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Rev. 07/10/02

DEPARTMENT OF HEALTH & HUMAN SERVICES

Office of the Secretary

Office of the General Counsel
1600 Clifton Road, N.E
Atlanta, Georgia 30333

November 18, 1994

Mr. Lee Gelman
Department of Justice
Environmental Enforcement Section
P.O. Box 7611
Washington, D.C. 20044

Dear Mr. Gelman:

Enclosed please find the Grant instrument entered into by Illinois and ATSDR for the "Lead Exposure Study for the NL industries/Taracopr Site in Granite City, Madison County, Illinois."

Please let me know if I may be of further assistance.

Sincerely,

Deborah Weimer
Senior Attorney

Enclosures

ILLINOIS DEPARTMENT OF
PUBLIC HEALTH
*A Healthier Today For A Better Tomorrow*

Bernard J. Turnock, M.D., Director

August 10, 1990

Henry S. Cassell, III
Grants Management Officer
Grants Management Branch
Procurement and Grants Office
Centers for Disease Control
255 Paces Ferry Road, NE, Room 300
Mail Stop E14
Atlanta, GA 30305

Re: Lead Exposure Study - Madison Co., Illinois
(Preapplication No. H75/ATH590119)

Dear Mr. Cassell:

This letter announces the submission of a grant application for a study of lead exposure in Madison County, Illinois. This grant proposal is being submitted under the ATSDR initiative for Pilot and Epidemiologic Studies To Determine The Relationship Between Human Exposure To Hazardous Substances And Adverse Health Outcomes. We would appreciate your consideration of this project.

If you need any assistance or clarification, please contact Thomas F. Long at (217) 782-5830

Sincerely,

Bernard J. Turnock MD

Bernard J. Turnock, M.D.
Director of Public Health

535 West Jefferson Street • Room 450 • Springfield, Illinois 62761
100 West Randolph Street • Suite 6-600 • Chicago, Illinois 60601

OMB Approval No. 0348-0043

# APPLICATION FOR FEDERAL ASSISTANCE

| | |
|---|---|
| 2. DATE SUBMITTED: 8/10/90 | Applicant Identifier: 88-07-08-05 |
| 3. DATE RECEIVED BY STATE | State Application Identifier |
| 4. DATE RECEIVED BY FEDERAL AGENCY | Federal Identifier |

1. TYPE OF SUBMISSION:
Application: ☐ Construction ☒ Non-Construction
Preapplication: ☐ Construction ☐ Non-Construction

5. APPLICANT INFORMATION

Legal Name: Illinois Department of Public Health

Organizational Unit: Division of Environmental Health

Address (give city, county, state, and zip code): 525 West Jefferson St. Springfield, Sangamon Co., IL 62761

Name and telephone number of the person to be contacted on matters involving this application (give area code): Thomas F. Long 217/782-5830

6. EMPLOYER IDENTIFICATION NUMBER (EIN): 3 7 - 6 0 0 2 0 5 7

7. TYPE OF APPLICANT: (enter appropriate letter in box) [A]
A State
B. County
C Municipal
D. Township
E Interstate
F Intermunicipal
G Special District
H Independent School Dist.
I State Controlled Institution of Higher Learning
J Private University
K. Indian Tribe
L Individual
M Profit Organization
N. Other (Specify) _____

8. TYPE OF APPLICATION:
☒ New ☐ Continuation ☐ Revision
If Revision, enter appropriate letter(s) in box(es): ☐ ☐
A Increase Award B Decrease Award C Increase Duration
D Decrease Duration Other (specify):

9. NAME OF FEDERAL AGENCY: Agency for Toxic Substances and Disease Registr

10. CATALOG OF FEDERAL DOMESTIC ASSISTANCE NUMBER: 1 3 . 1 6 1
TITLE: FY 1990 Pilot and Epidemiologic Studies to Determine the Relationship between Human Exposure to Hazardous Substances and Adverse Health Outcomes

11. DESCRIPTIVE TITLE OF APPLICANT'S PROJECT: Lead Exposure Study for the NL Industries/Taracorp Site in Granite City, Madison Co., Illinois.

12. AREAS AFFECTED BY PROJECT (cities, counties, states, etc.): Granite City, Madison, Venice Madison Co., IL

13. PROPOSED PROJECT:

| Start Date | Ending Date |
|---|---|
| 3/91 | 9/91 |

14. CONGRESSIONAL DISTRICTS OF:

| a. Applicant | b. Project |
|---|---|
| 1-22 (Statewide-Illinois) | 21 |

15. ESTIMATED FUNDING:

| | | |
|---|---|---|
| a. Federal | $ 468,000 | .00 |
| b. Applicant | $ -- | .00 |
| c. State | $ 38,842 | .00 |
| d. Local | $ -- | .00 |
| e. Other | $ -- | .00 |
| f. Program Income | $ 0 | .00 |
| g. TOTAL | $ 506,842 | .00 |

16. IS APPLICATION SUBJECT TO REVIEW BY STATE EXECUTIVE ORDER 12372 PROCESS?
a. YES. THIS PREAPPLICATION/APPLICATION WAS MADE AVAILABLE TO THE STATE EXECUTIVE ORDER 12372 PROCESS FOR REVIEW ON
DATE 8/10/90
b. NO ☐ PROGRAM IS NOT COVERED BY E.O. 12372
☐ OR PROGRAM HAS NOT BEEN SELECTED BY STATE FOR REVIEW

17. IS THE APPLICANT DELINQUENT ON ANY FEDERAL DEBT?
☐ Yes If "Yes," attach an explanation ☒ No

18. TO THE BEST OF MY KNOWLEDGE AND BELIEF, ALL DATA IN THIS APPLICATION/PREAPPLICATION ARE TRUE AND CORRECT. THE DOCUMENT HAS BEEN DULY AUTHORIZED BY THE GOVERNING BODY OF THE APPLICANT AND THE APPLICANT WILL COMPLY WITH THE ATTACHED ASSURANCES IF THE ASSISTANCE IS AWARDED

| | | |
|---|---|---|
| a. Typed Name of Authorized Representative: Bernard J. Turnock, MD | b. Title: Director | c. Telephone number: 217/782-5830 |
| d. Signature of Authorized Representative: Bernard J. Turnock MD | | e. Date Signed: 8/10/90 |

Previous Editions Not Usable

Standard Form 424 (REV. 4-88)
Prescribed by OMB Circular A-102

## SECTION C - NON-FEDERAL RESOURCES

| (a) Grant Program | (b) Applicant | (c) State | (d) Other Sources | (e) TOTALS |
|---|---|---|---|---|
| 13.161 Pilot and Epi Studies (ATSDR) | $ -- | $ 38,842 | $ -- | $ 38,842 |
| | | | | |
| 0. | | | | |
| 1. | | | | |
| 2. TOTALS (sum of lines 8 and 11) | $ -- | $ 38,842 | $ -- | $ 38,842 |

## SECTION D - FORECASTED CASH NEEDS

| | Total for 1st Year | 1st Quarter | 2nd Quarter | 3rd Quarter | 4th Quarter |
|---|---|---|---|---|---|
| 3. Federal | $ 468,000 | $ 117,000 | $ 117,000 | $ 117,000 | $ 117,000 |
| 4. NonFederal | 38,842 | 9,710.50 | 9,710.50 | 9,710.50 | 9,710.50 |
| 5. TOTAL (sum of lines 13 and 14) | $ 506,842 | $ 126,710.50 | $ 126,710.50 | $ 126,710.50 | $ 126,710.50 |

## SECTION E - BUDGET ESTIMATES OF FEDERAL FUNDS NEEDED FOR BALANCE OF THE PROJECT

| (a) Grant Program | FUTURE FUNDING PERIODS (Years) | | | |
|---|---|---|---|---|
| | (b) First | (c) Second | (d) Third | (e) Fourth |
| 16. 13.161 Pilot and Epi Studies (ATSDR) | $ 506,842 | $ 0 | $ 0 | $ 0 |
| 17. | | | | |
| 18. | | | | |
| 19. | | | | |
| 20. TOTALS (sum of lines 16-19) | $ 506,842 | $ 0 | $ 0 | $ 0 |

## SECTION F - OTHER BUDGET INFORMATION

(Attach additional Sheets if Necessary)

21. Direct Charges: See budget narrative

22. Indirect Charges: Calculated as 45% on personnel service and fringe benefits (excluding group insurance)

23. Remarks

OMB Approval No. 0 0044

# BUDGET INFORMATION — Non-Construction Programs

## SECTION A – BUDGET SUMMARY

| Grant Program Function or Activity (a) | Catalog of Federal Domestic Assistance Number (b) | Estimated Unobligated Funds | | New or Revised Budget | | |
|---|---|---|---|---|---|---|
| | | Federal (c) | Non-Federal (d) | Federal (e) | Non-Federal (f) | Total (g) |
| Pilot and Epi Studies (ATSDR) | 13.161 | $ -- | $ -- | $ 468,000 | $ 38,842 | $ 506,842 |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| TOTALS | | $ -- | $ -- | $ 468,000 | $ 38,842 | $ 506,842 |

## SECTION B – BUDGET CATEGORIES

| Object Class Categories | GRANT PROGRAM, FUNCTION OR ACTIVITY | | | | Total (5) |
|---|---|---|---|---|---|
| | (1) Federal | (2) State | (3) | (4) | |
| a. Personnel | $ 0 | $ 11,100 | $ | $ | $ 11,100 |
| b. Fringe Benefits | 0 | 2,098 | | | 2,098 |
| c. Travel | 25,000 | 2,500 | | | 27,500 |
| d. Equipment | 6,000 | 0 | | | 6,000 |
| e. Supplies | 12,500 | 2,500 | | | 15,000 |
| f. Contractual | 424,500 | 0 | | | 424,500 |
| g. Construction | 0 | 0 | | | 0 |
| h. Other Supplemental lab work | 0 | 15,000 | | | 15,000 |
| i. Total Direct Charges (sum of 6a - 6h) | 468,000 | 33,198 | | | 501,198 |
| j. Indirect Charges | 0 | 5,644 | | | 5,644 |
| k. TOTALS (sum of 6i and 6j) | $ 468,000 | $ 38,842 | $ | $ | $ 506,842 |
| 7. Program Income | $ 0 | $ 0 | $ | $ | $ 0 |

Standard Form 424A (4-88)
Prescribed by OMB Circular A-102

OMB Approval No. 0348-0040

# ASSURANCES — NON-CONSTRUCTION PROGRAMS

**Note:** Certain of these assurances may not be applicable to your project or program. If you have questions, please contact the awarding agency. Further, certain Federal awarding agencies may require applicants to certify to additional assurances. If such is the case, you will be notified.

As the duly authorized representative of the applicant I certify that the applicant:

1. Has the legal authority to apply for Federal assistance, and the institutional, managerial and financial capability (including funds sufficient to pay the non-Federal share of project costs) to ensure proper planning, management and completion of the project described in this application.

2. Will give the awarding agency, the Comptroller General of the United States, and if appropriate, the State, through any authorized representative, access to and the right to examine all records, books, papers, or documents related to the award; and will establish a proper accounting system in accordance with generally accepted accounting standards or agency directives.

3. Will establish safeguards to prohibit employees from using their positions for a purpose that constitutes or presents the appearance of personal or organizational conflict of interest, or personal gain.

4. Will initiate and complete the work within the applicable time frame after receipt of approval of the awarding agency.

5. Will comply with the Intergovernmental Personnel Act of 1970 (42 U.S.C. §§ 4728-4763) relating to prescribed standards for merit systems for programs funded under one of the nineteen statutes or regulations specified in Appendix A of OPM's Standards for a Merit System of Personnel Administration (5 C.F.R. 900, Subpart F).

6. Will comply with all Federal statutes relating to nondiscrimination. These include but are not limited to: (a) Title VI of the Civil Rights Act of 1964 (P.L. 88-352) which prohibits discrimination on the basis of race, color or national origin; (b) Title IX of the Education Amendments of 1972, as amended (20 U.S.C. §§ 1681-1683, and 1685-1686), which prohibits discrimination on the basis of sex; (c) Section 504 of the Rehabilitation Act of 1973, as amended (29 U.S.C. § 794), which prohibits discrimination on the basis of handicaps; (d) the Age Discrimination Act of 1975, as amended (42 U.S.C. §§ 6101-6107), which prohibits discrimination on the basis of age; (e) the Drug Abuse Office and Treatment Act of 1972 (P.L. 92-255), as amended, relating to nondiscrimination on the basis of drug abuse; (f) the Comprehensive Alcohol Abuse and Alcoholism Prevention, Treatment and Rehabilitation Act of 1970 (P.L. 91-616), as amended, relating to nondiscrimination on the basis of alcohol abuse or alcoholism; (g) §§ 523 and 527 of the Public Health Service Act of 1912 (42 U.S.C. 290 dd-3 and 290 ee-3), as amended, relating to confidentiality of alcohol and drug abuse patient records; (h) Title VIII of the Civil Rights Act of 1968 (42 U.S.C. § 3601 et seq.), as amended, relating to nondiscrimination in the sale, rental or financing of housing; (i) any other nondiscrimination provisions in the specific statute(s) under which application for Federal assistance is being made; and (j) the requirements of any other nondiscrimination statute(s) which may apply to the application.

7. Will comply, or has already complied, with the requirements of Titles II and III of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970 (P.L. 91-646) which provide for fair and equitable treatment of persons displaced or whose property is acquired as a result of Federal or federally assisted programs. These requirements apply to all interests in real property acquired for project purposes regardless of Federal participation in purchases.

8. Will comply with the provisions of the Hatch Act (5 U.S.C. §§ 1501-1508 and 7324-7328) which limit the political activities of employees whose principal employment activities are funded in whole or in part with Federal funds.

9. Will comply, as applicable, with the provisions of the Davis-Bacon Act (40 U.S.C. §§ 276a to 276a-7), the Copeland Act (40 U.S.C. § 276c and 18 U.S.C. §§ 874), and the Contract Work Hours and Safety Standards Act (40 U.S.C. §§ 327-333), regarding labor standards for federally assisted construction subagreements.

10. Will comply, if applicable, with flood insurance purchase requirements of Section 102(a) of the Flood Disaster Protection Act of 1973 (P.L. 93-234) which requires recipients in a special flood hazard area to participate in the program andto purchase flood insurance if the total cost of insurable construction and acquisition is $10,000 or more.

11. Will comply with environmental standards which may be prescribed pursuant to the following: (a) institution of environmental quality control measures under the National Environmental Policy Act of 1969 (P.L. 91-190) and Executive Order (EO) .11514; (b) notification of violating facilities pursuant to EO 11738; (c) protection of wetlands pursuant to EO 11990; (d) evaluation of flood hazards in floodplains in accordance with EO 11988; (e) assurance of project consistency with the approved State management program developed under the Coastal Zone Management Act of 1972 (16 U.S.C. §§ 1451 et seq.); (f) conformity of Federal actions to State (Clear Air) Implementation Plans under Section 176(c) of the Clear Air Act of 1955, as amended (42 U.S.C. § 7401 et seq.); (g) protection of underground sources of drinking water under the Safe Drinking Water Act of 1974, as amended, (P.L. 93-523); and (h) protection of endangered species under the Endangered Species Act of 1973, as amended, (P.L. 93-205).

12. Will comply with the Wild and Scenic Rivers Act of 1968 (16 U.S.C. §§ 1271 et seq.) related to protecting components or potential components of the national wild and scenic rivers system.

13. Will assist the awarding agency in assuring compliance with Section 106 of the National Historic Preservation Act of 1966, as amended (16 U.S.C. 470), EO 11593 (identification and protection of historic properties), and the Archaeological and Historic Preservation Act of 1974 (16 U.S.C. 469a-1 et seq.).

14. Will comply with P.L. 93-348 regarding the protection of human subjects involved in research, development, and related activities supported by this award of assistance.

15. Will comply with the Laboratory Animal Welfare Act of 1966 (P.L. 89-544, as amended, 7 U.S.C. 2131 et seq.) pertaining to the care, handling, and treatment of warm blooded animals held for research, teaching, or other activities supported by this award of assistance.

16. Will comply with the Lead-Based Paint Poisoning Prevention Act (42 U.S.C. §§ 4801 et seq.) which prohibits the use of lead based paint in construction or rehabilitation of residence structures.

17. Will cause to be performed the required financial and compliance audits in accordance with the Single Audit Act of 1984.

18. Will comply with all applicable requirements of all other Federal laws, executive orders, regulations and policies governing this program.

| SIGNATURE OF AUTHORIZED CERTIFYING OFFICIAL | TITLE |
|---|---|
| Bernard J. Turnock MD | Director |
| **APPLICANT ORGANIZATION** | **DATE SUBMITTED** |
| Illinois Department of Public Health | 8/10/90 |

Form Approved through 9 30 91
OMB No. 0937-0189
Burden Est.: 5 min. to 15 min.

# CHECKLIST

NOTE TO APPLICANT: Complete and forward this sheet with your application.

Type of Application

☒ NEW ☐ Noncompeting Continuation ☐ Competing Extension ☐ Supplemental

CHECKLIST

- ☒ Proper Signatures and Dates (Item 18 on face page and reverse side of appropriate assurances page).
- ☒ Human Subjects Certification (when applicable). on file
- ☒ Staff and Position Data (biographical sketch(es) with job description when required).
- ☒ Intergovernmental review under E.O. 12372 if required by the State.
- ☒ Civil Rights Assurance on File with HHS (45 CFR 80). on file
- ☒ Assurance Concerning the Handicapped on File with HHS (45 CFR 84). on file
- ☒ Assurance Concerning Sex Discrimination on File with HHS (45 CFR 86). on file
- ☒ Debarment Certification (45 CFR Part 76).
- ☒ Drug-Free Workplace Certification (45 CFR Part 76).

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A private, nonprofit organization must include evidence of its nonprofit status with the application. Any of the following is acceptable evidence:

- ☐ (a) A reference to the organization's listing in the Internal Revenue Service's most recent cumulative list of organizations.
- ☐ (b) A copy of a currently valid Internal Revenue Service Tax exemption certificate.
- ☐ (c) A statement from a State taxing body or the State Attorney General certifying that the organization is a nonprofit organization operating within the State and that no part of its net earnings may lawfully inure to the benefit or any private shareholder or individual.
- ☐ (d) A certified copy of the organization's certificate of incorporation or similar document if it clearly establishes the nonprofit status of the organization.
- ☐ (e) Any of the above proof for a State or national parent organization, and a statement signed by the parent organization that the applicant organization is a local nonprofit affiliate.

If an applicant has evidence of nonprofit status on file with an agency of PHS, it will not be necessary to file similar papers again, but the place and date must be indicated.

Previously filed with: _____ on _____
(date)

---

Name, title, address and telephone number of official in business office to be notified if an award is made.

Thomas F. Long Senior Toxicologist 217/782-5830
Illinois Department of Public Health
525 W. Jefferson St. Springfield, IL 62761

Name, title, address and telephone number of official responsible for carrying out the proposed project.

Linda Cohen - Office of Health Protection 217/782-3984
Illinois Department of Public Health
525 W. Jefferson St.
Springfield, IL 62761

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If this is an application for continued support, include: (1) the report of inventions conceived or reduced to practice required by the terms and conditions of the grant; or (2) a list of inventions already reported; or (3) a negative certification.

Proposal for Lead Exposure Study

NL Industries/Taracorp NPL Site
Granite City, Madison County, Illinois

## I. SUMMARY

The Illinois Department of Public Health (IDPH) is requesting the assistance of the Division of Health Studies of the Agency for Toxic Substances and Disease Registry (ATSDR) in evaluating the exposure to inorganic lead compounds of individuals residing in the area surrounding the NL Industries/Taracorp NPL site (Taracorp) in Granite City, Illinois. The purpose of this grant is multifold: 1) to determine if blood lead levels in sensitive populations in the affected area are elevated when compared to health guidelines and a control population, 2) to determine if blood lead levels correlate to environmental lead exposures while controlling for obvious confounding factors (e.g., occupation, smoking, etc.), 3) to determine through questionnaire and observation which factors (behavioral and environmental) are most important in determining individuals at risk, and 4) to determine if lead exposure can be detected in populations by use of biomarker testing. Information derived from this study can obviously be used to advise sensitive populations of the need for medical follow-up, but primarily this study will be of use in discerning the relationship and importance of various environmental parameters in influencing lead body burden. Additional uses include testing and validation of new methods of evaluating lead exposure in individuals. Such a study has practical benefits for Illinois and other states given the ubiquity of lead as an environmental contaminant and the degree of hazard posed to those exposed (particularly children). If a discernible and significant trend is detected as a result of any portion of the study, further and more detailed epidemiologic or biomedical studies of populations at risk at this and similar sites will be considered.

## II. BACKGROUND

### A. HISTORY

The Taracorp site is located in a mixed industrial/residential area within the city limits of Granite City, Madison County, Illinois and immediately adjacent to the cities of Madison and Venice. This site, a former secondary lead smelter, has contributed to substantial off-site, residential soil contamination by lead and associated metals as a result of the deposition of airborne lead emissions from eighty years of active smelting, surface run-off, and fugitive dust emissions from contaminated on-site surface soil and slag piles. Soil testing

by IDPH, the Illinois Environmental Protection Agency (IEPA), and the United States Environmental Protection Agency (USEPA) has determined that lead contamination in excess of background levels (approximately 60 parts per million) and state standards (200 parts per million) exists throughout the residential, commercial, and industrial properties in Granite City, Madison, and Venice that adjoin the site or used lead-contaminated waste from the site as fill. It is estimated that an area in excess of five square miles around the smelter site has been potentially affected by emissions from the facility. The actual area affected by lead contamination may be larger when additional off-site disposal practices are considered. Additionally, the size of the affected area will grow or shrink depending on what level of lead in soil is considered by regulatory agencies to be indicative of site-related contamination. The population within the affected area may number as high as 7,000 to 8,000 again depending on the size of the area influenced by site emissions and the hazard posed to exposed individuals as defined by the lead content of the soil. The most sensitive segment of the population (children between six months and six years of age) comprise between five and ten percent of the population. Playgrounds, day-care centers, schools, and a hospital exist within the area of concern.

The Taracorp site was placed on the National Priorities List (NPL or Superfund) by USEPA in the early 1980s. The site is bound by 16th Street on the north and east, State Street on the south, and railroad tracks on the west (Figure 1). The neighboring properties are composed mainly of operating or defunct industrial concerns, although residential properties are adjacent to Taracorp on the east and within a few blocks on the north, south, and west (Figure 2). Metal refining, fabricating, and associated activities were conducted at the site until 1903, when a secondary lead smelting operation was started. The smelter produced sheet lead, lead solder, shotgun pellets, lead wool, lead pipe, powdered lead, and secondary lead ingots. The smelter ceased operations in the early 1980s as a result of repeated violations of air and water discharge permits. Solid waste generated by smelting was disposed of on-site in a slag pile. At the present time, the Taracorp slag pile covers more than three acres, reaches a height of 40 feet, and weighs an estimated 250,000 tons. The lead content of the slag is as high as 30 percent. The waste pile consists primarily of blast furnace slag, lead bearing fines, and battery case materials. While the site is fenced, the waste pile is basically uncontrolled and subject to leaching, surface run-off, and wind erosion. Smaller slag piles, originating from Taracorp and associated with the operations of the adjacent St. Louis Lead Recyclers, also contribute to environmental degradation in the area. ATSDR has completed a Preliminary Health Assessment of the Taracorp site (Attachment 1). IDPH is in the process of developing a Full Health Assessment in cooperation with ATSDR. A 1983 study of the

area by IEPA and IDPH is included as Attachment 2 to provide further background information.

## B. DEMOGRAPHICS

According to the 1980 Census, the population of Granite City was 36,815 of which 98% were white. The population of Madison was 5,915 of which 58% were white. The population of Venice was 3,480 of which 33% were white. The total number of children under five years of age in the three municipalities was reported as 3,301 and the number between five and nine years of age was reported as 3,857. The area is highly dependent on heavy industry as an economic base and with the decline in manufacturing jobs, the population has also declined. It is estimated that the population has dropped between 10 and 15 percent since 1980. The socioeconomic status of the majority of the population is lower to middle class. The 1980 median household income in Granite City was $17,880, in Madison $13,031 and in Venice $9,750. The percentage of individuals below the poverty level in 1980 was 10.7 (Granite City), 17.9 (Madison), and 25.0 (Venice). The percentage of individuals completing high school in 1980 was 57.6 (Granite City), 43.7 (Madison), and 42.8 (Venice). These population characteristics appear likely to have remained relatively stable since 1980.

Depending on how the area contaminated by emissions from Taracorp is defined, the population potentially affected may number as high as 8,000 in areas of Granite City, Madison, and Venice. Based on discussion with local officials and school representatives, the number of children in this area under age nine is estimated to be between 400 and 600 with those under age five comprising about an equal number. An accurate census of the sensitive population(s) has yet to be conducted.

## C. CHARACTERIZATION OF THE SITE PRIOR TO STUDY

### 1. Air

Originally attention was drawn to this site as the result of repeated violations of the National Ambient Air Quality Standard (NAAQS) for lead. Throughout the late 1970s and early 1980s, air lead levels at the air monitor closest to the Taracorp site (15th and Madison Streets) regularly exceeded the 1.5 mcg/cu.m NAAQS standard for lead. The highest quarterly average recorded was 7.3 mcg/cu.m during the final months of 1981 (1981 yearly average of 3.03 mcg/cu.m). Based on these violations and other infractions of state and federal environmental regulations, Taracorp was denied an operating permit for their smelter. Smelting operations ceased in 1983 and air lead levels have remained well below the lead NAAQS ever since. In the last reported year (1988), the average level of lead in the air measured at the 15th and Madison Streets monitor was 0.26

mcg/cu.m while the two monitors further to the east measured 0.12 and 0.13 mcg/cu.m, respectively. Despite the vast improvement in air quality since 1982, the smelter was in operation for over 80 years. It was not subject to even marginal environmental controls for the majority of that time. The predominant wind direction is from the north through the west (70%) which would result in air deposition in the residential areas to the east and south of the site and consequent soil contamination by lead in these areas. Fugitive dust emissions from the waste piles and contaminated on-site surface soils continue to occur and may elevate air lead levels locally and lead to off-site soil contamination through dust deposition.

2. Soil

As the result of deposition of air emissions generated by active smelting and fugitive dust emissions from surface soils and slag piles, surface run-off from the site, tracking of lead-contaminated materials off-site by traffic, and the disposal of lead bearing wastes off-site, the soil in and around the site is contaminated to varying degrees with lead. On-site soils have shown concentrations of lead ranging from 1,500 to 48,000 parts per million (ppm) while the slag pile is estimated to contain up to 300,000 ppm. Off-site soil samples were collected from residential yards and gardens and analyzed for lead by IDPH, IEPA, and USEPA in the early 1980s. Lead concentrations ranged from 27 to 5,400 ppm (mean = 1,087 ppm, median = 675 ppm, n = 48). In 1988, IDPH conducted additional soil sampling in the area as part of an area-wide lead study. Soil lead concentrations in off-site soils ranged from 106 to 9,493 ppm (mean = 1,030 ppm, median = 905 ppm, n = 40).

For the most part, sampling revealed that soil lead levels were highest around the perimeter of the site with concentrations decreasing with increasing distance from the site. Relatively high soil lead levels were detected in the residential soils immediately to the east of the site. Samples were not taken near roads or close to houses to avoid biasing the results by including soil potentially influenced by lead from automotive exhaust and lead paint. A map containing the results of the soil sampling conducted in the early 1980s and an isopleth of estimated soil concentrations based on this sampling is included as Figures 3 and 4.

3. Water

All homes in the Granite City, Madison, and Venice area are served by a public water supply which utilizes the Mississippi River as its water source. This water supply is tested at regular intervals by IEPA and meets all drinking water standards. Many of the homes in the affected area are, however, of older construction, perhaps contemporary of the facility. The

possibility exists that the service connection or water distribution system in some homes utilizes lead pipe and/or lead solder. Plumbing of this sort may compound the lead exposure to individuals utilizing such water for drinking and cooking. The existence, extent, and significance of lead plumbing in this areas has not been established.

Private wells are known to exist in the area, but appear to be largely limited to industrial process water wells. Based on private well surveys conducted in Granite City for different purposes, it appears unlikely that individual home-owners utilize area ground water as a source of potable water. The few private wells found in Granite City are reportedly used solely for lawn and garden watering, car and pet washing and related outdoor activities. The overall poor quality of area ground water makes it unlikely that it would make a desirable drinking water supply. Analysis of water samples from site monitoring wells have not detected high levels of lead or other site-related contaminants in the ground water underlying the site. Lead concentrations have not exceeded 20 parts per billion. Additionally, the direction of ground water flow is primarily south-southwest, toward the Mississippi River and away from the majority of residential property.

There are two dominant surface water bodies in the area. The Mississippi River is approximately one mile to the west and is a source of drinking and process water, sport and commercial fishing, transport, and recreation. It is also the major surface water discharge point as well as a point of discharge and recharge for area ground water. Horseshoe Lake, an oxbow remnant of the Mississippi River's former channel, lies approximately one mile to the southeast of the site, and is primarily a recreational area (Horseshoe Lake State Park). Based on evidence so far developed neither surface water body is likely to be affected by this site. Liquid waste from Taracorp or surface run-off may have entered the sanitary or storm sewer system, but Granite City's waste water discharge into the Mississippi River meets state and federal water quality standards. Ground water, which would discharge primarily to the Mississippi River, does not appear to be markedly contaminated by leaching from surface soils or the slag pile.

4. Household Exposure

As previously mentioned, many of the homes in the affected area are older. The possibility exists that lead-based paints were used at some time on the exterior or interior surfaces. The existence and extent of lead paint in these homes has not been determined, but may contribute markedly to the lead contamination of soils and dusts, and to the exposure of individuals, particularly children, occupying these homes.

Likewise, house dust from homes in the affected area has not been sampled to determine the lead content. Previous studies have demonstrated house dust can contain as much or more lead as exterior soils as a result of chipping paint, tobacco smoke, hobbies, occupation, and airborne or tracked-in soil (Attachment 3). Given the amount of time spent indoors, house dust may be a more important source of lead than exterior soils in this regard.

5. Food

Overall, diet probably is the single largest source of lead exposure to individuals. Concern was raised over the effect of airborne lead emissions and elevated soil lead on the lead content of home-grown fruit and vegetables in the neighborhoods surrounding the site. During the characterization of off-site contamination carried out in the early 1980s, a limited number of vegetable and soil samples from area gardens were collected and analyzed for lead. The results of this sampling is included as Table 1. The number and type of specific vegetable samples are too small to draw any firm conclusions; however, it does appear that the soil lead concentration does influence the lead concentration in the plant tissue. Information on the number of gardens in the area, the type of plants grown, and the relative percentage of home-grown fruits and vegetables in individual diets are unknown. Soil and other environmental factors influencing plant uptake of lead are also unknown. The significance of dietary lead to overall lead exposure in this setting has also not been determined.

6. Human

The Taracorp site has been the focus of considerable attention and concern over the past decade. At least three screenings of potentially exposed populations have been conducted since the late 1970s. Two of these studies were conducted by IDPH. The first, in late 1982, sampled primarily residents of Granite City and Madison while residents of Venice were sampled in late 1983. The studies were undertaken as a result of concern over the high lead concentrations measured in air while the smelter was in operation. The results of the blood lead and erythrocyte protoporphyrin (EP) testing are as follows (both measured in micrograms per deciliter):

1982

| | N | Blood Lead (mcg/dl) | | | EP (mcg/dl) | | |
|---|---|---|---|---|---|---|---|
| Ages | | Range | Mean | Median | Range | Mean | Median |
| 0-5 | 47 | 1-37 | 13.2 | 11 | 1-76 | 31.9 | 15.5 |
| 6-10 | 3 | 8-24 | 14 | 10 | 1-24 | 14.3 | 18 |
| 11-20 | 4 | 7-16 | 10.3 | 9 | 11-21 | 14.0 | 12 |
| 21-60 | 45 | 2-28 | 9.6 | 8 | 1-53 | 16.5 | 17 |
| Total | 99 | 1-37 | 11.5 | 10 | 1-76 | 17.5 | 15.5 |

1983

| Ages | N | Blood Lead (mcg/dl) Range | Mean | Median | EP (mcg/dl) Range | Mean | Median |
|---|---|---|---|---|---|---|---|
| 0-5 | 31 | 4-27 | 9.1 | 7 | 21-56 | 31.2 | 30 |
| 6-10 | 10 | 5-10 | 6.9 | 6 | 19-33 | 27.4 | 28.5 |
| 11-20 | 36 | 4-18 | 7.9 | 7.5 | 14-79 | 31.9 | 28 |
| 21-60 | 47 | 5-25 | 9.0 | 7 | 16-93 | 34.6 | 33 |
| 61+ | 12 | 4-13 | 7.4 | 6 | 29-51 | 36.5 | 34 |
| Total | 136 | 4-27 | 8.4 | 7 | 14-93 | 32.5 | 32 |

No attempt was made to correlate blood lead levels to exterior soil lead levels although some attempt to identify interior lead sources were made in individuals identified as having high blood lead (at the time defined as 30 mcg/dl). The utility of this work in assessing the hazards posed by environmental lead has been called into question due to the small numbers of individuals (especially children) sampled and the time of year (late fall) that the sampling was conducted.

D. CURRENT SAMPLING

The only on-going environmental sampling in the area consists of the three ambient air monitors located in Granite City. The closest of these to the site is located atop a building at 15th and Madison Streets approximately 100 yards southeast of the site. The air monitoring results for 1989 will be available shortly.

Monitoring of the public water supply is carried out regularly. The sampling is conducted post-treatment and prior to it entering the distribution system. No water samples from the tap are currently analyzed. The information thus derived is of limited utility to assess the possible lead exposure as a result of lead plumbing or solder in homes.

As Madison County has no local health department, no on-going childhood blood lead screening program exists. Some individuals in the affected area may receive health care at area WIC (Women, Infants, and Children) Clinics supported by IDPH. These clinics may sample blood for lead and EP. The existence or extent of this information has not yet been determined, but could serve as a valuable, albeit limited, supplemental source of information. Additionally, some individuals have on their own sought out blood tests based on concern generated by USEPA's proposed clean-up of the site.

## III. STUDY PROPOSAL

### A. INTRODUCTION

The potential hazards posed by lead in the home and environment are undisputed and current research indicates that lead may have deleterious effects at lower levels than previously thought, particularly in children's mental development, and that a large number of children may be at risk from lead (1). There is a question, in fact, as to whether there is a threshold for the adverse effects of lead. The degree to which lead in soil poses a hazard and the magnitude of that hazard is not as clear, and may depend on numerous socioeconomic and behavioral factors in addition to the lead content of soil. The Centers for Disease Control (CDC) has stated that blood lead levels, primarily in the young, may be elevated as the result of contact with soil containing lead in excess of 500 parts per million. The concern over soil lead concentrations arises over the observation that direct soil contact may result in inadvertent soil ingestion by children which may in turn significantly increase lead exposure. Some studies have linked children's blood lead to the lead levels in exterior and interior soils and dusts. The significance of this relationship appears to vary widely (Attachment 3), but a positive relationship is seen in all cases. It is obvious that potential confounders were not completely considered in many of these studies, but they do often illustrate the interdependence between environmental sources and socioeconomic factors in determining lead body burden and consequent hazard.

Lead effects on nervous system developments were recognized early in this century, but were assumed to be reversible until the 1940s when researchers reported permanent effects on learning and behavior in children exposed to lead (2). The expanding knowledge of the adverse effects of lead has been accompanied by a continual reduction in the acceptable body burden of lead as defined by blood lead levels. The acceptable level of lead in children's blood has dropped from 60 mcg/dl in the 1950s to the present 25 mcg/dl (3). Based on the most recent research, CDC is considering dropping the acceptable blood lead level yet again. The number being considered is 15 mcg/dl, a level already adopted by some states. However, as with earlier blood lead levels, this does not imply that a that a safe level of blood lead has been identified. In the last few years, a number of studies have been conducted and are still on-going which indicate that children suffer neurological and developmental deficits at blood lead levels well below the current standard of 25 mcg/dl (4-7). These studies seem to indicate that pre-natal and post-natal exposures at levels of 10-15 mcg/dl are associated with low birth weight and reduced growth rate as well as with cognitive deficits and reduction in neurologic development as measured by IQ. Needleman and his co-workers (8-10) have suggested that if children with elevated blood lead experience an average drop of four IQ points,

the number of individuals with IQs below 80 would treble and those with IQs above 125 would vanish.

Studies also indicate that the fetus is at risk from environmental lead exposure as well as the young child (11, 12). Pregnancy and lactation may mobilize the lead from maternal bone stores in a manner identical to calcium mobilization. Lead will cross the placenta and the fetus may serve as a lead sink for mobilized maternal lead. While much attention has focused on the hazard of lead to the fetus and child, there are additional studies indicating risk to adults as well. Some studies have indicated that high blood lead levels in middle-aged males may increase their risk of developing hypertension (13). It has also been suggested that lead may aggravate osteoporosis in post menopausal women when bone lead stores as released by the demineralization processes (12).

Since the shutdown of smelting operations at Taracorp in the early 1980s, the primary routes of lead exposure to area residents has been through the ingestion and inhalation of contaminated soils and dusts. Except for the possible contribution of maternally-derived lead from long-term female residents of the area, the only important source of site-related lead exposure to the most sensitive segment of the population (pre-school children) has been directly or indirectly through soil and dust contamination. This exposure consists primarily of direct ingestion of contaminated soil by children, transfer of contaminated dusts to mouth by hands, swallowing of inhaled airborne particulate too large to penetrate to the lung, ingestion of food or liquids contaminated by lead-containing soils or dusts, and inhalation of lead-contaminated particulates small enough to penetrate to the lung. Additional exposures to lead may be occurring through old exterior and interior paints, plumbing, dietary sources (particularly canned foods), tobacco smoke, and parental occupations or hobbies. Given the air emissions originating from the smelter and the long half-life of lead in the body, long-time residents of the area would have received a significant lead exposure. Such individuals may be at risk for certain chronic disease states as suggested by previous studies. In the case of women of child-bearing years, pregnancy and lactation may serve to mobilize bone lead to the detriment of the fetus and neonate. There is a considerable body of animal and epidemiological evidence pointing to the serious chronic health problems posed by lead exposure; however, the relative importance of different environmental lead sources is at present unclear.

## B. HYPOTHESIS

While the soil around the Taracorp site is clearly contaminated with lead as a result of the facility operations and waste disposal practices, the contribution of this lead contamination to the overall body burden in exposed individuals is unclear.

The null hypothesis to be tested in this study is that lead body burden as measured by blood lead positively correlates to one or more sources of environmental lead exposure. An additional hypothesis under consideration is that exposure to lead can be detected by the use of one or more biomarkers in a series developed by ATSDR for use in health studies (Attachment 4).

## C. STUDY DESIGN

This study is to be divided into two distinct phases. The first phase consists of developing community awareness and cooperation for the study and a census of individuals living within the affected areas of Granite City, Madison, and Venice as defined by the boundaries of the proposed remedial action. Because this area represents only a small portion of the three adjoining municipalities and because it is suspected that significant population redistibution has occurred since the 1980 census, it is necessary to determine the actual numbers, age distribution and residences of prospective study participants. The second phase of the study will occur after collation of the census data and consists of collecting biological specimens (blood and urine) environmental samples, and questionnaire data from a subset of individuals identified in the census.

### 1. PHASE I

#### a. Community Contact

Prior to the start of the study, a public meeting will be held to announce the study, explain its purpose and how it will be carried out, address questions and concerns, and request the cooperation of the citizens. The Taracorp situation has generated considerable community interest and concern on the part of the citizens, local leaders, and the media. A study of the type proposed has been repeatedly called for by elected officials, civic leaders, the citizens, and the potentially responsible parties. It is expected that this degree of interest will translate to a high participation rate in the study by the citizens. The media interest will also guarantee widespread and favorable coverage for the study. Following the public meeting, further discussions, or meetings will be held with elected officials, civic leaders, local physicians and medical associations, and clergy, and the press to support the study and encourage participation in their community. A mailing list will also be developed from sign-up sheets at the various meetings and from the census itself. Interested citizens or groups, and potential study participants will be kept informed as to the study's progress and time-table by periodic mailings. This list will also be used to ensure that the final report is distributed to all interested parties.

b. Census

The study area consists primarily of the area proposed for remedial action under the USEPA's clean-up plan for the Taracorp site. This area comprises approximately 60 square blocks around the facility. An additional "buffer zone" of one block will be added to ensure complete coverage of the potentially exposed population.

The census will be based on town maps of the three municipalities and is anticipated to take place in the fall of 1990 or spring of 1991. Workers will be assigned a number of blocks to complete with additional blocks assigned as the census is completed. The census will be conducted from 9:00am to 9:00pm Monday through Saturday. Work on Sundays will be considered if necessary.

Prior to beginning the census, workers will be provided training in the study's overall purpose and goals, how to introduce themselves and obtain cooperation from area residents, issues of confidentiality, how to complete the appropriate forms, practice sessions to ensure familiarity and comfort with the forms, role playing exercises to prepare for potential problems, and associated administrative detail. Written instructions on proper filling out of forms will also be provided to workers for referral.

The census will be carried out utilizing two forms adapted from a similar study conducted by the Colorado Department of Health (CDH) in cooperation with ATSDR. The first form (Attachment 5) is the Block Survey form and contains a diagrammatic representation of the block upon which street names and lots can be indicated. Information gathered on this form will include block number, lot number (referring to the diagram), street address, type of building (single family, multiple family, business, vacant, etc.), acceptance of census interview, interviewer comments, and data. The Census form (Attachment 6) itself will be used to record attempted interviews and outcome of these attempts as well as necessary demographic information (number of individuals, age, sex, relationships, length of residence at the address, length of residence in the area, etc.).

If an adult (18 years or older) is at home, the interviewer will complete the Census form or make arrangements to do so at a later time. If no one or a minor is at home, information will be left explaining the study and that the interviewer will return. It will also provide the residents with a phone number and contact person if they wish to set up an interview appointment or give the information over the phone.

Each household in every block of the study area will be contacted at least four times on different days at different times before it is assigned a no contact status. Information regarding "no contact" households will be solicited from neighbors as a last resort. Areas with high percentages of "no contacts" will be

visited again for a fifth contact or telephoned if a number can be located. Vacant housing can be confirmed visually for the most part, but its status will also be confirmed by neighbors.

Data quality will be assured by spot checks of workers conducted during the interview process and by random contact callbacks to determine the accuracy of the information. Census information will be placed into a computer database for ease of manipulation. Lists of households and individuals eligible for inclusion in the study will be generated using this database.

c. Study Population

It is intended to request participation in the study by all children 18 years or younger, by all pregnant women, and by a random sample of all remaining adults (older than 18 years). This plan may have to be reconsidered if the results of the census determine the numbers of individuals eligible for inclusion under such a study is excessive. At a minimum, however, the study population would consist of all children 0 to 6 years old, all pregnant women, and a random sample of the remaining population. Adults selected for inclusion in the study will be asked to participate and sign a consent form. Parents or guardians of minors selected for inclusion in the study will be asked to allow their children's participation and to sign a consent form on their behalf.

Because of the industrialized nature of the area, it is felt important to establish a blood lead baseline for the area. Telephone numbers will be selected at random from the directories for the three municipalities. Once it is determined that the households lie outside the study area, but within areas of similar demographic make-up, residents will be contacted by phone and asked to provide information similar to that on the census form. If one or more members of the household meets the requirements for inclusion and agrees to participate in the study, an appointment will be made for a blood sample to be taken. These samples will be analyzed for lead and EP analyses with the results reported back to the individual and his/her physician. Individuals found to have elevated blood lead levels would be referred to the IDPH Childhood Lead Poisoning Program or the IDPH Adult Blood Lead Registry for additional testing and follow-up. The exact number of individuals necessary to establish a baseline will be determined prior to implementation of the study in consultation with ATSDR, IDPH, and the contracting statistician(s).

2. <u>PHASE II</u>

a. Questionnaire Design And Administration

The questionnaire to be used for this study will be based on questionnaires developed by ATSDR and its contractors for similar

studies conducted in Leadville and Leeds (Attachment 7 and 8) in order that consistency be maintained in these studies. The questionnaire will elicit information on demographics, socioeconomic status, occupational data, and behavioral characteristics for each individual and household participating in the study. The questionnaire will be reviewed by ATSDR, IDPH, and the contracting epidemiologist(s) to ensure completeness and accuracy. The questionnaire will be pilot-tested in another locale prior to its use in the study to identify any problems and to ensure that the questions elicit the proper response from participants. As with the census, workers will be trained in interviewing techniques and questionnaire administration. This orientation will include study purpose and goals, introductions, familiarization with the various forms, confidentiality, role-playing to prepare for difficult situations, and techniques to avoid the introduction of interviewer bias into the process.

Special training will also be given to workers who will conduct environmental sampling. This will again include study purpose and goals, but will primarily be directed toward standardizing sampling techniques, proper use and calibration of sampling equipment, avoiding cross-contamination of samples, maintaining chain-of-custody, and proper labeling and filling out of associated forms.

Individuals for inclusion in the study will be selected based on their meeting a pre-determined criterion (e.g. age, reproductive status, etc.) or at random. Solicitation for participation in the survey will be made by telephone and appointments for interview and sampling set up with those willing to participate. Where no telephone exists, personal visits will be made to request participation in the study and to set up appointments for interview and sampling. Attempts to contact households containing potential participants will be made throughout the course of the study before the household will be considered a "no contact". Appointments will be scheduled at the participant's convenience from 9:00am to 9:00pm Monday through Saturday with Sundays held in reserve if needed.

The interview team will consist of four individuals: a pediatric phlebotomist to explain the sampling, the consent form, and to draw the blood, an interviewer to administer the questionnaire and two environmental samples (indoor and outdoor) to collect dust, soil, water, and vegetable samples and to measure lead in paint. It is intended that two such teams be in the field during the survey period.

b. Biological Sampling

Trained phlebotomists will obtain two vacutainers of blood from each participant. Sufficient blood will be drawn to ensure a proper ratio of anti-coagulant to blood and to allow all requested analyses to be performed. The filled tubes will be

inverted several times to ensure complete mixing and labeled with the date and a pre-assigned laboratory identification number. This number will be placed on all associated paper work. These samples will be refrigerated after collection.

The blood samples will be logged in a chain-of-custody list as they are returned from the interviews. This chain-of-custody will then be maintained throughout the handling and shipping process. One container of blood will be delivered to a local certified medical laboratory for lead, FEP, and CBC analyses while the other container will be shipped to the CDC laboratory for biomarker analysis.

Additionally, urine samples will also be requested of study participants (excluding infants). The sampling procedure will be explained to the participant or an adult in the household. Written instructions and a collection bottle will be left at the home. The sample will be picked up the following day, logged into chain-of-custody and frozen for shipment. This specimen will be shipped to the CDC laboratory for biomarker analysis.

c. Environmental Sampling

Environmental sampling will consist of both interior and exterior samples. The interior sampling will be conducted prior to the exterior sampling to avoid introduction of materials from the outside into the house. Inside the home the following samples will be taken: 1) a composite floor dust sample from selected areas of the home, 2) a composite dust sample from the window sills in the same areas, 3) two water samples (first draw and fully flushed, 4) handwipes of the study subject(s), and 5) XRF lead readings on painted surfaces. Outside the home, the following samples will be taken: 1) two surface soil scrapings from an exposed dirt surface in a play area (as defined by the parents or guardian) and in the front of the home (preferably near the main entrance), 2) two composites of five soil core samples taken from the front and back yards, 3) at homes with gardens, a composite of five soil core samples from the garden and, where available, one sample each of a root crop (e.g., potato, carrot, etc.), a fruiting crop (e.g., tomato, pepper, etc.), and leafy crop (e.g., spinach, lettuce, etc.), and 4) XRF lead readings of exterior painted surfaces.

d. Interior Sampling

i. Floor Dust Sampling

A variety of methods have been used by other investigators to collect household dust. Most often the sampling device consists of a battery operated vacuum pump and a filter cassette. The pump is operated at a standard speed and a measured area of the floor sampled by repeated passes over the surface area. This methodology was used by the Colorado Department of Health and

ATSDR in the Leadville study (14). Recently USEPA developed a high volume surface sampler for the collection of house dust (15). This device consists of an intake nozzle, cyclone and filter. This device operates at approximately 9.5 L/sec and can collect more than two grams of floor dust from a rug in an average clean home in less than four minutes. The device can collect approximately 30% of dust less than 150 micrometers from plush carpet and over 90% of total dust from a bare floor. It retains over 95% in the cyclone with the remainder on the filter. The use of this device for dust sampling in this study is being explored.

Whatever collection device is used in this sampling, the sampling procedure will be conducted in a similar manner. In each room sampled (kitchen, living room, den or playroom, main entrance, and subject's bedroom), the sample area will be standardized by use of a template cut to a uniform size. Three separate unidirectional passes will be made over the sample area in different dirrections. Following completion of the composite floor sample in each household, the sample will be removed, sealed, labeled, and placed in a plastic bag. The sampling device will be cleaned between each composite sampling. The overall condition of the rooms in terms of dust accumulation will be noted.

ii. Window Sill Sampling

Window sill dust will be sampled in each room utilizing similar methodology with the exception of the use of a template. The entire sill area will be sampled and area of the sample determined by measurement. Following completion of the composite sill sampling in each household, the sample will be removed, sealed, labeled, and placed in a plastic bag. The sampling device will be cleaned between each composite sampling. The condition of the sill (peeling or chipping paint, dust, cracks or openings, etc.), the windows most often left open, the presence of air conditioning and storm windows will also be noted.

iii. Hand Lead Sampling

Hand lead may be more closely correlated to blood lead than dust or soil lead. For this reason samples of dislodgeable lead will be taken from the hands of each study subject. A pre-packaged alcohol swab, folded in half, will be used to wipe the subject's hands, back, front, and between the fingers. The swab will then be unfolded and the process repeated. The sampler will wear rubber gloves during the sampling to avoid contaminating the swab. Following the sampling, the swab will be placed in a sealable plastic bag and labeled. The condition of the hands and the last time they were washed will be noted.

iv. Water Sampling

Two water samples will be taken, both a first draw and fully flushed. The samples will be taken in a pre-prepared acid washed

500 milliliter polyethylene bottle containing one milliliter concentrated nitric acid. The bottles will remain tightly closed until just prior to the sampling and will be taken from the kitchen cold water tap. The fully flushed sample will be taken at the same time as the rest of the samples. The tap will be allowed to run for five minutes prior to this sampling. The first draw sample presents some problems in terms of convenience to the residents, but arrangements will be made to return first thing the following morning to gather this sample. Since the reason for this inconvenience involves the reluctance to allow the householder to handle the acid bottle, it is being determined whether the water sample can be acidified after sampling without altering the analytical results. If this can be done, a sample bottle can be left with the residents with instructions on how to perform the first-draw water sampling. These samples could then be collected the following morning. All sample bottles will be filled, capped immediately, and labeled. An inspection of the plumbing will also be conducted to ascertain the presence of lead pipes or solder.

v. XRF Analyses

The presence of lead in painted interior surfaces will be determined using portable XRF lead-in-paint analyzer. The XRF device will be calibrated at the beginning of each day's work and immediately before each residence to be sampled. Lead foil standards form the National Bureau of Standards will be used in this calibration. In various areas within each residence the XRF will be held to the wall or other flat surface and three consecutive readings taken, with each reading requiring about 30 seconds. The three readings and locations of the various sampling sites will be noted along with general information on the appearance and condition of the paint.

The specific sites for XRF analysis will vary according to the location of painted surfaces within a home. Any painted surfaces, particularly those in poor condition, may be analyzed. The exact number of readings will vary from house to house. Walls and trim in the same areas as sampled for dust will be done where paint exists. Additionally painted trim, doors and walls in the other rooms of the house or entries may be done. An occasional piece or pieces of painted furniture (cribs, high chairs, play pens, etc.) will be sampled.

e. Exterior Sampling

i. Exterior Soil Scrapings

Exterior soil scrapings will be used to assess lead content of exterior dusts and will be collected from both front and back

yards. The samples will be taken following the procedures of Bornschien et. al. (16) and consist of using a stainless steel curved spatula to scrape off the loose soil dust of the sampling area. Ideally, a spot in the back yard that serves as a play area will be selected for the back yard sample. The front yard sample will be taken from an area near the home's main entrance. A minimum of 100 milligrams for each sample will be collected and any obvious extraneous materials (twigs, pebbles, insects, etc.) avoided. The spatula will be cleaned between each sample. The location of these samples will be noted on a diagram occupying the sample sheet. Notation will be made of any paint chips in or around the area. If the exposed soil is large in area, several samples will be taken from different areas and composited. The samples will be placed in small plastic bags and labeled.

ii. Soil Core Sampling

A composite sample of five different soil core samples will be taken from both the front and back yard using a standard laboratory steel cork borer and punch. One sample each will be taken in the four corners of the yard and one in the center in both front and back yards. The locations of each sample will be placed on a diagram occupying the sample sheet. A one inch deep sample will be taken at each location with a pre-measured borer and the soil pushed out of the borer with the punch into a small plastic bag. Once all five samples of the composite are collected the bag will be sealed and labeled. The borer and punch will be cleaned between composite samples.

iii. Garden Soil and Vegetable Sampling

In homes with gardens, an additional composite soil sample will be taken along with representative vegetables. A composite of five soil samples will be taken in each garden in a manner similar to that described for the front and back yard soil core samples except the depth of the sample will be four inches. The soil will again be placed into a small plastic bag. After all five samples are collected, the bag will be sealed and labeled. The borer and punch will be cleaned between composite samples. Produce from these gardens representing root, fruiting, and leafy vegetables will be collected. The total number of samples from each garden will not exceed three. These vegetables may have to be collected at a later date or at different times to account for different ripening times. A sufficient amount of each representative vegetable will be collected, excess soil removed, wrapped in aluminum foil, sealed, and labeled. The samples will be frozen for analysis at a later date.

iv. XRF Analyses

XRF analyses of exterior painted surfaces will proceed in a manner similar to that conducted inside the house. The XRF

device will be calibrated prior to use using the NBS lead foil standards. On the exterior, painted siding and entry trims will be measured. Other areas of possible concern will include paint on outbuildings (garages, sheds, etc.) paint on window trim, shutters, porches, railings and outside furniture. The locations and descriptions of all areas samples with notations as to the condition of the paint and the occurrence of paint chips on the ground beneath.

f. IRB Submission

Due to the use of human subjects in this study, this proposal will be submitted to the Institutional Review Board (IRB) utilized by IDPH for approval. If required, approval by the IRB of any contracting organization will also be sought.

g. Quality Control

Quality control procedures for the biologic and environmental samples will be developed in conjunction with ATSDR prior to the beginning of the study, but in general will conform to the CDC and USEPA QA/QC procedures utilized by ATSDR in similar studies they have undertaken across the country (Attachment 9 and 10). In terms of follow-up and data control, all forms and samples will be tagged using labels generated prior to the study and assigned a unique identifier. This number will consist of two digits indicating the year, followed by a four digit study identification code, followed by a four digit personal code, and a character code identifying sample type. Once a subject agrees to participate in the study, a file will be opened which will contain all forms associated with household (consent forms, questionnaires, sampling forms, etc.). All forms will be labeled and the remaining labels will be placed into the file to be used to label the biologic and environmental samples collected. Forms returned after interview and sampling will be visually inspected for completeness and consistency of response. A number of subjects will be selected at random and partially re-interviewed to ensure initial interviews were conducted properly.

After completion of the survey, each file will be reviewed for completeness. Missing data or forms will be identified and completed before submission for coding if possible.

Results of biologic and environmental sampling analyses will be reviewed to ensure that all parameters analyzed meet the laboratory QA/QC requirements. Copies of those results, together with the completed questionnaires, will be sent to CDC for keypunching and editing. Data will be keypunched twice for verification and a variety of logical checks made to test data accuracy. Corrections will be made as necessary and a SAS data set generated and returned to the IDPH for further data analyses.

h. Statistical Analysis

Statistical analyses of this data set will be performed using the most current release of SAS (Version 5.18-SAS Institute, Cary, NC) and will consist of three phases. Data analyses may be restricted to age groups at highest risk for lead exposure in this area. This would include primarily zero to six years of age or, because of their potential high exposure due to mouthing behavior, those zero to three years of age.

The first phase consists of a univariate analysis approach. The univariate analysis will include descriptive statistics such as means, standard deviations, and percentiles for all continuous variables. More specifically, the statistics will be gathered on the outcome variable (all blood lead concentrations) and exposure variables such as soil lead, dust lead, hand lead, etc. The next analysis is based upon an assumption of normality; therefore a check of normality is needed. If the data are found not to be normally distributed, then the data will be transformed. As is often the case in such studies, the blood and environmental levels may not be normally distributed. If that is the case in this instance, statistical analyses will be performed using log-transformed blood lead values and environmental sampling results. Biological and environmental values that are below the analytical detection limit will be assumed to exist at one-half of the detection limit for all statistical analyses.

The first objective of the analysis is to determine if elevated blood lead concentrations exist in the study population (or a subset of it). This will be accomplished through the use of t-tests and analysis of variance in comparison to the control population, the results of similar studies elsewhere, or reference values. Frequency distributions will be performed for all behavioral and/or categorical variables.

The second phase of analysis consists of a bivariate approach. This bivariate analysis is dependent to a large degree upon the results of the t-tests. The bivariate analysis will address the second objective by identifying environmental and/or behavioral factors that can be associated with elevated levels of blood lead. A correlation matrix will be generated among all continuous variables to ascertain the relationship among themselves. Upon review of the correlation matrix, the analysis will then proceed to develop a simple linear regression model of blood lead concentration versus one independent (or exposure) variable.

The final phase of the analysis will be a multivariate approach. This analysis will be performed to determine which independent (or exposure) variables are the best predictors of blood lead concentration. Based upon several model-building techniques, the analysis will result in a multiple linear regression model. This model will predict the average blood lead concentration given several independent (or exposure) variables.

All planned statistical analyses will be subject to review and change by ATSDR and IDPH according to the needs of the study.

i. Privacy And Notification

The final report, and all such reports made available to the public, will not contain laboratory results or findings in association with any individual subject or person and only report aggregate data. All records containing personal identifiers and information will be maintained in accordance with the Privacy Act of 1974. Individual biological and environmental sample results will be provided to the individual or their parent(s) or legal guardian when the results become known. Data collected in this study will be shared with ATSDR.

Under the Privacy Act of 1974 (5U.S.C. Section 552a[e]), as well as by state statute, Federal and State employees or their contractors are responsible for protecting data collected on identifiable persons or organizations when the supplier of that data has not given consent to the agency or agencies to make that data public. This responsibility for protection extends to unauthorized visual observation, accidental loss, or theft. This implies that confidential records should be kept out of sight of unauthorized persons, stored in locked cabinets or locked rooms when not in use, copied only when absolutely necessary, and stored in sealed containers when archived. Statistics derived from such confidential data will be reported without inadvertent disclosure about particular study subjects.

After analytical results are received from the laboratories, they will be reviewed and specific recommendations made, where appropriate. The results, interpretations, and recommendations will be transmitted in letters to the subject by IDPH. These letters will include telephone numbers and contact names at IDPH and ATSDR for additional questions or information.

In cases where a test result reveals a finding of immediate significance to a person's health, that person and a physician or health care provider designated by that person will be notified immediately by IDPH and ATSDR. Lead cases identified in this study will be referred for follow-up and intervention to the appropriate IDPH divisions (Division of Family Health for Children and Division of Epidemiologic Studies for Adults).

j. Follow-up Studies

Should the results of this study indicate the need for additional or expanded health studies, IDPH will propose additional studies of this population for submission. The use of in vivo tibial XRF evaluation shows promise as a measure of long-term lead accumulation which has been of concern in this situation. Additional health endpoints involving neurobehavioral testing or nerve conduction velocity testing of sensitive populations may also be considered for further evaluation by IDPH. Expanded epidemiologic studies of this population may also be considered by IDPH in conjunction with ATSDR.

## D. PERSONNEL AND BUDGET

### 1. PROJECT PERSONNEL

The size and complexity of the proposed study will require IDPH to contract out the majority of the work. An appropriate contract organization has not yet been, but is currently being sought. The ideal contractor will have medical, toxicological, and environmental expertise and have experience with studies of this type. When a qualified contractor is identified, the appropriate information will be submitted to ATSDR for their concurrence in the selection.

State personnel will donate their services and time toward completion of this study. Overall project oversight will be performed by the Division of Environmental Health under the Manager of the Toxicology Program, Thomas F. Long. Day-to-day oversight and participation will be provided by the Regional Toxicologist, David R. Webb. Review of the epidemiologic aspects of the study and planned statistical analyses will be provided by the Division of Epidemiologic Studies under Holly Howe. Supplemented IDPH personnel can be assigned as needed to this project. Complete staff rosters and resumes will be submitted upon contractor selection. Additionally, analytical support in terms of QA/QC evaluation and some supplemental analyses may be obtained from the IDPH Laboratories if necessary.

### 2. STUDY BUDGET

The following grant budget estimate is based on anticipated costs associated with the various aspects of the proposed study. Personnel costs are based on average hourly rates for various activities, and estimated time expenditure. Costs for biologic sampling and analyses are based on quotes provided by local testing laboratories and the estimated number of samples. Environmental analyses costs are based on quotes from local environmental testing laboratories and the estimated number and type of environmental samples.

#### a. Federal Monies

PERSONNEL COSTS

| Number | Title | Hours | Hourly Rate | Total |
|---|---|---|---|---|
| 1 | Project Coordinator | 500 | $ 75 | $37,500 |
| 1 | Physician/Epidemiologist | 60 | $125 | 7,500 |
| 2 | Project Managers | 250 | $ 75 | 37,500 |
| 1 | Statistician | 80 | $ 75 | 6,000 |
| 5 | Census Takers | 120 | $ 10 | 6,000 |
| 2 | Phlebotomists | 300 | $ 10 | 6,000 |
| 2 | Interviewers | 500 | $ 10 | 10,000 |
| 4 | Environmental Samplers | 500 | $ 10 | 20,000 |
| | | | Total | $130,500 |

BIOLOGIC SAMPLING

| | |
|---|---|
| 1750 Child blood samples (exposed and ~~central~~) for lead, FEP, and CBC @ $40/sample | 70,000 |
| 750 Adult blood samples (exposed and control) for lead, FEP and CBC @ $40/sample | 30,000 |
| Additional sample tubes for biomarker study | 2,000 |
| Collection bottles for urine samples | 2,000 |
| Total | $104,000 |

ENVIRONMENTAL SAMPLING

| | |
|---|---|
| 4 Dust Samples (floor, sill, exterior front, and exterior back) @ $25/sample for 750 homes | 75,000 |
| 2 Soil Samples (backyard and front yard) @ $25/sample for 750 homes | 37,500 |
| 1 Soil Sample (garden @ $25/sample for 100 gardens) | 2,500 |
| 1 Hand Wipe (dislodgable lead dust) @ $25/sample for 1500 samples | 37,500 |
| 2 Water Samples (first draw and fully flushed) @ $20/sample for 750 homes | 30,000 |
| 3 Garden Samples (root, fruit, and leafy vegetables) @ $25/sample for 100 gardens | 7,500 |
| Total | $190,000 |

MISCELLANEOUS COSTS

| | |
|---|---|
| Rental or leased XRF machines (2) @ $50/day for 60 days | 3,000 |
| Sampling supplies and equipment (bags, gloves, spatulas, filters, bottles, etc.) | 6,000 |
| Rental or leased dust collection devices (2) @ $50/day for 60 days | 3,000 |
| Lodging (400 man/nights @ $40/night) | 16,000 |
| Travel (interstate and intrastate) | 9,000 |
| Printing and mailing costs | 4,000 |
| Telephone | 2,500 |
| Total | $43,500 |

Total Study Costs (Federal)

| | |
|---|---|
| Personnel | 130,500 |
| Biologic Sampling | 104,000 |
| Environmental Sampling | 190,000 |
| Miscellaneous | 43,500 |
| Total | $468,000 |

b. States Monies (in kind services)

Personnel Costs

| | | | |
|---|---|---|---|
| 1 | Toxicologist/Manager 6 months (10%) | 3500/month for | 2,100 |
| 1 | Environmental Epidemiologist 6 months (10%) | 3000/month for | 1,800 |
| 1 | Regional Toxicologist 6 months (20%) | 2200/month for | 2,640 |
| 2 | Sanitarians 6 months (20%) | 1900/month for | 4,560 |
| | | Total | $11,100 |
| Fringe Benefits (18.9%) of Personnel Costs) | | | 2,098 |
| | | Total | $13,198 |

Miscellaneous

| | | |
|---|---|---|
| Travel and Lodging | | 2,500 |
| Supplies | | 2,500 |
| Supplemental Laboratory Services | | 15,000 |
| | Total | $20,000 |

Total Study Costs (State Monies)

| | |
|---|---|
| Personnel | 13,198 |
| Miscellaneous | 20,000 |
| Indirect Costs | 5,644 |
| Total | $38,842 |

This budget represents the upper bound cost of the proposed study. The final costs are likely to lower.

## IV. CONCLUSIONS

The Taracorp site represents an exposure of long-standing to a cumulative hazard among a relatively stable population. The

hazard is largely confined to a single contaminant and a single environmental pathway. A number of sensitive sub-populations exist in the affected area and a unique opportunity exists to study the effects on these individuals utilizing new and promising methodologies. IDPH is requesting assistance from ATSDR not only in terms of a grant of financial support but also in terms of advice and participation in developing and implementing appropriate study design, selection of study population size and type, exposure and medical testing, and data analysis and interpretation.

## V. REFERENCES


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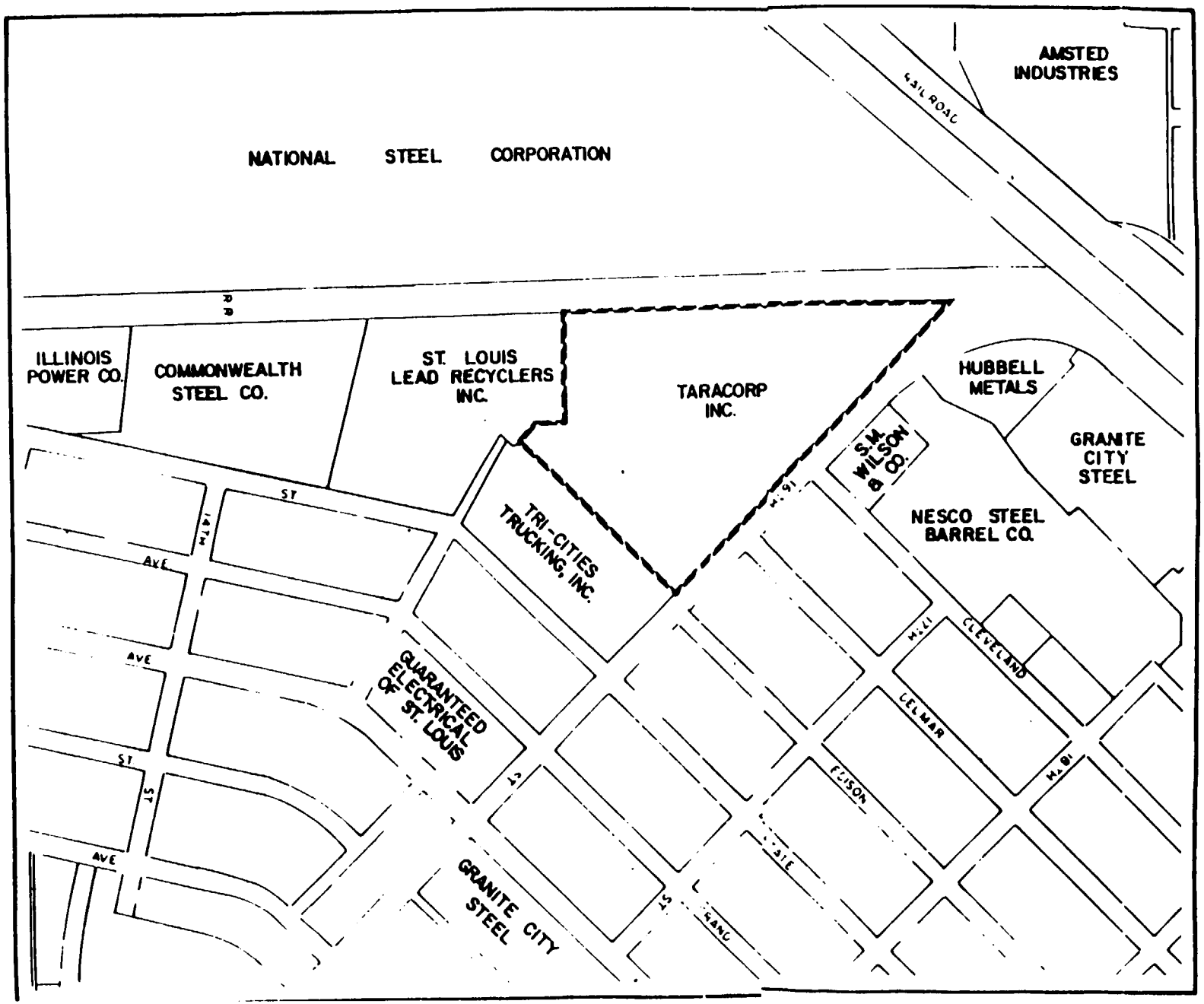
Figure 1



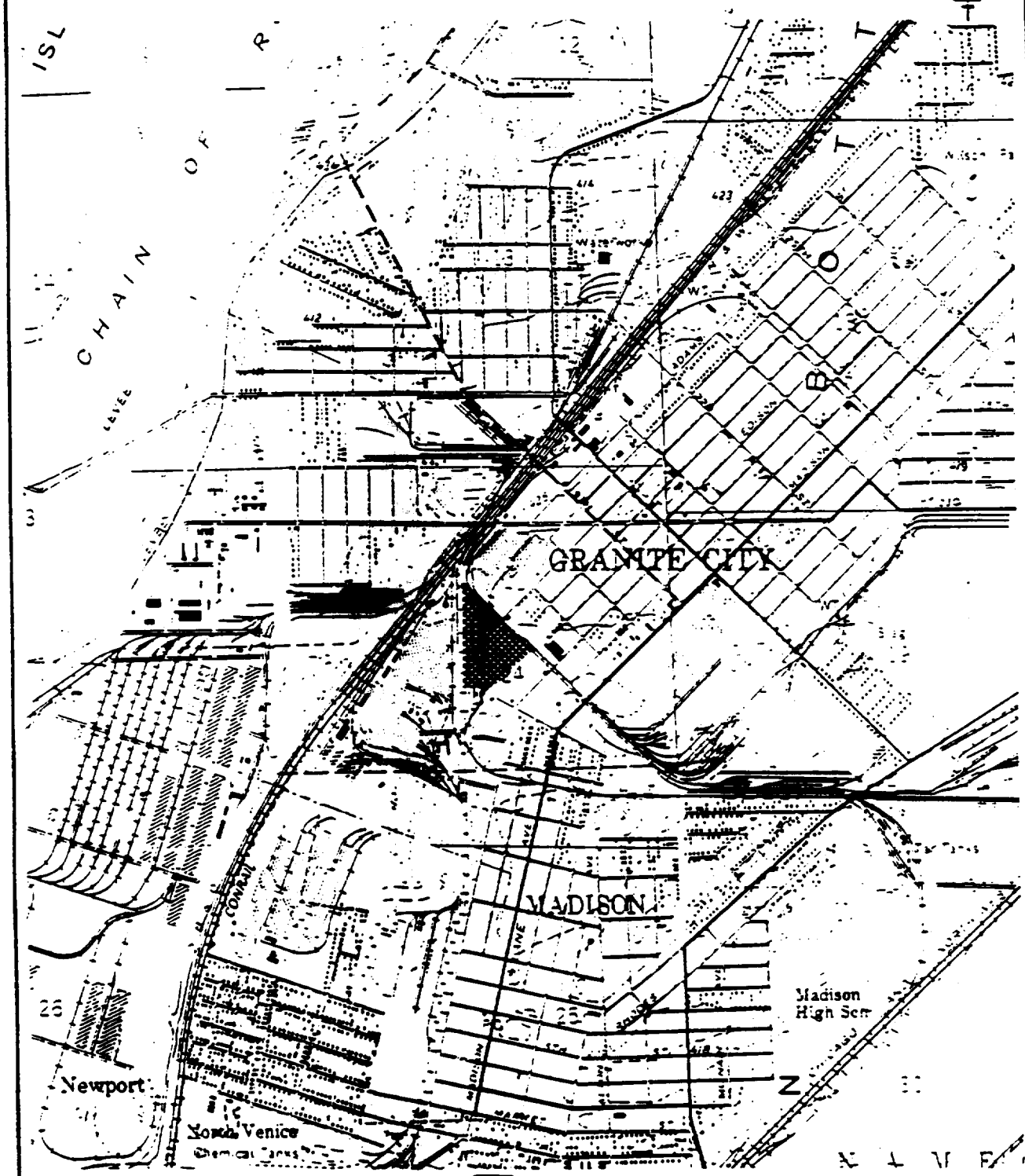

NL INDUSTRIES
GRANITE CITY SITE
GRANITE CITY, ILLINOIS

ADJACENT PROPERTIES MAP

SCALE
300 0 300
FEET

NL INDUSTRIES
GRANITE CITY SITE
GRANITE CITY, ILLINOIS

# LOCATION MAP




NOTE: MAP ADAPTED FROM U.S.G.S. GRANITE CITY QUADRANGLE

Figure 3

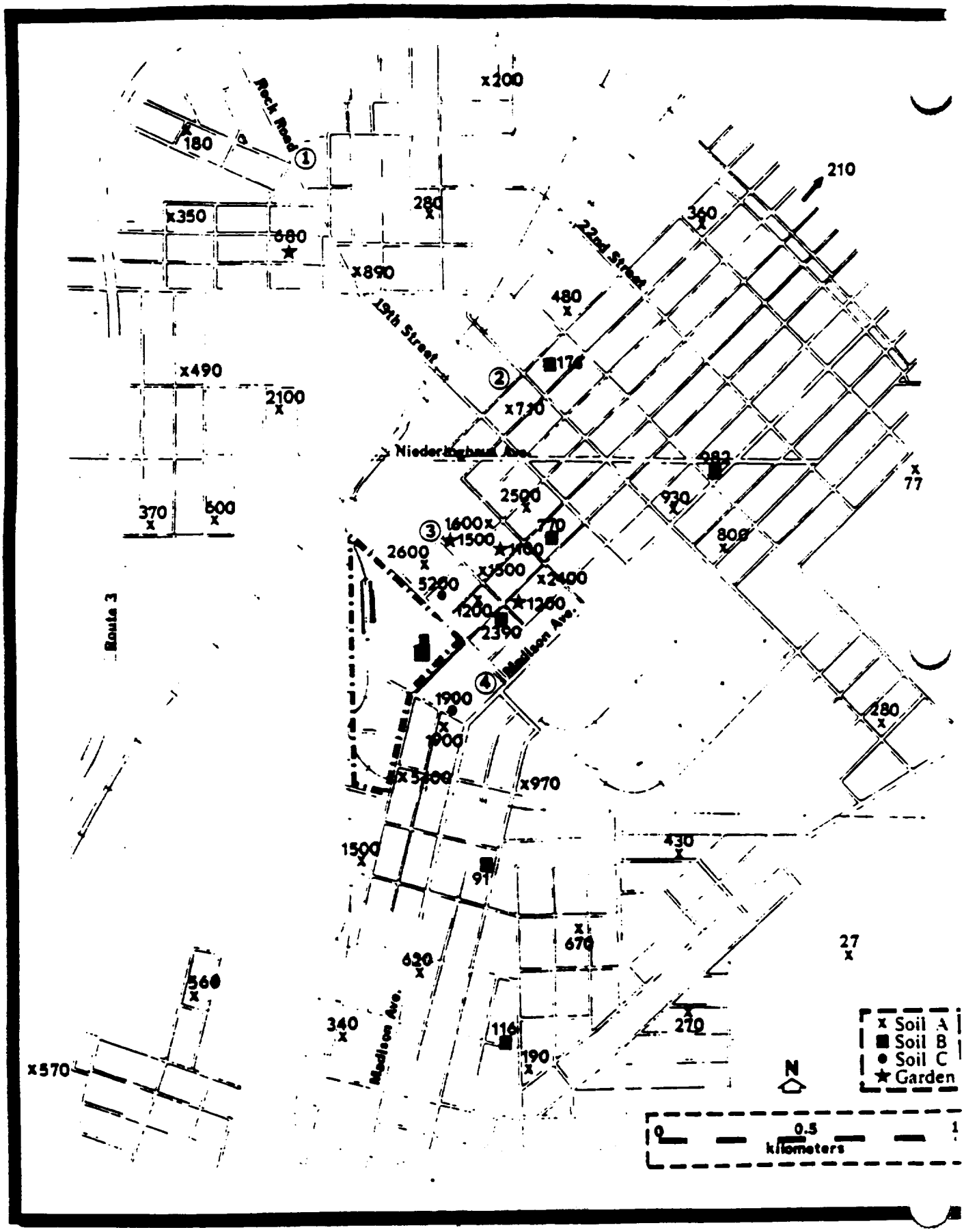

Rock Road
19th Street
22nd Street
Niederlinghaus Ave.
Madison Ave.
Route 3
x Soil A
■ Soil B
● Soil C
★ Garden
N
0
0.5
1
kilometers

Figure 4

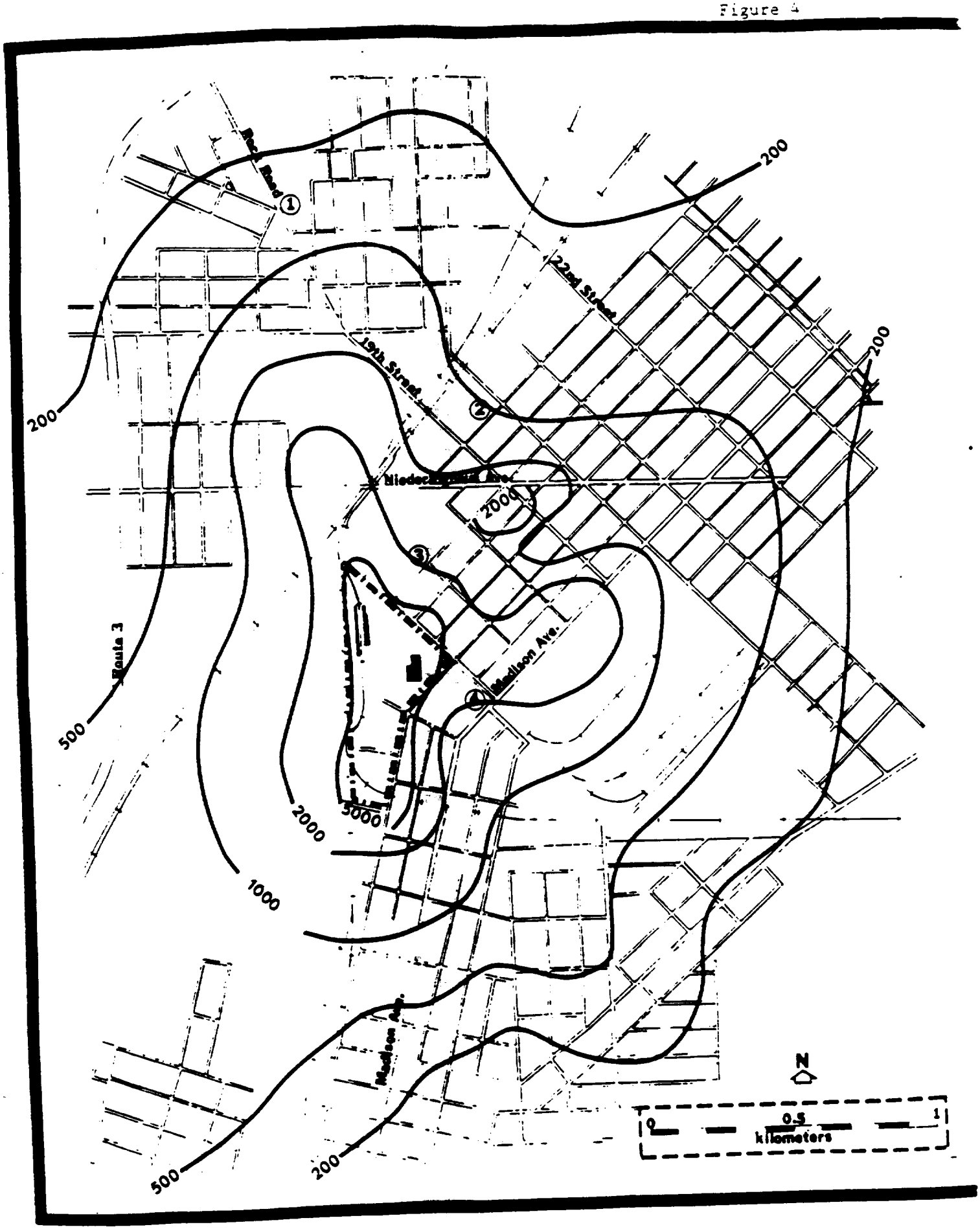

Red Road
22nd Street
19th Street
Madison Ave.
Route 3
200
500
1000
2000
5000
N
0
0.5
1
kilometers

Table 1

| Site # | Sample | Pb |
|---|---|---|
| 1 | Peppers | 0.119 |
| | Tomatoes | 0.122 |
| | Banana Peppers | 0.134 |
| | Cauliflower (frozen) | 0.198 |
| | Soil | 1500 |
| 2 | Eggplant | 0.048 |
| | Tomatoes | 0.066 |
| | Okra | 0.128 |
| | Carrots | 0.392 |
| | Soil | 1100 |
| 3 | Tomatoes | 0.035 |
| | Cabbage | 0.633 |
| | Peppers | 0.053 |
| | Cucumber | 0.083 |
| | Soil | 1200 |
| 4 | Okra | 0.020 |
| | Banana Peppers | 0.010 |
| | Tomatoes | 0.005 |
| | Peas | 0.002 |
| | Soil | 53 |
| 5** | Pepper | 0.007 |
| | Tomatoes | 0.007 |
| 6 | Okra | 0.014 |
| | Banana Peppers | 0.010 |
| | Soil | 97 |
| 7 | Tomatoes | 0.028 |
| | Squash | 0.124 |
| | Okra | 0.641 |
| | Beets | 0.087 |
| | Beet Leaves | 0.058 |
| | Soil | 680 |

* Soil values are based on dry weight
** Site #5 is located across the street from Site #6. Therefore a separate soil sample was not taken.

Attachment #1

# Abstract for

NL INDUSTRIES/TARACORP LEAD SITE

GRANITE CITY, MADISON COUNTY, ILLINOIS

JANUARY 18, 1989

# THE ATSDR HEALTH ASSESSMENT: A NOTE OF EXPLANATION

Section 104(i)(7)(A) of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended, states "...the term 'health assessment' shall include preliminary assessments of potential risks to human health posed by individual sites and facilities, based on such factors as the nature and extent of contamination, the existence of potential pathways of human exposure (including ground or surface water contamination, air emissions, and food chain contamination), the size and potential susceptibility of the community within the likely pathways of exposure, the comparison of expected human exposure levels to the short-term and long-term health effects associated with identified hazardous substances and any available recommended exposure or tolerance limits for such hazardous substances, and the comparison of existing morbidity and mortality data on diseases that may be associated with the observed levels of exposure. The Administrator of ATSDR shall use appropriate data, risk assessments, risk evaluations and studies available from the Administrator of EPA."

In accordance with the CERCLA section cited, ATSDR has conducted this preliminary health assessment on the data in the site summary form. Additional health assessments may be conducted for this site as more information becomes available to ATSDR.

# THE ATSDR HEALTH ASSESSMENT: A NOTE OF EXPLANATION

Section 104(i)(7)(A) of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended, states "...the term 'health assessment' shall include preliminary assessments of potential risks to human health posed by individual sites and facilities, based on such factors as the nature and extent of contamination, the existence of potential pathways of human exposure (including ground or surface water contamination, air emissions, and food chain contamination), the size and potential susceptibility of the community within the likely pathways of exposure, the comparison of expected human exposure levels to the short-term and long-term health effects associated with identified hazardous substances and any available recommended exposure or tolerance limits for such hazardous substances, and the comparison of existing morbidity and mortality data on diseases that may be associated with the observed levels of exposure. The Administrator of ATSDR shall use appropriate data, risk assessments, risk evaluations and studies available from the Administrator of EPA."

In accordance with the CERCLA section cited, ATSDR has conducted this preliminary health assessment on the data in the site summary form. Additional health assessments may be conducted for this site as more information becomes available to ATSDR.

PRELIMINARY HEALTH ASSESSMENT
NL INDUSTRIES/TARACORP LEAD SITE
GRANITE CITY, ILLINOIS
January 18, 1989

Prepared by:
Office of Health Assessment
Agency for Toxic Substances and Disease Registry

## Background

The NL Industries site is a National Priorities List (NPL) Site located in Granite City, Madison County, Illinois. Metal refining, fabricating, and associated activities were conducted at the site until 1903, when the secondary lead smelting operation was started. The secondary smelting operations produced a number of products, including sheet lead solder, shotgun lead pellets, lead wool, lead pipe, powdered lead, and secondary lead ingots. Historically, solid waste generated by the manufacturing facilities was stored on-site in a slag storage area. Liquid wastes were discharged through process sewers, which ran under the site, to the municipal sewer system.

NL Industries, Inc., formerly the National Lead Company, bought the site in 1928. Battery recycling facilities were installed at the site in the 1950's. In August 1979, NL Industries, Inc. sold the site to Taracorp, Inc., who operated the secondary lead smelting operation until 1983, when it filed for protection from its creditors under Chapter 11 of the Federal Bankruptcy Code. Taracorp is presently operating metal refining and fabricating facilities at the site.

A waste pile, composed of blast furnace slag, lead bearing fines in 55-gallon drums, and battery case material, is located on site. The volume of the pile is approximately 85,000 cubic yards. In addition, smaller piles, which were associated with the adjacent St. Louis Lead Recycler's operation, comprise 6300 cubic yards.

## Environmental Contamination and Physical Hazards

### A. Environmental Contamination

Groundwater in the vicinity of the site is contaminated with elevated levels of sulfates (288 mg/l), dissolved solids (993 mg/l), and manganese (0.99 mg/l).

The waste piles on site were sampled; analyses revealed elevated levels of lead (15,000-286,000 mg/kg), arsenic (620-4100 mg/kg), copper (5,800-11,000 mg/kg), and iron (21,000-340,000 mg/kg). Runoff from the waste pile has shown concentrations of lead ranging from 3 to 40 mg/l.

On-site soils have shown lead concentrations ranging from 1550-48,300 mg/kg. Soil lead sampling demonstrated surface soil lead concentrations in residential neighborhoods within 2000 feet east of the site at approximately 386-3600 mg/kg. Other areas near the site have shown similar concentrations of lead (400-3000 mg/kg).

The results of quarterly air sampling in the vicinity of the site in 1986 were considerably below the National Ambient Air Quality (NAAQ) standard for lead of 1.5 $ug/m^3$. Lead concentrations were detected in the air at locations near the site ranging from 0.13-0.42 $ug/m^3$.

B. Physical Hazards

There are no known physical hazards present at the NL Industries NPL Site.

Potential Environmental and Exposure Pathways

A. Environmental Pathways

1. Surface Water

The nearest surface water body to the site is the Chain of Rocks Canal, which is located over one mile away. No drainage swales or ditches were observed at the site which would connect storm runoff from the site to this surface water body.

Studies conducted as part of the Remedial Investigation (RI) have evaluated the characteristics of storm water runoff from the waste piles on site. The runoff has contained concentrations of lead in the range of 3-40 mg/l. Runoff from the pile either infiltrates and percolates to groundwater or evaporates.

2. Groundwater

The American Bottoms aquifer underlies the site. This unconfined aquifer is composed of clay, silt, and sand. It extends to at least 35 feet below the surface. Groundwater has been encountered at an average depth of 24 feet below the surface. The site is underlain to a depth of approximately 100 feet by alluvial, glaciofluvial, and glaciolacustrine deposits, which become progressively coarser with depth.

Water within the unconsolidated deposits beneath Granite City is used for industrial purposes. At least 36 private wells have been reported to be within two miles of the site. The RI stated, however, that it was not known whether these wells are used as potable water supplies. The Granite City Water System supplies most of the drinking water to the area residents. It uses the Mississippi River as its water source.

Twelve monitoring wells were installed at and near the site in October 1982. Additional monitoring wells have been installed since this date. Two on-site wells showed elevated concentrations, as compared to background, of sulfates, dissolved solids, arsenic, cadmium, manganese, nickel, and zinc. Off-site monitoring wells located downgradient of the site did not show any contamination at the time of the sampling.

Locally, the groundwater flows in a south-southwesterly direction towards the Mississippi River. Groundwater underlying the site is characterized by elevated levels of dissolved solids, sulfates, and manganese and does not appear to be suitable for development as a potable water supply.

3. Soil

Ninety-eight surface soil samples were taken from 52 locations on and off the site (primarily from off-site areas). Most of the samples were taken at depths of 0-3 and 3-6 inches below grade. Elevated levels of lead were found in the soil.

The waste piles located on the site were sampled and elevated levels of lead, arsenic, copper, and iron were found.

4. Air

The Illinois Environmental Protection Agency (ILEPA) operates several air quality sampling stations in the vicinity of the site and has generated quarterly monitoring data since 1978. Air quality at the monitoring locations near the site has been well within the NAAQ standard for lead.

B. Human Exposure Pathways

Based on the environmental media that have been contaminated at the site, the concentrations of contaminants that were found in these media, and the potentially exposed population near the site, the human exposure pathways of concern at the NL Industries site are as follows:

1. Inhalation of contaminated dust/soil.

2. Ingestion of contaminated soil.

3. Dermal absorption of contaminants found in the soil.

4. Ingestion of contaminated groundwater.

<u>Demographics and Land Use</u>

The site is located within a heavily industrialized section of Granite City, Illinois. Granite City is a community of approximately 40,000

located across the Mississippi River from St. Louis, Missouri. Residential and commercial areas are also located near the site. The site is located adjacent to properties owned by Trust 454, Terminal Railroad Associates, Inc., Illinois Central Gulf Railroad, Chicago and Northwestern Railroad, and Tri-Cities Trucking, Inc. St. Louis Lead Recycler's, Inc. is a tenant of trust 454.

Evaluation and Discussion

Because the soils and waste pile at the site are contaminated with lead and other inorganics, there is the possibility that contaminated soil particulates may become airborne and travel off-site as the result of wind, traffic, remedial activities (i.e., excavating, trenching), or recreational activities (i.e., bike riding). Remedial workers and others that may gain access to the site may also be exposed to contaminants found in the soils via accidental ingestion or dermal absorption while involved in on-site activities.

Because lead has been detected in residential surface soils at elevated levels, children playing in the area may be at special risk from exposure to contaminants because of the cumulative nature of their exposure and the fact that they are the most sensitive subpopulation for lead induced toxicity. In general, lead in soil and dust appears to be responsible for blood lead levels in children increasing above background levels when the concentration in the soil or dust exceeds 500 - 1000 mg/kg (Baker, et al., 1977; Mielke et al., 1984; Angle et al., 1984; Duggan and Inskip, 1985). The concentrations of lead found in the residential areas near the site showed concentrations up to three times higher than these levels.

The water underlying the site does not appear to be suitable for potable uses; however, this possible exposure pathway cannot be dismissed until further information is available. Because it is not known if there are private wells being used for drinking water supplies in the vicinity of the site, there is the possibility that residents are being exposed to site-related contamination via ingestion of contaminated groundwater.

Particulate lead compounds can be absorbed into the body via both the respiratory and gastrointestinal tracts with varying degrees of efficiency. Lead exposure is linked with neurological effects, systemic toxicity, including anemia and other hematologic effects, and reproductive effects.

Conclusions and Recommendations

Based on the available information, this site is considered to be of public health concern because of the risk to human health caused by the likelihood of exposure to hazardous substances via inhalation, ingestion, and direct contact exposures to contaminated soil. There is also the possibility that the human population in the area is being exposed via ingestion of contaminated groundwater.

If further environmental characterization, sampling from on-site areas, or sampling from impacted off-site areas become available, such material will form the basis for further assessment at a later date.

ATSDR recommends the following for the protection of public health near the site:

1. The contamination of residential soil in the vicinity of the NL Industries Site should be accurately evaluated. Such an evaluation should allow for an adequate determination of the levels of exposure of individuals per residence. If residents, specifically children, are indeed exposed to levels of contaminants, namely lead, which may result in adverse health effects, actions should immediately be taken to prevent further exposure.

2. It should be verified that there are no private wells being used as potable water supplies in the vicinity of the site.

3. On-site workers involved in remedial activities should be equipped with adequate personal protective equipment as required by the Occupational Safety and Health Administration (OSHA) and recommended by the National Institute for Occupational Safety and Health (NIOSH).

4. Air monitoring should be continued to insure that concentrations of lead in the ambient air remain below NAAQ standards.

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Attachment #2

# Study of Lead Pollution

in

Granite City, Madison and Venice, Illinois

April 1983

Illinois Environmental Protection Agency
2200 Churchill Road
Springfield, Illinois 62706

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## I) INTRODUCTION

During the last quarter of 1981, the Illinois Environmental Protection Agency's (IEPA's) air pollution monitor at 15th and Madison Streets in Granite City registered an unusually high average of lead. The sudden increase in airborne lead was unexpected because, up until then, the lead levels had been declining at that location. A preliminary investigation based on an analysis of meteorological data indicated that the lead came from the direction of the nearby lead smelter (Taracorp Industries) and a neighboring recycling operation (St. Louis Lead Recyclers). But a check with company officials and other area businesses did not reveal any obvious cause, such as an air pollution control equipment malfunction or a big jump in production. The average lead concentration at this monitoring site has since dropped, but at another monitoring site, it is still higher than the national health standard.

Up until the 1981-82 winter, the Agency thought that equipment and operating improvements at the smelter and the declining amount of lead in car exhausts would combine to bring airborne lead down to an acceptable level. But the jump in the 1981 fourth quarter average indicated that more may need to be done.

The Agency was concerned that the potential existed for another sudden rise in airborne lead and that unidentified sources of lead emissions might prevent the air quality of the area from improving. In mid-1982, the Agency began a more intensive investigation into the sources of lead in the vicinity of the monitor at 15th and Madison. To help pinpoint all the lead sources, another monitor was placed in the area. The Agency also began taking dust samples from open areas, streets and parking lots to get a more complete picture of where the lead was coming from and to assess the extent of contamination.

As part of the study the Agency also tried to determine if lead ingestion by people living in the study area is above recommended limits. Garden vegetable samples were collected, water testing records were reviewed, and soil samples were analyzed.

Another part of the study, conducted in cooperation with the Illinois Department of Public Health (IDPH), focused on the potential health effects of excessive lead levels in the environment.

This study report has been prepared by the IEPA. Participating in the data collection phase of this study with IEPA were the Illinois Department of Public Health, the United States Environmental Protection Agency, the United States Food and Drug Administration and the City of Granite City.

The hazard assessment portion of the study and the health-related recommendations contained in this report were developed by the IEPA in close cooperation with the Environmental Toxicology and the Lead Poisoning Control programs of the Illinois Department of Public Health. Their input and critical review of Section X of this report were particularly helpful.

## II) SUMMARY, FINDINGS AND RECOMMENDATIONS

Although significant contamination of the environment exists in the vicinity of the secondary lead smelter, the preliminary assessment of the IEPA and the IDPH is that a major near-term risk to public health is unlikely to exist provided that ambient air quality levels do not exceed the National Ambient Air Quality Standard and that routine personal health and hygiene measures are followed. However, the high levels of lead found in the soil on and near the smelter site are cause for continued concern. Because uncertainty remains regarding the long-term health implications of these high soil-lead concentrations, prudence dictates that dust control measures be implemented immediately. Further ground water and blood testing planned for the area will indicate what additional pollution control measures are necessary to reduce health hazards.

### A) Blood Samples

1. The Illinois Department of Public Health (IDPH) took blood samples from 97 individuals in 43 households within two miles of the lead smelter in Granite City during November and December 1982.

2. The amount of lead and FEP (a lead-related enzyme) found in the blood samples falls in the range considered to be acceptable by health practitioners. No cases of lead blood poisoning were found, nor were there any excessively high blood lead levels. Blood-lead tests are an indicator for lead exposure during the previous 90 days only. FEP tests, however, are indicative of longer exposures. The IDPH considers a blood-lead level of 30 micrograms per deciliter (ug/dl) or greater, in combination with an FEP level of 50 ug/dl or greater, to be dangerously high. For children six years old or less, the blood-lead samples averaged 10 ug/dl and the FEP levels averaged 17 ug/dl.

3. Forty-six children age six and under were tested. This is not as many as the testing program set out to obtain and not enough to draw broad conclusions about the rest of the children living in the area. The results of the 46 children's blood tests, however, provided no evidence that there are lead-related health problems present in the area. If the blood-lead and FEP levels of children in the survey remained the same in the years to come, these children would not be expected to develop lead-related health problems.

4. Because uncertainty remains in the conclusions drawn from the blood sampling data, the IDPH will continue to offer free blood tests to residents at its Granite City office (4700 Nameoki Road, phone 618/931-4545).

B) Soil Samples

1. Lead levels in the soil in some residential areas are very high. Near the lead smelter two surface soil samples exceeded 5000 parts-per-million of lead.

2. Fifty surface soil samples gathered in Granite City, Madison and Venice indicate that soil out to a distance of one and a half miles from the lead smelter has higher lead content than the levels of 50-100 parts per million found in other communities.

3. Generally, soil within one-half mile of the smelter can be expected to contain 1000 parts per million of lead.

4. Many other studies that have found high lead concentrations in soil have also found high blood-lead levels in people living in the same area. That relationship was not found in this study.

5. The health and hygiene practices listed below are generally recommended for anyone living in an urbanized/industrialized area, but they are particularly important for people living within about one-half mile of the smelter because of the high lead levels in the soil.

   A. Small children, generally six years old or less, should not be allowed to play in dirt. However, normal sport or play activities on dirt areas by children and adults do not need to be restricted.

   B. No one in the area, especially children, should put dirt, dirty hands or dirty objects in their mouths.

   C. Grass or other ground cover should be planted in residential yards where dirt is exposed.

   D. Children should not eat outdoors if they are likely to get soil on food or on their hands while eating.

   E. Everyone should wash their hands and faces thoroughly before eating.

C. Water Samples

1. Four groundwater monitoring wells were drilled by Taracorp at the Agency's request in November, 1982.

2. The initial groundwater samples have shown no significant lead pollution. However, not enough samples from different locations have been taken to draw conclusions. Sampling is continuing.

3. Gra .e City, Madison and Venice do . use groundwater as tneir source of drinking water. Drinking water test results fall well below the State's standard of 50 ug/l for lead.

4. A soil sample taken at the 14-15 foot level while drilling one well revealed an unusually high concentration of lead (2700 parts per million). Samples taken in the same boring at 5, 10, 20, 25 and 30 feet showed lead concentrations no higher than 50 ppm. Further sampling will have to be done to determine the cause of the high lead level at the 15-foot depth which was just above the water table.

5. Surface water runoff goes into the city's storm sewer system and subsequently to the waste water treatment plant. The effluent from the treatment plant meets lead water quality standards.

D. Garden Samples

1. In the fall of 1982 vegetables were taken from seven gardens in Granite City and analyzed in a United States Food and Drug Administration laboratory for lead. Soil samples were taken from each garden to see if a correlation existed between lead in the soil and lead in vegetables.

2. The garden vegetables analyzed included: peppers, tomatoes, banana peppers, cauliflower, eggplant, okra, carrots, tomatoes, cabbage, cucumbers, peas, squash, and beets.

3. Health experts estimate that on the average children 0-2 years old take in approximately 100 ug of lead each day in the food they eat. By the time children reach 8 1/2 years old they are taking in approximately 210 ug each day. The vegetables analyzed in this study showed higher lead levels where soil-lead concentrations were high. However, the levels were still low relative to the normal dietary intakes noted above.

4. Nevertheless, because of the high lead content of the soil, there are several recommendations that people with gardens within one-half mile of the smelter should follow:

   A. All vegetables from home gardens should be washed thoroughly before being eaten.

B. Garden soil should be tested periodically for phosphorous and pH levels. A neutral pH helps inhibit plant uptake of lead, as does an adequate amount of phosphorous.

C. The Madison County Cooperative Extension Service Office (618/656-8400) can advise people on how to collect a proper sample and where to send it for analysis. It will cost approximately $4 to have the phosphorous and pH tested. Additionally, the extension adviser will interpret the test results for gardeners and instruct them on how much lime or fertilizer needs to be added.

E) Air Samples

1. Lead monitoring began in Granite City and the rest of the State in 1978. Since then, the lead monitoring site at 15th and Madison Streets in Granite City has recorded 14 violations of the federal lead health standard (1.5 micrograms of lead per cubic meter of air as a quarterly arithmetic average).

2. The highest quarterly average at 15th and Madison was 7.3 $ug/m^3$, measured in the last quarter of 1981. Prior to that, the highest average was 4.4. Since 1981 the highest quarterly average has been 1.9 $ug/m^3$.

3. Wind speed and direction studies for those days when the highest ambient air concentrations of lead were measured show that the lead was coming from the direction of the Taracorp lead smelter.

F) Lead Source Evaluation

1. The Taracorp facility, which was purchased from N.L. Industries in 1979, is a secondary lead smelter located in Granite City. It takes lead from discarded batteries and other lead bearing wastes and reprocesses it into products such as sheet lead, solder, shot gun pellets, lead wool and lead ingots. The major process emission sources at Taracorp include a blast furnace, a rotary furnace, lead melting kettles and a battery breaker.

2. The smelter property contains a three-acre storage pile of broken batteries, blast furnace slag and other lead waste products.

3. Surface soil samples taken at the rear gate of the Taracorp smelter contained 140,000 to 300,000 parts per million (or 14 to 30 percent) lead.

4. On October 1, 1982, Taracorp Industri filed bankruptcy und Chapter 11 of the Federal bankr tcy laws and is seeking reorganization.

5. St. Louis Lead Recyclers, which began operation in 1980, is adjacent to Taracorp. Since 1982 it has been reclaiming lead from Taracorp's waste pile.

6. The IEPA's preliminary evaluation of these two operations indicates that lead emissions should be reduced. Consistent with this conclusion, the Agency has taken the following related actions:

   A. Denied a recent permit renewal application submitted by Taracorp for its blast furnace and associated equipment. Taracorp has appealed this denial to the Illinois Pollution Control Board.

   B. Coordinated with USEPA to obtain a formal engineering review of Taracorp and St. Louis Lead Recyclers and make recommendations regarding potential control measures. This review has been completed and a report is currently being prepared by USEPA.

   C. Requested the Illinois Attorney General to review the number of environmental law violations found at these sites and to obtain legally binding agreements from the companies regarding the implementation of control measures.

7. Although additional analytical work is underway to further delineate the sources of lead emissions, the IEPA believes that certain dust control measures should be implemented immediately to minimize lead emissions. These measures include: on-site traffic control; the paving or treating of roadways, parking lots and other traffic areas; regular cleaning of paved areas; covering open dirt areas with vegetation; and, fencing to reduce wind erosion. These and other measures, as they are developed, will be incorporated in the Attorney General's enforcement activities.

## III) STATE IMPLEMENTATION PLAN FOR AIR POLLUTION CONTROL

The United States Environmental Protection Agency (USEPA) officially listed lead (Pb) as an air pollutant on March 31, 1976 and proposed regulations for a National Ambient Air Quality Standard (NAAQS) on December 14, 1977. After a lengthy comment period, final designation of a NAAQS of 1.5 micrograms of lead per cubic meter of air (ug $Pb/m^3$) averaged over a calendar quarter was promulgated on October 5, 1978. On the same date, regulations for states to follow in developing a lead pollution control plan were also issued.

The IEPA completed e Illinois State Implementatio lan (SIP) for Lead (Vol. 9 of the Illinois SIP) in February 1981. Sixteen locations in the State were closely examined, but none were judged to present potential health problems, with the exception of the Granite City-Madison-Venice area.

IEPA formally submitted the Lead SIP to USEPA on July 21, 1981 and requested that two congressional townships (R10W, T3N; and R9W, T3N which encompass the civil townships of Venice, Nameoki and Granite City) in Madison County be designated nonattainment. In the March 22, 1982 Federal Register (Vol 47, No. 55) a final rulemaking was published by USEPA stating that the State had adequately demonstrated attainment and maintenance of the NAAQS for lead in all areas of the state except Granite City-Madison-Venice. The State is required to develop a control plan for the area that will ensure attainment and maintenance of the NAAQS. The control program measures implemented subsequent to completion of the Granite City-Madison-Venice lead study will form the basis for revision of the SIP.

The problem in the area is principally related to past and current emissions associated with a secondary lead smelter. This facility is presently owned by Taracorp Industries; however, prior to the fall of 1979, the facility was owned and operated by N.L. Industries. The analyses presented in this report and SIP Volume 9 indicate that current emissions from the facility still significantly contribute to air quality levels exceeding the national lead standard and that residual lead build-up in the soil surrounding the plant also contributes significantly to the ambient lead problem.

## IV) HISTORY OF AFFECTED AREA

The area with significant lead environmental contamination includes southwestern Granite City, northern Madison and northern Venice.

Data on the highest ambient air lead concentrations and the most significant lead emissions has focused attention on a section of land containing two major facilities: Taracorp Industries, a secondary lead smelter; and St. Louis Lead Recyclers, a lead reclamation facility.

Taracorp purchased the existing secondary lead smelter from N.L. Industries (formerly National Lead Company) in August of 1979. N.L. Industries took over the facility from the United Lead Company in 1928. The United Lead Company had acquired the facility from the Hoyt Metal Company in 1903. Most of the smelter is believed to be of original construction.

St. Louis Lead Recyclers came into existence in 1980. The company's original purpose was to reclaim lead from batteries. However, it soon entered an agreement with Taracorp to begin reclaiming lead from Taracorp's waste pile. Reclamation operations on the waste pile began in 1982.

Many other industries are located in the general area but none of them appear to contribute substantially to the lead problem.

## V) PROCESS DESCRI. .ON OF TARACORP AND ST. LOUIS LEAD RECYCLERS

### A) Taracorp

Taracorp is a secondary lead smelter which produces numerous lead products. These products include sheet lead, solder, shot gun lead pellets, lead wool, powdered lead and secondary lead ingots. The facility has a blast furnace (cupola), a rotary furnace, a number of lead melting kettles, a battery breaker operation, a natural gas fired boiler, and air pollution control equipment including several baghouses, cyclones, and an afterburner. A schematic of the Taracorp operation is provided in Figure V-1.

### B) St. Louis Lead Recyclers

St Louis Lead Recyclers reclaims various materials from the Taracorp waste pile. The process consists of the following steps:

1) Material from the waste pile is placed in a dump truck with a frontend loader. The truck is then weighed.

2) The material is then screened and hand sorted. Slag, matte, and trash are loaded back in the truck and reweighed. This weight is subtracted from the weight of material originally removed from the pile. The slag, matte, and trash have been returned to the pile in the past. However, the future disposition of this material is in question.

3) The remainder of the sorted material (battery cases, scrap, etc.) is transported to the recycling process.

4) The material for recycling is first crushed, shredded, and sprayed with a surfactant.

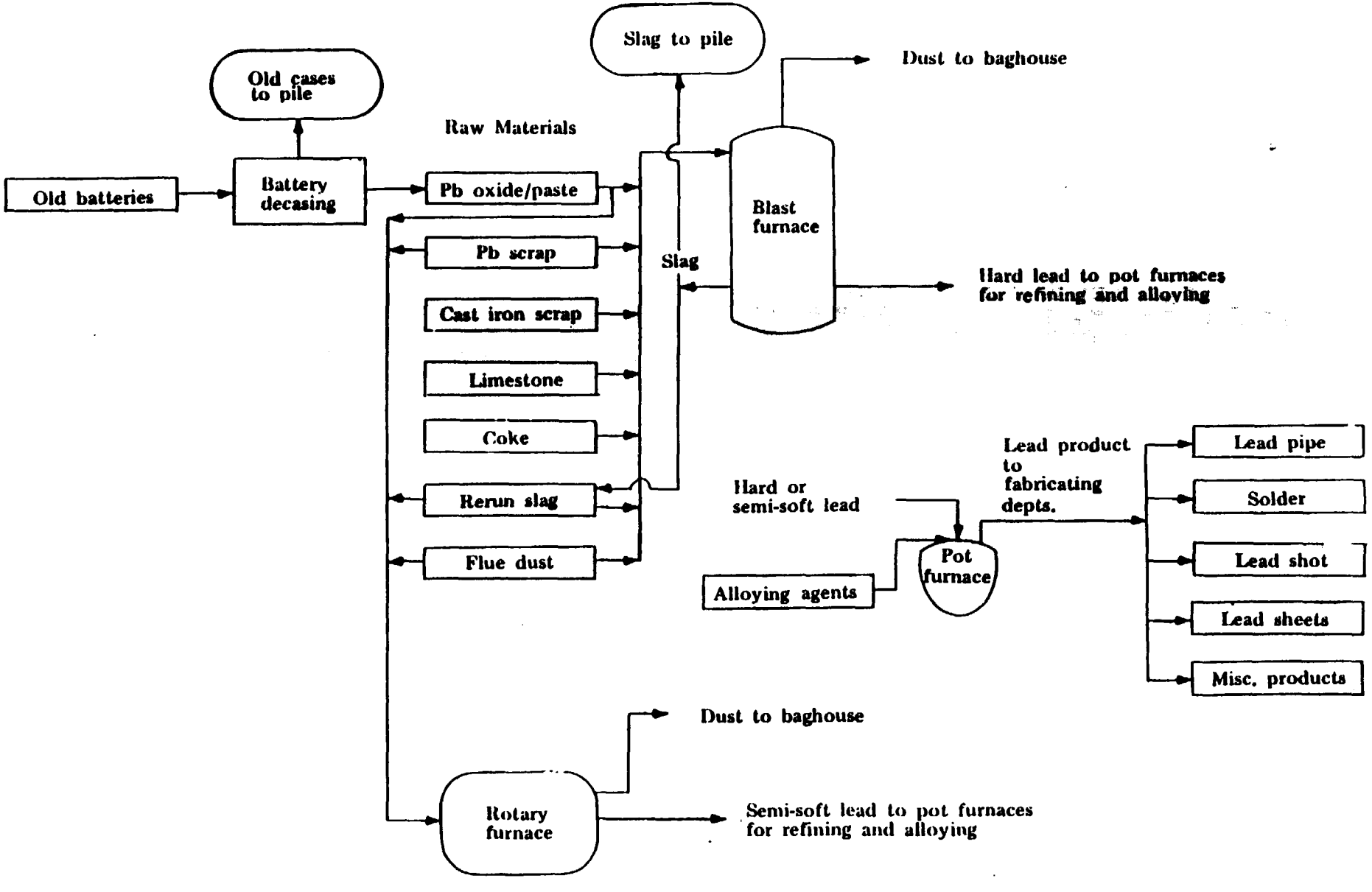
5) A wet separation process separates the lead oxide and elemental lead from the plastic and hard rubber (from battery cases).

6) An additional process separates the lead oxide from elemental lead. These materials are sold back to Taracorp, following aggregation in a quick-melt furnace.

7) The plastic and hard rubber are separated by floatation and washed. The plastic is sold to a plastic recycler. The hard rubber is presently being stockpiled while a market for it is being sought.

8) Water used in the process is clarified and recirculated.

Figure V - 1: Process Flow Diagram for Taracorp Secondary Lead Smelter



## VI) AIR POLLUTION ASSESSMENT

### A) Air Quality Monitoring

The IEPA's Division of Air Pollution Control has been monitoring ambient levels of lead on a statewide basis since mid-1978. Prior to 1978, lead air quality data were collected only within Cook County by local agencies. Table VI-1 lists the quarterly ambient lead averages (based on individual 24-hour samples taken every six days) for monitor locations (see Figure VI-1) in Granite City which have exceeded the Federal lead standard of 1.5 micrograms per cubic meter ($ug/m^3$) as a quarterly arithmetic average. The highest recorded quarterly average in Illinois was 7.3 $ug/m^3$, monitored at the 15th and Madison Street monitoring site. This same site has recorded 14 violations of the lead standard during the period 1978 through 1982. This is the most violations recorded at any monitoring site in Illinois. The ambient lead data is presented graphically in Figure VI-2.

Table VI-1
Ambient Lead Monitoring Data Summary
(1978 - 1982)
Quarterly Averages ($ug/m^3$)

| Yr/Qrt | 15th & Madison | 20th & Adams | Roosevelt & Rock Rd. | 1733 Cleveland |
|---|---|---|---|---|
| 1978 - 1 | - | - | - | - |
| 2 | 3.1 | 0.6 | 0.7 | - |
| 3 | 1.7 | 4.4 | 1.3 | - |
| 4 | 4.4 | 4.0 | 1.7 | - |
| 1979 - 1 | 2.6 | 1.0 | 1.3 | - |
| 2 | 3.2 | 0.9 | 1.2 | - |
| 3 | 2.0 | 1.1 | 1.3 | - |
| 4 | 3.0 | 2.6 | 1.2 | - |
| 1980 - 1 | 3.0 | 0.5 | 0.6 | - |
| 2 | 1.2 | 0.6 | 0.5 | - |
| 3 | 1.0 | 0.5 | 0.7 | - |
| 4 | 1.9 | 0.6 | 1.4 | - |
| 1981 - 1 | 2.1 | 0.5 | 0.5 | - |
| 2 | 1.0 | 1.6 | 0.9 | - |
| 3 | 1.8 | 0.5 | 1.1 | - |
| 4 | 7.3 | 0.5 | 0.9 | - |
| 1982 - 1 | 1.9 | 0.8 | 1.1 | - |
| 2 | 1.6 | 0.9 | 1.5 | - |
| 3 | 1.1 | 0.5 | 0.6 | - |
| 4 | 0.9 | 0.6 | 1.8 | 1.5 |

Figure 11 — Location of Lead Air Quality Monitors

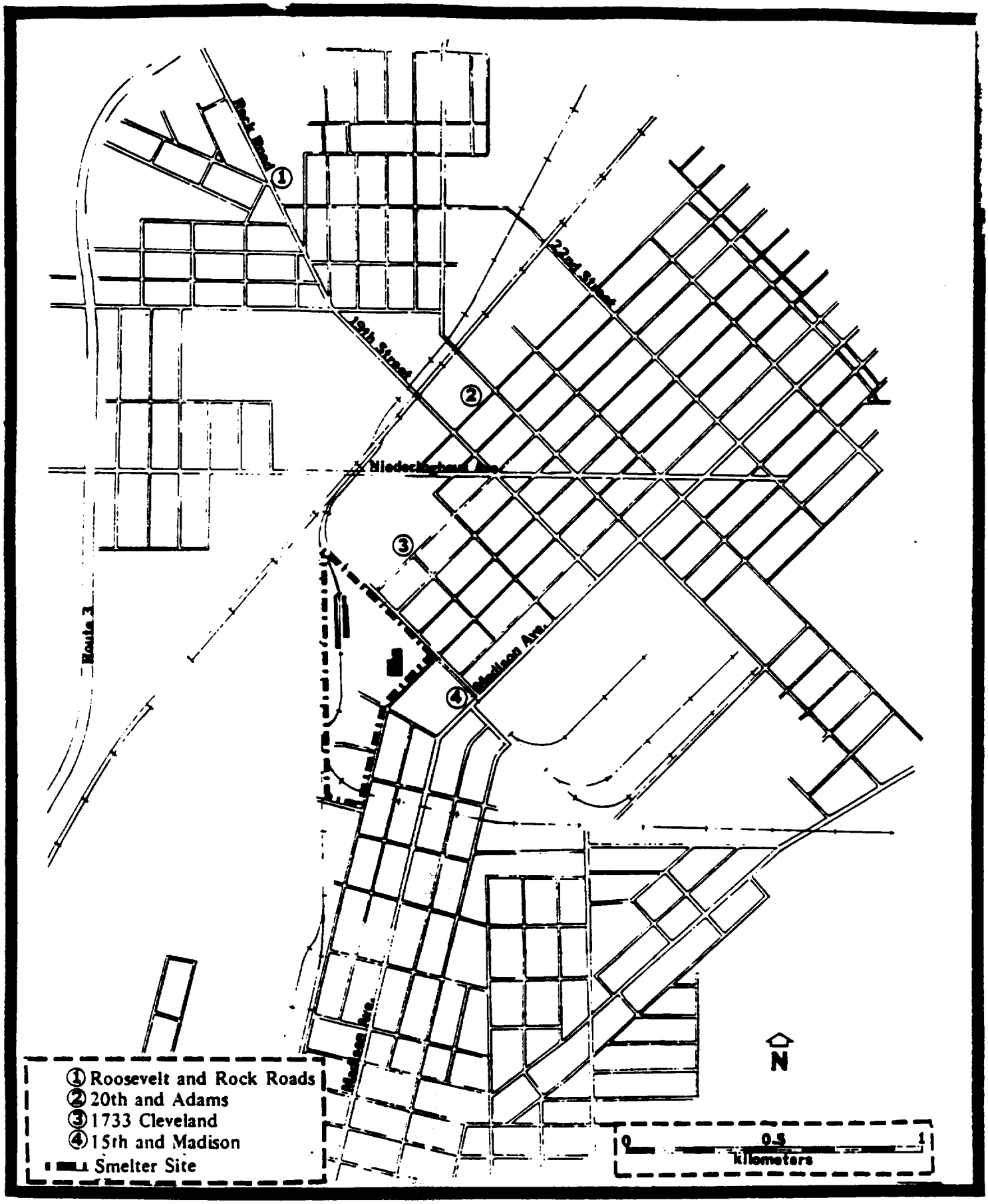
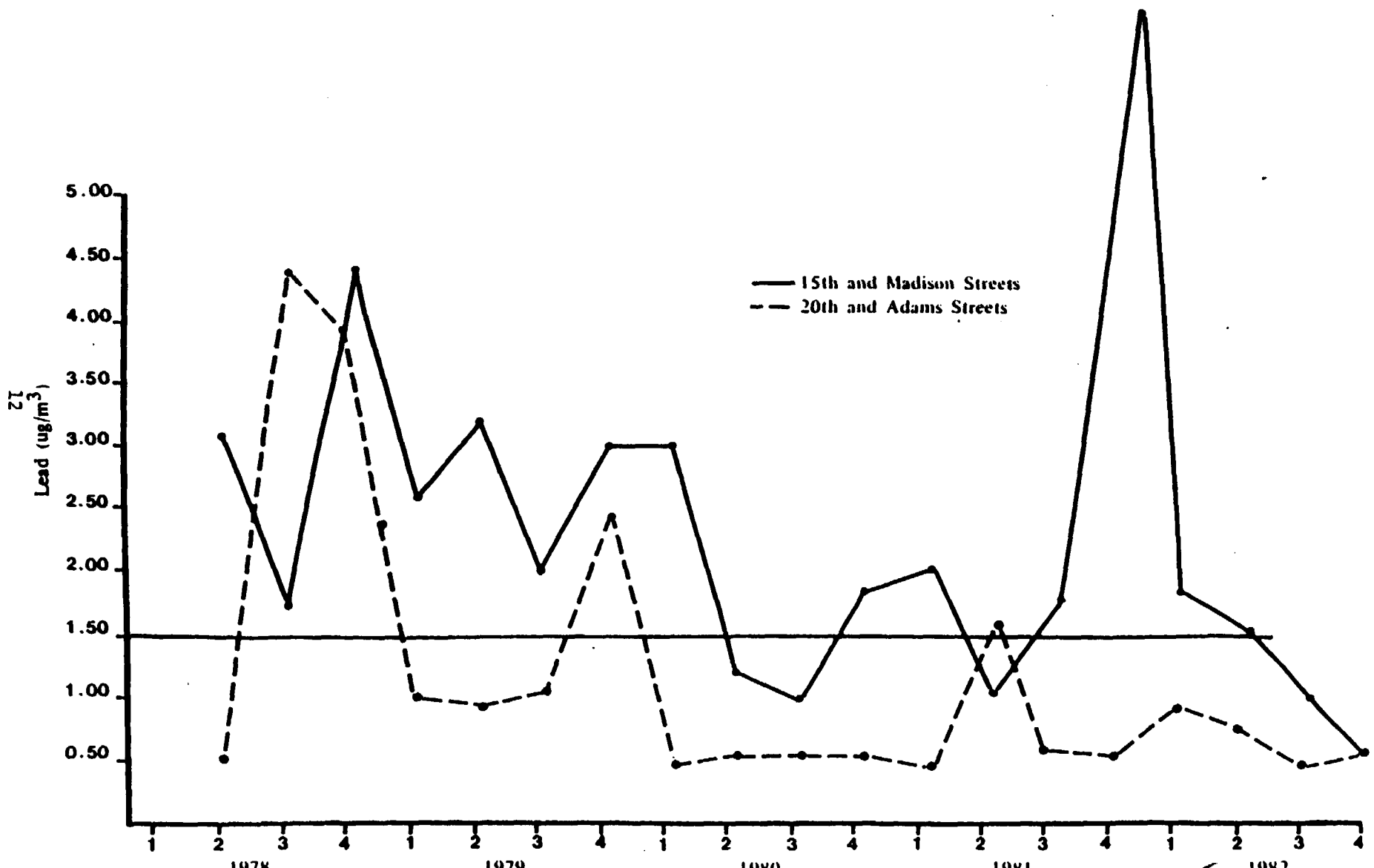


Figure VI - 2: Quarterly Ambient Air Lead Levels for Selected Granite City Monitors



B) Monitoring/Meteorological Analysis

To help pinpoint the emission sources contributing to high lead levels, composite wind frequency distributions were generated for each of three monitoring sites (15th and Madison, 20th and Adams, and Roosevelt and Rock Road) for days in 1981 and 1982 with lead concentrations greater than or equal to 1.0 $ug/m^3$.

The wind data used in the analysis was taken from the IEPA monitoring sites in East St. Louis and Edwardsville and the National Weather Service's station at Lambert Field in St. Louis.

Figure VI-3 is a graphical depiction of the composite wind frequency distributions (pollution roses) for 1981. Figure VI-4 depicts the wind directions at each site on high ambient lead concentation days in 1981. This cross-hatched area is indicative of the location of the most probable lead emission source contributing to the high lead concentrations.

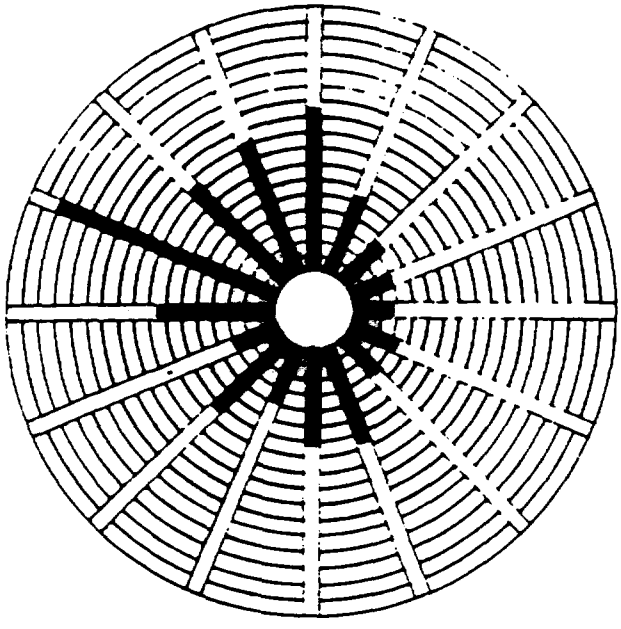
The same type of analysis was performed for 1982 wind data. Figure VI-5 depicts the pollution roses for the four monitors exhibiting high lead levels in 1982. Figure VI-6 depicts the range of the peak directions at each site on high ambient lead concentration days in 1982. Again, the cross-hatched area indicates the location of the most probable source contributing to the high lead concentrations. Taracorp Industries and St. Louis Lead Recyclers are located within the cross-hatched area. Less emphasis should be placed on the new monitor at 1733 Cleveland since it it was only recently installed and, thus, operated for less than one-fourth of the entire year.

C) Deposition Patterns

Soil samples were taken throughout the area. Samples used to determine deposition patterns were taken from vegetated areas in which there was no evidence of recent disturbance (these samples were termed "Soil A"). In addition to determining the concentration of lead, several other metals were examined. Arsenic, antimony and tin were evaluated because they are generally present in significant quantities in lead smelter emissions.

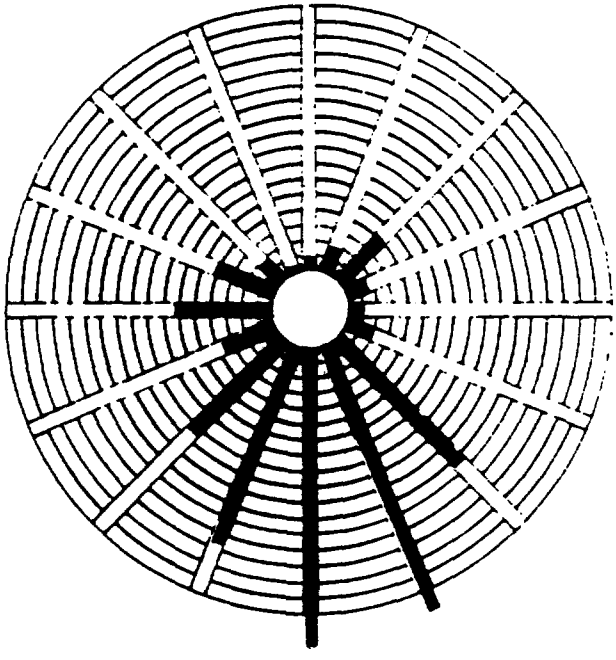
Figure VI-7 presents the results for lead. Because of the relatively small sample size, these isopleths (i.e., lines connecting points of equal concentration) should be considered only rough approximations of equal soil-lead concentration areas.

Figure VI - 3: Wind Frequency Distribution on High Lead Days in Granite City, [illegible]

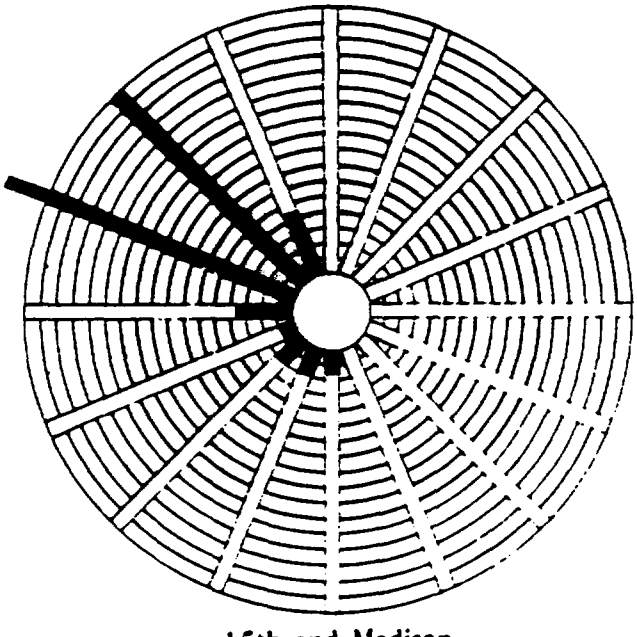


15th and Madison
(all days)

Each line equals 1%

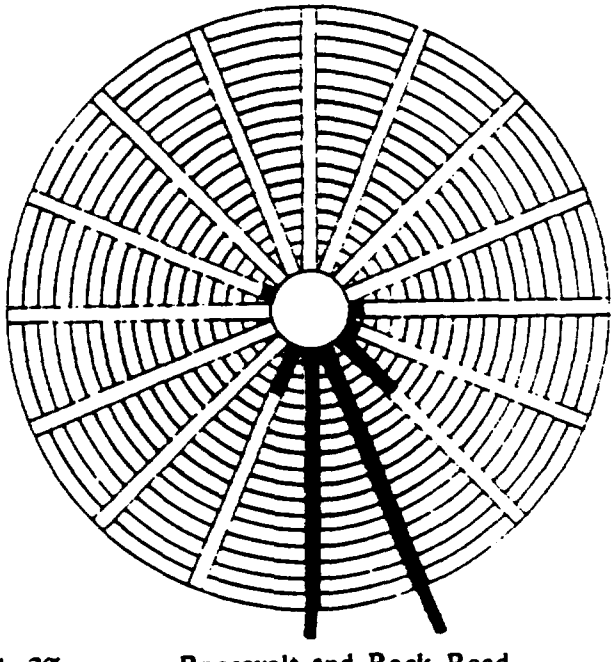


20th and Adams



15th and Madison
(above 10 ug/m$^3$)

Each line equals 2%



Roosevelt and Rock Road

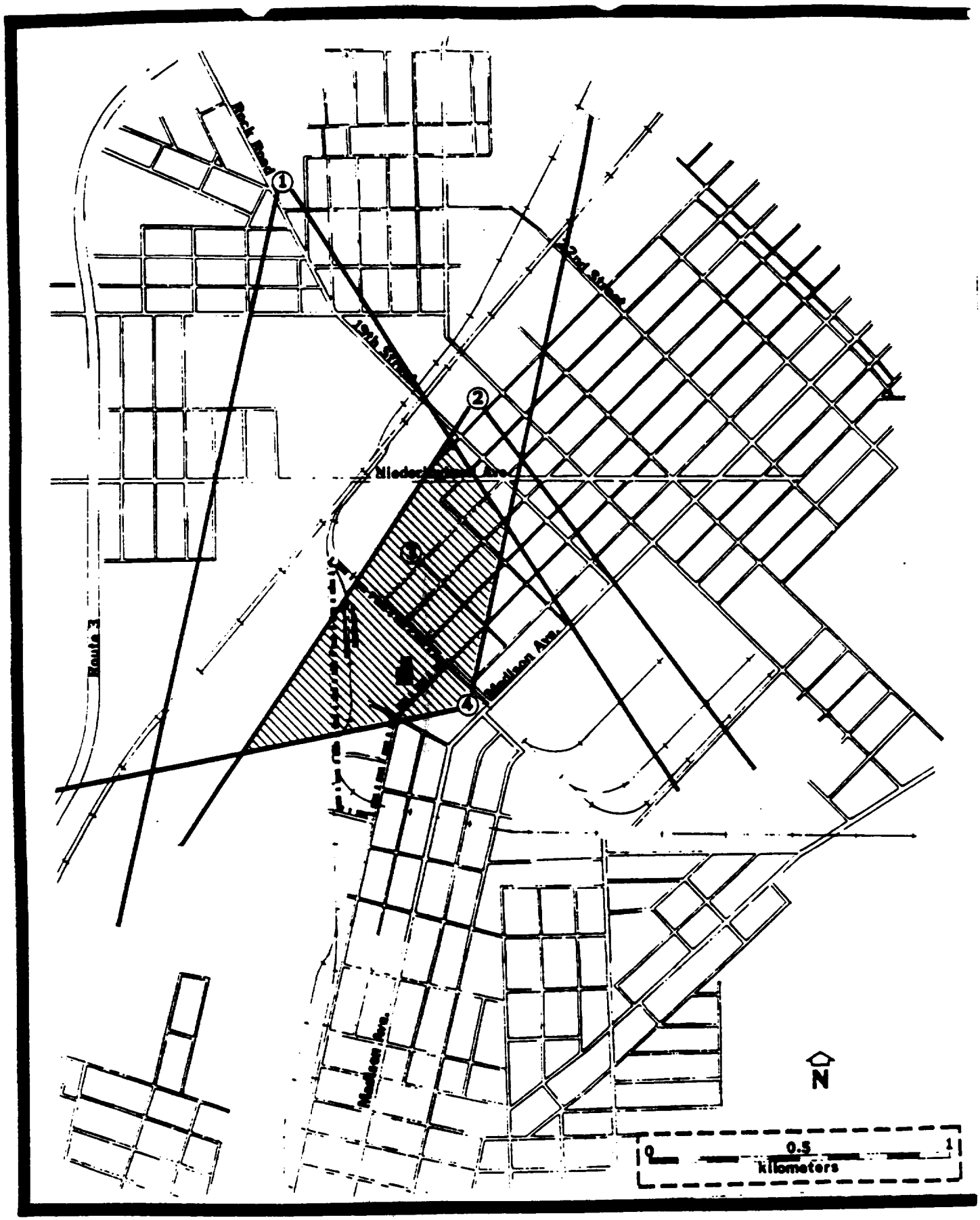
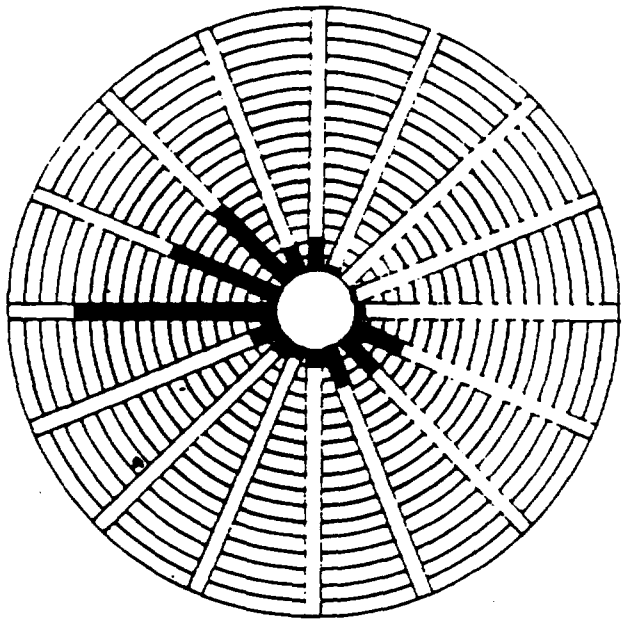
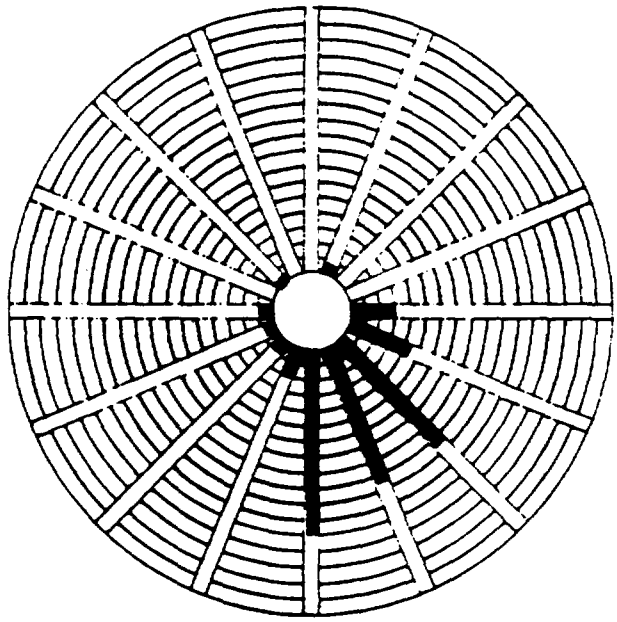

Rock Road
19th Street
2nd Street
Route 3
Madison Ave.
Madison Ave.
N
0
0.5
1
kilometers

Figure VI - 5: Wi Frequency Distribution on High Lead ays in Granite City During 1982

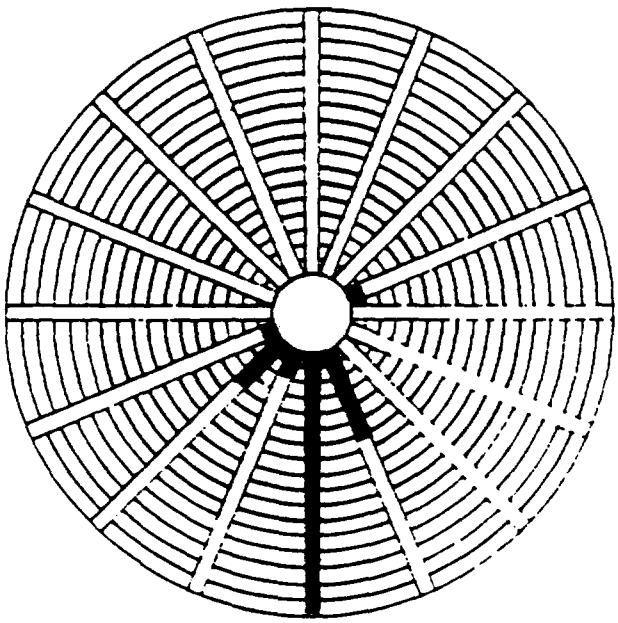


15th and Madison

Each line equals 2%

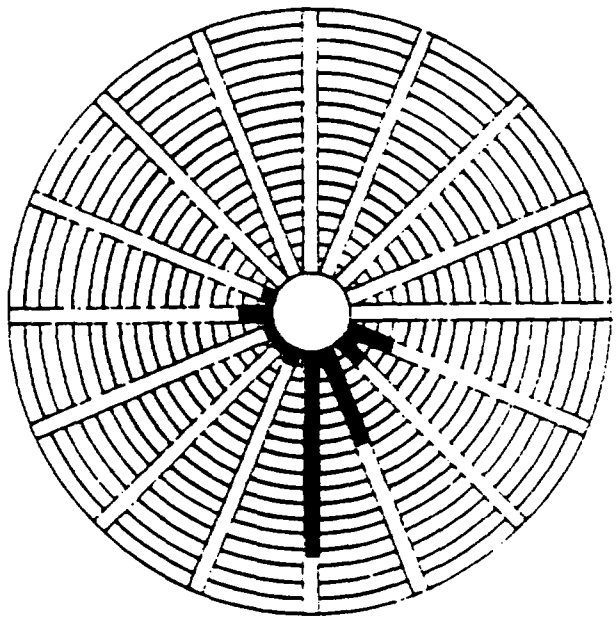


Roosevelt and Rock Road
(does not include November)



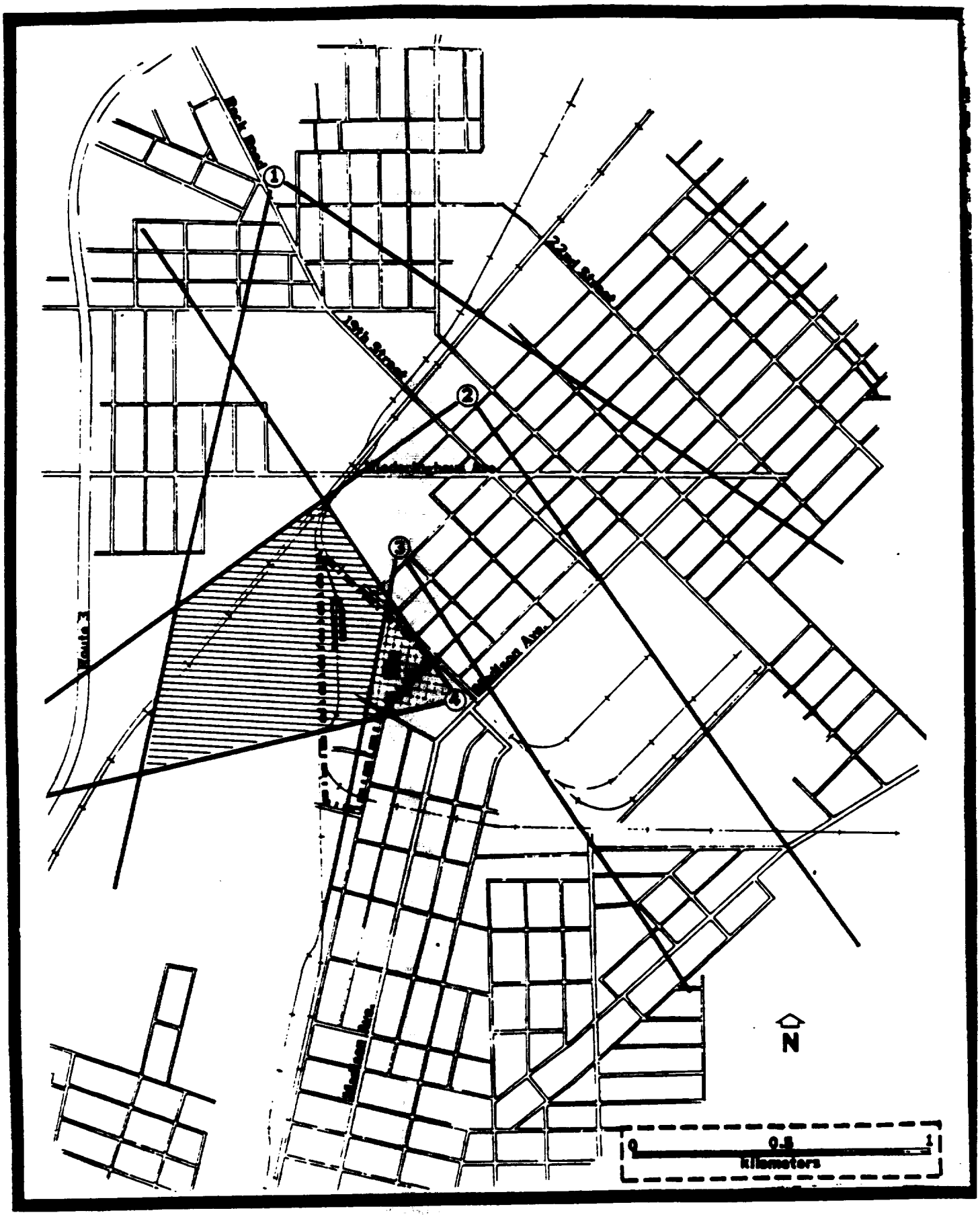
20th and Adams

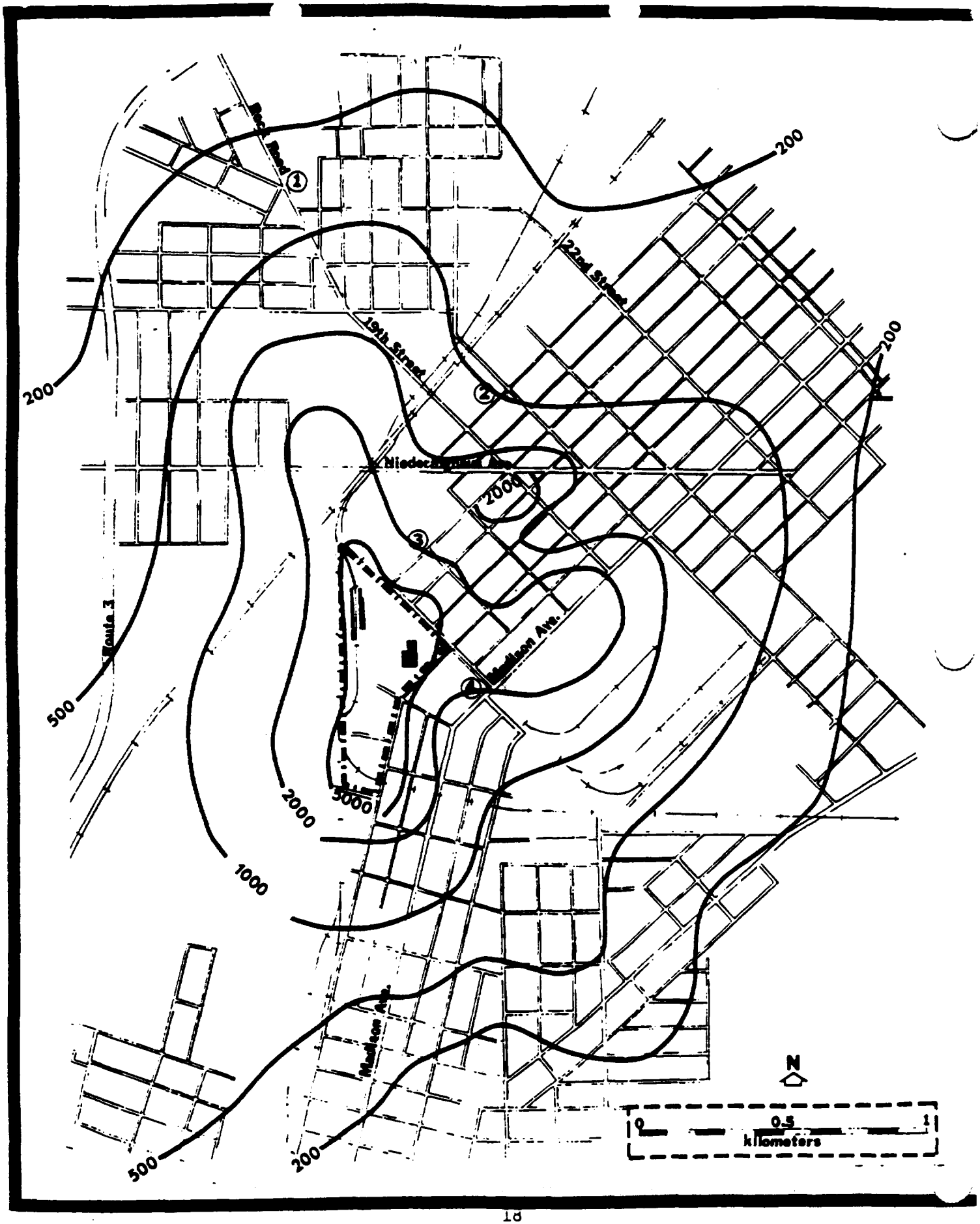
Each line equals 3%



1733 Cleveland

Figure VI - 6: Overlap of Lead Pollution Roses for 1982




Rec Road
22nd Street
19th Street
Route 3
Madison Ave.
Madison Ave.
200
200
200
500
500
2000
2000
3000
1000
N
0
0.5
1
kilometers

D) Major Emission Sources

Emission ɹrces at the smelter, the recyc. .ıg operation and adjoining grounds can be placed in two general catagories: process, and fugitive sources.

1) Process Sources

The Taracorp blast furnace (and associated activities) is the largest process source in the area. Materials handling activities prior to loading of the furnace skip hoist are discussed under the fugitive source section. Beginning with the loading of the skip hoist, however, significant process fugitive emissions are likely. The loading of the skip hoist and the subsequent charging of material into the furnace is poorly controlled. The charging of materials such as lead flue dust can cause significant emissions. Tapping operations are also poorly controlled and may contribute substantial emissions. Although under normal operations an attempt is made to control exhaust gases from the blast furnace, the overall system configuration does not represent good engineering practice. Under malfunction or charge bridging conditions, excess emissions are likely.

The rotary furnace is a second major potential emission source when in use. Poor hooding capture efficiency may allow significant emissions to escape into the "Mixed Metals A" building, where they are subsequently emitted to the ambient air.

Numerous kettles and operations throughout the facility are uncontrolled. Although not major sources taken individually, such sources may contribute substantial emissions when taken together.

Other process sources at both Taracorp and St. Louis Lead Recyclers should not contribute significant emissions under normal operations, but may be major sources under malfunction situations.

2) Fugitive Sources

Fugitive emissions are a significant cause of air quality problems in the area.

Handling of lead bearing material, particularly flue dust and battery plates, may result in significant emissions. This is especially true for the materials handling activities associated with blast furnace operations.

As discussed in Section IX, Land Pollution Problems, the soil on-site is heavily contaminated with lead. Resuspended dust from vehicular traffic as well as wind blown dust from the ground and waste storage piles can produce large quantities of lead particulate.

Additionally, the working of the waste pile can generate significant fugitive emissions.

E) Receptor Modeling

A detailed dispersion modeling analysis of lead air quality in the Granite City-Madison-Venice area was completed by the IEPA in February 1981. This analysis, which is discussed in detail in Volume 9 of the Illinois State Implementation Plan (SIP), indicated that both plant-related and non plant-related (i.e., fugitive emission) sources contribute to the elevated lead air quality levels in the area. The study also explained that a portion of the elevated lead levels in the area could not be accounted for with the emissions inventory that was used.

To provide for a more definitive analysis, a refined lead emissions inventory has been developed based on a more complete understanding of sources in the area. The factors contributing to this better understanding are as follows:

1) improved guidance concerning source emission factors;
2) more detailed knowledge of plant operations;
3) results of soil-lead sample analyses; and
4) updated estimates of lead emissions associated with motor vehicle activity.

To take advantage of the latest analytical tools available for verifying the significant sources of lead in the area, the IEPA has begun using receptor modeling techniques.

Until recently, dispersion models have been relied upon to apportion source impacts based upon assumptions regarding emission factors, plume behavior and meteorology. These models are sometimes not sufficient to accurately assess short-term source impacts or account for the sources contributing the total mass at a particular monitor. This is largely the result of the difficulties involved in developing realistic 24-hour inventories. In many instances receptor models, which incorporate data collected at a receptor (monitor) in order to deduce source impacts, have proven to be better for the short-term investigation of particulate sources. Receptor models can best be used in a complimentary fashion to improve accuracy and add confidence to the dispersion modeling analysis.

In this study the Chemical Element Balance (CEB) model, which matches source chemica' 'fingerprints" to those measure t the monitor in order to back-calculate the contributions from specific sources and source classes, is being used. This method requires that the suspected sources of lead and the monitor filters be analyzed for several chemical species by percent weight. X-ray fluorescence is recommended as a cost-effective and efficient method of analysing the samples for the spectrum of elements needed to explain the bulk of the particulate mass collected at the monitors. In the CEB model certain "fitting" elements are chosen based on experience and trial and error. These are used to construct a set of predictive equations, which are weighted to account for the uncertainties in the measurements of the various chemical species. This set of equations is then iteratively solved using statistical techniques. When an adequate fit is achieved, the mass contributed to the monitor by each source is computed for that day. By analyzing multiple days and considering meteorological data, an adjustment can often be made to the various emission factors used in dispersion modeling. Dispersion modeling analysis is still the best approach to determining the spatial extent of pollutant concentrations.

The CEB model has been programmed and is working. Some minor program refinements and test runs are necessary before the actual data is analyzed. Source samples have been collected and monitor filters have been selected for the chemical analysis. Arrangements have been made through USEPA Region V to have the chemical analysis performed. The company which is performing the analysis has extensive experience in both x-ray fluorescence and receptor modeling. Analysis of the filters by the contractor will be completed by the end of May 1983.

F) Air Quality Modeling

To further refine the dispersion modeling done previously, more extensive analyses will be conducted using the Industrial Source Complex Model (ISC). This model is listed as the USEPA Guideline Model designed to evaluate air quality in the vicinity of industrial complexes.

Point source, area source, and mobile source emissions are input to the model consistent with IEPA understanding of their operating rates during 1981. As it becomes available, the information resulting from the receptor modeling analysis will be used to supplement and refine the inventory which has been prepared. The results predicted by the model for each calendar quarter will be compared with lead air monitoring data collected during the same period. Based on these results, a correction factor will be developed for subsequent use with the model in this area.

Surface meteorological data collected by the National Weather Service (NWS) at St. Louis Lambert Field is being used. Upper air data from the nearest NWS site (Salem, Illinois) is being used as a basis for mixing height information.

The portion of the Granite City-Madison-Venice area being evaluated consists of a circular area, one mile in diameter, centered on the Taracorp facil' . The density of theoretical r :ptors is greatest near the center of the area.

The revised air quality modeling analyses will be completed in the summer of 1983. These analyses will assist in determining the need for and adequacy of additional control measures beyond those already being considered.

## VII) GROUNDWATER POLLUTION ASSESSMENT

The Granite City-Madison-Venice area is located in the American Bottoms where the soil consists principally of sand to a depth of about 120 feet. Although lead is generally insoluble and does not readily migrate through soil, the sandy conditions of the area, as well as the potential acidic conditions caused by the presence of battery acid, make the likelihood of groundwater contamination much more significant.

The groundwater in the area is not used for public consumption. Several industries do use groundwater for process purposes, including 3.6 million gallons per day by Granite City Steel. The public water supply in the area is drawn from the Mississippi River and complies with the lead drinking water quality standards.

Four monitoring wells were installed by Taracorp in November 1982. IEPA's opportunity to provide input as to the location of these wells was minimal. The locations of the wells is indicated in Figure VII-1. The initial sample results for lead (as evaluated by IEPA) are presented below.

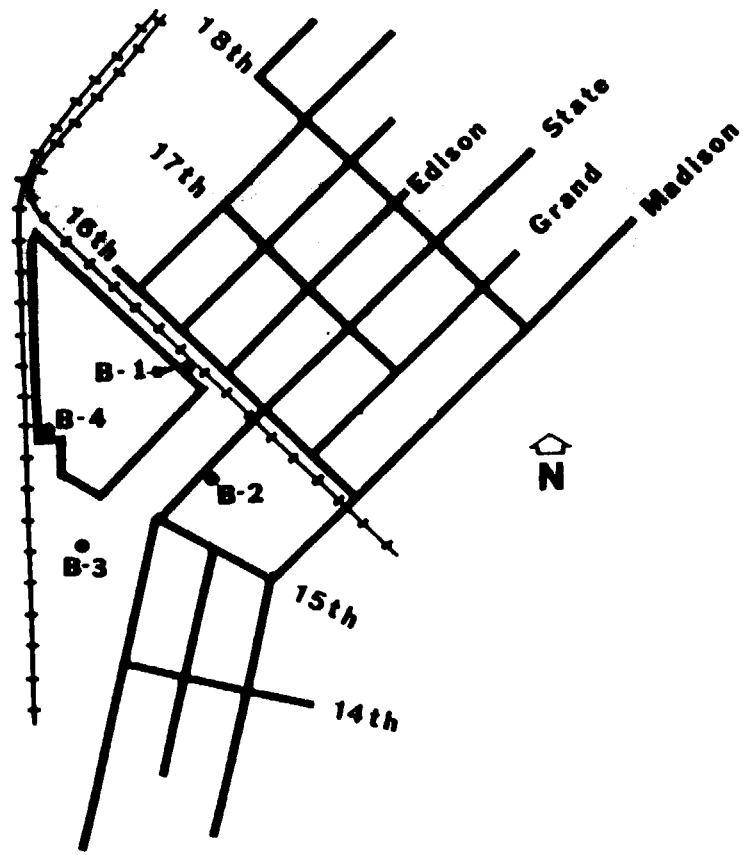
Table VII-1. Lead Concentrations in Groundwater
(micrograms per liter - ug/l)

| Well G101 | Well G102 | Well G103 | Well G104 |
|---|---|---|---|
| <5 | <5 | <5 | 60 |

Since the drinking water standard for lead is 50 ug/l, the lead concentrations do not appear significantly elevated. However, the variation among wells with regard to lead concentration cannot be readily explained. In addition, these results are only preliminary, and no final conclusions should be drawn until additional samples are taken and at least one additional well is in place.

During the boring of Well G101, soil samples were obtained at every five-foot interval. These samples were then split with Taracorp and subsequently analyzed. The results of the Agency's analysis for lead is as follows:

Figure VII - 1 : Ground Water Sampling Well Locations




Boring and Monitor Well Locations

B-1 = G101
B-2 = G102
B-3 = G103
B-4 = G104

Table VII-2. Lead Concentrations at Various Depths in Soil Taken from Boring of Well G101 (parts per million)

| | Sample Depth | Lead Present in ppm |
|---|---|---|
| (data in feet below ground surface) | 4 - 5.5 feet | 43 |
| | 9 - 10.5 feet | 51 |
| | 14 - 15.5 feet | 2700 |
| | 19 - 20.5 feet | 43 |
| | 24 - 25.5 feet | 14 |
| | 29 - 30.5 feet | 13 |

From the preliminary data it appears that the lead may be migrating down through the soil 14-15 feet below ground surface and precipitating out. Further sampling will have to be done to determine the cause of the high lead level at this depth.

Listed below are the water elevations from the monitor wells. Notice the rise in elevation between the November and January sampling. The water elevations show a general movement of the groundwater to the southwest.

| | November 16, 1982 | January 26, 1983 | February 28, 1983 |
|---|---|---|---|
| G101 | 399.3 | 402.8 | 402.9 |
| G102 | 399.2 | ----- | 401.6 |
| G103 | 398.2 | 402.1 | 401.9 |
| G104 | 397.7 | 400.5 | 400.6 |

The water table during these three sampling periods was slightly below the level of the soil sample that had the 2700 ppm of lead. It appears from the water chemical analysis that at this time the lead is being tied up in the soil. This does not mean that the lead cannot become mobile again.

G101 was intended to be the upgradient well but it appears from the groundwater analysis data, for pollutants other than lead, to be affected by the waste pile. Therefore, another upgradient well north of the site is needed. This should be drilled and constructed in the same manner as the previous set of wells. Another boring south of the site taking frequent soil samples and having them analyzed for lead would help to confirm the present data from the initial boring and the speculation on the movement of the lead down through the soils.

## VIII) SURFACE WATER POLLUTION ASSESSMENT

### A) Taracorp

The IEPA's Division of Water Pollution Control has never issued Taracorp any permit. However, permits are required for the battery acid neutralization system and the oil skimmer in the Pipe Department. A permit application for the neutralization system was received on January 17, 1983, but was found to be incomplete. The application was denied on February 25, 1983.

In addition, Taracorp has not characterized the lead concentration of runoff from their property. This runoff enters the Granite City combined sewer system and may contribute to water pollution through overflows or through problems caused in the Granite City treatment plant. Although effluent from the treatment plant meets State requirements, the lead content of the sludge is among the highest in the State. This sludge is currently being disposed of in an approved landfill.

### B) St. Louis Lead Recyclers

St. Louis Lead Recyclers holds a State permit for its pretreatment facility. The discharge point appears to be in compliance with all applicable rules, and no additional discharge points are believed to exist.

However, the grounds of St. Louis Lead Recyclers (which are leased from Bank Trust 454) are extensively contaminated with lead. In addition, St. Louis Lead Recyclers has over 6,000 tons of processed hard rubber, contaminated with lead, piled outside.

## IX) LAND POLLUTION ASSESSMENT

### A) On-site

Taracorp maintains a waste pile of lead bearing scrap covering approximately three acres and containing about 200,000 tons of material. The degree to which this pile extends below ground is unknown. The analyses of samples taken from the pile indicate that these materials are high in lead content. Slag and matte generated from the blast furnace operations are still being deposited on the pile. Because of the high lead content of the material in the pile, further evaluation of potential health hazards is planned.

In addition, operations of St. Louis Lead Recyclers involve transferring large quantities of wastes from one location to another. In sorting the material to be recycled, slag, matte and trash are separated out and piled in the open.

The hard rubber generated from the recycling process was spread-ou' ver the Bank Trust 454 propert; ; ground cover during the summer of 1982. Excess rubber was placed in an outdoor storage pile. Because of the high lead content of the hard rubber, St. Louis Lead Recyclers took up the spreadout hard rubber and placed it on the storage pile to reduce leaching and reintrainment. Process changes have also been made to reduce residual lead.

Total soil-lead analyses were performed at several locations on the site grounds. Samples were taken near the rear gate area of Taracorp in August of 1982. These samples indicated that the soil contained 300,000 ppm (30 percent) lead. Subsequent to this finding, St. Louis Lead Recyclers removed the top few inches of soil (when they removed the hard rubber) and Taracorp applied gravel to the immediate area. Samples taken after this indicate that soil in the rear gate area still contains about 140,000 ppm lead. Samples taken on other portions of the Bank Trust 454 property indicate high lead levels in the soil. The results of this sampling are presented in Table IX-1, and the locations of the sampling points are shown in Figure IX-1 .

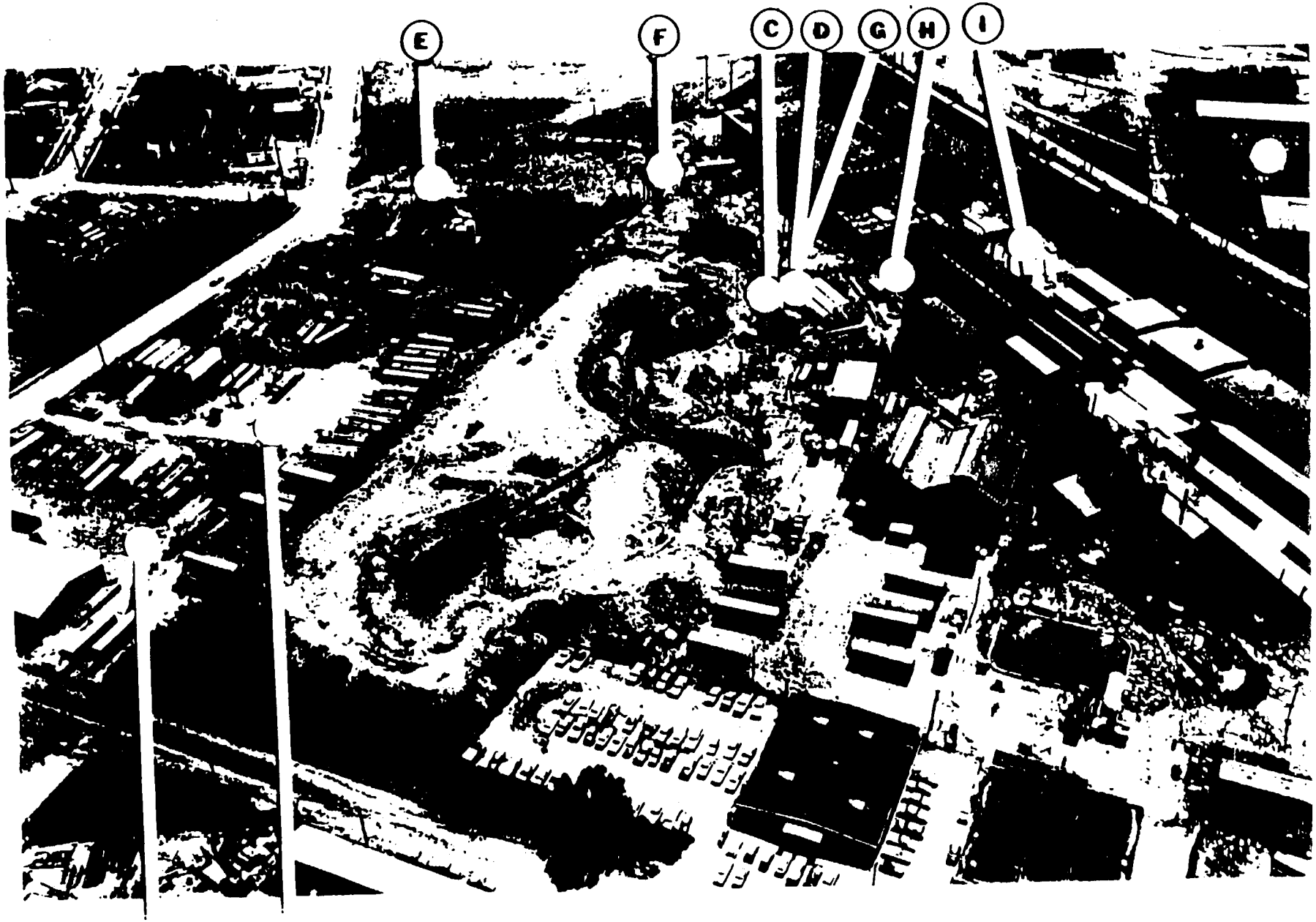
Table IX-1. Soil-Lead Concentrations for On-Site Samples

| Sample | Concentration (ppm Lead) | Date of Sample |
|---|---|---|
| A | 12,000 | (8/19/82) |
| B | 75,000 | (8/19/82) |
| C | 300,000 | (8/19/82) |
| D | 300,000 | (8/19/82) |
| E | 5,100 | (1/27/83) |
| F | 86,000 | (1/27/83) |
| G | 140,000 | (1/27/83) |
| H | 48,000 | (1/27/83) |
| I | 67,000 | (1/27/83) |

B. Off-site

Soil samples were taken from neighborhoods in the vicinity of the smelter. Four types of samples were taken: "A", "B", "C", and "Garden". "A" and "B" samples were taken with a standard soil borer/auger, one inch in diameter. The sampler was rotated as it was pushed into the soil to prevent compression of the sample. Only the uppermost inch was removed from the core and placed in a container. No attempt was made to remove vegetation, but this was not used in the profile's dimension. This procedure was repeated three times to obtain a composite sample. Each sample was removed at a distance of no less than 10 feet from any other sample. Care was taken to select undisturbed soil and to avoid removing a sample within 10 feet of painted structures, former structures, waste piles, roadways, or painted playground equipment.

Figure IX - 1: Location of On-site Surface Soil Samples[4]



Each sample type is discussed below:

"Soil A" - These samples were taken primarily to determine long term deposition patterns. The samples were taken from vegetated areas where the soil was unlikely to have been recently disturbed.

"Soil B" - These samples, which were intended to indicate levels to which children would most likely be exposed, were taken from open dirt areas in yards, playgrounds, etc. Samples were split between IEPA, IDPH and USEPA.

"Soil C" - These samples (2) were taken to determine the depth to which high lead levels may extend in the soil. The above protocol was used except that one nine-inch core was taken instead of three one-inch cores. The nine-inch core was divided into three, 3-inch sections for analysis.

"Garden" - As a part of the garden vegetable sampling program, soil samples were taken from each garden sampled. The samples were taken from the top three inches of soil with a spatula.

The results of "Soil A", "Soil B", "Garden" and the top three-inch section of "Soil C" samples are presented in Figure IX-2. It can be seen that the soil concentrations are generally highest in the immediate vicinity of the smelter and decrease with increasing distance. Using "Soil A" samples as the most reliable upper estimates of soil concentration (because they represent undisturbed soils) and recognizing that the other samples may underestimate typical surface soil concentrations, some rough lead concentration isopleths can be drawn. This has been done in Figure VI-7. The implication of these soil concentrations is discussed in the Hazard Assessment Section.

The "Soil B" values presented in Figure IX-2 are averages of values reported by IEPA, IDPH and USEPA. The agency-specific values are generally in good agreement, and provide confidence in the reliability of the laboratory results. The values are presented in Table IX-2.

Figure IX - 2: Surface Soil Sample Results (ppm Lead)

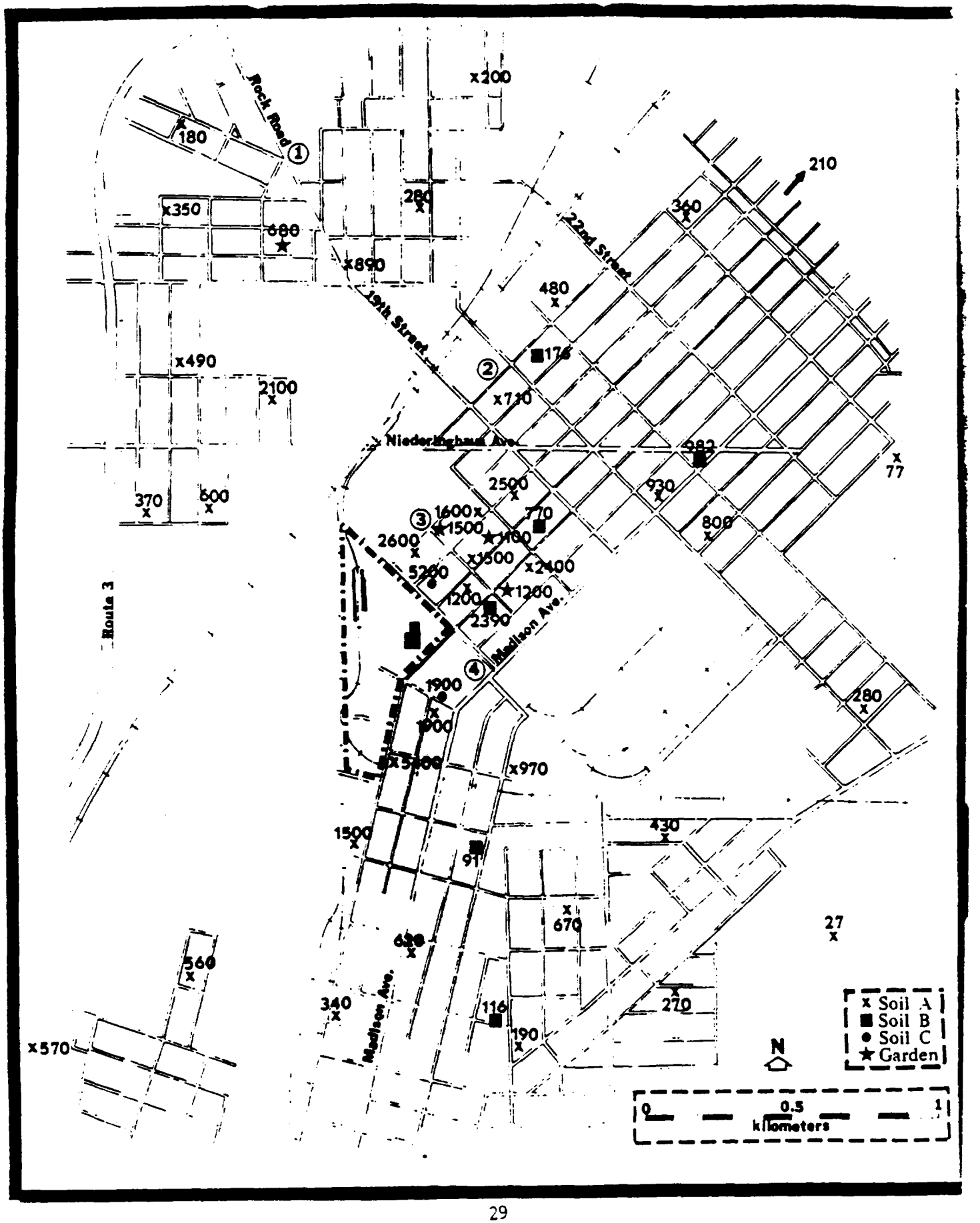


Table IX-2. Soil-Lead Concentrations for "Soil B" Samples (ppm)

| Sample Number | Avg. | IEPA | IDPH | USEPA |
|---|---|---|---|---|
| SB101 | 2390 | 2600 | 2860 | 1700 |
| SB102 | 770 | 800 | 759 | 750 |
| SB103 | 982 | 950 | 995 | 1000 |
| SB104 | 176 | 200 | 159 | 170 |
| SB105 | 51 | 59 | 44 | 49 |
| SB201 | 116 | 120 | 108 | 120 |
| SB202 | 91 | 120 | 76 | 76 |

"Soil C" sample results, presented in Table IX-3, demonstrate that lead contamination extends at least as far as nine inches below the surface.

Table IX-3. Soil-Lead Concentrations for "Soil C" Samples (ppm)

| Sample Number | 0-3" | 3-6" | 6-9" |
|---|---|---|---|
| SC101 | 5200 | 1300 | 290 |
| SC201 | 1900 | 810 | 980 |

## X ) HEALTH HAZARD ASSESSMENT

Through the use of environmental quality data, a rough estimate of human exposure to lead can be made. Comparing the exposure estimates to what is known about the toxicity of this substance, an estimate of the likely health effects can also be made.

In addition, attempts have been made to directly measure the extent of lead exposure in the population. This has been done by the Illinois Department of Public Health (IDPH) through a survey of blood-lead levels in the community. These measurements can aid in the overall assessment of the potential health hazard.

The hazard assessment is made by combining these factors. Exposure estimates can be compared to what is known about acceptable exposure levels; estimated blood-lead levels can be compared to acceptable blood-lead levels; and measured blood-lead and FEP levels can serve as direct checks on the estimates.

A) Toxicity of Lead

1) Routes of Exposure and Absorption

Inhalation

Lead can be absorbed into the bloodstream by inhaling airborne particulates containing lead. The rate of absorption depends on the particle size, the chemical species of lead, as well as factors specific to the individual. Although the relationship between ambient air lead concentrations and blood-lead concentrations varies considerably among individuals, nearly all studies have demonstrated ratios of 1:0.5 to 1:4.0 ($ug/m^3$ Pb to ug/dl Blood-Pb). Most studies report ratios of 1:1 to 1:2 (Ref. 1, pp 12-25, 12-29). Although USEPA has stated that no one ratio can accurately describe the air lead to blood lead ratio in all cases, one was selected by the USEPA as being representative of study results when the NAAQS for lead was proposed. The ratio was 1:2, indicating that a change in the ambient air lead concentration of 1 $ug/m^3$ results in a corresponding change of 2 ug lead per deciliter (dl) of blood (Ref. 3, p 41211).

Data cited in USEPA's Preliminary Draft Air Quality Criteria Document generally supports a linear relationship in the range of 1:1 to 1:4 for relatively low ambient concentrations (3.2 $ug/m^3$ or less) (Ref. 4, p. 13-27 to 13-29).

Oral Ingestion

The gastrointestinal tract is not as efficient in absorbing lead as the lungs. Absorption rates vary with a number of factors, including age, form of intake (food, soil, water, etc.), and nutritional factors. The chemical species of the lead may also be important. In general, adults will absorb 10-15 percent of ingested lead, but children may absorb up to 50 percent (Ref 1, p 10-2; Ref 4, p 13-5; Ref 6, p C-16).

Scientific studies have not developed a precise relationship between ingested lead and blood-lead levels. A general relationship of a 3-6 percent increase in blood-lead for a doubling of soil-lead concentrations has been noted in some studies (Ref 1, p 12-32). However, it is uncertain how much of this is due to inhalation and how much is due to ingestion. The relationship between blood-lead and soil-lead is discussed further in subsection X(C).

Food and water intake and its relationship to blood-lead is also unclear. Although a general relationship of 6 ug/dl blood lead for every 100 ug of daily dietary lead intake is suggested by various studies, there are many variables determining this rate, and the rate for children is expected to be higher (Ref 1, p 10-4, p 12-32).

Maximum acceptable daily dietary intake for children has been estimated to be 300 ug/day, with only 150 ug/day allowed for children under age three, and only 100 ug/day for infants under six months (Ref 7, p 5).

2) Distribution and Elimination

Once lead has entered the blood stream it has a high affinity for bone deposition. Roughly 95 percent of the lead found in adults is contained in the bones (Ref 1, pg 10-5). However, only about 72 percent of the lead in children is in the bones. More is found in the soft tissues, increasing its availability for recirculation (Ref 5, p C--20).

Blood-lead concentrations generally level off after a few months of constant exposure. This does not represent a true equilibrium level, however, as elimination of lead following termination of exposure generally takes much longer when the exposure occurred over several years as opposed to several months (Ref 5, p C-20; Ref 6, p 417).

In adults, lead is eliminated primarily through the urine, with fecal elimination and loss of epithelical tissue being of secondary importance. In children, however, fecal elimination appears to predominate (Ref 6, p 418).

3) Biological Effects

Lead intoxication has been associated with severe neurological disorders such as profound retardation, tremors, and loss of memory. Coma and death, though rare, have occurred in some extreme cases. However, these problems occur at much higher dosages than would normally be expected from environmental pollution (Ref 6, p 418). Environmental exposures can cause more subtle toxic effects such as blood system dysfunction, psyco-neurologic dysfunction, kidney dysfunction, and reproductive impairment.

Blood System Dysfunction

Anemia is presently considered to be the toxic effect occurring at the lowest excess blood-lead level. The anemia apparently can result from two separte effects of lead on the blood system (Ref 1, p 11-7 to 11-14). One effect is an increase in the fragility of the red blood cell membrane. The result is to decrease the average lifetime of red blood cells in the circulatory system.

The second effect is a reduction in the rate of synthesis of "heme", which is a molecule used to make the hemoglobin in red blood cells. The result is to decrease red blood cell production. One of the mechanisms by which this is believed to occur is the inhibition of a particular enzyme used in heme synthesis. Although inhibition of this enzyme occurs at blood-lead levels as low as 10 ug/dl, sufficient inhibition to significantly interfere with heme synthesis and result in amenia apparently does not occur until blood-lead levels of approximately 40 ug/dl. Thus, 40 ug/dl was considered a "threshold" level in the development of the NAAQS by the USEPA. However, USEPA designated 30 ug/dl as the maximum allowable level for children to provide an adequate margin of safety (Ref 2, p 46253).

Another result of enzyme inhibition in the heme synthesis process is the buildup of an organic chemical, protoporphyrin, in the erythrocytes, or red blood cells. Although not perfectly correlated with blood-lead levels, a test of erythrocyte protoporphyrin, or "EP", levels is often used as a screening technique for lead poisoning and is a better indicator of long-term (greater than 90-day) exposure.

Psyco-neurologic Dysfunction

Lead poisoning can cause profound psyco-neurological dysfunctions. Children appear to be the most susceptible portion of the population. Research has indicated that blood-lead levels as low as 50-60 ug/dl can cause significant psyco-neurological disorders (Ref 1, pp 11-18 to 11-26).

Since the publication of USEPA's 1977 Air Quality Criteria Document for Lead, many studies have been released on psyco-neurological effects at blood-lead levels of 30-40 mg/dl and below. The preliminary draft of the revised criteria document discusses these studies (Ref 4, pp 12-38 to 12-149). While some of the studies indicate significant impairment of performance skills due to lead exposure, the results cannot be considered conclusive because of methodological problems complicating their interpretation. The studies are receiving significant attention by USEPA in workshops being held on revisions to the criteria document.

Kidney Dysfunction

A progressive, degenerative disease of the kidneys called chronic lead nephropathy has been reported in industrial workers exposed to lead, older adults having had lead poisoning as children, and long-term drinkers of illicit lead-contaminated whiskey (Ref 1, p 11-44). Numerous methodological problems in measuring the relationship between lead exposure and kidney dysfunction exist. However, lead-related kidney disease and associated problems such as gout and hypertension continue to be a serious concern and the subject of toxicological study.

Reproductive Impairment

Lead readily crosses the placental barrier and may exert toxic effects directly on the conceptus or indirectly, through nutritional effects on the mother (Ref 1, p 11-46). Because of the relationship between lead exposure and reproductive impairment, women have generally been excluded from occupational environments containing lead.

Lead exposure has been associated with increased rates of stillbirth, miscarriage, premature membrane rupture and premature delivery (Ref 1, p 11-46).

While some evidence exists for teratogenic or mutagenic effects of lead, a direct association has not yet been established (Ref 1, p 1-47). Of particular concern, however, is the possibility of subtle, long-term behavioral or intelligence effects.

B) Exposure Estimates

1) Air

As shown in Section VI(A), Air Quality Monitoring, ambient lead concentrations have frequently exceeded 2.0 ug/m$^3$. This value as well as the NAAQS (1.5 ug/m$^3$) and 1.0 ug/m$^3$ is used in evaluating a range of exposures in subsection XI(C) of this report.

2) Soil

In Section IX(B), Land Pollution Problems - Off-site, soil sample results indicating extensive lead contamination in area neighborhoods are discussed. One set of soil samples was taken from exposed dirt areas where children may play.

These samples were designated "Soil B" samples and were desig d to estimate actual levels to ch children may be exposed. It can be seen from the results in Figure IX-2 that "Soil B" levels are slightly lower but roughly consistent with other soil samples. To encompass the range of soil concentrations found in the area, values of 200, 1,000, and 5,000 ppm are used in this report for the health hazard analysis, although the highest "Soil B" (open dirt areas) value was 2,390 ppm.

In order to determine exposure, some estimate must be made concerning the amount of soil a child can ingest. In reviewing the literature for an assessment of contaminated soil in Minnesota, Dr. Mary Arneson concluded that a reasonable estimate of the range of intake rates for children would be 50 to 500 mg dust or soil per hour of play. Although the number of hours per day that a child plays in a dirt area varies considerably, it is not unreasonable to assume that up to 5 hours of exposure could occur each day for an extended period of time during the summer. Thus, 250 to 2,500 mg of soil could be consumed each day, recognizing that 2,500 mg/day is probably extreme. Dr. Arneson also noted that from 20 to 100 mg/day may be ingested by infants (Ref 7, p 7).

In a National Academy of Sciences study on lead, soil intake values of 100 mg/day for children without pica, and 1000 mg/day for children with pica are reported (Ref. 8, p. 58). Pica is a condition affecting many children in which there is an unusually strong need for placing objects in the mouth.

The table below provides daily lead intakes that would result from the range of soil intakes and soil concentrations discussed above.

Table X-1. Daily Lead Intake (ug)

| Daily Soil Intake (mg) | Soil Lead Concentrations (ppm) 200 | 1000 | 5000 |
|---|---|---|---|
| 20 | 4 | 20 | 100 |
| 100 | 20 | 100 | 500 |
| 500 | 100 | 500 | 2500 |
| 1000 | 200 | 1000 | 5000 |
| 2500 | 500 | 2500 | 12,500 |

3) Food

The average daily intake of lead from food has been estimated at 100 ug/day for children 0-2 years old and 150 ug/day for children 2-3 years old (Ref 8, p 47). An estimate of 210 ug/day has been made for children 8.5 years old (Ref 5, p C-7). In this study, samples were taken of garden vegetables throughout the region and subsequently analyzed in a United States Food and Drug Administration laboratory. Table X-2 displays the results. The samples were taken in the Fall of 1982. The soil concentrations associated with each garden are listed, and are indicative of the area in which the garden is located; sites 4, 5 and 6 are from control areas on the northeast side of Granite City.

Table X-2. Lead Concentrations in Garden Samples [illegible]

| Site # | Sample | P |
|---|---|---|
| 1 | Peppers | 0.119 |
| | Tomatoes | 0.122 |
| | Banana Peppers | 0.134 |
| | Cauliflower (frozen) | 0.198 |
| | Soil | 1500 |
| 2 | Eggplant | 0.048 |
| | Tomatoes | 0.066 |
| | Okra | 0.128 |
| | Carrots | 0.392 |
| | Soil | 1100 |
| 3 | Tomatoes | 0.035 |
| | Cabbage | 0.633 |
| | Peppers | 0.053 |
| | Cucumber | 0.083 |
| | Soil | 1200 |
| 4 | Okra | 0.020 |
| | Banana Peppers | 0.010 |
| | Tomatoes | 0.005 |
| | Peas | 0.002 |
| | Soil | 53 |
| 5** | Pepper | 0.007 |
| | Tomatoes | 0.007 |
| 6 | Okra | 0.014 |
| | Banana Peppers | 0.010 |
| | Soil | 97 |
| 7 | Tomatoes | 0.028 |
| | Squash | 0.124 |
| | Okra | 0.641 |
| | Beets | 0.087 |
| | Beet Leaves | 0.058 |
| | Soil | 680 |

* Soil values are based on dry weight
** Site #5 is located across the street from Site #6. Therefore a separate soil sample was not taken.

Although lead concentrations vary considerably depending on the e of vegetable, it can general be concluded that vegetables in the contaminated region contain from 0.05-0.5 ppm lead and vegetables in control regions contain from 0.005 to 0.05 ppm lead on a wet weight basis.

Assuming that 10 to 100 g/day (based on a total diet of 1000 g/day) of garden vetables may be consumed for an extended period of time by children, daily lead intake estimates may be increased by 0.5-5 to 5-50 ug/day.

Except for the high end of these estimates, they do not represent a major portion of the daily dietary intakes discussed above. Gardens in the vicinity of the smelter were generally small and were not believed to produce a large quantity of vegetables. In addition, only a few samples (carrots, cabbage, and okra) demonstrated lead levels higher than 0.2 ppm. Considering both these factors, it would be extremely unlikely that a child would consume 100 g/day of a vegetable containing 0.5 ppm lead each day for 30 to 90 consecutive days. A more reasonable estimate would be that vegetables consumed over such a period of time would be closer to an average of 0.1 ppm lead. This would mean an intake of 1 to 10 ug/day from garden vegetables.

Soil cation exchange capacity and pH are the two largest factors determining lead uptake by plants. Assuring near neutral pH and normal cation exchange capacity will minimize lead uptake. However, significantly altering soil cation exchange capacity is often difficult. Phosphate and pH levels appropriate for optimal garden productivity will aid in reducing lead uptake.

4) Water

Drinking water in the community is taken from the Mississippi River. The lead concentration is less than the State drinking water standard of 0.05 ppm and most samples are below the laboratory detection limit of 0.005 ppm. Thus, present data indicates that exposure from drinking water is not abnormal.

5) Other

There are many other sources of lead exposure for children. One of the major sources can be consumption of lead-based paint chips in the home. Exposure through the work or hobbies of others in the family is also important. Many of these potential exposure sources were investigated through a questionnaire administered to residents in the area by IDPH in connection with their blood-lead survey. These other exposure sources were not found to be major based upon a preliminary analysis of the survey results.

C) Estimate of Blood-lead Levels

Much of the available toxicological data relates adverse effects to various concentrations of lead in the blood. Thus, estimating blood-lead concentrations resulting from environmental exposure is an important part of a health hazard assessment. Although much of the data is still preliminary, a rough estimate of potential health hazard can be made.

USEPA, in developing the National Ambient Air Quality Standard for lead, estimated a background blood-lead concentration from non-air sources of 12 ug/dl (Ref. 1, p 46254). Using this number, total blood-lead can be estimated by adding the contributions from airborne lead and other sources having concentrations higher than the background level.

1) Air

Based on a review of studies documenting the relationship between air-lead and blood-lead concentrations, USEPA concluded that the best estimate was 1:2; that is, every 1 $ug/m^3$ increase in air-lead concentrations results in an increase of 2 ug/dl in blood-lead. They note, however, that a range appears to exist, and that the ratio may be more severe for children and more severe at lower air-lead concentrations (Ref 2, p 46250; Ref 1, p 12-24 to 12-29). The 1:2 ratio is used for this analysis.

Table XI-3 provides estimates of the increase in blood-lead concentrations that would result from the range of air-lead concentrations under study assuming the 1:2 air/blood relationship.

Table X-3. Increases in Blood-Lead Due to Various Air-Lead Concentrations

| Ambient Air-Lead Concentration (ug/m3) | Increase in Blood-Lead (ug/dl) |
|---|---|
| 1.0 | 2.0 |
| 1.5 | 3.0 |
| 2.0 | 4.0 |
| 7.3 | 14.6 |

2) Soil

National background soil concentrations of lead have been documented as 10-30 ppm (Ref 5, p C-2; Ref 8, p 156). Although soil-lead concentrations associated with the development of the 12 ug/dl background blood-lead level are not known, it is reasonable to assume that the soil lead concentrations in the vicinity of the smelter (200 - 5000 ppm) almost entirely represent contamination above background.

In the Preliminary Draft of the revised Criteria Document, USEPA cites a study from which soil/blood relationships have been derived for children 1-3 and 6 years of age (Ref 4, p 11-94). They report an increase above background of 0.0076 x soil-lead (ppm) for children 1-3 years old, and 0.0046 x soil-lead (ppm) for children 6 years old. Based upon these relationships, Table X-4 provides blood-lead estimates for each age group, over various soil concentrations, assuming that the 0.0046 x soil ppm can be applied to all children over three years old.

Table X-4 Increases in Blood-lead Concentrations from Soil Ingestion (ug/dl)

| Soil Conc. (ppm) | Children 0-3 yrs old | Children over 3 yrs old |
|---|---|---|
| 100 | 0.76 | 0.46 |
| 200 | 1.52 | 0.92 |
| 500 | 3.80 | 2.30 |
| 1000 | 7.60 | 4.60 |
| 2000 | 15.20 | 9.20 |
| 5000 | 38.00 | 23.00 |

Several qualifications should noted at this point. First, the above formulas are presented in a draft document that has not yet been released for general review. Thus, they are subject to change and cannot be considered to reflect a final USEPA position. Second, the background blood-lead levels found in the above study, and other studies, have generally been higher than the 12 ug/dl used in this analysis. However, the Granite City-Madison-Venice area has not been associated with high blood-lead levels from consumption of paint chips or other sources based upon earlier blood-lead screening work. It must be recognized that there is considerable uncertainty in selecting the appropriate background level and soil-lead/blood-lead relationship.

Angle et. al. (1983) have also reported a linear relationship between blood-lead and other variables, including soil concentration (Ref. 9, p. 6). They report an increase of 0.00681 ug/dl for each ppm soil concentration for children 1-18 years old. This is roughly consistent with the values reported above by USEPA.

3) Diet

Because food and water exposure were found to be unlikely to pose a significant increase in lead intake, it will be assumed that no contribution to blood-lead beyond background will occur.

4) Other

Household exposures were not found to be significant and are therefore assumed not to affect blood-lead levels based upon preliminary findings of the blood-lead survey.

5) Overall Estimate

To estimate the overall blood-lead levels, the effects of both air and soil exposure must be combined. Since air quality modeling results are not yet complete, a precise relationship between air concentrations and soil concentrations cannot yet be delineated. Thus, it is assumed for this analysis that any air quality level can occur in conjunction with any soil quality level. However, the association of high air with high soil lead as well as low air with low soil lead is likely.

For the overall estimate, the soil/blood relationships presented in Table X-4 were used. These values were added to the blood-lead values from air exposure (Table X-3) and the background value of 12 ug/dl to derive the overall estimates in Table X-5. It should be noted that these are estimates of the population mean. Table X-6 presents similar results for children over 3 years of age.

As discussed in subsection (A) above, Toxicity of Lead, USEPA selected a level of 30 ug/dl in setting the National Ambient Air Quality Standard (NAAQS) to provide a sufficient margin of safety for children. Given the natural variation in blood-lead levels, and USEPA's goal of keeping all but 0.5 percent of the exposed children below the 30 ug/dl level, a population mean blood-lead level of 15 ug/dl was selected. (It should be noted, however, that approximately five percent of children exceed 30 ug/dl as a national average). This is based on evidence that blood-lead concentrations are lognormally distributed over a population with a standard geometric deviation (SGD) of 1.3. Higher and lower SGD's have been measured, but 1.3 was selected by USEPA.

Table X-5 Overall Mean Blood-lead Level Estimates for Children 0-3 yrs Old

| Soil Concentration (ppm) | Air Quality ($ug/m^3$) 1.0 | 1.5 | 2.0 |
|---|---|---|---|
| 100 | 14.76 | 15.76 | 16.76 |
| 200 | 15.52 | 16.52 | 17.52 |
| 500 | 17.80 | 18.80 | 19.80 |
| 1000 | 21.60 | 22.60 | 23.60 |
| 2000 | 29.20 | 30.20 | 31.20 |
| 5000 | 52.00 | 53.00 | 54.00 |

Table X-6 Overall Mean Blood-lead Level Estimates for Children Over 3 yrs Old

| Soil Concentration (ppm) | Air Quality ($ug/m^3$) 1.0 | 1.5 | 2.0 |
|---|---|---|---|
| 100 | 14.46 | 15.46 | 16.46 |
| 200 | 14.92 | 15.92 | 16.92 |
| 500 | 16.30 | 17.30 | 18.30 |
| 1000 | 18.60 | 19.60 | 20.60 |
| 2000 | 23.20 | 24.20 | 25.20 |
| 5000 | 37.00 | 38.00 | 39.00 |

As individual child blood-lead concentrations increase above the margin-of-safety level of 30 ug/dl, there is increasing likelihood of toxic effects. At an individual blood-lead level of 40 ug/dl, anemia has been well documented. Thus, toxic effects are likely above this value. As the population mean value increases from 15 ug/dl, an increasing percentage of the population is expected to exceed 30 and 40 ug/dl. To better illustrate the potential hazard, Tables X-7 through X-10 were constructed to show the percentage of the childhood population exceeding 30 and 40 ug/dl based on the mean levels presented in Tables X-5 and X-6. These values were calculated assuming an SGD of 1.3.

Table X-7 Pe..ent of Children 0-3 Yrs Old wi. Blood-lead Levels Above 30 ug/dl

| Soil Concentration (ppm) | Air Quality ($ug/m^3$) 1.0 | 1.5 | 2.0 |
|---|---|---|---|
| 100 | 0.5 | 0.7 | 1.3 |
| 200 | 0.6 | 1.2 | 2.0 |
| 500 | 2.3 | 3.8 | 5.7 |
| 1000 | 10.6 | 14.0 | 18.1 |
| 2000 | 46.02 | 51.20 | 55.96 |
| 5000 | 98.20 | 98.50 | 98.75 |

Table X-8 Percent of Children Over 3 Yrs Old with Blood-lead Levels over 30 ug/dl

| Soil Concentration (ppm) | Air Quality ($ug/m^3$) 1.0 | 1.5 | 2.0 |
|---|---|---|---|
| 100 | 0.3 | 0.6 | 1.1 |
| 200 | 0.4 | 0.8 | 1.5 |
| 500 | 1.0 | 1.8 | 3.0 |
| 1000 | 3.4 | 5.3 | 7.6 |
| 2000 | 16.4 | 20.6 | 25.5 |
| 5000 | 78.8 | 81.6 | 84.1 |

Table X-9 ercent of Children 0-3 Yrs Old h Blood-lead Levels Above 40 ug/dl

| Soil Concentration (ppm) | Air Quality ($ug/m^3$) 1.0 | 1.5 | 2.0 |
|---|---|---|---|
| 100 | 0.0 | 0.0 | 0.0 |
| 200 | 0.0 | 0.0 | 0.1 |
| 500 | 0.1 | 0.2 | 0.4 |
| 1000 | 0.9 | 1.5 | 2.2 |
| 2000 | 11.5 | 14.2 | 11.1 |
| 5000 | 84.1 | 85.8 | 87.3 |

Table X-10 Percent of Children Over 3 Yrs Old with Blood-lead Levels over 40 Ug/dl

| Soil Concentration (ppm) | Air Quality ($ug/m^3$) 1.0 | 1.5 | 2.0 |
|---|---|---|---|
| 100 | 0.0 | 0.0 | 0.0 |
| 200 | 0.0 | 0.0 | 0.0 |
| 500 | 0.0 | 0.0 | 0.1 |
| 1000 | 0.2 | 0.3 | 0.6 |
| 2000 | 1.9 | 2.7 | 3.9 |
| 5000 | 23.6 | 42.1 | 48.0 |

It can be seen from Tables X-5 and X-6 that, even for air quality levels under 2.0 $mg/m^3$ air quality, the percentage of children exceeding 30 mg/dl is far above USEPA's target of 0.5 percent, and significantly above the national average of 5 percent at higher soil levels. Note also that in areas of soil concentrations as high as 2000 to 5000 ppm, a substantial percentage of the children would exceed even the 40 ug/dl.

If the NAAQS of 1.5 ug/m3 were attained in the area, over 5 per ıt of the children would still eed the margin-of-safety level of 30 ug/dl unless soils were reduced to less than 1000 ppm. Tables X-7 and X-8 illustrate that even if ambient air concentrations could be reduced to 1.0 ug/m3, 33 percent below the standard, soil concentrations of 1000 ppm or higher might still cause a significant percentage of the children to exceed the margin-of-safety level of 30 ug/dl. It should also be noted, based on the information in Tables X-9 and X-10, that in areas of high soil concentration, a significant percentage of the children could exceed 40 ug/m3. This clearly illustrates the difficulty in determining an acceptable concentration of lead in one medium (e.g., air) because of uncertainty with respect to exposure through other media (e.g., soil).

Although recent ambient lead air quality levels have been well below the 7.3 mg/m3 peak reported for the fourth quarter at 1981, exposures during that time could have placed more than one-third of the children over 30 ug/dl in areas where soil-lead levels exceed 200 ppm, and more than 10 percent of the children over 40 mg/dl in areas where soil-lead levels exceed 500 ppm.

D) IDPH Blood-lead Survey

To help assess the hazard posed by lead contamination in Granite City, the Illinois Department of Public Health (IDPH) conducted a survey of blood-lead concentrations. The survey consisted of three parts. The first part was a questionnaire concerning the household and its members. It was used to help identify sources of lead exposure. Secondly, each house where blood samples were taken was examined for lead paint and other sources of lead contamination. The third part of the survey was comprised of data on each individual, particularly the resulting blood-lead and FEP levels. FEP (free erythrocyte protoporphryn) is an enzyme whose release in the blood is directly proportional to lead exposure.

The survey was administered during the fourth quarter of 1982. Statistical analysis of the results took considerable time because of the necessity for lab work and data entry to the computer system. A complete statistical analysis of the numerous variables included in the questionnaire is expected within the next two months. However, preliminary results are available.

Several problems were anticipated with respect to obtaining complete survey information. One was obtaining the full cooperation of residents. Because of competing priorities in many family situations, the limited State resources that could be devoted to gaining cooperation, and the relatively short time frame within which the work had to be completed, it was anticipated that some public resistance might be encountered. Unfortunately, this was the case and surveys were completed for only 43 households (97 individuals, with 46 being six years old or less).

Another complication was the slowdown of activity at the smelter. Monitoring data for the period of the blood-lead survey (see Air Quality Monitoring Section) showed that outdoor air quality was much better than normal. Also, exposure to soil-lead was substantially reduced compared to the summer.

The preliminary results of the survey indicate that excessive blood-lead levels and FEP levels were not present in the sampled population. IDPH considers a blood-lead level of 30 ug/dl or more, in conjunction with an FEP level of 50 mg/dl or greater to be "undue lead absorption", that is, a dangerously high level of lead absorption. No such cases were found, even though one or two could have normally occurred in a sample of 46 urban children.

In addition, the low FEP values (indicative of longer-term lead exposures of several months to a year) indicate that significant lead exposure has not been occurring for the sampled individuals as a whole.

Numerous factors relating potential household exposures to blood-lead and FEP indicate that such exposures are not significantly above normal.

However, the small number of people willing to participate in the study limits the extent to which these conclusions can be extrapolated to the rest of the population in the area. Thus, no significant lead exposure problems were found in the survey of residents in the vicinity of the lead smelter, but the lack of citizen participation (which resulted in a relatively small sample size) and, to some extent, the timing of the sampling effort, means that some uncertainty remains with regard to a possible health hazard. The results, however, are consistent with previous blood-lead screening work done in 1976 and 1979.

E) Hazard Assessment

The public health hazard posed by lead contamination is based not only on the toxicity of lead, but also on the level of environmental contamination and the extent to which people, particularly children, are exposed to these levels.

The public is exposed to lead in the vicinity of the smelter primarily through three means: air, soil, and garden vegetables. Each will be discussed in turn, and then they will be combined with data from the blood-lead survey to produce an overall hazard assessment.

## Air

Ambient air quality lead levels during 1982 were below 2.0 $ug/m^3$. Levels have been repeatedly monitored at levels exceeding the NAAQS (1.5 $ug/m^3$) have been monitored over the past four years, with a high of 7.3 $ug/m^3$ during the fourth quarter of 1981.

The potential for actual exposure of children to monitored ambient lead levels is greatest during the summer months when they spend a great deal of time outdoors. Thus, high ambient levels during the winter months should be less harmful than similar levels during the summer. Fortunately, the 1981 peak value of 7.3 $ug/m^3$ occurred in the Fall.

The NAAQS was based on the assumption that blood-lead due to air exposure would be added to a normal background blood-lead concentration of 12 ug/dl, and that exposures to more than 1.5 $ug/m^3$ would place a significant portion of the exposed children above the 30 $ug/m^3$ danger level. Thus, although ambient concentrations in 1982 were below 2.0 $ug/m^3$, levels above 1.5 $ug/m^3$ should be considered a potential health hazard. Significant exposures from other sources, such as soil, will aggrevate the effect of air exposure.

## Soil

The soil-lead concentrations found in the study area are significantly above background levels, particularly in Granite City. Levels as high as 2000 ppm are common in the inner-city portions of many urban areas such as Cincinnati, Ohio (Ref. 10) and Morton Grove, Illinois (Ref. 11). In other studies of residential areas surrounding smelters, values of 100-4000 ppm have been found in E. Helena, Montana (Ref. 4); 20-1,100 ppm in the Netherlands (Ref. 12); 20-4,800 ppm in Omaha, Nebraska (Ref. 3); 560-11,450 ppm in El Paso, Texas (Ref. 19), and 50-24,600 ppm in Silver Valley, Idaho (Ref. 15).

When a case of undue lead absorption is found in a child by the Illinois Department of Public Health, soil levels around the residence are required to be reduced to 200 ppm as a part of an overall plan to reduce lead exposure for that child to a minimum.

Figure X-1 in the exposure section provided estimates of lead intake given various soil-lead concentrations and various assumptions regarding daily soil ingestion. A daily soil intake of 0.1 g/day was used as a rough estimate for normal consumption by a child, and 1.0 g/day for a child with pica.

A maximum tolerated intake of lead for children 0.5-3 years old has been estimated at approximately 150 ug/day. This value is for daily intake from all sources. Most of this amount is ingested daily from normal diet, and very little from soil.

Based on Figure X-1, it can be seen that a substantial portion (100 ug/day) of the maximum tolerated daily intake of lead for normal children could be obtained from the soil in areas with concentrations over 1000 ppm. Although the USFDA maximum tolerated daily intake level is not related directly to a particular blood-lead level or toxic effect, exceeding the recommended level by 100 percent or more could generally be considered a hazard.

Estimates of blood-lead levels indicate that soil-lead concentrations over 1000 ppm may place a significant percentage of children at risk. In addition, consultation with others knowledgable in the field indicates a general concensus that soil-lead values of 1000-5000 ppm may be cause for concern (Ref. 16).

Garden Vegetables

Extended daily intakes of one to 10 ug/day from garden vegetables was estimated in the exposure section of this report. Compared to the 150 ug/day maximum tolerated daily intake limit, the contribution from eating garden vegetables grown in the area around the smelter appears to be minor.

However, this assessment is based on several assumptions. First, it is assumed that vegetables comprise no more than 10 percent of the diet by weight. Second, it is assumed that the amount of vegetables consumed over a period of 30 to 90 days is not primarily composed of root or leafy vegetables. Third, and most importantly, it is assumed that all vegetables are thoroughly washed. Eating unwashed leafy or root vegetables could greatly increase lead ingestion.

Overall Assessment

The preceding assessments, based upon results of studies in other areas, indicate that both air and soil concentrations found in the Granite City-Madison-Venice area could represent a health hazard. Garden vegetables grown in the vicinity of the smelter do not appear to pose a significant risk as long as they are thoroughly washed before eating.

Estimates made of blood-lead levels and the percentage of children exceeding 30 and 40 ug/dl (see Figures X-7 through X-10) indicate that soil concentrations over 1000 ppm, and especially over 2000 ppm, could pose a significant hazard, even if the NAAQS is attained in the area.

Preliminary findings from the IDPH blood-lead screening, however, indicate that unusually high blood-lead levels are not present. This may be partially explained by the fact that the samples were taken during November and December of 1982, when children were not spending many hours playing outdoors, and air quality levels were at or below the NAAQS. The fact that FEP blood values were not above acceptable levels indicates that exposure to lead during the preceding months to one year had not been unusually high.

The indication that high absorption of lead in the blood is not occuring is supported by a survey performed in September 1976 by the Illinois Association for Retarded Citizens, in which 4.5 percent, or about the national average, of the children in East Alton, Granite City, and Madison were found to have elevated blood-lead levels. Also supporting this conclusion are the results of a 1979 blood-lead screening of the area by the IDPH which indicate no unusual incidence of elevated blood-lead levels.

Thus, although significant environmental contamination exists in the vicinity of the smelter, and evaluation of the data collected must continue, the preliminary assessment is that a major risk to public health is unlikely to exist provided that ambient air quality levels do not exceed the NAAQS and that routine personal health and hygiene measures are followed.

## References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14. "Epidemic Lead Absorption Near An Ore Smelter", P.J. Landrigan, et. al., New England Journal of Medicine, January 16, 1975.

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16. April 15, 1983, IEPA memo from Tom Bierma to Steve Tamplin detailing personal discussions with lead specialists.


TB:jd/6536C/1-41/sp

Table Summary Table of Blood Lead:Soil Lead Relationships from Studies in Communities with Operating Smelters

| Author | City/Study Population | Soil Lead | Housedust Lead | Slope* |
|---|---|---|---|---|
| Angle & McIntire, 1979 | Omaha, NB<br>Age: 1-18 yrs<br>N = 1075 | Geom x = 227 ppm<br>95%tile = 843 ppm<br>(range: 16 - 4,792 ppm) | Geom x = 337 ppm<br>95%tile = 894 ppm<br>(range: 18 - 5,571 ppm) | 6.8 [a] |
| Yankel et al. 1977 | Kellogg, ID<br>Age: 1-9 yrs<br>N = 860 | x = 7000 ppm<br>(as high as 24,000 ppm) | x = 11,000 ppm<br>(as high as 140,000 ppm) | 1.1 [a] |
| Panhandle District et al. 1986 | Kellogg, ID<br>Age: 1-9 yrs<br>N = 364 | Geom x = 481 ppm (far)<br>3,474 ppm (near) | Geom x = 1,138 ppm (far)<br>3,933 ppm (near) | 3.0 [b] |
| Roels et al. 1980 | Belgium<br>Age: 10-14 yrs<br>N = 148 | <1 km from smelter<br>2,000 - 6,000 ppm | N/A | 3.5 [c] |
| Neri et al. 1978 | Trail, British Columbia<br>Age: 1-3 yrs<br>N = 87<br>Age: 1st grade<br>N = 103 | Group x in different areas of Trail ranged from:<br>225 - 1,800 ppm | N/A | 7.6 [a] for 1-3 yrs<br>4.6 [a] for 1st graders |
| Walter et al. 1980 | Kellogg, ID<br>Age: 1-9 yrs<br>N = 983 | Not given; presumably similar to Yankel et al, 1977 | Not given; presumably similar to Yankel et al, 1977 | 1.1 [a] average for ages 2-7 yrs |
| Roberts et al. 1974 | Toronto, Ontario<br>mixed adults/children<br>N = 80 | Group arith. x ranged from:<br>100 - 2,626 ppm | Group arith. x ranged from:<br>845 - 2,005 ppm | 4.0 [b] |

N/A not available

* defined as the increase in blood lead (ug/dl) per 1,000 ppm increase in soil lead

[a] calculated by EPA (U.S.EPA, 1986) - takes into account other sources of exposure

[b] ^PbB (ug/dl)/^PbS (ppm) - does not take into account other sources of exposure (calculated by Gradient)

[c] calculated by Duggan & Inskip, 1985 - corrected for increase due to inhalation of air lead

Attachment #3

Table 2 Summary Table of Blood Lead:Soil Lead Relationship from Urban Areas Without an Operating Smelter

| Author | City/Study Population | Soil Lead | Housedust Lead | Slope* |
|---|---|---|---|---|
| Galke, 1975 | Charleston, SC<br>Age: 0-5 yrs<br>N = 194 | Geom x = 585 ppm<br>(range: 9 - 7,890 ppm) | N/A | 1.5 [a] |
| Stark et al.<br>1982 | New Haven, CT<br>Age: 0-1 yrs<br>N = 153 | Five levels of SES<br>(group mean: 233 - 1,327 ppm);<br>Seven categories of housing construction<br>(group mean: 131 - 1,300 ppm) | For levels of SES<br>(group mean: 159 - 628 ppm);<br>For housing construction categories<br>(group mean: 239 - 756 ppm) | 2.2 [a] |
| Shellshear et al.<br>1975 | Christchurch,New Zealand<br>Age: 1-5 yrs.<br>N = 68 | Soil lead range:<br>150 - 1,959 ppm | N/A | 3.9 [d] |
| Bornschein et al.<br>1986 | Cincinnati, OH<br>Age: 1.5 yrs.<br>N = 81 | Geom x = 1,360 ppm<br>(range: 76 - 54,519 ppm) | Geom x = 900 ppm<br>(range: 82 - 13,820 ppm) | 6.2 [c]<br>from 0-1,000 ppm soil lead<br>Estimated slope: 0.76 [c]<br>from 1,000-2,000 ppm |
| Bornschein et al.<br>1988 | Cincinnati, OH<br>N/A | N/A | N/A | 1.2 [c]<br>when soil lead increased from 500-1,000 ppm |
| Reeves et al.<br>1982 | New Zealand<br>Age: 1-3 yrs<br>N = 195 | Soil lead range:<br>24 - 842 ppm | N/A | 5.5 [b] |
| Rabinowitz et al.<br>1985 | Boston, MA<br>Age: 0-2 yrs<br>N = 249 | Group mean soil ranged from 380 - 1,011 ppm | N/A | 8.1 [b] |
| Minnesota 1987 | Minneapolis-St. Paul, MN<br>Age: 0-5 yrs<br>N = 656 | (range: 0 - 30,000 ppm) | N/A | 2.7 [b] |

N/A not available

* defined as the increase in blood lead (ug/dl) per 1,000 ppm increase in soil lead

[a] calculated by EPA (U.S.EPA, 1986) - takes into account other sources of exposure

[b] ^PbB (ug/dl)/^PbS (ppm) - does not take into account other sources of exposure (calculated by Gradient)

[c] calculated by authors - takes into account other sources of exposure

[d] calculated by Duggan & Inskip, 1985 - takes into account air lead exposure

Table 3 Summary Table of Blood Lead:Soil Lead Relationship from Mining Sites

| Author | City/Study Population | Soil Lead | Housedust Lead | Slope* |
|---|---|---|---|---|
| Bornschein et al.<br>1988 | Telluride, CO<br>Age: <6 yrs<br>N = 94 | Geom x = 178 ppm | Geom x = 281 - 567 ppm | 2.2 [c]<br>based on increase from<br>500-1,000 ppm soil lead |
| Thomas et al.<br>1977 | Nelkyn & Y Fan, Wales<br>Age: 39-62 yrs<br>mean ages<br>N = 78 | Mine tailings in Y Fan:<br>42,000 ppm<br>Nelkyn - 44 km2 has<br>>1,000 ppm soil lead | N/A | Significant trend in<br>PbB in near vs. far<br>resident males:<br>near 21.9 ug/dl<br>mid 19.0 ug/dl<br>far 15.1 ug/dl |
| Gallacher et al.<br>1984 | 4 areas in<br>Wales<br>Age: 1-3 yrs<br>N = 93 | Geom x = for soil<br>road 356 ppm<br>deadend 271 ppm<br>mining 1,167 ppm<br>control 79 ppm | Geom x = for dust<br>road 202 ppm<br>deadend 177 ppm<br>mining 350 ppm<br>control 177 ppm | 4.1 [b] |
| Heyworth et al.<br>1981 | Northhampton,<br>Australia<br>Age: 5-14 yrs<br>N = 81 | Soil lead at town boundary:<br>300 ppm<br>playground range:<br>11,000 - 12,000 ppm | N/A | No significant difference<br>between children with homes<br>on tailings piles vs. those<br>who were not. PbB were<br>significantly higher in<br>children residing in town vs.<br>non-residents |
| Barltrop et al.<br>1975 | Derbyshire,<br>England<br>Age: 2-3 yrs<br>N = 82 | Geom x in areas with soil lead:<br><1,000 ppm 420 ppm<br>>1,000-10,000 ppm 3,390 ppm<br>>10,000 ppm 13,969 ppm | Geom x in areas with soil lead:<br><1,000 ppm 531 ppm<br>>1,000-10,000 ppm 1,564 ppm<br>>10,000 ppm 2,582 ppm | 0.6 [a] |
| Barltrop et al.<br>1988 | N. Petherton<br>& Shipham, England<br>Age: 3 yrs<br>N = 178 | Geom x = soil<br>low 177 ppm<br>high 1,850 ppm | Geom x = dust<br>low 478 ppm<br>high 879 ppm | 0 [b] |

N/A not available

* defined as the increase in blood lead (ug/dl) per 1,000 ppm increase in soil lead

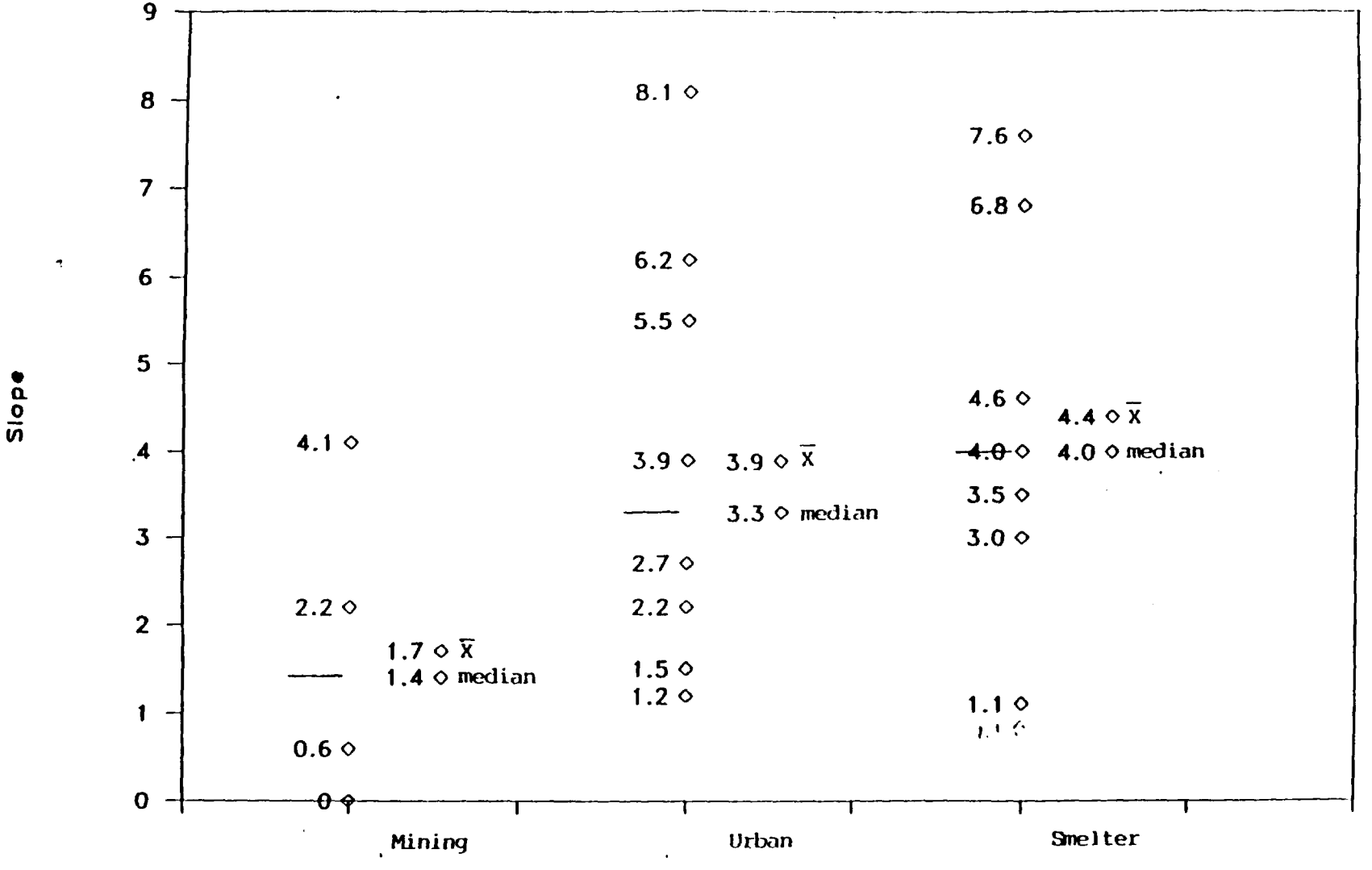
[a] calculated by EPA (U.S.EPA, 1986) - takes into account other sources of exposure

[b] ^PbB (ug/dl)/^PbS (ppm) - does not take into account other sources of exposure (calculated by Gradient)

[c] calculated by Duggan & Inskip, 1985 - corrected for increase due to inhalation of air lead

Figure 1

Slope Values for Mining, Smelter & Urban Studies[1]




1 See tables 1-3 for references

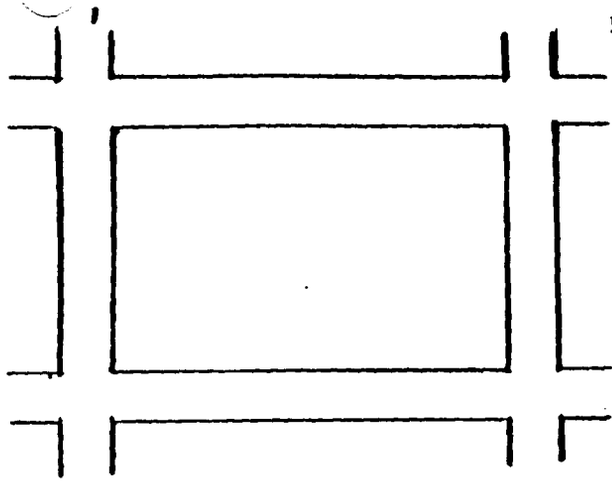
ATTACHMENT

| Medical Test | Cost | Quantity of BPR | ORGAN SYSTEM L | K | I | H | NP |
|---|---|---|---|---|---|---|---|
| Aspartate aminotransferase-- (AST or SGOT) | SMA - $10.00 | SMA - 12 mls B | X | | | | |
| Alanine aminotransferase-- (ALT or SPGT) | SMA | SMA | X | | | | |
| Gammaglutamyl transferase-- (GGT) | SMA | SMA | X | | | | |
| Alkaline phosphatase-- (AP) | SMA | SMA | X | | | | |
| Triglycerides | SMA | SMA | X | | | | |
| Cholesterol | SMA | SMA | X | | | | |
| Glucose | SMA | SMA | X | X | | | |
| Creatinine | SMA | SMA | X | | | | |
| Blood urea nitrogen-- (BUN) | SMA | SMA | X | X | | | |
| Serum electrolytes (sodium, potassium, chloride, bicarbonate) | SMA | SMA | | X | X | | |
| Urinalysis (routine dipstick with microscopic examination) | $ 3.00 | 12 mls U | | X | | | |
| Complete blood count including (differential, smear, hemoglobin, hematocrit, red blood cell indices) | $ 4.00 | 5 mls B, a | | | X | X | |
| Reticulocyte count | $ 4.00 | c | | | | X | |
| Total protein | SMA | SMA | X | X | X | | |
| Albumin | | | X | | X | | |
| Globulin | | | X | | X | | |
| Serum immunoglobulins (IgG, IgM, IgA, IgE) | $20.00 | b | | | X | | |
| Peripheral blood leukocyte surface marker analysis for: | $95.00 | c | | | | | |
| CD2 or CD3 lymphocytes (total T cells) | | | | | X | | |
| CD4 lymphocytes (helper T cells) | | | | | X | | |
| CD8 lymphocytes (mixed lymphocyte/ natural-killer cells) | | | | | X | | |
| CD8-CD3 lymphocytes (suppressor/cytotoxic T cells) | | | | | X | | |
| CD19 or CD20 lymphocytes (B cells) | | | | | X | | |

BFR--body fluid required
L--liver
K--kidney
I--immune system
H--hematologic
N--neuropsychological
SMA--included in SMA Chemistry Profile
a--3 mls blood for children
b--SMA tube contains sufficient blood for this test
c--complete blood count tube contains sufficient blood for this test
d--approximately $3500 for equipment and supplies as a one-time expense
B--whole blood
S--serum
U--urine
F--fasting specimen
M--early morning specimen
*$--figure is price, not cost

LEADVILLE HEAVY METALS EXPOSURE ASSESSMENT
SEPTEMBER 1987

BLOCK SURVEY FORM



Date _ _/_ _/87 Interviewer: _____

City: _____

Block # _ _ _ _

| Building # | Premises Address | Residential/ Single Family | Residential/ Multiple Family | Vacation/ Weekend | Business | Vacant | Census Completed | Census Refused | Comments |
|---|---|---|---|---|---|---|---|---|---|
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LEADVILLE HEAVY METALS EXPOSURE ASSESSMENT
September, 1987
CENSUS FORM

___ BLOCK __ B

Interviewer Initials __ . Date __ __/__ __/__ __ Time __ :__ am pm Adult at home? 1=yes 2=no Is this a year round residence? 1 2

Contact name _____ Last _____ First Best time to recontact __ __ : __ __

Address _____ Number _____ Street

Telephone Home __ __ __ - __ __ __ __
Work __ __ __ - __ __ __ __

Best day to recontact __Sun
__Mon
__Tue
__Wed
__Thu
__Fri
__Sat

Total number of persons in home ____ Contact #1 ____ #2 ____ #3 ____ #4 ____

Completion Status 1=Refused
2=Participate
3=No contact
4=Invalid address
5=Other

CENSUS FORM


| NAME | Sex 1=M 2=F | Relationship 1=self 2=spouse 3=parent 4=child 5=other family 6=other | Birthdate mo-day-yr | Lived in house 3 months? 1=yes 2=no | Lived in Leadville 3 months? 1=yes 2=no | Current miner in household? 1=yes 2=no | Past miner in household? 1=yes 2=no |
|---|---|---|---|---|---|---|---|
| 1. F_____ MI__ L_____ | __ | __ | __/__/__ | __ | __ | __ | __ |
| 2. F_____ MI__ L_____ | __ | __ | __/__/__ | __ | __ | __ | __ |
| 3. F_____ MI__ L_____ | __ | __ | __/__/__ | __ | __ | __ | __ |
| 4. F_____ MI__ L_____ | __ | __ | __/__/__ | __ | __ | __ | __ |
| 5. F_____ MI__ L_____ | __ | __ | __/__/__ | __ | __ | __ | __ |

| NAME | Sex 1=M 2=F | Relationship 1=self 2=spouse 3=parent 4=child 5=other family 6=other | Birthdate mo-day-yr | Lived in house 3 months? 1=yes 2=no | Lived in Leadville 3 months? 1=yes 2=no | Current miner in household? 1=yes 2=no | Past miner in household? 1=yes 2=no |
|---|---|---|---|---|---|---|---|
| 6. F_____ MI__ L_____ | __ | __ | __/__/__ | __ | __ | __ | __ |
| 7. F_____ MI__ L_____ | __ | __ | __/__/__ | __ | __ | __ | __ |
| 8. F_____ MI__ L_____ | __ | __ | __/__/__ | __ | __ | __ | __ |
| 9. F_____ MI__ L_____ | __ | __ | __/__/__ | __ | __ | __ | __ |
| 10. F_____ MI__ L_____ | __ | __ | __/__/__ | __ | __ | __ | __ |

Attachment F

# STATE OF COLORADO

**COLORADO DEPARTMENT OF HEALTH**

4210 East 11th Avenue
Denver, Colorado 80220
Phone (303) 320-8333

Roy Romer
Governor

Thomas M. Vernon, M.D.
Executive Director

## CONSENT FORM

## LEADVILLE HEAVY METAL STUDY
## BLOOD AND URINE SAMPLES

You are being asked to particpate in a study of your (or your child's/ward's) exposure to lead, cadmium and arsenic.

If you agree to participate in this study blood will be obtained by venipuncture which involves placing a needle in your (or your child's/ward's) arm and withdrawing 3 to 6 c.c.'s (about a teaspoonful) of blood. The needle will be left in for a few minutes. You can expect to experience some pain at the moment the needle goes into your arm. In about 10% of cases a small amount of bleeding under the skin will produce a bruise (hematoma). The risk of temporary clotting of the vein is about 1%, while the risk of infection of a hematoma or significant external blood loss is less that 1 in 1000.

In the case it is not possible to obtain blood from your child or ward by venipuncture, we will obtain blood samples by means of a finger stick. This is the standard method to obtain blood for routine hospital laboratory tests. Pain may be experienced when the lancet goes into the finger but otherwise the discomfort should be minimal. In about 10% of the cases a bruise will be produced and a small scar may persist for several weeks. The risk of infection is less than one in a thousand.

Urine samples may also be collected by urination into a container. The collections of blood and urine will be conducted by trained health specialists.

In addition, tap water samples and dust samples from inside and outside your home will be collected and analyzed for the content of arsenic, lead, cadmium and other metals. Furthermore, the paint on the inside and outside of your home will be measured for lead content. These procedures will take about one to one and a half hours. The investigators will also ask questions to help interpret the results such as smoking behavior, length of residence, etc.

Your participation is voluntary and refusal to participate will involve no penalty to you (or to your child/ward). You may withdraw from the study at any time without penalty or prejudice.

The investigators are not obligated to treat or further evaluate any problems that may be found. Results will be reviewed and interpreted by a panel of experts and a follow-up letter with interpretation will be sent to you. The results of the tests will be forwarded to your physician only with your permission. A list of private physicians will be supplied if you desire further care.

Blood samples will be analyzed for lead and a measure of the effects of lead. The blood sample will also be analyzed for the oxygen-carrying capacity of blood. The urine sample, if collected, will be analyzed for arsenic, cadmium and a measure of the effect of cadmium on the kidney.

The only benefit from this study will be the determination of the status of your (or your child's/ward's) exposure to lead, arsenic and cadmium.

Your name (or that of your child/ward) will NOT be used in any published report of this study.

AUTHORIZATION: I have read the above and understand the discomforts, inconveniences, and risks of this study. I agree to the participation of _____. I also give my permission to be contacted in the future should further testing be indicated. I understand that I (he/she) can refuse to participate or withdraw at any time. (Initial the first page of Consent Form if there are two or more pages used.)

DATE_____

SIGNED:_____
Adult Volunteer or Parent/Guardian

WITNESS_____
Investigator/Witness

To the Minor Child

We are going to take about a teaspoonful of blood by inserting a very small needle into your arm. There will be a small pain. It may leave a bruise or mark, but that will go away soon. We would also like you to take a small cup into the bathroom and urinate into it. This is to see if you have some chemicals in you.

For the participant who is a minor 7 years of age or older:
I agree with the consent given by my parent/guardian.

_____
Check, Initial, or Signature of Minor

# LEADVILLE HEAVY METAL EXPOSURE ASSESSMENT QUESTIONNAIRE

Household ID __ __ - __ __ (Block / Bldg.) Interviwer Initials __ __ __ (1-8)

Date __ __-__ __-__ __ Number of Selected Participants __ __ (9-16)

A. Children 6 months - 71 months (List by age, oldest first)

| | NAME | ID | LAB LABEL | Individual Completion | |
|---|---|---|---|---|---|
| 1. | _____ | __ __ | _____ | __ | (17-49) |
| 2. | _____ | __ __ | _____ | __ | (50-82) |
| 3. | _____ | __ __ | _____ | __ | (83-115) |
| 4. | _____ | __ __ | _____ | __ | (116-148) |

D. Person 6 - 14 years old

| | | | | |
|---|---|---|---|---|
| _____ | __ __ | _____ | __ | (149-181) |

C. Person 15 - 65 years old

| | | | | |
|---|---|---|---|---|
| _____ | __ __ | _____ | __ | (182-214) |

| Contact Number | Household Completion Status | Indiv. Compl. Codes |
|---|---|---|
| 1 ____ | 1=All complete | 1=Complete |
| 2 ____ | 2=Further visit needed | 2=Refusal |
| 3 ____ | | 3=Unable to contact |
| 4 ____ | | 4=Other |

Remarks:

The following person(s) has (have) been selected to be part of the second phase of the Leadville Heavy Metals Exposure Assessment. (List). We need to get some information on this (these) individual(s).

IF THERE ARE CHILDREN 6-71 MONTHS OR 6-14 YEARS:

For children under age 15 I will need to talk to the parent or legal guardian, preferably the person who can tell us about how the children spend their time.

IF THERE ARE SELECTED INDIVIDUALS 15+:

I will (also) need to talk to SELECTED INDIVIDUAL.

IF THIS IS PERSON NOT AVAILABLE:

When can I return to talk to SELECTED INDIVIDUAL?

__ __ __ DAY OF WEEK

__ __-__ __ MO-DAY

__ __:__ __ TIME AM PM

## 100. HOUSEHOLD CHARACTERISTICS

THE FOLLOWING QUESTIONS CAN BE ANSWERED BY ANY HOUSEHOLD MEMBER AGE 18 AND OVER

First I would like to ask you some questions about your home.

101. How long has this family been living in this home?

Years __ __ Months __ __ (215-218)

If less than three months, then obtain previous address within Leadville.

ADDRESS: _____

_____

102. What year was this house built?

Year __ __ __ __ (If unknown then enter 8888) (219-222)

103. Does your house have lead pipes for the plumbing?

1=Yes 2=No 8=Don't know (223)

104. What is the source of water for this house? (224)

1=City water lines

2=Private well

3=Other

8=Don't know

105. Have you repainted, sanded, or otherwise refinished any part of your home in the last month?

1=Yes 2=No 8=Don't know (225)

106. Have you ever repainted, sanded or otherwise refinished any part of your home prior to the last month?

1=Yes 2=No 8=Don't know (226)

If yes, ask for approximate year and month.

Year__ __ Month __ __ (227-230)

107. Does your home have storm windows?

1=Yes 2=No 8=Don't know (231)

Now I'd like to ask you some questions about the work and hobbies of persons living in this house.

108. Have any of the adults in the household worked as a miner or in a mining related job in the last 3 months?

1=Yes 2=No 8=Don't know (232)

IF YES, THEN COMPLETE QUESTIONS 109 through 112; OTHERWISE GO ON TO QUESTION 113.

109. Have any household member engaged in the following types of mine work in the last month?

| | | | | |
|---|---|---|---|---|
| a. Underground | 1=Yes | 2=No | 8=Don't know | (233) |
| b. Milling | 1=Yes | 2=No | 8=Don't know | (234) |
| c. Mill | 1=Yes | 2=No | 8=Don't know | (235) |
| d. Clerical/Admin. | 1=Yes | 2=No | 8=Don't know | (236) |
| e. Other | 1=Yes | 2=No | 8=Don't know | (237) |

110. What type of mine have family members worked in in the last month?

| | | | | |
|---|---|---|---|---|
| a. Lead only | 1=Yes | 2=No | 8=Don't know | (238) |
| b. Zinc only | 1=Yes | 2=No | 8=Don't know | (239) |
| c. Lead/Zinc | 1=Yes | 2=No | 8=Don't know | (240) |
| d. Silver | 1=Yes | 2=No | 8=Don't know | (241) |
| e. Molybdenum | 1=Yes | 2=No | 8=Don't know | (242) |
| f. Other | 1=Yes | 2=No | 8=Don't know | (243) |

111. Does any family member that works in a mine wear his/her work clothing home after working?

1=Yes 2=No 8=Don't know (244)

IF NO ASK Q.112; OTHERWISE GO ON TO Q.113.

112. Does any family member that works in a mine come home from work without showering?

1=Yes 2=No 8=Don't know (245)

113. Do you or any members of your household participate in any of the following hobbies or activities?

CODES: 1=Yes 2=No 8=Don't know

| | | | | |
|---|---|---|---|---|
| A. Paint pictures with artists paints? | 1 | 2 | 8 | (246) |
| B. Paint furniture in the home? | 1 | 2 | 8 | (247) |
| C. Work with stained glass? | 1 | 2 | 8 | (248) |
| D. Cast lead into fishing sinkers, bullets or anything else? | 1 | 2 | 8 | (249) |
| E. Work with soldering in electronics? | 1 | 2 | 8 | (250) |
| F. Work on soldering pipes? | 1 | 2 | 8 | (251) |
| G. Make pottery at home? | 1 | 2 | 8 | (252) |
| H. Ride a dirt bike or ATV in the local area? | 1 | 2 | 8 | (253) |

Now I'd like to ask you some questions about your diet and food preparation:

114. Does your family have a garden?

1=Yes 2=No 8=Don't know (254)

IF YES ASK Q.115;OTHERWISE GO ON TO Q.117.

115. Has soil been hauled in and placed on your garden?

1=Yes 2=No 8=Don't know (255)

116. About how often do members of your household eat vegetables grown in your garden or elsewhere in Leadville?

1=Once a week or more (256)
2=Occasionally (less than once per week)
3=Never IF NEVER GO ON TO Q.119
8=Don't know

117. About how often do members of your household eat leafy green vegetables, (such as lettuce or spinach) grown in your garden or elsewhere in Leadville?

1=Once a week or more (257)
2=Occasionally (less than once per week)
3=Never
8=Don't know

118. About how often do members of your household eat root vegetables, (such as beets or turnips) grown in your garden or elsewhere in Leadville?

1=Once a week or more (258)
2=Occasionally (less than once per week)
3=Never
8=Don't know

119. When food is served, is it ever served in homemade or imported clay pottery or ceramic dishes?

1=Yes 2=No 8=Don't know (259)

120. When food is stored or put away for awhile, is it sometimes stored in the original can after being opened?

1=Yes 2=No 8=Don't know (260)

121. Does anyone in this household smoke?

1=Yes 2=No 8=Don't know (261)

122. What is the highest grade or year of regular school that was completed by the head of this household

(262-263)

01=Elementary school
02=Junior High School
03=Some High School
04=High school graduate
05=Some college
06=College graduate
07=Graduate degree
08=Vocational school
09=Other
88=Don't know

123. Which of the statements in the following list comes closest to the total household income for this family before taxes in 1986?

(264)

1=Under $5,000
2=$5,000 or more but less than $10,000
3=$10,000 or more but less than $15,000
4=$15,000 or more but less than $20,000
5=$20,000 or more but less than $25,000
6=$25,000 or more but less than $30,000
7=$30,000 or more
8=Don't know
0=Refused to respond to this question

124. Do you have any dogs or cats that go in and out of the house?

1=Yes 2=No 8=Don't know (265)

125. Has anyone ever used any materials from the mines around your house or yard?

1=Yes 2=No 8=Don't know (266)

IF THERE IS AT LEAST ONE PARTICIPANT IN THIS HOUSEHOLD AGE 6-71 MONTHS, THEN PROCEED WITH SECTION 200.

IF NOT, AND THERE IS A PARTICIPANT AGE 6-14 YEARS PROCEED TO SECTION 300.

IF THE ONLY STUDY PARTICIPANT IS AGE 15 AND ABOVE PROCEED TO SECTION 400.

200. QUESTIONS ABOUT CHILDREN 6-71 MONTHS OLD. THESE SHOULD BE ANSWERED BY THE PARENT OR GUARDIAN OF THE CHILD

I need to ask a number of questions about (your/each) child that was selected for the study.

IF MORE THAN ONE:

I would like to start with the oldest.

LIST ALL INFORMATION IN SECTION 200 FOR THE FIRST CHILD AND THEN RETURN TO QUESTION 201 FOR THE SECOND OLDEST, ETC. MAKE SURE ORDER OF CHILDREN IS CONSISTENT WITH PAGE 1 OF THE QUESTIONNAIRE. ENTER RESPONSES TO QUESTIONS 201-204 IN TABLE 1 BELOW:

201. First of all, what is (the/that) child's name?

202. What is the child's date of birth? (MO/DA/YR)

203. What is the child's sex?

1=Male
2=Female

204. Circle code for race of each child. (Ask if necessary).

1=White, non-Hispanic
2=Hispanic
3=Black, non-Hispanic
4=Asian or Pacific Islander
5=American Indian/Alaska native
6=Other
7=Refused
8=Don't know

Table 1
Child's Characteristics

| Child No. | 201 NAME | 202 DATE OF BIRTH Mo-Da-Yr | 203 SEX 1=Male 2=Female | 204 RACE |
|---|---|---|---|---|
| 1 | _____ | __-__-__ | __ | __(267-74) |
| 2 | _____ | __-__-__ | __ | __(275-82) |
| 3 | _____ | __-__-__ | __ | __(283-90) |
| 4 | _____ | __-__-__ | __ | __(291-98) |

ENTER RESPONSE TO QUESTIONS 205-206 IN TABLE 2 BELOW:

205. Where does (child's name) spend most of his/her daytime hours?

1=At home
2=At babysitter
3=At a day care center
4=At a relative's home
5=At some other location.

206. About how many hours each day, on the average, does he/she spend away from home? (HOURS)

Table 2
Child's Daily Routine

| Child No. | 205 WHERE TIME SPENT DURING DAY | 206 AVERAGE HOURS AWAY | |
|---|---|---|---|
| 1 | 1 2 3 4 5 | __ __ | (299-301) |
| 2 | 1 2 3 4 5 | __ __ | (302-304) |
| 3 | 1 2 3 4 5 | __ __ | (305-307) |
| 4 | 1 2 3 4 5 | __ __ | (308-310) |

ENTER RESPONSES TO QUESTIONS 212-214 IN TABLE 4 BELOW:

212. Are his/her hands or face usually washed before eating?

1=Yes 2=No 8=Don't know

213. Are his/her hands or face usually washed before going to sleep?

1=Yes 2=No 8=Don't know

214. Are his/her hands or face usually washed after making mud pies, or playing with dirt or sand?

1=Yes 2=No 7=Not applicable 8=Don't know

Table 4
Hand Washing

| Child No. | 212 BEFORE EATS | 213 BEFORE SLEEP | 214 AFTER PLAY | |
|---|---|---|---|---|
| 1 | 1 2 8 | 1 2 8 | 1 2 7 8 | (335-37) |
| 2 | 1 2 8 | 1 2 8 | 1 2 7 8 | (338-40) |
| 3 | 1 2 8 | 1 2 8 | 1 2 7 8 | (341-43) |
| 4 | 1 2 8 | 1 2 8 | 1 2 7 8 | (344-46) |

ENTER ANSWERS TO QUESTIONS 215-220 IN TABLE 5 BELOW:

215. Has (CHILD'S NAME) used a pacifier in the last 6 months?

1=Yes 2=No 8=Don't know

216. Does he/she suck his/her thumb or fingers?

1=Yes 2=No 8=Don't know

217. Does he/she chew on his/her fingernails?

1=Yes 2=No 8=Don't know

218. Does he/she have a favorite blanket or stuffed toy?

1=Yes 2=No 8=Don't know

IF YES, ASK 219 AND 220. OTHERWISE SKIP TO QUESTION 221.

219. Does he/she carry this around during the day?

1=Yes 2=No 8=Don't know

220. Does he/she often put this in his/her mouth?

1=Yes 2=No 8=Don't know

Table 5

Mouthing Behavior

| | 215 | 216 | 217 | 218 | 219 | 220 | |
|---|---|---|---|---|---|---|---|
| CHILD NO. | PACIFIER | SUCK THUMB | CHEW NAILS | FAVORITE BLANKET/TOY | CARRY AROUND | TOY/ BLANKET MOUTH | |
| 1 | 1 2 8 | 1 2 8 | 1 2 8 | 1 2 8 | 1 2 8 | 1 2 8 | (347-52) |
| 2 | 1 2 8 | 1 2 8 | 1 2 8 | 1 2 8 | 1 2 8 | 1 2 8 | (353-58) |
| 3 | 1 2 8 | 1 2 8 | 1 2 8 | 1 2 8 | 1 2 8 | 1 2 8 | (359-64) |
| 4 | 1 2 8 | 1 2 8 | 1 2 8 | 1 2 8 | 1 2 8 | 1 2 8 | (365-70) |

ENTER THE RESPONSES TO QUESTIONS 221-226 IN TABLE 6 BELOW:

221. How many hours during the day do you think he/she usually spends playing on the floor when indoors in this home? (HOURS)
88=Don't know

222. Many children put some things other than food into their mouths. Would you say that (CHILD'S NAME):

1=Does this alot 3=Almost never
2=Just once in a while 8=Don't know

223. Does he/she put his/her mouth on furniture or on the window sill:

1=Does this alot 3=Almost never
2=Just once in a while 8=Don't know

224. Sometimes children swallow things other than food. Would you say that (CHILD'S NAME) swallows things other than food:

1=Does this alot 3=Almost never
2=Just once in a while 8=Don't know

(IF YES, SPECIFY ITEMS SWALLOWED BELOW)

225. Does (CHILD'S NAME) ever put paint chips in his/her mouth?

1=Does this alot 3=Almost never
2=Just once in a while 8=Don't know

226. Does (CHILD'S NAME) eat snow?

1=Does this alot 3=Almost never
2=Just once in a while 8=Don't know

Table 6
Things in mouth

| CHILD NO. | 221 HOURS | 222 THINGS IN MOUTH | 223 FURNITURE/ WINDOW SILL | 224 SWALLOWS | 225 PAINT CHIPS | 226 EATS SNOW | |
|---|---|---|---|---|---|---|---|
| 1 | __ __ | __ | __ | __ | __ | __ | (371-77) |
| 2 | __ __ | __ | __ | __ | __ | __ | (378-84) |
| 3 | __ __ | __ | __ | __ | __ | __ | (385-91) |
| 4 | __ __ | __ | __ | __ | __ | __ | (392-98) |

SPECIFY THINGS SWALLOWED:

Child No Item(s) swallowed:

__ _____

ENTER THE RESPONSES TO QUESTIONS 227 AND 228 IN TABLE 7 BELOW:

227. How often does (CHILD'S NAME) eat fish including tuna, shrimp, crabs, clams, or other seafood?

1=At least once a week
2=At least once a month
3=Less than once a month
8=Don't know

IF YES, PLEASE ASK QUESTION 228; OTHERWISE SKIP TO NEXT PAGE.

228. In the past week, how many meals did he/she have seafood? (MEALS)

Table 7
Seafood

| CHILD NO. | 227 EATS SEAFOOD | 228 SEAFOOD MEALS LAST WEEK | |
|---|---|---|---|
| 1 | 1 2 3 8 | ___ ___ | (399-401) |
| 2 | 1 2 3 8 | ___ ___ | (402-404) |
| 3 | 1 2 3 8 | ___ ___ | (405-407) |
| 4 | 1 2 3 8 | ___ ___ | (408-410) |

IF THERE IS NO CHILD AGE 6-14 OR ADULT PARTICIPANT IN THIS HOUSEHOLD, THEN THE QUESTIONNAIRE IS COMPLETED.

IF THERE IS A CHILD PARTICIPANT 6-14 THEN PROCEED WITH SECTION 300.

IF THERE IS NO CHILD PARTICIPANT, BUT THERE IS AN ADULT PARTICIPANT GO ON TO SECTION 400.

300. QUESTIONS ABOUT SELECTED CHILDREN 6-14 YEARS OLD. THESE SHOULD BE ANSWERED BY THE PARENT OR GUARDIAN OF THE CHILD WITH THE CHILD PRESENT

I need to ask a number of questions about your child (CHILD'S NAME) that was selected for the study.

301. First of all, the child's name is (CHILD'S NAME), is this correct?

IF CORRECT, ENTER HERE; OTHERWISE DETERMINE IF THE PROPER INDIVIDUAL HAS BEEN CONTACTED AND MAKE APPROPRIATE ADJUSTMENTS

NAME _____

302. What is the child's date of birth?

__ __-__ __-__ __ (MO-DA-YR) (411-416)

303. What is the child's sex?

1=Male (417)
2=Female

304. Circle code for race of each child. (Ask if necessary).

| | | |
|---|---|---|
| 1=White, non-Hispanic | 5=American Indian/Alaska native | |
| 2=Hispanic | 6=Other | (418) |
| 3=Black, non-Hispanic | 7=Refused | |
| 4=Asian or Pacific Islander | 8=Don't know | |

305. Where does (child's name) spend most of his/her daytime hours?

1=At home (419)
2=At babysitter
3=At a day care center
4=At a relative's home
5=At some other location.

306. About how many hours each day, on the average, does he/she spend away from home?

__ __ (HOURS) (420-421)

307. How often does (CHILD'S NAME) eat fish including tuna, shrimp, crabs, clams, or other seafood?

1=At least once a week (422)
2=At least once a month
3=Less than once a month
4=Never
8=Don't know

IF YES, PLEASE ASK QUESTION 308; OTHERWISE GO ON TO QUESTION 309.

308. In the past week, how many meals did he/she have seafood?

__ __ (MEALS) (423-424)

309. Does he/she play outdoors around the house or in the neighborhood?

1=Yes 2=No 8=Don't know (425)

310. If yes, then how many hours a day on the average does he/she play outdoors?

__ __ (HOURS) (426-427)

311. Where does he/she usually play when outdoors around the house?

1=Back yard
2=Front yard
3=Side yard
7=Other
8=Don't know
(428)

312. Is the ground where he/she usually plays mainly grassy, concrete/asphalt, plain dirt or soil, just a sandbox, or some other composition?

1=Grassy
2=Concrete/asphalt
3=Dirt/soil
4=Sandbox
7=Other (specify)
8=Don't know
(429)

313. Does he/she often take some food or a bottle with him/her outside to play?

1=Yes 2=No 8=Don't know (430)

314. Where does he/she usually play outdoors in the last 3 months when he/she is not playing in your own home yard?

1=Neighbor's yard (431)
2=School playground
3=Near or around creek
4=On or near tailings or slag piles
5=On sidewalks or streets
6=Other (specify)
8=Don't know

315. Are his/her hands or face usually washed before eating?

1=Yes 2=No 8=Don't know (432)

316. Are his/her hands or face usually washed before going to sleep?

1=Yes 2=No 8=Don't know (433)

317. Are his/her hands or face usually washed after making mud pies, or playing with dirt or sand?

1=Yes 2=No 7=Not applicable 8=Don't know (434)

318. Does he/she suck his/her thumb or fingers?

1=Yes 2=No 8=Don't know (435)

319. Does he/she chew on his/her fingernails?

1=Yes 2=No 8=Don't know (436)

320. Sometimes children swallow things other than food. Would you say that (CHILD'S NAME) swallows things other than food:

1=Does this alot (437)
2=Just once in a while
3=Almost never
8=Don't know

IF YES, SPECIFY THINGS SWALLOWED: _____

_____

321. Does (CHILD'S NAME) eat snow?

1=Does this alot (438)
2=Just once in a while
3=Almost never
8=Don't know

322. Does (CHILD'S NAME) participate in any of the following hobbies or activities?

1=Yes 2=No 8=Don't know

| | | | | | |
|---|---|---|---|---|---|
| A. | Paint pictures with artists paints? | 1 | 2 | 8 | (439) |
| B. | Paint furniture in the home? | 1 | 2 | 8 | (440) |
| C. | Work with stained glass? | 1 | 2 | 8 | (441) |
| D. | Cast lead into fishing sinkers, bullets or anything else? | 1 | 2 | 8 | (442) |
| E. | Work with soldering in electronics? | 1 | 2 | 8 | (443) |
| F. | Work on soldering pipes? | 1 | 2 | 8 | (444) |
| G. | Make pottery at home? | 1 | 2 | 8 | (445) |
| H. | Ride a dirt bike or ATV in the local area? | 1 | 2 | 8 | (446) |

IF THERE IS NO ADULT STUDY PARTICIPANT, THEN THE QUESTIONNAIRE IS COMPLETE.

IF THERE IS AN ADULT PARTICIPANT, PROCEED WITH SECTION 400.

400. QUESTIONS FOR SELECTED PERSON AGE 15-65; THESE QUESTIONS NEED TO BE ANSWERED BY THE SELECTED INDIVIDUAL

401. First of all, let me verify that your name is (NAME) ); is this correct?

IF CORRECT, ENTER HERE; OTHERWISE DETERMINE IF THE PROPER INDIVIDUAL HAS BEEN SELECTED AND MAKE APPROPRIATE ADJUSTMENTS

NAME _____

402. What is your date of birth?

__ __-__ __-__ __ (MO-DA-YR) (447-452)

403. Your sex is (SEX):

1=Male (453)

2=Female

404. What is your race?

1=White, non-Hispanic
2=Hispanic
3=Black, non-Hispanic
4=Asian or Pacific Islander
5=American Indian/Alaska native
6=Other (454)
7=Refused
8=Don't know

405. Do you work as a miner or in a mining related job?

1=Yes 2=No (455)

IF YES, CONTINUE WITH QUESTION 407;OTHERWISE ASK QUESTION 406.

406. Have you worked as a miner or in a mining related job in the past 6 months?

1=Yes 2=No (456)

IF YES, CONTINUE WITH QUESTION 407;OTHERWISE GO ON TO QUESTION 413.

407. What type of mine work have you (or were you) engaged in primarily in the last month?

1=Underground (457)
2=Milling
3=Mill
4=Clerical/Admin.
5=Other

408. What type of mine do you work (have you worked) at?

1=lead only (458)
2=zinc only
3=lead/zinc
4=silver
5=molybdenum
7=other

409. What is the name of the place where you work (have worked)?

_____

410. How long have you worked (did you work there) there, in years?

__ __ YEARS 00=Less than one year (459-460)

411. Do (did) you change out of your work clothes and leave them at work?

1=Yes 2=No (461)

412. Do (did) you shower at work before coming home?

1=Yes 2=No (462)

413. Do you participate in any of the following hobbies or activities?

1=Yes 2=No

| | | | |
|---|---|---|---|
| A. | Paint pictures with artists paints? | 1 2 | (463) |
| B. | Paint furniture in the home? | 1 2 | (464) |
| C. | Work with stained glass? | 1 2 | (465) |
| D. | Cast lead into fishing sinkers, bullets or anything else? | 1 2 | (466) |
| E. | Work with soldering in electronics? | 1 2 | (467) |
| F. | Work on soldering pipes? | 1 2 | (468) |
| G. | Make pottery at home? | 1 2 | (469) |
| H. | Ride a dirt bike or ATV in the local area? | 1 2 | (470) |

414. How often do you eat fish including tuna, shrimp, crabs, clams, or other seafood?

1=At least once a week (471)
2=At least once a month
3=Less than once a month
4=Never

IF EVER, PLEASE ASK QUESTION 415; OTHERWISE GO ON TO QUESTION 416.

415. In the past week, how many seafood meals did you have?

__ __ (MEALS) (472-473)

416. Do you have a garden?

1=Yes 2=No (474)

417. If yes, then do you frequently till, plant and weed the garden yourself?

1=Yes 2=No (475)

418. Have you done any of the following activities in the last month?

| | | | |
|---|---|---|---|
| 1=Painted a house inside or out | 1=Yes | 2=No | (476) |
| 2=Painted furniture | 1=Yes | 2=No | (477) |
| 3=Applied insecticides | 1=Yes | 2=No | (478) |

END OF QUESTIONNAIRE

ATTACHMENT #3

# LEEDS LEAD EXPOSURE ASSESSMENT QUESTIONNAIRE

INSTRUCTIONS TO THE :

INTERVIEWER & KEYPUNCHER

SECTION I - HOUSEHOLD CHARACTERISTICS

(YELLOW) ( 100 SERIES - PAGES 1 - 8 )

SECTION II - HOUSEHOLD MEMBER(S)
AGE(S) 9 MONTHS - 71 MONTHS
(9 months - less than 6 years)

(PINK) ( 200 SERIES - PAGES 9 - 15 )

I. GENERAL



Household ID ___ ___ ___-___ ___ (1
Block Bld.

Interviewer Initials ___ ___ ___ (6

Date ___ ___-___ ___-___ ___ (9
Month Day Year

A. HOUSEHOLD MEMBERS

A1. CHILDREN 9 MONTHS - 71 MONTHS (LIST BY AGE, YOUNGEST FIRST)
(9 months - less than 6 years old)

| Child Number | Name | ID number | Lab specimen label no. | Individua. completio: code ** | |
|---|---|---|---|---|---|
| 1. | _____ | ___ ___ | ___ ___ ___ | ___ | (: |
| 2. | _____ | ___ ___ | ___ ___ ___ | ___ | (2 |
| 3. | _____ | ___ ___ | ___ ___ ___ | ___ | (2 |
| 4. | _____ | ___ ___ | ___ ___ ___ | ___ | (3 |
| 5. | _____ | ___ ___ | ___ ___ ___ | ___ | (3 |
| 6. | _____ | ___ ___ | ___ ___ ___ | ___ | (4 |

** Individual Completion Codes

1 = Questionnaire only
2 = Blood test only
3 = Both completed
4 = Neither (refused)
5 = Other

**THE FOLLOWING QUESTIONS MUST BE ANSWERED BY A MEMBER OF THE HOUSEHOLD WHO IS 18 OR OVER, PREFERABLY THE PARENT**

## B.1. HOME

101. How long have the household members been living in this home?

(Enter 00 if less than 12 months) ___ ___ years (51-5

If LESS than 12 Months: ___ ___ months (53-5

If LESS than two months,
then write previous address within Leeds.

Address: _____

_____

102. What is the age of your current house? ___ ___ ___ years (55-5
(how many years old)

IF UNKNOWN THEN ENTER 999

103. Does your house have lead pipes for the plumbing? ___ (58)

1=Yes
2=No
9=Don't know

104. What is the source of water for this house? ___ (59)

1=City water lines
2.Private well
3=Other (specify _____ )
9=Don't know

105. Has anyone in your household removed old paint by sanding or othe methods and refinished or repainted any part of your home in the LAST TWO MONTHS ?

1=Yes
2=No
9=Don't know ___ (60)

106. Has anyone in your household removed old paint by sanding or o methods and refinished or repainted any part of your home **PRIOR TO THE LAST TWO MONTHS BUT WITHIN THE LAST ONE YEAR?**

1=Yes (approximately when ? ___ ___/ ___ ___ ) ____ (61
2=No month year (62-
9=Don't know

## B2. WORK and HOBBIES

107. In the last 6 months, has any member of the household worked at Interstate Lead Company (ILCO)?

1=Yes
2=No
9=Don't know ____ (66)

108. In the last 6 months, has any household member worked in one or more of these following jobs?

| | 1=Yes 2=No 9=Don't Know | |
|---|---|---|
| A. Foundry worker | ____ | (67) |
| B. Oil refinery worker | ____ | (68) |
| C. Painter | ____ | (69) |
| D. Chemical plant worker | ____ | (70) |
| E. Plumber | ____ | (71) |
| F. Glass worker | ____ | (72) |
| G. Paint pigment, zinc, or copper worker | ____ | (73) |
| H. Other lead-related industry worker | ____ | (74) |
| I. Lead smelter/battery plant worker | ____ | (75) |

**IF YES TO ANY OF THE QUESTIONS IN Q.107 OR Q.108 CONTINUE WITH Q.109;**

**IF NO, SKIP TO Q.112.**

109. Is any member of your household **PRESENTLY** (now) working in any of these jobs or at Interstate Lead Company (ILCO)?

1=Yes (SKIP TO Q.110)
2=No
9=Don't know ____ (76)

109.A. If he/she is not currently working, then when did he/she stop working at that job or ILCO?

___ ___ / ___ ___ (77-
Month / Year

110. Does the household member that works in one of these jobs or at ILCO wear his/her work clothing home?

1=Yes
2=No
9=Don't know ____ (81)

111. Does any household member that works in one of these jobs or at ILCO shower at work?

1=Yes
2=No
9=Don't know ____ (

112. Do you or any members of your household participate in any of t following hobbies or activities?

1=Yes 2=No 9=Don't

A. Paint pictures with artist's paints? ____

B. Paint furniture in the home? ____

C. Work with stained glass? ____

D. Cast lead into fishing sinkers, bullets or anything else? ____

E. Work with soldering in electronics? ____

F. Work on soldering pipes? ____

G. Make pottery at home? ____

H. Ride a dirt bike or All-terrain Vehicle in the local area? ____

B3. DIET and FOOD PREPARATION

113. Does your household have a vegetable garden? ____

1=Yes
2=No (SKIP TO Q.119)
9=Don't know

114. Has soil been hauled in and placed on your garden?

1=Yes
2=No
9=Don't know ____

115. During the growing season, about how often do members of your household eat **VEGETABLES** that were grown **IN YOUR GARDEN** ?

1=Once a week or more
2=Occasionally (less than once per week)
3=Never (SKIP TO Q.119)
9=Don't Know ____ (93)

116. About how often do members of your household eat VEGETABLES, specifically, **LEAFY GREEN VEGETABLES**, (such as lettuce or spinac and not tomatoes, squash, etc.) grown **IN YOUR GARDEN** ?

1=Once a week or more
2=Occasionally (less than once per week)
3=Never
9=Don't Know ____ (94)

117. About how often do members of your household eat VEGETABLES, specifically, **ROOT VEGETABLES** (such as beets, turnips, carrots, potatoes) grown **IN YOUR GARDEN** ?

1=Once a week or more
2=Occasionally (less than once per week)
3=Never
9=Don't Know ____ (

118. Are the vegetables grown **IN YOUR GARDEN** washed before cooking ?

1=Always
2=Sometimes
3=Never
9=Don't know ____ (96)

119. During the growing season, about how often do members of your household eat **VEGETABLES** that were grown **ELSEWHERE IN LEEDS** ?

1=Once a week or more
2=Occasionally (less than once per week)
3=Never (SKIP TO Q.123)
9=Don't Know ____ (97)

120. About how often do members of your household eat VEGETABLES, specifically, LEAFY GREEN VEGETABLES, (such as lettuce or spina and not tomatoes, squash, etc.) grown ELSEWHERE IN LEEDS?

1=Once a week or more
2=Occasionally (less than once per week)
3=Never
9=Don't Know ____ (98)

121. About how often do members of your household eat VEGETABLES, specifically, ROOT VEGETABLES (such as beets, turnips, carrots, potatoes) grown ELSEWHERE IN LEEDS?

1=Once a week or more
2=Occasionally (less than once per week)
3=Never
9=Don't Know ____ (99)

122. Are the vegetables grown ELSEWHERE IN LEEDS washed before cooki

1=Always
2=Sometimes
3=Never
9=Don't know ____ (100)

B4. OTHER

123. When food is served in your home, is it ever served in homemade or imported clay pottery or ceramic dishes?

1=Yes
2=No
9=Don't know ____ (101)

124. When canned food is stored in your home or put away for awhile, is it sometimes stored in the original can after being opened?

1=Yes
2=No
9=Don't know ____ (102)

125. Does anyone in this household smoke tobacco? (e.g;cigarettes,cigars)

1=Yes
2=No
9=Don't know ____ (103)

126. Are there dogs or cats that go in and out of the house?

1=Yes
2=No
9=Don't know ____ (104)

127. During the last six(6) months has anyone in your household ever borrowed or rented materials belonging to the ILCO plant such as equipment or other items that were used in or around your house or yard?

1=Yes
2=No
9=Don't know ____ (105)

128. What is the highest grade or year of regular school that was completed by anyone in your household?
(the number of years in school) ____ ____ (106-1

129. Which of the statements in the following list comes closest to the total household income for this family before taxes in 1987?

1 = Under $5,000 ____ (108)
2 = $5,000 - less than $10,000
3 = $10,000 - less than $15,000
4 = $15,000 - less than $20,000
5 = $20,000 - less than $25,000
6 = $25,000 - less than $30,000
7 = $30,000 or more
8 = Refused to respond to this question
9 = Don't know

SECTION II - HOUSEHOLD MEMBER(S) AGE(S) 9-71 MONTHS (9 months - < 6 year
(PINK) ( 200 SERIES - PAGES 9 - 15 )

INTERVIEWER :

THE QUESTIONS OF THIS SECTION SHOULD BE ANSWERED BY A PARENT OR GUARDIA OF THE CHILD

Complete all information for the youngest child interviewed and then rep questions 201-225 for each older child interviewed.

MAKE SURE ORDER OF EACH CHILD IS CONSISTENT WITH PAGE 1 OF THE QUESTIONNAIRE. ENTER RESPONSES TO QUESTIONS 201-204 IN TABLE 1 BELOW.

TABLE 1. CHILD'S CHARACTERISTICS (questions 201 to 204)

| Child No. | Q.201 NAME | Q.202 DATE OF BIRTH Month - Day - Year | Q.203 SEX | Q.204 RACE | |
|---|---|---|---|---|---|
| 1. | _____ | __ __-__ __-__ __ | __ | __ | (109-11 |
| 2. | _____ | __ __-__ __-__ __ | __ | __ | (117-12 |
| 3. | _____ | __ __-__ __-__ __ | __ | __ | (125-13 |
| 4. | _____ | __ __-__ __-__ __ | __ | __ | (133-14 |
| 5. | _____ | __ __-__ __-__ __ | __ | __ | (141-14 |
| 6. | _____ | __ __-__ __-__ __ | __ | __ | (149-15 |

QUESTIONS 201 - 204. I NEED TO ASK A NUMBER OF QUESTIONS ABOUT (YOUR/EACH CHILD THAT WAS SELECTED FOR THE STUDY - STARTING WITH THE YOUNGEST.

201. What is the child's name?

202. What is the child's date of birth? Month-Day-Year

203. What is the child's sex? 1=Male 2=Female

204. What is the race of each child. (Read list)

1=White
2=Black
3=American Indian/Alaska native
4=Asian or Pacific Islander
5=Refused
6=Other
9=Don't Know

**ENTER RESPONSE TO QUESTIONS 205-206 IN TABLE 2 BELOW:**

**TABLE 2. Child's Daily Routine (questions 205 to 206 )**

| CHILD No. | Q.205 WHERE TIME SPENT DURING DAY | (specify if 6) | Q.206 AVERAGE HOURS AWAY | |
|---|---|---|---|---|
| 1. | ___ | _____ | ___ ___ | (15 |
| 2. | ___ | _____ | ___ ___ | (16 |
| 3. | ___ | _____ | ___ ___ | (16 |
| 4. | ___ | _____ | ___ ___ | (16 |
| 5. | ___ | _____ | ___ ___ | (16 |
| 6. | ___ | _____ | ___ ___ | (17 |

205. Where does (child's name) usually spend most of his/her daytime hours?

1=At home
2=At school
3=At baby-sitter
4=At a day care center
5=At a relative's home
6=Other location.(specify)

206. About how many hours each day, on the average, does he/she spend away from home? (HOURS)

**ENTER RESPONSES TO QUESTIONS 207-211 IN TABLE 3 BELOW:**

**TABLE 3. OUTDOOR PLAY HABITS (questions 207 - 211)**

| CHILD NO. | Q.207 PLAYS | Q.208 HOURS | Q.209 WHERE PLAY (specify if 6) | Q.210 GROUND TYPE (specify if 6) | |
|---|---|---|---|---|---|
| 1. | ___ | ___ ___ | ___ _____ | ___ _____ | (175-179 |
| 2. | ___ | ___ ___ | ___ _____ | ___ _____ | (180-184 |
| 3. | ___ | ___ ___ | ___ _____ | ___ _____ | (185-189 |
| 4. | ___ | ___ ___ | ___ _____ | ___ _____ | (190-194 |
| 5. | ___ | ___ ___ | ___ _____ | ___ _____ | (195-199 |
| 6. | ___ | ___ ___ | ___ _____ | ___ _____ | (200-204 |

207. Does (CHILD'S NAME) play outdoors around the house or in the neighborhood?

1=Yes
2=No (SKIP TO Q.209)
9=Don't know

208. How many hours a day on the average does (CHILD'S NAME) play outdoors? (HOURS) 99=Don't know

209. Where does (CHILD'S NAME) usually play when outdoors around the house?

1=Back yard
2=Front yard
3=Side yard
4="All over"
8=Other(specify)_____
9=Don't know

210. Which of the following best describes the composition of the ground where (CHILD'S NAME) usually plays ?

1=Grass
2=Concrete/asphalt
3=Dirt/soil
4=Sandbox
5.All of the above
8=Other (specify)_____
9=Don't know

**ENTER RESPONSES TO QUESTIONS 211-213 IN TABLE 4 BELOW:**

TABLE 4. HAND WASHING HABITS (questions 211 - 213)

| Child No. | Q.211 TAKES BOTTLE | Q.212 PLAYING OUTSIDE (specify if 6) | Q.213 WASHES HANDS BEFORE EATING | |
|---|---|---|---|---|
| 1. | ____ | ____ _____ | ____ | (205-207) |
| 2. | ____ | ____ _____ | ____ | (208-210) |
| 3. | ____ | ____ _____ | ____ | (211-213) |
| 4. | ____ | ____ _____ | ____ | (214-216) |
| 5. | ____ | ____ _____ | ____ | (217-219) |
| 6. | ____ | ____ _____ | ____ | (220-222) |

211. How often does (CHILD'S NAME) take some food or a bottle with him/her outside to play?

1. Always
2. Sometimes
3. Never
9. Don't know

212. Where did (CHILD'S NAME) usually play outdoors when he/she was not pla in your yard at home?

1=Neighbor's yard
2=School playground
3=Near or around any creek
4=On or near ILCO site or waste areas
5=On sidewalks or streets
6=Other (specify)_____
9=Don't know

213. Are (CHILD'S NAME) hands usually washed before eating?

1=Yes
2=No
9=Don't know

**ENTER RESPONSES TO QUESTIONS 214-218 IN TABLE 5 BELOW:**

**TABLE 5. MOUTHING HABITS (questions 214 - 218)**

| CHILD NO. | Q.214 WASHES HANDS BEFORE SLEEPING | Q.215 WASHES HANDS AFTER PLAYING | Q.216 PACIFIER | Q.217 SUCK THUMB | Q.218 CHEW NAILS | |
|---|---|---|---|---|---|---|
| 1. | ____ | ____ | ____ | ____ | ____ | (223-2 |
| 2. | ____ | ____ | ____ | ____ | ____ | (228-2 |
| 3. | ____ | ____ | ____ | ____ | ____ | (233-2 |
| 4. | ____ | ____ | ____ | ____ | ____ | (238-2 |
| 5. | ____ | ____ | ____ | ____ | ____ | (243-2 |
| 6. | ____ | ____ | ____ | ____ | ____ | (248-2 |

214. Are (CHILD' NAME) hands usually washed before going to sleep?

1=Yes
2=No
9=Don't know

215. Are (CHILD'S NAME) hands usually washed after playing with dirt or sand?

1=Yes
2=No
7=Not applicable
9=Don't know

216. Has (CHILD'S NAME) used a pacifier in the last 6 months?

1=Yes
2=No
9=Don't know

217. Does (CHILD'S NAME) suck his/her thumb or fingers?

1=Yes
2=No
9=Don't know

218. Does (CHILD'S NAME) chew on his/her fingernails?

1=Yes
2=No
9=Don't know

**ENTER RESPONSES TO QUESTIONS 219-222 IN TABLE 6 BELOW:**

**TABLE 6. MOUTHING HABITS (questions 219 - 222)**

| CHILD NO. | Q.219 FAVORITE BLANKET/TOY | Q.220 CARRY AROUND | Q.221 TOY/BLANKET MOUTH | Q.222 HOURS | |
|---|---|---|---|---|---|
| 1. | ___ | ___ | ___ | ___ ___ | (253- |
| 2. | ___ | ___ | ___ | ___ ___ | (258- |
| 3. | ___ | ___ | ___ | ___ ___ | (263- |
| 4. | ___ | ___ | ___ | ___ ___ | (268- |
| 5. | ___ | ___ | ___ | ___ ___ | (273- |
| 6. | ___ | ___ | ___ | ___ ___ | (278- |

219. Does (CHILD'S NAME) have a favorite blanket or stuffed toy?

1=Yes
2=No (SKIP TO Q.222)
9=Don't know

220. Does (CHILD'S NAME) carry this blanket or toy around during the day?

1=Yes
2=No
9=Don't know

221. Does (CHILD'S NAME) often put this blanket or toy in his/her mouth?

1=Yes
2=No
9=Don't know

222. How many hours each day do you think (CHILD'S NAME) usually spends playing on the floor when indoors in this home? (HOURS)

99=Don't know

**ENTER RESPONSES TO QUESTIONS 223-225 IN TABLE 7 BELOW:**

TABLE 7. MOUTHING HABITS (questions 223 - 225)

| CHILD NO. | Q.223 THINGS IN MOUTH | Q.224 FURNITURE/ WINDOW SILL | Q.225 PAINT CHIPS | |
|---|---|---|---|---|
| 1. | ____ | ____ | ____ | (283-285) |
| 2. | ____ | ____ | ____ | (286-288) |
| 3. | ____ | ____ | ____ | (289-291) |
| 4. | ____ | ____ | ____ | (292-294) |
| 5. | ____ | ____ | ____ | (295-297) |
| 6. | ____ | ____ | ____ | (298-300) |

223. How often does (CHILD'S NAME) put things other than food into his/he: mouth and suck or swallow them?

1=Does this a lot
2=Just once in a while
3=Almost never
4=Never
9=Don't know

224. How often does (CHILD'S NAME) put his/her mouth on furniture or on th window sill?

1=Does this a lot
2=Just once in a while
3=Almost never
4=Never
9=Don't know

225. How often does (CHILD'S NAME) ever put paint chips in his/her mouth?

1=Does this a lot
2=Just once in a while
3=Almost never
4=Never
9=Don't know

THANK YOU VERY MUCH FOR ANSWERING THESE QUESTIONS

Attachment #4

# Colorado Metal Study

## CASE 87-0026

## SPECIMEN COLLECTION AND SHIPPING PROTOCOL

Division of Environmental Health Laboratory Sciences
Center for Environmental Health
Centers for Disease Control
Atlanta, Georgia 30333

Prepared:
Revised:

2360s

I. INTRODUCTION Page 2

II. URINE COLLECTION AND PROCESSING

A. COLLECTION PROCEDURE Page 3

B. PROCESSING PROCEDURE Page 3

III. SERUM PROCESSING Page 8

IV. SHIPMENT OF SPECIMENS TO CDC, ATLANTA, GA.

A. BEGINNING OF STUDY AND GENERAL INSTRUCTIONS Page 9

B. SPECIMEN SHIPPING LIST Page 10

C. FROZEN SPECIMENS Page 11

D. REFRIGERATED SPECIMENS Page 11

V. FLOW CHARTS:

URINE COLLECTION AND PROCESSING PROTOCOL FOR SPECIMENS Page 13

BLOOD COLLECTION AND PROCESSING PROTOCOL Page 22

## I. INTRODUCTION

The proper collection processing, storage and shipment of physiologic specimens from participants in the Colorado Metal study is critical to the success of the study. The following sections describe the procedures which must be followed for all specimen collections. These procedures must be strictly adhered to in order to avoid contamination, loss, or degradation of the specimens. Please familiarize yourself with the study protocol and insure that you understand the concept of the study, the role of all of the personnel involved, and your own role.

Note that subjects are to report to the clinic in a fasting state and this will require that blood collection be accomplished early in the visit to avoid discomfort to the subject and an adverse impact on compliance. Blood and urine collection must be completed and processed under carefully controlled conditions of good laboratory practice. Blood separation and processing must be accomplished promptly to avoid degradation of the specimen.

It is extremely important that all records associated with each subject be maintained in an organized and complete manner to ensure that all information is properly collected and accurate. Specimens should be labeled promptly and processed as a unit or "run" and precautions must be taken to avoid patient - specimen - label - record mixups. This type of error is usually the most common error in the laboratory setting, but careful planning and a well organized work area will keep such errors at a minimum. Some of the information required for the specimen label and shipping list will be collected at the time of specimen collection. Problems in blood and/or urine collection should be noted in the sample log and in the comments section of the shipping list.

## II. URINE COLLECTION AND PROCESSING (See protocol flowchart on page 20 and 21)

### A. COLLECTION PROCEDURE

1. Materials needed per participant.

   - Urine collection cup (250 mL, plastic, sterile)
   - Small Zip-lock bag
   - Preprinted label

2. Preparation of urine collection cup for participant.

   - Remove the cup and cap from its plastic wrapping being careful not to dislodge the cap or touch the inside of the container or cap.

   - Seal the cap on the container and affix the participant's preprinted label marked "URINE CONTAINER" and write their name on the label using a ballpoint pen.

3. Instructions for urine collection.

   - The following instructions should be explained to the participant prior to urine collection.

     . Hands should be washed with soap and water.

     . The collection cup should not be opened until just before voiding.

     . The person should leave the cap turned up while voiding, then recap the filled container immediately.

     . IT IS MOST IMPORTANT that the inside of the container and the cap not be touched or come into contact with any parts of the body or clothing or external surfaces. Exposure to air should be minimized.

     . The participant should deliver the capped specimen immediately to the clinic personnel.

### B. PROCESSING PROCEDURE

1. Materials and equipment needed per participant.

   - 15 mL Conical-bottom plastic tube (containing 120 uL nitric acid) (1)

- 6 mL Plastic tube (3)
- Powder-free lab gloves
- Safety glasses
- Lab apron
- Laboratory hood
- Deionized water
- Ultrapure concentrated nitric acid (G. Frederick Smith Chemical Co., Columbus, Ohio 43223, Catalogue No. 63, ultrex grade, or equivalent)
- Pipettor (Gilson Pipetman or other precision adjustable pipettor capable of dispensing 200 uL)
- Biorad BR-33 clear (metal-free) disposable pipet tips capable of containing 120 uL, or equivalent)
- Racks
- Preprinted labels
- Freezer (-20°C)

2. Special safety precautions.

- Nitric Acid - Special care should be taken when handling and dispensing the concentrated acid, since it is a caustic chemical capable of severe eye or skin damage. Wear a lab apron, powder-free gloves, and safety glasses. If the nitric acid comes in contact with any part of the body, quickly wash with copious quantities of water for at least 15 minutes.

- Sodium Azide - Special care should be taken when handling the 6 mL plastic tube with the pink dot, since it contains a small quantity of sodium azide (a poison). Wear a lab apron, powder-free gloves, and safety glasses. If the sodium azide comes in contact with any part of the body, quickly wash with copious quantities of water for at least 10 minutes.

3. Additon of sodium azide, sodium carbonate, and aprotinin to beta-2-microglobulin.

While working under a hood and wearing protective, unpowdered gloves, apron, and safety glasses, use pipettor to rinse a pipet tip with the mixture. Using the same pipet tip, aliquot 128 ul into each of 6 ml plastic tubes to be used for beta-2-microglobulin analyses. Process one tube at a time, removing the cap, adding the mixture, and replacing and tightly screwing the cap. Change the tip each time it becomes contaminated. Affix a pink dot to the side of the tube.

4. - Preparation of laboratory blanks.

. Wearing protective clothing and working under a hood, prepare one cadmium laboratory blank for each day on which urine specimens are collected.

. Select one of the 15 mL plastic tubes labeled with a turquoise dot and slowly add 12 mL ± 1 mL of deionized water. Then carefully aliquot 120 µl of nitric acid with the pipettor.

. Cap, label with the preprinted label "LAB BLANK-CD/AS", seal, and invert the tube five times.

. On each label and using a ballpoint pen, write the date collected and the initials of the laboratory technician preparing the lab blanks. Freeze the blanks in an upright position at -20°C and store them frozen until shipment to CDC with the urine specimens.

5. Processing (specimen).

- Wear powder-free lab gloves, safety glasses, and work over a laboratory sink.

- Using the preprinted labels provided for each participant, label each of the plastic tubes as follows:

| Size/Type Bottle | Bottle Label |
|---|---|
| 15 mL plastic (nitric acid) | 87-0026-0001-T1 "UR CD/ARSENIC" |
| 6 mL plastic (sodium azide) | 87-0026-0001-T2 "URINE BETA-2-M" |
| 6 ml plastic (no preservative) | 87-0026-0001-U1 "URINE CREATINE" |
| 6 mL plastic (no preservative) | 87-0026-0001-U2 "URINE RESERVE" |

- Use a ballpoint pen to add the date collected and your initials to the labels on all tubes.

- Gently swirl the specimen in the capped collection container to resuspend any solids.

- Immediately after mixing, pour the proper quantity of urine into each plastic tube and use the correct aliquoting priority as shown in the protocol flowchart on page 20.

- Cap and tightly seal each tube.

- Dissolve the preservatives in the "URINE BETA-2-M" tube by inverting 4-6 times. Immediately freeze (within 2-5 minutes) in an upright position in a dry ice/ethanol bath or a -70°C or colder freezer.

6. Addition of acid preservatives.

- Addition of nitric acid to cadmium/arsenic tubes.

NOTE: RINSE OUTSIDE OF PIPET TIP WITH DISTILLED WATER BEFORE USE.

. While working under a hood and wearing protective unpowdered gloves, apron and safety glasses, use a pipettor to rinse a pipet tip with nitric acid. Using the same tip aliquot 120 mL into each of the 15-mL conical-bottom tubes containing the participant's urine which will be used for cadmium analyses. Process one tube at a time, removing the cap, adding the acid, and replacing and tightly screwing the cap. Do not touch the interior of the cap or tube or place the cap or pipet tip on external surfaces which may be contaminated for trace elements. Change the tip each time it becomes contaminated. Affix a turqoise dot to the side of the tube. Invert the tubes gently 5 times and freeze immediately at -20°C.

7. Processing (Field Blank).

- After every 19 study participants one conical-bottom tube will be prepared as a "Field Blank" using deionized water in place of urine. Prepare these blanks under the same conditions as for processing specimens.

  . Immediately after processing the preceding urine specimen, obtain one of the conical-bottom tubes labeled with a turquoise dot.

  . Affix a preprinted Field Blank label "FIELD BLANK-CD/AS".

  . Using the deionized water provided, pour 12 mL ± 1 mL of water into the tube to the graduation mark. Then carefully add 120 mL nitric acid, recap and mix as for urine specimens.

  . Using a ballpoint pen, add the date collected and your initials to the label.

  . Freeze the Field Blanks in an upright position at -20°C and store them frozen with the urine specimens until they are shipped to CDC.

8. Tests done at the field site.
A specific gravity will be done on all urines. The results should be written in the comments section of the inventory sheet.

## III. WHOLE BLOOD COLLECTION

1. Materials needed per participant.

   - Gauze sponges, sterile, individually wrapped 2x2" (2).
   - Alcohol wipe
   - Bandaid
   - 5 mL lavender-top vacutainer for adults 12 years and older.(2)
   - 3 ml lavender-top vacutainer for children 11 years old and younger.(2)
   - 20 gauge 1 1/2" needle, sterile
   - 23 G butterfly assembly with adapter for children.
   - Preprinted labels
   - Tourniquet
   - Vacutainer holder
   - refrigerator

2. Venipuncture procedure.

   - Locate the puncture site. Hold with 2 fingers on one side of the "alcohol wipe" so that only the other side touches the puncture site. Wipe the area in a circular motion beginning with a narrow radius and moving outward so as not to cross over the area already cleaned. Repeat with a second alcohol wipe.

   - Locate a suitable table and chair for blood drawing and lay out blood collection supplies.

   - Locate vein and cleanse in manner previously described, then apply the tourniquet. If it is necessary to feel the vein again, do so; but after you feel it, cleanse with alcohol prep again, and dry with a sterile gauze square.

   - Fix the vein by pressing down on the vein about 1 inch below the proposed point of entry into the skin and pull the skin taut.

   - Approach the vein in the same direction the vein is running, holding the needle so that it makes a 15° angle with the examinee's arm.

   - Push the needle, with bevel facing up, firmly and deliberately into the vein. If the needle is in the vein, blood will flow freely into the tube. If no blood enters the tube, probe for the vein until entry is indicated by blood flowing into the tube.

   - For collection, loosen the tourniquet immediately after blood flow is established and release entirely as the last tube fills.

- When the needle is out of the arm, press gauze firmly on the puncture. Heavy pressure as the needle is being withdrawn should be avoided because it may cause the sharp point of the needle to cut the vein.

- Have the examinee raise his arm (not bend it) and continue to hold the gauze in place for several minutes. This will help prevent hematomas.

- Invert the lavender-top tube several times to ensure proper mixing.

- Report to the physician any reaction experienced by the participant during the venipuncture procedure.

- Label all tubes with the preprinted labels provided, and use a ballpoint pen to add the date collected and your initials to the label. The lavender-top tube should be affixed with the label showing the participant's ID number (e.g. 87-0026-0001-B1) and identified "BLOOD-PB".

- Place a bandaid on the subject's arm.

- Place the lavender-top tubes upright in a rack in the refrigerator within 30 minutes after being drawn. Log in the specimens and keep refrigerated (not frozen) until picked up for shipment.

## IV. SHIPMENT OF SPECIMENS TO CDC, ATLANTA, GA.

### A. BEGINNING OF STUDY AND GENERAL INSTRUCTIONS

- Determine the times 'FEDERAL EXPRESS' packages are picked up in order to connect with the best flights to Atlanta, Georgia. Shipments to Atlanta will be scheduled weekly and scheduled only Monday through Wednesday mornings. IMPORTANT: Since the materials packed in accordance with the instructions below will remain frozen (over dry ice) or cool (over cold packs) only about 2 1/2 days, shipments should not arrive in Atlanta on weekends or on Federal holidays.

- Inquire about regulations in your area concerning shipment of human blood, serum, and urine specimens with dry ice and the quantity of dry ice allowed per shipper. Also, make sure the specimens will be received at CDC within 24 hours.

- Maintain a supply of dry ice from a local supplier for shipping specimens each week. A block should be sawed at the plant into "1 slabs. Then each of these should be sawed lengthwise. A 7"x10" slab would fit easily into the shipper without having to break the slab. (Large pieces are preferable to small chunks, since they do not volatilize as rapidly.)

- Shipments of whole blood require a coolant to keep the materials cool during the shipment (NOT FROZEN). The laboratory techs should keep 10-12 coolant packs in the freezer at all times; replace the ones used weekly to maintain the inventory for other unexpected demands for these items.

- For all shipments, do not pack shippers with frozen specimens and dry ice or with whole blood and frozen coolant until just before shipment.

- Telephone the laboratory at CDC the day the shipment is mailed (404) 454-4300. Speak with Brenda Lewis.

B. SPECIMEN SHIPPING LIST

- For each shipment, fill out a blank Specimen Shipping List provided by CDC. If the number of specimens in a shipment is too large to fit on one page, please use the continuation sheets provided. Please give the following information on the blank shipping lists (See attached example of a completed Specimen Shipping Lists):

  . Page number - e.g. 1 of 4
  . Shipment Number - number shipments sequentially starting with 1
  . No. frozen shippers - total number of shippers (containing frozen urine specimens) which are being mailed in this shipment.
  . No. refrigerated shippers - total number of shippers (containing refrigerated whole blood) which are being mailed in this shipment
  . Type of Specimens - whole blood and/or urine
  . No. of Specimens - number of each type of specimen shipped
  . Name, Title, Signature, and Phone Number of person sending shipment or initials as indicated on the continuation sheets.
  . Date Shipped
  . Specimen ID for each participant - e.g. 87-0026-0001
  . For each participant, check (X) each individual specimen type/aliquot included in this shipment
  . Date Collected - e.g. 081187
  . Comments - Specify any deviations from collection, storage, and shipment protocols, and date of occurrence.

- Photocopy 2 extra copies of the completed shipping list. As will be described again later, the original will be shipped with the specimens, a copy mailed to CDC in a separate envelope, and a

C. FROZEN SPECIMENS

1. Materials needed per shipper

- 1 styrofoam shipper (each shipper will hold frozen specimens from approximately 10-12 participants)
- 10-12 lbs. dry ice
- 30-36 bubble-pack bags 4" x 7 1/2"
- Safety glasses or eye shield
- Strapping tape
- Gloves for handling dry ice and frozen specimens
- Sheets of bubble-pack packing material
- 'FEDERAL EXPRESS' label, preaddressed by Centers for Disease Control personnel
- DRY ICE label
- HUMAN BLOOD - THIS SIDE UP label
- CDC 'Specimen Shipping List' filled out
- Zip-lock bag
- Frozen urine specimens (6 urine tubes per participant)

2. Packing procedure.

- When packing the shippers, use gloves to handle the dry ice to avoid burning the hands. Glasses or an eye shield should also be worn if the dry ice cakes are to be broken into small pieces.

- Place the six frozen urine specimens from each participant in one 4" x 7 1/2" bubble bag and seal using the peel-off adhesive strip.

- Pack 10-12 sets of filled bubble bags upright in the bottom of the shipper. If necessary, use sheets of bubble-pack packing material to ensure the specimens vertical position.

- Put one layer of sheet bubble-pack material on top of the specimens.

- Fill the shipper with dry ice (probably will hold 10-12 lbs).

- Place more bubble material to even the top and place the polyfoam lid on top of the shipper.

- Insert the completed 'Specimen Shipping List' in a 12" x 12" Zip-lock bag and secure to the top of the polyfoam lid with filament tape. (Remember to photocopy two copies of the 'Specimen Shipping List'. Keep one copy for your records and mail the other copy in a separate envelope to the same CDC address listed below.)

- Secure the outer carton lid on the shipper with filament tape.

3. Shipping procedure.

- Cover or remove previous address labels on all shippers.

- Label each shipper with the following:

  . Preaddressed, 'FEDERAL EXPRESS' label with the following address:

Brenda Lewis
Chamblee, Building 32, Room 1502
Centers for Disease Control
4770 Buford Highway
Chamblee, GA. 30341

D. REFRIGERATED SPECIMENS

1. Materials needed per shipper

- 1 styrofoam shipper
- 2 foam racks each capable of holding fifteen 5 or 3 mL vacutainers
- 4 twenty-four oz. cold packs (frozen before shipment)
- 6 layers of bubble-pack
- Filament tape
- Gloves for handling frozen cold packs
- 'FEDERAL EXPRESS' label
- HUMAN BLOOD - THIS SIDE UP label
- KEEP REFRIGERATED - DO NOT FREEZE label
- Zip-lock bag
- Refrigerated blood specimens in 5 or 3 mL lavender top vacutainers

Note: Inventory of blood specimens should be included in specimen shipping list enclosed with frozen specimens.

2. Packing procedure.

   - Place cold paks in a -20°C freezer the day before the shipment. Four 24 ounce packs will be needed for each shipper used. More cold packs may be needed if freezer does not attain -20°C. Up to 50 specimens can be shipped per shipper.

   - Working quickly, so that the blood will not be exposed to ambient temperature for more than 5 to 10 minutes, wrap up to 50 tubes with bubble-pack material; secure with tape.

   - Place two ice paks in the bottom of the shipper. Cover with bubble paper before adding wrapped specimens; add specimens and cover with additional bubble paper before adding two additional ice paks. Fill the shipper with additional bubble material and place the polyfoam lid on top of the shipper.

   - Secure the outer carton lid on the shipper with filament tape.

3. Shipping procedure.

   - Cover or remove previous address labels on all shippers.

   - Label each shipper with the following:

     . Preaddressed, 'FEDERAL EXPRESS' mailing label with the following address:

       Brenda Lewis
       Chamblee, Building 32, Room 1502
       Centers for Disease Control
       4770 Buford Highway
       Chamblee, GA 30341

     . HUMAN BLOOD-THIS SIDE UP label.

     . KEEP REFRIGERATED-DO NOT FREEZE label.

     .ORM-A written on the box.

- Call the 'FEDERAL EXPRESS' office at 1-800-238-5355 to arrange for pick-up.

   - Telephone the laboratory at CDC the day the shipment is mailed (404) 454-4300. Speak with Brenda Lewis.

Colorado Metal Exposure
Leadville, Colorado
Case 87-0026
Urine Collection and Processing Protocol

Urine Sample (30ml)

Collection Container Labeled
"Urine Container"

Aliquot into
Designated Bottles

| T1 | T2 | U1 | U2 |
|---|---|---|---|
| 15 ml plastic "Ur. Cd/As" | 6 ml plastic "Ur. Beta-2-M" | 6 ml plastic "Ur. Creatinine | 6 ml plastic "Ur. Reserve" |
| Add 12 ml Urine | Add 128 ul Azide Mixture | | |
| Add 120 ul HNO3 | Add 5 ml Urine | Add 5 ml Urine | Add 5 ml Urine |
| Mix by Inverting 5 times | Mix by Inverting 4-6 times | | |
| Freeze at -20°C | Freeze at -70°C within 2-5 minutes | Freeze at -20°C | Freeze at -20°C |

Mail to CDC on dry ice using
of "Federal Express"

Page ___ of ___

# SPECIMEN INFORMATION SYSTEM
## FORM 1 - COLORADO EXPOSURE
## SPECIMEN SHIPPING LIST - Continued

Case Number : 87-0026 Initials of Shipper _____

Shipment Number : _____ Initials of Receiver _____

| Specimen ID 87-0026 - Person | Type*/Aliquot No. (Mark Shipped Specimen) T1 | T2 | U1 | U2 | B1 | B2 | | | | Date Collected MM-DD-YY | Comments (Specify any deviation collection, storage, and shipmen protocols, and date of occurrence |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 87-0026-XXXX | X | X | X | X | X | X | X | X | X | XX-XX-XX | |
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| 87-0026 ____ | | | | | | | | | | | |

*Type of specimens: T = Urine (preserved), U = Urine (unpreserved), B = Whole Blood

Attachment

# Quality Control Protocol For Environmental Samples

This protocol is intended to identify both systematic and stochastic errors in either the environmental sampling or analytical results. Numerous sources of error can be anticipated in an environmental sampling survey of this nature. This protocol is designed to discover systematic errors in analytical results caused by: 1-incorrect zero determinations (false positives), 2-interlaboratory bias (more than one analytical laboratory will determine trace metal concentrations in the dust samples, soil cores and entry way surface scrapings), 3-sampling bias among environmental teams. Additionally, the stochastic variance will be used to identify values which occur, apparently at random, outside an acceptable range.

While no QA/QC protocol can prevent systematic and random errors, a training session emphasizing consistent sampling procedures among the environmental teams will allow this protocol to detect suspect data. These data should be treated on an individual basis, and interpretations should be tempered by a motivation toward "general conclusions", not isolated incidents. An effective protocol allows data interpretations based on general trends with minimum influence from unique or biased data. In essence this leads to the most robust, yet conservative, conclusions.

This protocol requires four types of QC samples: blanks, splits, duplicates and Youden pairs. These samples are described below for the environmental sampling phase of the Leadville Survey. In addition to QC samples, the teams must take careful field notes which are to be recorded in the lab coordinator's master log. Also, some samples (scrapings and soil cores) will be retained in the advent of future concerns regarding sample acquisitions or analyses.

This protocol is capable of assessing data precision and to a limited extent data accuracy. The absence of a certified standard reference material for heavy metals in soil and dust (using the specific digestion protocol employed at the EPA analytical sites) limits accuracy assessment in an absolute sense. However, the use of blanks and Youden pairs allows relative accuracy to be determined and false positives (values erroneously reported above detection limit) to be identified.

DUPLICATES. Each environmental sampling team will collect duplicate water, soil cores, entry way scrapings and dust samples at the 20th, 40th, 60th, etc. sampled houses. The duplicate samples will be assigned unique sample numbers and will be treated as completely independent samples. The team will note which houses have been doubly sampled and this information will be recorded in the master log, but not provided to the analytical laboratories.

The water sample duplicate will consist of a second tap aliquot being drawn after the primary sample is drawn. The same faucet should be used and water flow should not be interrupted between samples. Duplicate water samples are intended to gauge analytical precision at actual field concentrations.

The duplicate soil cores, surface scrapings and floor dust samples will be acquired in the general vicinity of the primary sample sites. It is not necessary to obtain these duplicate samples adjacent to the primary samples, but if possible the duplicate should be from the general vicinity. Specifically, soil cores should be within two feet of each other, surface scrapings should be from the same entry way, floor dust should be from the same room/hallway. These duplicates are not anticipated to yield the same analytical values, but are intended to allow data interpretors to address the representativeness of the primary samples.

The duplicate ll dust samples are slightly more involved. The primary sample should be taken from only half the window sill (right side or left side). The duplicate will then be obtained from the unsampled areas. While it is not unreasonable to expect differences between right and left side samples, closer agreement should exist between sill dust duplicates than between floor dust duplicates. Thus, the sill dust duplicates offer insight to relative determination accuracy.

SPLITS. Split samples will be prepared by the lab coordinator at the rate of one split for each twenty samples recored in the master log. Split samples will be obtained for water, soil cores and surface scrapings only since it is undesirable to open the dust cartridges. Splits are accomplished by removing approximately one half of the original sample to a second container and assigning a new and independent sample number to the split fraction.

The absence of analytical systematic error can be claimed if the difference between split samples is less than the reported analytical precision.

YOUDENS. Youden pairs are based on QC procedures developed by Youden(1) for determining interlaboratory errors and modified by Meglen(2) for assessing temporal intralaboratory errors. The interpretive process will follow that described by Meglen and results will be used to identify systematic interlaboratory errors and random errors outside of acceptable limits.

The environmental laboratory coordinator will include two Youden pairs (four samples total) in each shipment of 200 total solid samples. One pair will be from the dust composite; the second pair will be from the soil composite. Each pair will be assigned sample numbers such that their treatment by receiving laboratories will be identical to other samples' treatment.

The soil composite will be prepared by the lab coordinator. A small fraction of each soil core and surface scraping will be retained in a soil composite container. When a sufficient quantity of material is accumulated, the entire composite will be homogenized and used as a source for Youden determinations. The dust composite will consist of a sieved and homogenized floor dust sample previously acquired.

Water samples will include Youden pairs at a rate of one pair per twenty samples. The water Youden composite will be obtained using a procedure analogous to that described above for soils.

BLANKS. Blank samples will be sent with each sample shipment at the rate of one blank per youden pair. A blank sample has "less than detection limit" concentrations for the desired analytes. These blanks allow data interpretation to readily identify erroneously positive results.

Distilled deionized water will be used for water blanks. A National Bureau of Standards standard reference soil with below detection limit values (total digest, graphite furnace analysis) will be used for the soil and scrapings blank. Crushed and sieved Brazilian quartz will be used for dust blanks.

By following the above procedures and viewing the data with a degree of skepticism, any conclusions drawn wholly or in part from the environmental samples should be both conservative and accurate.

1. Youden, W.J.: Statistical Techniques For Collaborative Testing: Association of Official Analytical Chemists, Washington, D.C., 1969 (rev 1973).

2. Meglen, R.R.: A Quality Control Protocol For The Analytical Laboratory: Center for Environmental Sciences, University of Colorado, Denver, 1977.

OMB Approval No. 0348-0043

# APPLICATION FOR FEDERAL ASSISTANCE

| | |
|---|---|
| 2. DATE SUBMITTED: 6/24/91 | Applicant Identifier: 88-07-05-08 |
| 3. DATE RECEIVED BY STATE | State Application Identifier |
| 4. DATE RECEIVED BY FEDERAL AGENCY: JUN 25 1991 | Federal Identifier: F75/ATH59119-02 |

1. TYPE OF SUBMISSION:
Application: ☐ Construction ☒ Non-Construction
Preapplication: ☐ Construction ☐ Non-Construction

5. APPLICANT INFORMATION

Legal Name: Illinois Dept. of Public Health

Organizational Unit: Division of Environmental Health

Address (give city, county, state, and zip code):
525 West Jefferson St.
Springfield, Sangamon Co., IL 62761

Name and telephone number of the person to be contacted on matters involving this application (give area code):
Thomas F. Long
217/782-5830

6. EMPLOYER IDENTIFICATION NUMBER (EIN): 3 7 — 6 0 0 2 0 5 7

7. TYPE OF APPLICANT: (enter appropriate letter in box) [A]
A State
B County
C Municipal
D. Township
E. Interstate
F Intermunicipal
G Special District
H Independent School Dist.
I State Controlled Institution of Higher Learning
J Private University
K Indian Tribe
L Individual
M Profit Organization
N Other (Specify) _____

8. TYPE OF APPLICATION:
☐ New ☐ Continuation ☒ Revision

If Revision, enter appropriate letter(s) in box(es): [A] [ ]
A. Increase Award B. Decrease Award C Increase Duration
D. Decrease Duration Other (specify):

9. NAME OF FEDERAL AGENCY:
Agency for Toxic Substances and Disease Registry

10. CATALOG OF FEDERAL DOMESTIC ASSISTANCE NUMBER: 1 3 . 1 6 1

TITLE: Pilot and Epidemiologic Studies to Determine the Relationship Between Human Exposure to Hazardous Substances and Adverse Health Outcomes

11. DESCRIPTIVE TITLE OF APPLICANT'S PROJECT:
Lead Exposure Study for the NL Industrie Taracorp NPL Site in Granite City, Madison Co., Illinois

12. AREAS AFFECTED BY PROJECT (cities, counties, states, etc.):
Granite City, Madison, Venice
Madison County
Illinois

13. PROPOSED PROJECT:

| Start Date | Ending Date |
|---|---|
| 9/29/91 | 9/30/92 |

14. CONGRESSIONAL DISTRICTS OF:
a. Applicant: 1-22 (statewide)
b. Project: 21

15. ESTIMATED FUNDING:

| | | |
|---|---|---|
| a. Federal | $ 252,770 | .00 |
| b. Applicant | $ 0 | .00 |
| c. State | $ 32,638 | .00 |
| d. Local | $ 0 | .00 |
| e. Other | $ 0 | .00 |
| f. Program Income | $ 0 | .00 |
| g. TOTAL | $ 285,408 | .00 |

16. IS APPLICATION SUBJECT TO REVIEW BY STATE EXECUTIVE ORDER 12372 PROCESS?
a. YES. THIS PREAPPLICATION/APPLICATION WAS MADE AVAILABLE TO THE STATE EXECUTIVE ORDER 12372 PROCESS FOR REVIEW ON:
DATE 6/21/91
b. NO. ☐ PROGRAM IS NOT COVERED BY E.O. 12372
☐ OR PROGRAM HAS NOT BEEN SELECTED BY STATE FOR REVIEW

17. IS THE APPLICANT DELINQUENT ON ANY FEDERAL DEBT?
☐ Yes If "Yes," attach an explanation. ☒ No

18. TO THE BEST OF MY KNOWLEDGE AND BELIEF, ALL DATA IN THIS APPLICATION/PREAPPLICATION ARE TRUE AND CORRECT. THE DOCUMENT HAS BEEN DULY AUTHORIZED BY THE GOVERNING BODY OF THE APPLICANT AND THE APPLICANT WILL COMPLY WITH THE ATTACHED ASSURANCES IF THE ASSISTANCE IS AWARDED

| | | |
|---|---|---|
| a. Typed Name of Authorized Representative: John R. Lumpkin, M.D. | b. Title: Director | c. Telephone number: 217/782-4974 |
| d. Signature of Authorized Representative: John R. Lumpkin MD | | e. Date Signed: 6/24/91 |

Previous Editions Not Usable

Standard Form 424 REV 4-88
Prescribed by OMB Circular A-102

# INSTRUCTIONS FOR THE SF 424

This is a standard form used by applicants as a required facesheet for preapplications and applications submitted for Federal assistance. It will be used by Federal agencies to obtain applicant certification that States which have established a review and comment procedure in response to Executive Order 12372 and have selected the program to be included in their process, have been given an opportunity to review the applicant's submission.

Item: Entry:

1. Self-explanatory.
2. Date application submitted to Federal agency (or State if applicable) & applicant's control number (if applicable).
3. State use only (if applicable).
4. If this application is to continue or revise an existing award, enter present Federal identifier number. If for a new project, leave blank.
5. Legal name of applicant, name of primary organizational unit which will undertake the assistance activity, complete address of the applicant, and name and telephone number of the person to contact on matters related to this application.
6. Enter Employer Identification Number (EIN) as assigned by the Internal Revenue Service.
7. Enter the appropriate letter in the space provided.
8. Check appropriate box and enter appropriate letter(s) in the space(s) provided:
   - "New" means a new assistance award.
   - "Continuation" means an extension for an additional funding/budget period for a project with a projected completion date.
   - "Revision" means any change in the Federal Government's financial obligation or contingent liability from an existing obligation.
9. Name of Federal agency from which assistance is being requested with this application.
10. Use the Catalog of Federal Domestic Assistance number and title of the program under which assistance is requested.
11. Enter a brief descriptive title of the project. if more than one program is involved, you should append an explanation on a separate sheet. If appropriate (e.g., construction or real property projects), attach a map showing project location. For preapplications, use a separate sheet to provide a summary description of this project.

Item: Entry:

12. List only the largest political entities affected (e.g., State, counties, cities).
13. Self-explanatory.
14. List the applicant's Congressional District and any District(s) affected by the program or project.
15. Amount requested or to be contributed during the first funding/budget period by each contributor. Value of in-kind contributions should be included on appropriate lines as applicable. If the action will result in a dollar change to an existing award, indicate *only* the amount of the change. For decreases, enclose the amounts in parentheses. If both basic and supplemental amounts are included, show breakdown on an attached sheet. For multiple program funding, use totals and show breakdown using same categories as item 15.
16. Applicants should contact the State Single Point of Contact (SPOC) for Federal Executive Order 12372 to determine whether the application is subject to the State intergovernmental review process.
17. This question applies to the applicant organization, not the person who signs as the authorized representative. Categories of debt include delinquent audit disallowances, loans and taxes.
18. To be signed by the authorized representative of the applicant. A copy of the governing body's authorization for you to sign this application as official representative must be on file in the applicant's office. (Certain Federal agencies may require that this authorization be submitted as part of the application.)

OMB Approval No. 0348-0044

# BUDGET INFORMATION — Non-Construction Programs

## SECTION A – BUDGET SUMMARY

| Grant Program Function or Activity (a) | Catalog of Federal Domestic Assistance Number (b) | Estimated Unobligated Funds | | New or Revised Budget | | |
|---|---|---|---|---|---|---|
| | | Federal (c) | Non-Federal (d) | Federal (e) | Non-Federal (f) | Total (g) |
| 1. ATSDR-Pilot and Epi Studies | 13.161 | $ 150,000 | $ 0 | $ 252,770 | $ 32,638 | $ 285,408 |
| 2. | | | | | | |
| 3. | | | | | | |
| 4. | | | | | | |
| 5. TOTALS | | $ 150,000 | $ 0 | $ 252,770 | $ 32,638 | $ 285,408 |

## SECTION B – BUDGET CATEGORIES

| 6 Object Class Categories | GRANT PROGRAM, FUNCTION OR ACTIVITY (1) Federal | (2) State | (3) | (4) | Total (5) |
|---|---|---|---|---|---|
| a. Personnel | $ 24,504 | $ 19,362 | $ | $ | $ 43,866 |
| b. Fringe Benefits | 5,237 | 4,138 | | | 9,375 |
| c. Travel | 7,448 | 0 | | | 7,448 |
| d. Equipment | 0 | 0 | | | 0 |
| e. Supplies | 580 | 0 | | | 580 |
| f. Contractual | 200,536 | 0 | | | 200,536 |
| g. Construction | 0 | 0 | | | 0 |
| h. Other | 2,900 | 0 | | | 2,900 |
| i. Total Direct Charges (sum of 6a - 6h) | 241,205 | 23,500 | | | 264,705 |
| j. Indirect Charges | 11,565 | 9,138 | | | 20,703 |
| k. TOTALS (sum of 6i and 6j) | $ 252,770 | $ 32,638 | $ | $ | $ 285,408 |
| 7. Program Income | $ 0 | $ 0 | $ | $ | $ 0 |

## SECTION C - NON-FEDERAL RESOURCES

| (a) Grant Program | (b) Applicant | (c) State | (d) Other Sources | (e) TOTALS |
|---|---|---|---|---|
| 8.13.161 - ATSDR Pilot and Epidemilogical Studies | $ 0 | $ 32,638 | $ 0 | $ 32,638 |
| 9. | | | | |
| 10. | | | | |
| 11. | | | | |
| 12. TOTALS (sum of lines 8 and 11) | $ 0 | $ 32,638 | $ 0 | $ 32,638 |

## SECTION D - FORECASTED CASH NEEDS

| | Total for 1st Year | 1st Quarter | 2nd Quarter | 3rd Quarter | 4th Quarter |
|---|---|---|---|---|---|
| 13. Federal | $ 252,770 | $ 63,192.50 | $ 63,192.50 | $ 63,192.50 | $ 63,192.50 |
| 14. NonFederal | 32,638 | 8,159.50 | 8,159.50 | 8,159.50 | 8,159.50 |
| 15. TOTAL (sum of lines 13 and 14) | $ 285,408 | $ 71,352.00 | $ 71,352.00 | $ 71,352.00 | $ 71,352.00 |

## SECTION E - BUDGET ESTIMATES OF FEDERAL FUNDS NEEDED FOR BALANCE OF THE PROJECT

| (a) Grant Program | FUTURE FUNDING PERIODS (Years) | | | |
|---|---|---|---|---|
| | (b) First | (c) Second | (d) Third | (e) Fourth |
| 16.13.161-ATSDR Pilot and Epidemiologic Studies | $ 285,408 | $ NA | $ NA | $ NA |
| 17. | | | | |
| 18. | | | | |
| 19. | | | | |
| 20. TOTALS (sum of lines 16 -19) | $ 285,408 | $ NA | $ NA | $ NA |

## SECTION F - OTHER BUDGET INFORMATION

(Attach additional Sheets if Necessary)

21. Direct Charges:
See Attached Budget Narrative and Breakdown

22. Indirect Charges: Indirect Costs based on 42% of personal services plus fringe benefits (excluding group insurance)

23. Remarks
See Attached Budget Narrative and Breakdown

OMB Approval No. 0348-0040

# ASSURANCES — NON-CONSTRUCTION PROGRAMS

**Note:** Certain of these assurances may not be applicable to your project or program. If you have questions, please contact the awarding agency. Further, certain Federal awarding agencies may require applicants to certify to additional assurances. If such is the case, you will be notified.

As the duly authorized representative of the applicant I certify that the applicant:

1. Has the legal authority to apply for Federal assistance, and the institutional, managerial and financial capability (including funds sufficient to pay the non-Federal share of project costs) to ensure proper planning, management and completion of the project described in this application.

2. Will give the awarding agency, the Comptroller General of the United States, and if appropriate, the State, through any authorized representative, access to and the right to examine all records, books, papers, or documents related to the award; and will establish a proper accounting system in accordance with generally accepted accounting standards or agency directives.

3. Will establish safeguards to prohibit employees from using their positions for a purpose that constitutes or presents the appearance of personal or organizational conflict of interest, or personal gain.

4. Will initiate and complete the work within the applicable time frame after receipt of approval of the awarding agency.

5. Will comply with the Intergovernmental Personnel Act of 1970 (42 U.S.C. §§ 4728-4763) relating to prescribed standards for merit systems for programs funded under one of the nineteen statutes or regulations specified in Appendix A of OPM's Standards for a Merit System of Personnel Administration (5 C.F.R. 900, Subpart F).

6. Will comply with all Federal statutes relating to nondiscrimination. These include but are not limited to: (a) Title VI of the Civil Rights Act of 1964 (P.L. 88-352) which prohibits discrimination on the basis of race, color or national origin; (b) Title IX of the Education Amendments of 1972, as amended (20 U.S.C. §§ 1681-1683, and 1685-1686), which prohibits discrimination on the basis of sex; (c) Section 504 of the Rehabilitation Act of 1973, as amended (29 U.S.C. § 794), which prohibits discrimination on the basis of handicaps; (d) the Age Discrimination Act of 1975, as amended (42 U.S.C. §§ 6101-6107), which prohibits discrimination on the basis of age; (e) the Drug Abuse Office and Treatment Act of 1972 (P.L. 92-255), as amended, relating to nondiscrimination on the basis of drug abuse; (f) the Comprehensive Alcohol Abuse and Alcoholism Prevention, Treatment and Rehabilitation Act of 1970 (P.L. 91-616), as amended, relating to nondiscrimination on the basis of alcohol abuse or alcoholism; (g) §§ 523 and 527 of the Public Health Service Act of 1912 (42 U.S.C. 290 dd-3 and 290 ee-3), as amended, relating to confidentiality of alcohol and drug abuse patient records; (h) Title VIII of the Civil Rights Act of 1968 (42 U.S.C. § 3601 et seq.), as amended, relating to nondiscrimination in the sale, rental or financing of housing; (i) any other nondiscrimination provisions in the specific statute(s) under which application for Federal assistance is being made; and (j) the requirements of any other nondiscrimination statute(s) which may apply to the application.

7. Will comply, or has already complied, with the requirements of Titles II and III of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970 (P.L. 91-646) which provide for fair and equitable treatment of persons displaced or whose property is acquired as a result of Federal or federally assisted programs. These requirements apply to all interests in real property acquired for project purposes regardless of Federal participation in purchases.

8. Will comply with the provisions of the Hatch Act (5 U.S.C. §§ 1501-1508 and 7324-7328) which limit the political activities of employees whose principal employment activities are funded in whole or in part with Federal funds.

9. Will comply, as applicable, with the provisions of the Davis-Bacon Act (40 U.S.C. §§ 276a to 276a-7), the Copeland Act (40 U.S.C. § 276c and 18 U.S.C. §§ 874), and the Contract Work Hours and Safety Standards Act (40 U.S.C. §§ 327-333), regarding labor standards for federally assisted construction subagreements.

10. Will comply, if applicable, with flood insurance purchase requirements of Section 102(a) of the Flood Disaster Protection Act of 1973 (P.L. 93-234) which requires recipients in a special flood hazard area to participate in the program andto purchase flood insurance if the total cost of insurable construction and acquisition is $10,000 or more.

11. Will comply with environmental standards which may be prescribed pursuant to the following: (a) institution of environmental quality control measures under the National Environmental Policy Act of 1969 (P.L. 91-190) and Executive Order (EO) 11514; (b) notification of violating facilities pursuant to EO 11738; (c) protection of wetlands pursuant to EO 11990; (d) evaluation of flood hazards in floodplains in accordance with EO 11988; (e) assurance of project consistency with the approved State management program developed under the Coastal Zone Management Act of 1972 (16 U.S.C. §§ 1451 et seq.); (f) conformity of Federal actions to State (Clear Air) Implementation Plans under Section 176(c) of the Clear Air Act of 1955, as amended (42 U.S.C. § 7401 et seq.); (g) protection of underground sources of drinking water under the Safe Drinking Water Act of 1974, as amended, (P.L. 93-523); and (h) protection of endangered species under the Endangered Species Act of 1973, as amended, (P.L. 93-205).

12. Will comply with the Wild and Scenic Rivers Act of 1968 (16 U.S.C. §§ 1271 et seq.) related to protecting components or potential components of the national wild and scenic rivers system.

13. Will assist the awarding agency in assuring compliance with Section 106 of the National Historic Preservation Act of 1966, as amended (16 U.S.C. 470), EO 11593 (identification and protection of historic properties), and the Archaeological and Historic Preservation Act of 1974 (16 U.S.C. 469a-1 et seq.).

14. Will comply with P.L. 93-348 regarding the protection of human subjects involved in research, development, and related activities supported by this award of assistance.

15. Will comply with the Laboratory Animal Welfare Act of 1966 (P.L. 89-544, as amended, 7 U.S.C. 2131 et seq.) pertaining to the care, handling, and treatment of warm blooded animals held for research, teaching, or other activities supported by this award of assistance.

16. Will comply with the Lead-Based Paint Poisoning Prevention Act (42 U.S.C. §§ 4801 et seq.) which prohibits the use of lead based paint in construction or rehabilitation of residence structures.

17. Will cause to be performed the required financial and compliance audits in accordance with the Single Audit Act of 1984.

18. Will comply with all applicable requirements of all other Federal laws, executive orders, regulations and policies governing this program.

| SIGNATURE OF AUTHORIZED CERTIFYING OFFICIAL | TITLE |
|---|---|
| John D. Lumpkin, MD | DIRECTOR |
| APPLICANT ORGANIZATION | DATE SUBMITTED |
| ILLINOIS DEPT. OF PUBLIC HEALTH | 6/24/91 |

Form Approved through 9/30/91
OMB No. 0937-0189
Burden Est.- 5 min. to 15 min.

# CHECKLIST

NOTE TO APPLICANT: Complete and forward this sheet with your application.

Type of Application

☐ NEW ☒ Noncompeting Continuation ☐ Competing Extension ☐ Supplemental

CHECKLIST

- ☒ Proper Signatures and Dates (Item 18 on face page and reverse side of appropriate assurances page).
- ☒ Human Subjects Certification (when applicable). signed forms will submitted when received
- ☒ Staff and Position Data (biographical sketch(es) with job description when required).
- ☒ Intergovernmental review under E.O. 12372 if required by the State.
- ☒ Civil Rights Assurance on File with HHS (45 CFR 80).
- ☒ Assurance Concerning the Handicapped on File with HHS (45 CFR 84).
- ☒ Assurance Concerning Sex Discrimination on File with HHS (45 CFR 86).
- ☒ Debarment Certification (45 CFR Part 76).
- ☒ Drug-Free Workplace Certification (45 CFR Part 76).

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A private, nonprofit organization must include evidence of its nonprofit status with the application. Any of the following is acceptable evidence:

- ☐ (a) A reference to the organization's listing in the Internal Revenue Service's most recent cumulative list of organizations.
- ☐ (b) A copy of a currently valid Internal Revenue Service Tax exemption certificate.
- ☐ (c) A statement from a State taxing body or the State Attorney General certifying that the organization is a nonprofit organization operating within the State and that no part of its net earnings may lawfully inure to the benefit or any private shareholder or individual.
- ☐ (d) A certified copy of the organization's certificate of incorporation or similar document if it clearly establishes the nonprofit status of the organization.
- ☐ (e) Any of the above proof for a State or national parent organization, and a statement signed by the parent organization that the applicant organization is a local nonprofit affiliate.

If an applicant has evidence of nonprofit status on file with an agency of PHS, it will not be necessary to file similar papers again, but the place and date must be indicated.

Previously filed with: _____ on _____ (date)

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Name, title, address and telephone number of official in business office to be notified if an award is made.

Mary Rhodes- Office of Health Protection
Illinois Dept. of Public Health 525 West Jefferson St.
Springfield, Il 62761 217/782-3984

Name, title, address and telephone number of official responsible for carrying out the proposed project.

Thomas F. Long - Division of Environmental Health 3rd Floor
Illinois Dept. of Public Health 525 West Jefferson St.
Springfield, IL 62761 217/782-5830

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If this is an application for continued support, include: (1) the report of inventions conceived or reduced to practice required by the terms and conditions of the grant; or (2) a list of inventions already reported; or (3) a negative certification.

## BIOGRAPHICAL SKETCH

Existing curricula vitae of project staff members may be used if they are updated and contain all information requested below. You may add any information listed below to complete existing documents. For development of new curricula vitae include items listed below in the format most suitable.

Name of staff member
Educational history—School, location, dates attended, degrees earned (specify year), major field of study
Professional experience
Honors received and dates
Recent relevant publications

## JOB DESCRIPTION

Title of position
Description of duties and responsibilities
Qualification of position
Supervisory relationships
Skills and knowledge required
Prior experience required
Personal qualities
Amount of travel and other special conditions
Salary range
Hours per day or week

b. Discuss accomplishments to date and list in chronological order a schedule of accomplishments, progress or milestones anticipated with the new funding request. If there have been significant changes in the project objectives, location approach, or time delays, explain and justify. For other requests for changes or amendments, explain the reason for the change(s). If the scope or objectives have changed or an extension of time is necessary, explain the circumstances and justify. If the total budget has been exceeded, or if individual budget items have changed more than the prescribed limits contained in the applicable Office of Management and Budget Circular (No. A-102, or A-110). Explain and justify the change and its effect on the project.

c. For supplemental assistance requests, explain the reason for the request and justify the need for additional funding.

## CERTIFICATION REGARDING LOBBYING

## CERTIFICATION FOR CONTRACTS, GRANTS, LOANS AND COOPERATIVE AGREEMENTS

The undersigned certifies, to the best of his or her knowledge and belief that:

(1) No federal appropriated funds have been paid or will be paid, by or on behalf of the undersigned, to any person for influencing or attempting to influence an officer or an employee of any agency, a member of congress, an officer or employee of congress, or an employee of a member or congress in connection with the awarding of any federal contract, the making of any federal grant, the making of any federal loan, the entering into of any cooperative agreement, and the extension, continuation , renewal, amendment, or modification of any federal contract, grant, loan, or cooperative agreement.

(2) If any funds other than federal appropriated funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any agency, a member of congress, an officer or employee of congress, or an employee of a member of congress in connection with this federal contract, grant, loan, or cooperative agreement, the undersigned shall complete and submit Standard Form-111, "Disclosure Form to Report Lobbying," in accordance with its instructions.

(3) The undersigned shall require that the language of this certification be included in the award documents for all subawards at all tiers (including subcontracts, subgrants, and contracts under grants, loans and cooperative agreements) and that all subrecipients shall certify and disclose accordingly.

This certification is a material representation of fact upon which reliance was placed when this transaction was made or entered into. Submission of this certification is a prerequisite for making or entering into this transaction imposed by Section 1352, Title 31, U.S. Code. Any person who fails to file the required certification shall be subject to a civil penalty of not less than $10,000 and not more than $100,000 for each such failure.

John R. Lumpkin MD
Signature

6/24/91
Date

John R. Lumpkin, M.D.
Name of Authorized Individual

H75/ATH590119-02
Application or Contract Number

Illinois Dept. of Public Health 525 West Jefferson St. Springfield, IL 62761
Name and Address of Organization

**Federal Budget Breakdown and Justification**
**H75/ATH 590119-02**

A. Personnel — Total $24,504

| | Annual Salary | %Effort | No. of Months | Amount |
|---|---|---|---|---|
| Required Position #1 - Sanitarian II | $24,504 | 100 | 12 | $24,504 |

This position will have the responsibility for oversight on this project including coordination of the activities of the various contractors and agencies involved in the different aspects of the study. The individual will be responsible for conducting follow-up with individuals found to have elevated body burdens or high environmental exposure(s). Education, outreach and intervention will be primary functions of this position in addition to seeing that the study requirements are fulfilled. Currently, the position is vacant, but will be located in the Edwardsville Regional Office

B. Fringe Benefits — Total $5,237

Fringe benefits applicable to direct salaries and wages are treated as direct costs. The fringe benefit rats is 21.37% of salaries and wages for position #1.

C. Travel — Total $7,448

Out-of-state travel for 2 individuals for 1 trip
Transportation costs - $1,500
Per diem expenses - $ 500

Sub-total $ 2,000

In-state travel for work on study
15 trips Springfield to Granite City-100 mi roundtrip - 3000 mi
15 trips Champaign to Granite City-350 mi roundtrip - 5250 mi
80 trips Edwardsville to Granite City-40 mi roundtrip - 3200 mi
4 person via auto @ $ .24 per mile for 12 months, total miles - 11,450 - $ 2,748
30 night lodging @ $50/night - $ 1,500
Per diem expenses - $ 1,200

Sub-total $5,448

One trip is to an out-of-state meeting with ATSDR is planned to discuss and review data analysis and interpretation. The cost is based on a two night trip to Atlanta for two individuals (T. Long and C. Copley) and on past costs associated with similar studies. In-state travel is associated with study follow-up, public meetings, monthly meetings with the citizen's advisory panel, and miscellaneous travel in and around the study area. It is anticipated that this money will support travel for state personnel from the Springfield Central Office (Tom Long or other designated staff), the Champaign Regional Office (Cathy Copley), and the Edwardsville Regional Office (Dave Webb and the person designated to fill the vacant study position in the regional office).

preparation of data tapes, report writing and revision, attendance at public meetings, and consultation with IDPH and ATSDR as to study outcome and additional work needed. It is estimated that the study will take approximately 25% of his time over the next 12 months.

25% time (500 hours) @ $85/hr - $ 42,500

- Clerical Support

The availability of a skilled secretary/typist or word processor is required for management of forms, preparation and revision of documents, and other study-related needs. Approximately 25% of this individual's time over the next 12 month period will be devoted to this project.

25% time @ $24,116/yr - $ 6,029

- Data Entry

All information from this study which includes questionnaire data, results of biologic sampling and environmental sampling as well as any supplemental data will have to be key-punched into a database for analysis as well as for the development of data tapes for ATSDR. It is assumed, given the amount of data, the equivalent of four data entry clerks working for a month will be needed.

4 data entry clerks-8 hrs/per day for 30 days @ $7.50/hr - $ 7,200

- Travel

Four trips are planned for the P.I and Co-P.I. These include trips to the study area for conduct of the study, follow-up of cases, public meetings, and trips to Atlanta or other cities to discuss study outcome with ATSDR and other parties involved in the studies.

4-roundtrip airfares between Washington, D.C. (Kimbrough) and St. Louis (or Atlanta) - $750 each X 4 - $ 3,000

4-roundtrip airfares between San Francisco, CA (LeVois) and St. Louis (or Atlanta) - $1,250 each X 4 - $ 5,000

20 night lodging at $60/night - $ 1,200
Per diem expenses (20 days at $25 each) - $ 500

$ 9,700

- Follow-up Costs

Additional monies will be necessary to conduct follow-up testing on individuals identified at risk because of abnormal laboratory tests, elevated body burdens, or unusual environmental results. Such follow-up includes repeats of blood work, analysis of medical records, further evaluation of the contribution of home and workplace exposure, follow-up of pregnancies and analysis of cord blood and breast milk, etc.

| | |
|---|---|
| 150 follow-up bloods at @ $50 each | - $ 7,500 |
| 75 cord blood and breast milk @ $50 each | - $ 7,500 |
| 150 additional environmental samples @ $50 each | - $ 7,500 |
| review of medical records and additional follow-up | - $ 10,000 |
| | $ 32,500 |

- General Overhead and Administrative Costs

IEHR has quoted a cost estimate of 25% for this study

| | |
|---|---|
| $160,429 (subtotal) X 25% | - $ 40,107 |

G. Consultant — Total $ 0

There is no plan to utilize additional consultants for this project.

H. Other — Total $ 2,900

| | |
|---|---|
| Printing - 1 cent per page X 50,000 pages | - $ 500 |
| Telephone - $100/month X 12 months | - $ 1,200 |
| Postage - $100/month for 12 months | - $ 1,200 |

- Indirect Costs

The most recent indirect cost rate agreement was determined on June 24, 1990. The rate is 42% and is computed on the following direct cost base: 42% on personal services plus fringe benefits (less group insurance).

Total Direct and Indirect Costs - $ 252,770

Note: While this cost exceeds the $200,00 base indicated by ATSDR for Year Two, it needs to be recognized that because of budget problems already discussed, the majority of money allocated to Year One of the grant is unspent. A significant portion of this money will be returned to ATSDR, but at the same time, much work remains to be done in Year Two that should have been completed in Year One. Since the total study lost is estimated at $450,000 and the total award is $550,000 ($350,000 in Year One and $200,00 in Year Two), it is hoped that an equitable distribution of resources over the two time periods can be arrived at in order to complete the project.

**State Budget Breakdown and Justification**
**H75/ATH 590119-02**

A. Personnel — Total $ 19,362

| | Annual Salary | %Effort | No. of Months | Amount Required |
|---|---|---|---|---|
| Position #1 - Sanitarian II | $24,504 | 50 | 12 | $ 12,252 |
| Position #2 - Sanitarian III | $28,440 | 25 | 12 | $ 7,110 |

Position #1 is held by Cathy Copley. Cathy is employed as a toxicologist specializing in lead hazards. She has been involved in this study in terms of carrying out the census, developing local contacts and setting up the infrastructure for the study. She will be available to help out as needed with the management of the study and follow-up. She is currently located in the Champaign, IL Regional Office.

Position #2 is held by David Webb who is located in the Edwardsville (Metro-East St. Louis area) Regional Office of IDPH. The study area is located in this region and Dave has been involved in the site for several years. He is the primary author of the ATSDR health assessment on the site. He will be available part-time to assist in project management and oversight as well as any necessary follow-up.

B. Fringe Benefits — Total $ 4,138

Fringe benefits applicable to direct salaries and wages are treated as direct costs. The fringe benefits rate is 21.37% of salaries and wages for positions #1 and #2.

C. Travel

No state travel funds are allocated for this study.

D. Equipment — Total $ 0

No equipment purchases with state money are anticipated.

E. Supplies — Total $ 0

No supplies for this study will be purchased with state funds.

F. Contractual — Total $ 0

No state-funded contracts will be developed for this study.

G. Consultant — Total $ 0

No state-funded consultants will be used for this study.

H. Other — Total $ 0

No other states expenditures are anticipated for this study.

I. Indirect Costs Total $ 9,138

The most recent indirect cost rate agreement was determined on June 24, 1991. The rate is 42% and is computed on the following direct cost base: 42% on a base of personal services plus fringe benefits (excluding group insurance).

Total Direct and Indirect Costs $ 32,638

**PROGRESS REPORT - H75/ATH 590119-02**
**PILOT AND EPIDEMIOLOGIC STUDIES TO DETERMINE THE RELATIONSHIP BETWEEN HUMAN EXPOSURE TO HAZARDOUS SUBSTANCES AND ADVERSE HEALTH OUTCOMES**

MADISON COUNTY (ILLINOIS) LEAD EXPOSURE STUDY

The Illinois Department of Public Health (IDPH) in cooperation with the Agency for Toxic Substances and Disease Registry (ATSDR) and the U.S. Environmental Protection Agency (USEPA) is evaluating the exposure to inorganic lead compounds of individuals residing in the area surrounding the NL Industries/Taracorp National Priorities List (NPL) site in Granite City, Illinois. The purpose of this study is to 1) determine if the lead and cadmium body burdens in potentially exposed individuals in the affected areas are elevated compared to health guidelines and control populations, 2) determine if lead and cadmium body burdens correlate to environmental lead and cadmium exposures while controlling for obvious confounding factors, 3) determine through use of a questionnaire which factors (behavioral, environmental, etc.) are most critical in identifying individuals or populations at risk, and 4) determine if selected biomarkers are useful in detecting exposure to environmental contaminants. This study is also part of a larger ATSDR effort involving two other states (Missouri and Kansas). Data for all studies will be combined to increase overall study power.

Information from this study will be used to advise individuals with elevated body burdens of lead and/or cadmium of the need for medical evaluation and follow-up of these individuals. Additionally, the study will allow the relationship and importance of various environmental parameters in influencing lead and/or cadmium body burdens to be better understood. This study has practical benefits for Illinois and other states given the ubiquity of lead and associated heavy metals in the environment and the degree of hazard posed to those exposed (particularly children). If a discernible and significant trend is detected as a result of this study, further and more detailed epidemiologic or biomedical studies of individuals at risk at this or similar sites will be considered.

BACKGROUND OF THE PROBLEM

The Taracorp site is located in a mixed industrial/residential area within the city limits of Granite City, Madison County, Illinois and immediately adjacent to the cities of Madison and Venice. This site, a former secondary lead smelter, has contributed to substantial off-site, residential soil contamination by lead and associated metals as a result of the deposition of airborne lead emissions from eighty years of active smelting, surface run-off and fugitive dust emissions from contaminated on-site surface soil and slag piles, and tracking of contaminated soils off-site by vehicular and pedestrian traffic. Soil testing by IDPH, the Illinois Environmental Protection Agency (IEPA), and USEPA has determined that lead contamination in excess of background levels (approximately 60 parts per million) and state standards (200 parts per million) exists throughout the residential, commercial, and

industrial properties in Granite City, Madison, and Venice that adjoin the site or used lead-contaminated waste from the site as fill. Off-site soil may contain lead as high as 10,000 parts per million. It is estimated that an area in excess of five square miles around the smelter site has been potentially affected by emissions from the facility. The actual area affected by lead contamination may be larger when additional off-site disposal practices are considered. Additionally, the size of the affected area will grow or shrink depending on what level of lead in soil is considered by regulatory agencies to be indicative of site-related contamination. The population within the affected area may number as high as 7,000 to 8,000 again depending on the size of the area influenced by site emissions and the hazard posed to exposed individuals as defined by the lead content of the soil. The most sensitive segment of the population (children between six months and six years of age) comprise between five and ten percent of the population. Playgrounds, day-care centers, schools, and a hospital exist within the area of concern.

The Taracorp site was placed on the National Priorities List (NPL or Superfund) by USEPA in 1986. The site is bound by 16th Street on the north and east, State Street on the south, and railroad tracks on the west. The neighboring properties are composed mainly of operating or defunct industrial concerns, although residential properties are adjacent to Taracorp on the east and within a few blocks on the north, south and west. Metal refining, fabricating, and associated activities were conducted at the site until 1903, when a secondary lead smelting operation was started. The smelter produced sheet lead, lead solder, shotgun pellets, lead wool, lead pipe, powdered lead, and secondary lead ingots. The smelter ceased operations in the early 1980s as a result of repeated violations of air and water discharge permits. Solid waste generated by smelting was disposed of on-site in a slag pile, At the present time, the Taracorp slag pile covers more than three acres, reaches a height of 40 feet, and weighs an estimated 250,000 tons. The lead content of the slag is as high as 30 percent. The waste pile consists primarily of blast furnace slag, lead bearing fines, and battery case materials. While the site is fenced, the waste pile is basically uncontrolled and subject to leaching, surface run-off, and wind erosion resulting in exposure to adjacent populations. Smaller slag piles, originating from Taracorp and associated with the operations of the adjacent St. Louis Lead Recyclers, also contribute to environmental degradation in the area.

Detailed information regarding the area demographics, environmental contamination, previous health studies, and regulatory action are included in the original project proposal submitted to ATSDR.

PROJECT PROGRESS TO DATE

A. Study Hypothesis

The two main hypotheses addressed in this study are 1) measures of body burden of selected heavy metals (primarily blood lead and

urinary cadmium) positively correlate with one or more environmental sources of heavy metals (e.g., exterior soil concentrations, air concentrations, house dust levels, etc.), and 2) adverse health outcomes indicating organ system injury or disease as indicated by abnormal results of selected biomarker panels correlate positively with body burden measurements and exposure histories.

As previously mentioned, this exposure study is now part of a larger multi-state study involving sites in Missouri and Kansas as well. It is ATSDR's intention to utilize data from all three studies, as well as one additional study, in a single meta-analysis of heavy metal exposure, body burden measure, and health effects. It is important, therefore, that each separate study be conducted in as similar a manner as possible and all potential sources of variability be reduced as much as possible to promote comparable results. Illinois personnel have participated in meetings or conference calls with representatives of Missouri, Kansas, ATSDR, USEPA, and the Centers for Disease Control (CDC) on several occasions to work on and coordinate protocols, questionnaires, and other details of the studies. As such, each of the individual studies have been modified somewhat to reduce differences as much as possible. ATSDR has taken the lead in developing the core question and training guide for use by the states in their respective studies. ATSDR is also coordinating efforts at providing sampling and laboratory support for the studies.

B. Budgetary and Contractual Difficulties

Several serious problems have arisen during the first year of this study which threatened to halt or delay it. In Illinois, the state legislature must vote spending authority for all budget items, including federal monies. Due to disagreements between the legislature and the governor over the state's budget, spending authority for fall and spring supplemental budgets was not appropriated. In other words, although ATSDR had awarded the money, IDPH could not spend any of it without authorization from the legislature. To prevent the study from foundering, IDPH provided state funds to cover essential needs of the study until the problem could be corrected. This included funds for personal services expended on behalf of the study, travel to ATSDR-sponsored meetings and the study area, questionnaire development and review, printing, mailing, and telecommunications costs, and some contractual obligations. The spending authorization problem resolves itself without further complication on July 1, 1991 with the beginning of the new state fiscal year. This provides only three months remaining in the federal fiscal year to utilize these as-of-yet untouched Year One funds on behalf of the study.

It was the original intent of IDPH to contract out the major parts of this study to an outside academic or research institution. The selected institution would be responsible for carrying out the census, conducting the questionnaire, biomedical sampling, and environmental sampling, assuring the proper handling and management

of forms and samples, and conducting the analysis of the data as well as sub-contracting with other organizations or groups as necessary. After due consideration, the University of Illinois Schools of Veterinary Medicine and Public Health were selected as the prime contractor for this study. Despite the problems with the availability of study funds as outlined above, significant progress had been made in developing the study design and identifying needs and resources. In mid-April of 1991, however, the USEPA revealed that the University of Illinois was considered a potentially responsible party (PRP) at the NL Industries/Taracorp NPL site. This raised concern over potential conflict of interest on the part of the university. ATSDR indicated in late May of this year that these circumstances excluded the University of Illinois from participating in this study as the IDPH's contractor and ATSDR requested IDPH to find another individual or group to serve as its contractor. Coming as it did just prior to embarking on the area census and two months before the main portion of the study was scheduled to commence, this problem threatened the entire study. The groundwork done by the university was lost and no new contractor was immediately identifiable nor could one be expected to simply step in where the last had left off. Additionally, the University of Illinois had worked largely without remuneration due to the budget problems discussed above. Other contractors were not expected to extend the state the same courtesy.

IDPH is currently in negotiation with another group to take over the main portion of the project. This group, the Institute for Evaluating Health Risks (IEHR), is headquartered in Washington, D.C. and is a non-profit organization dedicated to evaluating environmental and occupational health risks. The individual who would head the project is Renate Kimbrough, M.D. Dr. Kimbrough is a world-renowned health scientist who has worked for both CDC and USEPA on a variety of environmental health issues. Her outstanding reputation and abilities, together with her acquaintance with this study as a consultant to USEPA Region 7 (Kansas City) in reviewing the study protocol, make her uniquely qualified to participate. She would be assisted in the project by Maurice LeVois, Ph.D., who would be responsible for overseeing data collection and data analysis. Dr. LeVois is an epidemiologist/biostatistician of wide repute. His past work has included Agent Orange studies conducted on behalf of the federal government. He has already conducted some background work as regards this project. IDPH intends to contract with IEHR for the services of Doctors Kimbrough and LeVois in completing this study and analysis and interpretation of the data. Negotiations regarding the contract and work product are still ongoing, and will be reviewed by ATSDR prior to finalization. No identifiable or suggested conflict of interest exists with IEHR or the individuals who will be working on this study. IDPH will provide support personnel if needed to address any shortfalls in study personnel or services and will maintain oversight on the project though a dedicated staff member. The contractor will be responsible for sub-contracts as required by the study. Because of the problems with the funding and contracts, a detailed budget for the remaining months of the first year and the second year will

have to be prepared once contractor negotiations are complete. This budget will be provided to ATSDR for review and approval when finished along with resumes of project participants (contractual and otherwise).

C. Protection of Human Subjects

The protocol for this study and the statement of informed consent were submitted to the Institutional Review Board (IRB) at the Southern Illinois University School of Medicine in February of 1991. IDPH personnel have met with the IRB three times (March, May, and June 1991) to discuss the study and to work out problems necessary to get IRB approval for the study. The IRB has granted tentative approval to the study protocol and statement of informed consent subject to correction of some minor errors. IDPH expects to receive the signed forms from the IRB by the end of June 1991 and will provide them at that time to ATSDR and the National Institute of Health.

D. Laboratory Support

As originally conceived, IDPH or its contractors would have sought out contract laboratories to conduct biomedical and environmental analyses. Because of the multi-state nature of the present study and the need to reduce variability as much as possible, it has been decided to utilize the same laboratories as much as possible. Toward this end, ATSDR has made arrangements with CDC and the Midwest Research Institute (Kansas City, MO) to conduct the largest portion of the biomedical testing. The CDC laboratory will conduct blood lead, blood and urinary cadmium, zinc protoporphyrin, and the immune system biomarkers in Atlanta while MRI will conduct the remaining biomarker analyses in Kansas City. MRI and CDC will also provide sampling supplies, labels, shipping, and support personnel as needed to facilitate this effort. A local hospital, St. Elizabeth's in Granite City, will be utilized to conduct blood chemistries and other tests which must be performed on-site. Environmental sampling and analysis will be performed in conjunction with USEPA (Region 5). This will include exterior soil sampling, interior dust samples, water samples, paint samples, and air samples (available from pre-existing air monitoring stations). USEPA is developing the environmental sampling protocol in conjunction with ATSDR and IDPH and will provide a sampling team or teams to collect and catalog the samples. A USEPA contract laboratory will be used to analyze the samples although direct-reading XRF machines will probably be utilized to determine lead content of paint. All data will be quality-controlled and assured before being provided to the contractor for analysis.

E. Census (Phase I)

Despite the loss of the first contractor, IDPH plans to complete the census on time utilizing state personnel and hourly workers. The census questionnaire has been developed and contains questions relating to household make-up, gender, age, race, socioeconomic

descriptors. Census takers will be broken into teams and assigned specific areas and blocks to work. These areas has been identified based on the areas of contamination as identified by USEPA, IEPA, and IDPH soil sampling and the 1990 census tract maps. The census is considered necessary due to population changes since 1980, unavailability of individual and/or household characteristics from the 1990 census, and some concern over the accuracy or completeness of the 1990 census in some areas. The census will provide details necessary for the identification and selection of study participants as well as the community's first introduction to the study and its needs. Census takers have been interviewed and will be hired shortly. Training is planned for the first week in July with field work beginning the second week (July 8th). Call-back on a random selection of census forms will be conducted as a quality assurance method. Analysis of the census data and contact with individuals (or their legal guardians) selected as possible study participants will be ongoing during and after the census. Information from this census will be used in the final determination of a control population for the study.

F. Main Study (Phase II)

The major portion of the study is planned for mid-August of 1991 and will consist primarily of administration of the questionnaire to study participants and biomedical sampling. At the same time, environmental sampling at the homes of selected study participants will also be conducted. It is anticipated that at least some of their work will extend into September. While details of this phase of the study and final review and approval of protocols and forms are still incomplete, the basic conduct of the project will follow in this manner: individuals will be contacted by phone for an appointment to come into a central location and provide samples and information (some individuals will be visited at home if they are unable to come to the designated location). Once at the location, the questionnaire will be administered by trained personnel and biologic sampling performed by a phlebotomist or pediatric phlebotomist and an assistant. The samples will be labelled and prepared appropriately for shipment. All samples collected will be shipped daily to the appropriate laboratory for analysis. At the same time, the biologic samples are taken, an appointment for the environmental sampling will be made and this information given to the appropriate party. The results of the questionnaire, biomedical analyses, and environmental analyses will be entered into a dataset and correlational analyses performed on it. It is also anticipated that some additional follow-up may be necessary on some individuals and/or their home environment.

G. Citizen Participation and Community Awareness

An exposure study of this type has been the expressed desire of a large number of citizens in all three communities as well as that of elected officials and civic leaders. There is a high degree of concern and interest about the exposure from the NPL site due to statements regarding the potential hazards posed by the site.

Media attention to the controversy has been high. A public meeting to announce the study has been scheduled for the end of June and a news release about the study and the public meeting has been made available. Stories regarding the study have appeared in local newspapers and those in St. Louis. The main participants in the study will be present in Granite City to discuss the study and answer questions. Additionally, the opportunity will be used to discuss and work out the remaining practical problems while together.

Additionally, IDPH has formed a citizen advisory panel for this study to enable community input and community acceptance of the conduct and results of the study. The use of the local hospital and the hiring of local workers to participate in the census and study will further enhance community awareness of participation in, and acceptance of, this study. Additional public meetings will be held prior to the start of the main study and after the analysis and interpretation of the results.

H. Follow-up of Affected Individuals

There is a need to define what steps will be taken if and when an unacceptably high biological or environmental sample result is found. Since Madison County lacks a local health department, it will be IDPH's responsibility to follow-up on cases with excessive body burdens both to identify the source and to recommend appropriate medical treatment. Staff within the Environmental Toxicology Program utilizing IDPH's authority under either the Childhood Lead Poisoning Prevention Act or the Adult Blood Lead Registry Act will contact cases or their legal guardians once the results are known. CDC has indicated a six week turn-around time on biologic samples and will contact IDPH by phone for cases which demand immediate action. IDPH personnel will examine the questionnaire or the observations made during environmental sampling to identify any possible sources and will consult with the homeowner, tenant, or landlord to recommend intervention strategies. Additionally, IDPH will make recommendations by phone and in writing as to appropriate medical evaluation and will seek permission to contact the family physician with the results of the biomedical testing. In such cases, additional biomedical or environmental follow-up may be necessary to ensure that intervention has been successful.

I. Year Two Strategy

It is anticipated that some data collection activities from the first year may overlap into the second; however, the primary activities associated with the second year will be devoted to data entry, data analysis and interpretation, follow-up of subjects identified as at risk with biomedical or environmental intervention, report writing and review, and public dissemination and discussion of study results. A tape of the dataset will be provided to ATSDR for inclusion and use in their meta-analysis of the multi-state heavy metal study. The majority of Year Two

activities can be carried out at the offices of the contractor; however, any additional biomedical or environmental monitoring may require on-site visits by the contractor or IDPH personnel. Additionally, meetings with both the public and ATSDR will require some travel. A time line for the remaining months of Year One and those of Year Two is attached.

J. Conclusion

Despite difficulties with budget problems and acceptable contractors, the study of exposure to site-related contaminants at the NL Industries/Taracorp NPL site is progressing. A new contractor with exceptional qualifications has been found and negotiations are proceeding, IRB approval of the study is complete, the community is aware of and involved in the study, all necessary resources for completion of the study have been identified and located, and major budgetary problems resolved. The only critical factor is time; however, it appears that the study can be done within the proposed and necessary period.

Time Line-Madison County (IL) Lead Exposure Study

| | YEAR ONE | | | | YEAR TWO | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | June | July | Aug | Sept | Oct | Nov | Dec | Jan | Feb | Mar | Apr | May | June | July | Aug | Sept | Oct |
| Public Meetings | X | | X | | | | | | | | | | | | | X | |
| Population Census | | [—] | | | | | | | | | | | | | | | |
| Analysis of Census/Selection of Participant | | [—] | | | | | | | | | | | | | | | |
| Study Preparation | | [—] | | | | | | | | | | | | | | | |
| Questionnaire /Biomedical Sampling | | | [—] | | | | | | | | | | | | | | |
| Environmental Sampling | | | [—] | | | | | | | | | | | | | | |
| Follow-up | | | | | [—] | | | | | | | | [—] | | | | |
| Data Entry | | | | [—] | | | | | | | | | | | | | |
| Data Analysis | | | | | | | [—] | | | | | | | | | | |
| Draft Report and Review | | | | | | | | | | | [—] | | | | | | |
| Public Comment | | | | | | | | | | | | | [—] | | | | |
| Final Report | | | | | | | | | | | | | | | [—] | | |
| | | | | | | | | | | | | | | | | | |

DEPARTMENT OF HEAL .. & HUMAN SERVICES

Public Health Service

Agency for Toxic Substances
and Disease Registry
Atlanta GA 30333

RECEIVED
JUN 1991
Division of
Environmental
Health

May 24, 1991

Mr. Thomas Long
Illinois Department of
Public Health
525 West Jefferson Street
Springfield Illinois 62671

Reference: Grant Number H75/ATH590119-01

Dear Mr. Long:

The Division of Health Studies has discovered that the contractor (the University of Illinois) for Illinois Department of Public Health (IDH) is a Potential Responsible Party (PRP) at the site where the health study for the above referenced grant will take place. This presents a conflict of interest that could jeopardized the outcome of the study. The study protocol requires that the contractor's duties include professional judgements that are largely subjective and may substantially influence the outcome of the study.

Because of their potential conflict of interest, we recommend that the IDH avoid contracting with the University of Illinois on this study site.

Approval must be obtained from the Government prior to awarding future subcontracts so that we can determine if there is a potential conflict of interest.

If you have any questions on this matter, please contact Grants Management Specialist, Van Malone at (404) 842-6630.

Sincerely,

Henry S. Cassell III

Henry S. Cassell, III
Grants Management Officer
Grants Management Branch
Procurement and Grants Office

# Illinois Department of Public Health

## NEWS RELEASE

FOR IMMEDIATE RELEASE Tom Schafer 217-782-5750

SPRINGFIELD, IL, June 19 -- Dr. John R. Lumpkin, state health director, today announced an 18-month, $500,000 study of possible lead exposure to residents living in the vicinity of the NL Industries/Taracorp site in Granite City.

Dr. Lumpkin said the first phase of the study will begin in July when the residents of about 4,000 homes located within a mile of NL Industries/Taracorp will be contacted about being part of the study. The second phase, he said, is scheduled to follow in late August and consist of a detailed questionnaire, blood and urine sampling of some of the residents and environmental sampling in and around the homes of selected participants.

"The purpose of this study is to address the concerns of the area residents about their health and the health of their children," Dr. Lumpkin said. "In addition, given the widespread occurrence of lead in the environment, understanding how and when it becomes a hazard is important to protect the health and welfare of Illinois citizens."

The Department will hold a public hearing June 27 at 7 p.m. in the Granite City Township Hall, 2060 Delmar Ave., Granite City to discuss the study.

In 1983, NL Industries/Taracorp, a secondary lead smelter for 80 years, ceased smelting operations and in 1986, due to lead contamination at the site, was placed on the U.S. Environmental Protection Agency (USEPA) National Priorities (Superfund) List.

-- more --

Granite City Lead Study - Census ID _____

Summer, 1991 Household # _____

## INTRODUCTION

Hello, my name is _____ As you may know, the Illinois Department of Public Health is planning a study in Granite City, Venice, Madison and other surrounding areas to determine blood lead levels in some children and in some adults. Before this study can be done, we need to know more about this community. We will not be able to include everyone in this study. So even though you may or may not decide to participate, we would still like for you to tell us about the members of this household. I would like 15 minutes of your time to ask you some questions. This information will be kept confidential. If I should ask you any questions that you do not wish to answer, just tell me.

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ILLINOIS DEPARTMENT
OF PUBLIC HEALTH

Granite City Lead Study - Cer s

Summer, 1991

ID _____

Household # _____

House Address: _____

City: _____ Zip: _____ Phone: _____

Refused to answer questions Yes ___ No ___

List on the numbered lines below the names of each person living in this house or apartment. Begin with the head of the household and include all persons staying here who have no other home.

| INCLUDE | DO NOT INCLUDE |
|---|---|
| Everyone who usually lives here such as family members, housemates and roomates, foster roommates, foster children, roomers, boarders, and live-in employees. | Persons who usually live somewhere else. |
| Persons who are temporarily away on a business trip, on vacation, or in a general hospital. | Persons who are institutionilized. |
| College students who stay here while attending college. | College students who live somewhere else while attending college. |
| Persons in the Armed Forces who live here. | Persons in the Armed Forces who live somewhere else. |
| Newborn babies still in the hospital. | |
| Children in boarding schools below the college level. | |
| Persons who stay here most of the week while working even if they have a home somewhere else. somewhere else. | Persons who stay somewhere else most of the week while working. |

| | Last | First | Initial |
|---|---|---|---|
| Person 1 (head): | | | |
| Person 2: | | | |
| Person 3: | | | |
| Person 4: | | | |
| Person 5: | | | |
| Person 6: | | | |
| Person 7: | | | |
| Person 8: | | | |
| Person 9: | | | |
| Person 10: | | | |
| Person 11: | | | |
| Person 12: | | | |

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OF PUBLIC HEALTH

Granite City Lead Study - Census

Summer, 1991

ID _____

Household # _____

## HOUSEHOLD DATA

Circle the answer which best applies

**#1**

Which describes this building best?

1. Mobile home or trailer
2. One family house detached from any other house
3. Duplex
4. Row House
5. Building with 2 apartments
6. Building with 3 or 4 apartments
7. Building with 5 to 9 apartments
8. Building with 10 or more apartments
9. Don't know

**#2**

How many rooms do you have in this house or apartment excluding bathrooms or halls?

1. 2 or less
2. 3 to 4 rooms
3. 5 to 6 rooms
4. 7 to 8 rooms
5. 8 to 9 rooms
6. 10 or more rooms
9. Don't know

**#3**

What year was the house built?

1. Before 1880
2. 1880 to 1899
3. 1900 to 1919
4. 1920 to 1939
5. 1940 to 1959
6. 1960 to 1979
7. 1980 to present
9. Don't know

**#4**

Is this house or apartment

1. Owned by you or someone in this household with mortgage or loan?
2. Owned by you or someone in this household free and clean (without a mortgage)?
3. Rented for cash rent?
4. Occupied without payment of cash rent?
5. Other _____
9. Don't know

**#5**

Which of the following best describes this household's yearly income (before taxes)?

1. Less than $10,000
2. $10,000/yr to $19,999/yr
3. $20,000/yr to $29,999/yr
4. $30,000/yr to $39,999/yr
5. $40,000/yr to $49,999/yr
6. $50,000 or more
7. Refused response
9. Don't know

**#6**

Which of the following best describes the highest level of education completed by the head of this household?

1. Grade school
2. Some high school
3. High school
4. Some college
5. College (B.A., B.S. etc.)
6. Some postgraduate work
7. Postgraduate work (i.e., Master's, Ph.D. J.D., M.D., etc.)
9. Don't know

**#7**

If you pay rent or mortgage for this apartment or house, which of the following best describes the monthly payment?

1. $100 or less
2. $101 to $150
3. $151 to $200
4. $201 to $250
5. $251 to $300
6. $301 to $350
7. $351 to $400
8. $401 or more
9. Don't know

**#8**

How long have you and your family occupied this apartment or house?

1. Less than 2 months
2. 3 months to 11 months
3. 1 year to 2 years
4. 3 years to 5 years
5. 6 years to 8 years
6. 9 years or more
9. Don't know

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ILLINOIS DEPARTMENT
OF PUBLIC HEALTH

OMB Approval No. 0348-0043

# APPLICATION FOR FEDERAL ASSISTANCE

| | |
|---|---|
| 2. DATE SUBMITTED | Applicant Identifier |
| 3. DATE RECEIVED BY STATE | State Application Identifier |
| 4. DATE RECEIVED BY FEDERAL AGENCY JUN 12 1990 | Federal Identifier H75/ATH590119 |

1. TYPE OF SUBMISSION:
Application: ☐ Construction ☐ Non-Construction
Preapplication: ☐ Construction ☒ Non-Construction

5. APPLICANT INFORMATION

Legal Name: Illinois Department of Public Health

Organizational Unit: Division of Environmental Health

Address (give city, county, state, and zip code): 525 West Jefferson Street, Springfield, IL 62761

Name and telephone number of the person to be contacted on matters involving this application (give area code): Thomas F. Long (217)782-5830

6. EMPLOYER IDENTIFICATION NUMBER (EIN): 3 7 – 6 0 0 2 0 5 7

7. TYPE OF APPLICANT: (enter appropriate letter in box) A

A State
B County
C Municipal
D Township
E Interstate
F Intermunicipal
G Special District
H Independent School Dist
I State Controlled Institution of Higher Learning
J Private University
K Indian Tribe
L Individual
M Profit Organization
N Other (Specify)

8. TYPE OF APPLICATION:
☒ New ☐ Continuation ☐ Revision

If Revision, enter appropriate letter(s) in box(es): ☐ ☐
A Increase Award B Decrease Award C Increase Duration
D Decrease Duration Other (specify)

9. NAME OF FEDERAL AGENCY: Agency for Toxic Substance and Disease Registry

10. CATALOG OF FEDERAL DOMESTIC ASSISTANCE NUMBER: 1 3 . 1 6 1

TITLE: Pilot and Epidemiologic Studies to determine relationship between exposure to hazardous substances and adverse health outcomes.

11. DESCRIPTIVE TITLE OF APPLICANT'S PROJECT:
Pre-application for Lead Exposure Project - Granite City, Madison County, IL

ATSDR Announcement #012

12. AREAS AFFECTED BY PROJECT (cities, counties, states, etc.):
1) Madison County
2) Illinois

13. PROPOSED PROJECT

| Start Date | Ending Date |
|---|---|
| 8/90 | 8/91 |

14. CONGRESSIONAL DISTRICTS OF

| a. Applicant | b. Project |
|---|---|
| 18th, 20th | 21st |

15. ESTIMATED FUNDING:

| | | |
|---|---|---|
| a. Federal | $ 399,600 | .00 |
| b. Applicant | $ 0 | .00 |
| c. State | $ 49,932 | .00 |
| d. Local | $ 0 | .00 |
| e. Other | $ 0 | .00 |
| f. Program Income | $ 0 | .00 |
| g. TOTAL | $ 449,532 | .00 |

16. IS APPLICATION SUBJECT TO REVIEW BY STATE EXECUTIVE ORDER 12372 PROCESS?
a. YES THIS PREAPPLICATION/APPLICATION WAS MADE AVAILABLE TO THE STATE EXECUTIVE ORDER 12372 PROCESS FOR REVIEW ON
DATE 5/1/90
b. NO ☒ PROGRAM IS NOT COVERED BY E.O. 12372
☐ OR PROGRAM HAS NOT BEEN SELECTED BY STATE FOR REVIEW

17. IS THE APPLICANT DELINQUENT ON ANY FEDERAL DEBT?
☐ Yes If "Yes," attach an explanation ☒ No

18. TO THE BEST OF MY KNOWLEDGE AND BELIEF, ALL DATA IN THIS APPLICATION/PREAPPLICATION ARE TRUE AND CORRECT, THE DOCUMENT HAS BEEN DULY AUTHORIZED BY THE GOVERNING BODY OF THE APPLICANT AND THE APPLICANT WILL COMPLY WITH THE ATTACHED ASSURANCES IF THE ASSISTANCE IS AWARDED.

| | | |
|---|---|---|
| a. Typed Name of Authorized Representative: Bernard J. Turnock, MD | b. Title: Director | c. Telephone number: 217/782-4977 |
| d. Signature of Authorized Representative: Bernard J. Turnock MD | | e. Date Signed: 6/11/90 |

Previous Editions Not Usable

Standard Form 424 (REV. 4-88)
Prescribed by OMB Circular A-102

Granite City Lead Study - Census

Summer, 1991

| Please fill one column for each person listed on second page. | Person # ____ (Head of Household) First Name _____ | Person # ____ First Name _____ | Person # ____ First Name _____ | Person # ____ First Name _____ |
|---|---|---|---|---|
| #9 How are person 2 and others related to person 1? | | | | |
| 1. Husband/wife | 1 | 1 | 1 | 1 |
| 2. Natural-born/adopted son/daughter | 2 | 2 | 2 | 2 |
| 3. Stepson/stepdaughter | 3 | 3 | 3 | 3 |
| 4. Brother/sister | 4 | 4 | 4 | 4 |
| 5. Father/mother | 5 | 5 | 5 | 5 |
| 6. Grandchild | 6 | 6 | 6 | 6 |
| 7. Other _____ | 7 | 7 | 7 | 7 |
| 9. Don't know | 9 | 9 | 9 | 9 |
| #10 If not related to person 1 | | | | |
| 1. Roomer, boarder | 1 | 1 | 1 | 1 |
| 2. Housemate, roommate | 2 | 2 | 2 | 2 |
| 3. Unmarried partner | 3 | 3 | 3 | 3 |
| 4. Other non relative | 4 | 4 | 4 | 4 |
| 9. Don't know | 9 | 9 | 9 | 9 |
| #11 Which best describes the race of persons in your household? | | | | |
| 1. Caucasian | 1 | 1 | 1 | 1 |
| 2. African-American | 2 | 2 | 2 | 2 |
| 3. Indian American | 3 | 3 | 3 | 3 |
| 4. Eskimo or Aleut | 4 | 4 | 4 | 4 |
| 5. Asian or Pacific | 5 | 5 | 5 | 5 |
| 6. Other _____ | 6 | 6 | 6 | 6 |
| 9. Don't know | 9 | 9 | 9 | 9 |
| #12 Spanish or Spanish origin? | 1. Y<br>2. N<br>9. Don't know | 1. Y<br>2. N<br>9. Don't know | 1. Y<br>2. N<br>9. Don't know | 1. Y<br>2. N<br>9. Don't know |
| #13 Sex | 1. M<br>2. F | 1. M<br>2. F | 1. M<br>2. F | 1. M<br>2. F |
| #14 Age in Years | _____ | _____ | _____ | _____ |
| #15 Date of Birth | ___/___/___ | ___/___/___ | ___/___/___ | ___/___/___ |
| #16 Marital Status | | | | |
| 1. Now married | 1 | 1 | 1 | 1 |
| 2. Widowed | 2 | 2 | 2 | 2 |
| 3. Divorced | 3 | 3 | 3 | 3 |
| 4. Separated | 4 | 4 | 4 | 4 |
| 5. Single | 5 | 5 | 5 | 5 |
| 9. Don't know | 9 | 9 | 9 | 9 |

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ILLINOIS DEPARTMENT
OF PUBLIC HEALTH

Granite City Lead Study - Census ID _____

Summer, 1991 Household # _____

The Illinois Department of Public Health thanks you for your cooperation. The census information given to the Illinois Department of Public Health will be used to help determine which particular areas are best to study. We need some of this information to choose groups of residents that may be exposed to lead as well as similar groups of residents that are not exposed.

If you have any further questions regarding this study, please contact Illinois Department of Public Health, Division of Environmental Health at (217)782-5830, 525 West Jefferson Street, Springfield, IL 62761 or (618)656-6680, #22 Kettle River Drive, Edwardsville, IL 62025.

*** LEAVE THIS PAGE AT HOUSEHOLD AFTER CENSUS COMPLETED ***

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OF PUBLIC HEALTH

OMB Approval No. [illegible]-0044

# BUDGET INFORMATION — Non-Construction Programs

## SECTION A – BUDGET SUMMARY

| Grant Program Function or Activity (a) | Catalog of Federal Domestic Assistance Number (b) | Estimated Unobligated Funds | | New or Revised Budget | | |
|---|---|---|---|---|---|---|
| | | Federal (c) | Non-Federal (d) | Federal (e) | Non-Federal (f) | Total (g) |
| 1 ATSDR Pilot/Epi Studies | 13.161 | $ 0 | $ 0 | $ 399,600 | $ 49,932 | $ 449,532 |
| 2 | | | | | | |
| 3 | | | | | | |
| 4 | | | | | | |
| 5. TOTALS | | $ | $ | $ 399,600 | $ 49,932 | $ 449,532 |

## SECTION B – BUDGET CATEGORIES

| 6 Object Class Categories | GRANT PROGRAM, FUNCTION OR ACTIVITY (1) | (2) | (3) | (4) | Total (5) |
|---|---|---|---|---|---|
| a. Personnel | $ 0 | $ 30,000 | $ | $ | $ 30,000 |
| b. Fringe Benefits | 0 | 5,694 | | | 5,694 |
| c. Travel | 17,100 | 0 | | | 17,100 |
| d. Equipment | 121,500 | 0 | | | 121,500 |
| e. Supplies | 11,000 | 0 | | | 11,000 |
| f. Contractual | 250,000 | 0 | | | 250,000 |
| g. Construction | 0 | 0 | | | 0 |
| h. Other | 0 | 0 | | | 0 |
| i. Total Direct Charges (sum of 6a - 6h) | 399,600 | 35,694 | | | 435,294 |
| j. Indirect Charges | 0 | 14,238 | | | 14,238 |
| k. TOTALS (sum of 6i and 6j) | $ 399,600 | $ 49,932 | $ | $ | $ 449,532 |
| 7 Program Income | $ 0 | $ 0 | $ | $ | $ 0 |

## SECTION C - NON-FEDERAL RESOURCES

| (a) Grant Program | (b) Applicant | (c) State | (d) Other Sources | (e) TOTALS |
|---|---|---|---|---|
| 8. 13.161 Pilot/Epi. Studies to Determine Relationshi | $ | $ 49,932 | $ | $ 49,932 |
| 9. between Human Exposure to Hazardous Substances and Adverse Health Outcomes | | | | |
| 10. | | | | |
| 11. | | | | |
| 12. TOTALS (sum of lines 8 and 11) | $ | $ 49,932 | $ | $ 49,932 |

## SECTION D - FORECASTED CASH NEEDS

| | Total for 1st Year | 1st Quarter | 2nd Quarter | 3rd Quarter | 4th Quarter |
|---|---|---|---|---|---|
| 13. Federal | $ 399,600 | $ | $ | $ | $ |
| 14. NonFederal | 49,932 | | | | |
| 15. TOTAL (sum of lines 13 and 14) | $ 449,532 | $ 112,383 | $ 112,383 | $ 112,383 | $ 112,383 |

## SECTION E - BUDGET ESTIMATES OF FEDERAL FUNDS NEEDED FOR BALANCE OF THE PROJECT

| (a) Grant Program | FUTURE FUNDING PERIODS (Years) | | | |
|---|---|---|---|---|
| | (b) First | (c) Second | (d) Third | (e) Fourth |
| 16. 13.161 Pilot/Epi Studies to Determine Relationship | $ 399,600 | $ 0 | $ 0 | $ 0 |
| 17. between Human Exposure to Hazardous Substances and Adverse Health Outcomes | | | | |
| 18. | | | | |
| 19. | | | | |
| 20. TOTALS (sum of lines 16-19) | $ 399,600 | $ 0 | $ 0 | $ 0 |

## SECTION F - OTHER BUDGET INFORMATION

(Attach additional Sheets if Necessary)

21. **Direct Charges:** Majority of funds contractual (personnel and testing) See text for description.

22. **Indirect Charges:** Provisional rate of 42% on base of personal services and fringe benefits excluding group insurance

23. **Remarks**

OMB Approval No. 0348-0040

# ASSURANCES — NON-CONSTRUCTION PROGRAMS

**Note:** Certain of these assurances may not be applicable to your project or program. If you have questions, please contact the awarding agency. Further, certain Federal awarding agencies may require applicants to certify to additional assurances. If such is the case, you will be notified.

As the duly authorized representative of the applicant I certify that the applicant:

1. Has the legal authority to apply for Federal assistance, and the institutional, managerial and financial capability (including funds sufficient to pay the non-Federal share of project costs) to ensure proper planning, management and completion of the project described in this application.

2. Will give the awarding agency, the Comptroller General of the United States, and if appropriate, the State, through any authorized representative, access to and the right to examine all records, books, papers, or documents related to the award; and will establish a proper accounting system in accordance with generally accepted accounting standards or agency directives.

3. Will establish safeguards to prohibit employees from using their positions for a purpose that constitutes or presents the appearance of personal or organizational conflict of interest, or personal gain.

4. Will initiate and complete the work within the applicable time frame after receipt of approval of the awarding agency.

5. Will comply with the Intergovernmental Personnel Act of 1970 (42 U.S.C. §§ 4728-4763) relating to prescribed standards for merit systems for programs funded under one of the nineteen statutes or regulations specified in Appendix A of OPM's Standards for a Merit System of Personnel Administration (5 C.F.R. 900, Subpart F).

6. Will comply with all Federal statutes relating to nondiscrimination. These include but are not limited to: (a) Title VI of the Civil Rights Act of 1964 (P.L. 88-352) which prohibits discrimination on the basis of race, color or national origin; (b) Title IX of the Education Amendments of 1972, as amended (20 U.S.C. §§ 1681-1683, and 1685-1686), which prohibits discrimination on the basis of sex; (c) Section 504 of the Rehabilitation Act of 1973, as amended (29 U.S.C. § 794), which prohibits discrimination on the basis of handicaps; (d) the Age Discrimination Act of 1975, as amended (42 U.S.C.§§ 6101-6107), which prohibits discrimination on the basis of age; (e) the Drug Abuse Office and Treatment Act of 1972 (P.L. 92-255), as amended, relating to nondiscrimination on the basis of drug abuse; (f) the Comprehensive Alcohol Abuse and Alcoholism Prevention, Treatment and Rehabilitation Act of 1970 (P.L. 91-616), as amended, relating to nondiscrimination on the basis of alcohol abuse or alcoholism; (g) §§ 523 and 527 of the Public Health Service Act of 1912 (42 U.S.C. 290 dd-3 and 290 ee-3), as amended, relating to confidentiality of alcohol and drug abuse patient records; (h) Title VIII of the Civil Rights Act of 1968 (42 U.S.C. § 3601 et seq.), as amended, relating to nondiscrimination in the sale, rental or financing of housing; (i) any other nondiscrimination provisions in the specific statute(s) under which application for Federal assistance is being made; and (j) the requirements of any other nondiscrimination statute(s) which may apply to the application.

7. Will comply, or has already complied, with the requirements of Titles II and III of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970 (P.L. 91-646) which provide for fair and equitable treatment of persons displaced or whose property is acquired as a result of Federal or federally assisted programs. These requirements apply to all interests in real property acquired for project purposes regardless of Federal participation in purchases.

8. Will comply with the provisions of the Hatch Act (5 U.S.C. §§ 1501-1508 and 7324-7328) which limit the political activities of employees whose principal employment activities are funded in whole or in part with Federal funds.

9. Will comply, as applicable, with the provisions of the Davis-Bacon Act (40 U.S.C. §§ 276a to 276a-7), the Copeland Act (40 U.S.C. § 276c and 18 U.S.C. §§ 874), and the Contract Work Hours and Safety Standards Act (40 U.S.C. §§ 327-333), regarding labor standards for federally assisted construction subagreements.

10. Will comply, if applicable, with flood insurance purchase requirements of Section 102(a) of the Flood Disaster Protection Act of 1973 (P.L. 93-234) which requires recipients in a special flood hazard area to participate in the program andto purchase flood insurance if the total cost of insurable construction and acquisition is $10,000 or more.

11. Will comply with environmental standards which may be prescribed pursuant to the following: (a) institution of environmental quality control measures under the National Environmental Policy Act of 1969 (P.L. 91-190) and Executive Order (EO) 11514; (b) notification of violating facilities pursuant to EO 11738; (c) protection of wetlands pursuant to EO 11990; (d) evaluation of flood hazards in floodplains in accordance with EO 11988; (e) assurance of project consistency with the approved State management program developed under the Coastal Zone Management Act of 1972 (16 U.S.C. §§ 1451 et seq.); (f) conformity of Federal actions to State (Clear Air) Implementation Plans under Section 176(c) of the Clear Air Act of 1955, as amended (42 U.S.C. § 7401 et seq.); (g) protection of underground sources of drinking water under the Safe Drinking Water Act of 1974, as amended, (P.L. 93-523); and (h) protection of endangered species under the Endangered Species Act of 1973, as amended, (P.L. 93-205).

12. Will comply with the Wild and Scenic Rivers Act of 1968 (16 U.S.C. §§ 1271 et seq.) related to protecting components or potential components of the national wild and scenic rivers system.

13. Will assist the awarding agency in assuring compliance with Section 106 of the National Historic Preservation Act of 1966, as amended (16 U.S.C. 470), EO 11593 (identification and protection of historic properties), and the Archaeological and Historic Preservation Act of 1974 (16 U.S.C. 469a-1 et seq.).

14. Will comply with P.L. 93-348 regarding the protection of human subjects involved in research, development, and related activities supported by this award of assistance.

15. Will comply with the Laboratory Animal Welfare Act of 1966 (P.L. 89-544, as amended, 7 U.S.C. 2131 et seq.) pertaining to the care, handling, and treatment of warm blooded animals held for research, teaching, or other activities supported by this award of assistance.

16. Will comply with the Lead-Based Paint Poisoning Prevention Act (42 U.S.C. §§ 4801 et seq.) which prohibits the use of lead based paint in construction or rehabilitation of residence structures.

17. Will cause to be performed the required financial and compliance audits in accordance with the Single Audit Act of 1984.

18. Will comply with all applicable requirements of all other Federal laws, executive orders, regulations and policies governing this program.

| SIGNATURE OF AUTHORIZED CERTIFYING OFFICIAL | TITLE |
|---|---|
| Bernard J. Turnock MD | Director |
| **APPLICANT ORGANIZATION** | **DATE SUBMITTED** |
| Illinois Department of Public Health | 6/11/90 |

Form Approved through 9/30/91
OMB No. 0937-0189
Burden Est. 5 min. to 15 min.

# CHECKLIST

NOTE TO APPLICANT: Complete and forward this sheet with your application.

Type of Application

[X] NEW [ ] Noncompeting Continuation [ ] Competing Extension [ ] Supplemental

CHECKLIST

[X] Proper Signatures and Dates (Item 18 on face page and reverse side of appropriate assurances page).

NA [ ] Human Subjects Certification (when applicable).

NA [ ] Staff and Position Data (biographical sketch(es) with job description when required).

[X] Intergovernmental review under E.O. 12372 if required by the State.

On file [ ] Civil Rights Assurance on File with HHS (45 CFR 80).

On file [ ] Assurance Concerning the Handicapped on File with HHS (45 CFR 84).

On file [ ] Assurance Concerning Sex Discrimination on File with HHS (45 CFR 86).

On file [ ] Debarment Certification (45 CFR Part 76).

On file [ ] Drug-Free Workplace Certification (45 CFR Part 76).

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A private, nonprofit organization must include evidence of its nonprofit status with the application. Any of the following is acceptable evidence:

[ ] (a) A reference to the organization's listing in the Internal Revenue Service's most recent cumulative list of organizations.

[ ] (b) A copy of a currently valid Internal Revenue Service Tax exemption certificate.

[ ] (c) A statement from a State taxing body or the State Attorney General certifying that the organization is a nonprofit organization operating within the State and that no part of its net earnings may lawfully inure to the benefit or any private shareholder or individual.

[ ] (d) A certified copy of the organization's certificate of incorporation or similar document if it clearly establishes the nonprofit status of the organization.

[ ] (e) Any of the above proof for a State or national parent organization, and a statement signed by the parent organization that the applicant organization is a local nonprofit affiliate.

If an applicant has evidence of nonprofit status on file with an agency of PHS, it will not be necessary to file similar papers again, but the place and date must be indicated.

Previously filed with: _____ on _____
(date)

---

Name, title, address and telephone number of official in business office to be notified if an award is made.

Linda Cohen/Office of Health Protection
Illinois Department of Public Health/525 W. Jefferson St.
Springfield, IL 62761 217/782-3984

Name, title, address and telephone number of official responsible for carrying out the proposed project.

Thomas F. Long, Senior Toxicologist
Division of Environmental Health
Illinois Department of Public Health
525 W. Jefferson St.
Springfield, IL 62761 (217)782-5830

If this is an application for continued support, include: (1) the report of inventions conceived or reduced to practice required by the terms and conditions of the grant; or (2) a list of inventions already reported; or (3) a negative certification.

Pre-Proposal for Lead Exposure Study

NL Industries/Taracorp NPL Site
Granite City, Madison County, Illinois

## I. SUMMARY

The Illinois Department of Public Health (IDPH) is requesting the assistance of the Division of Health Studies of the Agency for Toxic Substances and Disease Registry (ATSDR) in evaluating the exposure to inorganic lead compounds of individuals residing in the area surrounding the NL Industries/Taracorp NPL site (Taracorp) in Granite City, Illinois. The purpose of this study is multifold: 1) to determine if blood lead levels in sensitive populations in the affected area are elevated when compared to health guidelines and a control population, 2) to determine if blood lead levels correlate to environmental lead exposures while controlling for obvious confounding factors (e.g., occupation, smoking, etc.), 3) to determine through questionnaire and observation which factors (behavioral and otherwise) are most important in determining individuals at risk, 4) to determine if alternate methods of monitoring lead body burdens are viable and furnish better data as to cumulative hazards posed by lead, 5) to determine if subtle effects of lead can be detected in exposed populations by use of physiological and/or behavioral testing, and 6) to determine if a surrogate population (household pets) can serve as a useful sentinel population to alert health officials of potential environmental hazards. Information derived from this study can obviously be used to advise sensitive populations of the need for medical follow-up, but primarily this study will be of use in discerning the relationship and importance of various environmental parameters in influencing lead body burden and health outcomes. Additional uses include testing and validation of new methods of evaluating lead burden and effects in exposed individuals. Such a study has practical benefits for Illinois and other states given the ubiquity of lead as an environmental contaminant and the degree of hazard posed to those exposed (particularly children). If a discernible and significant trend is detected as a result of any portion of the study, further and more detailed epidemiologic studies of populations at risk at this and similar sites will be considered.

## II. BACKGROUND

### A. HISTORY

The Taracorp site is located in a mixed industrial/residential area within the city limits of Granite City, Madison County, Illinois and immediately adjacent to the cities of Madison and Venice. This site, a former secondary lead smelter, has

contributed to substantial off-site, residential soil contamination by lead and associated metals as a result of the deposition of airborne lead emissions from eighty years of active smelting, surface run-off, and fugitive dust emissions from contaminated on-site surface soil and slag piles. Soil testing by IDPH, the Illinois Environmental Protection Agency (IEPA), and the United States Environmental Protection Agency (USEPA) has determined that lead contamination in excess of background levels (approximately 100 parts per million) and state standards (200 parts per million) exists throughout the residential, commercial, and industrial properties in Granite City, Madison, and Venice that adjoin the site or used lead-contaminated waste from the site as fill. It is estimated that an area in excess of five square miles around the smelter site has been potentially affected by emissions from the facility. The actual area affected by lead contamination may be larger when additional off-site disposal practices are considered. Additionally, the size of the affected area will grow or shrink depending on what level of lead in soil is considered by regulatory agencies to be indicative of site-related contamination. The population within the affected area may number as high as 7,000 to 8,000 again depending on the size of the area influenced by site emissions and the hazard posed to exposed individuals as defined by the lead content of the soil. The most sensitive segment of the population (children between six months and six years of age) comprise between five and ten percent of the population. Playgrounds, day-care centers, schools, and a hospital exist within the area of concern.

The Taracorp site was placed on the National Priorities List (NPL or Superfund) by USEPA in the early 1980s. The site is bound by 16th Street on the north and east, State Street on the south, and railroad tracks on the west (Figure 1). The neighboring properties are composed mainly of operating or defunct industrial concerns, although residential properties are adjacent to Taracorp on the east and within a few blocks on the north, south, and west (Figure 2). Metal refining, fabricating, and associated activities were conducted at the site until 1903, when a secondary lead smelting operation was started. The smelter produced sheet lead, lead solder, shotgun pellets, lead wool, lead pipe, powdered lead, and secondary lead ingots. The smelter ceased operations in the early 1980s as a result of repeated violations of air and water discharge permits. Solid waste generated by smelting was disposed of on-site in a slag pile. At the present time, the Taracorp slag pile covers more than three acres, reaches a height of 40 feet, and weighs an estimated 250,000 tons. The lead content of the slag is as high as 30 percent. The waste pile consists primarily of blast furnace slag, lead bearing fines, and battery case materials. While the site is fenced, the waste pile is basically uncontrolled and subject to leaching, surface run-off, and wind erosion. Smaller slag piles, originating from Taracorp and associated with the operations of the adjacent St. Louis Lead Recyclers, also

contribute to environmental degradation in the area. ATSDR has completed a Preliminary Health Assessment of the Taracorp site (Attachment 1). IDPH is in the process of developing a Full Health Assessment in cooperation with ATSDR. A 1983 study of the area by IEPA and IDPH is included as Attachment 2 to provide further background information.

B. DEMOGRAPHICS

According to the 1980 Census, the population of Granite City was 36,815 of which 98% were white. The population of Madison was 5,915 of which 58% were white. The population of Venice was 3,480 of which 33% were white. The total number of children under five years of age in the three municipalities were reported as 3301 and the number between five and nine years of age were reported as 3,857. The area is highly dependent on heavy industry as an economic base and with the decline in manufacturing jobs, the population has also declined. It is estimated that the population has dropped between 10 and 15 percent since 1980. The socioeconomic status of the majority of the population is lower to middle class. The 1980 median household income in Granite City was $17,880, in Madison $13,031 and in Venice $9,750. The percentage of individuals below the poverty level in 1980 was 10.7 (Granite City), 17.9 (Madison), and 25.0 (Venice). The percentage of individuals completing high school in 1980 was 57.6 (Granite City), 43.7 (Madison), and 42.8 (Venice). These population characteristics appear likely to have remained relatively stable since 1980.

Depending on how the area contaminated by emissions from Taracorp is defined, the population potentially affected may number as high as 8,000 in areas of Granite City, Madison, and Venice. Based on discussion with local officials and school representatives, the number of children under age nine is estimated to be between 400 and 600 with those under age five comprising about half this number. An accurate census of the sensitive population(s) has yet to be conducted.

C. CHARACTERIZATION OF THE SITE PRIOR TO STUDY

1. Air

Originally attention was drawn to this site as the result of repeated violations of the National Ambient Air Quality Standard (NAAQS) for lead. Throughout the late 1970s and early 1980s, air lead levels at the air monitor closest to the Taracorp site (15th and Madison Streets) regularly exceeded the 1.5 mcg/cu.m NAAQS standard for lead. The highest quarterly average recorded was 7.3 mcg/cu.m during the final months of 1981 (1981 yearly average of 3.03 mcg/cu.m). Based on these violations and other infractions of state and federal environmental regulations, Taracorp was denied an operating permit for their smelter. Smelting operations ceased in 1983 and air lead levels have

remained well below the lead NAAQS ever since. In the last reported year (1988), the average level of lead in the air measured at the 15th and Madison Streets monitor was 0.26 mcg/cu.m while the two monitors further to the east measured 0.12 and 0.13 mcg/cu.m, respectively. Despite the vast improvement in air quality since 1982, the smelter was in operation for over 80 years. It was not subject to even marginal environmental controls for the majority of that time. The predominant wind direction is from the north through the west (70%) which would result in air deposition in the residential areas to the east and south of the site and consequent soil contamination by lead in these areas. Fugitive dust emissions from the waste piles and contaminated on-site surface soils continue to occur and may elevate air lead levels locally and lead to off-site soil contamination through dust deposition.

2. Soil

As the result of deposition of air emissions generated by active smelting and fugitive dust emissions from surface soils and slag piles, surface run-off from the site, tracking of lead-contaminated materials off-site by traffic, and the disposal of lead bearing wastes off-site, the soil in and around the site is contaminated to varying degrees with lead. On-site soils have shown concentrations of lead ranging from 1,500 to 48,000 parts per million (ppm) while the slag pile is estimated to contain up to 300,000 ppm. Off-site soil samples were collected from residential yards and gardens and analyzed for lead by IDPH, IEPA, and USEPA in the early 1980s. Lead concentrations ranged from 27 to 5,400 ppm (mean = 1,087 ppm, median = 675 ppm, n = 48). In 1988, IDPH conducted additional soil sampling in the area as part of an area-wide lead study. Soil lead concentrations in off-site soils ranged from 106 to 9,493 ppm (mean = 1,030 ppm, median = 905 ppm, n = 40).

For the most part, sampling revealed that soil lead levels were highest around the perimeter of the site with concentrations decreasing with increasing distance from the site. Relatively high soil lead levels were detected in the residential soils immediately to the east of the site. Samples were not taken near roads or close to houses to avoid biasing the results by including soil potentially influenced by lead from automotive exhaust and lead paint. A map containing the results of the soil sampling conducted in the early 1980s and an isopleth of estimated soil concentrations based on this sampling is included as Figures 3 and 4.

3. Water

All homes in the Granite City, Madison, and Venice area are served by a public water supply which utilizes the Mississippi River as its water source. This water supply is tested at regular intervals by IEPA and meets all drinking water

standards. Private wells are known to exist in the area, but appear to be largely limited to industrial process water wells. Based on private well surveys conducted in Granite City for different purposes, it appears unlikely that individual home-owners utilize area ground water as a source of potable water. The few private wells found in Granite City are reportedly used solely for lawn and garden watering, car and pet washing and related outdoor activities. The overall poor quality of area ground water makes it unlikely that it would make a desirable drinking water supply. Analysis of water samples from site monitoring wells have not detected high levels of lead or other site-related contaminants in the ground water underlying the site. Lead concentrations have not exceeded 20 parts per billion. Additionally, the direction of ground water flow is primarily south-southwest, toward the Mississippi River and away from the majority of residential property. Many of the homes in the affected area are of older construction, perhaps contemporary of the facility. The possibility exists that the service connection or water distribution system in some homes utilizes lead pipe and/or lead solder. Plumbing of this sort may compound the lead exposure to individuals utilizing such water for drinking and cooking. The existence, extent, and significance of lead plumbing in this areas has not been established.

There are two dominant surface water bodies in the area. The Mississippi River is approximately one mile to the west and is a source of drinking and process water, sport and commercial fishing, transport, and recreation. It is also the major surface water discharge point as well as a point of discharge and recharge for area ground water. Horseshoe Lake, an oxbow remnant of the Mississippi River's former channel, lies approximately one mile to the southeast of the site, and is primarily a recreational area (Horseshoe Lake State Park). Based on evidence so far developed neither surface water body is likely to be affected by this site. Liquid waste from Taracorp or surface run-off may have entered the sanitary or storm sewer system, but Granite City's waste water discharge into the Mississippi River meets state and federal water quality standards. Ground water, which would discharge primarily to the Mississippi River, does not appear to be markedly contaminated by leaching from surface soils or the slag pile.

4. Household Exposure

As previously mentioned, many of the homes in the affected area are older. The possibility exists that lead-based paints were used at some time on the exterior or interior surfaces. The existence and extent of lead paint in these homes has not been determined, but may contribute markedly to the lead contamination of soils and dusts, and to the exposure of individuals, particularly children, occupying these homes.

Likewise, house dust from homes in the affected area has not been sampled to determine the lead content. Previous studies have demonstrated house dust can contain as much or more lead as exterior soils as a result of chipping paint, tobacco smoke, hobbies, occupation, and airborne or tracked-in soil (Attachment 3). Given the amount of time spent indoors, house dust may be a more important source of lead than exterior soils in this regard.

5. Food

Overall, diet probably is the single largest source of lead exposure to individuals. Concern was raised over the affect of airborne lead emissions and elevated soil lead on the lead content of home-grown fruit and vegetables in the neighborhoods surrounding the site. During the characterization of off-site contamination carried out in the early 1980s, a limited number of vegetable and soil samples from area gardens were collected and analyzed for lead. The results of this sampling is included as Table 1. The number and type of specific vegetable samples are too small to draw any firm conclusions; however, it does appear that the soil lead concentration does influence the lead concentration in the plant tissue. Information on the number of gardens in the area, the type of plants grown, and the relative percentage of home-grown fruits and vegetables in individual diets are unknown. Soil and other environmental factors influencing plant uptake of lead are also unknown. The significance of dietary lead to overall lead exposure in this setting has also not been determined.

6. Human

The Taracorp site has been the focus of considerable attention and concern over the past decade. At least three screenings of potentially exposed populations have been conducted since the late 1970s. Two of these studies were conducted by IDPH. The first, in late 1982, sampled primarily residents of Granite City and Madison while residents of Venice were sampled in late 1983. The studies were undertaken as a result of concern over the high lead concentrations measured in air while the smelter was in operation. The results of the blood lead and erythrocyte protoporphyrin (EP) testing are as follows (both measured in micrograms per deciliter):

1982

| | N | Blood Lead (mcg/dl) | | | EP (mcg/dl) | | |
|---|---|---|---|---|---|---|---|
| Ages | | Range | Mean | Median | Range | Mean | Median |
| 0-5 | 47 | 1-37 | 13.2 | 11 | 1-76 | 31.9 | 15.5 |
| 6-10 | 3 | 8-24 | 14 | 10 | 1-24 | 14.3 | 18 |
| 11-20 | 4 | 7-16 | 10.3 | 9 | 11-21 | 14.0 | 12 |
| 21-60 | 45 | 2-28 | 9.6 | 8 | 1-53 | 16.5 | 17 |
| Total | 99 | 1-37 | 11.5 | 10 | 1-76 | 17.5 | 15.5 |

1983

| Ages | N | Blood Lead (mcg/dl) Range | Mean | Median | EP (mcg/dl) Range | Mean | Median |
|---|---|---|---|---|---|---|---|
| 0.5 | 31 | 4-27 | 9.1 | 7 | 21-56 | 31.2 | 30 |
| 6-10 | 10 | 5-10 | 6.9 | 6 | 19-33 | 27.4 | 28.5 |
| 11-20 | 36 | 4-18 | 7.9 | 7.5 | 14-79 | 31.9 | 28 |
| 21-60 | 47 | 5-25 | 9.0 | 7 | 16-93 | 34.6 | 33 |
| 61+ | 12 | 4-13 | 7.4 | 6 | 29-51 | 36.5 | 34 |
| Total | 136 | 4-27 | 8.4 | 7 | 14-93 | 32.5 | 32 |

No attempt was made to correlate blood lead levels to exterior soil lead levels although some attempt to identify interior lead sources were made in individuals identified as having high blood lead (at the time defined as 30 mcg/dl). The utility of this work in assessing the hazards posed by environmental lead has been called into question due to the small numbers of individuals (especially children) sampled and the time of year (late fall) that the sampling was conducted.

D. CURRENT SAMPLING

The only on-going environmental sampling in the area consists of the three ambient air monitors located in Granite City. The closest of these to the site is located atop a building at 15th and Madison Streets approximately 100 yards southeast of the site. The air monitoring results for 1989 will be available shortly.

Monitoring of the public water supply is carried out regularly. The sampling is conducted post-treatment and prior to it entering the distribution system. No water samples from the tap are currently analyzed. The information thus derived is of limited utility to assess the possible lead exposure as a result of lead plumbing or solder in homes.

As Madison County has no local health department, no on-going childhood blood lead screening program exists. Some individuals in the affected area may receive health care at area WIC (Women, Infants, and Children) Clinics supported by IDPH. These clinics may sample blood for lead and EP. The existence or extent of this information has not yet been determined, but could serve as a valuable, albeit limited, supplemental source of information. Additionally, some individuals have on their own sought out blood tests based on concern generated by USEPA's proposed clean-up of the site.

## III. STUDY PROPOSAL

### A. INTRODUCTION

The potential hazards posed by lead in the home and environment are undisputed and current research indicates that lead may have deleterious effects at lower levels than previously thought, particularly in children's mental development, and that a large number of children may be at risk from lead (1). There is a question, in fact, as to whether there is a threshold for the adverse effects of lead. The degree to which lead in soil poses a hazard and the magnitude of that hazard is not as clear, and may depend on numerous socioeconomic and behavioral factors in addition to the lead content of soil. The Centers for Disease Control (CDC) has stated that blood lead levels, primarily in the young, may be elevated as the result of contact with soil containing lead in excess of 500 parts per million. The concern over soil lead concentrations arises over the observation that direct soil contact may result in inadvertent soil ingestion by children which may in turn significantly increase lead exposure. Some studies have linked children's blood lead to the lead levels in exterior and interior soils and dusts. The significance of this relationship appears to vary widely (Attachment 3), but a positive relationship is seen in all cases. It is obvious that potential confounders were not completely considered in many of these studies, but they do often illustrate the interdependence between environmental sources and socioeconomic factors in determining lead body burden and consequent hazard.

Lead effects on nervous system developments were recognized early in this century, but were assumed to be reversible until the 1940s when researchers reported permanent effects on learning and behavior in children exposed to lead (2). The expanding knowledge of the adverse effects of lead has been accompanied by a continual reduction in the acceptable body burden of lead as defined by blood lead levels. The acceptable level of lead in children's blood has dropped from 60 mcg/dl in the 1950s to the present 25 mcg/dl (3). Based on the most recent research, CDC is considering dropping the acceptable blood lead level yet again. The number being considered is 15 mcg/dl, a level already adopted by some states. However, as with earlier blood lead levels, this does not imply that a that a safe level of blood lead has been identified. In the last few years, a number of studies have been conducted and are still on-going which indicate that children suffer neurological and developmental deficits at blood lead levels well below the current standard of 25 mcg/dl (4-7). These studies seem to indicate that pre-natal and post-natal exposures at levels of 10-15 mcg/dl are associated with low birth weight and reduced growth rate as well as with cognitive deficits and reduction in neurologic development as measured by IQ. Needleman and his co-workers (8-10) have suggested that if children with elevated blood lead experience an average drop of four IQ points,

the number of individuals with IQs below 80 would treble and those with IQs above 125 would vanish.

Studies also indicate that the fetus is at risk from environmental lead exposure as well as the young child (11, 12). Pregnancy and lactation may mobilize the lead from maternal bone stores in a manner identical to calcium mobilization. Lead will cross the placenta and the fetus may serve as a lead sink for mobilized maternal lead. While much attention has focused on the hazard of lead to the fetus and child, there are additional studies indicating risk to adults as well. Some studies have indicated that high blood lead levels in middle-aged males may increase their risk of developing hypertension (13). It has also been suggested that lead may aggravate osteoporosis in post menopausal women when bone lead stores as released by the demineralization processes (12).

Since the shutdown of smelting operations at Taracorp in the early 1980s, the primary routes of lead exposure to area residents has been through the ingestion and inhalation of contaminated soils and dusts. Except for the possible contribution of maternally-derived lead from long-term female residents of the area, the only important source of site-related lead exposure to the most sensitive segment of the population (pre-school children) has been through soil and dust contamination. This exposure consists primarily of direct ingestion of contaminated soil by children, transfer of contaminated dusts to mouth by hands, swallowing of inhaled airborne particulate too large to penetrate to the lung, ingestion of food or liquids contaminated by lead-containing soils or dusts, and inhalation of lead-contaminated particulates small enough to penetrate to the lung. Additional exposures to lead may be occurring through old exterior and interior paints, plumbing, dietary sources (particularly canned foods), tobacco smoke, and parental occupations or hobbies. Given the air emissions originating from the smelter and the long half-life of lead in the body, long-time residents of the area would have received a significant lead exposure. Such individuals may be at risk for certain chronic disease states as suggested by previous studies. In the case of women of child-bearing years, pregnancy and lactation may serve to mobilize bone lead to the determinant of the fetus and neonate. There is a considerable body of animal and epidemiological evidence pointing to the serious chronic health problems posed by lead exposure; however, the relative importance of different environmental lead sources is at present unclear.

## B. HYPOTHESIS

While the soil around Taracorp is clearly contaminated with lead as a result of site operations, the contribution of this lead contamination to overall body burden is uncertain. The

hypotheses to be tested are 1) that lead body burdens as measured by a variety of tests positively correlate to one or more environmental sources of lead (primarily lead in soil and/or dust) and 2) that adverse health outcomes as defined by a variety of physiological and/or behavioral tests positively correlate to increases in lead body burdens as previously defined.

## C. STUDY DESIGN

In order to test the hypotheses, the study is divided into four phases. These consist of 1) definition of study area and population(s), 2) evaluation of lead body burden, 3) determination of environmental lead sources, and 4) evaluation of health status of the study population. Each point will be discussed in turn.

### 1. Study Area and Population

The size of the affected area is dependent upon how the contamination is defined. Utilizing the CDC's evaluative guideline of 500 ppm soil lead (which coincides with USEPA's proposed cleanup level), the area involved is approximately 55 square blocks and contains an estimated 3,000 to 4,000 individuals. Utilizing the state standard of 200 ppm soil lead would basically double the area and the population involved. Utilizing exceedences over the background level of lead in the urban area (100 ppm) would probably cause yet another doubling. There is no clearly defined or accepted level of soil lead upon which to base this decision. In the absence of such a standard, IDPH proposes utilizing a level of 200 ppm soil lead as a means of defining the study area.

The selection of the study population is also problematic. Children are of primary concern, but it is unclear how many children live within the affected area and their age distribution. A census of the area should be undertaken to furnish this information for decision-making purposes. It is suggested that all children in the area be initially screened and a subset of these be selected for further study based on age, location, and associated risk factors. It may be desirable as well to select a group of long-time female residents of child-bearing age to be included in the study. Additionally, a group of long-time residents of both sexes could be included in the study to assess the effects of long-term lead exposure on this population. Whatever the composition of the study population(s), a control population will be selected from a similar area within the communities unaffected by lead contamination. A control population will be essential in assessing the relative lead contributions from living in an urban area as compared to living in an urban area with high potential exposure to lead from the surrounding environment. The final selection of the study area and the number and composition of the study population(s) will be determined in consultation with ATSDR and USEPA.

## 2. Lead Body Burden

In most cases, lead body burden has been assessed by determining the lead content and/or the erythrocyte protoporphyrin (EP) level of blood. This study will also utilize blood lead testing of the study and control populations as one measure of lead exposure. EP testing is not viewed as essential and would significantly increase the cost of testing. The exact number of blood analyses to be undertaken is unknown at present, but will depend on the number of individuals ultimately making up the study and control populations. Screening of large numbers of potentially exposed individuals along with repeat sampling of selected subsets could entail several hundred samples. The sampling needs to be completed during the late summer/early fall in order to determine the blood lead levels during the period of likely maximum response.

Because blood lead measures are only considered representative of relatively recent exposure (within the past few weeks to few months), the utility of this measure in assessing long-term lead exposure and the hazard which this exposure entails has been called into question. Several alternative methods of assessing long-term lead exposure have been used that overcome the short-comings of blood lead measurement. Analysis of the lead content of deciduous teeth has been used as a determinant of long-term lead exposure. This approach is obviously limited to children. Due to the relatively small numbers of individuals likely to be involved and the intermittent nature of tooth loss, this method appears unlikely to furnish meaningful information in the short-term, but may be a useful and relatively simple method of gathering body burden data over an extended period of time. A more promising technique is the in vivo x-ray measurement of bone lead. This approach takes advantage of the fact that 90% of body lead is retained in bone with a biological half-life of several decades. Bone lead thus represents the cumulative result of continuous absorption and excretion integrated over time. Recent work with in vivo XRF measurement of the lead content of the tibia indicates that this approach provides a safe, accurate, and noninvasive method for estimating cumulative lead exposure and absorption (14). XRF bone lead measurements of the study population can be compared with that population of control populations or calibration standards to determine the relative difference in bone lead content. Such comparisons can, in turn, be related to long-term environmental exposure and used to assess the long-term hazard posed by such exposure. Unfortunately, such XRF instruments are not in common use and largely confined to research. The machinery is relatively expensive and can be used for investigative purposes only under the supervision of an IRB. Given these circumstances, the most practical approach to utilizing this methodology, would be to locate such a machine (preferably in the St. Louis area) and contract with the operator to provide the service to the study. Alternatively, given ATSDR's interest and involvement in lead issues around the

country, ATSDR may wish to invest in and utilize this technology. The instrument and expertise could then be loaned out as needed during investigations. IDPH could also purchase the machine as part of this grant and utilize it in on-going lead studies state-wide. The utilization of such technology should be decided in discussion with ATSDR and USEPA.

An indirect measure of lead exposure and hazard can be developed by utilizing a surrogate population of household pets, especially dogs. There is some evidence to suggest that such studies can serve as useful early warning or sentinels of human disease (15, 16). Because of their living in close proximity to humans, the degree of soil contact, the similar biologic response, and the short life-span, the lead body burden of dogs (and perhaps cats) can reflect the human hazard potential. A large pet population exists in association with residents of the affected neighborhood. Collection of blood samples from pets of both study and control populations could be correlated with the results of human and environmental samples to determine how closely the results mirror one another.

3. Environmental Lead Levels

It will be necessary to sample or account for a wide variety of environmental sources of lead. This should include individual or composite samples of residential soil (front yard, back yard, foundation), house dust samples, first and late draw water samples (accompanied by inspection of plumbing), paint samples or XFF paint analysis, and perhaps dietary samples. Additional exposures (occupation, smoking, hobbies) as well as other risk factors will be identified through questionnaire and observation. The number of samples required to adequately reflect environmental exposure will depend on the number of individuals within the study and control populations, and will be determined in conjunction with ATSDR and USEPA. Data derived from environmental samples can be used in conjunction with the physiologically-based pharmacokinetic model for lead recently developed by USEPA (Cincinnati). The results of the human monitoring can then be used to validate the predictions of the model. Additional important information can be obtained by determining the predominant inorganic forms of lead present at this site. The form of lead has been shown to substantially influence the bioavailability of lead and thus the hazard posed by it.

4. Health Outcomes

The ultimate purpose of this study is to determine if adverse health effects are associated with exposure to lead. The types of tests that might be employed range from physiological and biochemical (e.g. kidney function, nerve conduction, enzyme inhibition, etc.) to neurobehavioral evaluation. The appropriate

battery of tests will be selected in conjunction with ATSDR and USEPA. The number and make-up of individuals from study and control populations included in the testing will likewise be decided in conjunction with ATSDR and USEPA.

## D. PERSONNEL AND FACILITIES

Due to the need for rapid implementation of portions of this study, part or all of it will be contracted out to an academic institution with public health and/or environmental experience. Control over the project within IDPH will be the responsibility of Thomas Long in IDPH's Division of Environmental Health. He will maintain oversight over the contractor to ensure all aspects of the project are being carried out satisfactorily. Additionally, epidemiologic support and oversight (review of experimental design, questionnaire review, review of data analysis techniques, etc.) will be provided by IDPH's Division of Epidemiologic Studies under the supervision of Holly Howe.

Local facilities are available to support study activities. The Granite City Hospital will allow access to its facilities for purposes of human sampling and medical testing. Office and clerical support are available in the IDPH Regional Office in Edwardsville (15 minutes away). The local officials have promised help and cooperation in conducting this study.

## F. ESTIMATED BUDGET

Currently, only a rough estimate of a study can be provided due the uncertainty over the form the final study design will take. The following estimate is provided only as a suggestion of anticipated costs.

Personnel (contractual)

| | |
|---|---|
| 1 Project Director (full time/1 year) | 30,000 |
| 2 Project Associates (half time/1 year) | 30,000 |
| 3 Interviewers (quarter time/1 year) | 22,500 |
| 3 Phlebotomists (quarter time/1 year) | 15,000 |
| Total | $97,500 |

Sampling and Equipment

| | |
|---|---|
| Human Blood Lead (1000 samples @ $35 each) | 35,000 |
| Canine Blood Lead (500 samples @ $35 each) | 17,500 |
| In vivo Tibial XRF Machine (direct purchase)* | 100,000 |
| Soil and Dust Sampling (1600 @ $25)** | 40,000 |
| Water Sampling (800 @ $25)** | 20,000 |
| Medical Testing (400 @ $100/test)*** | 40,000 |
| Microcomputer and Software | 15,000 |
| Total | $267,500 |

*Leasing or contracting this portion out would be a considerable savings over direct purchase with the requirements for operator training and equipment maintenance.

**Cost may be absorbed by USEPA.

***Actual cost will depend on the type and number of medical tests utilized.

Miscellaneous

| | | |
|---|---|---|
| Travel | | 7,500 |
| Lodging | | 9,600 |
| Printing and Mailing | | 8,000 |
| Phone | | 3,000 |
| Office Furniture | | 6,500 |
| | Total | $34,600 |

Total Estimated Costs

| | | |
|---|---|---|
| Personnel | | 97,500 |
| Sampling and Equipment | | 267,500 |
| Miscellaneous | | 34,600 |
| | Total | $399,600 |

This estimate errs on the side of caution. Actual costs are likely to be lower.

## IV. CONCLUSIONS

The Taracorp site represents an exposure of long-standing to a cumulative hazard among a relatively stable population. The hazard is largely confined to a single contaminant and a single environmental pathway. A number of sensitive sub-populations exist in the affected area and a unique opportunity exists to study the effects on these individuals utilizing new and promising methodologies. IDPH is requesting assistance from ATSDR not only in terms of financial support but also in terms of advice and participation in developing and implementing appropriate study design, selection of study population size and type, exposure and medical testing, and data analysis.

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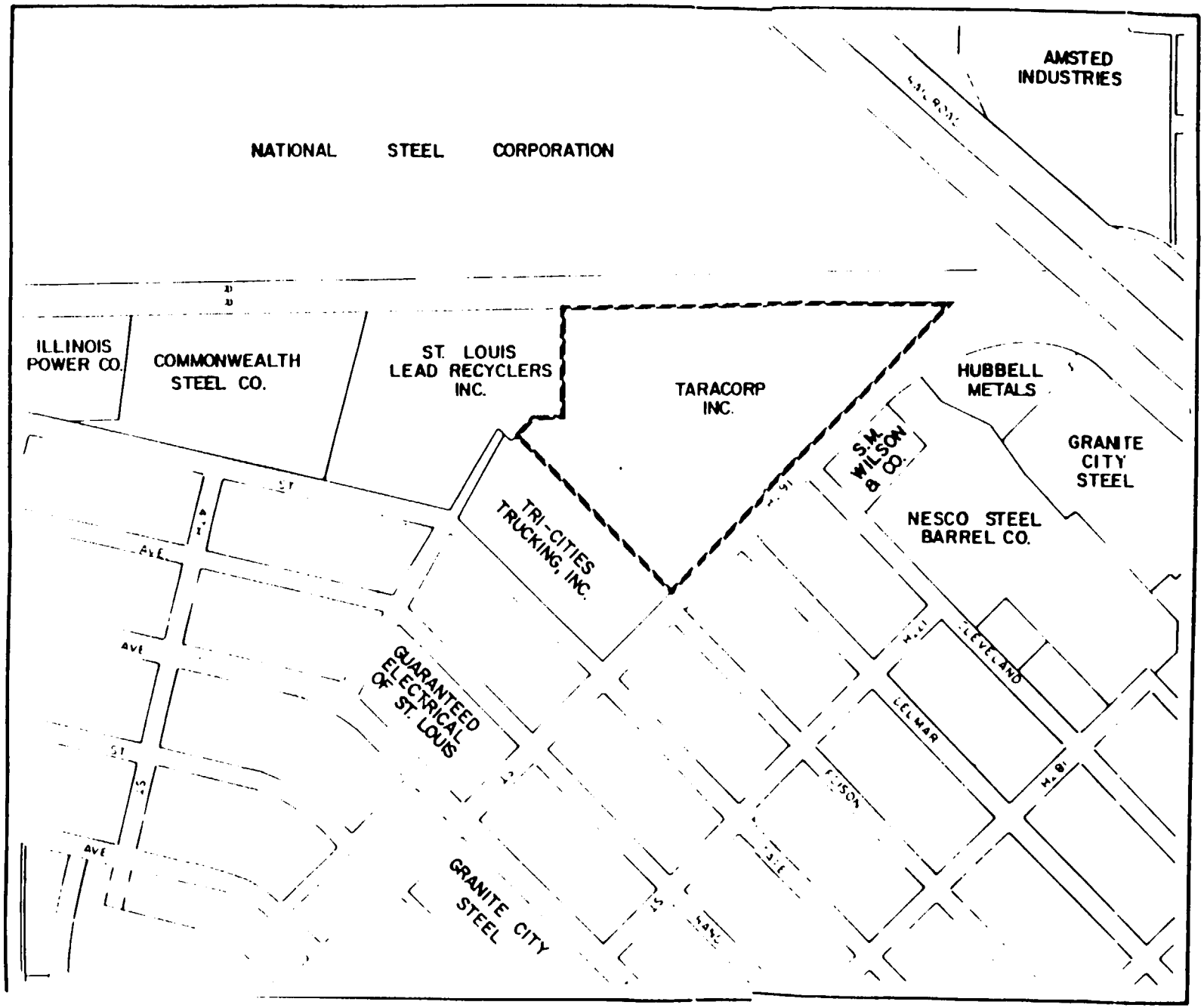
Figure 1




N

NL INDUSTRIES
GRANITE CITY SITE
GRANITE CITY, ILLINO

ADJACENT PROPERTIES MAP

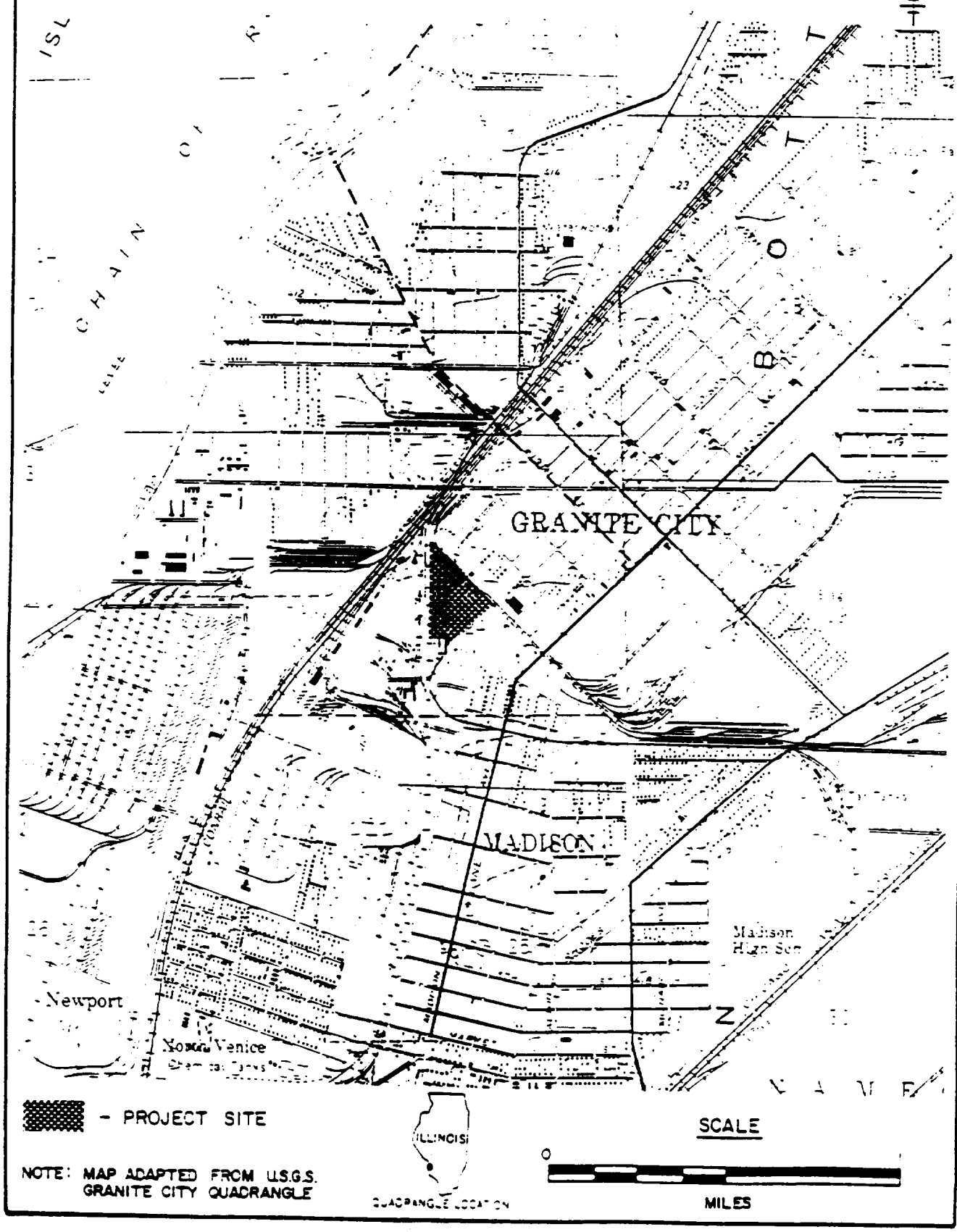
SCALE

300 0 30

FEET

NL INDUSTRIES
GRANITE CITY SITE
GRANITE CITY, ILLINOIS

# LOCATION MAP




NOTE: MAP ADAPTED FROM U.S.G.S. GRANITE CITY QUADRANGLE

Figure [illegible]

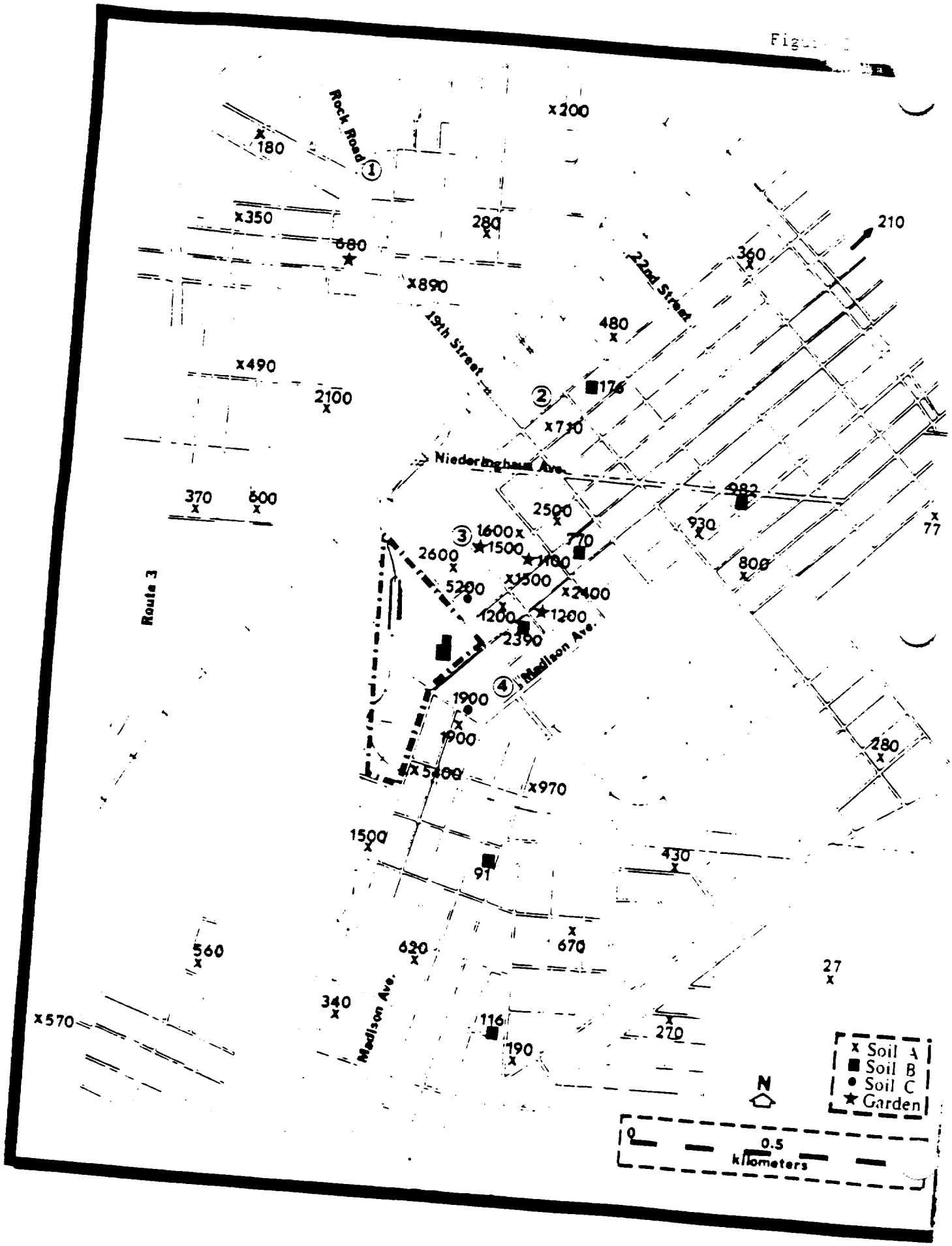

Rock Road
19th Street
22nd Street
Niederlinghaus Ave.
Madison Ave.
Route 3
Soil A
Soil B
Soil C
Garden
N
0
0.5
kilometers

Figure 4

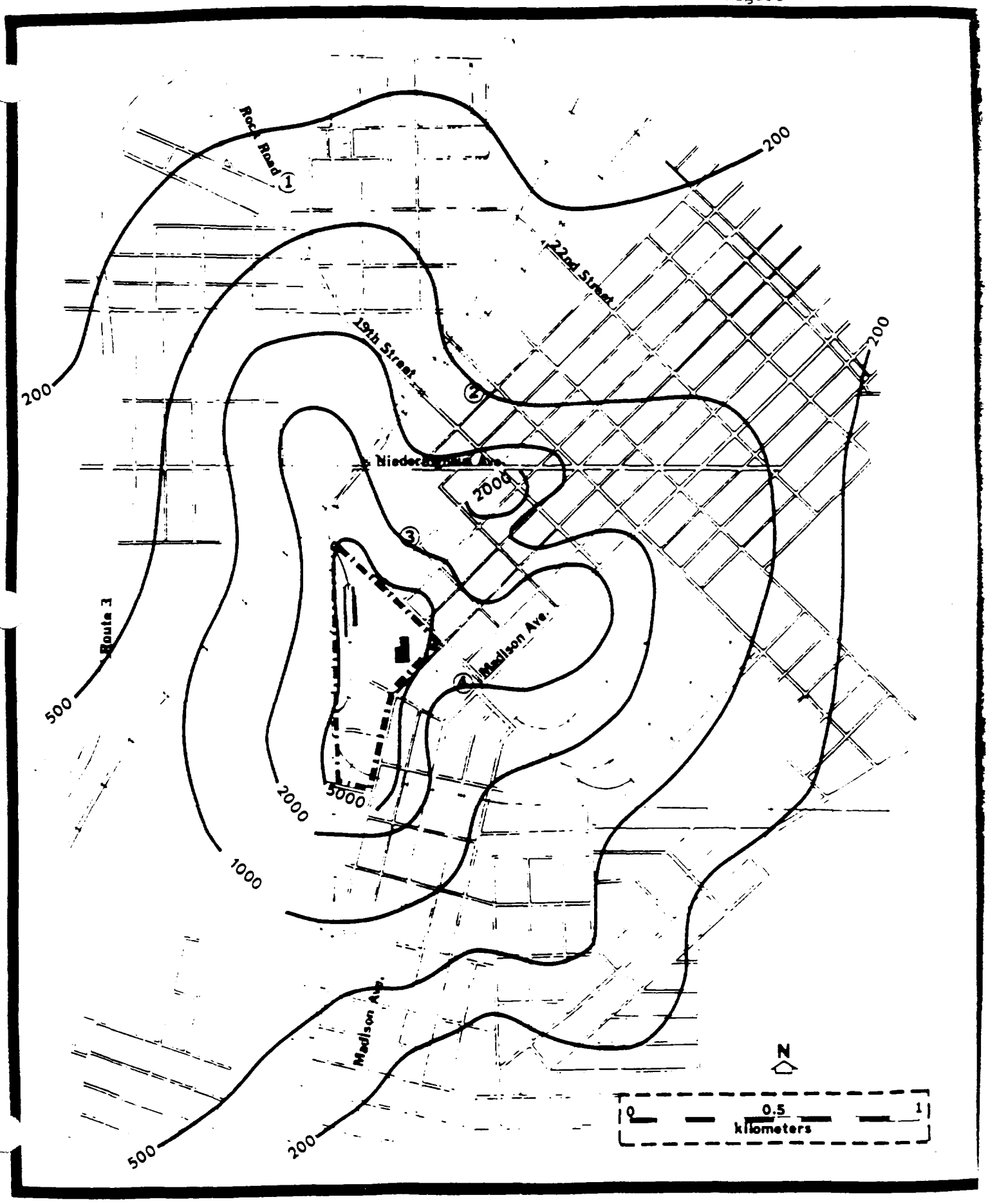

Rock Road
1
200
22nd Street
19th Street
4
200
Niederauer Ave.
2000
3
Route 3
Madison Ave.
2
500
2000
5000
1000
Madison Ave.
500
200
N
0
0.5
1
kilometers

Table 1

| Site # | Sample | Pb |
|---|---|---|
| 1 | Peppers | 0.119 |
| | Tomatoes | 0.122 |
| | Banana Peppers | 0.134 |
| | Cauliflower (frozen) | 0.198 |
| | Soil | 1500 |
| 2 | Eggplant | 0.048 |
| | Tomatoes | 0.066 |
| | Okra | 0.128 |
| | Carrots | 0.392 |
| | Soil | 1100 |
| 3 | Tomatoes | 0.035 |
| | Cabbage | 0.633 |
| | Peppers | 0.053 |
| | Cucumber | 0.083 |
| | Soil | 1200 |
| 4 | Okra | 0.020 |
| | Banana Peppers | 0.010 |
| | Tomatoes | 0.005 |
| | Peas | 0.002 |
| | Soil | 53 |
| 5** | Pepper | 0.007 |
| | Tomatoes | 0.007 |
| 6 | Okra | 0.014 |
| | Banana Peppers | 0.010 |
| | Soil | 97 |
| 7 | Tomatoes | 0.028 |
| | Squash | 0.124 |
| | Okra | 0.641 |
| | Beets | 0.087 |
| | Beet Leaves | 0.058 |
| | Soil | 680 |

* Soil values are based on dry weight
** Site #5 is located across the street from Site #6. Therefore a separate soil sample was not taken.

Attachment #1

PRELIMINARY HEALTH ASSESSMENT
NL INDUSTRIES/TARACORP LEAD SITE
GRANITE CITY, ILLINOIS
January 18, 1989

Prepared by:
Office of Health Assessment
Agency for Toxic Substances and Disease Registry

Background

The NL Industries site is a National Priorities List (NPL) Site located in Granite City, Madison County, Illinois. Metal refining, fabricating, and associated activities were conducted at the site until 1903, when the secondary lead smelting operation was started. The secondary smelting operations produced a number of products, including sheet lead solder, shotgun lead pellets, lead wool, lead pipe, powdered lead, and secondary lead ingots. Historically, solid waste generated by the manufacturing facilities was stored on-site in a slag storage area. Liquid wastes were discharged through process sewers, which ran under the site, to the municipal sewer system.

NL Industries, Inc., formerly the National Lead Company, bought the site in 1928. Battery recycling facilities were installed at the site in the 1950's. In August 1979, NL Industries, Inc. sold the site to Taracorp, Inc., who operated the secondary lead smelting operation until 1983, when it filed for protection from its creditors under Chapter 11 of the Federal Bankruptcy Code. Taracorp is presently operating metal refining and fabricating facilities at the site.

A waste pile, composed of blast furnace slag, lead bearing fines in 55-gallon drums, and battery case material, is located on site. The volume of the pile is approximately 85,000 cubic yards. In addition, smaller piles, which were associated with the adjacent St. Louis Lead Recycler's operation, comprise 6300 cubic yards.

Environmental Contamination and Physical Hazards

A. Environmental Contamination

Groundwater in the vicinity of the site is contaminated with elevated levels of sulfates (288 mg/l), dissolved solids (993 mg/l), and manganese (0.99 mg/l).

The waste piles on site were sampled; analyses revealed elevated levels of lead (15,000-286,000 mg/kg), arsenic (620-4100 mg/kg), copper (5,800-11,000 mg/kg), and iron (21,000-340,000 mg/kg). Runoff from the waste pile has shown concentrations of lead ranging from 3 to 40 mg/l.

On-site soils have shown lead concentrations ranging from 1550-48,300 mg/kg. Soil lead sampling demonstrated surface soil lead concentrations in residential neighborhoods within 2000 feet east of the site at approximately 386-3600 mg/kg. Other areas near the site have shown similar concentrations of lead (400-3000 mg/kg).

The results of quarterly air sampling in the vicinity of the site in 1986 were considerably below the National Ambient Air Quality (NAAQ) standard for lead of 1.5 $ug/m^3$. Lead concentrations were detected in the air at locations near the site ranging from 0.13-0.42 $ug/m^3$.

B. Physical Hazards

There are no known physical hazards present at the NL Industries NPL Site.

Potential Environmental and Exposure Pathways

A. Environmental Pathways

1. Surface Water

The nearest surface water body to the site is the Chain of Rocks Canal, which is located over one mile away. No drainage swales or ditches were observed at the site which would connect storm runoff from the site to this surface water body.

Studies conducted as part of the Remedial Investigation (RI) have evaluated the characteristics of storm water runoff from the waste piles on site. The runoff has contained concentrations of lead in the range of 3-40 mg/l. Runoff from the pile either infiltrates and percolates to groundwater or evaporates.

2. Groundwater

The American Bottoms aquifer underlies the site. This unconfined aquifer is composed of clay, silt, and sand. It extends to at least 35 feet below the surface. Groundwater has been encountered at an average depth of 24 feet below the surface. The site is underlain to a depth of approximately 100 feet by alluvial, glaciofluvial, and glaciolacustrine deposits, which become progressively coarser with depth.

Water within the unconsolidated deposits beneath Granite City is used for industrial purposes. At least 36 private wells have been reported to be within two miles of the site. The RI stated, however, that it was not known whether these wells are used as potable water supplies. The Granite City Water System supplies most of the drinking water to the area residents. It uses the Mississippi River as its water source.

Twelve monitoring wells were installed at and near the site in October 1982. Additional monitoring wells have been installed since this date. Two on-site wells showed elevated concentrations, as compared to background, of sulfates, dissolved solids, arsenic, cadmium, manganese, nickel, and zinc. Off-site monitoring wells located downgradient of the site did not show any contamination at the time of the sampling.

Locally, the groundwater flows in a south-southwesterly direction towards the Mississippi River. Groundwater underlying the site is characterized by elevated levels of dissolved solids, sulfates, and manganese and does not appear to be suitable for development as a potable water supply.

3. Soil

Ninety-eight surface soil samples were taken from 52 locations on and off the site (primarily from off-site areas). Most of the samples were taken at depths of 0-3 and 3-6 inches below grade. Elevated levels of lead were found in the soil.

The waste piles located on the site were sampled and elevated levels of lead, arsenic, copper, and iron were found.

4. Air

The Illinois Environmental Protection Agency (ILEPA) operates several air quality sampling stations in the vicinity of the site and has generated quarterly monitoring data since 1978. Air quality at the monitoring locations near the site has been well within the NAAQ standard for lead.

B. Human Exposure Pathways

Based on the environmental media that have been contaminated at the site, the concentrations of contaminants that were found in these media, and the potentially exposed population near the site, the human exposure pathways of concern at the NL Industries site are as follows:

1. Inhalation of contaminated dust/soil.

2. Ingestion of contaminated soil.

3. Dermal absorption of contaminants found in the soil.

4. Ingestion of contaminated groundwater.

<u>Demographics and Land Use</u>

The site is located within a heavily industrialized section of Granite City, Illinois. Granite City is a community of approximately 40,000

located across the Mississippi River from St. Louis, Missouri. Residential and commercial areas are also located near the site. The site is located adjacent to properties owned by Trust 454, Terminal Railroad Associates, Inc., Illinois Central Gulf Railroad, Chicago and Northwestern Railroad, and Tri-Cities Trucking, Inc. St. Louis Lead Recycler's, Inc. is a tenant of trust 454.

Evaluation and Discussion

Because the soils and waste pile at the site are contaminated with lead and other inorganics, there is the possibility that contaminated soil particulates may become airborne and travel off-site as the result of wind, traffic, remedial activities (i.e., excavating, trenching), or recreational activities (i.e., bike riding). Remedial workers and others that may gain access to the site may also be exposed to contaminants found in the soils via accidental ingestion or dermal absorption while involved in on-site activities.

Because lead has been detected in residential surface soils at elevated levels, children playing in the area may be at special risk from exposure to contaminants because of the cumulative nature of their exposure and the fact that they are the most sensitive subpopulation for lead induced toxicity. In general, lead in soil and dust appears to be responsible for blood lead levels in children increasing above background levels when the concentration in the soil or dust exceeds 500 - 1000 mg/kg (Baker, et al., 1977; Mielke et al., 1984; Angle et al., 1984; Duggan and Inskip, 1985). The concentrations of lead found in the residential areas near the site showed concentrations up to three times higher than these levels.

The water underlying the site does not appear to be suitable for potable uses; however, this possible exposure pathway cannot be dismissed until further information is available. Because it is not known if there are private wells being used for drinking water supplies in the vicinity of the site, there is the possibility that residents are being exposed to site-related contamination via ingestion of contaminated groundwater.

Particulate lead compounds can be absorbed into the body via both the respiratory and gastrointestinal tracts with varying degrees of efficiency. Lead exposure is linked with neurological effects, systemic toxicity, including anemia and other hematologic effects, and reproductive effects.

Conclusions and Recommendations

Based on the available information, this site is considered to be of public health concern because of the risk to human health caused by the likelihood of exposure to hazardous substances via inhalation, ingestion, and direct contact exposures to contaminated soil. There is also the possibility that the human population in the area is being exposed via ingestion of contaminated groundwater.

If further environmental characterization, sampling from on-site areas, or sampling from impacted off-site areas become available, such material will form the basis for further assessment at a later date.

ATSDR recommends the following for the protection of public health near the site:

1. The contamination of residential soil in the vicinity of the NL Industries Site should be accurately evaluated. Such an evaluation should allow for an adequate determination of the levels of exposure of individuals per residence. If residents, specifically children, are indeed exposed to levels of contaminants, namely lead, which may result in adverse health effects, actions should immediately be taken to prevent further exposure.

2. It should be verified that there are no private wells being used as potable water supplies in the vicinity of the site.

3. On-site workers involved in remedial activities should be equipped with adequate personal protective equipment as required by the Occupational Safety and Health Administration (OSHA) and recommended by the National Institute for Occupational Safety and Health (NIOSH).

4. Air monitoring should be continued to insure that concentrations of lead in the ambient air remain below NAAQ standards.

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Attachment - #2

# Study of Lead Pollution

in

Granite City, Madison and Venice, Illinois

April 1983

Illinois Environmental Protection Agency
2200 Churchill Road
Springfield, Illinois 62706

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## I) INTRODUCTION

During the last quarter of 1981, the Illinois Environmental Protection Agency's (IEPA's) air pollution monitor at 15th and Madison Streets in Granite City registered an unusually high average of lead. The sudden increase in airborne lead was unexpected because, up until then, the lead levels had been declining at that location. A preliminary investigation based on an analysis of meteorological data indicated that the lead came from the direction of the nearby lead smelter (Taracorp Industries) and a neighboring recycling operation (St. Louis Lead Recyclers). But a check with company officials and other area businesses did not reveal any obvious cause, such as an air pollution control equipment malfunction or a big jump in production. The average lead concentration at this monitoring site has since dropped, but at another monitoring site, it is still higher than the national health standard.

Up until the 1981-82 winter, the Agency thought that equipment and operating improvements at the smelter and the declining amount of lead in car exhausts would combine to bring airborne lead down to an acceptable level. But the jump in the 1981 fourth quarter average indicated that more may need to be done.

The Agency was concerned that the potential existed for another sudden rise in airborne lead and that unidentified sources of lead emissions might prevent the air quality of the area from improving. In mid-1982, the Agency began a more intensive investigation into the sources of lead in the vicinity of the monitor at 15th and Madison. To help pinpoint all the lead sources, another monitor was placed in the area. The Agency also began taking dust samples from open areas, streets and parking lots to get a more complete picture of where the lead was coming from and to assess the extent of contamination.

As part of the study the Agency also tried to determine if lead ingestion by people living in the study area is above recommended limits. Garden vegetable samples were collected, water testing records were reviewed, and soil samples were analyzed.

Another part of the study, conducted in cooperation with the Illinois Department of Public Health (IDPH), focused on the potential health effects of excessive lead levels in the environment.

This study report has been prepared by the IEPA. Participating in the data collection phase of this study with IEPA were the Illinois Department of Public Health, the United States Environmental Protection Agency, the United States Food and Drug Administration and the City of Granite City.

The hazard assessment portion of the study and the health-related recommendations contained in this report were developed by the IEPA in close cooperation with the Environmental Toxicology and the Lead Poisoning Control programs of the Illinois Department of Public Health. Their input and critical review of Section X of this report were particularly helpful.

## II) SUMMARY, FINDINGS AND RECOMMENDATIONS

Although significant contamination of the environment exists in the vicinity of the secondary lead smelter, the preliminary assessment of the IEPA and the IDPH is that a major near-term risk to public health is unlikely to exist provided that ambient air quality levels do not exceed the National Ambient Air Quality Standard and that routine personal health and hygiene measures are followed. However, the high levels of lead found in the soil on and near the smelter site are cause for continued concern. Because uncertainty remains regarding the long-term health implications of these high soil-lead concentrations, prudence dictates that dust control measures be implemented immediately. Further ground water and blood testing planned for the area will indicate what additional pollution control measures are necessary to reduce health hazards.

### A) Blood Samples

1. The Illinois Department of Public Health (IDPH) took blood samples from 97 individuals in 43 households within two miles of the lead smelter in Granite City during November and December 1982.

2. The amount of lead and FEP (a lead-related enzyme) found in the blood samples falls in the range considered to be acceptable by health practitioners. No cases of lead blood poisoning were found, nor were there any excessively high blood lead levels. Blood-lead tests are an indicator for lead exposure during the previous 90 days only. FEP tests, however, are indicative of longer exposures. The IDPH considers a blood-lead level of 30 micrograms per deciliter (ug/dl) or greater, in combination with an FEP level of 50 ug/dl or greater, to be dangerously high. For children six years old or less, the blood-lead samples averaged 10 ug/dl and the FEP levels averaged 17 ug/dl.

3. Forty-six children age six and under were tested. This is not as many as the testing program set out to obtain and not enough to draw broad conclusions about the rest of the children living in the area. The results of the 46 children's blood tests, however, provided no evidence that there are lead-related health problems present in the area. If the blood-lead and FEP levels of children in the survey remained the same in the years to come, these children would not be expected to develop lead-related health problems.

4. Because uncertainty remains in the conclusions drawn from the blood sampling data, the IDPH will continue to offer free blood tests to residents at its Granite City office (4700 Nameoki Road, phone 618/931-4545).

B) Soil Sampl

1. Lead levels in the soil in some residential areas are very high. Near the lead smelter two surface soil samples exceeded 5000 parts-per-million of lead.

2. Fifty surface soil samples gathered in Granite City, Madison and Venice indicate that soil out to a distance of one and a half miles from the lead smelter has higher lead content than the levels of 50-100 parts per million found in other communities.

3. Generally, soil within one-half mile of the smelter can be expected to contain 1000 parts per million of lead.

4. Many other studies that have found high lead concentrations in soil have also found high blood-lead levels in people living in the same area. That relationship was not found in this study.

5. The health and hygiene practices listed below are generally recommended for anyone living in an urbanized/industrialized area, but they are particularly important for people living within about one-half mile of the smelter because of the high lead levels in the soil.

   A. Small children, generally six years old or less, should not be allowed to play in dirt. However, normal sport or play activities on dirt areas by children and adults do not need to be restricted.

   B. No one in the area, especially children, should put dirt, dirty hands or dirty objects in their mouths.

   C. Grass or other ground cover should be planted in residential yards where dirt is exposed.

   D. Children should not eat outdoors if they are likely to get soil on food or on their hands while eating.

   E. Everyone should wash their hands and faces thoroughly before eating.

C. Water Samples

1. Four groundwater monitoring wells were drilled by Taracorp at the Agency's request in November, 1982.

2. The initial groundwater samples have shown no significant lead pollution. However, not enough samples from different locations have been taken to draw conclusions. Sampling is continuing.

3. Grani City, Madison and Venice do nc ıse groundwater as the.r source of drinking water. Drinking water test results fall well below the State's standard of 50 ug/l for lead.

4. A soil sample taken at the 14-15 foot level while drilling one well revealed an unusually high concentration of lead (2700 parts per million). Samples taken in the same boring at 5, 10, 20, 25 and 30 feet showed lead concentrations no higher than 50 ppm. Further sampling will have to be done to determine the cause of the high lead level at the 15-foot depth which was just above the water table.

5. Surface water runoff goes into the city's storm sewer system and subsequently to the waste water treatment plant. The effluent from the treatment plant meets lead water quality standards.

D. Garden Samples

1. In the fall of 1982 vegetables were taken from seven gardens in Granite City and analyzed in a United States Food and Drug Administration laboratory for lead. Soil samples were taken from each garden to see if a correlation existed between lead in the soil and lead in vegetables.

2. The garden vegetables analyzed included: peppers, tomatoes, banana peppers, cauliflower, eggplant, okra, carrots, tomatoes, cabbage, cucumbers, peas, squash, and beets.

3. Health experts estimate that on the average children 0-2 years old take in approximately 100 ug of lead each day in the food they eat. By the time children reach 8 1/2 years old they are taking in approximately 210 ug each day. The vegetables analyzed in this study showed higher lead levels where soil-lead concentrations were high. However, the levels were still low relative to the normal dietary intakes noted above.

4. Nevertheless, because of the high lead content of the soil, there are several recommendations that people with gardens within one-half mile of the smelter should follow:

   A. All vegetables from home gardens should be washed thoroughly before being eaten.

B. rden soil should be tested per. ıically for phosphorous and pH levels. A neutral pH helps inhibit plant uptake of lead, as does an adequate amount of phosphorous.

C. The Madison County Cooperative Extension Service Office (618/656-8400) can advise people on how to collect a proper sample and where to send it for analysis. It will cost approximately $4 to have the phosphorous and pH tested. Additionally, the extension adviser will interpret the test results for gardeners and instruct them on how much lime or fertilizer needs to be added.

E) Air Samples

1. Lead monitoring began in Granite City and the rest of the State in 1978. Since then, the lead monitoring site at 15th and Madison Streets in Granite City has recorded 14 violations of the federal lead health standard (1.5 micrograms of lead per cubic meter of air as a quarterly arithmetic average).

2. The highest quarterly average at 15th and Madison was 7.3 $ug/m^3$, measured in the last quarter of 1981. Prior to that, the highest average was 4.4. Since 1981 the highest quarterly average has been 1.9 $ug/m^3$.

3. Wind speed and direction studies for those days when the highest ambient air concentrations of lead were measured show that the lead was coming from the direction of the Taracorp lead smelter.

F) Lead Source Evaluation

1. The Taracorp facility, which was purchased from N.L. Industries in 1979, is a secondary lead smelter located in Granite City. It takes lead from discarded batteries and other lead bearing wastes and reprocesses it into products such as sheet lead, solder, shot gun pellets, lead wool and lead ingots. The major process emission sources at Taracorp include a blast furnace, a rotary furnace, lead melting kettles and a battery breaker.

2. The smelter property contains a three-acre storage pile of broken batteries, blast furnace slag and other lead waste products.

3. Surface soil samples taken at the rear gate of the Taracorp smelter contained 140,000 to 300,000 parts per million (or 14 to 30 percent) lead.

4. On October 1, 1982, Taracorp Industries filed bankruptcy under Chapter 11 of the Federal bankruptcy laws and is seeking reorganization.

5. St. Louis Lead Recyclers, which began operation in 1980, is adjacent to Taracorp. Since 1982 it has been reclaiming lead from Taracorp's waste pile.

6. The IEPA's preliminary evaluation of these two operations indicates that lead emissions should be reduced. Consistent with this conclusion, the Agency has taken the following related actions:

   A. Denied a recent permit renewal application submitted by Taracorp for its blast furnace and associated equipment. Taracorp has appealed this denial to the Illinois Pollution Control Board.

   B. Coordinated with USEPA to obtain a formal engineering review of Taracorp and St. Louis Lead Recyclers and make recommendations regarding potential control measures. This review has been completed and a report is currently being prepared by USEPA.

   C. Requested the Illinois Attorney General to review the number of environmental law violations found at these sites and to obtain legally binding agreements from the companies regarding the implementation of control measures.

7. Although additional analytical work is underway to further delineate the sources of lead emissions, the IEPA believes that certain dust control measures should be implemented immediately to minimize lead emissions. These measures include: on-site traffic control; the paving or treating of roadways, parking lots and other traffic areas; regular cleaning of paved areas; covering open dirt areas with vegetation; and, fencing to reduce wind erosion. These and other measures, as they are developed, will be incorporated in the Attorney General's enforcement activities.

## III) STATE IMPLEMENTATION PLAN FOR AIR POLLUTION CONTROL

The United States Environmental Protection Agency (USEPA) officially listed lead (Pb) as an air pollutant on March 31, 1976 and proposed regulations for a National Ambient Air Quality Standard (NAAQS) on December 14, 1977. After a lengthy comment period, final designation of a NAAQS of 1.5 micrograms of lead per cubic meter of air (ug $Pb/m^3$) averaged over a calendar quarter was promulgated on October 5, 1978. On the same date, regulations for states to follow in developing a lead pollution control plan were also issued.

The IEPA completed tl Illinois State Implementation ı ın (SIP) for Lead (Vol. 9 of the Illinois SIP) in February 1981. Sixteen locations in the State were closely examined, but none were judged to present potential health problems, with the exception of the Granite City-Madison-Venice area.

IEPA formally submitted the Lead SIP to USEPA on July 21, 1981 and requested that two congressional townships (R10W, T3N; and R9W, T3N which encompass the civil townships of Venice, Nameoki and Granite City) in Madison County be designated nonattainment. In the March 22, 1982 Federal Register (Vol 47, No. 55) a final rulemaking was published by USEPA stating that the State had adequately demonstrated attainment and maintenance of the NAAQS for lead in all areas of the state except Granite City-Madison-Venice. The State is required to develop a control plan for the area that will ensure attainment and maintenance of the NAAQS. The control program measures implemented subsequent to completion of the Granite City-Madison-Venice lead study will form the basis for revision of the SIP.

The problem in the area is principally related to past and current emissions associated with a secondary lead smelter. This facility is presently owned by Taracorp Industries; however, prior to the fall of 1979, the facility was owned and operated by N.L. Industries. The analyses presented in this report and SIP Volume 9 indicate that current emissions from the facility still significantly contribute to air quality levels exceeding the national lead standard and that residual lead build-up in the soil surrounding the plant also contributes significantly to the ambient lead problem.

## IV) HISTORY OF AFFECTED AREA

The area with significant lead environmental contamination includes southwestern Granite City, northern Madison and northern Venice.

Data on the highest ambient air lead concentrations and the most significant lead emissions has focused attention on a section of land containing two major facilities: Taracorp Industries, a secondary lead smelter; and St. Louis Lead Recyclers, a lead reclamation facility.

Taracorp purchased the existing secondary lead smelter from N.L. Industries (formerly National Lead Company) in August of 1979. N.L. Industries took over the facility from the United Lead Company in 1928. The United Lead Company had acquired the facility from the Hoyt Metal Company in 1903. Most of the smelter is believed to be of original construction.

St. Louis Lead Recyclers came into existence in 1980. The company's original purpose was to reclaim lead from batteries. However, it soon entered an agreement with Taracorp to begin reclaiming lead from Taracorp's waste pile. Reclamation operations on the waste pile began in 1982.

Many other industries are located in the general area but none of them appear to contribute substantially to the lead problem.

## V) PROCESS DESCRIPT . OF TARACORP AND ST. LOUIS LEA RECYCLERS

### A) Taracorp

Taracorp is a secondary lead smelter which produces numerous lead products. These products include sheet lead, solder, shot gun lead pellets, lead wool, powdered lead and secondary lead ingots. The facility has a blast furnace (cupola), a rotary furnace, a number of lead melting kettles, a battery breaker operation, a natural gas fired boiler, and air pollution control equipment including several baghouses, cyclones, and an afterburner. A schematic of the Taracorp operation is provided in Figure V-1.

### B) St. Louis Lead Recyclers

St Louis Lead Recyclers reclaims various materials from the Taracorp waste pile. The process consists of the following steps:

1) Material from the waste pile is placed in a dump truck with a frontend loader. The truck is then weighed.

2) The material is then screened and hand sorted. Slag, matte, and trash are loaded back in the truck and reweighed. This weight is subtracted from the weight of material originally removed from the pile. The slag, matte, and trash have been returned to the pile in the past. However, the future disposition of this material is in question.

3) The remainder of the sorted material (battery cases, scrap, etc.) is transported to the recycling process.

4) The material for recycling is first crushed, shredded, and sprayed with a surfactant.

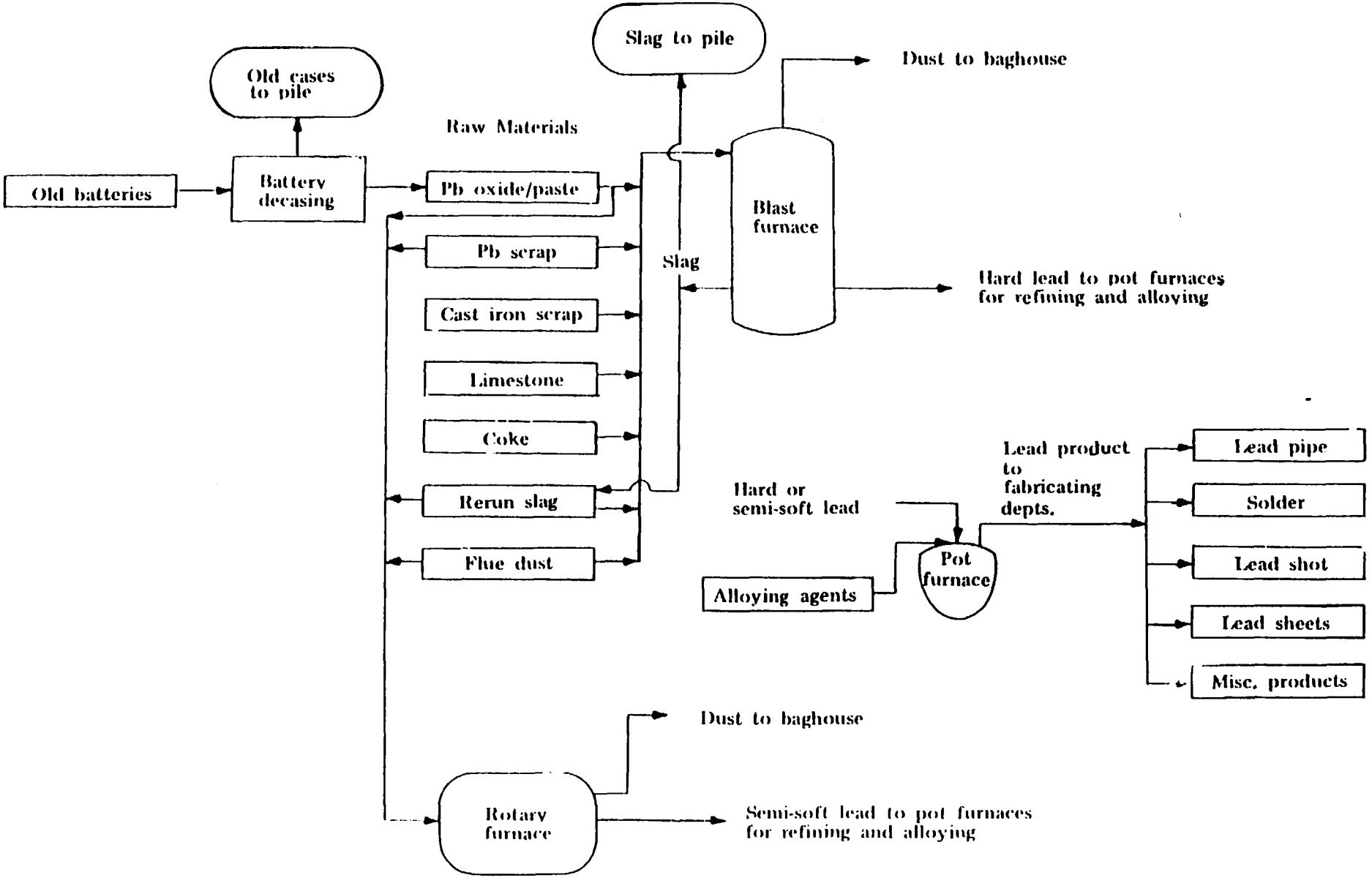
5) A wet separation process separates the lead oxide and elemental lead from the plastic and hard rubber (from battery cases).

6) An additional process separates the lead oxide from elemental lead. These materials are sold back to Taracorp, following aggregation in a quick-melt furnace.

7) The plastic and hard rubber are separated by floatation and washed. The plastic is sold to a plastic recycler. The hard rubber is presently being stockpiled while a market for it is being sought.

8) Water used in the process is clarified and recirculated.

Figure V - 1: Process Flow Diagram for Taracorp Secondary Lead Smelter



## VI) AIR POLLUTION ;ESSMENT

### A) Air Quality Monitoring

The IEPA's Division of Air Pollution Control has been monitoring ambient levels of lead on a statewide basis since mid-1978. Prior to 1978, lead air quality data were collected only within Cook County by local agencies. Table VI-1 lists the quarterly ambient lead averages (based on individual 24-hour samples taken every six days) for monitor locations (see Figure VI-1) in Granite City which have exceeded the Federal lead standard of 1.5 micrograms per cubic meter ($ug/m^3$) as a quarterly arithmetic average. The highest recorded quarterly average in Illinois was 7.3 $ug/m^3$, monitored at the 15th and Madison Street monitoring site. This same site has recorded 14 violations of the lead standard during the period 1978 through 1982. This is the most violations recorded at any monitoring site in Illinois. The ambient lead data is presented graphically in Figure VI-2.

Table VI-1
Ambient Lead Monitoring Data Summary
(1978 - 1982)
Quarterly Averages ($ug/m^3$)

| Yr/Qrt | 15th & Madison | 20th & Adams | Roosevelt & Rock Rd. | 1733 Cleveland |
|---|---|---|---|---|
| 1978 - 1 | - | - | - | - |
| 2 | 3.1 | 0.6 | 0.7 | - |
| 3 | 1.7 | 4.4 | 1.3 | - |
| 4 | 4.4 | 4.0 | 1.7 | - |
| 1979 - 1 | 2.6 | 1.0 | 1.3 | - |
| 2 | 3.2 | 0.9 | 1.2 | - |
| 3 | 2.0 | 1.1 | 1.3 | - |
| 4 | 3.0 | 2.6 | 1.2 | - |
| 1980 - 1 | 3.0 | 0.5 | 0.6 | - |
| 2 | 1.2 | 0.6 | 0.5 | - |
| 3 | 1.0 | 0.5 | 0.7 | - |
| 4 | 1.9 | 0.6 | 1.4 | - |
| 1981 - 1 | 2.1 | 0.5 | 0.5 | - |
| 2 | 1.0 | 1.6 | 0.9 | - |
| 3 | 1.8 | 0.5 | 1.1 | - |
| 4 | 7.3 | 0.5 | 0.9 | - |
| 1982 - 1 | 1.9 | 0.8 | 1.1 | - |
| 2 | 1.6 | 0.9 | 1.5 | - |
| 3 | 1.1 | 0.5 | 0.6 | - |
| 4 | 0.9 | 0.6 | 1.8 | 1.5 |

Figure 4 - 1: Location of Lead Air Quality Monitors

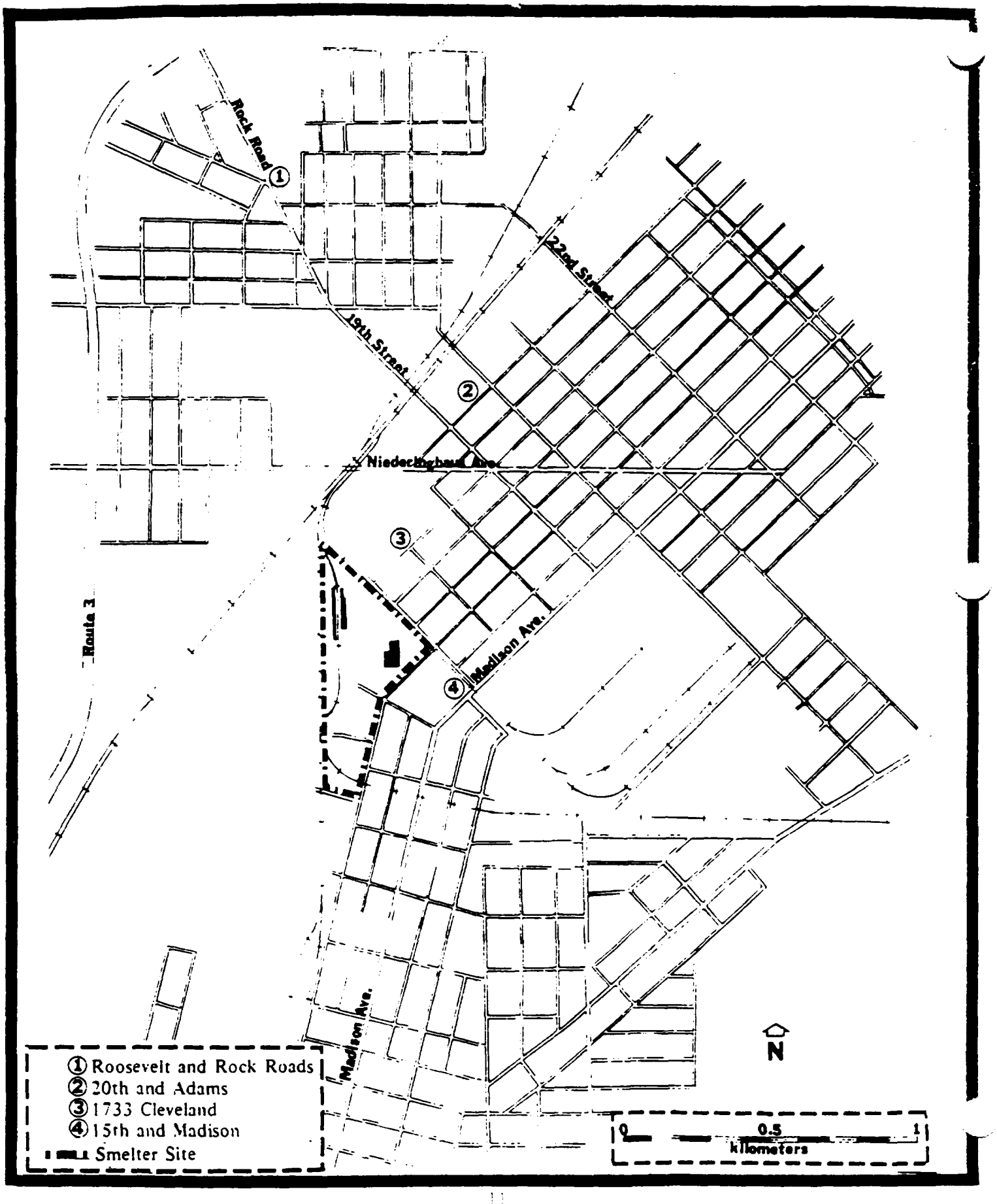
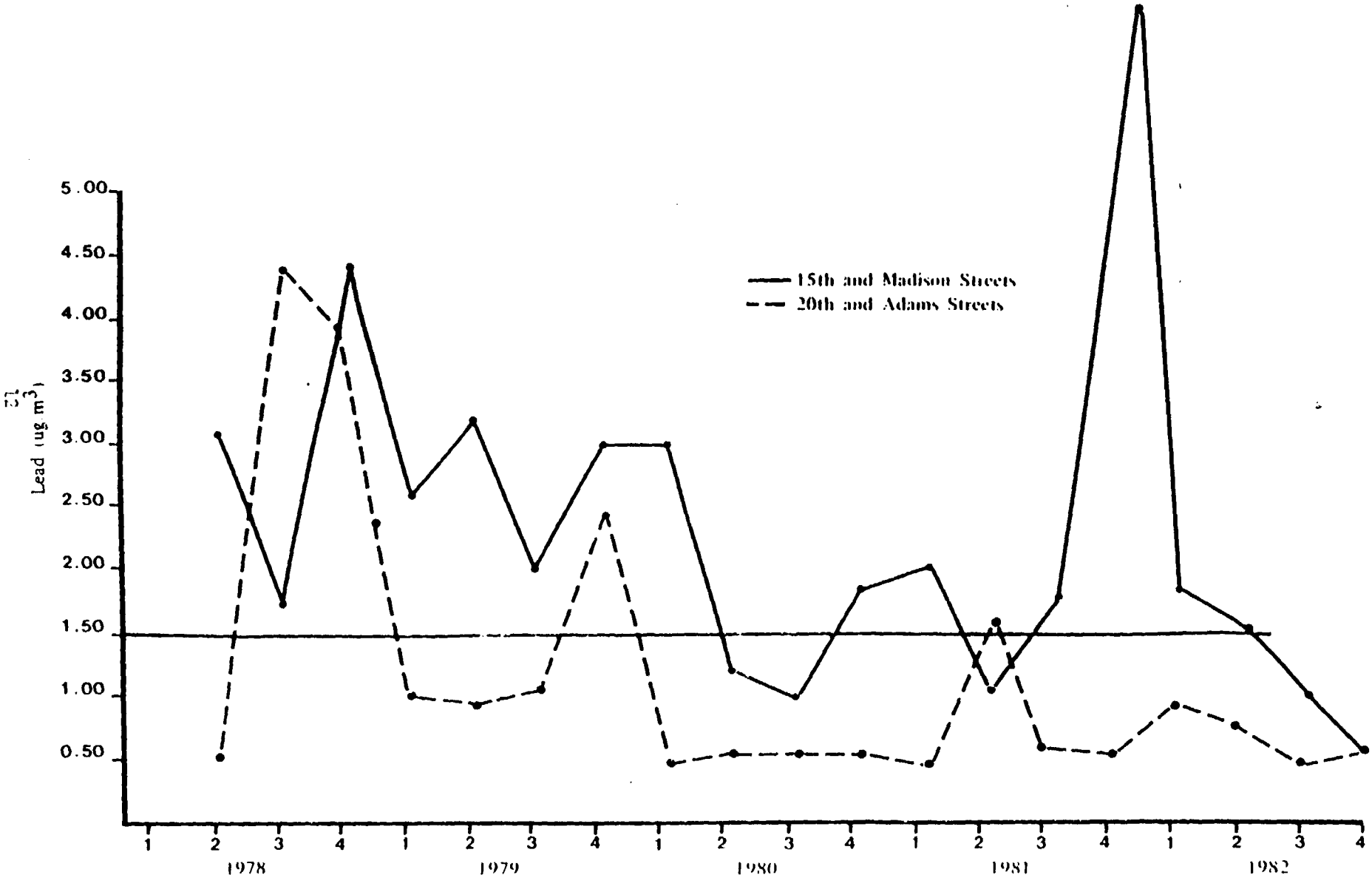


Figure VI - 2: Quarterly Ambient Air Lead Levels for Selected Granite City Monitors



B) Monitoring/Meteorological Analysis

To help pinpoint the emission sources contributing to high lead levels, composite wind frequency distributions were generated for each of three monitoring sites (15th and Madison, 20th and Adams, and Roosevelt and Rock Road) for days in 1981 and 1982 with lead concentrations greater than or equal to 1.0 $ug/m^3$.

The wind data used in the analysis was taken from the IEPA monitoring sites in East St. Louis and Edwardsville and the National Weather Service's station at Lambert Field in St. Louis.

Figure VI-3 is a graphical depiction of the composite wind frequency distributions (pollution roses) for 1981. Figure VI-4 depicts the wind directions at each site on high ambient lead concentation days in 1981. This cross-hatched area is indicative of the location of the most probable lead emission source contributing to the high lead concentrations.

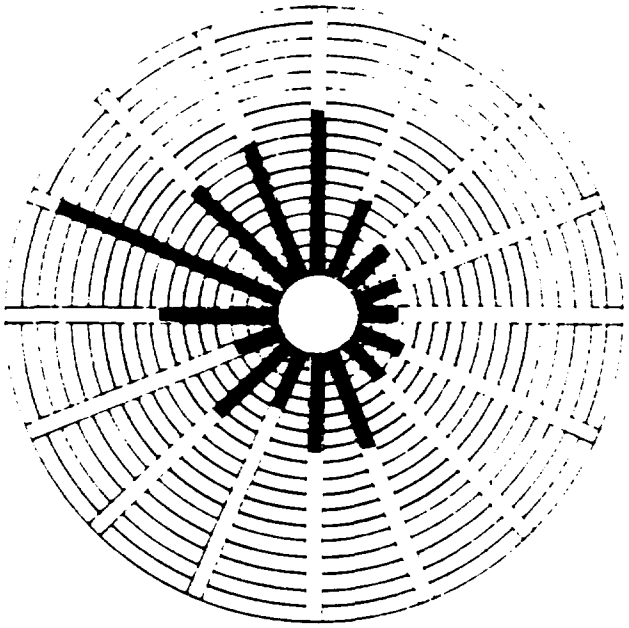
The same type of analysis was performed for 1982 wind data. Figure VI-5 depicts the pollution roses for the four monitors exhibiting high lead levels in 1982. Figure VI-6 depicts the range of the peak directions at each site on high ambient lead concentration days in 1982. Again, the cross-hatched area indicates the location of the most probable source contributing to the high lead concentrations. Taracorp Industries and St. Louis Lead Recyclers are located within the cross-hatched area. Less emphasis should be placed on the new monitor at 1733 Cleveland since it it was only recently installed and, thus, operated for less than one-fourth of the entire year.

C) Deposition Patterns

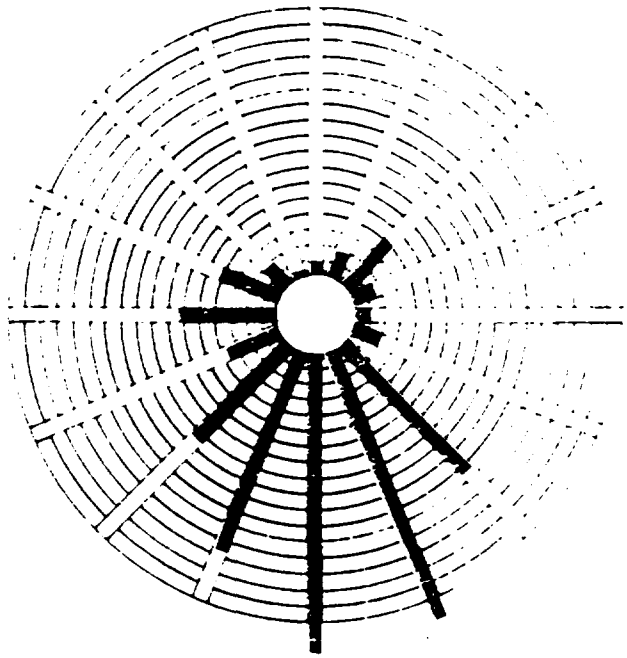
Soil samples were taken throughout the area. Samples used to determine deposition patterns were taken from vegetated areas in which there was no evidence of recent disturbance (these samples were termed "Soil A"). In addition to determining the concentration of lead, several other metals were examined. Arsenic, antimony and tin were evaluated because they are generally present in significant quantities in lead smelter emissions.

Figure VI-7 presents the results for lead. Because of the relatively small sample size, these isopleths (i.e., lines connecting points of equal concentration) should be considered only rough approximations of equal soil-lead concentration areas.

Figure VI - 3: Wind Frequency Distribution on High Lead Days in Granite City During 1981

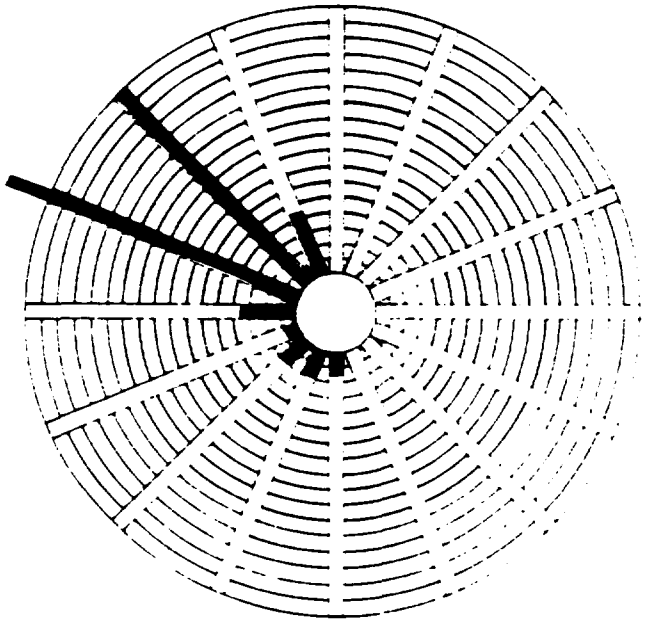


15th and Madison
(all days)

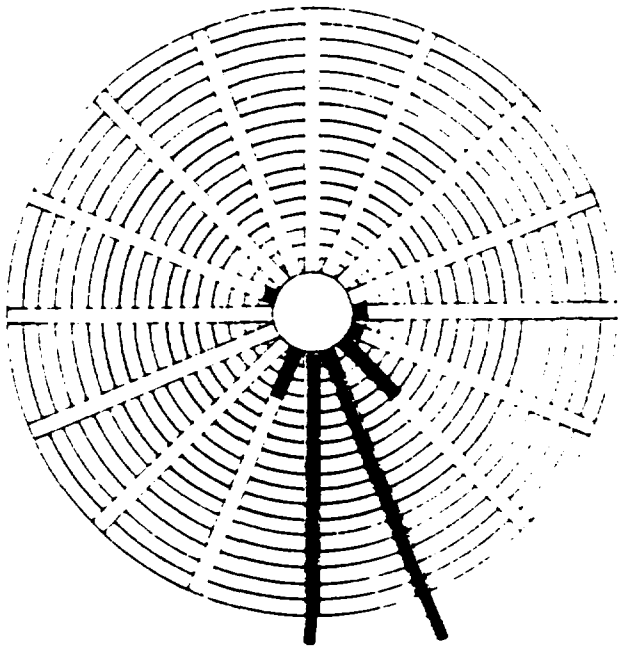


20th and Adams

Each line equals 1%



15th and Madison
(above 10 ug m$^3$)



Roosevelt and Rock Road

Each line equals 2%

Fig VI - 4: Overlap of Lead Pollution I s for 1981

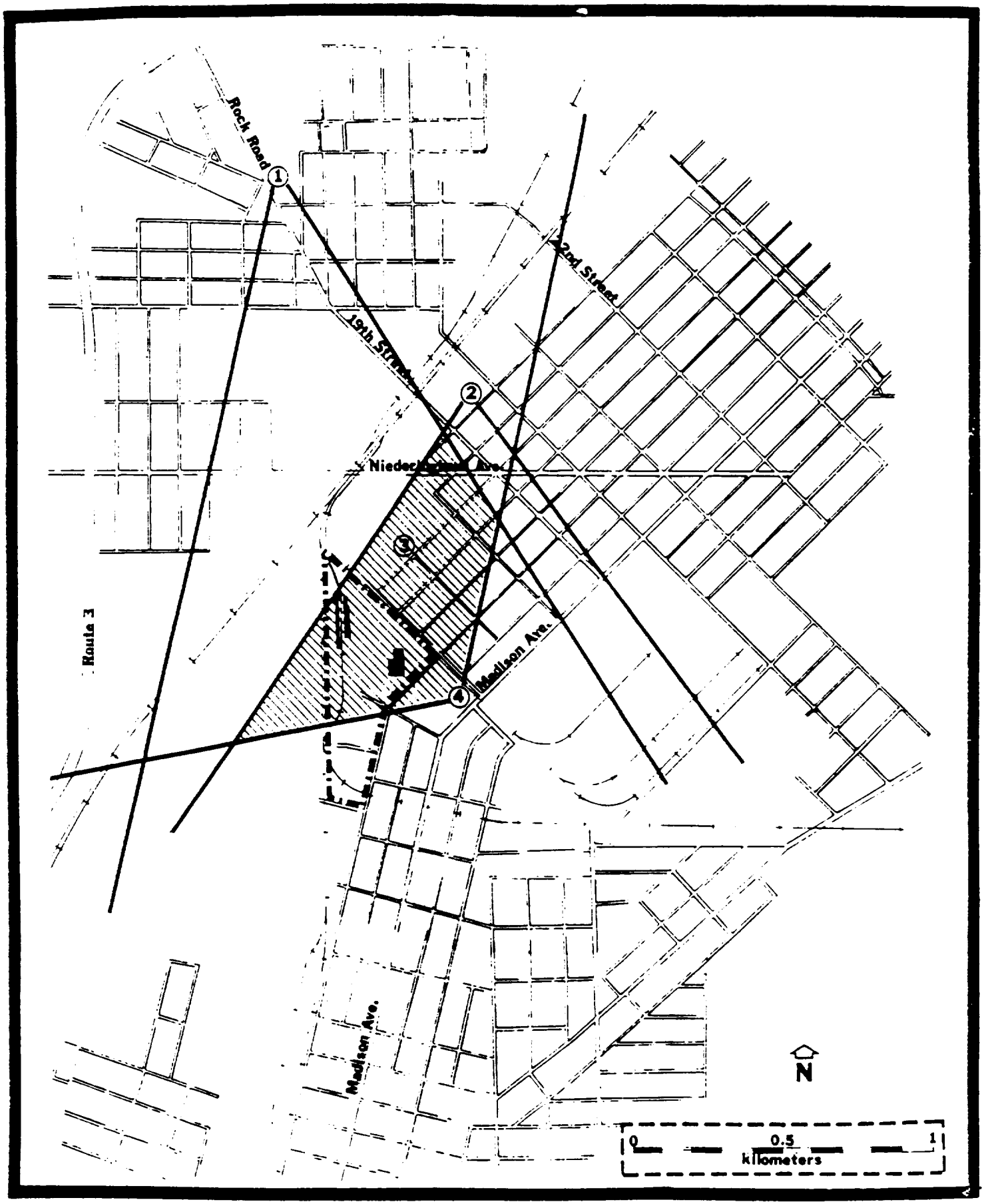
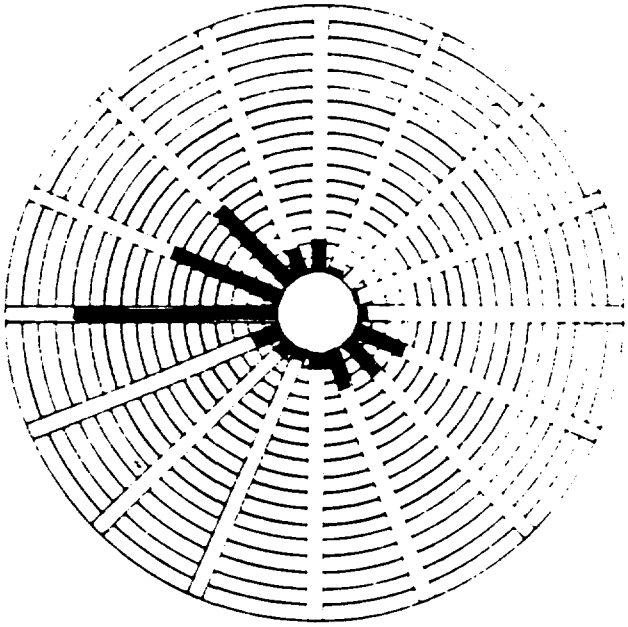
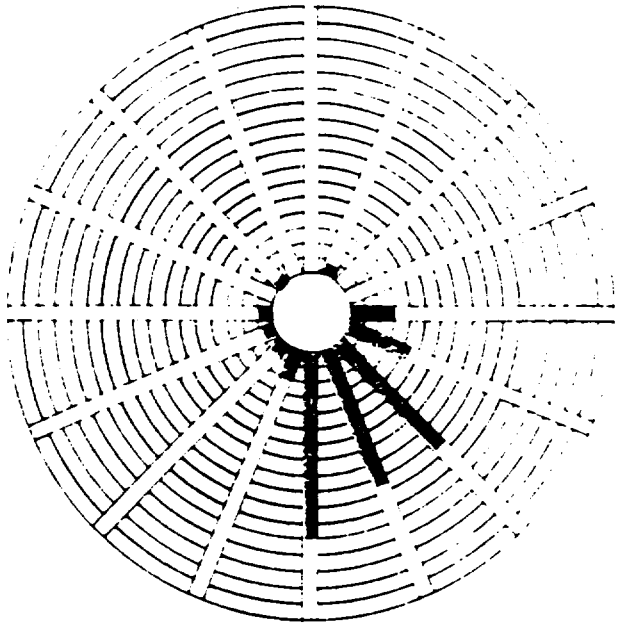


Figure VI - 5: Wind Frequency Distribution on High Lead Days in Granite City During 1982

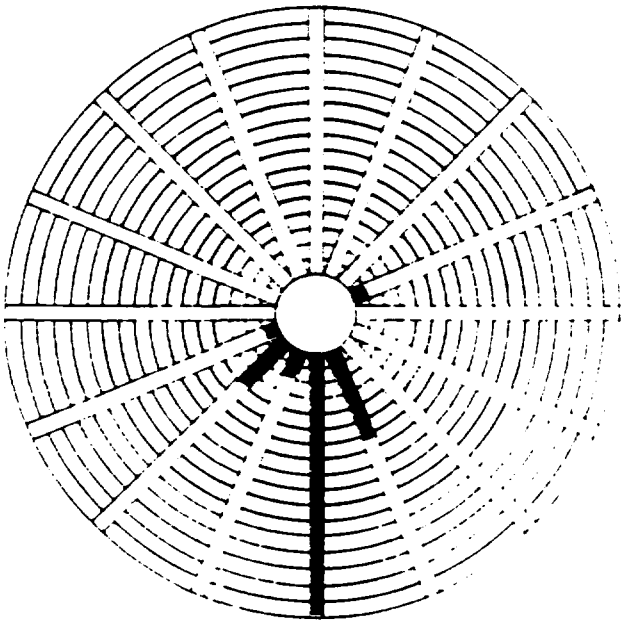


15th and Madison

Each line equals 2%

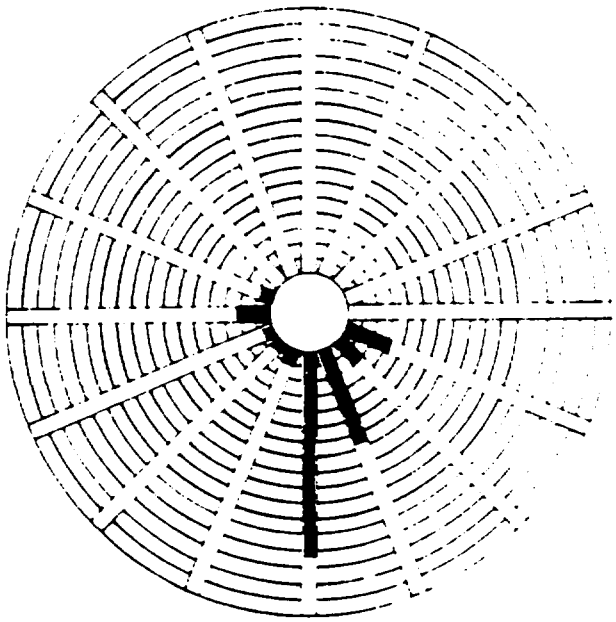


Roosevelt and Rock Road
(does not include November)



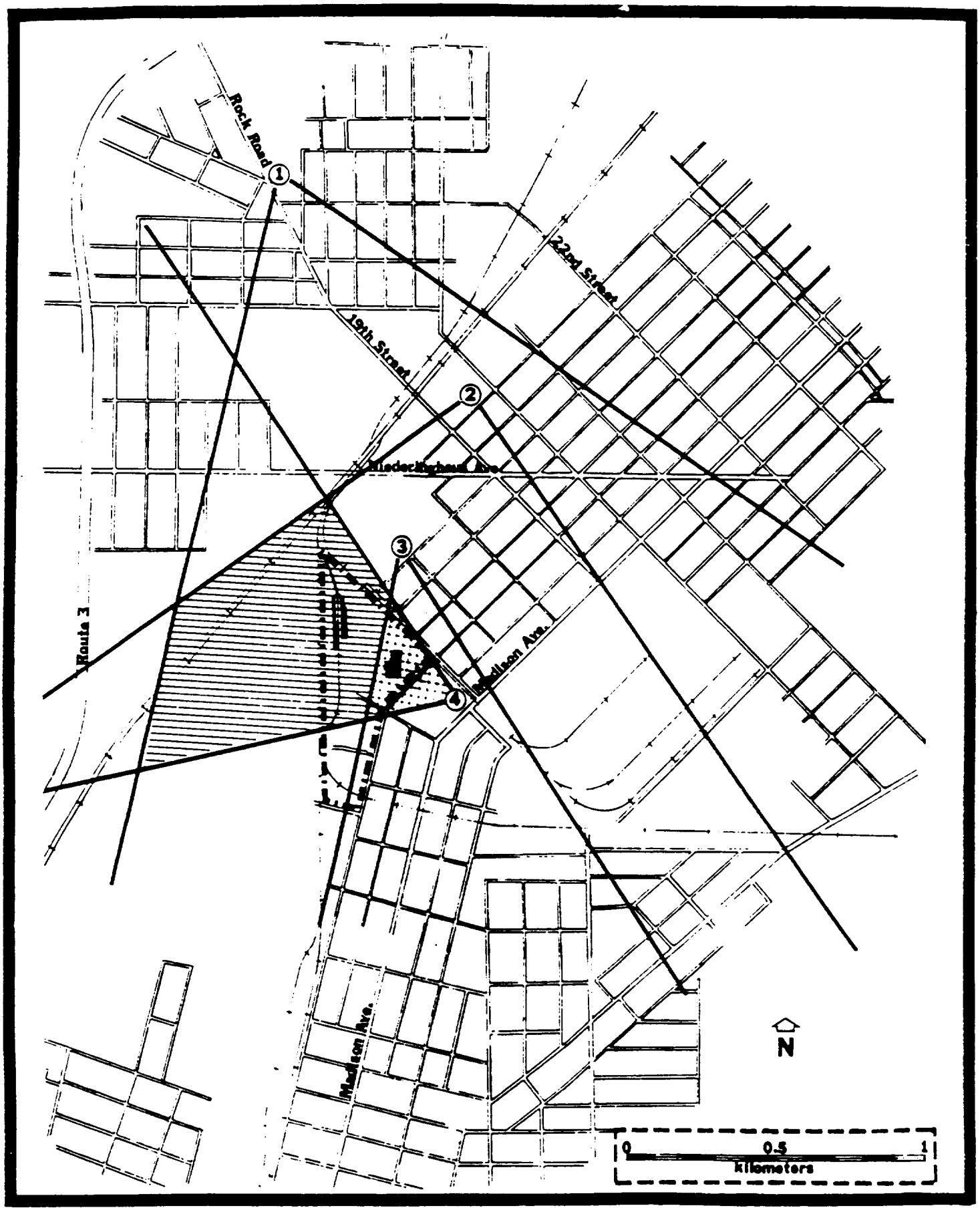
20th and Adams

Each line equals 3%

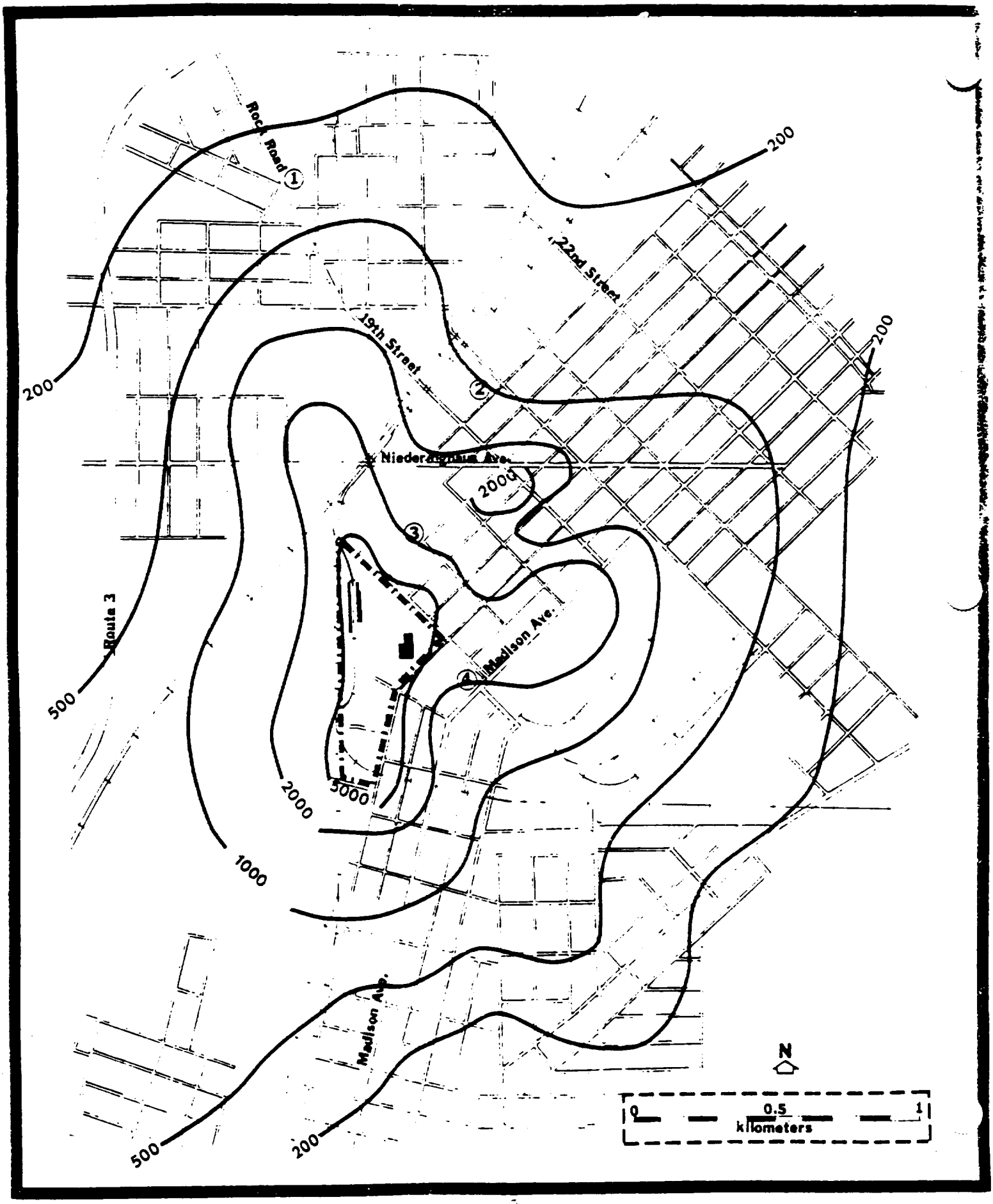


1733 Cleveland

Figu VI - 6: Overlap of Lead Pollution Ro for 1982



Figur 1 - 7: Lead Concentrations in Surfa. Soil (ppm)



D) Major Emissi. . Sources

Emission sources at the smelter, the recycling operation and adjoining grounds can be placed in two general catagories: process, and fugitive sources.

1) Process Sources

The Taracorp blast furnace (and associated activities) is the largest process source in the area. Materials handling activities prior to loading of the furnace skip hoist are discussed under the fugitive source section. Beginning with the loading of the skip hoist, however, significant process fugitive emissions are likely. The loading of the skip hoist and the subsequent charging of material into the furnace is poorly controlled. The charging of materials such as lead flue dust can cause significant emissions. Tapping operations are also poorly controlled and may contribute substantial emissions. Although under normal operations an attempt is made to control exhaust gases from the blast furnace, the overall system configuration does not represent good engineering practice. Under malfunction or charge bridging conditions, excess emissions are likely.

The rotary furnace is a second major potential emission source when in use. Poor hooding capture efficiency may allow significant emissions to escape into the "Mixed Metals A" building, where they are subsequently emitted to the ambient air.

Numerous kettles and operations throughout the facility are uncontrolled. Although not major sources taken individually, such sources may contribute substantial emissions when taken together.

Other process sources at both Taracorp and St. Louis Lead Recyclers should not contribute significant emissions under normal operations, but may be major sources under malfunction situations.

2) Fugitive Sources

Fugitive emissions are a significant cause of air quality problems in the area.

Handling of lead bearing material, particularly flue dust and battery plates, may result in significant emissions. This is especially true for the materials handling activities associated with blast furnace operations.

As dis ssed in Section IX, Land Pollu n Problems, the soil on-site is heavily contaminated with lead. Resuspended dust from vehicular traffic as well as wind blown dust from the ground and waste storage piles can produce large quantities of lead particulate.

Additionally, the working of the waste pile can generate significant fugitive emissions.

E) Receptor Modeling

A detailed dispersion modeling analysis of lead air quality in the Granite City-Madison-Venice area was completed by the IEPA in February 1981. This analysis, which is discussed in detail in Volume 9 of the Illinois State Implementation Plan (SIP), indicated that both plant-related and non plant-related (i.e., fugitive emission) sources contribute to the elevated lead air quality levels in the area. The study also explained that a portion of the elevated lead levels in the area could not be accounted for with the emissions inventory that was used.

To provide for a more definitive analysis, a refined lead emissions inventory has been developed based on a more complete understanding of sources in the area. The factors contributing to this better understanding are as follows:

1) improved guidance concerning source emission factors;
2) more detailed knowledge of plant operations;
3) results of soil-lead sample analyses; and
4) updated estimates of lead emissions associated with motor vehicle activity.

To take advantage of the latest analytical tools available for verifying the significant sources of lead in the area, the IEPA has begun using receptor modeling techniques.

Until recently, dispersion models have been relied upon to apportion source impacts based upon assumptions regarding emission factors, plume behavior and meteorology. These models are sometimes not sufficient to accurately assess short-term source impacts or account for the sources contributing the total mass at a particular monitor. This is largely the result of the difficulties involved in developing realistic 24-hour inventories. In many instances receptor models, which incorporate data collected at a receptor (monitor) in order to deduce source impacts, have proven to be better for the short-term investigation of particulate sources. Receptor models can best be used in a complimentary fashion to improve accuracy and add confidence to the dispersion modeling analysis.

In this study the Chemical Element Balance (CEB) model, which matches source chemical "fingerprints" to those measured at the monitor in order to back-calculate the contributions from specific sources and source classes, is being used. This method requires that the suspected sources of lead and the monitor filters be analyzed for several chemical species by percent weight. X-ray fluorescence is recommended as a cost-effective and efficient method of analysing the samples for the spectrum of elements needed to explain the bulk of the particulate mass collected at the monitors. In the CEB model certain "fitting" elements are chosen based on experience and trial and error. These are used to construct a set of predictive equations, which are weighted to account for the uncertainties in the measurements of the various chemical species. This set of equations is then iteratively solved using statistical techniques. When an adequate fit is achieved, the mass contributed to the monitor by each source is computed for that day. By analyzing multiple days and considering meteorological data, an adjustment can often be made to the various emission factors used in dispersion modeling. Dispersion modeling analysis is still the best approach to determining the spatial extent of pollutant concentrations.

The CEB model has been programmed and is working. Some minor program refinements and test runs are necessary before the actual data is analyzed. Source samples have been collected and monitor filters have been selected for the chemical analysis. Arrangements have been made through USEPA Region V to have the chemical analysis performed. The company which is performing the analysis has extensive experience in both x-ray fluorescence and receptor modeling. Analysis of the filters by the contractor will be completed by the end of May 1983.

F) Air Quality Modeling

To further refine the dispersion modeling done previously, more extensive analyses will be conducted using the Industrial Source Complex Model (ISC). This model is listed as the USEPA Guideline Model designed to evaluate air quality in the vicinity of industrial complexes.

Point source, area source, and mobile source emissions are input to the model consistent with IEPA understanding of their operating rates during 1981. As it becomes available, the information resulting from the receptor modeling analysis will be used to supplement and refine the inventory which has been prepared. The results predicted by the model for each calendar quarter will be compared with lead air monitoring data collected during the same period. Based on these results, a correction factor will be developed for subsequent use with the model in this area.

Surface meteorological data collected by the National Weather Service (NWS) at St. Louis Lambert Field is being used. Upper air data from the nearest NWS site (Salem, Illinois) is being used as a basis for mixing height information.

The portion of th 'ranite City-Madison-Venice are eing evaluated consists of a circular area, one mile in diameter, centered on the Taracorp facility. The density of theoretical receptors is greatest near the center of the area.

The revised air quality modeling analyses will be completed in the summer of 1983. These analyses will assist in determining the need for and adequacy of additional control measures beyond those already being considered.

## VII) GROUNDWATER POLLUTION ASSESSMENT

The Granite City-Madison-Venice area is located in the American Bottoms where the soil consists principally of sand to a depth of about 120 feet. Although lead is generally insoluble and does not readily migrate through soil, the sandy conditions of the area, as well as the potential acidic conditions caused by the presence of battery acid, make the likelihood of groundwater contamination much more significant.

The groundwater in the area is not used for public consumption. Several industries do use groundwater for process purposes, including 3.6 million gallons per day by Granite City Steel. The public water supply in the area is drawn from the Mississippi River and complies with the lead drinking water quality standards.

Four monitoring wells were installed by Taracorp in November 1982. IEPA's opportunity to provide input as to the location of these wells was minimal. The locations of the wells is indicated in Figure VII-1. The initial sample results for lead (as evaluated by IEPA) are presented below.

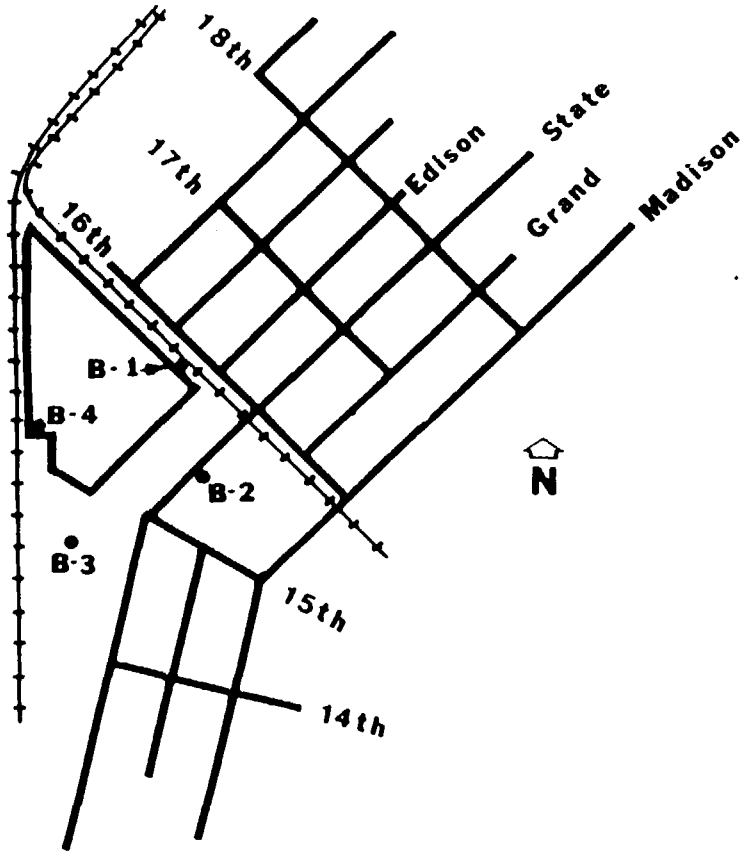
Table VII-1. Lead Concentrations in Groundwater
(micrograms per liter - ug/l)

| Well G101 | Well G102 | Well G103 | Well G104 |
|---|---|---|---|
| < 5 | < 5 | < 5 | 60 |

Since the drinking water standard for lead is 50 ug/l, the lead concentrations do not appear significantly elevated. However, the variation among wells with regard to lead concentration cannot be readily explained. In addition, these results are only preliminary, and no final conclusions should be drawn until additional samples are taken and at least one additional well is in place.

During the boring of Well G101, soil samples were obtained at every five-foot interval. These samples were then split with Taracorp and subsequently analyzed. The results of the Agency's analysis for lead is as follows:

Figure VII - 1 : Ground Water Sampling Well Locations




Boring and Monitor Well Locations

B-1 = G101
B-2 = G102
B-3 = G103
B-4 = G104

Table VII-2. Lead Concentrations at Various Depths in Soil Taken from Boring of Well G101 (parts per million)

| | Sample Depth | Lead Present in ppm |
|---|---|---|
| (data in feet below ground surface) | 4 - 5.5 feet | 43 |
| | 9 - 10.5 feet | 51 |
| | 14 - 15.5 feet | 2700 |
| | 19 - 20.5 feet | 43 |
| | 24 - 25.5 feet | 14 |
| | 29 - 30.5 feet | 13 |

From the preliminary data it appears that the lead may be migrating down through the soil 14-15 feet below ground surface and precipitating out. Further sampling will have to be done to determine the cause of the high lead level at this depth.

Listed below are the water elevations from the monitor wells. Notice the rise in elevation between the November and January sampling. The water elevations show a general movement of the groundwater to the southwest.

| | November 16, 1982 | January 26, 1983 | February 28, 1983 |
|---|---|---|---|
| G101 | 399.3 | 402.8 | 402.9 |
| G102 | 399.2 | ----- | 401.6 |
| G103 | 398.2 | 402.1 | 401.9 |
| G104 | 397.7 | 400.5 | 400.6 |

The water table during these three sampling periods was slightly below the level of the soil sample that had the 2700 ppm of lead. It appears from the water chemical analysis that at this time the lead is being tied up in the soil. This does not mean that the lead cannot become mobile again.

G101 was intended to be the upgradient well but it appears from the groundwater analysis data, for pollutants other than lead, to be affected by the waste pile. Therefore, another upgradient well north of the site is needed. This should be drilled and constructed in the same manner as the previous set of wells. Another boring south of the site taking frequent soil samples and having them analyzed for lead would help to confirm the present data from the initial boring and the speculation on the movement of the lead down through the soils.

## VIII) SURFACE WATER POLLUTION ASSESSMENT

### A) Taracorp

The IEPA's Division of Water Pollution Control has never issued Taracorp any permit. However, permits are required for the battery acid neutralization system and the oil skimmer in the Pipe Department. A permit application for the neutralization system was received on January 17, 1983, but was found to be incomplete. The application was denied on February 25, 1983.

In addition, Taracorp has not characterized the lead concentration of runoff from their property. This runoff enters the Granite City combined sewer system and may contribute to water pollution through overflows or through problems caused in the Granite City treatment plant. Although effluent from the treatment plant meets State requirements, the lead content of the sludge is among the highest in the State. This sludge is currently being disposed of in an approved landfill.

### B) St. Louis Lead Recyclers

St. Louis Lead Recyclers holds a State permit for its pretreatment facility. The discharge point appears to be in compliance with all applicable rules, and no additional discharge points are believed to exist.

However, the grounds of St. Louis Lead Recyclers (which are leased from Bank Trust 454) are extensively contaminated with lead. In addition, St. Louis Lead Recyclers has over 6,000 tons of processed hard rubber, contaminated with lead, piled outside.

## IX) LAND POLLUTION ASSESSMENT

### A) On-site

Taracorp maintains a waste pile of lead bearing scrap covering approximately three acres and containing about 200,000 tons of material. The degree to which this pile extends below ground is unknown. The analyses of samples taken from the pile indicate that these materials are high in lead content. Slag and matte generated from the blast furnace operations are still being deposited on the pile. Because of the high lead content of the material in the pile, further evaluation of potential health hazards is planned.

In addition, operations of St. Louis Lead Recyclers involve transferring large quantities of wastes from one location to another. In sorting the material to be recycled, slag, matte and trash are separated out and piled in the open.

The hard rubber generated from the recycling process was spread-out over the Bank Trust 454 property as ground cover during the summer of 1982. Excess rubber was placed in an outdoor storage pile. Because of the high lead content of the hard rubber, St. Louis Lead Recyclers took up the spreadout hard rubber and placed it on the storage pile to reduce leaching and reintrainment. Process changes have also been made to reduce residual lead.

Total soil-lead analyses were performed at several locations on the site grounds. Samples were taken near the rear gate area of Taracorp in August of 1982. These samples indicated that the soil contained 300,000 ppm (30 percent) lead. Subsequent to this finding, St. Louis Lead Recyclers removed the top few inches of soil (when they removed the hard rubber) and Taracorp applied gravel to the immediate area. Samples taken after this indicate that soil in the rear gate area still contains about 140,000 ppm lead. Samples taken on other portions of the Bank Trust 454 property indicate high lead levels in the soil. The results of this sampling are presented in Table IX-1, and the locations of the sampling points are shown in Figure IX-1 .

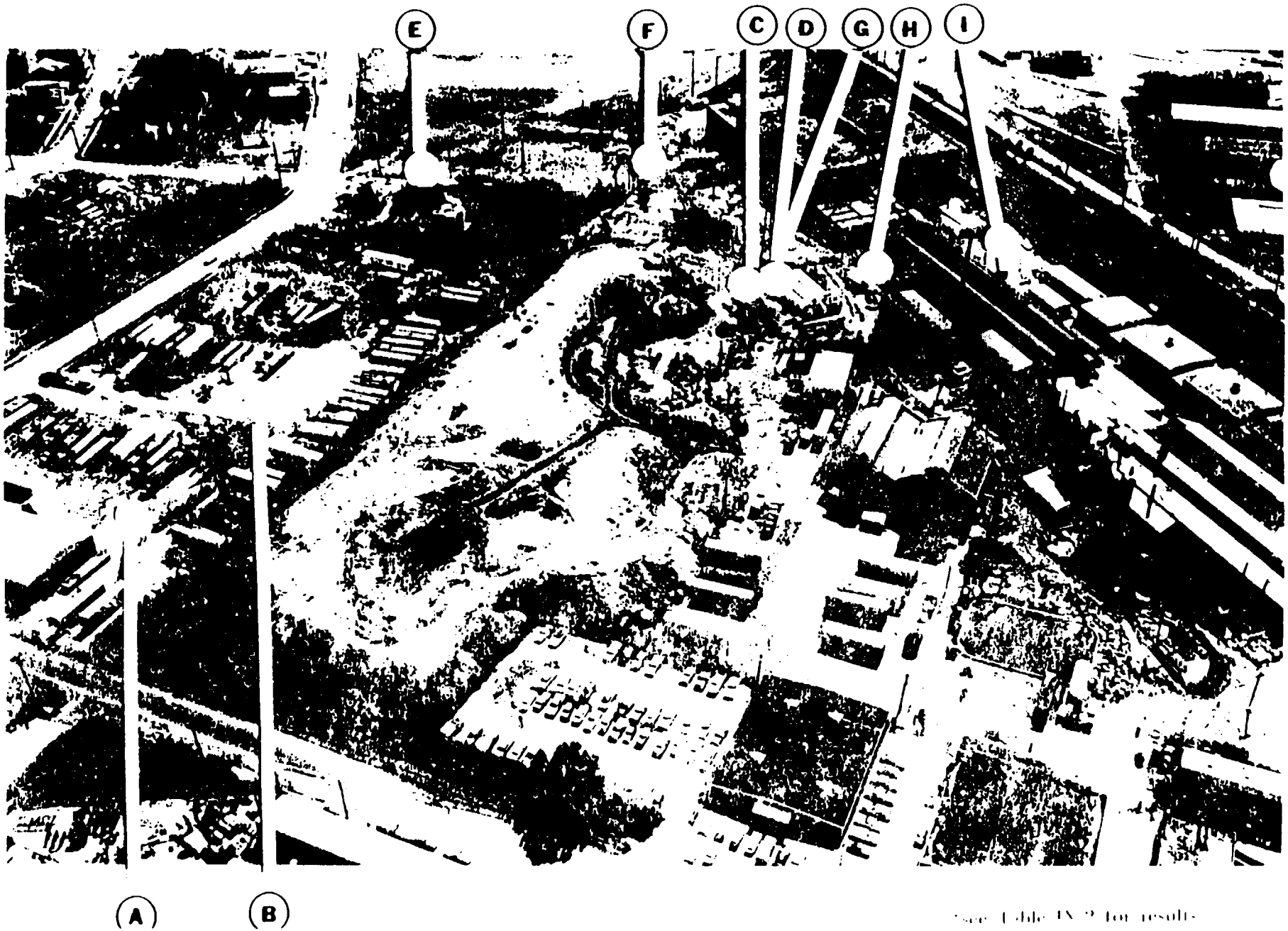
Table IX-1. Soil-Lead Concentrations for On-Site Samples

| Sample | Concentration (ppm Lead) | Date of Sample |
|---|---|---|
| A | 12,000 | (8/19/82) |
| B | 75,000 | (8/19/82) |
| C | 300,000 | (8/19/82) |
| D | 300,000 | (8/19/82) |
| E | 5,100 | (1/27/83) |
| F | 86,000 | (1/27/83) |
| G | 140,000 | (1/27/83) |
| H | 48,000 | (1/27/83) |
| I | 67,000 | (1/27/83) |

B. Off-site

Soil samples were taken from neighborhoods in the vicinity of the smelter. Four types of samples were taken: "A", "B", "C", and "Garden". "A" and "B" samples were taken with a standard soil borer/auger, one inch in diameter. The sampler was rotated as it was pushed into the soil to prevent compression of the sample. Only the uppermost inch was removed from the core and placed in a container. No attempt was made to remove vegetation, but this was not used in the profile's dimension. This procedure was repeated three times to obtain a composite sample. Each sample was removed at a distance of no less than 10 feet from any other sample. Care was taken to select undisturbed soil and to avoid removing a sample within 10 feet of painted structures, former structures, waste piles, roadways, or painted playground equipment.

Figure IX - 1: Location of On-site Surface Soil Samples[1]




[1] See Table IX-2 for results

Each sample type is discussed below:

"Soil A" - These samples were taken primarily to determine long term deposition patterns. The samples were taken from vegetated areas where the soil was unlikely to have been recently disturbed.

"Soil B" - These samples, which were intended to indicate levels to which children would most likely be exposed, were taken from open dirt areas in yards, playgrounds, etc. Samples were split between IEPA, IDPH and USEPA.

"Soil C" - These samples (2) were taken to determine the depth to which high lead levels may extend in the soil. The above protocol was used except that one nine-inch core was taken instead of three one-inch cores. The nine-inch core was divided into three, 3-inch sections for analysis.

"Garden" - As a part of the garden vegetable sampling program, soil samples were taken from each garden sampled. The samples were taken from the top three inches of soil with a spatula.

The results of "Soil A", "Soil B", "Garden" and the top three-inch section of "Soil C" samples are presented in Figure IX-2. It can be seen that the soil concentrations are generally highest in the immediate vicinity of the smelter and decrease with increasing distance. Using "Soil A" samples as the most reliable upper estimates of soil concentration (because they represent undisturbed soils) and recognizing that the other samples may underestimate typical surface soil concentrations, some rough lead concentration isopleths can be drawn. This has been done in Figure VI-7. The implication of these soil concentrations is discussed in the Hazard Assessment Section.

The "Soil B" values presented in Figure IX-2 are averages of values reported by IEPA, IDPH and USEPA. The agency-specific values are generally in good agreement, and provide confidence in the reliability of the laboratory results. The values are presented in Table IX-2.

F e IX - 2: Surface Soil Sample Resu... (ppm Lead)

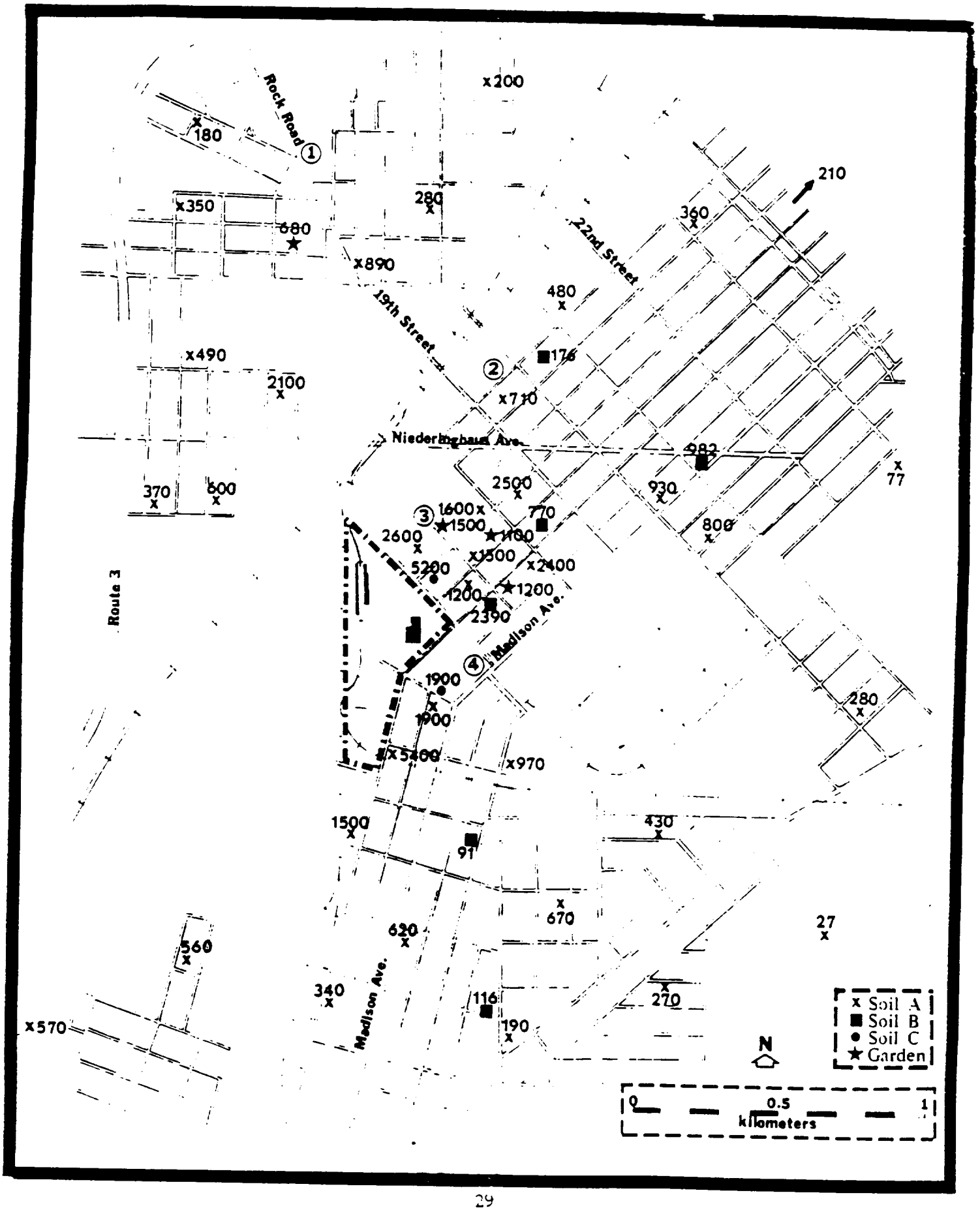


Table IX-2. Sc -Lead Concentrations for "Soil ᴗ Samples (ppm)

| Sample Number | Avg. | IEPA | IDPH | USEPA |
|---|---|---|---|---|
| SB101 | 2390 | 2600 | 2860 | 1700 |
| SB102 | 770 | 800 | 759 | 750 |
| SB103 | 982 | 950 | 995 | 1000 |
| SB104 | 176 | 200 | 159 | 170 |
| SB105 | 51 | 59 | 44 | 49 |
| SB201 | 116 | 120 | 108 | 120 |
| SB202 | 91 | 120 | 76 | 76 |

"Soil C" sample results, presented in Table IX-3, demonstrate that lead contamination extends at least as far as nine inches below the surface.

Table IX-3. Soil-Lead Concentrations for "Soil C" Samples (ppm)

| Sample Number | 0-3" | 3-6" | 6-9" |
|---|---|---|---|
| SC101 | 5200 | 1300 | 290 |
| SC201 | 1900 | 810 | 980 |

## X ) HEALTH HAZARD ASSESSMENT

Through the use of environmental quality data, a rough estimate of human exposure to lead can be made. Comparing the exposure estimates to what is known about the toxicity of this substance, an estimate of the likely health effects can also be made.

In addition, attempts have been made to directly measure the extent of lead exposure in the population. This has been done by the Illinois Department of Public Health (IDPH) through a survey of blood-lead levels in the community. These measurements can aid in the overall assessment of the potential health hazard.

The hazard assessment is made by combining these factors. Exposure estimates can be compared to what is known about acceptable exposure levels; estimated blood-lead levels can be compared to acceptable blood-lead levels; and measured blood-lead and FEP levels can serve as direct checks on the estimates.

A) Toxicity of Lead

1) Routes of Exposure and Absorption

Inhalation

Lead can be absorbed into the bloodstream by inhaling airborne particulates containing lead. The rate of absorption depends on the particle size, the chemical species of lead, as well as factors specific to the individual. Although the relationship between ambient air lead concentrations and blood-lead concentrations varies considerably among individuals, nearly all studies have demonstrated ratios of 1:0.5 to 1:4.0 (ug/m$^3$ Pb to ug/dl Blood-Pb). Most studies report ratios of 1:1 to 1:2 (Ref. 1, pp 12-25, 12-29). Although USEPA has stated that no one ratio can accurately describe the air lead to blood lead ratio in all cases, one was selected by the USEPA as being representative of study results when the NAAQS for lead was proposed. The ratio was 1:2, indicating that a change in the ambient air lead concentration of 1 ug/m$^3$ results in a corresponding change of 2 ug lead per deciliter (dl) of blood (Ref. 3, p 41211).

Data cited in USEPA's Preliminary Draft Air Quality Criteria Document generally supports a linear relationship in the range of 1:1 to 1:4 for relatively low ambient concentrations (3.2 ug/m$^3$ or less) (Ref. 4, p. 13-27 to 13-29).

Oral Ingestion

The gastrointestinal tract is not as efficient in absorbing lead as the lungs. Absorption rates vary with a number of factors, including age, form of intake (food, soil, water, etc.), and nutritional factors. The chemical species of the lead may also be important. In general, adults will absorb 10-15 percent of ingested lead, but children may absorb up to 50 percent (Ref 1, p 10-2; Ref 4, p 13-5; Ref 6, p C-16).

Scientific studies have not developed a precise relationship between ingested lead and blood-lead levels. A general relationship of a 3-6 percent increase in blood-lead for a doubling of soil-lead concentrations has been noted in some studies (Ref 1, p 12-32). However, it is uncertain how much of this is due to inhalation and how much is due to ingestion. The relationship between blood-lead and soil-lead is discussed further in subsection X(C).

Food and water intake and its relationship to blood-lead is also unclear. Although a general relationship of 6 ug/dl blood-lead for every 100 ug of daily dietary lead intake is suggested by various studies, there are many variables determining this rate, and the rate for children is expected to be higher (Ref 1, p 10-4, p 12-32).

Maximum acceptable daily dietary intake for children has been estimated to be 300 ug/day, with only 150 ug/day allowed for children under age three, and only 100 ug/day for infants under six months (Ref 7, p 5).

2) Distribution and Elimination

Once lead has entered the blood stream it has a high affinity for bone deposition. Roughly 95 percent of the lead found in adults is contained in the bones (Ref 1, pg 10-5). However, only about 72 percent of the lead in children is in the bones. More is found in the soft tissues, increasing its availability for recirculation (Ref 5, p C--20).

Blood-lead concentrations generally level off after a few months of constant exposure. This does not represent a true equilibrium level, however, as elimination of lead following termination of exposure generally takes much longer when the exposure occurred over several years as opposed to several months (Ref 5, p C-20; Ref 6, p 417).

In adults, lead is eliminated primarily through the urine, with fecal elimination and loss of epithelical tissue being of secondary importance. In children, however, fecal elimination appears to predominate (Ref 6, p 418).

3) Biological Effects

Lead intoxication has been associated with severe neurological disorders such as profound retardation, tremors, and loss of memory. Coma and death, though rare, have occurred in some extreme cases. However, these problems occur at much higher dosages than would normally be expected from environmental pollution (Ref 6, p 418). Environmental exposures can cause more subtle toxic effects such as blood system dysfunction, psyco-neurologic dysfunction, kidney dysfunction, and reproductive impairment.

Blood System Dysfunction

Anemia is presently considered to be the toxic effect occurring at the lowest excess blood-lead level. The anemia apparently can result from two separte effects of lead on the blood system (Ref 1, p 11-7 to 11-14). One effect is an increase in the fragility of the red blood cell membrane. The result is to decrease the average lifetime of red blood cells in the circulatory system.

The se. .d effect is a reduction in the ate of synthesis of "heme", which is a molecule used to make the hemoglobin in red blood cells. The result is to decrease red blood cell production. One of the mechanisms by which this is believed to occur is the inhibition of a particular enzyme used in heme synthesis. Although inhibition of this enzyme occurs at blood-lead levels as low as 10 ug/dl, sufficient inhibition to significantly interfere with heme synthesis and result in amenia apparently does not occur until blood-lead levels of approximately 40 ug/dl. Thus, 40 ug/dl was considered a "threshold" level in the development of the NAAQS by the USEPA. However, USEPA designated 30 ug/dl as the maximum allowable level for children to provide an adequate margin of safety (Ref 2, p 46253).

Another result of enzyme inhibition in the heme synthesis process is the buildup of an organic chemical, protoporphyrin, in the erythrocytes, or red blood cells. Although not perfectly correlated with blood-lead levels, a test of erythrocyte protoporphyrin, or "EP", levels is often used as a screening technique for lead poisoning and is a better indicator of long-term (greater than 90-day) exposure.

Psyco-neurologic Dysfunction

Lead poisoning can cause profound psyco-neurological dysfunctions. Children appear to be the most susceptible portion of the population. Research has indicated that blood-lead levels as low as 50-60 ug/dl can cause significant psyco-neurological disorders (Ref 1, pp 11-18 to 11-26).

Since the publication of USEPA's 1977 Air Quality Criteria Document for Lead, many studies have been released on psyco-neurological effects at blood-lead levels of 30-40 mg/dl and below. The preliminary draft of the revised criteria document discusses these studies (Ref 4, pp 12-38 to 12-149). While some of the studies indicate significant impairment of performance skills due to lead exposure, the results cannot be considered conclusive because of methodological problems complicating their interpretation. The studies are receiving significant attention by USEPA in workshops being held on revisions to the criteria document.

Kidney Dysfunction

A progressive, degenerative disease of the kidneys called chronic lead nephropathy has been reported in industrial workers exposed to lead, older adults having had lead poisoning as children, and long-term drinkers of illicit lead-contaminated whiskey (Ref 1, p 11-44). Numerous methodological problems in measuring the relationship between lead exposure and kidney dysfunction exist. However, lead-related kidney disease and associated problems such as gout and hypertension continue to be a serious concern and the subject of toxicological study.

Reproductive Impairment

Lead readily crosses the placental barrier and may exert toxic effects directly on the conceptus or indirectly, through nutritional effects on the mother (Ref 1, p 11-46). Because of the relationship between lead exposure and reproductive impairment, women have generally been excluded from occupational environments containing lead.

Lead exposure has been associated with increased rates of stillbirth, miscarriage, premature membrane rupture and premature delivery (Ref 1, p 11-46).

While some evidence exists for teratogenic or mutagenic effects of lead, a direct association has not yet been established (Ref 1, p 1-47). Of particular concern, however, is the possibility of subtle, long-term behavioral or intelligence effects.

B) Exposure Estimates

1) Air

As shown in Section VI(A), Air Quality Monitoring, ambient lead concentrations have frequently exceeded 2.0 $ug/m^3$. This value as well as the NAAQS (1.5 $ug/m^3$) and 1.0 $ug/m^3$ is used in evaluating a range of exposures in subsection XI(C) of this report.

2) Soil

In Section IX(B), Land Pollution Problems - Off-site, soil sample results indicating extensive lead contamination in area neighborhoods are discussed. One set of soil samples was taken from exposed dirt areas where children may play.

These samples were designated "Soil B" samples and were designed to estimate actual levels to which children may be exposed. It can be seen from the results in Figure IX-2 that "Soil B" levels are slightly lower but roughly consistent with other soil samples. To encompass the range of soil concentrations found in the area, values of 200, 1,000, and 5,000 ppm are used in this report for the health hazard analysis, although the highest "Soil B" (open dirt areas) value was 2,390 ppm.

In order to determine exposure, some estimate must be made concerning the amount of soil a child can ingest. In reviewing the literature for an assessment of contaminated soil in Minnesota, Dr. Mary Arneson concluded that a reasonable estimate of the range of intake rates for children would be 50 to 500 mg dust or soil per hour of play. Although the number of hours per day that a child plays in a dirt area varies considerably, it is not unreasonable to assume that up to 5 hours of exposure could occur each day for an extended period of time during the summer. Thus, 250 to 2,500 mg of soil could be consumed each day, recognizing that 2,500 mg/day is probably extreme. Dr. Arneson also noted that from 20 to 100 mg/day may be ingested by infants (Ref 7, p 7).

In a National Academy of Sciences study on lead, soil intake values of 100 mg/day for children without pica, and 1000 mg/day for children with pica are reported (Ref. 8, p. 58). Pica is a condition affecting many children in which there is an unusually strong need for placing objects in the mouth.

The table below provides daily lead intakes that would result from the range of soil intakes and soil concentrations discussed above.

Table X-1. Daily Lead Intake (ug)

| Daily Soil Intake (mg) | Soil Lead Concentrations (ppm) 200 | 1000 | 5000 |
|---|---|---|---|
| 20 | 4 | 20 | 100 |
| 100 | 20 | 100 | 500 |
| 500 | 100 | 500 | 2500 |
| 1000 | 200 | 1000 | 5000 |
| 2500 | 500 | 2500 | 12,500 |

3) Food

The average daily intake of lead from food has been estimated at 100 ug/day for children 0-2 years old and 150 ug/day for children 2-3 years old (Ref 8, p 47). An estimate of 210 ug/day has been made for children 8.5 years old (Ref 5, p C-7). In this study, samples were taken of garden vegetables throughout the region and subsequently analyzed in a United States Food and Drug Administration laboratory. Table X-2 displays the results. The samples were taken in the Fall of 1982. The soil concentrations associated with each garden are listed, and are indicative of the area in which the garden is located; sites 4, 5 and 6 are from control areas on the northeast side of Granite City.

Table X-2. Lead concentrations in Garden Samples (ppm - wet weight*)

| Site # | Sample | Pb |
|---|---|---|
| 1 | Peppers | 0.119 |
| | Tomatoes | 0.122 |
| | Banana Peppers | 0.134 |
| | Cauliflower (frozen) | 0.198 |
| | Soil | 1500 |
| 2 | Eggplant | 0.048 |
| | Tomatoes | 0.066 |
| | Okra | 0.128 |
| | Carrots | 0.392 |
| | Soil | 1100 |
| 3 | Tomatoes | 0.035 |
| | Cabbage | 0.633 |
| | Peppers | 0.053 |
| | Cucumber | 0.083 |
| | Soil | 1200 |
| 4 | Okra | 0.020 |
| | Banana Peppers | 0.010 |
| | Tomatoes | 0.005 |
| | Peas | 0.002 |
| | Soil | 53 |
| 5** | Pepper | 0.007 |
| | Tomatoes | 0.007 |
| 6 | Okra | 0.014 |
| | Banana Peppers | 0.010 |
| | Soil | 97 |
| 7 | Tomatoes | 0.028 |
| | Squash | 0.124 |
| | Okra | 0.641 |
| | Beets | 0.087 |
| | Beet Leaves | 0.058 |
| | Soil | 680 |

* Soil values are based on dry weight
** Site #5 is located across the street from Site #6. Therefore a separate soil sample was not taken.

Although lead concentrations vary considerably depending on the type of vegetable, it can generally be concluded that vegetables in the contaminated region contain from 0.05-0.5 ppm lead and vegetables in control regions contain from 0.005 to 0.05 ppm lead on a wet weight basis.

Assuming that 10 to 100 g/day (based on a total diet of 1000 g/day) of garden vetables may be consumed for an extended period of time by children, daily lead intake estimates may be increased by 0.5-5 to 5-50 ug/day.

Except for the high end of these estimates, they do not represent a major portion of the daily dietary intakes discussed above. Gardens in the vicinity of the smelter were generally small and were not believed to produce a large quantity of vegetables. In addition, only a few samples (carrots, cabbage, and okra) demonstrated lead levels higher than 0.2 ppm. Considering both these factors, it would be extremely unlikely that a child would consume 100 g/day of a vegetable containing 0.5 ppm lead each day for 30 to 90 consecutive days. A more reasonable estimate would be that vegetables consumed over such a period of time would be closer to an average of 0.1 ppm lead. This would mean an intake of 1 to 10 ug/day from garden vegetables.

Soil cation exchange capacity and pH are the two largest factors determining lead uptake by plants. Assuring near neutral pH and normal cation exchange capacity will minimize lead uptake. However, significantly altering soil cation exchange capacity is often difficult. Phosphate and pH levels appropriate for optimal garden productivity will aid in reducing lead uptake.

4) Water

Drinking water in the community is taken from the Mississippi River. The lead concentration is less than the State drinking water standard of 0.05 ppm and most samples are below the laboratory detection limit of 0.005 ppm. Thus, present data indicates that exposure from drinking water is not abnormal.

5) Other

There are many other sources of lead exposure for children. One of the major sources can be consumption of lead-based paint chips in the home. Exposure through the work or hobbies of others in the family is also important. Many of these potential exposure sources were investigated through a questionnaire administered to residents in the area by IDPH in connection with their blood-lead survey. These other exposure sources were not found to be major based upon a preliminary analysis of the survey results.

C) Estimate of ood-lead Levels

Much of the available toxicological data relates adverse effects to various concentrations of lead in the blood. Thus, estimating blood-lead concentrations resulting from environmental exposure is an important part of a health hazard assessment. Although much of the data is still preliminary, a rough estimate of potential health hazard can be made.

USEPA, in developing the National Ambient Air Quality Standard for lead, estimated a background blood-lead concentration from non-air sources of 12 ug/dl (Ref. 1, p 46254). Using this number, total blood-lead can be estimated by adding the contributions from airborne lead and other sources having concentrations higher than the background level.

1) Air

Based on a review of studies documenting the relationship between air-lead and blood-lead concentrations, USEPA concluded that the best estimate was 1:2; that is, every 1 $ug/m^3$ increase in air-lead concentrations results in an increase of 2 ug/dl in blood-lead. They note, however, that a range appears to exist, and that the ratio may be more severe for children and more severe at lower air-lead concentrations (Ref 2, p 46250; Ref 1, p 12-24 to 12-29). The 1:2 ratio is used for this analysis.

Table XI-3 provides estimates of the increase in blood-lead concentrations that would result from the range of air-lead concentrations under study assuming the 1:2 air/blood relationship.

Table X-3. Increases in Blood-Lead Due to Various Air-Lead Concentrations

| Ambient Air-Lead Concentration (ug/m3) | Increase in Blood-Lead (ug/dl) |
|---|---|
| 1.0 | 2.0 |
| 1.5 | 3.0 |
| 2.0 | 4.0 |
| 7.3 | 14.6 |

2) Soil

National background soil concentrations of lead have been documented as 10-30 ppm (Ref 5, p C-2; Ref 8, p 156). Although soil-lead concentrations associated with the development of the 12 ug/dl background blood-lead level are not known, it is reasonable to assume that the soil lead concentrations in the vicinity of the smelter (200 - 5000 ppm) almost entirely represent contamination above background.

In the Preliminary Draft of the revised Criteria Document, USEPA cites a study from which soil/blood relationships have been derived for children 1-3 and 6 years of age (Ref 4, p 11-94). They report an increase above background of 0.0076 x soil-lead (ppm) for children 1-3 years old, and 0.0046 x soil-lead (ppm) for children 6 years old. Based upon these relationships, Table X-4 provides blood-lead estimates for each age group, over various soil concentrations, assuming that the 0.0046 x soil ppm can be applied to all children over three years old.

Table X-4 Increases in Blood-lead Concentrations from Soil Ingestion (ug/dl)

| Soil Conc. (ppm) | Children 0-3 yrs old | Children over 3 yrs old |
|---|---|---|
| 100 | 0.76 | 0.46 |
| 200 | 1.52 | 0.92 |
| 500 | 3.80 | 2.30 |
| 1000 | 7.60 | 4.60 |
| 2000 | 15.20 | 9.20 |
| 5000 | 38.00 | 23.00 |

Several qualifications should noted at this point. First, the above formulas are presented in a draft document that has not yet been released for general review. Thus, they are subject to change and cannot be considered to reflect a final USEPA position. Second, the background blood-lead levels found in the above study, and other studies, have generally been higher than the 12 ug/dl used in this analysis. However, the Granite City-Madison-Venice area has not been associated with high blood-lead levels from consumption of paint chips or other sources based upon earlier blood-lead screening work. It must be recognized that there is considerable uncertainty in selecting the appropriate background level and soil-lead/blood-lead relationship.

Angle et. al. (1983) have also reported a linear relationship between blood-lead and other variables, including soil concentration (Ref. 9, p. 6). They report an increase of 0.00681 ug/dl for each ppm soil concentration for children 1-18 years old. This is roughly consistent with the values reported above by USEPA.

3) Diet

Because food and water exposure were found to be unlikely to pose a significant increase in lead intake, it will be assumed that no contribution to blood-lead beyond background will occur.

4) Other

Household exposures were not found to be significant and are therefore assumed not to affect blood-lead levels based upon preliminary findings of the blood-lead survey.

5) Overall Estimate

To estimate the overall blood-lead levels, the effects of both air and soil exposure must be combined. Since air quality modeling results are not yet complete, a precise relationship between air concentrations and soil concentrations cannot yet be delineated. Thus, it is assumed for this analysis that any air quality level can occur in conjunction with any soil quality level. However, the association of high air with high soil lead as well as low air with low soil lead is likely.

For the overall estimate, the soil/blood relationships presented in Table X-4 were used. These values were added to the blood-lead values from air exposure (Table X-3) and the background value of 12 ug/dl to derive the overall estimates in Table X-5. It should be noted that these are estimates of the population mean. Table X-6 presents similar results for children over 3 years of age.

As discussed in subsection (A) above, Toxicity of Lead, USEPA selected a level of 30 ug/dl in setting the National Ambient Air Quality Standard (NAAQS) to provide a sufficient margin of safety for children. Given the natural variation in blood-lead levels, and USEPA's goal of keeping all but 0.5 percent of the exposed children below the 30 ug/dl level, a population mean blood-lead level of 15 ug/dl was selected. (It should be noted, however, that approximately five percent of children exceed 30 ug/dl as a national average). This is based on evidence that blood-lead concentrations are lognormally distributed over a population with a standard geometric deviation (SGD) of 1.3. Higher and lower SGD's have been measured, but 1.3 was selected by USEPA.

Table X-5 Overall Mean Blood-lead Level Estimates for Children 0-3 yrs Old

| Soil Concentration (ppm) | Air Quality ($ug/m^3$) | | |
|---|---|---|---|
| | 1.0 | 1.5 | 2.0 |
| 100 | 14.76 | 15.76 | 16.76 |
| 200 | 15.52 | 16.52 | 17.52 |
| 500 | 17.80 | 18.80 | 19.80 |
| 1000 | 21.60 | 22.60 | 23.60 |
| 2000 | 29.20 | 30.20 | 31.20 |
| 5000 | 52.00 | 53.00 | 54.00 |

Table X-6 Overall Mean Blood-lead Level Estimates for Children Over 3 yrs Old

| Soil Concentration (ppm) | Air Quality ($ug/m^3$) | | |
|---|---|---|---|
| | 1.0 | 1.5 | 2.0 |
| 100 | 14.46 | 15.46 | 16.46 |
| 200 | 14.92 | 15.92 | 16.92 |
| 500 | 16.30 | 17.30 | 18.30 |
| 1000 | 18.60 | 19.60 | 20.60 |
| 2000 | 23.20 | 24.20 | 25.20 |
| 5000 | 37.00 | 38.00 | 39.00 |

As individual child blood-lead concentrations increase above the margin-of-safety level of 30 ug/dl, there is increasing likelihood of toxic effects. At an individual blood-lead level of 40 ug/dl, anemia has been well documented. Thus, toxic effects are likely above this value. As the population mean value increases from 15 ug/dl, an increasing percentage of the population is expected to exceed 30 and 40 ug/dl. To better illustrate the potential hazard, Tables X-7 through X-10 were constructed to show the percentage of the childhood population exceeding 30 and 40 ug/dl based on the mean levels presented in Tables X-5 and X-6. These values were calculated assuming an SGD of 1.3.

Table X-7 Percent of Children 0-3 Yrs Old with Blood-lead Levels Above 30 ug/dl

| Soil Concentration (ppm) | Air Quality ($ug/m^3$) | | |
|---|---|---|---|
| | 1.0 | 1.5 | 2.0 |
| 100 | 0.5 | 0.7 | 1.3 |
| 200 | 0.6 | 1.2 | 2.0 |
| 500 | 2.3 | 3.8 | 5.7 |
| 1000 | 10.6 | 14.0 | 18.1 |
| 2000 | 46.02 | 51.20 | 55.96 |
| 5000 | 98.20 | 98.50 | 98.75 |

Table X-8 Percent of Children Over 3 Yrs Old with Blood-lead Levels over 30 ug/dl

| Soil Concentration (ppm) | Air Quality ($ug/m^3$) | | |
|---|---|---|---|
| | 1.0 | 1.5 | 2.0 |
| 100 | 0.3 | 0.6 | 1.1 |
| 200 | 0.4 | 0.8 | 1.5 |
| 500 | 1.0 | 1.8 | 3.0 |
| 1000 | 3.4 | 5.3 | 7.6 |
| 2000 | 16.4 | 20.6 | 25.5 |
| 5000 | 78.8 | 81.6 | 84.1 |

Table X-9 Percent of Children 0-3 Yrs Old with Blood-lead Levels Above 40 ug/dl

| Soil Concentration (ppm) | Air Quality ($ug/m^3$) 1.0 | 1.5 | 2.0 |
|---|---|---|---|
| 100 | 0.0 | 0.0 | 0.0 |
| 200 | 0.0 | 0.0 | 0.1 |
| 500 | 0.1 | 0.2 | 0.4 |
| 1000 | 0.9 | 1.5 | 2.2 |
| 2000 | 11.5 | 14.2 | 11.1 |
| 5000 | 84.1 | 85.8 | 87.3 |

Table X-10 Percent of Children Over 3 Yrs Old with Blood-lead Levels over 40 Ug/dl

| Soil Concentration (ppm) | Air Quality ($ug/m^3$) 1.0 | 1.5 | 2.0 |
|---|---|---|---|
| 100 | 0.0 | 0.0 | 0.0 |
| 200 | 0.0 | 0.0 | 0.0 |
| 500 | 0.0 | 0.0 | 0.1 |
| 1000 | 0.2 | 0.3 | 0.6 |
| 2000 | 1.9 | 2.7 | 3.9 |
| 5000 | 23.6 | 42.1 | 48.0 |

It can be seen from Tables X-5 and X-6 that, even for air quality levels under 2.0 $mg/m^3$ air quality, the percentage of children exceeding 30 mg/dl is far above USEPA's target of 0.5 percent, and significantly above the national average of 5 percent at higher soil levels. Note also that in areas of soil concentrations as high as 2000 to 5000 ppm, a substantial percentage of the children would exceed even the 40 ug/dl.

If the AAQS of 1.5 ug/m3 were attained in the area, over 5 percent of the children would still exceed the margin-of-safety level of 30 ug/dl unless soils were reduced to less than 1000 ppm. Tables X-7 and X-8 illustrate that even if ambient air concentrations could be reduced to 1.0 ug/m3, 33 percent below the standard, soil concentrations of 1000 ppm or higher might still cause a significant percentage of the children to exceed the margin-of-safety level of 30 ug/dl. It should also be noted, based on the information in Tables X-9 and X-10, that in areas of high soil concentration, a significant percentage of the children could exceed 40 ug/m3. This clearly illustrates the difficulty in determining an acceptable concentration of lead in one medium (e.g., air) because of uncertainty with respect to exposure through other media (e.g., soil).

Although recent ambient lead air quality levels have been well below the 7.3 mg/m3 peak reported for the fourth quarter at 1981, exposures during that time could have placed more than one-third of the children over 30 ug/dl in areas where soil-lead levels exceed 200 ppm, and more than 10 percent of the children over 40 mg/dl in areas where soil-lead levels exceed 500 ppm.

D) IDPH Blood-lead Survey

To help assess the hazard posed by lead contamination in Granite City, the Illinois Department of Public Health (IDPH) conducted a survey of blood-lead concentrations. The survey consisted of three parts. The first part was a questionnaire concerning the household and its members. It was used to help identify sources of lead exposure. Secondly, each house where blood samples were taken was examined for lead paint and other sources of lead contamination. The third part of the survey was comprised of data on each individual, particularly the resulting blood-lead and FEP levels. FEP (free erythrocyte protoporphryn) is an enzyme whose release in the blood is directly proportional to lead exposure.

The survey was administered during the fourth quarter of 1982. Statistical analysis of the results took considerable time because of the necessity for lab work and data entry to the computer system. A complete statistical analysis of the numerous variables included in the questionnaire is expected within the next two months. However, preliminary results are available.

Several problems were anticipated with respect to obtaining complete survey information. One was obtaining the full cooperation of residents. Because of competing priorities in many family situations, the limited State resources that could be devoted to gaining cooperation, and the relatively short time frame within which the work had to be completed, it was anticipated that some public resistance might be encountered. Unfortunately, this was the case and surveys were completed for only 43 households (97 individuals, with 46 being six years old or less).

Another complication was the slowdown of activity at the smelter. Monitoring data for the period of the blood-lead survey (see Air Quality Monitoring Section) showed that outdoor air quality was much better than normal. Also, exposure to soil-lead was substantially reduced compared to the summer.

The preliminary results of the survey indicate that excessive blood-lead levels and FEP levels were not present in the sampled population. IDPH considers a blood-lead level of 30 ug/dl or more, in conjunction with an FEP level of 50 mg/dl or greater to be "undue lead absorption", that is, a dangerously high level of lead absorption. No such cases were found, even though one or two could have normally occurred in a sample of 46 urban children.

In addition, the low FEP values (indicative of longer-term lead exposures of several months to a year) indicate that significant lead exposure has not been occurring for the sampled individuals as a whole.

Numerous factors relating potential household exposures to blood-lead and FEP indicate that such exposures are not significantly above normal.

However, the small number of people willing to participate in the study limits the extent to which these conclusions can be extrapolated to the rest of the population in the area. Thus, no significant lead exposure problems were found in the survey of residents in the vicinity of the lead smelter, but the lack of citizen participation (which resulted in a relatively small sample size) and, to some extent, the timing of the sampling effort, means that some uncertainty remains with regard to a possible health hazard. The results, however, are consistent with previous blood-lead screening work done in 1976 and 1979.

E) Hazard Assessment

The public health hazard posed by lead contamination is based not only on the toxicity of lead, but also on the level of environmental contamination and the extent to which people, particularly children, are exposed to these levels.

The public , exposed to lead in the vicini _ of the smelter primarily through three means: air, soil, and garden vegetables. Each will be discussed in turn, and then they will be combined with data from the blood-lead survey to produce an overall hazard assessment.

## Air

Ambient air quality lead levels during 1982 were below 2.0 $ug/m^3$. Levels have been repeatedly monitored at levels exceeding the NAAQS (1.5 $ug/m^3$) have been monitored over the past four years, with a high of 7.3 $ug/m^3$ during the fourth quarter of 1981.

The potential for actual exposure of children to monitored ambient lead levels is greatest during the summer months when they spend a great deal of time outdoors. Thus, high ambient levels during the winter months should be less harmful than similar levels during the summer. Fortunately, the 1981 peak value of 7.3 $ug/m^3$ occurred in the Fall.

The NAAQS was based on the assumption that blood-lead due to air exposure would be added to a normal background blood-lead concentration of 12 ug/dl, and that exposures to more than 1.5 $ug/m^3$ would place a significant portion of the exposed children above the 30 $ug/m^3$ danger level. Thus, although ambient concentrations in 1982 were below 2.0 $ug/m^3$, levels above 1.5 $ug/m^3$ should be considered a potential health hazard. Significant exposures from other sources, such as soil, will aggrevate the effect of air exposure.

## Soil

The soil-lead concentrations found in the study area are significantly above background levels, particularly in Granite City. Levels as high as 2000 ppm are common in the inner-city portions of many urban areas such as Cincinnati, Ohio (Ref. 10) and Morton Grove, Illinois (Ref. 11). In other studies of residential areas surrounding smelters, values of 100-4000 ppm have been found in E. Helena, Montana (Ref. 4); 20-1,100 ppm in the Netherlands (Ref. 12); 20-4,800 ppm in Omaha, Nebraska (Ref. 3); 560-11,450 ppm in El Paso, Texas (Ref. 19), and 50-24,600 ppm in Silver Valley, Idaho (Ref. 15).

When a case of undue lead absorption is found in a child by the Illinois Department of Public Health, soil levels around the residence are required to be reduced to 200 ppm as a part of an overall plan to reduce lead exposure for that child to a minimum.

Figure X-1 . the exposure section provided estimates of lead intake given various soil-lead concentrations, and various assumptions regarding daily soil ingestion. A daily soil intake of 0.1 g/day was used as a rough estimate for normal consumption by a child, and 1.0 g/day for a child with pica.

A maximum tolerated intake of lead for children 0.5-3 years old has been estimated at approximately 150 ug/day. This value is for daily intake from all sources. Most of this amount is ingested daily from normal diet, and very little from soil.

Based on Figure X-1, it can be seen that a substantial portion (100 ug/day) of the maximum tolerated daily intake of lead for normal children could be obtained from the soil in areas with concentrations over 1000 ppm. Although the USFDA maximum tolerated daily intake level is not related directly to a particular blood-lead level or toxic effect, exceeding the recommended level by 100 percent or more could generally be considered a hazard.

Estimates of blood-lead levels indicate that soil-lead concentrations over 1000 ppm may place a significant percentage of children at risk. In addition, consultation with others knowledgable in the field indicates a general concensus that soil-lead values of 1000-5000 ppm may be cause for concern (Ref. 16).

## Garden Vegetables

Extended daily intakes of one to 10 ug/day from garden vegetables was estimated in the exposure section of this report. Compared to the 150 ug/day maximum tolerated daily intake limit, the contribution from eating garden vegetables grown in the area around the smelter appears to be minor.

However, this assessment is based on several assumptions. First, it is assumed that vegetables comprise no more than 10 percent of the diet by weight. Second, it is assumed that the amount of vegetables consumed over a period of 30 to 90 days is not primarily composed of root or leafy vegetables. Third, and most importantly, it is assumed that all vegetables are thoroughly washed. Eating unwashed leafy or root vegetables could greatly increase lead ingestion.

## Overall Assessment

The preceding assessments, based upon results of studies in other areas, indicate that both air and soil concentrations found in the Granite City-Madison-Venice area could represent a health hazard. Garden vegetables grown in the vicinity of the smelter do not appear to pose a significant risk as long as they are thoroughly washed before eating.

Estimates r. e of blood-lead levels and the ,.rcentage of children exceeding 30 and 40 ug/dl (see Figures X-7 through X-10) indicate that soil concentrations over 1000 ppm, and especially over 2000 ppm, could pose a significant hazard, even if the NAAQS is attained in the area.

Preliminary findings from the IDPH blood-lead screening, however, indicate that unusually high blood-lead levels are not present. This may be partially explained by the fact that the samples were taken during November and December of 1982, when children were not spending many hours playing outdoors, and air quality levels were at or below the NAAQS. The fact that FEP blood values were not above acceptable levels indicates that exposure to lead during the preceding months to one year had not been unusually high.

The indication that high absorption of lead in the blood is not occuring is supported by a survey performed in September 1976 by the Illinois Association for Retarded Citizens, in which 4.5 percent, or about the national average, of the children in East Alton, Granite City, and Madison were found to have elevated blood-lead levels. Also supporting this conclusion are the results of a 1979 blood-lead screening of the area by the IDPH which indicate no unusual incidence of elevated blood-lead levels.

Thus, although significant environmental contamination exists in the vicinity of the smelter, and evaluation of the data collected must continue, the preliminary assessment is that a major risk to public health is unlikely to exist provided that ambient air quality levels do not exceed the NAAQS and that routine personal health and hygiene measures are followed.

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TB:jd/6536C/1-41/sp

Table 1 Summary Table of Blood Lead:Soil Lead Relationship from Studies in Communities with Operating Smelters

| Author | City/Study Population | Soil Lead | Housedust Lead | Slope* |
|---|---|---|---|---|
| Angle & McIntire, 1979 | Omaha, NB<br>Age: 1-18 yrs<br>N = 1075 | Geom x = 227 ppm<br>95%tile = 843 ppm<br>(range: 16 - 4,792 ppm) | Geom x = 337 ppm<br>95%tile = 894 ppm<br>(range: 18 - 5,571 ppm) | 6.8 [a] |
| Yankel et al. 1977 | Kellogg, ID<br>Age: 1-9 yrs<br>N = 860 | x = 7000 ppm<br>(as high as 24,000 ppm) | x = 11,000 ppm<br>(as high as 140,000 ppm) | 1.1 [a] |
| Panhandle District et al. 1986 | Kellogg, ID<br>Age: 1-9 yrs<br>N = 364 | Geom x = 481 ppm (far)<br>3,474 ppm (near) | Geom x = 1,138 ppm (far)<br>3,933 ppm (near) | 3.0 [b] |
| Roels et al. 1980 | Belgium<br>Age: 10-14 yrs<br>N = 148 | <1 km from smelter<br>2,000 - 6,000 ppm | N/A | 3.5 [c] |
| Neri et al. 1978 | Trail, British Columbia<br>Age: 1-3 yrs<br>N = 87<br>Age: 1st grade<br>N = 103 | Group x in different areas of Trail ranged from:<br>225 - 1,800 ppm | N/A | 7.6 [a] for 1-3 yrs<br>4.6 [a] for 1st graders |
| Walter et al. 1980 | Kellogg, ID<br>Age: 1-9 yrs<br>N = 983 | Not given; presumably similar to Yankel et al, 1977 | Not given; presumably similar to Yankel et al, 1977 | 1.1 [a] average for ages 2-7 yrs |
| Roberts et al. 1974 | Toronto, Ontario<br>mixed adults/children<br>N = 80 | Group arith. x ranged from:<br>100 - 2,626 ppm | Group arith. x ranged from:<br>845 - 2,005 ppm | 4.0 [b] |

N/A not available

* defined as the increase in blood lead (ug/dl) per 1,000 ppm increase in soil lead

[a] calculated by EPA (U.S.EPA, 1986) - takes into account other sources of exposure

[b] ^PbB (ug/dl)/^PbS (ppm) - does not take into account other sources of exposure (calculated by Gradient)

[c] calculated by Duggan & Inskip, 1985 - corrected for increase due to inhalation of air lead

ATTACHMENT 1

Table 2 Summary Table of Blood Lead:Soil Lead Relationship from Urban Areas Without an Operating Smelter

| Author | City/Study Population | Soil Lead | Housedust Lead | Slope* |
|---|---|---|---|---|
| Galke, 1975 | Charleston, SC<br>Age: 0-5 yrs<br>N = 194 | Geom x = 585 ppm<br>(range: 9 - 7,890 ppm) | N/A | 1.5 [a] |
| Stark et al.<br>1982 | New Haven, CT<br>Age: 0-1 yrs<br>N = 153 | Five levels of SES<br>(group mean: 233 - 1,327 ppm);<br>Seven categories of housing construction<br>(group mean: 131 - 1,300 ppm) | For levels of SES<br>(group mean: 159 - 628 ppm);<br>For housing construction categories<br>(group mean: 239 - 756 ppm) | 2.2 [a] |
| Shellshear et al.<br>1975 | Christchurch,New Zealand<br>Age: 1-5 yrs.<br>N = 68 | Soil lead range:<br>150 - 1,959 ppm | N/A | 3.9 [d] |
| Bornschein et al.<br>1986 | Cincinnati, OH<br>Age: 1.5 yrs.<br>N = 81 | Geom x = 1,360 ppm<br>(range: 76 - 54,519 ppm) | Geom x = 900 ppm<br>(range: 82 - 13,820 ppm) | 6.2 [c]<br>from 0-1,000 ppm soil lead<br>Estimated slope: 0.76 [c]<br>from 1,000-2,000 ppm |
| Bornschein et al.<br>1988 | Cincinnati, OH<br>N/A | N/A | N/A | 1.2 [c]<br>when soil lead increased<br>from 500-1,000 ppm |
| Reeves et al.<br>1982 | New Zealand<br>Age: 1-3 yrs<br>N = 195 | Soil lead range:<br>24 - 842 ppm | N/A | 5.5 [b] |
| Rabinowitz et al.<br>1985 | Boston, MA<br>Age: 0-2 yrs<br>N = 249 | Group mean soil ranged<br>from 380 - 1,011 ppm | N/A | 8.1 [b] |
| Minnesota 1987 | Minneapolis-St. Paul, MN<br>Age: 0-5 yrs<br>N = 656 | (range: 0 - 30,000 ppm) | N/A | 2.7 [b] |

N/A not available

* defined as the increase in blood lead (ug/dl) per 1,000 ppm increase in soil lead

[a] calculated by EPA (U.S.EPA, 1986) - takes into account other sources of exposure

[b] ^PbB (ug/dl)/^PbS (ppm) - does not take into account other sources of exposure (calculated by Gradient)

[c] calculated by authors - takes into account other sources of exposure

[d] calculated by Duggan & Inskip, 1985 - takes into account air lead exposure

Table 3 Summary Table of Blood Lead:Soil Lead Relationship from Mining Sites

| Author | City/Study Population | Soil Lead | Housedust Lead | Slope* |
|---|---|---|---|---|
| Bornschein et al. 1988 | Telluride, CO<br>Age: <6 yrs<br>N = 94 | Geom x = 178 ppm | Geom x = 281 - 567 ppm | 2.2 [c]<br>based on increase from 500-1,000 ppm soil lead |
| Thomas et al. 1977 | Halkyn & Y Fan, Wales<br>Age: 39-62 yrs<br>mean ages<br>N = 78 | Mine tailings in Y Fan:<br>42,000 ppm<br>Halkyn - 44 km2 has<br>>1,000 ppm soil lead | N/A | Significant trend in PbB in near vs. far resident males:<br>near 21.9 ug/dl<br>mid 19.0 ug/dl<br>far 15.1 ug/dl |
| Gallacher et al. 1984 | 4 areas in Wales<br>Age: 1-3 yrs<br>N = 93 | Geom x = for soil<br>road 356 ppm<br>deadend 271 ppm<br>mining 1,167 ppm<br>control 79 ppm | Geom x = for dust<br>road 202 ppm<br>deadend 177 ppm<br>mining 350 ppm<br>control 177 ppm | 4.1 [b] |
| Heyworth et al. 1981 | Northhampton, Australia<br>Age: 5-14 yrs<br>N = 81 | Soil lead at town boundary:<br>300 ppm<br>playground range:<br>11,000 - 12,000 ppm | N/A | No significant difference between children with homes on tailings piles vs. those who were not. PbB were significantly higher in children residing in town vs. non-residents |
| Barltrop et al. 1975 | Derbyshire, England<br>Age: 2-3 yrs<br>N = 82 | Geom x in areas with soil lead:<br><1,000 ppm 420 ppm<br>>1,000-10,000 ppm 3,390 ppm<br>>10,000 ppm 13,969 ppm | Geom x in areas with soil lead:<br><1,000 ppm 531 ppm<br>>1,000-10,000 ppm 1,564 ppm<br>>10,000 ppm 2,582 ppm | 0.6 [a] |
| Barltrop et al. 1988 | N. Petherton & Shipham, England<br>Age: 3 yrs<br>N = 178 | Geom x = soil<br>low 177 ppm<br>high 1,850 ppm | Geom x = dust<br>low 478 ppm<br>high 879 ppm | 0 [b] |

N/A not available

* defined as the increase in blood lead (ug/dl) per 1,000 ppm increase in soil lead

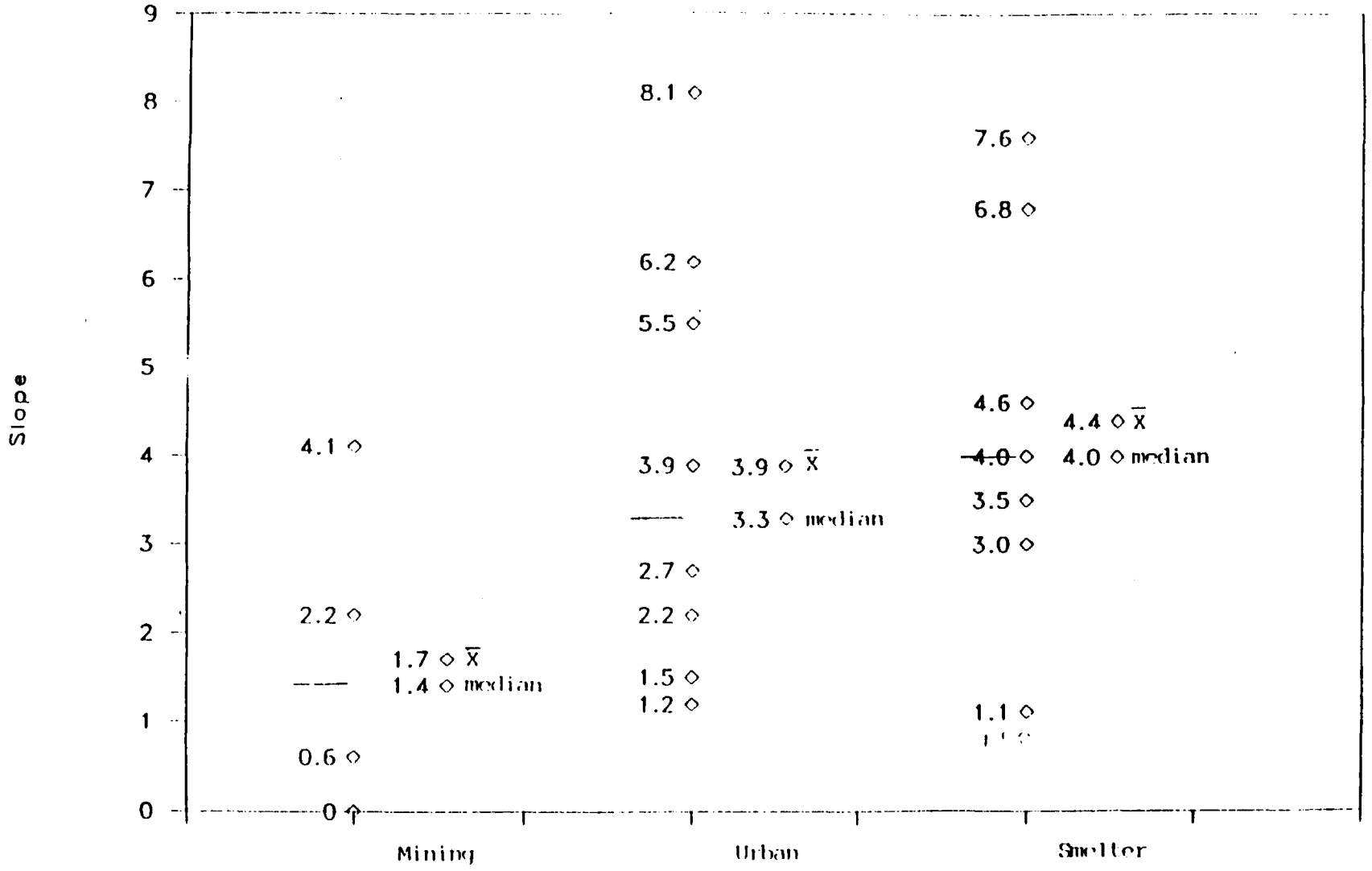
[a] calculated by EPA (U.S.EPA, 1986) - takes into account other sources of exposure

[b] ^PbB (ug/dl)/^PbS (ppm) - does not take into account other sources of exposure (calculated by Gradient)

[c] calculated by Duggan & Inskip, 1985 - corrected for increase due to inhalation of air lead

Figure 1

Slope Values for Mining, Smelter & Urban Studies[1]




1 See tables 1-3 for references

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STATE OF ILLINOIS
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**Grant Agreement**

The Illinois Department of Public Health, Office of Health Protection, Division of Environmental Health, hereinafter referred to as the "Department", and The Institute for Evaluating Health Risks, Suite 608, 1101 Vermont Ave., NW, Washington, D.C. 20005, hereinafter referred to as the "Grantee", agree as follows:

(1) **Services**: The Grantee will provide services as described in Appendix A, attached hereto and incorporated herein, and agrees to act in compliance with all state and federal statutes and administrative rules applicable to the provision of services pursuant to this grant agreement.

(2) **Term**: The period of this grant agreement is July 1, 1991 through September 30, 1992; however, it may be terminated at any time during this period by either party upon giving written notice to the other party thirty (30) calendar days in advance of the actual termination date. Upon termination the Grantee shall be paid for work satisfactorily completed prior to the date of termination.

(3) **Compensation**:

(A) The Department will compensate the Grantee as provided in Appendix A. The amount of payment shall not exceed a maximum amount of $ 450,000.

(B) Obligations of the Department will cease immediately without penalty of further payment being required if the Illinois General Assembly or federal funding source fails to appropriate or otherwise make available sufficient funds for this grant agreement.

(C) If the Grantee's cost of property and casualty insurance increases by 25% or more or if new state regulations impose additional costs to the Grantee during the term of this grant agreement, then the Grantee may request the Department to review this grant agreement and adjust the compensation or reimbursement provisions thereof in accordance with any agreement reached, all of which shall be subject to the limitations of the Department's appropriated funds.

(4) **Audit Requirements**

(A) **Local Governments**: The Grantee will maintain complete records of all services and receipts and disbursements relative to this grant agreement and agrees to make all such records available to the Department and its agents for audit in accordance with the Fiscal Control and Internal Auditing Act and OMB Circular A-128. Such records shall be so retained and available during normal business hours for three (3) years following termination of this grant agreement or for such time as may be provided in applicable state and federal statutes and administrative rules, whichever time is longer. The Grantee further agrees to maintain all records which are subject to an active or announced audit until such audit is completed.

for.

(B) **Non-Profit Organizations**: The Grantee is responsible for meeting the audit requirements of the Fiscal Control and Internal Auditing Act and for compliance with OMB Circular A-133 to contract with an independent accounting firm to perform an organization-wide audit. The Grantee will provide a copy of the audit to the Department. The Grantee will maintain complete records of all services, receipts, and disbursements relative to this grant agreement, insofar as such records support the audit.

(5) **Conditions**: Conditions of this grant agreement, if any, are attached hereto and incorporated herein as Appendix B. No payment shall be made by the Department to the Grantee until all conditions specified in Appendix B have been satisfied.

(6) **Subgrantee**: The Grantee will not utilize the services of a subgrantee to fulfill obligations under this grant agreement without the prior written consent of the Department. The Department hereby provides written consent to the Grantee to utilize the subgrantee(s) named and at such amount(s) as named in Appendix B.

(7) **Work Product**: All documents, including reports and all other work products, produced by the Grantee under this grant agreement shall become and remain the property of the Department.

(8) **Applicable Law**: This grant agreement shall be governed in all respects by the laws of the State of Illinois.

(9) **Certification**:

(A) The Grantee certifies that Grantee has not been (i) convicted of bribery or attempting to bribe an officer or employee of the State of Illinois, nor (ii) made an admission of guilt of such conduct which is a matter of record; nor (iii) has an official, agent, or employee of the Grantee committed bribery or attempted bribery on behalf of the Grantee and pursuant to the direction or authorization of a responsible official of the Grantee. (Ill.Rev.Stat., ch. 127, par. 132. 10-1)

(B) If the Grantee is a charitable organization subject to the Charitable Trust Act, Ill.Rev.Stat., ch. 14, par. 51 et seq., or AN ACT to regulate solicitation and collection of funds for charitable purposes, Ill.Rev.Stat., ch. 23, par. 5101 et seq., the Grantee certifies that all information required by the statutes referenced herein has been filed with the Illinois Attorney General.

(C) The Grantee certifies that the Grantee has not been barred from contracting with a unit of state or local government as a result of violation of bid-rigging or bid-rotating provisions in the Criminal Code of 1961. (Ill.Rev.Stat., ch. 38, par. 33E-3, 33E-4, 33E-11)

(D) The Grantee certifies that Grantee is not prohibited from selling goods or services to the State of Illinois because it pays dues or fees on behalf of its employees or agents, or subsidizes or otherwise reimburses them, for payment of their dues or fees to any club which unlawfully discriminates. (Ill.Rev.Stat., ch. 68, par. 101-102)

(E) The Grantee certifies that no Federal appropriated funds have been paid or will be paid, by or on behalf of the undersigned, to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with the awarding of any Federal contract, the making of any Federal grant, the making of any Federal loan, the entering into of any cooperative agreement, and the extension, continuation, renewal, amendment, or modification of any Federal contract, grant, loan, or cooperative agreement.

(F) The Grantee certifies compliance with all provisions of the Drug Free Workplace Act, P.A. 86-1459, to be located at Ill.Rev.Stat., ch. 127, par. 132.111 et seq., effective January 1, 1992.

(10) Conflict of Interest: The Grantee agrees to comply with the provisions of the Illinois Purchasing Act prohibiting conflict of interest. (Ill.Rev.Stat., ch. 127, par. 132. 11-1 through 132.11-5)

(11) Unlawful Discrimination:

(A) The Grantee agrees not to commit unlawful discrimination in employment in Illinois as that term is used in Article 2 of the Illinois Human Rights Act (Ill.Rev.Stat. ch. 68, par. 1-101 et seq.) and agrees to act in conformity with 44 Ill.Adm.Code 750. APP. A.

(B) The Grantee agrees to comply with the Federal Civil Rights Act of 1964, the Federal Rehabilitation Act of 1973, and all other federal and State of Illinois laws, regulations or orders which prohibit discrimination because of race, color, religion, sex, national origin, ancestry, age, marital status, or physical or mental handicap.

(12) Amendments: This grant agreement may not be amended without prior written approval of both the Grantee and the Department.

(13) Assignment: The Grantee understands and agrees that this grant agreement may not be sold, assigned, or transferred in any manner and that any actual or attempted sale, assignment, or transfer shall render this grant agreement null, void, and of no further effect.

(14) Confidentiality: The Grantee agrees to protect from any and all disclosure all information which identifies or which could lead to the identity of recipients of services provided pursuant to this grant agreement, except as provided in Appendix A.

(15) Civil Law Suits: This grant agreement is not subject to AN ACT to provide for representation and indemnification in certain civil law suits. (Ill.Rev.Stat., ch. 127, par. 1301 et seq.)

(16) Notices: All legal notices affecting a material element of this grant agreement required or desired to be made by either party to this grant agreement shall be sent by certified mail to the following respective addresses:

to the Department: Illinois Department of Public Health
Office/Division of: Health Protection/Environmental Health
535 West Jefferson Street
Springfield, Illinois 62761
Attention: Clinton C. Mudgett, Chief

to the Grantee: Institute for Evaluating Health Risks

Suite 608

1101 Vermont Ave., NW

Washington, D.C. 20005

Attn: Renate D. Kimbrough, M.D.

(17) **Controlling Terms**: In the event of any conflict between the terms of this grant agreement and terms of any appendix or exhibit or other attachment or matter incorporated herein or referenced herein, the terms of this grant agreement shall be controlling.

(18) **Federal Taxpayer Identification Number**:

Under penalties of perjury, I certify that 943081970 is Grantee's correct Federal Taxpayer Identification Number or Governmental Unit Code. Grantee is doing business as a(an):

| | |
|---|---|
| ____ Partnership | ____ Real Estate Agent |
| ____ Corporation | ____ Governmental Entity |
| XX Not-for-Profit Corp | ____ Tax Exempt Organization (IRC 501[a] only) |
| ____ Medical and Health Care Services Provider Corp | ____ Trust or Estate |

(19) **Total Agreement**: The Grantee and the Department understand and agree that this grant agreement constitutes the total agreement between them and that no promises, terms, or conditions not recited herein or incorporated herein or referenced herein shall be binding upon either the Grantee or the Department.

**For the Grantee:**

Grantee Signature

Typed Name

Title

943081970
FEIN Number

IDHR Number (if applicable)

**For the Illinois Department of Public Health:**

Recommended by

Director of Public Health Signature

John R. Lumpkin, M.D.
Typed Name

Execution Date

# APPENDIX A

Under the provisions of an Agency for Toxic Substances and Disease Registry (ATSDR) grant to the Department to conduct a lead exposure study of the populace in proximity to the NL Industries/Taracorp National Priorities List (NPL) site in Granite City (Madison County) Illinois, a grant from the Department is to be awarded to an outside academic or research group to carry out the provisions of this project. The scope of this study, and the responsibility of the Department's grantee is to conduct, coordinate, and oversee the various aspects of the study. This responsibility includes the requirement to hire, train, supervise, and pay hourly employees to carry out work necessary to complete the project, oversee the administration and completion of appropriate forms and questionnaire, conduct and/or oversee the different biomedical and environmental sampling required of the project, conduct appropriate quality assurance and control on data collected, ensure proper handling, shipping, and delivery of the various samples and forms, conduct data entry and analysis of the accumulated information, provide interpretation and written reports of the study outcome, conduct follow-up as needed or indicated from study results, be available to discuss findings and recommendations from the study with the public, local officials, and regulatory agencies, and maintain records of all study-related expenditures for purposes of cost recovery and payment

The Department intends to contract with the Institute for Evaluating Health Risks (IEHR) headquartered in Washington, D.C. to conduct this study. The IEHR will provide the services of a principal investigator (Renate D. Kimbrough, M.D.) and a co-principal investigator/field manager (Maurice LeVois, Ph.D.) to head the project as well as the services of other professional and support staff as needed. Doctors Kimbrough and LeVois have wide experience in the field of toxicology, pathology, epidemiology, biostatistics, and environmental and occupational health.

## Services

Under the provisions of this grant, the grantee (IEHR) will:

1) analyze the results of the population census to identify and locate potential participants in the project, and provide assistance in contacting these individuals and enlisting their cooperation.

2) hire, train, and/or supervise all workers needed to carry out the objectives of the study. Such workers may include phlebotomists, phlebotomy assistants, interviewers, laboratory workers, environmental samplers, and other ancillary personnel.

3) plan, direct, and oversee the on-site activities of this study including conduction of interviews, performance of biomedical sampling, oversight and/or participation in environmental sampling, oversight of sample chain-of-custody and shipping,

maintenance of records and expenditure information, and perform other logistical and practical matters necessary to conduct this project in an efficient and professional manner.

4) develop a computer database utilizing the information obtained from interviews and as the result of biomedical and environmental sampling and analysis to facilitate appropriate statistical analyses.

5) provide the Department and ATSDR a data tape or tapes of the aforementioned data sufficient for analytical requirements and/or record-keeping.

6) perform appropriate statistical analysis of the study data to allow interpretation of the results and conclusions to be drawn.

7) prepare, maintain, and submit time-keeping information and other receipts or records of expenditures for this study adequate to the purpose of accountability and cost recovery.

8) maintain the data developed through this study in a manner which ensures confidentiality and protection of study subjects.

9) prepare and submit a draft report to the department and ATSDR on the study outcome, interpretation, and recommendations.

10) prepare and submit a final report incorporating changes and revisions suggested by the Department, ATSDR, and other peer reviewers.

11) follow-up with individuals identified as being at-risk or their physicians with appropriate recommendations or intervention strategies.

12) be available to attend public meetings or other gatherings to discuss study outcomes, interpretations, and recommendations.

<u>Compensation</u>

The Department shall provide compensation to the maximum indicated in the following areas:

| | | |
|---|---|---|
| 1) | Personal Services | Total $264,500 |
| | a) Principal Investigator 800 hrs @ $125/hr (Renate Kimbrough, M.D.) | $100,000 |

The P.I. is responsible for conduct, completion, interpretation, and follow-up of the study. The estimated time involved includes on-site activities as well as time spent in analyzing data and developing reports.

b) Co-Principal Investigator 800 hrs @ $85/hr $ 68,000

The Co-P.I. is responsible for training of hourly workers, collection of data, data entry and analysis, and study interpretation. The estimated time includes on-site activities as well as time spent in data analysis and interpretation, and report writing.

c) Environmental Sample Field Supervisor 500 hrs @$40/hr (vacant) $ 20,000

The field supervisor will oversee or participate in collection and interpretation of environmental samples. The estimated time includes on-site activities associated with sampling and time spent in interpretation of data and report writing.

d) Administrative Assistant 500 hrs @ $15/hr $ 7,500

e) Secretary/Word Processor 500 hrs @ $10/hr $ 5,000

f) Data Entry Clerks (4) 400 hrs @ $10/hr $ 16,000

Positions d-f are required for the management of files, forms, and other study documents; management and planning of personnel time and study requirements, data entry and management of study information and report generation.

g) Interviewers (15) 300 hrs @ $10/hr $ 30,000

h) Schedulers (4) 200 hrs @ $10/hr $ 8,000

i) Drivers (2) 200 hrs @ $10/hr $ 4,000

j) File Managers (2) 200 hrs @ $15/hr $ 6,000

Positions g-j are hourly workers hired locally to perform on-site services in scheduling and interviewing study participants, managing forms, and other duties as assigned.

2) Fringe Benefits Total $ 0

Fringe benefit costs are subsumed in the hourly rate paid to professional and contractual workers.

3) Travel, lodging and per diem Total $ 44,820

This includes actual and necessary travel expenses incurred in the performance of the grantee's duties and responsibilities under this grant. These monies will be used for the following:

i) Travel

| | |
|---|---|
| - Airfare (3 professionals) 7 round trips | $ 21,000 |
| - Rental car (2) 60 days @ $50/day | $ 6,000 |
| - Mini-Vans (3) 30 days @ $50/day | $ 4,500 |

| | |
|---|---|
| ii) Lodging (3 professionals) 60 days @ $50/day | $ 9,000 |
| iii) Per Diem (3 professionals) 60 days @ $24/day | $ 4,320 |

All such payment will be in accordance with the travel regulations promulgated by the Illinois Travel Regulation Council and the Rules of the Governor's Travel Control Board (80 Ill. Adm-Code 2800) in effect on the date of travel.

| | |
|---|---|
| 4) Miscellaneous Costs | $ 50,680 |
| Printing | $ 6,000 |
| Overnight Mail/Postage | $ 6,000 |
| Telecommunications | $ 7,500 |
| Furniture Rental (desks, chairs, partitions, file cabinets) | $ 7,500 |
| Laboratory Analyses (follow-up) | $ 20,000 |
| Supplies | $ 3,680 |
| 5) General and Administrative Costs Total | $ 90,000 |

General administrative costs assessed by IEHR is based on 25% of all services conducted under this grant.

Grant Total $450,000

Total expenditure by the grantee is not to exceed $450,000 for the grant period. Monies may be moved from one budget category to another if study needs require such re-allocation; however, all such re-allocation must be approved by the Department. The grant period shall extend from July 1, 1991 to September 30, 1992 or for a period of fifteen months from initiation of activities under this grant.

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## APPENDIX B

Immediately upon initiation of this contract, the Department will transfer or authorize transfer of $300,000 to IEHR for purposes of carrying out the study as outlined in Appendix A and in accordance with the budget. Following the change in the Federal fiscal year (September 30, 1991) and the beginning of the second year of the study, an additional $150,000 will be transferred to IEHR to bring the total grant award to $450,000. This money will be maintained in an account by IEHR and be drawn against for proper expenditures associated with the study design and in keeping with the budget. Any interest generated by this account will be maintained with the principal and will be used only for study expenditures. Reallocation of study funding within and between budget categories is allowed, but only after prior discussion and written approval from the Department. Sub-contracting study activities is allowable although the Department reserves the right of approval of any sub-contractors and the percentage of the total study in which they are involved. Ninety days following the end of the contract period, all unexpended funds (and interest generated) are to be returned to the Department along with a complete accounting of expenditures incurred and personnel time utilized in completion of the study and its deliverables. This record must be suitable for purposes of cost-recovery and accountability.

For purposes of this grant, deliverables are defined as all final reports including the findings of the census, personal interviews, biomedical sampling, environmental, and any correlational or statistical analyses of this data together with its interpretations and recommendations. Additionally any and all information or forms containing personal identifiers or other confidential information must be returned to the Department following the end of the contract period. In addition, the grantee agrees:

1) To carefully restrict the use of this information. The information shall be used only for preparation and design of the Department Lead Exposure Study in the Granite City area.

2) To state in any publication based on this information that conclusions, opinions, and recommendations expressed in said article are not necessarily the conclusions, opinions, or recommendations of the Department.

3) That in conduct of this study, and subsequent related studies, should personal or privileged information subject to this agreement be requested, that such information will not be released. The requestor will be referred to the Department.

4) That any and all data developed under this grant which may lead to the identity of any person is strictly privileged and confidential and agrees to keep all such data strictly confidential and secure at all times.

5) That all confidential data developed under the terms of this grant may be used only for the purposes named in this or

subsequent agreements, and that any other or additional use of the data beyond that authorized may result in immediate termination of this agreement by the Department.

6) That all confidential data developed under the provisions of this grant shall be sent only by certified mail and are the sole property of the Department and may not be copied or reproduced in any form or manner without prior written permission of the Department. Internal copies or reproductions for the sole purpose of working procedures will be kept to minimum and will be destroyed upon completion of each task. All confidential information or copies of said information shall be returned to the Department upon completion of the grant. The investigators, in conjunction with members of the Department, will not be prohibited from publishing the results of the investigation as long as they are in compliance with the confidentiality provisions of the contract. The grantee is entitled to retain copies of non-confidential information.

7) The Department reserves the right to review any publications by the grantee prior to publication to confirm compliance with this agreement.

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# Revised Budget - Madison County Lead Study
## July 1991

I. Phase I (census) - July 1st - 31st, 1991

A) Personal Services

Personnel Costs

| | |
|---|---|
| 1 - Sanitarian II @ 2042/month for 1 month | $ 2,042 |
| 3 - Sanitarian III @ 2370/month for 1/2 month | $ 3,555 |
| Subtotal | $ 5,597 |
| Fringe Benefits (17.95% of Personnel Costs) | $ 1,005 |
| Total Personnel Services | $ 6,602 |
| Indirect Costs (42% of Personal Services and Fringe less group insurance | $ 2,656 |
| Total | $ 9,258 |

B) Travel

| | |
|---|---|
| Lodging (3 individuals) 50/day for 14 days | $ 2,100 |
| Per diem (3 individuals) 24/day for 14 days | $ 1,008 |
| (1 individual) 14/day for 14 days | $ 196 |
| Mileage (4 individuals to and from Granite City and necessary driving) 3000 mi @ .24/mi | $ 720 |
| Total | $ 4,024 |

C) Contractual

| | |
|---|---|
| 40 Census Takers @ 6.50/hour, 8 hour/day, 14 days | $ 29,120 |
| 6 Team Leaders @ 8.00/hour, 8 hour/day, 14 days | $ 8,064 |

D) Supplies and Miscellaneous

| | |
|---|---|
| Printing (20,000 forms, 6 pages each) | $ 1,000 |
| Paper (10 boxes) | $ 150 |
| Telecommunications | $ 150 |
| Postage | $ 250 |
| Total | $ 1,550 |

Total Census Costs

| | |
|---|---|
| Personal Services | $ 6,602 |
| Indirect Costs | $ 2,656 |
| Travel | $ 4,024 |
| Contractual | $ 37,184 |
| Supplies and Miscelaneous | $ 1,550 |
| Total | $ 52,016 |

## II. Phase II

### A) Personal Services

**Personnel Costs**

| | |
|---|---|
| 2 - Sanitarian III @ 2370/month for 1 month | $ 5,790 |
| 1 - Sanitarian II @ 2042/month for 2 months | $ 4,048 |
| Subtotal | $ 9,788 |
| Fringe Benefits (17.94% of Personnel Costs) | $ 1,757 |
| FY91 Total Personal Services | $ 11,545 |
| Indirect Costs (42% of Personal Services less group insurance) | $ 5,477 |
| Total | $ 17,022 |

### B) Travel

| | |
|---|---|
| Lodging (2 individuals) 30 days @ 50/day | $ 3,000 |
| Per diem (2 individuals) 30 days @ 24/day | $ 1,440 |
| (2 individuals) 30 days @ 14/day | $ 840 |
| Travel (4 individuals to and from Granite City and necessary driving) 5000 miles @ .24 mile | $ 1,200 |
| Total | $ 6,480 |

### C) Contractual

- Personnel

| | |
|---|---|
| 1 Principal Investigator @ 125/hour for 300 hours | $ 37,500 |
| 1 Co-Principal Investigator @ 85/hour for 300 hours | $ 25,500 |
| 1 Environmental Sample field Manager @ 40/hour for 300 hours | $ 12,000 |
| 1 Administrative Assistant @ 15/hour for 100 hours | $ 1,500 |
| 1 Secretary/Word Processor @ 10/hour for 100 hours | $ 1,000 |
| 4 Data Entry Clerks @ 10/hour for 150 hours | $ 9,000 |
| 15 Interviewers @ 10/hour for 300 hours | $ 30,000 |
| 4 Scheduler @ 10/hour for 200 hours | $ 8,000 |
| 2 Drivers @ 10/hour for 200 hours | $ 4,000 |
| 2 File Managers @ 15/hour for 200 hours | $ 6,000 |
| Subtotal | $129,500 |
| Fringe Benefits (subsumed in hourly rate paid to contractual workers) | $ 0 |

- Travel

| | |
|---|---|
| Airfare (2 professionals) 3 roundtrips between Washington D.C. and St. Louis @ 1000 each | $ 6,000 |
| (1 professional) 3 roundtrips between San Francisco and St. Louis @ 1000 each | $ 3,000 |
| Lodging (3 professionals) @ 50/day for 40 days | $ 6,000 |
| Per diem (3 professionals) @ 24/day for 40 days | $ 2,880 |
| Rental Car (2) @ 50/day for 40 days | $ 4,000 |
| Mini-Vans (3) @ 50 day for 30 days | $ 4,500 |
| Subtotal | $ 26,380 |

- Miscellaneous Costs

| | |
|---|---|
| Printing (forms, letters, reports, etc.) | $ 4,500 |
| Overnight Mail/Postage | $ 4,000 |
| Telecommunications | $ 5,000 |
| Furniture Rental | $ 7,500 |
| Supplies | $ 2,000 |
| Subtotal | $ 23,000 |

| | |
|---|---|
| - General and Administrative Costs - 25% of total contractual obligations | $ 44,720 |

D) Miscellaneous Costs

| | |
|---|---|
| Sampling equipment | $ 6,000 |
| Telecommunications | $ 1,000 |
| Postage | $ 500 |
| Printing | $ 500 |
| Subtotal | $ 8,000 |

Total FY91 Phase II Costs

| | |
|---|---|
| Personal Services | $ 11,545 |
| Indirect Costs | $ 5,477 |
| Travel | $ 6,480 |
| Contractual | $223,600 |
| Miscellaneous Costs | $ 8,000 |
| Total | $255,102 |

Total FY91 Phase I and II Costs

| | |
|---|---|
| Phase I | $ 52,016 |
| Phase II | $255,102 |
| Grand Total | $307,118 |

III. Phase II (Sampling and Analysis) - FY 92
(October 1, 1991 through September 30, 1992)

A. <u>Personal Services</u>

- Personnel Costs

| | |
|---|---|
| 1 Sanitarian II @ 2042/month for 12 months | $ 24,504 |
| Fringe Benefits (17.95% of Personnels Costs) | $ 4,398 |
| Total Personnel Costs | $ 28,902 |
| Indirect Costs (42% of Personal Services less group insurance) | $ 11,624 |
| Total | $ 40,526 |

B) Travel

| | |
|---|---|
| Lodging (2 individuals) 15 days @ 50/day | $ 1,500 |
| Per diem (2 individuals) 25 days @ 24/day | $ 720 |
| (1 individual) 30 days @ 14/day | $ 420 |
| Mileage (3 individuals to and from Granite City and necessary driving) 2500 miles @ 24/mile | $ 600 |
| Airfare (2 individuals) roundtrip to Atlanta from Springfield, IL @ 50/each | $ 1,000 |
| Total | $ 4,240 |

C) Contractual

- Personnel

| | |
|---|---|
| 1 Principal Investigator @ 125/hour for 500 hours | $ 62,500 |
| 1 Co-Principal Investigator @ 85/hour for 500 hours | $ 42,500 |
| 2 Environmental Sample Field Managers @ 40/hour for 200 hours | $ 8,000 |
| 1 Administrative Assistant @ 15/hour for 400 hours | $ 6,000 |
| 1 Secretary/Word Processor @ 10/hour for 400 hours | $ 4,000 |
| 4 Data Entry Clerks @ 10/hour for 300 hours | $ 12,000 |
| Subtotal | $ 35,000 |
| Fringe Benefits (subsumed in hourly rate paid to contractual workers) | $ 0 |

- Travel

| | |
|---|---|
| Airfare (2 professionals) 4 roundtrips between Washington D.C. and St. Louis/Atlanta @ 1000 each | $ 8,000 |
| (1 professional) 4 roundtrips between San Francisco and St Louis/Atlanta @ 1000 each | $ 4,000 |
| Lodging (3 professionals) @ 50/day for 20 days | $ 3,000 |
| Per diem (3 professionals) @ 24/day for 20 days | $ 1,440 |
| Rental Car (2) @ 50/day for 20 days | $ 2,000 |
| Subtotal | $ 18,440 |

- Miscellaneous Costs

| | |
|---|---|
| Printing | $ 1,500 |
| Overnight Mail/Postage | $ 2,000 |
| Telecommunications | $ 2,500 |
| Follow-up Laboratory Sampling and Analysis | $ 20,000 |
| Supplies | $ 1,680 |
| Subtotal | $ 27,680 |

- General and Administrative Costs - 25% of Total contractual obligaitons $ 45,280

D) Miscellaneous Costs

| | |
|---|---|
| Mailing | $ 500 |
| Telecommunications | $ 500 |
| Supplies (Paper) | $ 250 |
| Total | $ 1,250 |

Total FY92 Phase II Costs

| | |
|---|---|
| Personal Services | $ 28,902 |
| Indirect Costs | $ 11,624 |
| Travel | $ 4,240 |
| Contractual | $226,400 |
| Miscellaneous Costs | $ 1,250 |
| Grand Total | $272,416 |

| | Phase I (FY91) | Phase II (FY91) | Phase II (FY92) | Total |
|---|---|---|---|---|
| Personal Services | $ 6,602 | $ 11,545 | $ 28,902 | $ 47,049 |
| Indirect Costs | $ 2,656 | $ 5,477 | $ 11,624 | $ 19,757 |
| Travel | $ 4,024 | $ 6,480 | $ 4,240 | $ 14,744 |
| Contractual | | | | |
| Personnel | $ 37,184 | $129,500 | $135,000 | $301.684 |
| Travel | $ 0 | $ 26,380 | $ 18,440 | $ 44,820 |
| Misc. Costs | $ 0 | $ 23,000 | $ 27,680 | $ 50,680 |
| Admin. Costs | $ 0 | $ 44,720 | $ 45,280 | $ 90,000 |
| Miscellanous Costs | $ 1,550 | $ 8,000 | $ 1,250 | $ 10,800 |
| Totals | $ 52,016 | $255,102 | $272,416 | $579,534 |