely related pesticide DDT (ATSDR 1989b, 1992c). Therefore, we do not expect any health effects from exposure to either chlordane or DDD-contaminated dust during the 1992 site cleanup. Since clean soil and grass now cover the site, we do not expect any future exposure to contaminated dust. Since there is no air monitoring data before 1992, we do not know the public health threat from breathing contaminated dust before that time.

2. A few nearby residents are concerned that contaminated ground water will reach their private wells and affect their health.

It is unlikely that contaminants from this site will reach private wells in the near future. Monitoring well data shows that contaminated ground water is limited to the area under the Armstrong Trailer Park north of the site. There are no known drinking water wells in this area north of the site. The City of Orlando supplies area residents and businesses with water from distant wells. Nearby residents or businesses who use private wells and are concerned about water quality can request the Orange County Public Health Unit test their water for pesticides.

3. A few nearby residents are concerned that contaminated ground water will reach Lake Fairview and affect their health via consumption of fish, incidental ingestion of water, or skin absorption.

It is unlikely that contaminants from this site will reach Lake Fairview in the near future. Monitoring well data shows that contaminated ground water is limited to the area under the Armstrong Trailer Park north of the site. These data show that contaminated ground water has not reached Lake Fairview. The EPA is reviewing cleanup options to contain the spread of contaminated ground water.

4. One nearby resident was concerned his health had been affected by living near this site. He did not specify what illnesses he thought were site related. He was also concerned that the stress of living near a hazardous waste site had affected his health.

We estimate that some adults in the Armstrong Trailer Park are at a moderate increased cancer risk from incidental ingestion of chlordane-contaminated soil before 1994. We are unable to relate any other illnesses to chemicals from this site at the estimated exposure levels.

Stress can affect people's health and cause many illnesses. Living next to a hazardous waste site can add to normal stress in people's lives. Although inconclusive, the psychological literature suggests the possibility of exposure to hazardous substances can cause heightened uncertainty regarding health, demoralization, possibly increased psychological disorders, and social conflict. Until the literature is more definitive, however, we cannot evaluate the health effects from the stress of living next to a hazardous waste site. Also, we currently cannot separate the health effects caused by the stress of living next to a hazardous waste site from health effects caused by other stresses.

5. One nearby resident was concerned his emphysema was aggravated by breathing contaminated dust from the site.

Dust, whether contaminated with pesticides or not, can aggravate emphysema and other respiratory conditions. Since there is no air monitoring data before 1992, we do not know the public health threat from breathing contaminated dust before that time. The levels of dust in the air during the 1992 site cleanup may have aggravated this resident's emphysema. None of the pesticides detected in the air, however, have been found to cause or aggravate emphysema or other respiratory problems. Since clean soil and grass now cover the site, we do not expect any future exposure to contaminated dust.

6. Some nearby residents were concerned that home-grown fruits and vegetables were no longer safe to eat.

Although there has been no testing of any of these fruits or vegetables, there is no indication from the existing soil and ground water monitoring data that they would be unsafe to eat.

7. One residents is concerned that her children continue to suffer from skin rashes, runny noses, fever, bronchitis, and other flu-like symptoms.

Since Chevron removed contaminated soil from the site in 1992 and from the Armstrong Trailer Park in 1994, it is unlikely these illness are due to chemicals from this site.

CONCLUSIONS

We classify the Chevron Chemical Co. (Ortho Division) Superfund hazardous waste site as a public health hazard based on past exposures to pesticide-contaminated soil.

1. Since there was no air monitoring before 1992, we cannot assess the public health threat from inhalation of contaminated dust before 1992. Nearby residents breathed pesticide-contaminated dust during the 1992 site cleanup. We do not, however, expect any health effects because of this exposure. Because clean soil and grass cover the site, we do not expect any future exposure to pesticide-contaminated dust.

2. Contaminated ground water has spread under the Armstrong Trailer Park northeast of the site. Ground-water monitoring data, however, show that it has not reached Lake Fairview. We do not know of anyone drinking the contaminated ground water. Based on our estimates, adults would be at a low increased risk of liver cancer from chlordane if they drank the contaminated ground water over a lifetime.

3. Some long-term residents of the Armstrong Trailer Park may have for years unknowingly eaten very small amounts of chlordane-contaminated soil from their yards. People routinely eat very small amounts of soil (incidental ingestion) when they work in their yards or around the house and don't wash their hands before smoking, eating, etc. We estimate some of the long-term residents of the Armstrong Trailer Park have a moderately increased risk of liver cancer because of unknowingly having eaten very small amounts of chlordane-contaminated soil. Since Chevron cleaned up the chlordane-contaminated soil in 1994, we estimate the increased cancer risk from exposure since then is insignificant.

4. Some nearby residents are concerned that their health may have been affected by exposure to contaminated dust, ground water, and surface water. Since there is no air monitoring data, we do not know the public health threat from breathing contaminated dust before 1992. We do not expect any health effects from exposure to pesticide-contaminated dust during the 1992 site cleanup. Clean soil and grass now cover the site and we do not anticipate any future exposure to contaminated dust. We do not know of anyone drinking contaminated ground water at or near this site. Based on our estimates, some adults in the Armstrong Trailer Park would be at a low increased risk of cancer if they drank the chlordane-contaminated ground water over a lifetime. We did not estimate potential exposure from incidental ingestion and skin absorption of contaminants during swimming, boating, etc. in Lake Fairview. Ground-water monitoring data show that contamination has not reached Lake Fairview. Dilution, physical retardation, and biodegradation in the ground water make it impractical to predict future concentrations in this nearby lake. Without an estimate of contaminant concentration in the lake, we cannot estimate exposure or likely health effects.

RECOMMENDATIONS

Cease/Reduce Exposure Recommendations

1. Maintain the grass cover or suppress dust during any on-site activity. To prevent possible exposures to pesticide-contaminated dust, Chevron should maintain the grass cover or suppress dust during any on-site activity.

2. Prohibit any new private wells near this site or prohibit domestic use of the contaminated ground water until it meets state and federal drinking water standards for all contaminants. The Southwest Florida Water Management District should prohibit any new private wells near this site. Or, they should prohibit domestic use of the contaminated ground water until it meets all state and federal drinking-water standards.

Public Education Recommendations

3. Inform the long-term residents of the Armstrong Trailer Park that some may have a moderately increased risk of liver cancer because of unknowingly having eaten very small amounts of chlordane-contaminated soil. Inform all of the residents of the Armstrong Trailer Park that since Chevron cleaned up the chlordane-contaminated soil in 1994, we estimate the increased cancer risk from current exposure is insignificant. The Florida Department of Health and Rehabilitative Services (HRS) should educate the long-term residents of the Armstrong Trailer Park. Florida HRS should inform them that some may have a moderately increased risk of liver cancer because of unknowingly having eaten very small amounts of chlordane-contaminated soil. Florida HRS should also inform the residents of the Armstrong Trailer Park that since Chevron cleaned up the chlordane-contaminated soil in 1994, the increased cancer risk from exposure since that time is insignificant.

4. Inform the community of the results of this public health assessment. The Florida Department of Health and Rehabilitative Services should inform the community of the results of this public health assessment.

Health Activities Recommendation Panel (HARP) Recommendations

The Comprehensive Environmental Response Compensation and Liability Act of 1980 (CERCLA), as amended, requires the ATSDR to perform public actions needed at hazardous waste sites. To decide if the ATSDR should act, ATSDR's Health Activities Recommendation Panel (HARP) has evaluated the data and information developed in the Chevron Chemical Co. (Ortho Division) Public Health Assessment.

The Panel has decided that the following actions are needed at this site:

1. Community health education is needed to inform nearby residents of the long-term health risk from past exposure to contaminants from this site.

If information becomes available indicating exposure at levels of concern, the ATSDR will evaluate that information to decide what actions, if any, are necessary.

PUBLIC HEALTH ACTIONS

This section describes what the ATSDR and/or the Florida HRS will do at the Chevron Chemical Co. (Ortho Division) site after the completion of this public health assessment report. The purpose of a Public Health Action Plan is to reduce any existing health hazards and to prevent any from occurring in the future. The ATSDR and/or the Florida HRS will do the following:

1. The Florida Department of Health and Rehabilitative Services (HRS) will inform the long-term residents of the Armstrong Trailer Park that some may have a moderately increased risk of liver cancer because of unknowingly having eaten very small amounts of chlordane-contaminated soil. Florida HRS will also inform the residents of the Armstrong Trailer Park that since Chevron cleaned up the chlordane-contaminated soil in 1994, the increased cancer risk from exposure since that time is insignificant.

2. The Florida Department of Health and Rehabilitative Services will inform the community of the results of this public health assessment.

The ATSDR and/or the Florida HRS will reevaluate the Public Health Action Plan when new environmental, toxicological, or health outcome data are available.

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Florida Department of Health and Rehabilitative Services

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Division of Health Assessment and Consultation

The ATSDR Regional Representative:

Bob Safay
Regional Services
Office of the Assistant Administrator

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CERTIFICATION

The Florida Department of Health and Rehabilitative Services (HRS) prepared this Chevron Chemical Co. (Ortho Divisioin) public health assessment under a cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR). Florida HRS followed approved methodology and procedures existing when they began this public health assessment.

Technical Project Officer, SPS, RPB, DHAC

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

for BW

Director, DHAC, ATSDR

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APPENDICES

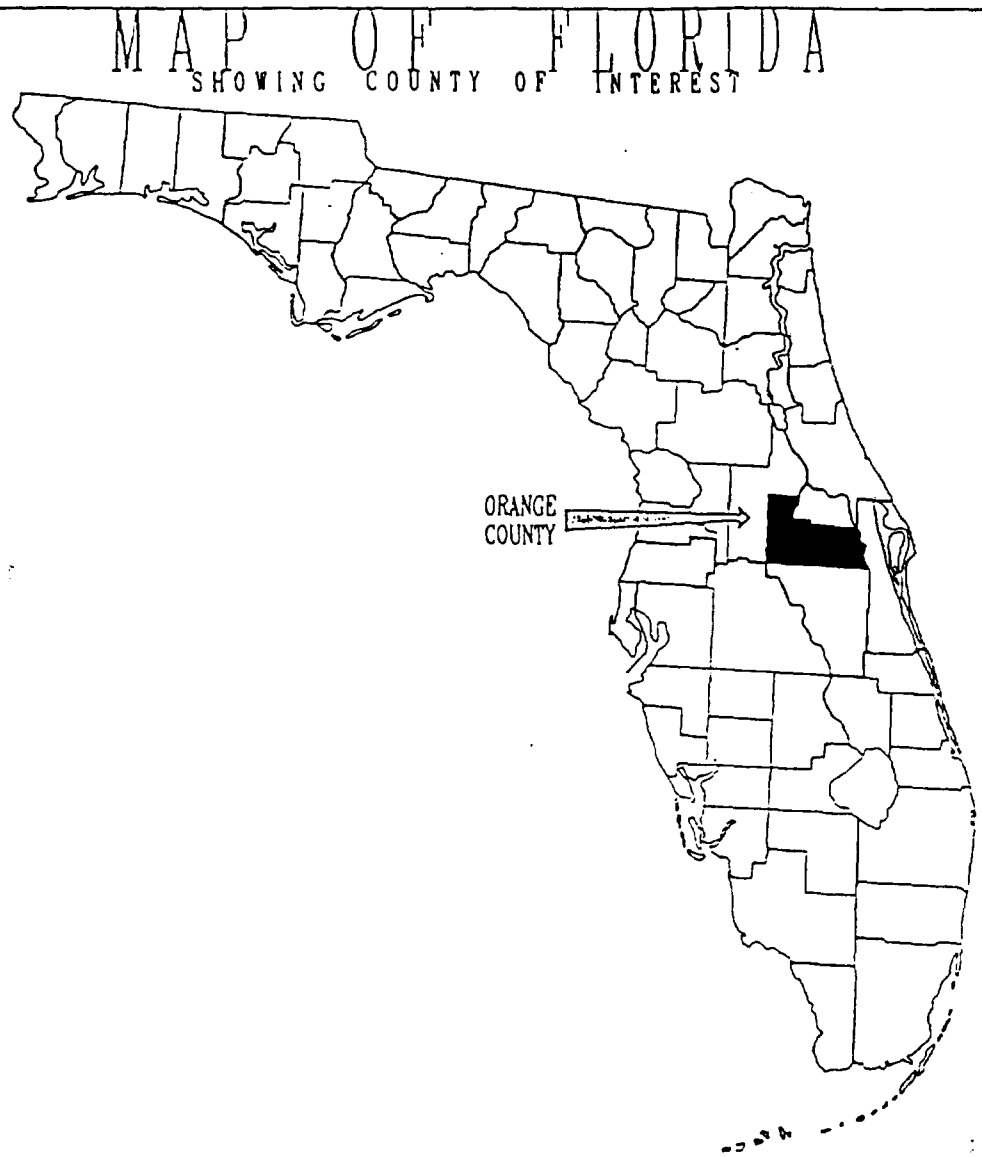

Figure 1. Florida Map

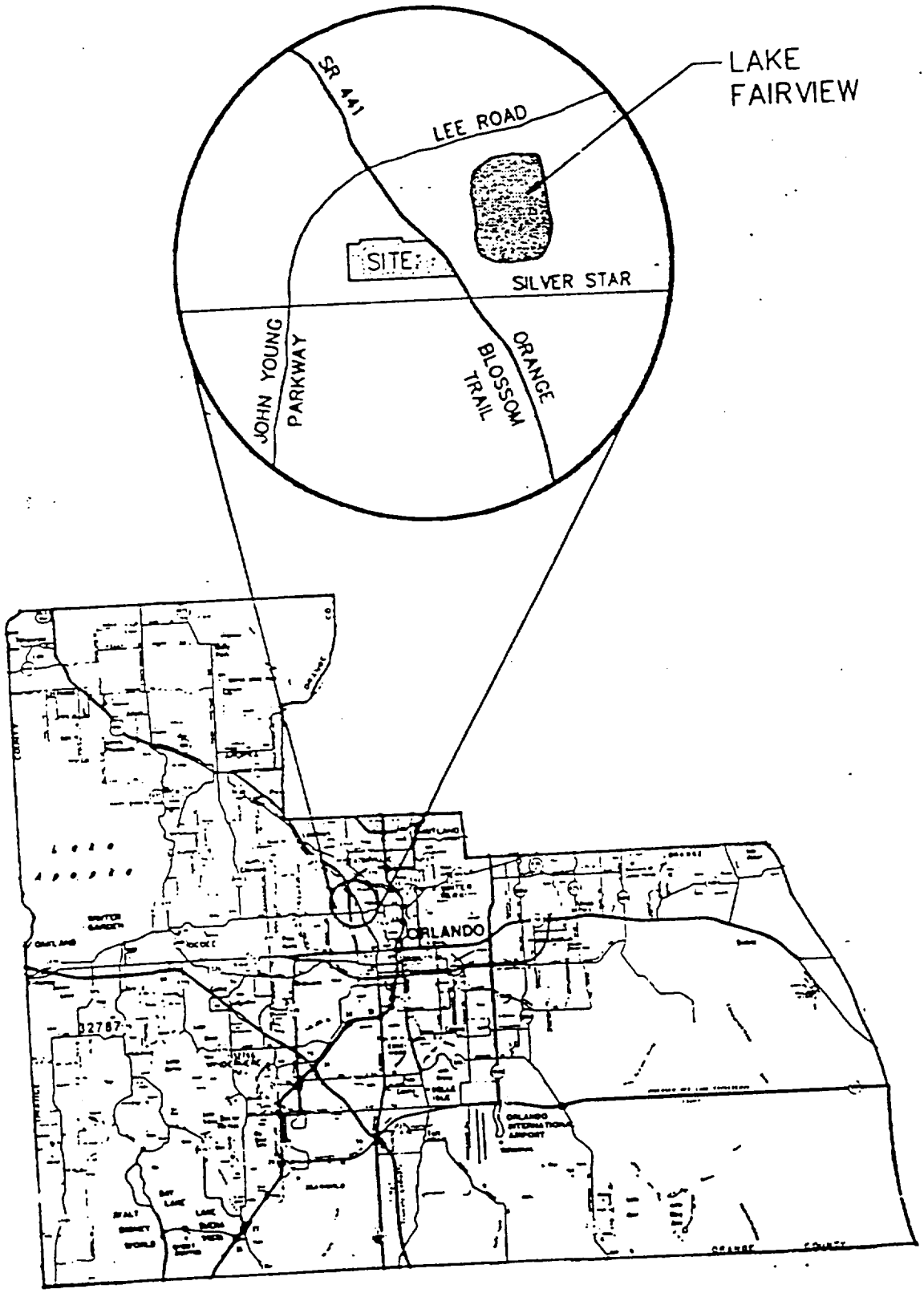

Figure 2
Vicinity Map

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Consultants

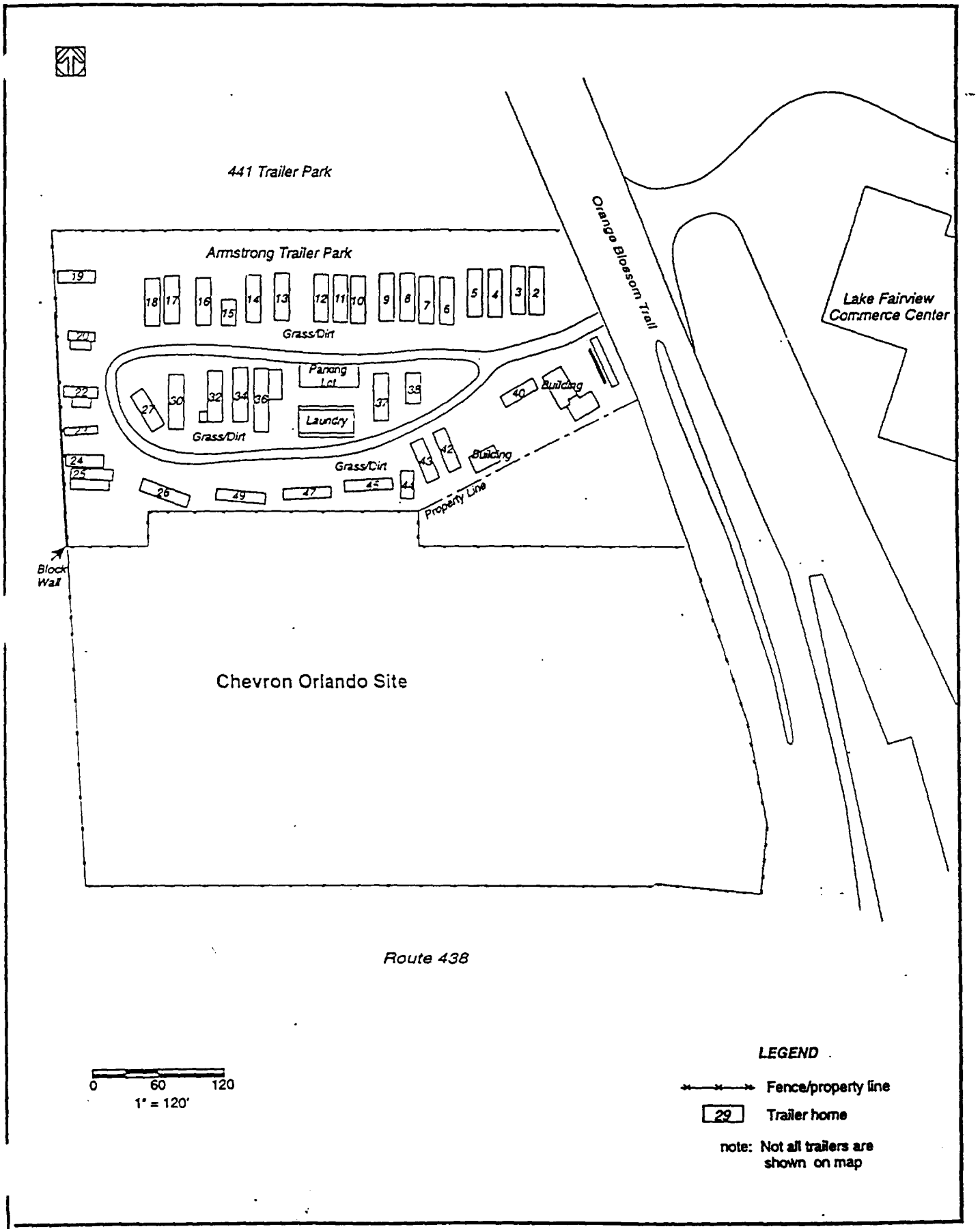

Figure 3 Study area; Chevron, Orlando site.

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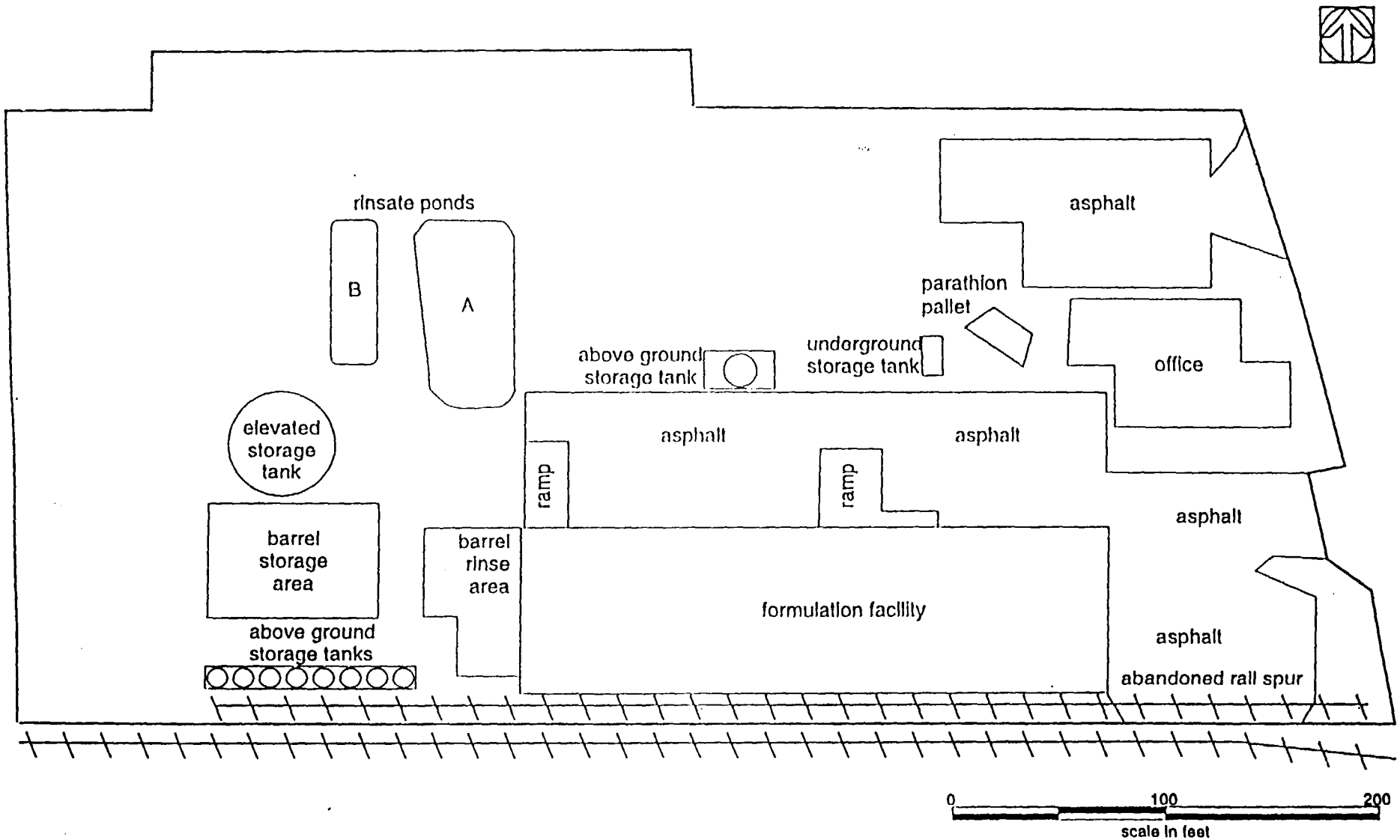

Figure 4 Historic site layout for former Chevron, Orlando facility.

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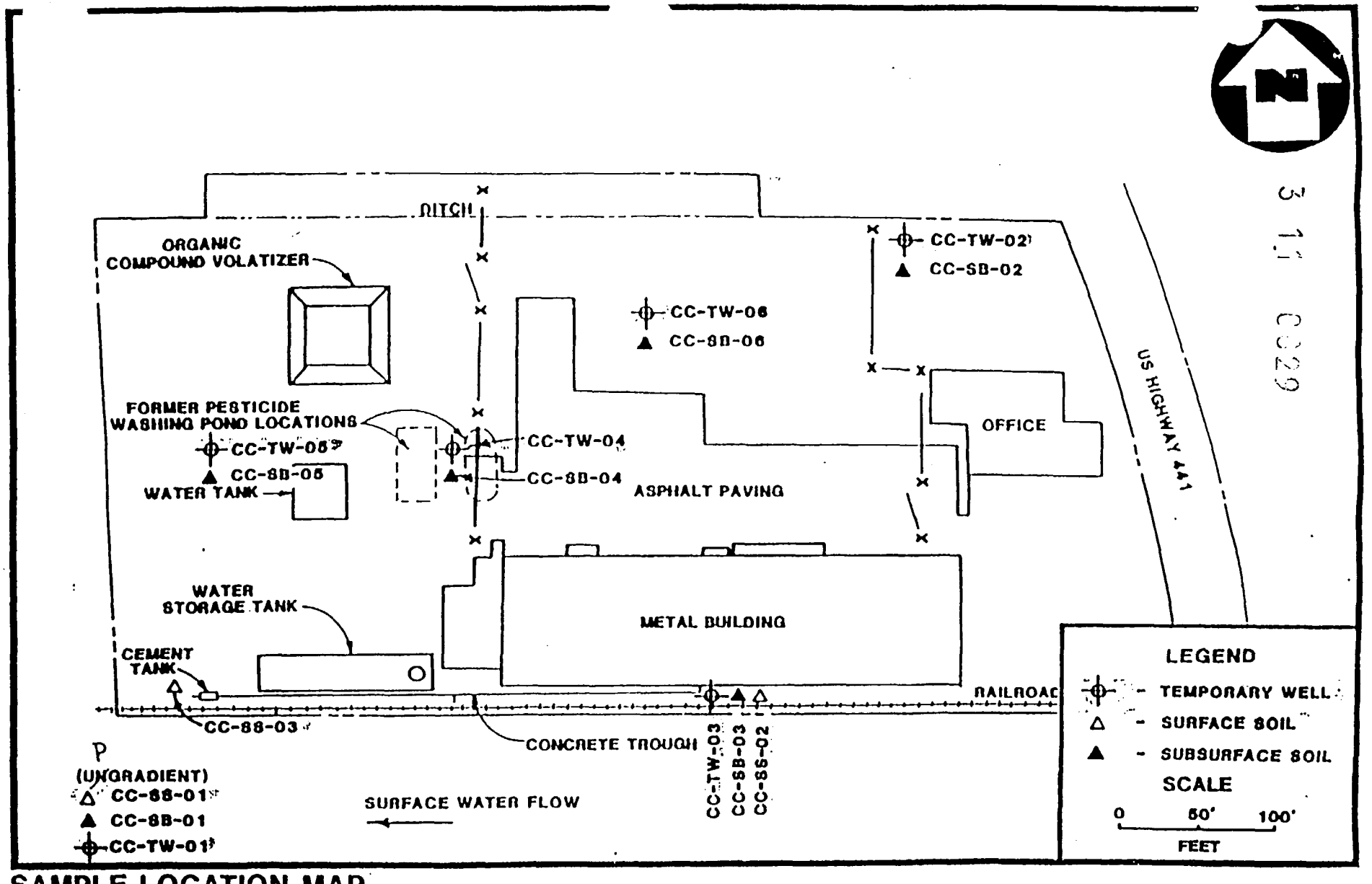

SAMPLE LOCATION MAP
CHEVRON CHEMICAL / ORTHO
ORLANDO, ORANGE COUNTY, FLORIDA

FIGURE 5

NUS CORPORATION

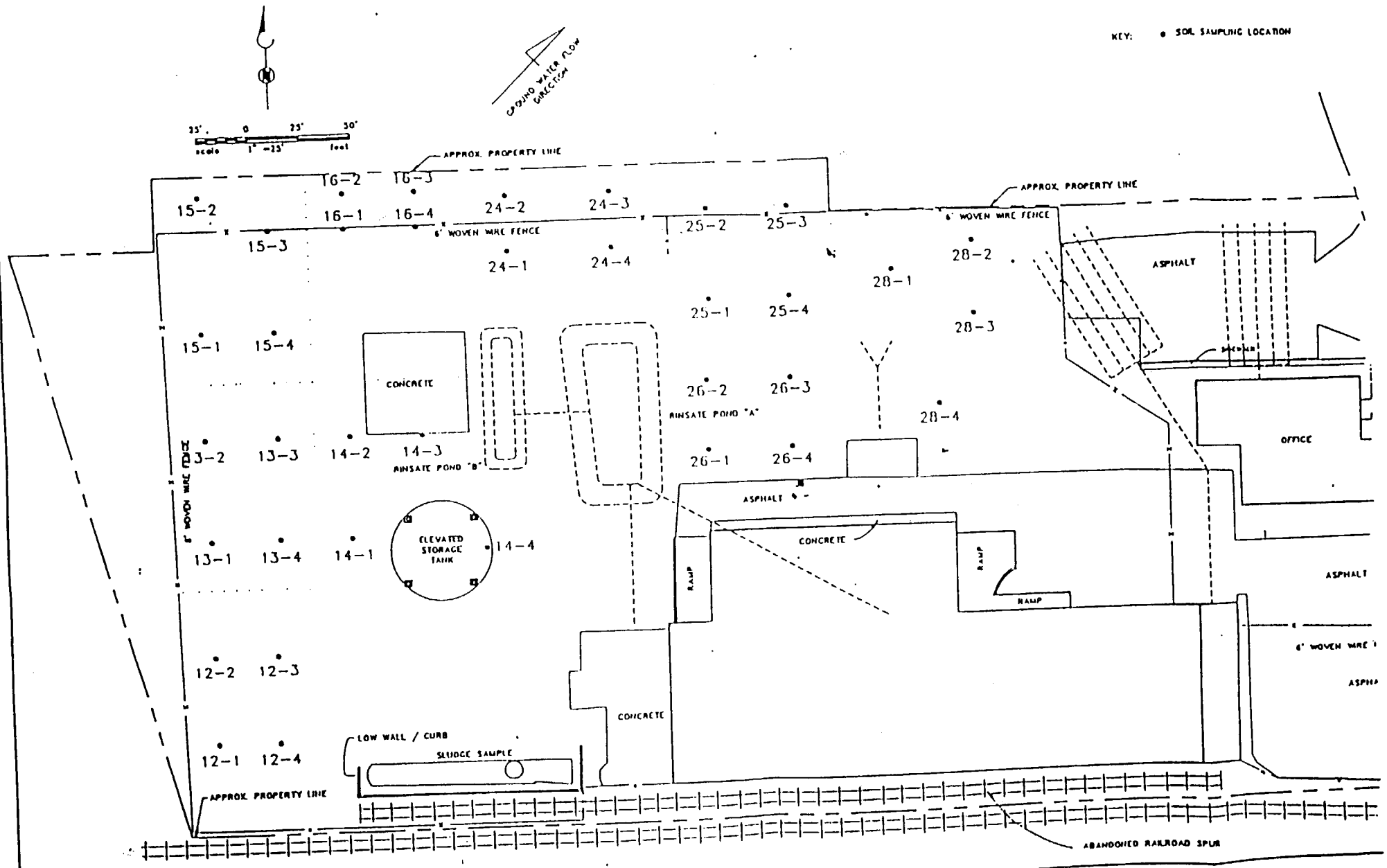

Figure 6

Brown and Caldwell Consultants

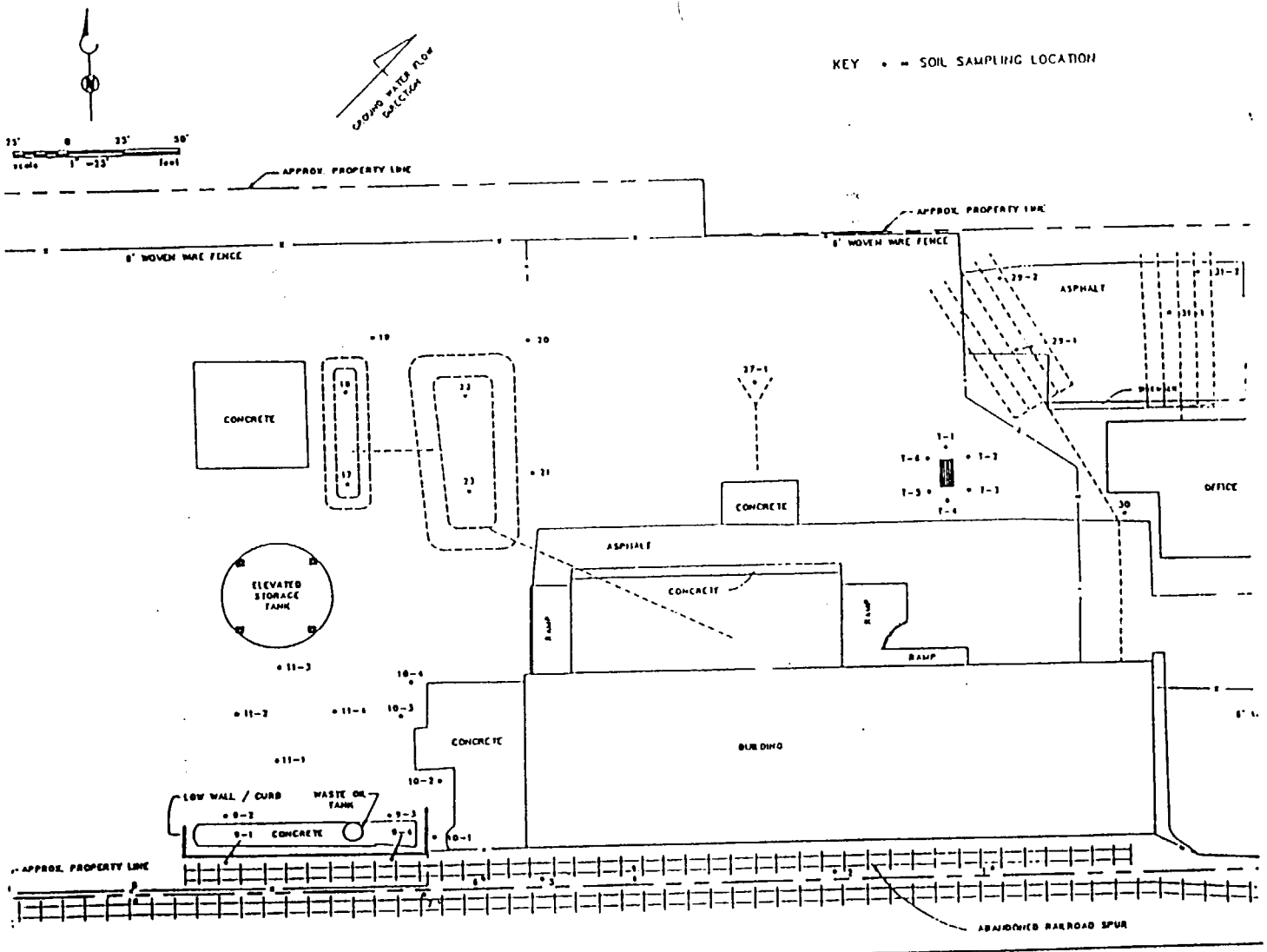

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Figure 7. Soil Sample Locations

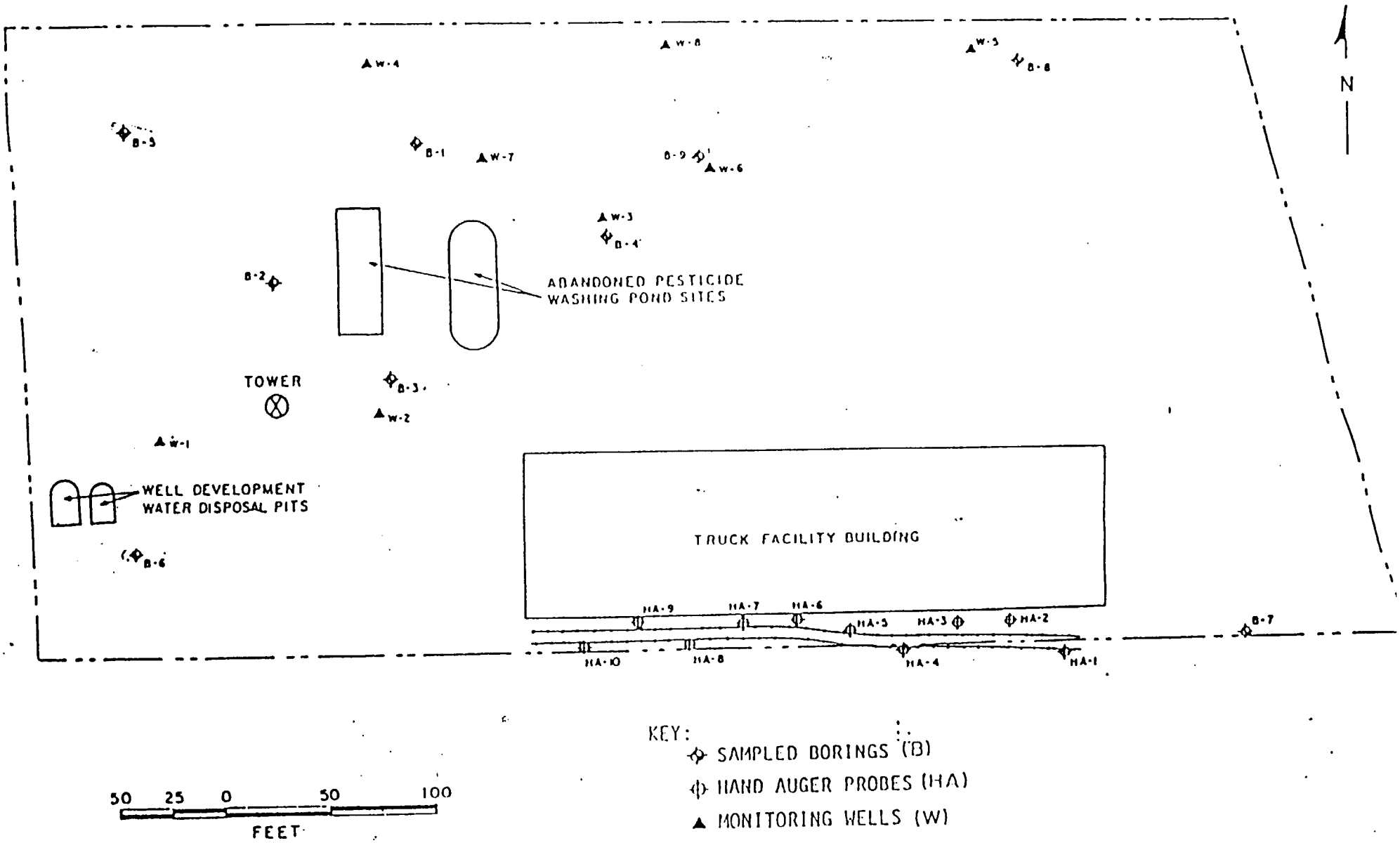
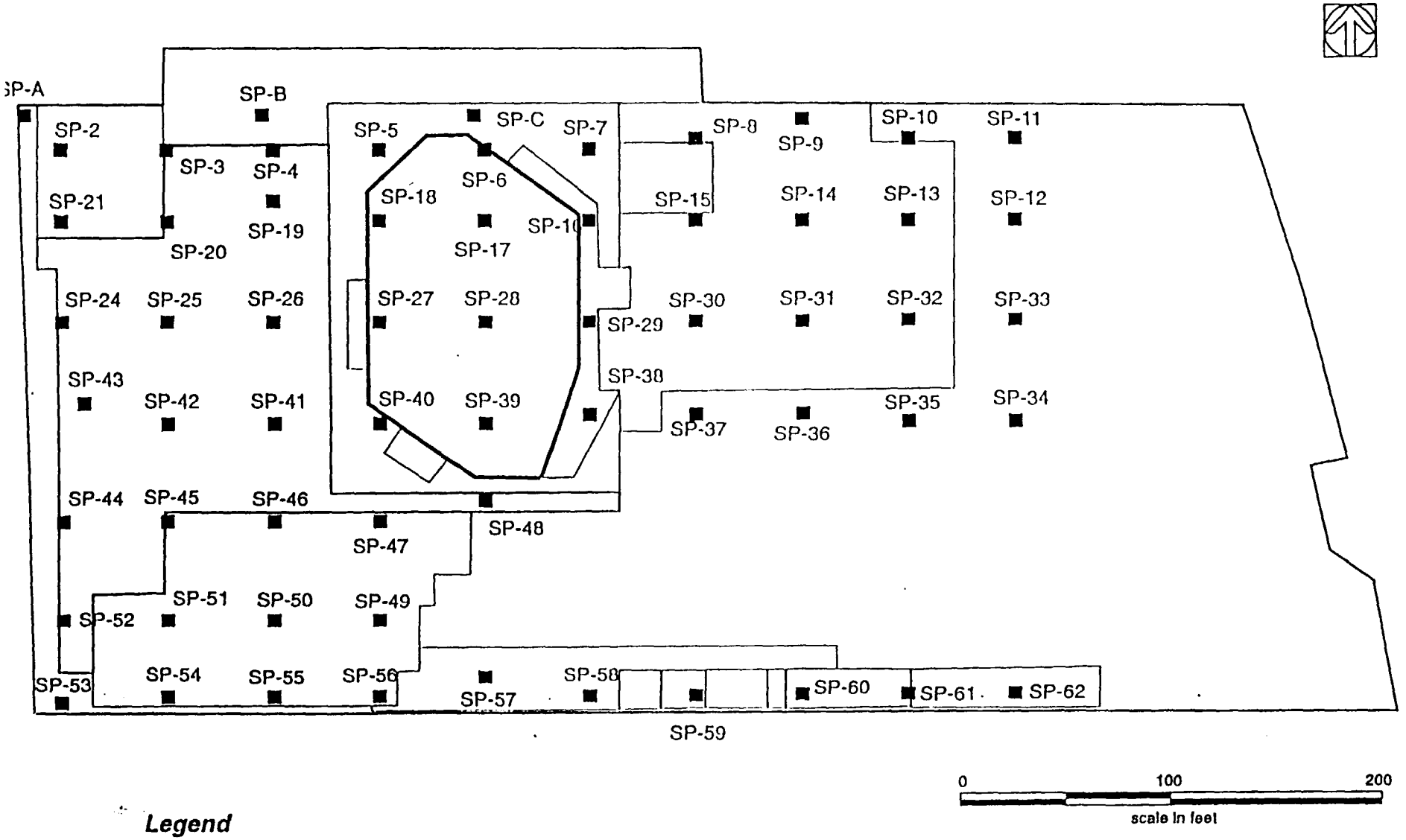


Figure 8. Sample Locations

PLOT PLAN



Legend

SP-53 Soil boring indentification

Figure 9: Soil boring locations from 1991 Removal Action plan (BCC 1991), Chevron, Orlando site.

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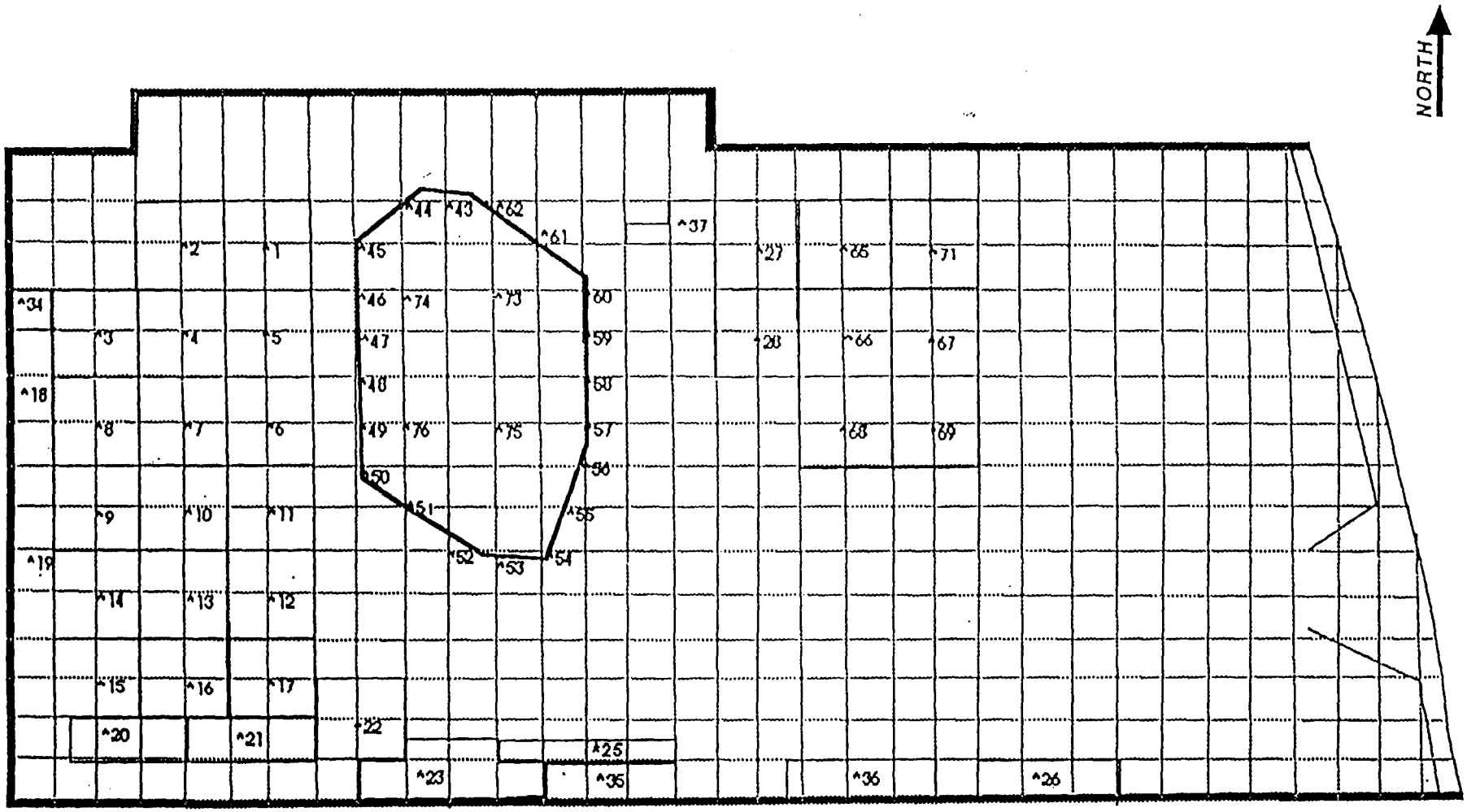

20 ft. by 20 ft Grid

Legend

^19 Confirmation Sample Location

Figure 10. 1992 Removal Action Soil Confirmation Sample Locations

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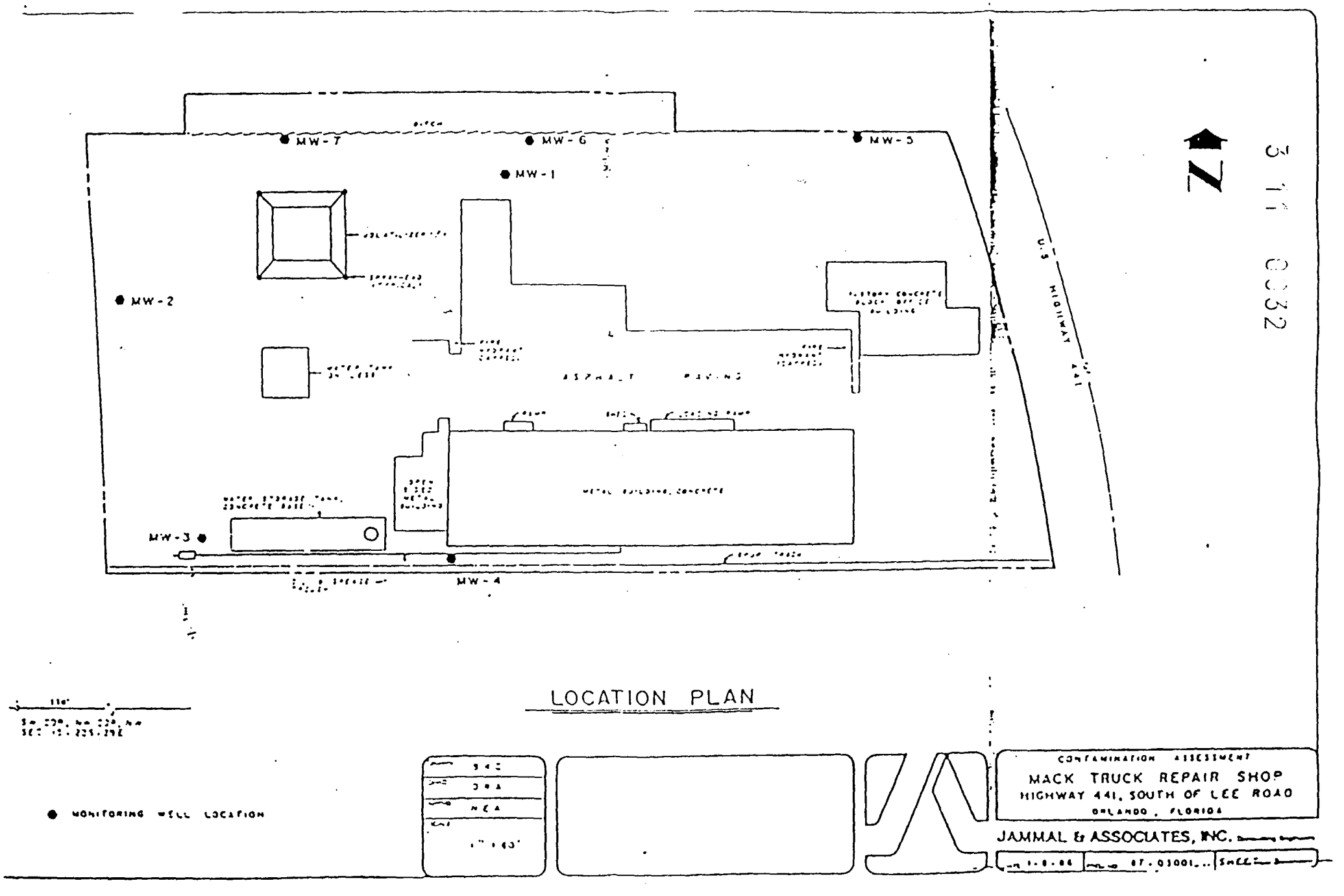

Figure 11. Monitor Well Locations

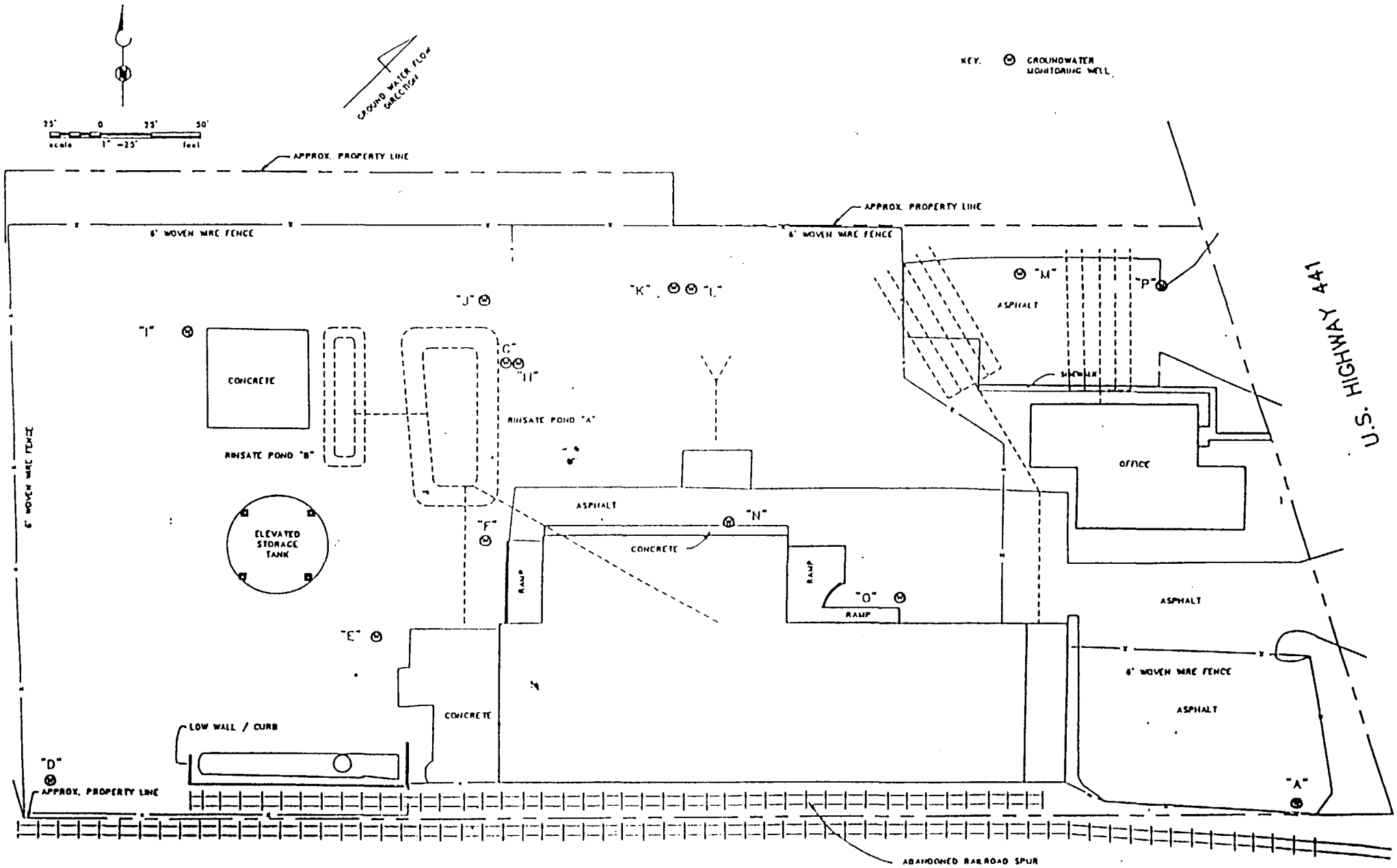

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Figure 12. Groundwater Monitoring Well Locations

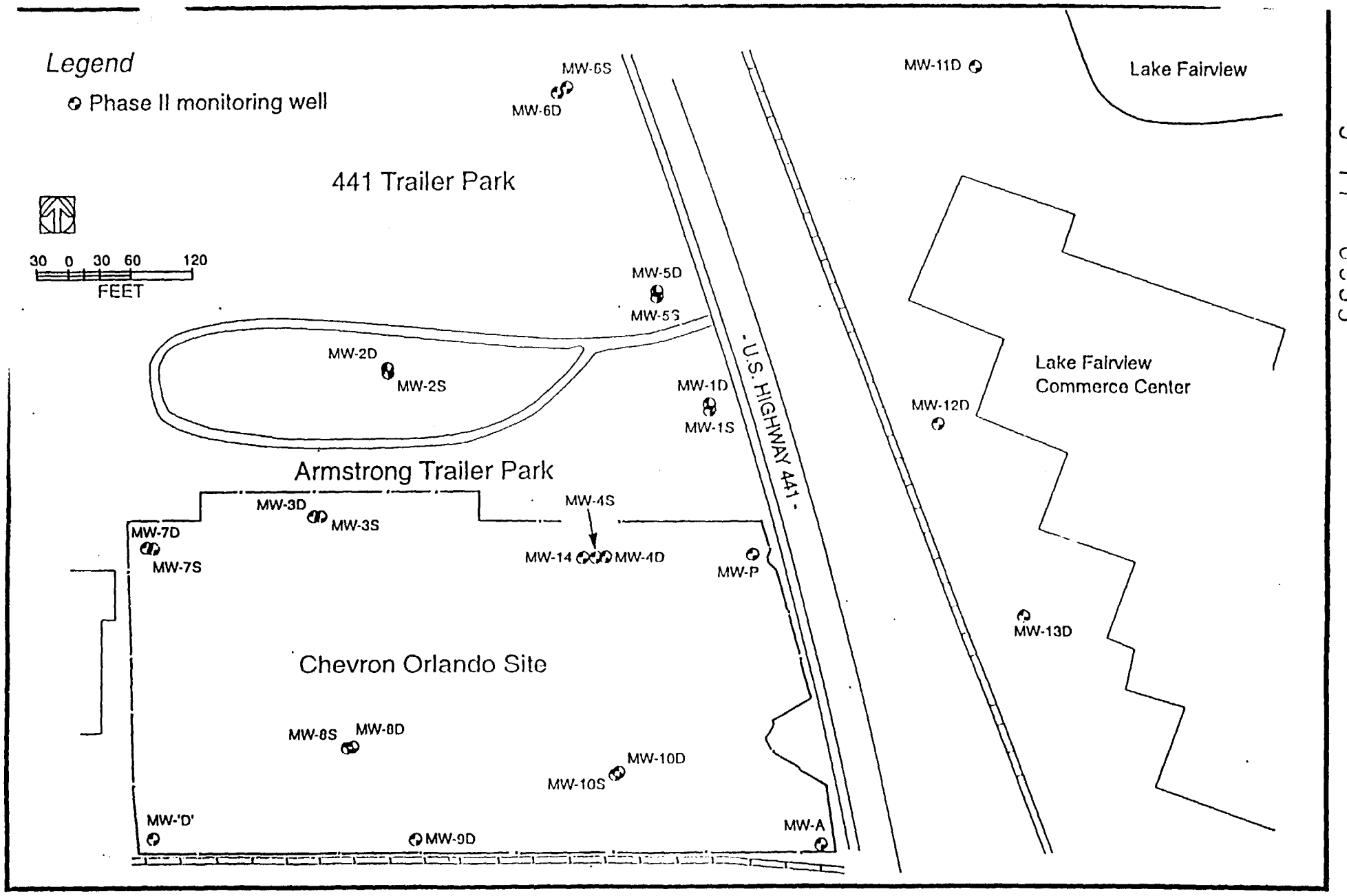

Figure 13. Monitoring wells sampled during Phase II groundwater investigation, September 1993, Chevron, Orlando site.

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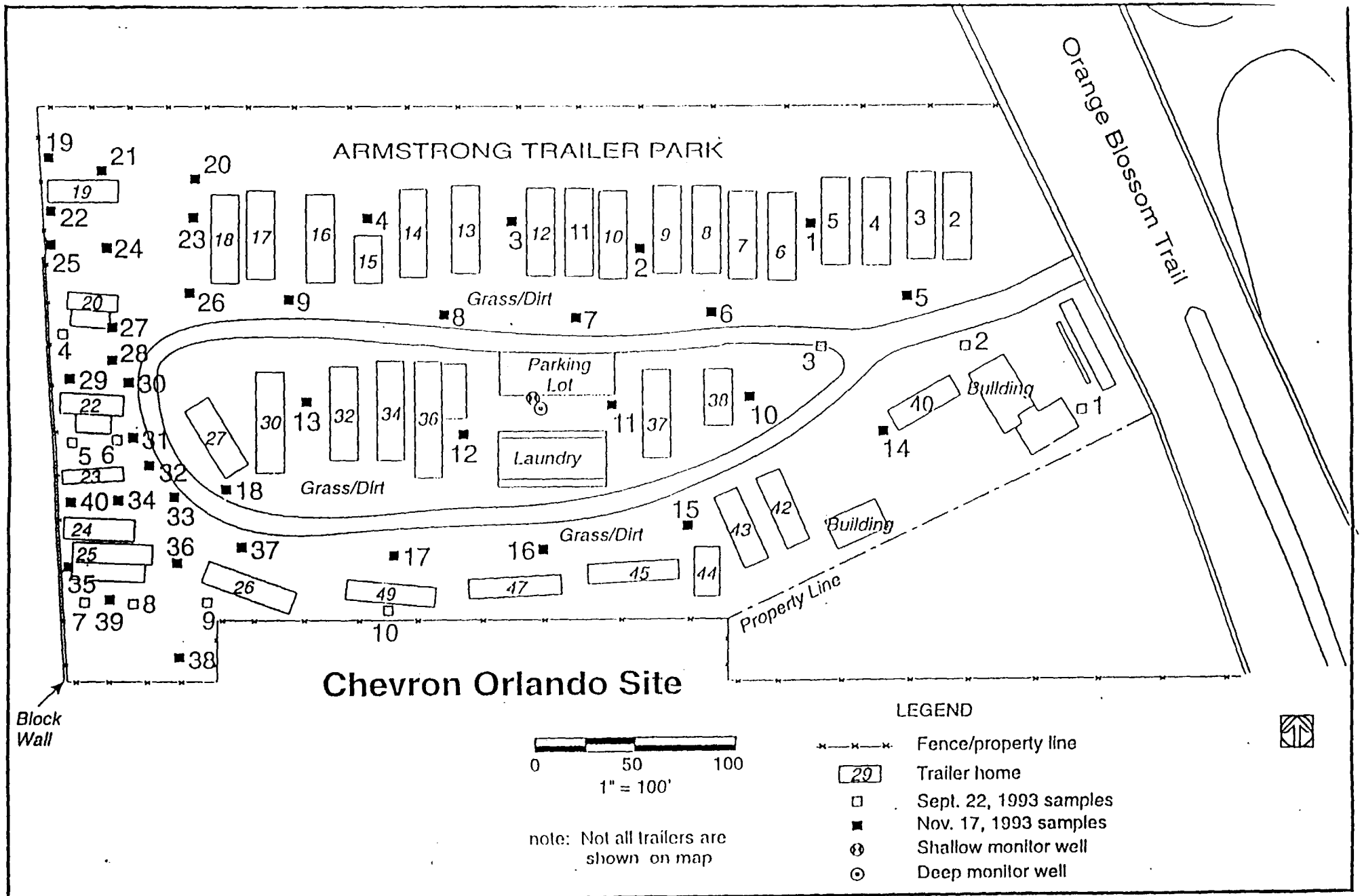

Figure 14. Armstrong trailer park Phase I and Phase II soil sampling location map, Chevron, Orlando site.

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Appendix B. Tables

Table 1. Maximum Concentrations in On-Site Surface Soil (0-1 Foot) Before 1992 Cleanup

Contaminants of Concern	Maximum Concen-tration (mg/kg)	Total # positive---- ---- Total # samples	Back-ground Concen-tration (mg/kg)	Comparison Value	
				(mg/kg)	Source
Chlordane	1,400	10/10	<0.1	0.5	CREG
DDD	1,600	11/12	<0.02	3	CREG
DDT	1,800	11/12	<0.02	2	CREG
Dieldrin	4	10/12	<0.02	0.04	CREG
Heptachlor Epoxide	<15	0/12	<0.01	0.08	CREG

mg/kg - milligrams per kilogram
CREG - Cancer Risk Evaluation Guide (for 10^{-6} excess cancer risk)
Sources of data: NUS 1990; Brown and Caldwell 1990a

Table 2. Maximum Concentrations in On-Site Subsurface Soil (>1 Foot) Before 1992 Cleanup

Contaminants of Concern	Maximum Concen-tration (mg/kg)	Total # positive---- ---- Total # samples	Back-ground Concen-tration (mg/kg)	Comparison Value	
				(mg/kg)	Source
Chlordane	110,000	302/436	<0.1	0.5	CREG
DDD	1,600	240/420	<0.02	3	CREG
DDT	1,800	106/426	<0.02	2	CREG
Dieldrin	81	87/260	<0.02	0.04	CREG
Heptachlor Epoxide	500	3/278	<0.01	0.08	CREG

mg/kg - milligrams per kilogram
CREG - Cancer Risk Evaluation Guide (for 10^{-6} excess cancer risk)
Sources of data: NUS 1990; Dames & Moore 1983; Brown and Caldwell 1990,1992

Table 3. Maximum Concentrations in On-Site Subsurface Soil (>1 Foot) After 1992 Cleanup

Contaminants of Concern	Maximum Concen-tration (mg/kg)	Total # positive---- ---- Total # samples	Back-ground Concen-tration (mg/kg)	Comparison Value	
				(mg/kg)	Source
Chlordane	350	208/304	<0.1	0.5	CREG
DDD	210	145/302	<0.02	3	CREG
DDT	58	53/302	<0.02	2	CREG
Dieldrin	16	60/227	<0.02	0.04	CREG
Heptachlor Epoxide	3	6/218	<0.01	0.08	CREG

mg/kg - milligrams per kilogram
CREG - Cancer Risk Evaluation Guide (for 10^{-6} excess cancer risk)
Sources of data: NUS 1990; Brown and Caldwell 1992; Task 1994a

Table 4. Maximum Concentration in On-Site Surficial-Aquifer Ground Water Before 1992 Cleanup

Contaminants of Concern	Maximum Concen-tration (μg/L)	Total # positive---- ---- Total # samples	Back-ground Concen-tration (μg/L)	Comparison Value	
				(μg/L)	Source
Chlordane	1,100	13/57	<1	0.03	CREG
DDD	49,000	12/57	<0.3	0.1	CREG
DDT	140	3/57	<0.3	0.1	CREG
Dieldrin	3,800	10/57	<0.1	0.002	CREG
Heptachlor Epoxide	30	3/30	<0.07	0.004	CREG

μg/L - micrograms per liter
CREG - Cancer Risk Evaluation Guide (for 10^{-6} excess cancer risk)
Sources of data: NUS 1990; Dames & Moore 1983; Jammal & Associates 1987; Brown and Caldwell 1990a, 1992.

Table 5. Maximum Concentration in On-Site Surficial-Aquifer Ground Water After 1992 Cleanup

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Contaminants of Concern	Maximum Concen-tration (μg/L)	Total # positive---- ---- Total # samples	Back-ground Concen-tration (μg/L)	Comparison Value	
				(μg/L)	Source
Chlordane	13	1/16	<1	0.03	CREG
DDD	3	2/16	<0.3	0.1	CREG
DDT	<0.3	0/16	<0.3	0.1	CREG
Dieldrin	<0.1	0/16	<0.1	0.002	CREG
Heptachlor Epoxide	<0.1	0/16	<0.07	0.004	CREG

μg/L - micrograms per liter
CREG - Cancer Risk Evaluation Guide (for 10^{-6} excess cancer risk)
Sources of data: NUS 1990; Chevron 1993; PTI 1993

Table 6. Maximum Concentrations in On-Site Air[1]

Contaminants of Concern	Maximum Concen-tration (μg/m³)	Total # positive---- ---- Total # samples	Back-ground Concen-tration (μg/m³)	Comparison Value	
				(μg/m³)	Source
Chlordane	0.49	22/57	NA	0.2	EMEG/MRL
DDD	0.026	4/57	NA	0.01	CREG
DDT	ND	0/57	NA	----	----
Dieldrin	ND	0/57	NA	----	----
Heptachlor Epoxide	ND	0/57	NA	----	----

[1] Air monitoring data were only collected during the 1992 site cleanup.
NA-not analyzed; ND-not detected; μg/m³-micrograms per cubic meter
EMEG/MRL - ATSDR Intermediate Environmental Media Evaluation Guide/Minimal Risk Level
CREG - Cancer Risk Evaluation Guide
Source of data: Brown and Caldwell 1992

Table 7. Maximum Concentrations in Off-Site Surface Soil (0-1 Foot) Before 1994 Removal

Contaminants of Concern	Maximum Concen-tration (mg/kg)	Total # positive---- ---- Total # samples	Back-ground Concen-tration (mg/kg)	Comparison Value	
				(mg/kg)	Source
Chlordane	370	49/49	0.62	0.5	CREG
DDD	3	10/49	0.009	3	CREG
DDT	3.3	45/49	0.11	2	CREG
Dieldrin	2	20/49	0.18	0.04	CREG
Heptachlor Epoxide	0.15	3/49	<0.004	0.08	CREG

mg/kg - milligrams per kilogram
CREG - Cancer Risk Evaluation Guide (for 10^{-6} excess cancer risk)
Source of data: NUS 1990; PTI 1994

Table 8. Maximum Concentrations in Off-Site Surface Soil (0-1 Foot) After 1994 Removal

Contaminants of Concern	Maximum Concen-tration (mg/kg)	Total # positive---- ---- Total # samples	Back-ground Concen-tration (mg/kg)	Comparison Value	
				(mg/kg)	Source
Chlordane	3.5	17/21	0.62	0.5	CREG
DDD	0.007	1/21	0.009	3	CREG
DDT	0.34	14/21	0.11	2	CREG
Dieldrin	0.3	5/21	0.18	0.04	CREG
Heptachlor Epoxide	<0.004	0/21	<0.004	0.08	CREG

mg/kg - milligrams per kilogram
CREG - Cancer Risk Evaluation Guide (for 10^{-6} excess cancer risk)
Sources of data: NUS 1990; Chevron 1994a, 1994b

Table 9. Maximum Concentration in Off-Site Surficial Aquifer Ground Water (5-32 Feet Deep)

Contaminants of Concern	Maximum Concen-tration (μg/L)	Total # positive---- ---- Total # samples	Back-ground Concen-tration (μg/L)	Comparison Value	
				(μg/L)	Source
Chlordane	50	4/19	<1	0.03	CREG
DDD	7.5	4/19	<0.3	0.1	CREG
DDT	<0.3	0/19	<0.3	0.1	CREG
Dieldrin	<0.1	0/19	<0.1	0.002	CREG
Heptachlor Epoxide	<0.07	0/19	<0.07	0.004	CREG

μg/L - micrograms per liter
CREG - Cancer Risk Evaluation Guide (for 10^{-6} excess cancer risk)
Sources of data: NUS 1990; Brown and Caldwell 1992; Chevron 1993; PTI 1993

Table 10. Maximum Concentrations in Off-Site Air[1,2]

Contaminants of Concern	Maximum Concen-tration (μg/m³)	Total # positive---- ---- Total # samples	Back-ground Concen-tration (μg/m³)	Comparison Value	
				(μg/m³)	Source
Chlordane	0.49	22/57	NA	0.2	EMEG/ MRL
DDD	0.026	4/57	NA	0.01	CREG
DDT	ND	0/57	NA	----	----
Dieldrin	ND	0/57	NA	----	----
Heptachlor Epoxide	ND	0/57	NA	----	----

[1] Air monitoring data were only collected during the 1992 site cleanup.
[2] We assume off-site air quality similar to that at site boundary
NA-not analyzed; ND-not detected; μg/m³-micrograms per cubic meter
EMEG/MRL - ATSDR Intermediate Environmental Media Evaluation Guide/Minimal Risk Level; CREG - Cancer Risk Evaluation Guide
Source of data: Brown and Caldwell 1992

Table 11. Completed Exposure Pathways

PATHWAY NAME	EXPOSURE PATHWAY ELEMENTS					TIME
	SOURCE	ENVIRONMENTAL MEDIA	POINT OF EXPOSURE	ROUTE OF EXPOSURE	EXPOSED POPULATION	
Off-Site Incidental Soil Ingestion	Contaminated On-Site Soil	Storm Water Transport of Contaminated Soil	Soil in Armstrong Trailer Park	Incidental Soil Ingestion	Approx. 150 Residents	Past (1952 to 1994)
Off-Site Inhalation	Contaminated On-Site Soil	Air	Armstrong and 441 Trailer Parks	Inhalation	Approx. 300 Residents	Past (1952 to 1976 and during 1992)

Table 12. Potential Exposure Pathways

PATHWAY NAME	POTENTIAL EXPOSURE PATHWAY ELEMENTS					TIME
	SOURCE	ENVIRONMENTAL MEDIA	POINT OF EXPOSURE	ROUTE OF EXPOSURE	EXPOSED POPULATION	
Off-Site Ground Water	Contam-inated On-Site Soil	Ground Water	Ground Water Under Armstrong Trailer Park	Ingestion	150 Residents of Armstrong Trailer Park	Future
Off-Site Surface Water	Contam-inated On-Site Soil	Ground-Water Transport	Lake Fairview	Incidental Ingestion and Skin Absorption	500 Annual Recreational Users of Lake Fairview	Future

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Appendix C. Summary of Public Comments on the Draft Public Health Assessment Report and Florida HRS Response.

Summary of Public Comments on the Draft Public Health Assessment Report and Florida HRS Response

From February 22 to March 31, 1995, Florida HRS solicited public comment on the draft public health assessment report. On March 3, the Orange County Public Health Unit distributed flyers to the approximately 50 residences in the Armstrong Trailer Park. These flyers summarized the draft public health assessment report, solicited public comment, and announced a public meeting. In a March 9 front-page (local section) story, the Orlando Sentinel newspaper summarized the findings of the draft public health assessment and announced the public meeting. From 4:00 to 7:00 PM on March 9, Florida HRS held a public meeting in the laundry room of the Armstrong Trailer Park. At this meeting the trailer park manager/owner and 15 to 20 residents expressed a number of concerns. We also received one set of written comments during the public comment period. Following is a summary of these concerns/comments and our responses:

Comment #1 Some of the residents of the Armstrong Trailer Park were concerned they were exposure to contaminated dust during the 1992 site cleanup. They complained of strong odors, skin rashes, burning eyes and noses, nausea, sore throats, and chest pains during that time.

Florida HRS Response: During the 1992 soil removal, Chevron monitored pesticides in the airborne dust along the boundary between the site and the Armstrong Trailer Park. They only found chlordane and DDD in the airborne dust. The maximum concentration of chlordane in the air during the 1992 site cleanup, however, was below the ATSDR intermediate Minimal Risk Level (ATSDR 1989a, 1992b). Although there is no ATSDR Minimal Risk Level for DDD, the maximum concentration of DDD in the air during the 1992 site cleanup was 250 times less than the EPA air unit risk for the closely related pesticide DDT (ATSDR 1989b, 1992c). Therefore, we do not expect any health effects from exposure to either chlordane or DDD-contaminated dust during the 1992 site cleanup.

The symptoms the residents complained of may, however, have been caused by solvent vapors released when Chevron removed the contaminated soil. Soil at the site is known to have been contaminated with solvents. We do not have any records, however, of air monitoring for solvents during the 1992 cleanup. Therefore, we cannot say for sure if exposure to solvent vapors caused the above symptoms.

Since clean soil and grass now cover the site, we do not expect any future exposure to contaminated dust. Since there is no air monitoring data before 1992, we do not know the public health threat from breathing contaminated dust before that time.

Comment #2 One resident of the Armstrong complained that her children continue to suffer from skin rashes, runny noses, fever, bronchitis, and other flu-like symptoms.

Florida HRS Response: Since Chevron removed contaminated soil from the site in 1992 and from the Armstrong Trailer Park in 1994, it is unlikely these illness are due to chemicals from this site.

Comment #3 Some of the residents of the Armstrong Trailer Park were concerned that fruits and vegetables grown at the trailer park were no longer safe to eat.

Florida HRS Response: Although there has been no testing of any of these fruits or vegetables, there is no indication from the existing soil and ground water monitoring data that they would be unsafe to eat.

Comment #4 Chevron observed that our draft public health assessment "sensibly" concluded that this site is unlikely to pose any significant health threat. Chevron noted the draft public health assessment reached this conclusion despite the use of may conservative assumptions. These assumptions included the use of the maximum soil and ground-water concentrations as opposed to the upper 95% confidence interval and the use of high-end estimates of the amount of soil ingested by children. Chevron also suggested giving a numerical description of the increased cancer risk in addition to the qualitative descriptors such as "low" or "moderate."

Florida HRS Response: Standard methodology for preparing public health assessments calls for the use of many conservative (health protective) assumptions. These include the use of the maximum concentrations of contaminants found in each media and the use of high-end estimates of the amount of soil ingested by children. These health protective assumptions are necessary to prevent us from failing to identify a threat to public health when one exists. When our assessment fails to identify a public health threat, as is the case at this site, then we are confident that none exists. At other sites, where our initial assessment identifies a problem, we then examine our assumptions before reaching a conclusion.

Although we use numerical models to quantitatively estimate increased rates of cancer, standard methodology for preparing public health assessments suggests a qualitative description of the results. We have found that presenting numerical estimates of the increased cancer risk is confusing to the general public. Therefore, we convert our numerical estimate of the increased cancer risk to qualitative language such as "low" or "medium" that the general public can understand.

Comment #5 Chevron suggested that since sufficient environmental data are available at this site, using a statistical representation of the data in the tables would be less misleading to the public than using the maximum concentrations.

Florida HRS Response: We agree that for soil and ground water, sufficient environmental data exist to be able to use statistical techniques to describe "central tendencies." The purpose of our assessment, however, is not to assess the severity and extent of the environmental contamination but to assess its impact on public health. Therefore, for our assessment, it is appropriate to use the maximum detected concentration to assess the public health threat, even though this may make the severity and extent of environmental contamination look worse than it is.

Comment #6 **Chevron asserted it is inappropriate to apply the ATSDR Cancer Risk Evaluation Guides to assessing the short-terms inhalation exposures during the 1992 site cleanup.**

Florida HRS response: In our assessment for the inhalation exposure pathway, we assume nearby residents were exposed to site-related contaminated dust for the 24 years (1952 to 1976) Chevron was in operation. Unfortunately, there is no air monitoring during that time. We assumed that they were not exposed from 1976 to 1993 when vegetation covered the unpaved portions of the site. Since the only air monitoring data we have is during the 1992 site cleanup, we agree that a short-term comparison value would be more appropriate. Therefore, we have modified Tables 6 and 10 to use the ATSDR Intermediate Environmental Media Evaluation Guide/Minimal Risk Level for chlordane (0.2 $\mu g/m^3$) instead of the life-time Cancer Risk Evaluation Guide (0.003$\mu g/m^3$). We could not modify the comparison value for DDD since there is no shorter-term comparison value.

Comment #7 Chevron asserted that the air monitoring data do not support the conclusion that dust generated during the 1992 site cleanup could have aggravated one nearby resident's existing emphysema condition.

Florida HRS Response: Respirable size dust can aggravate an existing case of emphysema. The air samples taken during the 1992 site cleanup were analyzed for total suspended solids but not for respirable size dust. The highest concentration of total suspended solids: 12.5 mg/m^3 (sample #B-04, 3/23/92) is greater than the 1993 American Conference of Governmental Industrial Hygienist, Time Weighted Average (ACGIH TWA of) 10 mg/m^3 for "nuisance particulates" but less than the Occupational Safety and Health Administration, Permissible Exposure Level (OSHA PEL) of 15 mg/m^3 (ACGIH 1993). Unfortunately, both of these guidelines apply to work place exposure and do not take into account sick individuals nor do they account for exposure for more than eight hour per day. Non-workers may be more susceptible due to preexisting medical conditions and/or longer exposure periods. Therefore, it is reasonable to expect that dust from the 1992 site cleanup may have aggravated this nearby resident's existing emphysema condition.