SHIELDALLOY METALLURGICAL CORPORATION

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Docket 40-7102
License SMB-743

June 29, 1993

Mr. Chuck Ameigh, Acting Chief
Licensing Branch
Division of Fuel Cycle Safety and Safeguards
U.S. Nuclear Regulatory Commission, MS4E4
Washington, DC 20555

Certified Mail: P 284 354 829
Return Receipt Requested

RE: Environmental Assessment Questions for SMB-743 Renewal

Dear Mr. Ameigh:

Enclosed please find the requested environmental information, pursuant to Ms. Elinor Adensam's letter to Shieldalloy Metallurgical Corporation (SMC) dated May 5, 1993. As directed by Ms. Adensam, SMC has provided the information specified in the bold print of the annotated outline. SMC's reply includes information from various government agencies and SMC records and reports. The following information is referenced according to that section of the annotated outline from which it was requested.

I believe this additional information should provide the NRC with sufficient data to complete the environmental assessment. If there are any questions concerning this submittal, please contact me at the above number.

Sincerely,

Craig R. Rieman

Craig R. Rieman
Radiological Safety Manager

CRR:sae
CC: w/o attachments
Steven N. Rappaport, SMC
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PDR ADOCK 04007102
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drawings located in files

1.3. Interaction with Other Agencies

SMC has requested records of consultation from the NJDEPE concerning operating permits regarding the Clean Air Act and Clean Water Act but has not received replies as of the date of this letter. Included in Attachment A is a copy of SMC's Administrative Consent Order with the NJDEPE signed in 1988 and amended in 1992. These documents describe SMC's ongoing CERCLA investigation.

2.1. Site Location

An aerial map has been enclosed in Attachment B. This map is a photocopy of a section of a U.S. Geological Survey 7.5 Minute Newfield Quadrangle map.

2.2. Demography

Census statistics are provided in Attachment C. In this Attachment you will find as Section 1 the 1980 population distribution data, in four polar sectors to a distance of 80 km. This data was taken from the USEPA's GEMS program. Section 2 contains resident population statistics for Cumberland and Gloucester County municipalities as provided by the U.S. Department of Commerce. Section 3 contains population and housing data for the land area within 50 miles of SMC. The data is circular and is grouped in radii from 0-0.5 mile, 0.5-1 mile, 1-5 miles, 5-10 miles, 10-25 miles and 25-50 miles. The state codes shown in Section 3 are as follows:

State 34:	New Jersey
State 10:	Delaware
State 24:	Maryland
State 42:	Pennsylvania

The county codes are as follows:

County 10001:	Kent
County 10003:	New Castle
County 10005:	Sussex
County 24011:	Caroline
County 24015:	Cecil
County 24029:	Kent

County 24035:	Queen Annes
County 34001:	Atlantic
County 34005:	Burlington
County 34007:	Camden
County 34009:	Cape May
County 34011:	Cumberland
County 34015:	Gloucester
County 34021:	Mercer
County 34025:	Mamouth
County 34029:	Chester
County 34033:	Salem
County 42017:	Bucks
County 42045:	Delaware
County 42091:	Montgomery
County 42101:	Philadelphia

2.3.1. Current Land Use

The aerial map found in Attachment B may also be used for this requested information. In addition, land use zoning maps are found in Attachment D. The City of Vineland zone map, a Vineland Tax Map Key are included with enlargements of sections 5, 7 and 9 provided because of their proximity to SMC. These maps have been utilized to determine land use in the SMC vicinity. Also included is a Newfield Borough Master Land Use Plan zone map and a National Wetlands Inventory map for Newfield, NJ.

2.3.2. Cultural Resources

SMC requested from the National Park Service a complete listing of all sites listed on the National Register of Historic Places within Gloucester and Cumberland Counties of New Jersey. Enclosed as Attachment E is a copy of this information as received from the U.S. Department of Interior, National Park Service, P.O. Box 37127, Washington, D.C. 20013-7127.

2.4.3. Seismology

Attachment F contains a chronological data chart of seismic activity from March 17, 1800 to February 26, 1992 for the land area within 50 miles of SMC. Also included is a map depicting epicenters of known magnitudes occurring in south-central New Jersey between March 17, 1800 and February 26, 1993. The information in this attachment was provided by the U.S. Geological Survey, National Earthquake Information Center.

2.5.1. Surface Water

Attachment G includes two SMC site drawings which depict SMC's three discharge outfalls.

2.5.2. Groundwater

Hydraulic conductivity values have been determined for the Newfield facility. These values have been determined during various phases of the CERCLA investigation. Pages 48 and 49 of the "Remedial Investigation Technical Report"[1] provides calculations and values of the hydraulic conductivity. SMC believes the NRC was provided a copy of this report without appendices during the NRC's site visit to SMC on February 19, 1993. However, photocopies of pages 48 and 49 have been provided in Attachment H. In addition, enclosed with this letter report is a copy of the "Final Focused Feasibility Study Report Groundwater Remediation"[2]. Appendix B of this report provides groundwater modeling information.

2.6. Meteorology and Climatology

SMC ordered from the National Climatic Data Center STAR data for the Millville, NJ Airport from 1987-1990 including:

1. Normal 24 hour data, combined-multiple year data on 3.5 inch disc and,

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1 TRC Environmental Corporation's "Remedial Investigation Technical Report", Project No. 7650-N51, Windsor, Connecticut, April, 1992.

2 TRC Environmental Corporation's "Final Focused Feasibility Study Report Groundwater Remediation", Project No. 13248-N51, Windsor, Connecticut, April, 1993.

2. Nighttime STAR data (midnight to noon) tabulation on 3.5 inch disc.

The 3.5 inch computer disc containing this information is found in Attachment I.

2.8.3. Endangered Species

Attachment J includes a current listing (2/93) of the Federally Listed Endangered, Threatened and Candidate Species in New Jersey. This listing was obtained from the U.S. Department of Interior; Fish and Wildlife Service, Ecological Services; P.O. Box 354; Absecon, NJ 08201.

3.1. The Facility and 3.2.1. Material Receipt

Attachment K contains a current SMC site map (Figure 1) which identifies areas of source material storage and processing and the storage of NRC-regulated slags and dusts. Also included in Attachment K are floor plans of warehouses A and G (D203A and D203G) and the production areas, Departments 111 and 102 (D111 and D102). A map of the storage yard (Figure 2) is also provided to show where various slags and materials are stored. Floor plans for the baghouses are unavailable.

The following information is provided to detail the receipt of pyrochlore from SMC's supplier in Canada and its movement within SMC.

> SMC takes possession of the pyrochlore in St-Honore, Cte-Dubuc, Quebec and provides exclusive-use truck transportation for the material. Each truckload of pyrochlore contains 13 supersacks of material weighing approximately 1450 kg. each. Thirteen supersacks of pyrochlore make up one lot which therefore consists of approximately 18,850 kg. These supersacks are located in double rows (except for the 13th supersack) on the floor of the enclosed trailer. The receipt of pyrochlore for 1991 and 1992 was 118 and 119 lots respectively. SMC receives about 10 lots per month of pyrochlore from Canada. These shipments enter the United States through customs in Champlain, New York and travel through New York State into New Jersey where their arrival at the SMC gatehouse is announced by SMC security to warehouse personnel.

Figure 3 in Attachment K shows the movement through the SMC facility. Shipments of pyrochlore are received at SMC by verifying the truck's gross weight on the SMC truck scale before unloading at Warehouse G (D203G). Supersacks are removed from the trucks by forklifting the sacks through their attached handling loops. The supersacks are then palletized and computer label bar-coded as they are entered into the SMC inventory system. The process of palletizing and inventorying requires the supersacks to be in D203G for only a few hours at most. Supersacks are transferred from D203G to Department 111 (D111) for storage before processing. SMC typically stores a one month inventory or approximated 10 lots (188,500 kg.) of pyrochlore in D111 storage. This inventory quantity varies depending on production and shipping schedules.

The next movement of pyrochlore is involved with the production of FeCb. The FeCb process description is provided on pages 15 and 16 of SMC's report "Applicant's Environmental Report for the Newfield, New Jersey Facility". FeCb slag generated during the production process is separated from the FeCb alloy button by use of a hydraulic hammer within D111. The force of the hammer on the slag/alloy interface cracks the slag into smaller, more manageable pieces of slag. FeCb slag is then transferred from D111 to the SMC storage yard where it is stockpiled with existing FeCb slag. One batch of FeCb production generates approximately 5100 kg of slag. FeCb production typically results in three or four batches each day of production. The handling of the FeCb baghouse dusts is described in Section 4.1 Gaseous Discharges.

3.2.3. Material Processing

The D111 floor plan can be found in Attachment K.

4.1. Gaseous Discharges

Attachment L contains a flowchart of the ferrocolumbium production in D111. This flow diagram shows three activities of the production line which potentially produce fugitive emissions of effluents (e.g. dusts). Fugitive emission point 1 (F1) is created during infrequent releases of fugitive particulates from the D111 FeCb

baghouse system. These releases are caused by failures in the baghouse capture system and usually result in releases lasting 5 - 15 minutes in length before they are controlled. Therefore an estimated average quantity of particulates released from D111 would be approximately 5 kg. per release. This estimate is based on visual observations, length of releases and the known weight of D111 - generated baghouse dusts.

Emission point F2 and F3 result from the transfer of FeCb baghouse dust and slag to the SMC storage yard. The transfer of FeCb slag from D111 to the storage yard is accomplished by scooping the slag in a front-end loader. This method can result in small quantities of dusts from the D111 floor being scooped and transferred to the FeCb slag pile where most dust likely accumulates in the void space of the slag pile. However, based on visual observations, it is estimated that less than 100 g. of dusts are fugitively released during this transfer and that smaller amounts (<30 g.) migrate due to wind transport.

Fugitive emission point F3 may be created as a result of the transfer of baghouse dusts from the dust storage site to the storage yard. The following discussion describes the handling of dusts captured during FeCb production.

The production of FeCb results in the production of dusts and fumes which are captured and collected in two distinct baghouse filter systems. The operation of these baghouse systems is described on page 17 of SMC's Environmental Report dated October 27, 1992. These baghouses are maintained on both a scheduled and an as-needed basis. Maintenance is performed on the baghouses each month to ensure proper performance. In addition, in the event of a malfunction of a baghouse, inspection and maintenance activities are performed. Inspection activities include leak testing all filters within the baghouse with a fluorescent powder and a black light to detect faulty filters. Maintenance activities include visual inspection of the volume of baghouse dusts, routine changes of air filters and upkeep of fan motors and electrical switches.

The Flex-Kleen baghouse stack is equipped with three in-line particulate monitors. These triboflow monitors are adjusted to detect increases in particulate flow through the stack by measuring triboelectrical charges in the stream. These monitors alarm in the furnace operator's control room and initiate the shut down of production to allow for a leak test inspection by the D111 operators. The baghouse is then shut down and leak tested, and air filters are replaced as appropriate. After all baghouse filters have been leak tested to ensure no fugitive emissions, the triboflow monitors are adjusted so that any additional particulate in the stack will be

detected. In the 2½ year period from January 1991 to June 1993, SMC has replaced 260 of the total of 2340 air filters in the two baghouses. These replacements are a result of 26 inspections or alarms which indicated a need to replace air filters.

Both the AAF and Flex-Kleen baghouses are continuous cleaning devices. The AAF baghouse is composed of six individual compartments each with 90 air filters. Five compartments function as each compartment is cycled through a cleaning mode by reversing air jets in a chamber which dislodges the accumulated dusts on the filters. Dusts are then conveyed by a vacuum system from the bottom of the cleaned chamber and deposited in the baghouse silo.

The Flex-Kleen baghouse is also a continuous cleaning device which empties into the common baghouse silo. The Flex-Kleen consists of two compartments each with 900 air filters for a total of 1800 filters. Cleaning of the air filters is accomplished by a pulsing air stream on the downstream side of the air filter. This pulsing action displaces the accumulated dusts on the air filter allowing the dust to settle in the bottom of the baghouse in hoppers. The bottom of each hopper is sealed by a pneumatically controlled valve. Each valve is automatically opened and closed in a sequence programmed into an automatic timer. During the interval that the valve is open, an electric vibrator attached to the hopper is activated to insure that all material in the hopper is carried into the discharge line. Once in the discharge line, dusts are transferred via a vacuum system to the common silo.

The baghouse silo collects baghouse dusts for approximately ten days of FeCb production. Each batch process of FeCb generates between 700-800 kg. of baghouse dust. There is typically three or four batches of FeCb fired in a 24 hour period. Therefore between 2100 and 3200 kg of baghouse dust is accumulated. The silo has a capacity of 2310 ft^3 and is periodically, manually inspected to determine the volume of stored dusts. Collected material is discharged from the silo through a vibrating bin activator. Dusts egress through a remote-controlled loading spout which is equipped with a flexible extension trunk. This trunk is encased with a larger flexible tube which contains a vacuum system to capture discharged fugitive dusts. The complete trunk unit is lowered to a covered dump truck modified with a hatch to attach the trunk. Dusts are then emptied into the dump truck and transported to the SMC storage yard.

Once in the storage yard, the dump truck empties the dusts on the existing baghouse dust pile also known as the lime pile because of the similarities of the dust with lime. During the transfer of the dusts from the dump truck, D111 operators thoroughly mist the dusts with a water mist to control fugitive dust emissions. Although this method of dust control eliminates the vast majority of potential fugitive emissions, some dust may escape the misting water. Fugitive emission point F3 is

identified on the D111 flow diagram and is believed to produce at most 2 kg of fugitive effluent during the complete emptying of the silo. This estimate is based on visual observations and the known mass of the dust.

Once the complete dump truck load of dusts is emptied, the unloaded dusts and surrounding area are misted with water. This additional misting allows the baghouse dust to form a self-hardened crust which prevents future wind borne emissions. In addition, SMC periodically covers the baghouse dust pile with a cement-like (e.g. gunite) material. This method avoids possible degradation and movement of the baghouse dusts until final disposition of the dusts is determined.

4.3. Solid Waste

The following chart provides quantities of FeCb standard , FeCb high ratio, CbNi tech, CbNi tech refractory, Columbite slags and FeCb baghouse dust in storage, amount generated in 1992, and the amount expected to be generated in 1993:

Slag	Kgs Inventory	Kgs Generated 1992	Kgs Generated 1993 (expected)
FeCb Std.	5×10^7	3×10^6	3×10^6
FeCb H.R.	6×10^6	4×10^4	0 **
CbNi Tech	2×10^5	2×10^4	0 **
CbNi Tech Refractory	2×10^5	*	0 **
Columbite	1×10^6	0	0 **
FeCb Baghouse Dust	5×10^6	3×10^5	3×10^5

* CbNi tech refractory was generated as a result of CbNi tech commingling with a chromium slag refractory. This commingling of NRC-regulated material occurred over many years as the refractory was continuously reused. SMC does not expect any additional amount of this material to be generated.

** SMC does not expect to produce these products and consequently their slag in the foreseeable future because of market conditions.

The radionuclide concentrations of all the NRC-regulated slags is estimated to be similar throughout the different types of slags because of the use of the same source of pyrochlore in each of the processes. The range of thorium-232 in slag is from approximately 50 pCi/g to 1600 pCi/g while uranium-238 is from 100 to 800 pCi/g. The radionuclide concentrations in the baghouse dusts range from 40 to 140 pCi/g of Th-232 and 10 to 140 pCi/g of U-238. The radiological concentrations have been determined by both ORAU[3] and SMC.

A description of the amount generated in a 24 hour period and the handling of the slags and baghouse dusts can be found in the response to Section 4.1. Gaseous Discharges. That response describes the process of the stabilization of the baghouse dust. Because the various slags exist in a vitrified state and have a very low leachability[4], they are stored in identified piles in the SMC storage yard. These slags along with all NRC-regulated wastes generated by SMC are stored indefinitely on-site in the storage yard.

SMC also stores the following slags in the storage yard:

Slag	Inventory (Kg)
FeV	8×10^7
FeCb High Purity	6×10^6
NiV	9×10^2
CbNi High Purity	3×10^4
FeB	2×10^4
80% FeV	9×10^3

[3]Oak Ridge Associated Universities "Radiological Survey of the Shieldalloy Metallurgical Corporation, Newfield, New Jersey Facility", July, 1988.

[4]Teledyne Isotopes, Inc. "Report of Leachability Study", March 1992.

These slags were not generated with the addition of any NRC-regulated source material. SMC has identified markets for most of these slags. Therefore, these inventories have steadily decreased. Although radionuclide concentrations for most of these slags are unavailable, extensive radiological analysis of the FeV slag has been performed. The radiological analysis of the FeV slag shows U-238 concentrations from 1-9 pCi/g and Th-232 from 7-15 pCi/g.[5]

5.1.1. Airborne Effluents

Attachment K contains a diagram which depicts the locations of various slags and the FeCb baghouse dust within the SMC storage yard. These radiological sources include slag piles of FeCb standard grade, FeCb high ratio, FeCb columbite, CbNi tech refractory, CbNi tech grade and the FeCb baghouse dust pile. The closest residence from the center of the storage yard is 250 meters to the south of the storage yard. This determination was made by reviewing overhead photographs and scaled site drawings.

5.1.2. Liquid Effluents

Attachment M contains a SMC report titled "The Baseline Radiological Risk Assessment for the Hudson's Branch Watershed". This report was generated after off-site concentrations of thorium and uranium in soils were noted slightly in excess of background during a site-wide radiological assessment of the site.[6] In order to consider possible remedial action decisions, this baseline risk assessment was performed. Using very conservative assumptions (e.g. a farm family scenario building a house directly within the flood plain), a maximum radiation dose assessment was determined. The dose assessment was then factored to consider the risk of fatal cancer to a member of the hypothetical farm family. The risk of no action, which decreased significantly with time and distance from the 135 m^2 area of interest, was determined to be 1.77×10^{-6}.

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[5]Hilbert Associates, Inc. "Final Project Report Survey and Sampling Program for FeV Slag Project No. V40-01 at the Shieldalloy Corporation, Newfield, New Jersey", and

Hilbert Associates, Inc. "Final Project Report Survey and Sampling Program for FeV Slag Project No. V40-02 at the Shieldalloy Corporation, Newfield, New Jersey".

[6]Berger, C.D., K. Wiggins, H. Pritchard, and A. Chance "Assessment of Environmental Radiological Conditions at the Newfield Facility", IT Corporation Report No. IT/NS-92-106, May, 1992.

5.2.1. **Operational Releases to the Atmosphere** and 5.2.2. **Operational Releases of Liquid Effluent**

SMC has been requested to provide a statement of compliance with Air Quality Permits and Water Quality Permits. In order to document SMC's compliance record, a request was made of the New Jersey Department of Environmental Protection and Energy to provide records of inspections or investigation. A copy of this letter can be found in Attachment N. As of the date of this letter, SMC has not received a reply from the NJDEPE.

6.2.1. **Atmospheric Monitoring**

Attachment O contains a SMC report titled "Radiation Dose Estimates for Members of the General Public at the Newfield, New Jersey Facility". This report provides an analysis of the routine annual average atmospheric releases of radioactivity from the Newfield facility. The calculations provided in this report are presented to show compliance with 10 CFR20.1302 and with annual dose limits set in 10CFR20.1301. These off-site dose estimates to the hypothetical maximally-exposed individual are in lieu of on-site and off-site monitoring systems for air emissions which is allowed by 10CFR20.1302.

ATTACHMENT C

SECTION 1

POPULATION DATA FOR SHIELDALLOY METALLURGICAL CORP.
NEWFIELD, NJ (ZIPCODE 08344)

LATITUDE 39:32:58	LONGITUDE 75:1:30		1980 POPULATION
KM	0-40	40-80	SECTOR TOTALS
S1	518,565	3,800,750	4,319,315
S2	54,541	235,943	290,484
S3	100,574	120,115	220,689
S4	76,873	644,244	721,118
RING TOTALS	750,553	4,801,053	5,551,606

The total population from the 1980 census for the area is 5,551,606. the area was divided into two rings; 40 km and 80 km from the center. Each ring was divided into 4 sectors (S 1 - S 4), starting at the northern axis of a polar grid.

ATTACHMENT A

Let's protect our earth

State of New Jersey
DEPARTMENT OF ENVIRONMENTAL PROTECTION
DIVISION OF HAZARDOUS WASTE MANAGEMENT

Michele M. Putnam
Deputy Director
Hazardous Waste Operations

John J. Trela, Ph.D., Director
401 East State St.
CN 028
Trenton, N.J. 08625-0028
(609)633-1408

Lance R. Miller
Deputy Director
Responsible Party Remedial Action

IN THE MATTER OF SHIELDALLOY METALLURGICAL CORPORATION AND METALLURG, INC.	: : :	ADMINSTRATIVE CONSENT ORDER

This Administrative Consent Order is entered into pursuant to the authority vested in the Commissioner of the New Jersey Department of Environmental Protection (hereinafter "NJDEP" or the "Department") by N.J.S.A. 13:1D-1 et seq. the Water Pollution Control Act, N.J.S.A. 58:10A-1 et seq., the Solid Waste Management Act, N.J.S.A. 13:1E-1 et seq., the Spill Compensation and Control Act, N.J.S.A. 58:10-23.11 et seq., and duly delegated to the Assistant Director for Responsible Party Cleanups of the Division of Hazardous Waste Management pursuant to N.J.S.A. 13:1B-4.

FINDINGS

1. Since 1951, Shieldalloy Metallurgical Corporation (hereinafter "Shieldalloy"), a subsidiary of Metallurg, Inc. (hereinafter "Metallurg"), has owned and operated a chromium alloy and specialty alloy manufacturing facility ("the facility") in Newfield, Gloucester County, New Jersey. The facility is located on 61.6 acres comprising Newfield Block 7, Lot 7; and Block 26, Lots 1, 4, 5, and 16 (hereinafter "the site").

2. Past practices at Shieldalloy, including the discharge of chromium contaminated wastewater from the wet air scrubber and the discharge of chromium contaminated waste water from a previous chromium oxide production operation into an unlined lagoon, have caused widespread groundwater contamination at and emanating from the site. This contamination has been documented by both Shieldalloy and the Department through routine ground water monitoring of monitor wells located both on and off-site.

3. Chromium is a pollutant as defined in the Water Pollution Control Act, N.J.S.A. 58:10A-1 et seq. Chromium is a hazardous constituent as defined under the Solid Waste Management Act (N.J.S.A. 13:1E-1 et seq.). Chromium is also a hazardous substance as defined under the Spill Compensation and Control Act, N.J.S.A. 58:10-23.11.

4. On September 5, 1984 NJDEP and Shieldalloy entered into an Administrative Consent Order (hereinafter "1984 ACO") calling for, in part, the conducting of a remedial investigation and feasibility study

(hereinafter "RI/FS") of remedial action alternatives to remedy the contamination at the facility and hydraulically downgradient thereof and is more particularly described in Paragraphs 18 and 19 of the 1984 ACO. This 1984 ACO is hereby incorporated by reference into this document in its entirety.

5. Remedial investigations conducted pursuant to the 1984 ACO led to the approval of a remedial action alternative in December of 1987. This alternative includes a total combined ground water pumping rate of 400 gallons per minute, 24 hours a day, seven days a week from three (3) pumping centers. Additionally, ground water investigations conducted pursuant to the 1984 ACO have indicated that this remedial action alternative must be initiated in a timely fashion as an interim remedial measure to ensure that an effective cleanup is achieved.

6. Remedial investigation and remedial action proposals submitted by Shieldalloy pursuant to the 1984 ACO have focused on remediation of the known off-site chromium contamination in groundwater. The Department has determined, based on a review of the submittals from Shieldalloy, that investigations conducted by Shieldalloy to date have not identified and remediated all on-site and off-site contamination.

7. There are nine (9) surface impoundments located on the property of Shieldalloy that the Department contends are subject to the requirements of N.J.A.C. 7:26-1 et seq. Of these nine (9) surface impoundments, seven of them, (i.e. B1, B2, B3, B5, B6, B11 and B12) have been used to treat and/or store waste waters and sludges that the Department contends are classified as EP Toxic for chromium, Hazardous Waste Number D007, pursuant to N.J.A.C. 7:26-8.12. The remaining two surface impoundments (B7 and B8) are currently under consideration by the Department for classification as non-hazardous waste impoundments. Data submitted to the Department by Shieldalloy indicate that basins B7 and B8 may be classified as non-hazardous. Studies performed by Shieldalloy (submittals of April 1985, April 1986 and October 1986) have shown that one or more of the nine (9) surface impoundments are leaking and Shieldalloy has concluded that these surface impoundments are contributing to the ground water contamination.

8. Shieldalloy discontinued the use of basins B1, B2, B3 and B5 on or about August 16, 1987. Shieldalloy intends to discontinue the use of basins B6, B7, B8, B11 and B12 in the future. Closure of all nine (9) basins will be regulated pursuant to New Jersey Pollutant Discharge Elimination System (hereinafter "NJPDES") permit NJ0004103.

9. To date, Shieldalloy has not yet fully investigated and remediated the chromium contamination at and emanating from the impoundments.

10. Ground water samples taken by Shieldalloy between April 1985, and October 1987 reveal the presence of volatile organic chemical contamination at the site and in areas downgradient of the site. Due to past volatile organic chemical use at the facility, the site is a source of volatile organic contamination of the groundwater. The Department's and Shieldalloy's data for volatile organic chemicals have revealed that there are higher concentrations of volatile organic chemicals outside the plume of

chromium contamination emanating from the Shieldalloy facility, suggesting sources of volatile organic chemical contamination other than Shieldalloy.

11. The Department contends that, to date, Shieldalloy has failed to fully investigate (specifically, on site and off site plume delineation and on-site source verification) and remediate the volatile organic contamination at and emanating from the site. However, volatile organic contamination present in ground water collected and discharged by the existing ground water remediation system has not caused any violations of discharge limits pursuant to NJPDES Discharge to Surface Water permit NJ0004103.

12. The Shieldalloy facility generates twelve (12) different types of slag, dross and bag house dust which it places in piles on the ground at the site. In the past, at least three of these piles were chromium slag generated from the aluminothermic production of chromium metal (hereinafter "chromium slag pile area"). These slag piles were composite sampled during a site inspection by Department personnel on February 10, 1987 and analyzed for EP toxicity parameters. At the time of inspection, green puddles of water surrounded all the freshly dumped chromium slag piles. One of the three chromium slag piles contained chromium in concentrations exceeding the EP toxicity limit and the Department contends is therefore a hazardous waste pursuant to N.J.A.C. 7:26-8.12. Therefore, the Department contends that Shieldalloy has and is currently storing hazardous waste in open piles in violation of N.J.A.C. 7:26-9.2. Further, the Department contends that Shieldalloy has and continues to operate a hazardous waste management facility without Department approval in violation of the Solid Waste Management Act N.J.S.A. 13:1E5, and the Hazardous Waste Regulations, N.J.A.C. 7:26-12.1(a). Shieldalloy denies that the chromium slag is a hazardous waste and denies that their practices are in violation of such statutes and regulations. Additionally, these issues are the subject of a pending Administrative Hearing request made by Shieldalloy in response to the Department's Administrative Order and Notice of Civil Administrative Penalty Assessment dated June 14, 1988.

13. To date, Shieldalloy has not fully investigated and remediated contamination at and emanating from the chromium slag pile area.

14. Shieldalloy has and continues to place the other 11 slags, drosses and bag house dusts on the ground (hereinafter "general slag area") which the Department contends is in violation of the Solid Waste Management Act N.J.S.A. 13:1E-1 et seq., specifically, the operation of a Solid Waste Management Facility without obtaining the required operating permits. Shieldalloy denies the Department's contentions, and denies that these materials are solid waste and asserts that some of these materials (i.e., electrofurnace bag house dust, standard ratio ferro-columbium slag and high ratio ferro-columbium slag) are subject to the exclusive jurisdiction of the Nuclear Regulatory Commission. These issues are the subject of a pending Administrative Hearing request made by Shieldalloy in response to the Department's Administrative Order and Notice of Civil Administrative Penalty Assessment dated June 14, 1988.

15. To date, Shieldalloy has not fully investigated and remediated contamination at and emanating from the general slag area.

16. Based on the facts set forth in these FINDINGS, the Department has determined that Shieldalloy has violated the Water Pollution Control Act, N.J.S.A. 58:10A-1 et seq., specifically N.J.S.A. 58:10A-6 and the regulations promulgated pursuant thereto, N.J.A.C. 7:14A-1 et seq., specifically N.J.A.C. 7:14A-1.2.

17. To determine the nature and extent of the problem presented by the discharge of pollutants at the Shieldalloy site and to develop environmentally sound remedial actions, it is necessary to conduct interim remedial measures alternatives (hereinafter "IRM"), and a remedial investigation and feasibility study (hereinafter "RI/FS") of remedial action for the site. Upon completion of the RI/FS, it will be necessary to implement a remedial action plan to correct the problems presented by the discharge of pollutants at the site.

18. To resolve this matter without the necessity for litigation, and without admitting any violation of law or any violation of the 1984 ACO, Shieldalloy has agreed to conduct an RI/FS and to implement the remedial action alternative selected by the Department and submitted to the United States Environmental Protection Agency (hereinafter "USEPA") for their approval pursuant to the Comprehensive Environmental Response, Compensation and Liability Act (42 USC 9601 et seq. hereinafter "CERCLA") and the Superfund Amendments and Reauthorization Act (hereinafter "SARA") to remedy all pollution at and/or emanating from the site.

19. The USEPA will be involved in the RI/FS and remedial action selection process. The USEPA will receive all documents prepared pursuant to this Administrative Consent Order. Comments made by the USEPA will be considered for incorporation into the Department's comments and transmitted to Shieldalloy. The Department will prepare a Record of Decision (hereinafter "ROD") based on the remedial action alternative selected by the Department. The Department will transmit the ROD to the Regional Administrator of the USEPA for signature.

ORDER

NOW, THEREFORE IT IS HEREBY ORDERED AND AGREED THAT:

I. Remedial Investigation and Cleanup

A. Interim Remedial Measures

20. Within the time limits specified below, Shieldalloy shall implement the following Interim Remedial Measures:

a. On or before February 15, 1989, begin start-up of the new 400 gpm ground water remediation system. The system shall be in operation 24 hrs/day and 7 days a week.

b. Within forty-five (45) calendar days after the effective date of this Administrative Consent Order, install a minimum of three (3) wells located downgradient of the chromium slag piles and upgradient of the new above ground treatment tanks. Within twenty

one (21) days after installation, but no sooner than fourteen (14) days after installation, these wells shall be sampled for Priority Pollutants +40. The locations of these wells must be approved by the Department prior to installation. Shieldalloy shall notify the Department at least two weeks prior to the date of installation to allow the Department the opportunity to be on-site at the time of installation.

c. Within thirty (30) calendar days after the effective date of this Administrative Consent Order, submit a report describing all past practices at the facility involving the use and disposal of volatile organic chemicals that could have contributed to ground water contamination.

d. Continue to operate the existing ground water remediation system as is presently operated until the new 400 gpm system is operational as required above.

e. Within thirty (30) calendar days after the effective date of this Administrative Consent Order commence storage of all newly generated chromium slag in the following manner:

1) Chromium slag shall be cooled in the building of creation and maintained there (the time for cooling and crushing shall not exceed thirty (30) calendar days) until such time as it is broken up and crushed to a suitable size.

2) After being crushed to a suitable size, the crushed chromium slag shall be placed in bulk bags of adequate strength to allow proper management of the chromium slag without impairment of the ability of the bulk bag to fully contain the crushed chromium slag including dust. Otherwise, the crushed chromium slag shall be placed in other enclosed containers capable of meeting the above requirements. The bulk bags and/or enclosed containers shall be stored inside a building with a concrete floor, or with other measures approved by the Department in writing to prevent soil contamination from occurring, until the time of shipment.

3) Shieldalloy shall comply with all applicable requirements of the Occupational Safety and Health Act (hereinafter "OSHA") during the handling of chromium slag.

Investigation and remediation of soil and ground water contamination at and emanating from the previous storage of chromium slag in piles shall be performed during the RI/FS and shall be performed in accordance with the procedures specified in paragraphs 21 through 36.

f. Investigation and remediation of soil and ground water contamination at and emanating from the general slag area shall be performed during the RI/FS and shall be performed in accordance with the procedures specified in paragraphs 21 through 36.

g. Shieldalloy shall incorporate the following sampling program into the monitoring program being conducted pursuant to paragraph 22(a) of the 1984 ACO:

1. Wells W2; SC 11S, SC 12S, SC 13S, A, and W3 (shallow) will be sampled quarterly for the first two calendar years following the date of execution of this Administrative Consent Order, and thereafter in accordance with subparagraph (c) of this paragraph.

   (a) For the first four quarters the ground water samples will be filtered in the field and both fractions analyzed for gross alpha activity. In the event that in any sample either the filtered solids or the filtrate indicate a level of gross alpha activity in excess of 5 picocuries per litre, that sample will be further analyzed for the radionuclides U-238; U-235; U-234; Th-232; Th-228; Ra-226:

   (b) After the first four quarters the results of the analyses will be reviewed jointly by the Department and Shieldalloy to determine whether the field filtration of the well samples is necessary and desirable and a decision will be made before the collection of the fifth series of quarterly samples whether or not to filter all subsequent samples in the field. The Department's decision shall control. If the decision is not to filter subsequent samples in the field, then the analytical program will continue based on total activity.

   (c) Quarterly sampling shall continue as specified in a and b above until four (4) consecutive quarterly sample results from all monitor wells show radioactivity less than 5 picocuries/litre unless Shieldalloy can show, to the satisfaction of Department, based on a comparison of sample results from upgradient and downgradient monitor wells, that the radioactivity is attributed to natural background conditions. If it is shown, to the Department's satisfaction, that radioactivity in excess of 5 picocuries/litre is attributed to natural background conditions or that no sample results exceed 5 picocuries/litre, then sampling will be reduced to a frequency of once a year. Samples collected at the yearly frequency shall be analyzed for gross alpha and beta activity and shall be analyzed for the specific isotopes referenced in subparagraph a above in the event that the level of gross alpha activity of the ground water exceeds 5 picocuries/litre.

3.. All samples will be analyzed for radionuclides in a USNRC approved laboratory.

4. Five copies of the results of the radioactivity analyses shall be sent to the Department within ninety (90) days of sampling.

B. Remedial Investigation

21. Within ninety (90) calendar days after the effective date of this Administrative Consent Order, Shieldalloy shall submit to the addresses specified in Paragraph 45 a detailed draft Remedial Investigation Work Plan (thereinafter the "RI Work Plan") in accordance with the scope of work set forth in Appendix A, and Appendices B and C, which are attached hereto and made a part hereof.

22. Within forty-five (45) calendar days after receipt of the Department's written comments on the draft RI Work Plan, Shieldalloy shall modify the draft RI Work Plan to conform to the Department's comments and shall submit the modified RI Work Plan to the addresses specified in Paragraph 45. The determination as to whether or not the modified RI Work Plan, as resubmitted, conforms to the Department's comments shall be made solely by the Department.

23. Upon receipt of the Department's written final approval of the RI Work Plan, Shieldalloy shall conduct the remedial investigation in accordance with the approved RI Work Plan and the schedule therein.

24. Shieldalloy shall submit to the addresses specified in Paragraph 45 a draft Remedial Investigation Report (hereinafter "RI Report") in accordance with Appendix A III A through E and the RI Work Plan and the schedule therein.

25. If upon review of the draft RI Report the Department determines that additional remedial investigation is required, Shieldalloy shall conduct additional remedial investigation as directed in writing by the Department and submit a second draft RI Report.

26. Within forty-five (45) calendar days after receipt of the Department's written comments on the draft or second draft (if applicable pursuant to the preceding paragraph) RI Report, Sheildalloy shall modify the draft or second draft RI Report to conform to the Departments comments and shall submit the modified RI Report to the addresses specified in Paragraph 45. The determination as to whether or not the modified RI Report, as resubmitted, conforms with the Department's comments shall be made solely by the Department.

C. Feasibility Study

27. Within sixty (60) calendar days after receipt of the Department's written final approval of the RI Report, Shieldalloy shall submit to the addresses specified in Paragraph 45 a draft Feasibility Study Work Plan (hereinafter, "FS Work Plan") in accordance with the scope of work set forth in Appendix D which is attached hereto and made part hereof.

28. Within forty-five (45) calendar days after receipt of the Department's written comments on the draft FS Work Plan, Shieldalloy shall modify the

draft FS Work Plan to conform to the Department's comments and shall submit the modified FS Work Plan to the addresses specified in Paragraph 45. The determination as to whether or not the modified FS Work Plan, as resubmitted, conforms to the Department's comments shall be solely by the Department.

29. Upon receipt of the Department's written final approval of the FS Work Plan, Shieldalloy shall conduct the feasibility study in accordance with the approved FS Work Plan and the schedule therein.

30. Shieldalloy shall submit to the addresses specified in Paragraph 45 a draft Feasibility Study Report (hereinafter "FS Report") in accordance with Appendix D III A through F and the approved FS Work Plan and the schedule therein.

31. Within forty-five (45) calendar days after receipt of the Department's written comments on the draft FS Report, Shieldalloy shall modify the draft FS Report to conform to the Department's comments and shall submit the modified FS Report to the addresses specified in Paragraph 45. The determination as to whether or not the modified FS Report, as resubmitted, conforms to the Department's comments shall be made solely by the Department.

D. Remedial Action

32. The Department will make the final selection of the remedial action alternative.

33. Within sixty (60) calendar days after receipt of the Department's written notification of remedial action alternative, Shieldalloy shall submit to the addresses specified in Paragraph 45 a detailed draft Remedial Action Plan in accordance with the scope of work set forth in Appendix E which is attached hereto and made a part hereof.

34. Within forty-five (45) calendar days after receipt of the Department's written comments on the draft Remedial Action Plan, Shieldalloy shall modify the draft Remedial Action Plan to conform to the Department's comments and shall submit the modified Remedial Action Plan to the addresses specified in Paragraph 45. The determination as to whether or not the modified Remedial Action Plan, as resubmitted, conforms to the Department's comments shall be made solely by the Department.

35. Upon receipt of the Department's written final approval of the Remedial Action Plan, Shieldalloy shall implement the approved Remedial Action Plan in accordance with the schedule therein.

E. Additional Remedial Investigation and Remediation

36. If the Department determines at any time that additional remedial investigation and/or remediation is required to protect human health or the environment, Shieldalloy shall conduct such additional activities as directed by the Department. Such additional activities shall be performed in accordance with the RI, FS and RA Work Plans contained in Appendices A through F.

F. Progress Reports

37. Shieldalloy shall submit to the Department quarterly progress reports; the first progress report shall be submitted on or before the 30th day of the month following the first full quarter after the effective date of this Administrative Consent Order. Each progress report, thereafter shall be submitted on or before the 30th day of the month following the quarter being reported. Each progress report shall detail the status of Shieldalloy's compliance with this Administrative Consent Order and shall include the following:

a. Identification of site and reference to this Administrative Consent Order;

b. Status of work at the site and progress to date;

c. Difficulties or problems encountered during the reporting period;

d. Actions taken or to be taken to rectify difficulties or problems;

e. Activities planned for the next reporting period;

f. Required and actual completion dates for each item required by this Administrative Consent Order;

g. An explanation of any non-compliance with the approved work plan(s), Remedial Action Plan or schedule(s);

h. All data collected, including quality assurance evaluations with supporting documentation, and field observations;

i. A discussion of performance evaluation of all remedial measures implemented to date.

II. Permits

38. Within forty-five (45) calendar days of receiving written notification from the Department, Shieldalloy shall apply for all necessary Federal, State and local permits for existing activities, except for the permits that will be the subject of a pending Administrative Hearing as specified in Paragraphs 12 and 14, and, where applicable, former activities, in accordance with the requirements of N.J.A.C. 7:14A-1 et seq., N.J.A.C. 7:26-1 et seq., and N.J.A.C. 7:27-8, and other applicable statutes and regulations. This requirement in no way effects Shieldalloy's responsibility to obtain, or to have obtained in the past, any required permits or approvals nor the Department's right to seek penalties or other relief due to Shieldalloy's failure to obtain the required permits or approvals.

39. Shieldalloy shall submit complete applications for all Federal, State and local permits required to carry out the obligations of this

Administrative Consent Order in accordance with the preceding paragraph and the approved time schedules.

40. Within sixty (60) calendar days of receipt of written comments concerning any permit application to a Federal, State or local agency, or sooner if required by the permitting agency, Shieldalloy shall modify the permit application to conform to the agency's comments and resubmit the permit application to the agency. The determination as to whether or not the permit application, as resubmitted, conforms with the agency's comments shall be made solely by the agency.

41. This Administrative Consent Order shall not relieve Shieldalloy from obtaining and complying with all applicable Federal, State and local Permits, as well as all applicable statutes and regulations while carrying out the obligations imposed by this Administrative Consent Order.

42. This Administrative Consent Order shall not preclude the Department from requiring that Shieldalloy apply for any permit or permit modification issued by the Department under the authority of the Water Pollution Control Act, N.J.S.A. 58:10A-1 et seq., the Solid Waste Management Act, N.J.S.A. 13:1E-1 et seq., and/or any other statutory authority for the actions this Administrative Consent Order requires Shieldalloy to undertake. The terms and conditions of any such permit shall not be preempted by the terms and conditions of this Administrative Consent Order even if the terms and conditions of any such permit are more stringent than the terms and conditions of this Administrative Consent Order.

III. Project Coordination

43. Shieldalloy shall submit to the Department all documents required by this Administrative Consent Order, including correspondence relating to force majeure issues, by certified mail, return receipt requested or by hand delivery with an acknowledgement of receipt form for the Department's signature. The date that the Department executes the receipt or acknowledgement will be the date the Department uses to determine Shieldalloy's compliance with the requirements of this Administrative Consent Order and the applicability of stipulated penalties.

44. Within seven (7) calendar days after the effective date of this Administrative Consent Order, Shieldalloy shall submit to the Department the name, title, address and telephone number of the individual who will be the Department's contact with Shieldalloy for all matters concerning this Administrative Consent Order. Shieldalloy shall contact the individual identified in the following paragraph for all matters concerning this Administrative Consent Order.

45. Shieldalloy shall submit the specified number of copies of all documents required by this Administrative Consent Order to:

(Four (4) Copies)
New Jersey Department of Environmental Protection
Division of Hazardous Waste Management
Melinda Dower, Chief
Bureau of Federal Case Management

CN-028
Trenton, New Jersey 08625

(Two (2) Copies)
U.S. Environmental Protection Agency, Region II
Site Compliance Branch
Emergency and Remedial Response Division
26 Federal Plaza
New York, NY 10278

(Two (2) Copies)
U.S. Environmental Protection Agency, Region II
New Jersey Facilities Section
Hazardous Waste Facilities Branch
Air and Waste Management Division
26 Federal Plaza
New York, NY 10278

46. Shieldalloy shall notify the Department in writing two weeks prior to the initiation of all field activities.

IV. Financial Requirements

A. Financial Assurance

47. Within twenty-one (21) calendar days after the effective date of this Administrative Consent Order, Shieldalloy shall submit to the Department a proposed irrevocable letter of credit which meets the following requirements:

a. Is identical to the wording specified in Appendix F which is attached hereto and made a part hereof;

b. Is issued for one year;

c. Is issued by a New Jersey or Federally chartered bank, savings bank, or savings and loan association.

48. Within twenty-one (21) calendar days after the effective date of this Administrative Consent Order, Shieldalloy shall submit to the Department a proposed irrevocable standby trust fund agreement which meets the following requirements:

a. Is identical to the wording specified in Appendix G which is attached hereto and made a part hereof;

b. The irrevocable standby trust fund shall be the depository for all funds paid pursuant to a draft by the Department against the letter of credit;

c. The trustee shall be an entity which has the authority to act as a trustee and whose trust operations are regulated and examined by a a Federal or New Jersey agency;

d. Is accompanied by a certification of acknowledgement that is identical to the wording specified in Appendix H.

49. Within fourteen (14) calendar days after receipt of the Department's written comments on the proposed letter of credit, the proposed trust agreement, and the proposed certification of acknowledgement, Shieldalloy shall modify the documents to conform to the Department's comments and resubmit them to the Department.

50. Within fourteen (14) calendar days after receipt of the Department's written approval of the letter of credit, the trust agreement, and the certification of acknowledgement, Shieldalloy shall:

a. Obtain and provides to the Department the irrevocable letter of credit in the amount of $8,000,000.00 (eight million dollars);

b. Establish the irrevocable standby trust fund and deposit an initial amount of $1,000.00 (one thousand dollars) into the irrevocable standby trust fund; and

c. Submit an originally signed duplicate of the trust agreement to the Department accompanied by the certification of acknowledgement.

51. Shieldalloy shall maintain the standby trust fund until terminated by the written agreement of the Department, the trustee and Shieldalloy, or of the trustee and the Department if Shieldalloy ceases to exist. Shieldalloy shall maintain the letter of credit until the Department returns the letter of credit to the issuing institution of termination. In the event that the Department determines that Shieldalloy has failed to perform any of its obligations under this Administrative Consent Order, the Department may draw on the letter of credit; provided, however, that before any draw can be made, the Department shall notify Shieldalloy in writing of the obligation(s) which it has not performed, and Shieldalloy shall have a reasonable time, not to exceed fourteen (14) calendar days, to perform such obligation(s).

52. At any time Shieldalloy may apply to the Department to substitute other financial assurances in a form, manner and amount acceptable to the Department.

B. <u>Cost Review</u>

53. Beginning three hundred sixty-five (365) calendar days after the effective date of this Administrative Consent Order and annually thereafter on that same calendar day, Shieldalloy shall submit to the Department a detailed review of all costs required for Shieldalloy's compliance with this Administrative Consent Order. This cost review shall include a detailed summary of all monies spent to date pursuant to this Administrative Consent Order, the estimated cost of all future expenditures required to comply with this Administrative Consent Order (including any operation and maintenance costs), and the reason for any changes from the previous cost review submitted by Shieldalloy.

54. At any time after Shieldalloy submits the first cost review pursuant to the preceding paragraph, Shieldalloy may request the Department's approval to reduce the amount of the letter of credit to reflect the remaining of performing its obligations under this Administrative Consent Order. If the Department grants written approval of the request, Shieldalloy may amend the amount of the then existing letter of credit.

55. If the estimated cost of meeting Shieldalloy's obligations in this Administrative Consent Order at any time exceed the amount of the letter of credit, Shieldalloy shall, within thirty (30) calendar days after receipt of written notice of the Department's determination, increase the amount of the then existing letter of credit so that it is equal to the estimated cost as determined by the Department.

C. Oversight Cost Reimbursement

56a. Within twenty-eight (28) calendar days after receipt from the Department of an itemized accounting of all costs incurred in connection with its oversight functions of this Administrative Consent Order for a fiscal year, or any part thereof, Shieldalloy shall submit to the Department a certified check payable to the "Treasurer, State of New Jersey" for the full amount of the Department's oversight costs.

b. For the purpose of this paragraph, oversight costs include, but are not limited to, hourly rates and hours worked by each individual and fringe benefits and overhead for monitoring Shieldalloy's compliance with this Administrative Consent Order; reviewing and presenting comments to Shieldalloy on materials submitted by Shieldalloy and conducting onsite inspections; sampling and analysis costs; and copy costs.

c. Shieldalloy agrees to pay oversight costs pursuant to this paragraph not to exceed $100,000 annually, on a calendar year basis. The Department reserves the right to seek recovery from Shieldalloy of any administrative costs in excess of $100,000.00. Shieldalloy is not agreeing to pay or that it is liable for administrative costs in excess of $100,000.00 for any calendar year.

D. Stipulated Penalties

57. Shieldalloy shall pay stipulated penalties to the Department for its failure to comply with any of the paragraphs in this Administrative Consent Order according to the following schedule, unless the Department has modified the compliance date pursuant to the force majeure provisions hereinbelow:

Calendar Days After Due Date	Stipulated Penalties
1 - 7	$ 100. per calendar day
8 - 14	500. per calendar day
15 - 21	1,000. per calendar day
22 - 28	2,500. per calendar day
29 - over	5,000. per calendar day

58. Any such penalty shall be due and payable fourteen (14) calendar days following receipt of a written demand by the Department. Payment of such stipulated penalties shall be made by cashier's or certified check payable to the "Treasurer, State of New Jersey". Each payment of a stipulated penalty shall include a letter describing the basis for the penalty.

V. Force Majeure

59. If any event occurs which Shieldalloy believes will or may cause delay in the achievement of any provision of this Administrative Consent Order, Shieldalloy shall notify the Department in writing within seven (7) calendar days of the delay or anticipated delay, as appropriate, referencing this paragraph and describing the anticipated length of the delay, the precise cause or causes of the delay, any measures taken or to be taken to minimize the delay, and the time required to take any such measures to minimize the delay. Shieldalloy shall take all necessary action to prevent or minimize any such delay.

60. If the Department finds that: (a) Shieldalloy has complied with the notice requirements of the preceding paragraph and; (b) that any delay or anticipated delay has been or will be caused by fire, flood, riot, strike or other circumstances beyond the control of Shieldalloy, the Department shall extend the time for performance hereunder for a period no longer than the delay resulting from such circumstances. If the Department determines that either Shieldalloy has not complied with the notice requirements of the preceding paragraph, or the event causing the delay is not beyond the control of Shieldalloy, failure to comply with the provisions of this Administrative Consent Order shall constitute a breach of the requirements of this Administrative Consent Order. The burden of proving that any delay is caused by circumstances beyond the control of Shieldalloy and the length of any such delay attributable to those circumstances shall rest with Shieldalloy. Increases in the cost or expenses incurred by Shieldalloy in fulfilling the requirements of this Administrative Consent Order shall not be a basis for an extension of time. Delay in an interim requirement shall not automatically justify or excuse delay in the attainment of subsequent requirements.

VI. General Provisions

61. This Administrative Consent Order shall be binding on Shieldalloy, its agents, successors, assignees and any trustee in bankruptcy or receiver appointed pursuant to a proceeding in law or equity.

62. Shieldalloy shall perform all work conducted pursuant to this Administrative Consent Order in accordance with prevailing professional standards.

63. Pursuant to the requirements of N.J.S.A. 45:8-27 et seq., all engineering drawings, land surveying, design and construction reports and any plan or specification involving professional engineering prepared by or on behalf of Shieldalloy under this Consent Order shall be signed and sealed by a New Jersey Licensed Professional Engineer or Land Surveyor or Registered Architect, or a Licensed Professional Engineer or Land Surveyor or Registered Architect as defined under N.J.S.A. 45:8-40, as the case may

be. In addition, pursuant to N.J.S.A. 45:8-41, all plans, specifications and estimates in the design, construction or maintenance of any public work involving professional engineering shall be made, and the construction and maintenance shall be supervised, by a Licensed Professional Engineer or a Registered Architect, and any work involving land surveying shall be performed only by a New Jersey Licensed Land Surveyor.

64. Shieldalloy shall conform all actions pursuant to this Administrative Consent Order with all applicable Federal, State, and local laws and regulations. Shieldalloy shall be responsible for obtaining all necessary permits, licenses and other authorizations.

65. All appendices referenced in this Administrative Consent Order, as well as the RI Report, the FS Report, and all other reports, work plans and documents required under the terms of this Administrative Consent Order are, upon approval by the Department, incorporated into this Administrative Consent Order by reference and made apart hereof.

66. Shieldalloy shall make available to the Department all data and information, including raw sampling and monitoring data, concerning pollution at and/or emanating from the site.

67. Shieldalloy shall make available to the Department all technical records and contractual documents maintained or created by Shieldalloy or its contractors in connection with this Administrative Consent Order.

68. Shieldalloy shall preserve, during the pendency of this Administrative Consent Order and for a minimum of six (6) years after its termination, all data, records and documents in their possession or in the possession of their divisions, employees, agents, accountants, contractors, or attorneys which relate in any way to the implementation of work under this Administrative Consent Order, despite any document retention policy to the contrary. After this six year period, Shieldalloy shall notify the Department within twenty-eight (28) days prior to the destruction of any such documents. If the Department requests in writing that some or all of the documents be preserved for a longer time period, Shieldalloy shall comply with that request. Upon request by the Department, the Shieldalloy shall make available to the Department such records or copies of any such records.

69. In order to assert a claim of confidentiality or privilege for any information submitted by Shieldalloy pursuant to this Administrative Consent Order, Shieldalloy must follow the procedures in N.J.A.C. 7:14A-11.1 et seq.

70. No obligations imposed by this Administrative Consent Order (with the exception of paragraph 57) are intended to constitute a debt, claim, penalty or other civil action which should be limited or discharged in a bankruptcy proceeding. All obligations imposed by this Administrative Consent Order shall constitute continuing regulatory obligations imposed pursuant to the police powers of the State of New Jersey intended to protect human health or the environment.

71. In addition to the Department's statutory and regulatory rights to enter and inspect, Shieldalloy shall allow the Department and its authorized representatives access to the site at all times for the purpose of monitoring Shieldalloy's compliance with this Administrative Consent Order provided that: (i) the Department or its representative seeking access to the facility shall endeavor to notify Shieldalloy's Project Coordinator upon their arrival at the facility, the Department or its representative shall give the Project Coordinator ninety (90) minutes to arrive at the facility during times other than normal business hours before proceeding with the inspection; (ii) the Department or its representatives shall comply with the applicable Worker Health and Safety Plan for the site; and (iii) the Department or its representative shall supply their own safety equipment.

72. The Department reserves the right to require Shieldalloy to take additional actions should the Department determine that such actions are necessary to protect human health or the environment. Nothing in this Administrative Consent Order shall constitutes a waiver of any statutory right of the Department pertaining to any of the laws of the State of New Jersey should the Department determine that such measures are necessary.

73. Shieldalloy shall not construe any informal advice, guidance, suggestions, or comments by the Department, or by persons action on behalf of the Department, as relieving Shieldalloy of its obligation to obtain written approvals as may be required herein, unless such advice, guidance, suggestion, or comments by the Department shall be submitted in writing to Shieldalloy.

74. No modification or waiver of this Administrative Consent Order shall be valid except by written amendment to this Administrative Consent Order duly executed by Shieldalloy and the Department.

75. Shieldalloy hereby consents to and agrees to comply with this Administrative Consent Order which shall be fully enforceable as an Order in the New Jersey Superior Court upon the filing of a summary action for compliance pursuant to N.J.S.A. 13:1D-1 et seq., the Water Pollution Control Act, N.J.S.A. 58:10A-1 et seq. and/or the Solid Waste Management Act, N.J.S.A. 13:1E-1 et seq.

76. Shieldalloy agrees not to contest the authority or jurisdiction of the Department to issue this Administrative Consent Order and also agrees not to contest the terms of this Administrative Consent Order in any action to enforce its provisions.

77. In any action brought by the Department to enforce this Administrative Consent Order, Shieldalloy reserves any rights it may have to defend itself including the right to assert the defense that the Department decisions were unreasonable, arbitrary or capricious. Further, Shieldalloy reserves any rights it may have to contest any requirements of permits issued by the Department, but only to the extent that such requirements are in addition to the requirements of this Administrative Consent Order.

78. Shieldalloy shall give written notice of this Administrative Consent Order to any successor in interest prior to transfer of ownership of Shieldalloy facilities which are the subject of this Administrative Consent

Order, and shall simultaneously verify to the Department that such notice has been given.

79. The Department recognizes that the site is regulated by the Nuclear Regulatory Commission, therefore, certain activities conducted pursuant to this Administrative Consent Order at this site may require the approval of the Nuclear Regulatory Commission in addition to the approval of the Department.

80. The Department agrees to provide an opportunity for Shieldalloy to meet with the Director of the Division in the Department responsible for monitoring Shieldalloy's compliance with this Administrative Consent Order concerning the Department's decision on any selection of a remedial/corrective action alternative and NJDEP's actions or determinations on RI/FS reports (Paragraphs 25, 31, 32 and 36), if Shieldalloy objects in writing to any NJDEP's actions or determinations made pursuant to this Administrative Consent Order, within ten (10) calendar days after receipt of such decision from NJDEP. NJDEP and Shieldalloy shall have ten (10) calendar days thereafter to meet with the Director to resolve the objection. After the meeting, NJDEP will provide to Sheildalloy a written statement of the reasons for its final decision.

81. The requirements of this Administrative Consent Order shall be deemed satisfied upon the receipt by Shieldalloy's of written notice from the Department that Shieldalloy has demonstrated, to the satisfaction of the Department, that all the terms of this Administrative Consent Order have been completed.

82. If the last day allowed by this Administrative Consent Order for the doing of any act falls on a Saturday, a Sunday, or a legal Federal or State holiday, the time allowed for such act will be extended to include the next day which is not one of the aforementioned days.

83. This Administrative Consent Order shall become effective upon the execution hereof by both parties.

State of New Jersey
Department of Environmental Protection and Energy
Division of Responsible Party Site Remediation
CN 028
Trenton, NJ 08625-0028

RECEIVED
AUG 21 1992
DEP. ENV. SERV.

Scott A. Weiner
Commissioner

Karl J. Delaney
Director

IN THE MATTER OF SHIELDALLOY METALLURGICAL CORPORATION AND METALLURG, INC.	: : :	SECOND AMENDMENT TO ADMINISTRATIVE CONSENT ORDER DATED 10/5/88

This Second Amendment to the Administrative Consent Order dated October 5, 1988 is entered into pursuant to the authority vested in the Commissioner of the New Jersey Department of Environmental Protection and Energy (hereinafter "NJDEPE" or the "Department") by N.J.S.A. 13:1D-1 et seq., the Water Pollution Control Act, N.J.S.A. 58:10A-1 et seq., the Solid Waste Management Act, N.J.S.A. 13:1E-1 et seq., the Spill Compensation and Control Act, N.J.S.A. 58:10-23.11 et seq., and duly delegated to the Assistant Director for Responsible Party Cleanups of the Division of Responsible Party Site Remediation pursuant to N.J.S.A. 13:1B-4.

FINDINGS

1. Since 1951, Shieldalloy Metallurgical Corporation (hereinafter "Shieldalloy"), a subsidiary of Metallurg, Inc. (hereinafter "Metallurg"), has owned and operated a chromium alloy and specialty alloy manufacturing facility ("the facility") in Newfield, Gloucester County, New Jersey. The facility is located on 61.6 acres comprising Newfield Block 7, Lot 7: and Block 26, Lots 1,4,5, and 16 (hereinafter "the site").

2. On October 5, 1988 the Department entered into an Administrative Consent Order (hereinafter "ACO") with Shieldalloy for remedial investigation and cleanup of the site. The ACO was amended for the first time on August 31, 1989. This Amendment shall serve as the second amendment to the ACO and is intended to govern the closure of basins B1, B2, B3, B5, B11, B12 and basins B6, B7 and B8.

ORDER

Amendments to Existing Paragraphs of the ACO

The following paragraphs of the ACO are amended as follows:

8. Shieldalloy discontinued the use of basins B1, B2, B3, and B5 on or about August 16, 1987. Shieldalloy has discontinued the use of basins B6, B7, B8, B11 and B12. Shieldalloy submitted the most recent Draft Closure Plan to the Department on November 24, 1989. Shieldalloy submitted the Lagoon Characterization Work Plan for Lagoons B6, B7, & B8 to the Department on April 21, 1992.

80. The Department agrees to provide an opportunity for Shieldalloy to meet with the Director of the Division in the Department responsible for monitoring Shieldalloy's compliance with this Administrative Consent Order concerning the Department's decision on any selection of a remedial/corrective action alternative and the Department's actions or determinations on RI/FS reports (paragraphs 25, 31, 32, 36) and closure plan submittals (paragraphs 84 through 87), if Shieldalloy objects in writing to any actions or determinations of the Department made pursuant to this Administrative Consent Order, within ten (10) calendar days after receipt of such decision from the Department. The Department and Shieldalloy shall have ten (10) calendar days thereafter to meet with the

director to resolve the objection. After the meeting, NJDEPE will provide to Shieldalloy a written statement of the reasons for its final decision.

New Paragraphs

The following heading and paragraphs supplement the ACO:

VIII. Basin Closure

84. Shieldalloy shall close all nine (9) basins in accordance with the terms and conditions of this Administrative Consent Order and as described in paragraphs 85 through 87, below.

85. Shieldalloy shall close basins B1, B2, B3, B5, B11 and B12 in accordance with the following schedule:

a. Within forty-five (45) calendar days after the effective date of this Amendment, Shieldalloy shall submit to the Department the Closure Plan for basins B1, B2, B3, B5, B11, and B12. The Closure Plan must include an implementation schedule.

b. Upon the Department's approval, Shieldalloy shall implement the Approved Closure Plan in accordance with the schedule therein.

86. Subject to paragraph 87, below, Shieldalloy shall close basins B6, B7 and B8 in accordance with the following schedule:

a. Upon the Department's approval, Shieldalloy shall implement the Approved Lagoon Characterization Work Plan in accordance with the schedule therein.

b. (1) Within one hundred twenty (120) calendar days of Lagoon Characterization Work Plan approval, Shieldalloy shall submit to the Department the Draft Treatability Study Work Plan.

(2) Within the time required by the schedule set forth in the approved Lagoon Characterization Work Plan Shieldalloy shall submit the Draft Lagoon Characterization Report.

c. Within forty-five (45) calendar days of receipt of the Department's comments, Shieldalloy shall submit the Revised Lagoon Characterization Report and Revised Treatability Study Work Plan that addresses the Department's comments.

d. Upon the Department's approval, Shieldalloy shall implement the Approved Treatability Study Work Plan in accordance with the schedule therein.

e. (1) Within the time required by the schedule set forth in the approved Treatability Study Work Plan, Shieldalloy shall submit to the Department the Draft Treatability Study Report.

(2) Within sixty (60) calendar days of Treatability Study Work Plan approval Shieldalloy shall submit the Draft Feasibility Study Work Plan.

f. Within forty-five (45) calendar days of receipt of the Department's comments, Shieldalloy shall submit the Revised Treatability Study Report and the Revised Feasibility Study Work Plan in accordance with the Department's comments.

g. Upon the Department's approval, Shieldalloy shall conduct the Feasibility Study in accordance with the schedule therein.

h. Within the time required by the schedule set forth in the approved Feasibility Study Work Plan, Shieldalloy shall submit to the Department the Draft Feasibility Study Report. The Feasibility Study Report shall include all post-closure requirements for the closure alternatives evaluated. Shieldalloy may propose a preferred closure alternative. Selection of the closure alternative shall be made by the Department.

i. Within forty-five (45) calendar days of receipt of the Department's comments, Shieldalloy shall submit the Revised Feasibility Study Report in accordance with the Department's comments.

j. Within forty-five (45) calendar days of Feasibility Study Report approval, Shieldalloy shall submit to the Department the Closure Plan for basins B6, B7, and B8.

k. Upon the Department's approval, Shieldalloy shall implement the approved Closure Plan in accordance with the schedule contained therein.

87. a. The Department recognized that Shieldalloy is exploring off-site disposal options for the contents of basins B6, B7, and B8, which options may either (1) render the completion of all the steps of paragraph 86 above unnecessary, or (2) allow simplification and foreshortening of the studies and activities required by paragraph 86 as prerequisites to the submission of the closure plan.

b. Therefore, at any time during the process described in paragraph 86 above, Shieldalloy may submit to the Department a closure plan (with an implementation schedule) which incorporates the off-site treatment and disposal of the contents of basins B6, B7, and B8. The submission of such a closure plan shall suspend the requirements of paragraph 86 above until the Department and Shieldalloy have completed the procedures set forth in the remainder of this paragraph 87.

c. As provided by N.J.A.C. 7:26-9.8(h), within 90 days of receiving this closure plan the Department shall approve, modify, or disapprove the closure plan pursuant to the Department's regulatory standards governing closure plans for surface impoundments, specifically including N.J.A.C. 7:26-9.8(b) and (e), and N.J.A.C. 7:26-10.6(h).

d. If the Department disapproves the plan, it shall provide Shieldalloy with a detailed written statement of reasons for the disapproval. Shieldalloy shall have the option of continuing with the steps set forth in paragraph 86 above, or submitting a modified plan for approval within 30 days of receiving the Department's statement of reasons for disapproval.

e. If Shieldalloy submits a modified plan, the Department will approve, modify or disapprove this plan in writing within 60 days of receipt.

f. If the Department modifies or disapproves this plan Shieldalloy shall have the option of continuing with the steps set forth in paragraph 86 above, or submitting a modified plan to conform to the Department's comments within 30 days of receiving the Department's comments.

g. If the Department disapproves the modified plan submitted in accordance with paragraph 87f above Shieldalloy shall be required to continue with the requirements of paragraph 86 above.

h. Upon receipt of the Department's approval of a closure plan under the provisions of this paragraph Shieldalloy shall implement the approved closure plan in accordance with the schedule contained therein.

88. All other provisions of this ACO remain in full force and effect unless specifically modified by this Amendment.

89. This Second Amendment to the Administrative Consent Order dated 10/5/88 shall become effective upon the execution hereof by both parties.

DEPARTMENT OF ENVIRONMENTAL PROTECTION AND ENERGY

Date: 9-11-92

By: Ronald T. Corcory
Ronald T. Corcory, Assistant Director
Responsible Party Cleanup Element
Division of Responsible Party Site Remediation

Shieldalloy Metallurgical Corporation

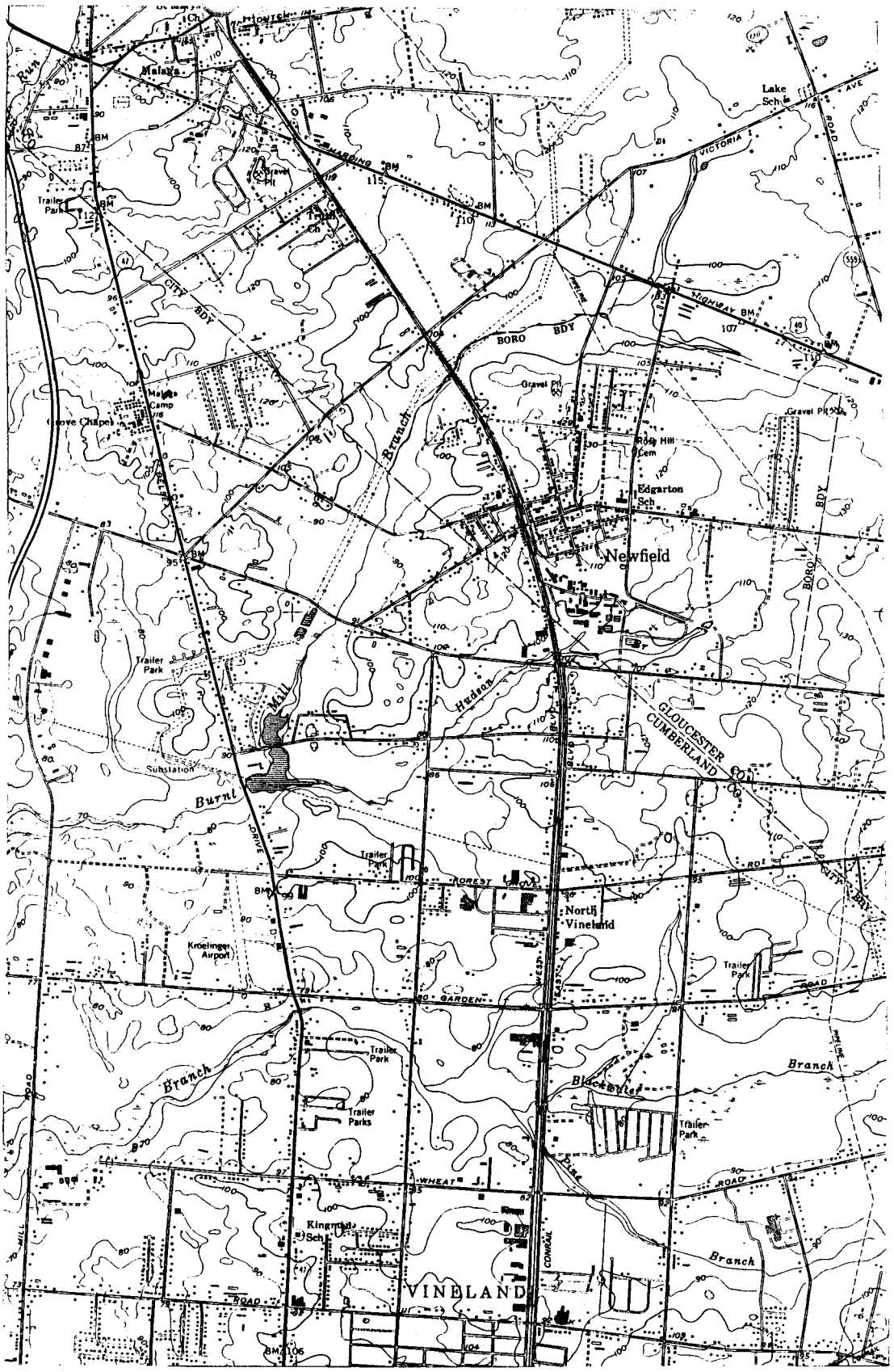
Date: 8/26/92

By: Richard D. Way

Name: Richard D. Way

Title: Senior Vice President, Manufacturing

ATTACHMENT B



NEWFIELD, N. J.
39075-E1-TF-024

1953
PHOTOREVISED 1986
DMA 5963 II SE-SERIES V822

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

NEWFIELD QUADRANGLE
NEW JERSEY
7.5 MINUTE SERIES (TOPOGRAPHIC)

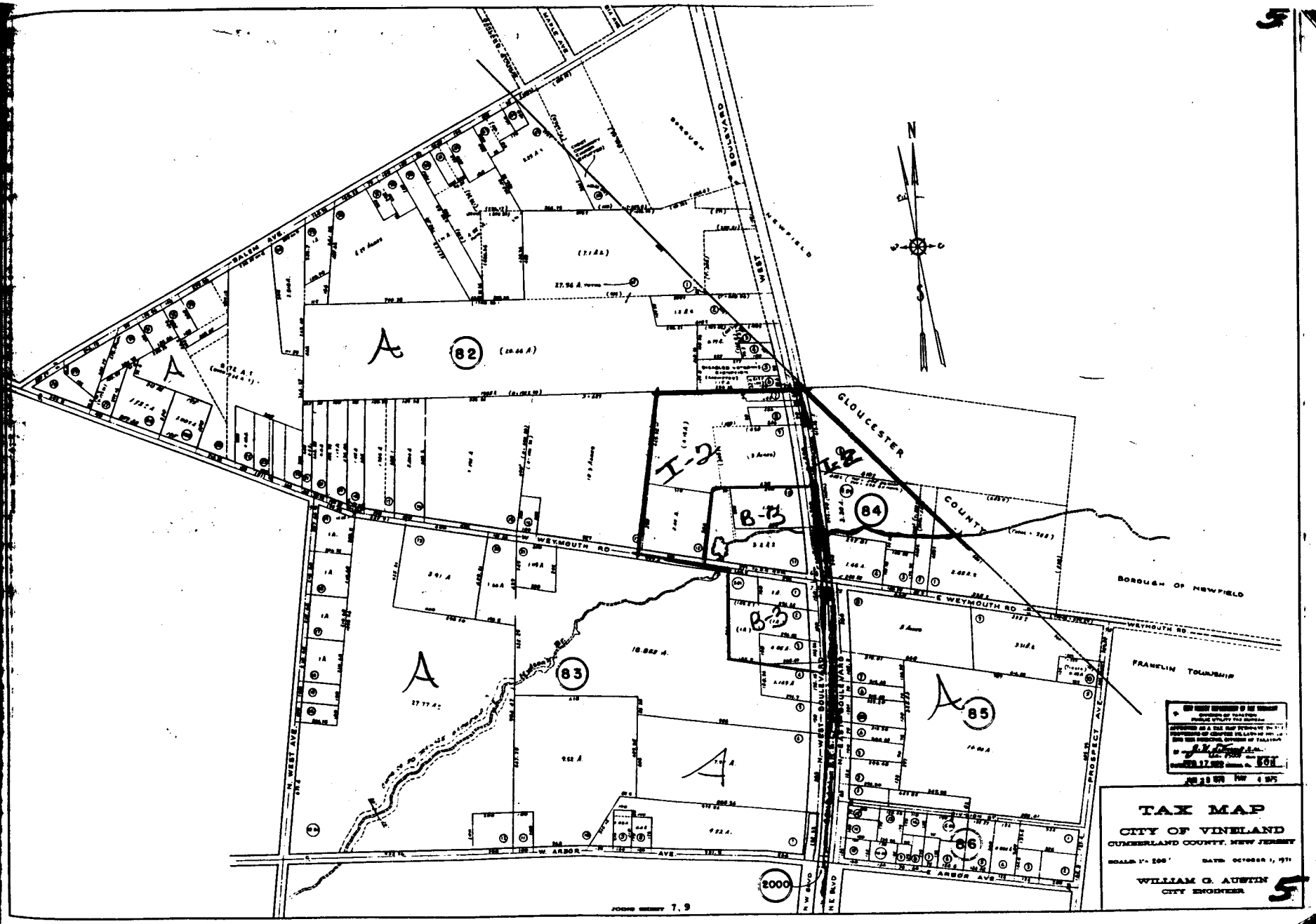
SCALE 1:24 000

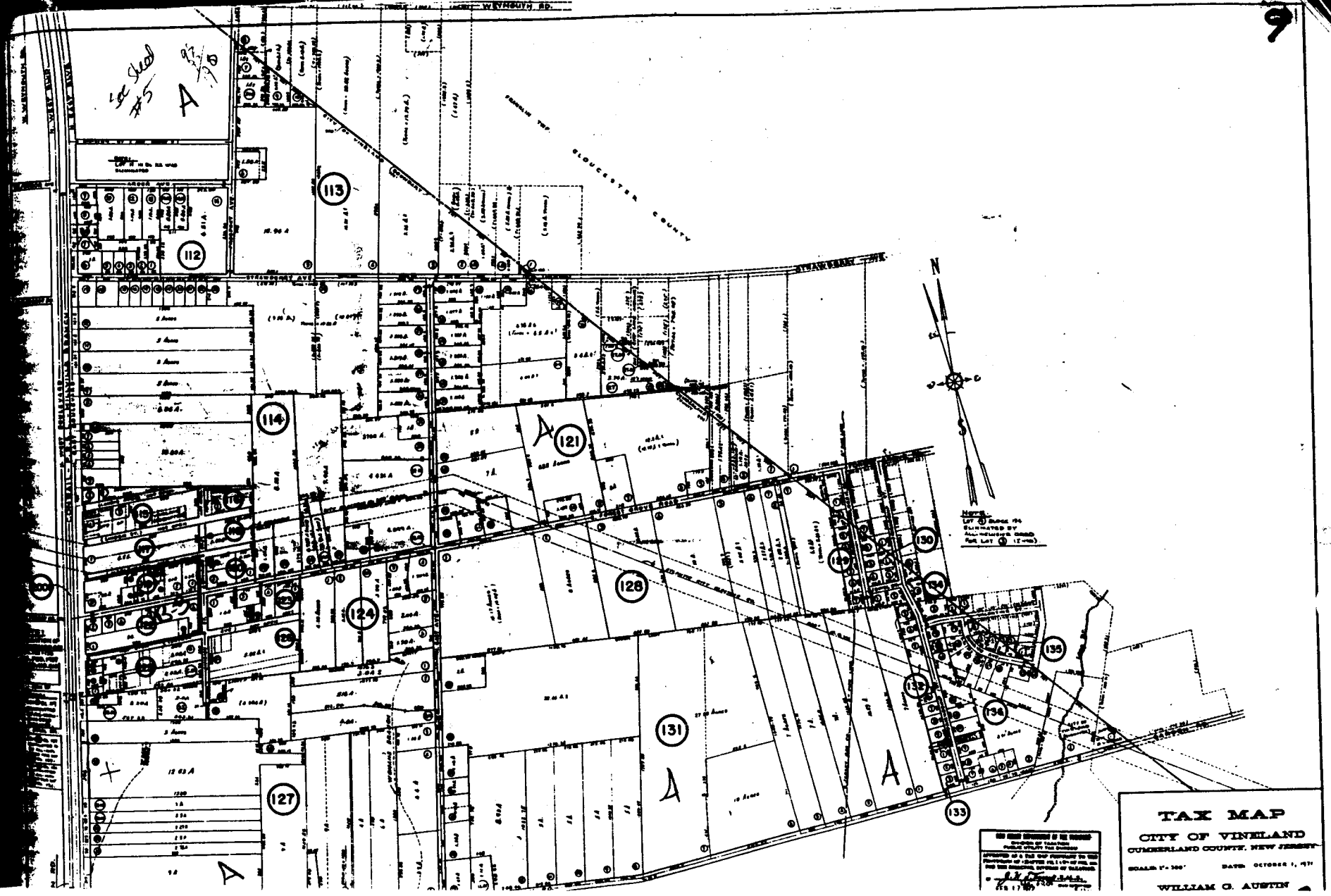
1 ½ 0 1 MILE

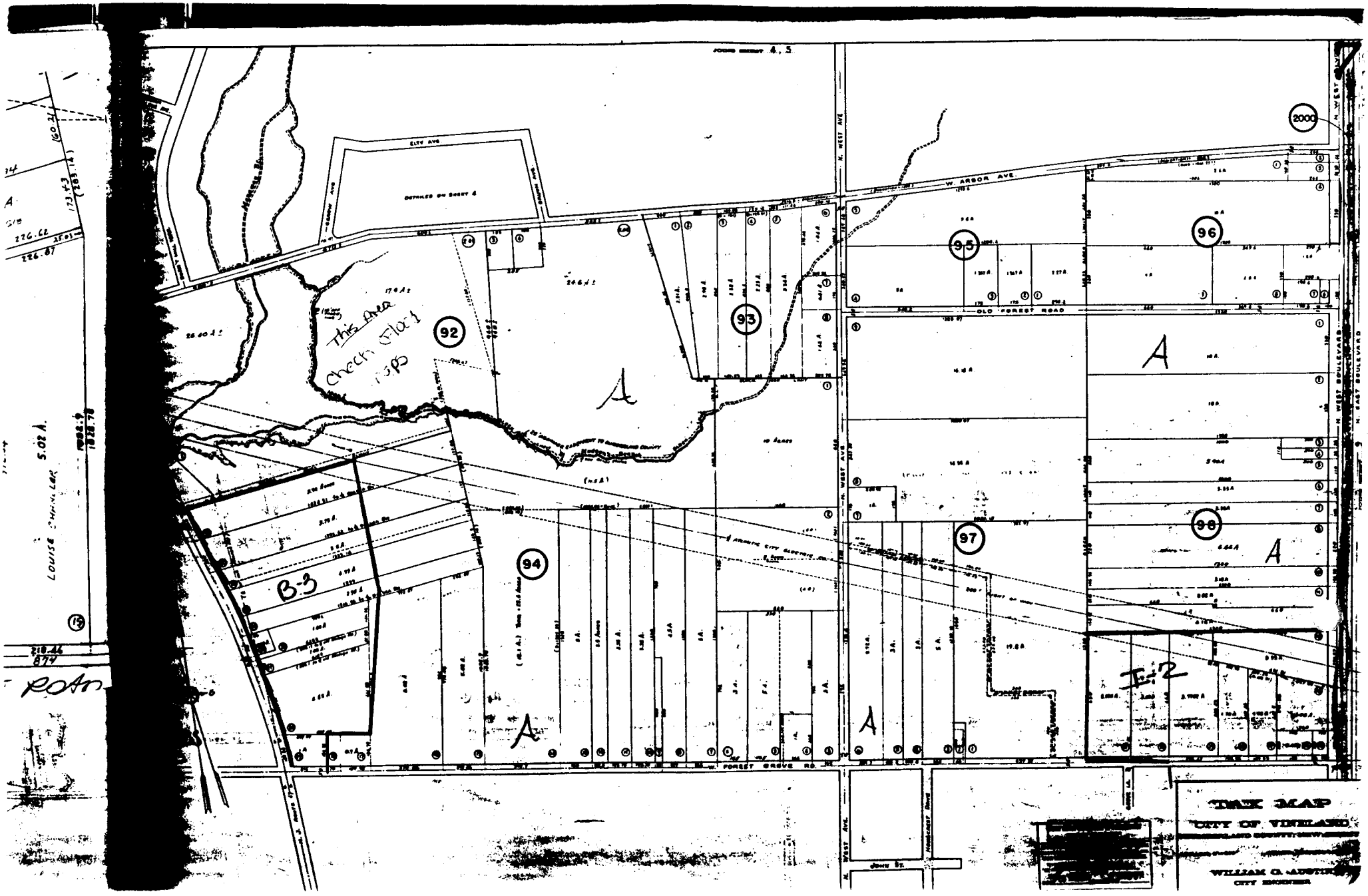
1000 0 1000 2000 3000 4000 5000 6000 7000 FEET

1 .5 0 1 KILOMETER

MN GN
11½°
204 MILS
0°02'
1 MIL


TAX MAP
CITY OF VINELAND
CUMBERLAND COUNTY, NEW JERSEY
SCALE 1" = 200'
DATE OCTOBER 1, 1971
WILLIAM G. AUSTIN
CITY ENGINEER
N
S
E
W
SALEM AVE
BOULEVARD
WEST
NEWFIELD
GLOUCESTER
COUNTY
W WEYMOUTH RD
E WEYMOUTH RD
WEYMOUTH RD
BOROUGH OF NEWFIELD
FRANKLIN TOWNSHIP
N WEST AVE
PROSPECT AVE
W ARBOR AVE
E ARBOR AVE
N WEST BOULEVARD
E WEST BOULEVARD
NW BLVD
NE BLVD
82
83
84
85
86
2000
A
B-3
I-2
7.9


TAX MAP
CITY OF VINELAND
CUMBERLAND COUNTY, NEW JERSEY
SCALE 1" = 100'
DATE OCTOBER 1, 1971
WILLIAM G. AUSTIN
WEYMOUTH RD.
STRAWBERRY AVE.
GLOUCESTER COUNTY
N
112
113
114
121
124
127
128
130
131
132
133
134
135
A


TAX MAP
CITY OF VINELAND
WILLIAM G. AUSTIN
CITY ENGINEER
W. ARBOR AVE.
OLD FOREST ROAD
W. FOREST GROVE RD.
N. WEST AVE
N. WEST BOULEVARD
N. EAST BOULEVARD
ELTY AVE
Hawthorne Blvd
Jerry St.
LOUISE SPRING LAKE
5.02 A.
92
93
94
95
96
97
98
2000
A
B-3
I-2
This area check flood maps

ATTACHMENT C

ATTACHMENT C

SECTION 1

POPULATION DATA FOR SHIELDALLOY METALLURGICAL CORP.
NEWFIELD, NJ (ZIPCODE 08344)

LATITUDE 39:32:58	LONGITUDE 75:1:30		1980 POPULATION
KM	0-40	40-80	SECTOR TOTALS
S1	518,565	3,800,750	4,319,315
S2	54,541	235,943	290,484
S3	100,574	120,115	220,689
S4	76,873	644,244	721,118
RING TOTALS	750,553	4,801,053	5,551,606

The total population from the 1980 census for the area is 5,551,606. the area was divided into two rings; 40 km and 80 km from the center. Each ring was divided into 4 sectors (S 1 - S 4), starting at the northern axis of a polar grid.

ATTACHMENT C

SECTION 2

Resident Population of Municipalities by County: 1980 & 1990

Gloucester County & Municipalities

GLOUCESTER County Municipalities	Total Population Census 4/1/80	Total Population Census 4/1/90	Change: 1980-1990 Number	Change: 1980-1990 Percent	Change: 1980-1990 Annual Growth Rate(%)
Clayton borough	6,013	6,155	142	2.4%	0.23%
Deptford township	23,473	24,137	664	2.8%	0.28%
East Greenwich township	4,142	5,258	1,116	26.9%	2.41%
Elk township	3,187	3,806	619	19.4%	1.79%
Franklin township	12,396	14,482	2,086	16.8%	1.57%
Glassboro borough	14,574	15,614	1,040	7.1%	0.69%
Greenwich township	5,406	5,102	(304)	-5.6%	-0.58%
Harrison township	3,585	4,715	1,130	31.5%	2.78%
Logan township	3,078	5,147	2,069	67.2%	5.28%
Mantua township	9,193	10,074	881	9.6%	0.92%
Monroe township	21,639	26,703	5,064	23.4%	2.13%
National Park borough	3,552	3,413	(139)	-3.9%	-0.40%
Newfield borough	1,563	1,592	29	1.9%	0.18%
Paulsboro borough	6,944	6,577	(367)	-5.3%	-0.54%
Pitman borough	9,744	9,365	(379)	-3.9%	-0.40%
South Harrison township	1,486	1,919	433	29.1%	2.59%
Swedesboro borough	2,031	2,024	(7)	-0.3%	-0.03%
Washington township	27,878	41,960	14,082	50.5%	4.17%
Wenonah borough	2,303	2,331	28	1.2%	0.12%
West Deptford township	18,002	19,380	1,378	7.7%	0.74%
Westville borough	4,786	4,573	(213)	-4.5%	-0.45%
Woodbury city	10,353	10,904	551	5.3%	0.52%
Woodbury Heights borough	3,460	3,392	(68)	-2.0%	-0.20%
Woolwich township	1,129	1,459	330	29.2%	2.60%
TOTAL, GLOUCESTER COUNTY	199,917	230,082	30,165	15.1%	1.42%

Note: The 1990 population counts are subject to possible corrections for undercount or overcount. The United States Department of Commerce is considering whether to correct these counts and will publish corrected counts, if any, not later than July 15, 1991.

Source: 1980 and 1990 Censuses of Population and Housing.

ATTACHMENT C

SECTION 2

Resident Population of Municipalities by County: 1980 & 1990

Cumberland County & Municipalities

CUMBERLAND County Municipalities	Total Population Census 4/1/80	Total Population Census 4/1/90	Change: 1980-1990 Number	Change: 1980-1990 Percent	Change: 1980-1990 Annual Growth Rate(%)
Bridgeton city	18,795	18,942	147	0.8%	0.08%
Commercial township	4,674	5,026	352	7.5%	0.73%
Deerfield township	2,523	2,933	410	16.3%	1.52%
Downe township	1,803	1,702	(101)	-5.6%	-0.57%
Fairfield township	5,693	5,699	6	0.1%	0.01%
Greenwich township	973	911	(62)	-6.4%	-0.66%
Hopewell township	4,365	4,215	(150)	-3.4%	-0.35%
Lawrence township	2,116	2,433	317	15.0%	1.41%
Maurice River township	4,577	6,648	2,071	45.2%	3.80%
Millville city	24,815	25,992	1,177	4.7%	0.46%
Shiloh borough	604	408	(196)	-32.5%	-3.85%
Stow Creek township	1,365	1,437	72	5.3%	0.52%
Upper Deerfield township	6,810	6,927	117	1.7%	0.17%
Vineland city	53,753	54,780	1,027	1.9%	0.19%
TOTAL, CUMBERLAND COUNTY	132,866	138,053	5,187	3.9%	0.38%

Note: The 1990 population counts are subject to possible corrections for undercount or overcount. The United States Department of Commerce is considering whether to correct these counts and will publish corrected counts, if any, not later than July 15, 1991.

Source: 1980 and 1990 Censuses of Population and Housing.

ATTACHMENT C

SECTION 3

LONGITUDE	75017500	
LATITUDE	39541111	
RADIUS	0.50	(miles)

FULL CIRCLE

Population	418
Housing	166

POPULATION BY STATE

State 34 Population	418
Total Population	418

POPULATION BY COUNTY

County 34011 Population	89
County 34015 Population	329
Total Population	418

HOUSING BY STATE

State 34 Housing	166
Total Housing	166

HOUSING BY COUNTY

County 34011 Housing	33
County 34015 Housing	133
Total Housing	166

ATTACHMENT C

SECTION 3

LONGITUDE	75017500
LATITUDE	39541111
OUTER RADIUS	1.00 (miles)
INNER RADIUS	0.50 (miles)

FULL CONCENTRIC	
CONCENTRIC	
Population	1935
Housing	652
OUTER CIRCLE	
Population	2353
Housing	818
INNER CIRCLE	
Population	418
Housing	166

POPULATION BY STATE

State 34 Population	1935
Total Population	1935

POPULATION BY COUNTY

County 34011 Population	623
County 34015 Population	1312
Total Population	1935

HOUSING BY STATE

State 34 Housing	652
Total Housing	652

HOUSING BY COUNTY

County 34011 Housing	209
County 34015 Housing	443
Total Housing	652

ATTACHMENT C

SECTION 3

LONGITUDE	75017500	
LATITUDE	39541111	
OUTER RADIUS	5.00	(miles)
INNER RADIUS	1.00	(miles)

FULL CONCENTRIC	
CONCENTRIC	
Population	51705
Housing	18508
OUTER CIRCLE	
Population	54058
Housing	19326
INNER CIRCLE	
Population	2353
Housing	818

POPULATION BY STATE

State 34 Population	51705
Total Population	51705

POPULATION BY COUNTY

County 34001 Population	4405
County 34011 Population	39301
County 34015 Population	6331
County 34033 Population	1668
Total Population	51705

HOUSING BY STATE

State 34 Housing	18508
Total Housing	18508

HOUSING BY COUNTY

County 34001 Housing	1754
County 34011 Housing	14080
County 34015 Housing	2120
County 34033 Housing	554
Total Housing	18508

ATTACHMENT C

SECTION 3

LONGITUDE	75017500	
LATITUDE	39541111	
OUTER RADIUS	10.00	(miles)
INNER RADIUS	5.00	(miles)

FULL CONCENTRIC	
CONCENTRIC	
Population	77448
Housing	27591
OUTER CIRCLE	
Population	131506
Housing	46917
INNER CIRCLE	
Population	54058
Housing	19326

POPULATION BY STATE

State 34 Population	77448
Total Population	77448

POPULATION BY COUNTY

County 34001 Population	9249
County 34007 Population	49
County 34011 Population	29875
County 34015 Population	29106
County 34033 Population	9169
Total Population	77448

HOUSING BY STATE

State 34 Housing	27591
Total Housing	27591

HOUSING BY COUNTY

County 34001 Housing	3223
County 34007 Housing	20
County 34011 Housing	11091
County 34015 Housing	10023
County 34033 Housing	3234
Total Housing	27591

ATTACHMENT C

SECTION 3

LONGITUDE	75017500
LATITUDE	39541111
OUTER RADIUS	25.00 (miles)
INNER RADIUS	10.00 (miles)

FULL CONCENTRIC

CONCENTRIC	
Population	694073
Housing	258193
OUTER CIRCLE	
Population	825579
Housing	305110
INNER CIRCLE	
Population	131506
Housing	46917

POPULATION BY STATE

State 34 Population	694073
Total Population	694073

POPULATION BY COUNTY

County 34001 Population	61020
County 34005 Population	41801
County 34007 Population	299937
County 34009 Population	5426
County 34011 Population	68165
County 34015 Population	192330
County 34033 Population	25394
Total Population	694073

HOUSING BY STATE

State 34 Housing	258193
Total Housing	258193

HOUSING BY COUNTY

County 34001 Housing	23023
County 34005 Housing	14683
County 34007 Housing	114287
County 34009 Housing	1930
County 34011 Housing	24881
County 34015 Housing	69479
County 34033 Housing	9910
Total Housing	258193

ATTACHMENT C

SECTION 3

LONGITUDE	75017500
LATITUDE	39541111
OUTER RADIUS	50.00 (miles)
INNER RADIUS	25.00 (miles)

FULL CONCENTRIC	
CONCENTRIC	
Population	4927468
Housing	2052038
OUTER CIRCLE	
Population	5753047
Housing	2357148
INNER CIRCLE	
Population	825579
Housing	305110

POPULATION BY STATE

State 10 Population	549453
State 24 Population	45652
State 34 Population	1075509
State 42 Population	3256854
Total Population	4927468

POPULATION BY COUNTY

County 10001 Population	100946
County 10003 Population	441946
County 10005 Population	6561
County 24011 Population	539
County 24015 Population	40810
County 24029 Population	2971
County 24035 Population	1332
County 34001 Population	149653
County 34005 Population	353265
County 34007 Population	202838
County 34009 Population	89663
County 34015 Population	674
County 34021 Population	134799
County 34025 Population	3778
County 34029 Population	111776
County 34033 Population	29063
County 42017 Population	384891
County 42029 Population	250409
County 42045 Population	547651
County 42091 Population	488326
County 42101 Population	1585577
Total Population	4927468

HOUSING BY STATE

ATTACHMENT C

SECTION 3

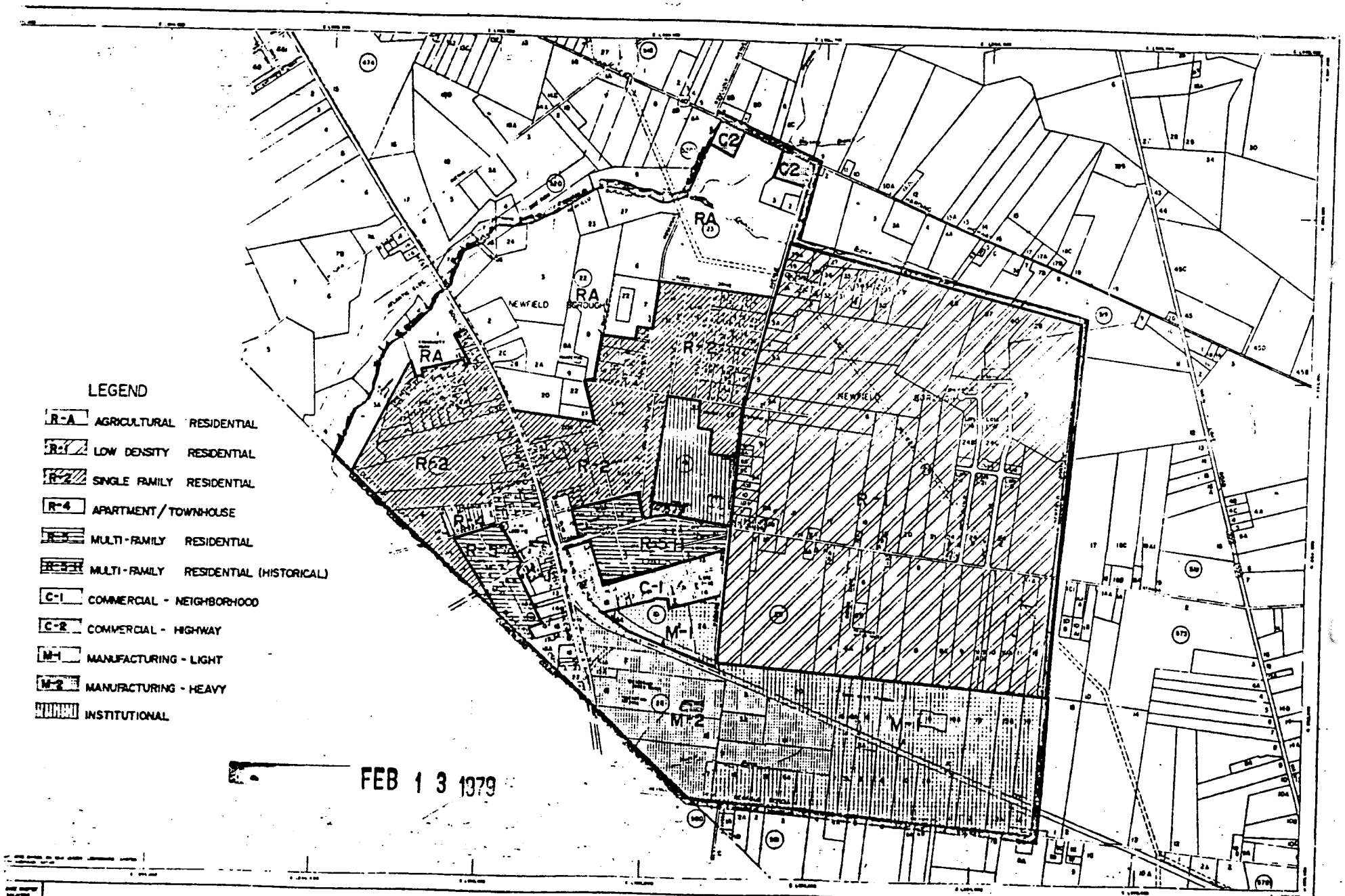
State 10	Housing	214802
State 24	Housing	17834
State 34	Housing	503600
State 42	Housing	1315802
Total Housing		2052038

HOUSING BY COUNTY

County 10001	Housing	38180
County 10003	Housing	173560
County 10005	Housing	3062
County 24011	Housing	196
County 24015	Housing	15803
County 24029	Housing	1313
County 24035	Housing	522
County 34001	Housing	78877
County 34005	Housing	128553
County 34007	Housing	75838
County 34009	Housing	83607
County 34015	Housing	261
County 34021	Housing	51959
County 34025	Housing	1367
County 34029	Housing	71487
County 34033	Housing	11651
County 42017	Housing	140624
County 42029	Housing	94418
County 42045	Housing	211024
County 42091	Housing	194837
County 42101	Housing	674899
Total Housing		2052038

ATTACHMENT D

As of Sept. 9, 1982



FEB 1 3 1979

MASTER LAND USE PLAN

BOROUGH OF NEWFIELD
GLOUCESTER CO.
NEW JERSEY

Brown/Sullivan, Associates
Planning Consultants

ATTACHMENT E

NATIONAL REGISTER OF HISTORIC PLACES
INDEX OF LISTED PROPERTIES

KEY: Property Name, Address/Boundary, City, Vicinity, Listed Date, Reference Number, Multiple Name

NEW JERSEY
Gloucester County
Barnsboro Hotel
Jct. of Pitman and Sewell Rds.
Barnsboro 1/25/73 73001095
Butler Farm
E of Swedesboro
Swedesboro vicinity 12/01/78 78001763
Chew, Jesse, House
611 Mantua Blvd.
Sewell 10/18/72 72000797
Clark, Benjamin, House
Glassboro Rd.
Wenonah 1/25/73 73001099
Free Library and Reading Room--Williamstown Memorial Library
405 S. Main St.
Williamstown 10/01/87 87001761
Hunter--Lawrence--Jessup House
58 N. Broad St.
Woodbury 10/18/72 72000798
Ladd's Castle
1337 Lafayette Ave.
Colonial Manor 10/31/72 72000794
Moravian Church
Swedesboro-Sharptown Rd.
Oliphant's Mill 4/03/73 73001097
Mullica Hill Historic District
Roughly, Main St. from Mullica Hill--Bridgeport Rd. to jct. of Commissioner's Rd. and Bridgeton Pike, Harrison Township
Mulllica Hill 4/25/91 91000483
Nothnagle, C. A., Log House
Swedesboro-Paulsboro Rd.
Gibbstown 4/23/76 76001153
Otto, Bodo, House
SR 551 and Quaker Rd.
Mickleton 12/12/76 76001154
Pitman Grove
Bounded by Holly, East, Laurel, and West Aves. (both sides)
Pitman 8/19/77 77000870
Red Bank Battlefield
E bank of Delaware River and W end of Hessian Ave.
National Park 10/31/72 72000796

NATIONAL REGISTER OF HISTORIC PLACES
INDEX OF LISTED PROPERTIES

KEY: Property Name, Address/Boundary, City, Vicinity, Listed Date,
Reference Number, Multiple Name

NEW JERSEY
Gloucester County
Richwood Methodist Church
Elmer Rd.
Richwood 1/19/79 79001490
Salisbury Farm
Address Restricted
Bridgeport vicinity 3/07/79 79001489
St. Peter's Episcopal Church
King's Hwy.
Clarksboro 8/10/77 77000869
St. Thomas Episcopal Church
SE corner Main and Focer Sts.
Glassboro 3/03/75 75001137
Stratton, Gov. Charles C., House
0.5 mi. E of Swedesboro on King's Hwy.
Woolwich Township 1/29/73 73001101
Thompson House
Woodbury MRA
103 Penn St.
Woodbury 7/13/88 88000996
Trinity Church
NW corner of Church St. and King's Hwy.
Swedesboro 1/29/73 73001098
Whitall, James, Jr., House
100 Grove Ave.
National Park 2/06/73 73001096
Whitney Mansion
Whitney Ave.
Glassboro 12/05/72 72000795
Woodbury Friends' Meetinghouse
120 N. Broad St.
Woodbury 2/06/73 73001100

NATIONAL REGISTER OF HISTORIC PLACES
INDEX OF LISTED PROPERTIES

KEY: Property Name, Address/Boundary, City, Vicinity, Listed Date, Reference Number, Multiple Name

NEW JERSEY
Cumberland County
Beth Hillel Synagogue
Irving Ave.
Carmel 11/07/78 78001755
Bridgeton Historic District
Roughly bounded by RR Tracks, South Ave., Lake, Commerce, Water, Belmont, Cohensey, and Penn Sts.
Bridgeton 10/29/82 82001043
Buck, Jeremiah, House
297 E. Commerce St.
Bridgeton 12/30/75 75001130
Deerfield Pike Tollgate House
89 Old Deerfield Pike
Bridgeton 5/21/75 75001131
Deerfield Presbyterian Church
NE of Seabrook
Seabrook vicinity 9/29/80 80002481
Giles, Gen. James, House
143 W. Broad St.
Bridgeton 3/08/78 78001754
Greenwich Historic District
Main St. from Cohansey River N to Othello
Greenwich 1/20/72 72000772
Hoskins, Caesar, Log Cabin
Jct. of South and Second Sts.
Mauricetown 9/10/87 87001521
Maskel, Thomas, House
2 mi. W of Greenwich on Bacon's Neck Rd.
Greenwich vicinity 6/10/75 75001132
Miah Maull Shoal Lighthouse
In Delaware Bay 5 mi. SW of Egg Island Point
Delaware Bay 2/04/91 90002188
Millville's First Bank Building
2nd and E. Main Sts.
Millville 11/20/80 80002480
Old Broad Street Presbyterian Church and Cemetery
Broad and Lawrence Sts.
Bridgeton 12/02/74 74001159
Old Stone Church
N of Cedarville on NJ 553
Cedarville vicinity 5/12/77 77000860

NATIONAL REGISTER OF HISTORIC PLACES
INDEX OF LISTED PROPERTIES

KEY: Property Name, Address/Boundary, City, Vicinity, Listed Date,
Reference Number, Multiple Name

NEW JERSEY
Cumberland County
Potter's Tavern
49--51 Broad St.
Bridgeton 9/10/71 71000501
SPINDRIFT SAILING YACHT
S. of Bridgeton
Bridgeton vicinity 4/22/82 82003271
Seeley, Samuel W., House
274 E. Commerce St.
Bridgeton 5/13/76 76001150

ATTACHMENT F

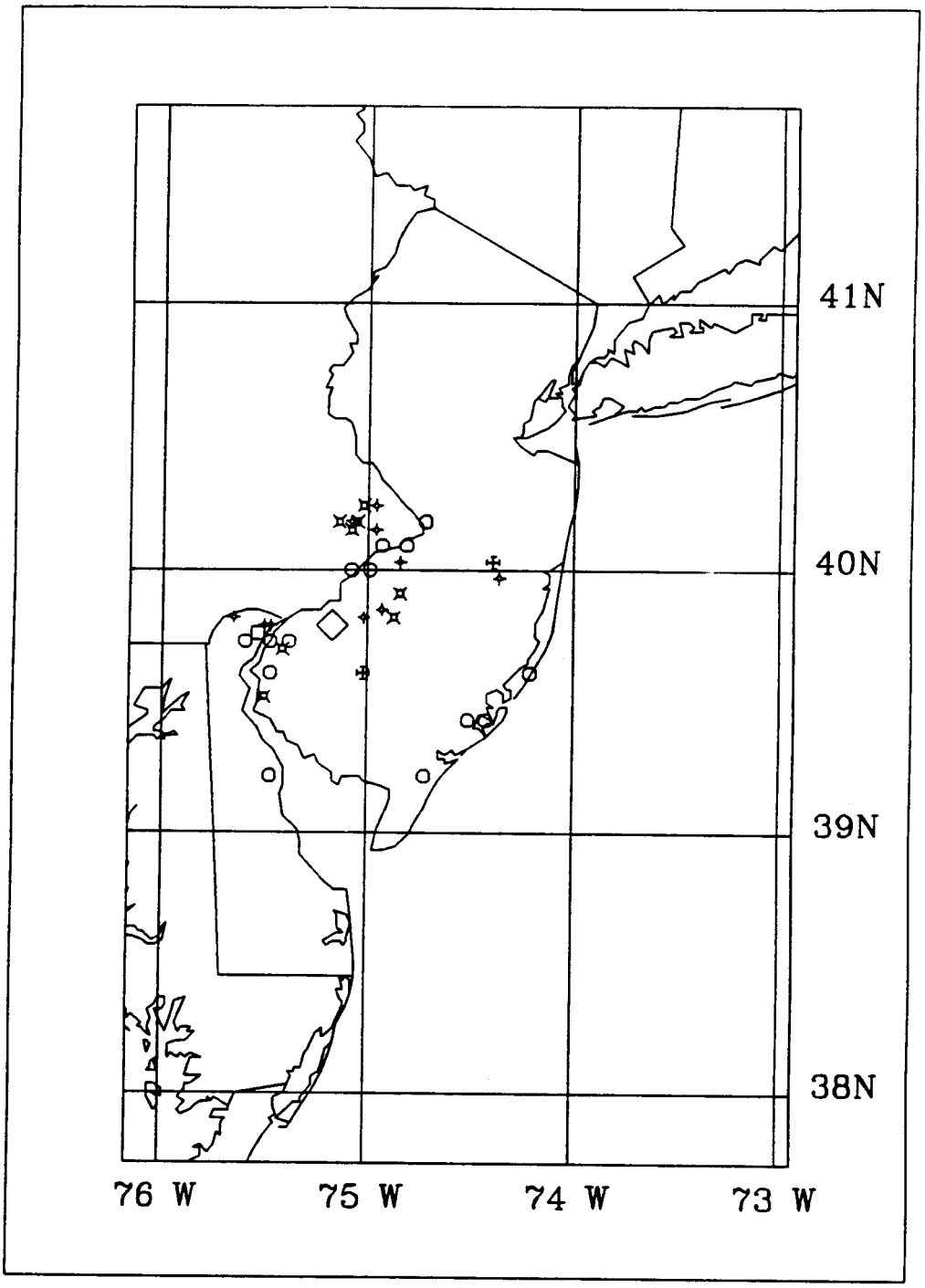
• • • • • • • • • • • • • • • • • • E A R T H Q U A K E D A T A B A S E S Y S T E M • • • • • • • • • • • • • • • • • •

FILE CREATED: 11-JUN-1993 07:43:19.46
Circle Search Earthquakes= 57
Latitude: 39.541N Longitude: 75.018W
Radius: 83.000 km
Year: 1800 - 1993
Selected Catalogs: PDE SRA DNAG
Duplicate Eliminator Used: Time separation (sec) = 10.0000 Distance separation (km) = 15.0000
Acceptable Catalog(s): SRA PDE DNAG

CATALOG SOURCE	DATE YEAR	MO	DA	ORIGIN TIME	••COORDINATES•• LAT.	LONG.	DEPTH km	pP STN DEV	••••MAGNITUDES•••• mb	OBS	Ms	OBS	CONTRIBUTED VALUES	F-E REG	STA	••••INFORMATION•••• IEMFMDIPF NFAPOEDFL TFPS PEDG	PHENOMENA DTSVMIG
SRA	1800	03	17	Z	40.000	-75.100								473	H	2.....P.	.....
SRA	1800	11	29	Z	40.000	-75.100								473	H	5.....P.	.....
SRA	1801	11	12	Z	40.000	-75.100								473	H	3.....P.	.....
SRA	1811	12	09	010000.00Z	40.000	-75.100								473	H	3.....P.	.....
DNAG	1840	11	11		39.800	-75.200	0						5.25MINEUS	493		.....	.....
SRA	1840	11	11	Z	40.000	-75.100								473	H	5.....P.	.....
SRA	1840	11	14	Z	40.000	-75.100								473	H	.F.....P.	.....
SRA	1871	10	09	144000.00Z	39.700	-75.500								493	H	7.....P.	.....
SRA	1871	10	10	050000.00Z	39.600	-75.500								493	H	4.....P.	.....
SRA	1877	09	10	145900.00Z	40.100	-74.800								494	H	4.....P.	.....
SRA	1879	03	26	003000.00Z	39.200	-75.500								493	H	5.....P.	.....
SRA	1910	04	23	Z	39.200	-74.700								494	H	3.....P.	.....
SRA	1912	11	06	184000.00Z	39.400	-74.500								494	H	3.....P.	.....
SRA	1919	08	05	050000.00Z	39.600	-74.200								494	H	.F.....P.	.....
SRA	1921	01	26	234000.00Z	40.000	-75.000								473	H	5.....P.	.....
SRA	1926	01	26	234000.00Z	40.000	-75.000								473	H	5.....P.	.....
SRA	1933	01	25	020000.00Z	40.200	-74.700								494	H	5.....P.	.....
SRA	1938	08	23	050453.40	40.051	-74.360	21						4.00Mn ST	494	C	.....P.	.....
SRA	1939	11	15	025348.70	39.580	-75.046	3						4.00FA DG	493	C	5.....P.	.....
SRA	1944	01	08	Z	39.800	-75.500								493	H	5.....P.	.....
SRA	1948	08	03	190440.00Z	39.400	-74.400								494	H	3.....P.	.....
SRA	1961	12	27	170600.00Z	40.100	-74.900								494	G	5.....P.	.....
SRA	1968	12	10	091248.00	39.924	-74.820	23						3.00Mn DG	494	B	5.....P.	.....
SRA	1971	07	14	Z	39.700	-75.600								493	G	4.....P.	.....
SRA	1971	12	29	Z	39.700	-75.600								493	G	4.....P.	.....
SRA	1972	01	02	070000.00Z	39.700	-75.600								493	G	4.....P.	.....
SRA	1972	01	03	Z	39.700	-75.600								493	G	4.....P.	.....
SRA	1972	01	07	034500.00Z	39.700	-75.600								493	G	4.....P.	.....
SRA	1972	01	22	064000.00Z	39.700	-75.600								493	G	4.....P.	.....
SRA	1972	01	23	013500.00Z	39.700	-75.600								493	G	4.....P.	.....
SRA	1972	01	23	072200.00Z	39.700	-75.600								493	G	4.....P.	.....
SRA	1972	02	11	001630.0 Z	39.700	-75.600								493	G	5.....P.	.....
SRA	1972	02	11	153000.00Z	39.700	-75.600								493	G	.F.....P.	.....
SRA	1972	08	14	010900.00Z	39.700	-75.600								493	G	4.....P.	.....
SRA	1972	08	14	015500.00Z	39.700	-75.600								493	G	.F.....P.	.....
SRA	1973	02	28	082133.20	39.686	-75.435	12						3.80MnSLM	493	B	5.....P.	.....

CATALOG SOURCE	DATE YEAR	MO	DA	ORIGIN TIME	***COORDINATES** LAT.	LONG.	DEPTH km	pP	STN DEV	*****MAGNITUDES**** mb OBS	Ms OBS	CONTRIBUTED VALUES	F-E REG	STA	****INFORMATION**** IEMFMDIPF NFAPOEDFL TFPS PEDG	PHENOMENA DTSVNMG	RADIAL DIST km
SRA	1973	07	10	043802.0 Z	39.700	-75.400							493 F		4.....P.	.....	37
SRA	1974	04	28	141920.0 Z	39.700	-75.600							493 G		4.....P.	.....	52
SRA	1977	01	21	205044.50	39.070	-74.330	6					2.70MnPAL	494 B		.....P.	.....	75
SRA	1977	02	10	191425.0 Z	39.800	-75.500						2.00MnDEL	493 C		6.....P.	.....	50
SRA	1980	03	02	115447.90	40.210	-75.000	0					2.80MnPAL	473 B		.....P.	.....	74
SRA	1980	03	05	170654.50	40.190	-75.160	5					3.50MnPAL	473 B		4.....P.	.....	73
SRA	1980	03	05	172032.40	40.180	-75.070	5					3.10MnPAL	473 B		.....P.	.....	71
SRA	1980	03	11	060026.00	40.160	-75.100	5					3.70MnPAL	473 B		5.....P.	.....	00
SRA	1980	03	11	161605.50	40.250	-74.990	2					2.80MnPAL	494 B		.....P.	.....	78
SRA	1980	05	02	152323.50	40.100	-74.990	5					2.80MnPAL	494 B		.....P.	.....	68
SRA	1980	05	02	190224.40	40.260	-75.030	0					3.00MnPAL	473 B		.....P.	.....	79
SRA	1980	08	30	091909.00	39.840	-74.880	2					3.00MnPAL	494 B		.....P.	.....	35
SRA	1982	04	12	221431.20	40.050	-74.820	7					2.40MnPAL	494 B		5.....P.	.....	58
SRA	1983	11	17	195506.50	39.832	-75.660	5					2.20MnBLA	493 C		4.....P.	.....	83
SRA	1983	12	12	051509.50	39.832	-75.660	5					2.00Mn GS	493 B		4.....P.	.....	83
SRA	1984	01	19	230334.00	39.795	-75.524	5					2.40MDPAL	493 C		4.....P.	.....	51
SRA	1985	10	11	014750.70	39.768	-75.569						1.90MDDEL	493 B		.F.....P.	.....	52
SRA	1985	10	20	075526.60	39.764	-75.551						1.70MDDEL	493 B		.F.....P.	.....	51
PDE	1990	10	23	013448.27	39.512	-75.506	10	G	0.33			3.20MDNED 2.90Mn GS	493	12	5F.....	.....	42
PDE	1991	09	29	122135.00L&	39.848	-75.031	5					2.20MDPAL	493	4	.....	.....	34
PDE-W	1993	02	26	211333.81•	39.876	-74.942	5	G	0.44			2.50MnGS	494	8	4F.....	.....	37

First date: Mar 17, 1800 Last date: Feb 26, 1993



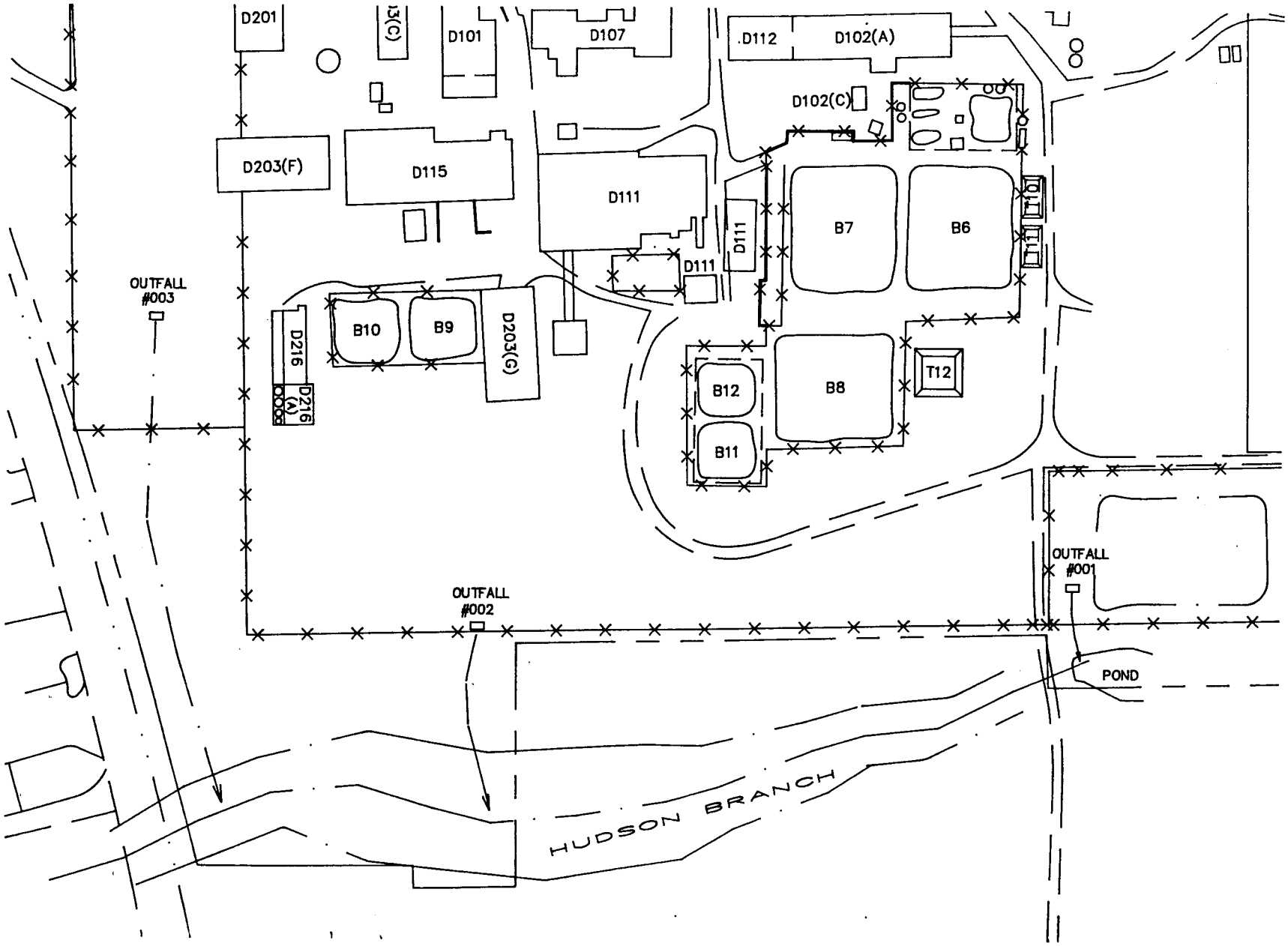
Computer graphics by Roger N. Hunter, Geophysicist

MAGNITUDES:

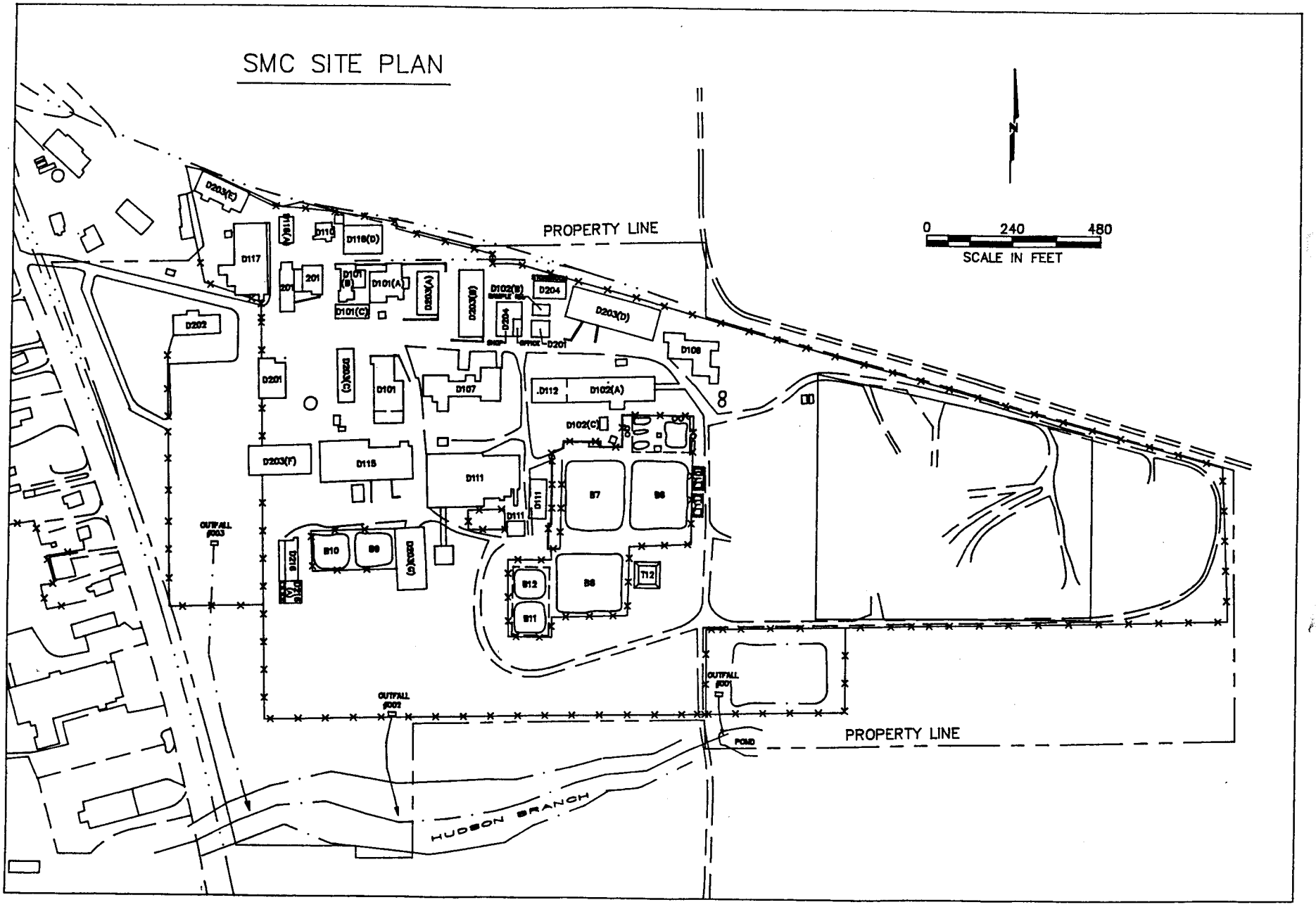
? ○ 1 □ 2 ✦ 3 ⌑ 4 ✢ 5 ◇

U. S. Geological Survey, National Earthquake Information Center
Data taken from the Earthquake Data Base System

ATTACHMENT G


D201
13(C)
D101
D107
.D112
D102(A)
D102(C)
D203(F)
D115
D111
D111
D111
B7
B6
T10
T11
OUTFALL
#003
D216
D216
(A)
B10
B9
D203(G)
B12
B11
B8
T12
OUTFALL
#001
OUTFALL
#002
POND
HUDSON BRANCH

SMC SITE PLAN



ATTACHMENT H

than during the spring. This was found to be true for SC19D, but the water elevation did not change at SC19S.

Prior investigations have determined the hydraulic characteristics for the Cohansey Sand at the SMC site (DRAI, 1988). These investigations have determined separate transmissivities (T) and specific yield (Sy) values for both the shallow (water table) and deep (lower Cohansey Sand) ground water flow regimes. These values were averaged from four aquifer tests performed for SMC, as well as from two tests conducted during development of the Newfield supply well adjacent to the site (to the northwest). The following hydrologic parameters were calculated for the upper and lower Cohansey Sand respectively: T = 130,000 gpd/ft and Sy = 0.03 (upper) and T = 74,000 gpd/ft and Sy = 0.002 (lower). Across the site, vertical hydraulic conductivities of 0.006 to 3 gpd/ft^2 were calculated. The variation in vertical hydraulic conductivities indicates a high degree of variability in the connection between the upper and lower sands, and may also reflect differences in the length of screened interval as well as differences in the depth of screened intervals in the tested wells (DRAI, 1988). Utilizing the transmissivity value from the upper Cohansey Sand (as it will give a more conservative estimation of ground water velocities) presented above, as well as an estimate of the thickness of the aquifer, the hydraulic conductivity of the Cohansey Sand can be estimated.

$T = Kb$ converts to $K = T/b$

where T = Transmissivity (130,000 gpd/ft = 17380 ft/day) and
b = Saturated thickness (120 ft)

then K = Hydraulic Conductivity (145 ft/day)

The average linear ground water flow velocity can be calculated using the hydraulic conductivity calculated above, an estimated formation porosity and the hydraulic gradient across the site:

$$V = KL/n$$

where V = average linear ground water flow velocity (ft/day)

K = calculated hydraulic conductivity (145 ft/day)
L = hydraulic gradient, from Figure 15 (0.004 ft/ft)
n = estimated formation porosity (0.3 ft^3/ft^3)

Using the above formula and values, the average linear ground water flow velocity across the site is 2 ft/day. This is considered an order of magnitude estimate only. The actual flow velocity of contaminants in ground water is less than the ground water flow velocity due to absorption and dispersion effects within the aquifer matrix.

ATTACHMENT I

ATTACHMENT J

Revised 2/93

FEDERALLY LISTED ENDANGERED AND THREATENED SPECIES IN NEW JERSEY

An **ENDANGERED SPECIES** is any species that is in danger of extinction throughout all or a significant portion of its range.

A **THREATENED SPECIES** is any species that is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range.

FISHES

Sturgeon, shortnose*	Acipenser brevirostrum	E

REPTILES

Turtle, Atl. Ridley*	Lepidochelys kempii	E
Turtle, green*	Chelonia mydas	T
Turtle, hawksbill*	Eretmochelys imbricata	E
Turtle, leatherback*	Dermochelys coriacea	E
Turtle, loggerhead*	Caretta caretta	T

BIRDS

Eagle, bald	Haliaeetus leucocephalus	E
Falcon, Am. peregrine	Falco peregrinus anatum	E
Falcon, Arctic peregrine	Falco peregrinus tundrius	T
Plover, piping	Charadrius melodus	T
Tern, roseate	Sterna dougallii dougallii	E

MAMMALS

Bat, Indiana	Myotis sodalis	E
Cougar, eastern	Felis concolor couguar	E+
Whale, blue*	Balaenoptera musculus	E
Whale, finback*	Balaenoptera physalus	E
Whale, humpback*	Megaptera novaeangliae	E
Whale, right*	Balaena glacialis	E
Whale, sei*	Balaenoptera borealis	E
Whale, sperm*	Physeter catodon	E

RECEIVED
MAY 21 1993
DEPT. ENV. SERV.

Revised 4/93

CANDIDATE SPECIES IN NEW JERSEY

CANDIDATE SPECIES in categories 1 and 2 are species that appear to warrant consideration for addition to the List of Endangered and Threatened Wildlife and Plants. Although these species receive no substantive or procedural protection under the Endangered Species Act, the Service encourages federal agencies and other planners to give consideration to these species in the environmental planning process.

Species		Category
VERTEBRATES		
Turtle, bog	Clemmys muhlenbergii	2
Terrapin, northern diamondback	Malaclemys terrapin terrapin	2
Snake, northern pine	Pituophis melanoleucus melanoleucus	2
Duck, harlequin	Histrionicus histrionicus	2
Rail, Black	Laterallus jamaicensis	2
Shrike, migrant loggerhead	Lanius ludovicianus migrans	2
Sparrow, Henslow's	Ammodramus henslowii	2
Warbler, cerulean	Dendroica cerulea	2
Bat, eastern small-footed	Myotis subulatus leibii	2
Rabbit, New England cottontail	Sylvilagus transitionalis	2
Shrew, long-tailed	Sorex dispar	3C
Shrew, Tuckahoe masked	Sorex cinereus nigriculus	2
Woodrat, eastern	Neotoma floridana magister	2
INVERTEBRATES		
Beetle, cobblestone tiger	Cicindela marginipennis	2
Butterfly, regal fritillary	Speyeria idalia	2*
Butterfly, tawny crescent	Phyciodes batesi	2
Dragonfly, banded bog skimmer	Williamsonia lintneri	2
Dragonfly, extra-striped snaketail	Ophiogomphus anomalus	2*
Moth, Albarufan dagger	Acronicta albarufa	2
Moth, Bucholz' dart	Agrotis bucholzi	2
Moth, Daecke's pyralid	Crambus daeckeellus	2
Moth, Hebard's noctuid	Erythroecia hebardi	2
Moth, Lemmer's pinnion	Lithophane lemmeri	3C
Moth, precious underwing	Catocala pretiosa	2
Moth, Carter's noctuid	Spartiniphaga carterae	2
Moth, annointed sallow noctuid	Pyreferra ceromatica	2*
Skipper, Eastern beardgrass	Atrytone arogos arogos	2
Skipper, grizzled	Pyrgus wyandot	2*
Mussel, brook floater	Alasmidonta varicosa	2
Mussel, green floater	Lasmigona subviridis	2
Mussel, yellow lamp	Lampsilis cariosa	2

ATTACHMENT K

FIGURE 1

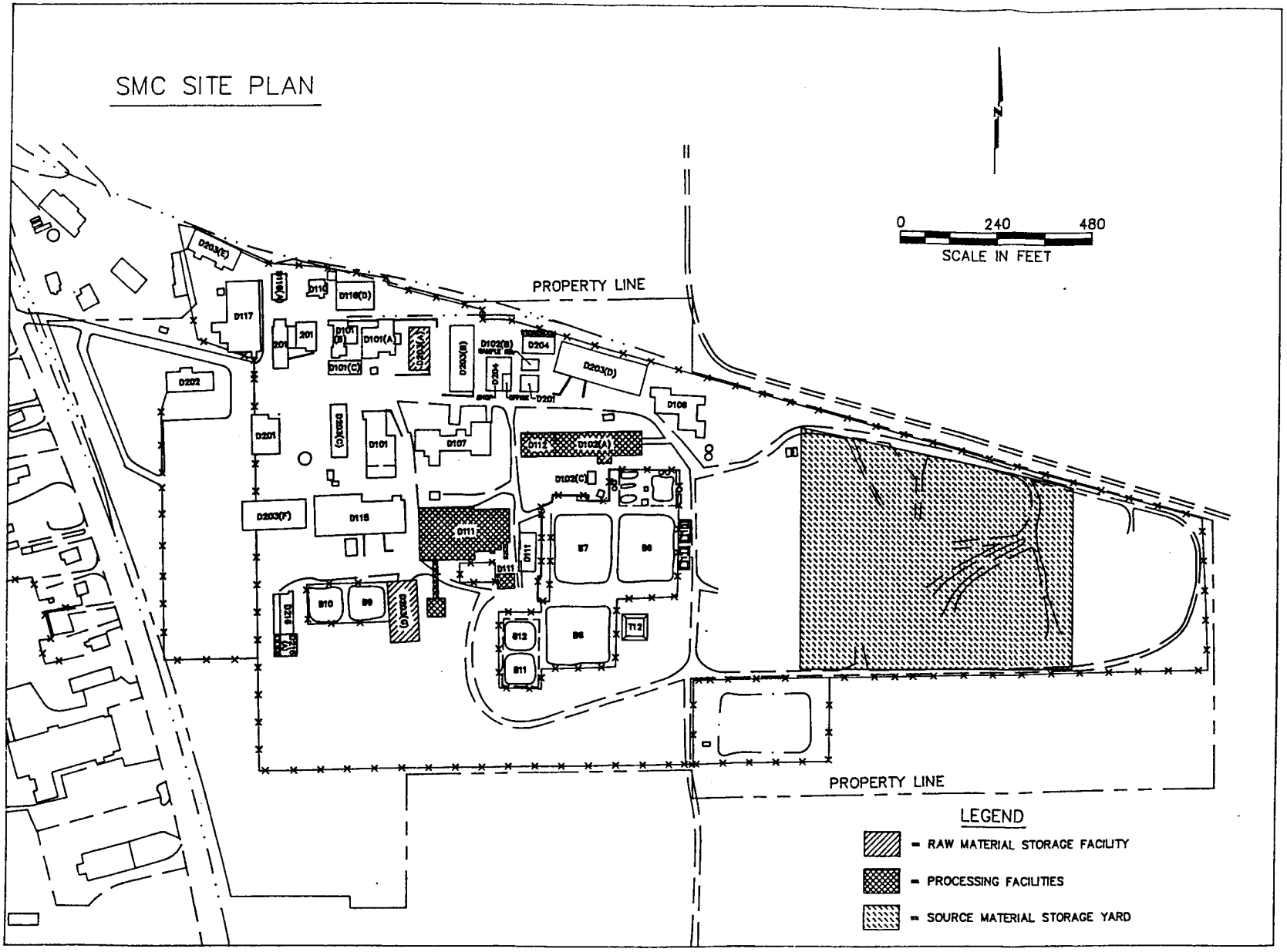
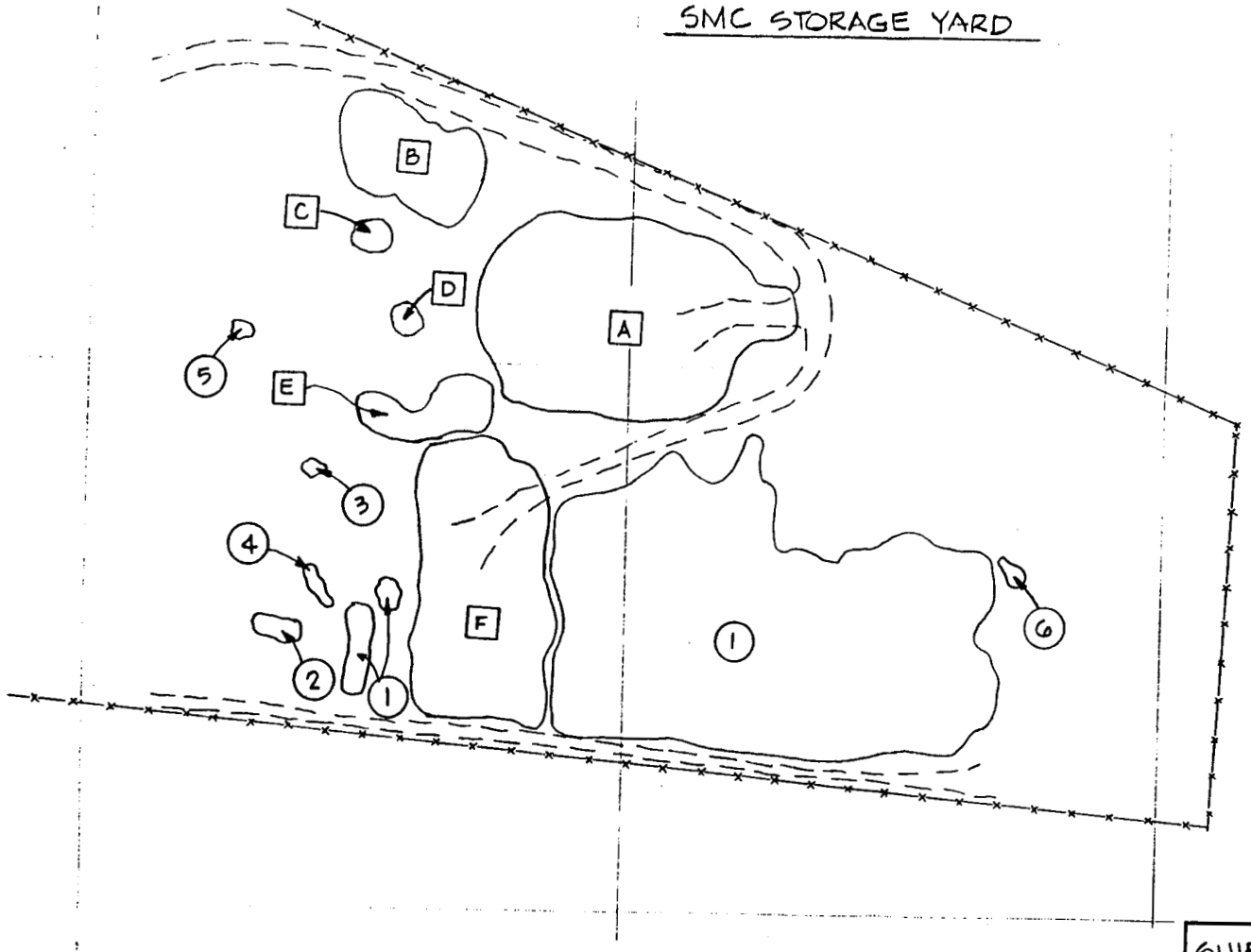

SMC SITE PLAN
N
0
240
480
SCALE IN FEET
PROPERTY LINE
PROPERTY LINE
LEGEND
= RAW MATERIAL STORAGE FACILITY
= PROCESSING FACILITIES
= SOURCE MATERIAL STORAGE YARD

FIGURE 2



NRC REGULATED MATERIAL

- A FeCb STANDARD
- B FeCb HIGH RATIO
- C CbNi TECH
- D CbNi TECH REFRACTORY
- E COLUMBITE
- F FeCb BAGHOUSE DUST

OTHER SLAG MATERIALS

1. FeV
2. FeCb HIGH PURITY
3. NiV
4. CbNi HIGH PURITY
5. FeB
6. 80% FeV

SHIELDALLOY METALLURGICAL CORP

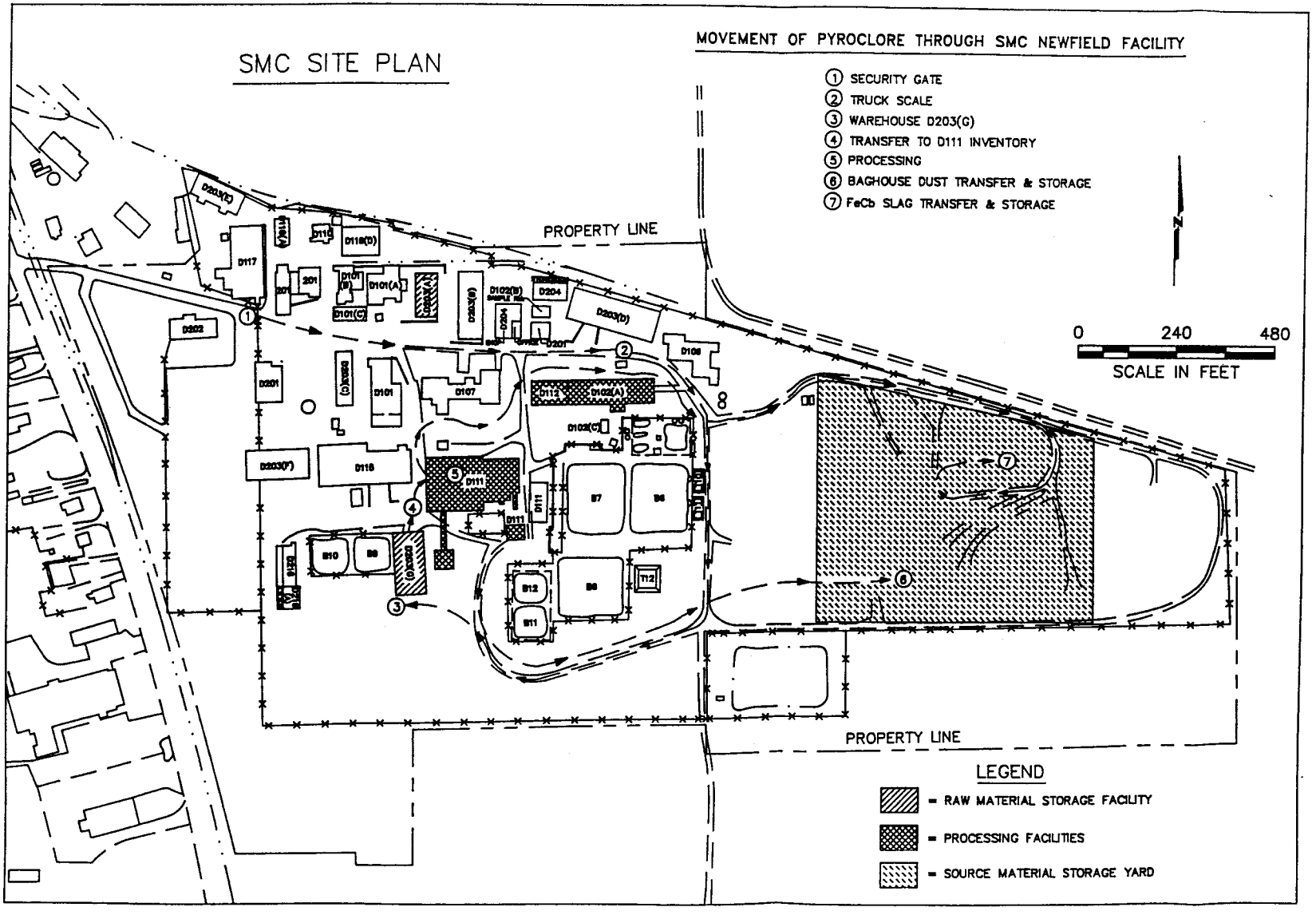
SCALE:	APPROVED BY	DRAWN BY
DATE: 6/23/93		REV'D 6-28-93

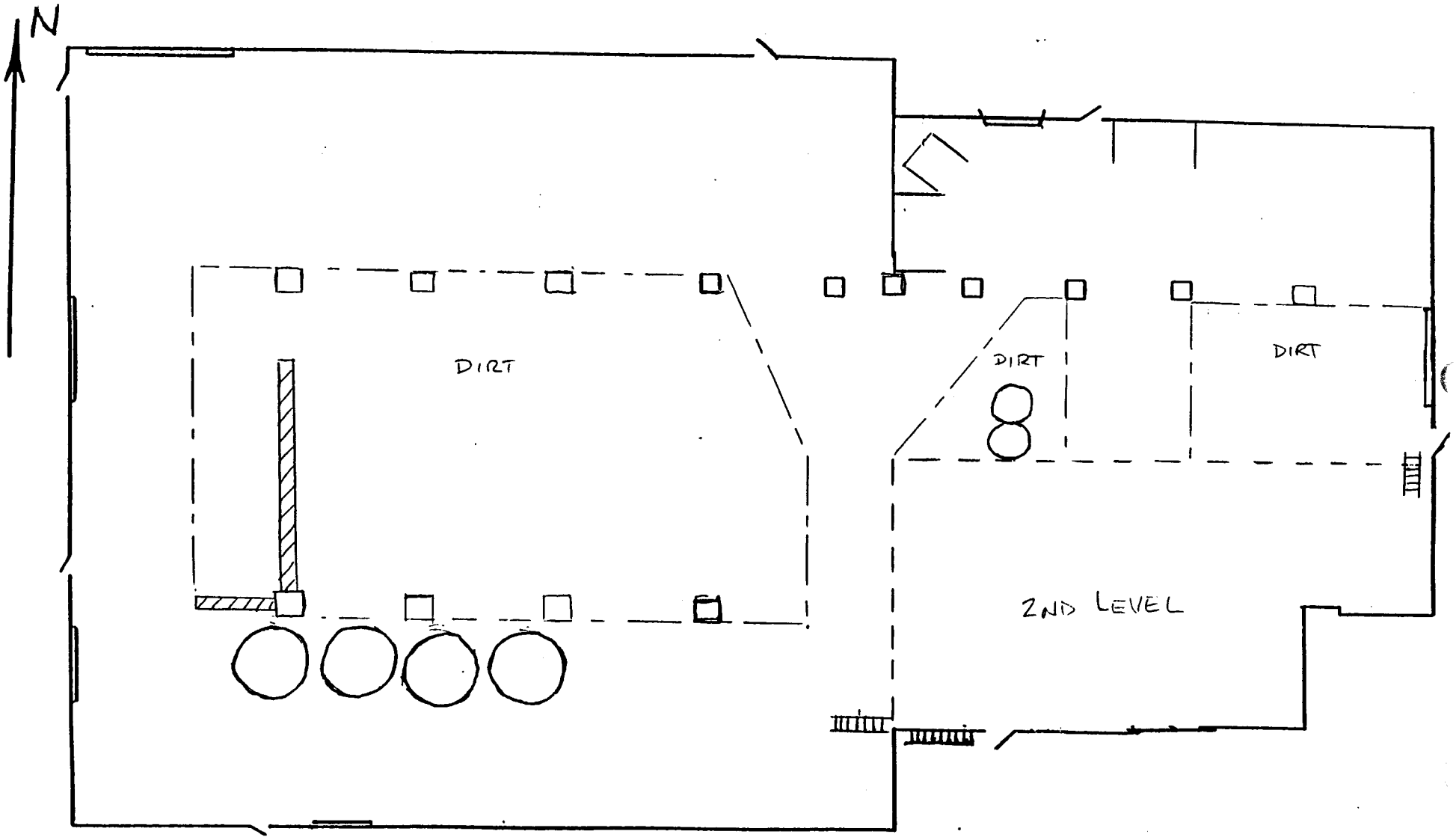
PARTIAL PLAN STORAGE YARD PILES

REV	0	1	DRAWING NUMBER 2140623-93

DIETZGEN NO. 198-MF AGEPROOF MASTER FORM

FIGURE 3


SMC SITE PLAN
MOVEMENT OF PYROCLORE THROUGH SMC NEWFIELD FACILITY
1 SECURITY GATE
2 TRUCK SCALE
3 WAREHOUSE D203(G)
4 TRANSFER TO D111 INVENTORY
5 PROCESSING
6 BAGHOUSE DUST TRANSFER & STORAGE
7 FeCb SLAG TRANSFER & STORAGE
PROPERTY LINE
PROPERTY LINE
0 240 480
SCALE IN FEET
LEGEND
= RAW MATERIAL STORAGE FACILITY
= PROCESSING FACILITIES
= SOURCE MATERIAL STORAGE YARD

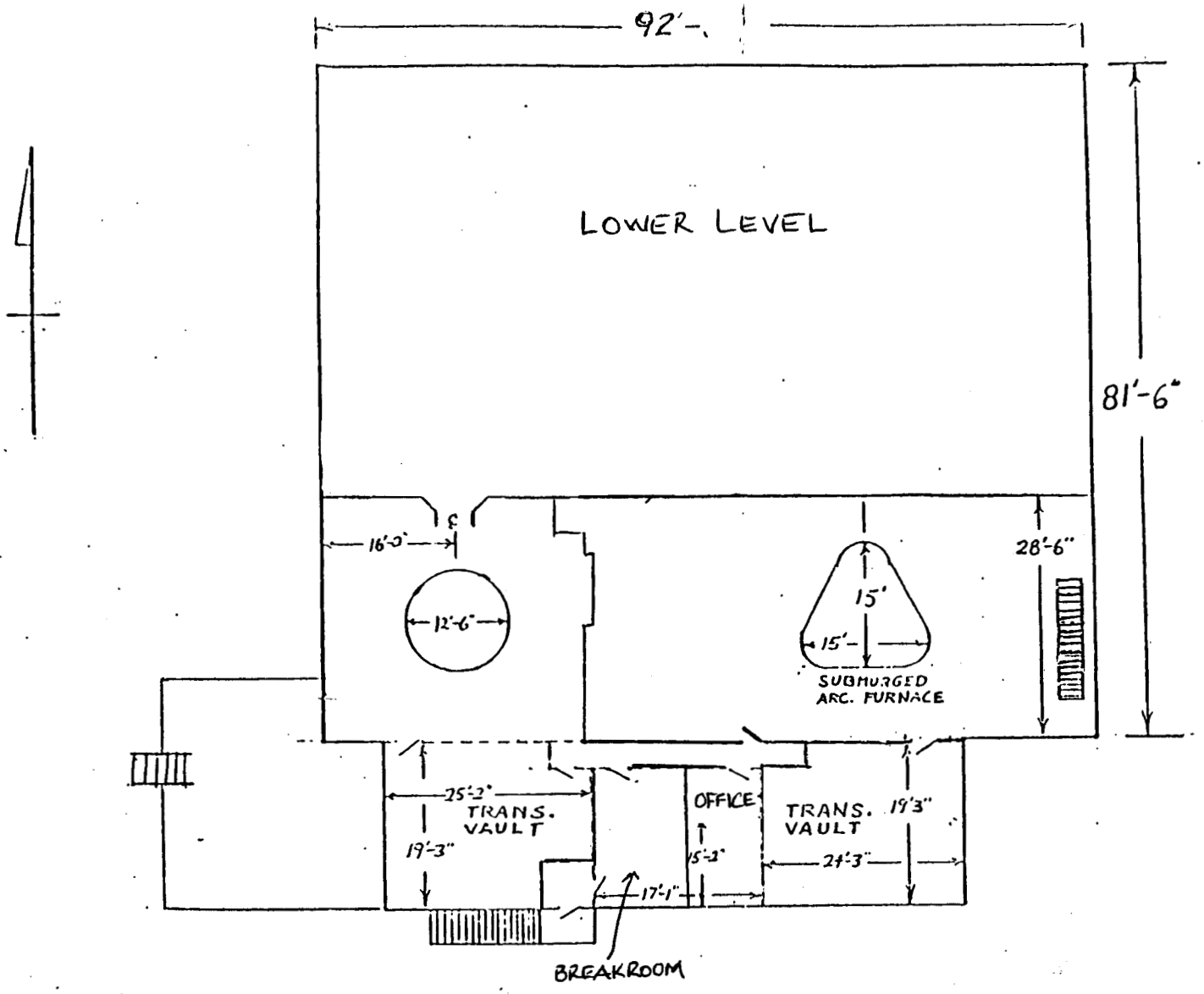


SHIELDALLOY METALLURGICAL CORP.

SCALE: 1" = 25'	APPROVED BY:	DRAWN BY ATM
DATE: 3/6/90		REVISED 10/25/90

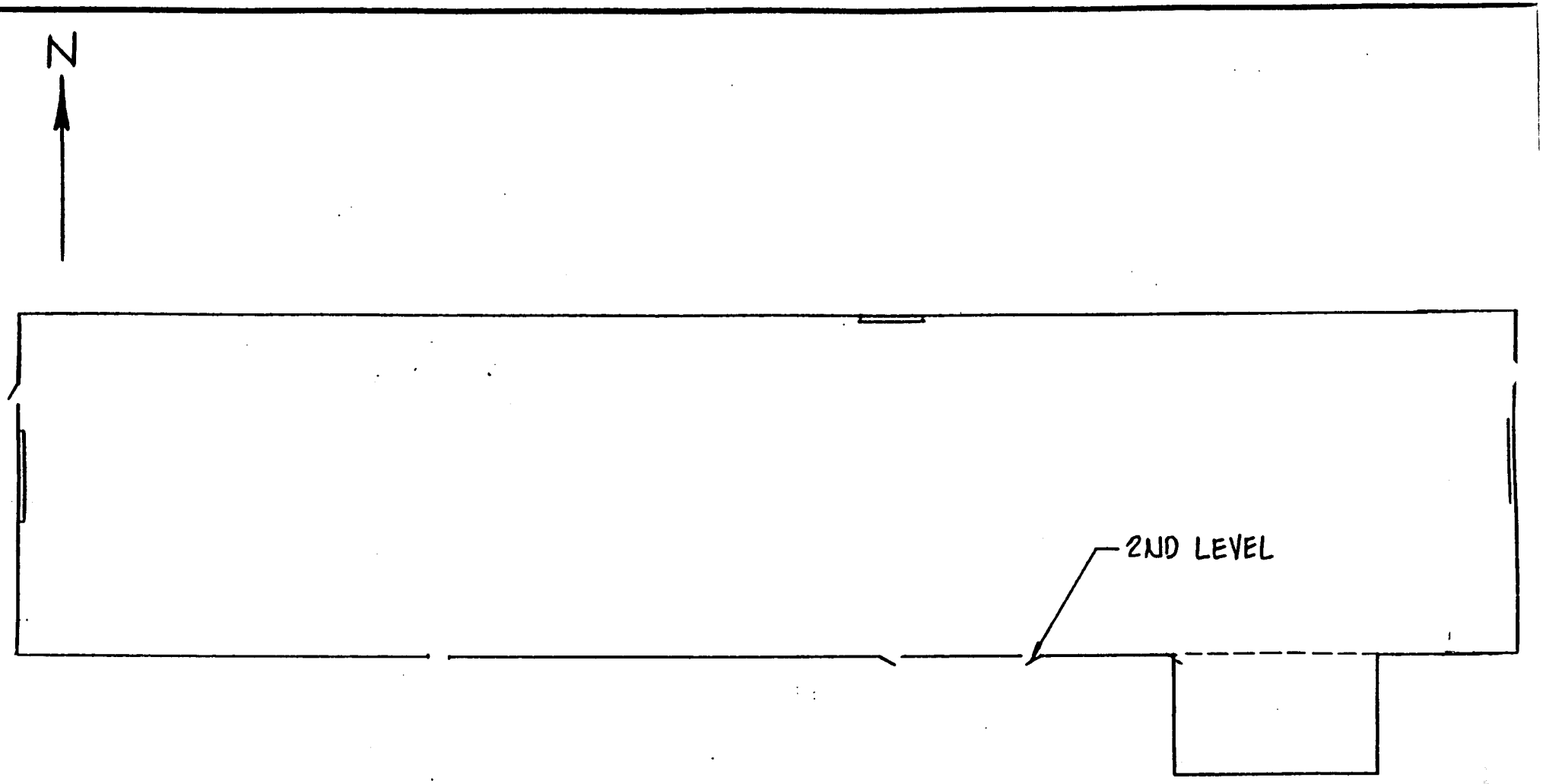
DEPT-111 MFG BLDG

REV	1	2	DRAWING NUMBER 111030690



D-111 UPPER LEVEL

SCALE: 1" = 20'	APPROVED BY:	DRAWN BY:
DATE: 2 Feb 77		REVISED
		DRAWING NUMBER

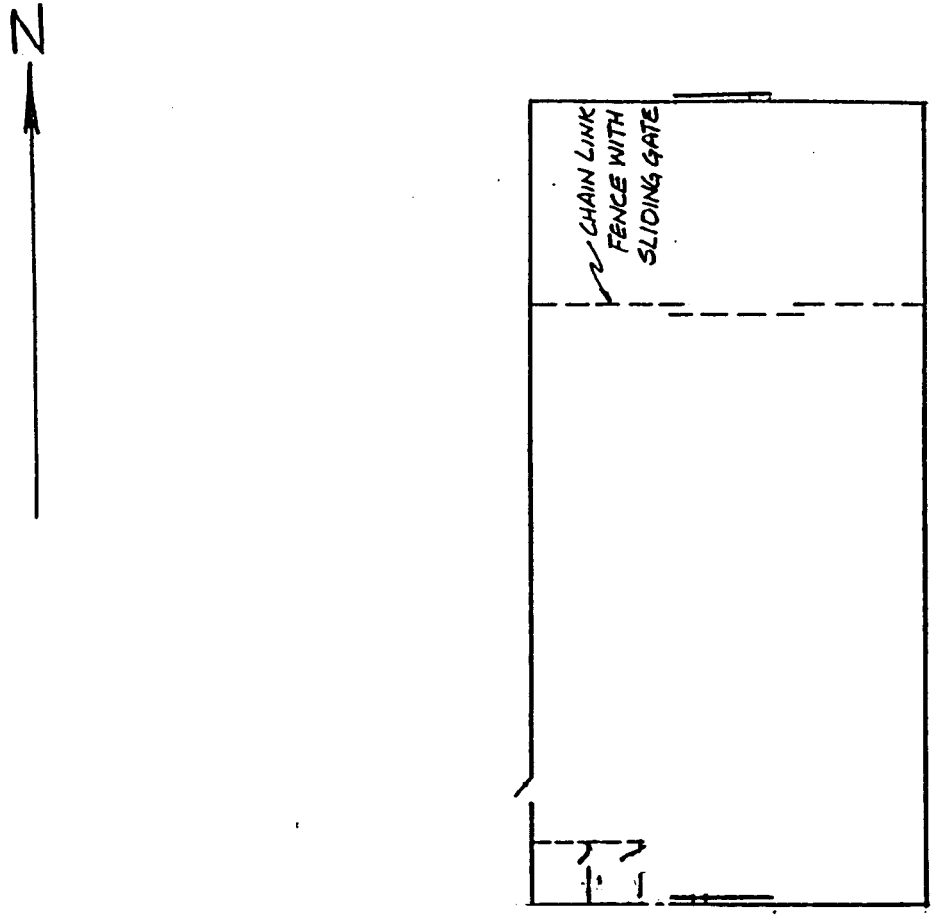


SHIELDALLOY METALLURGICAL CORP.

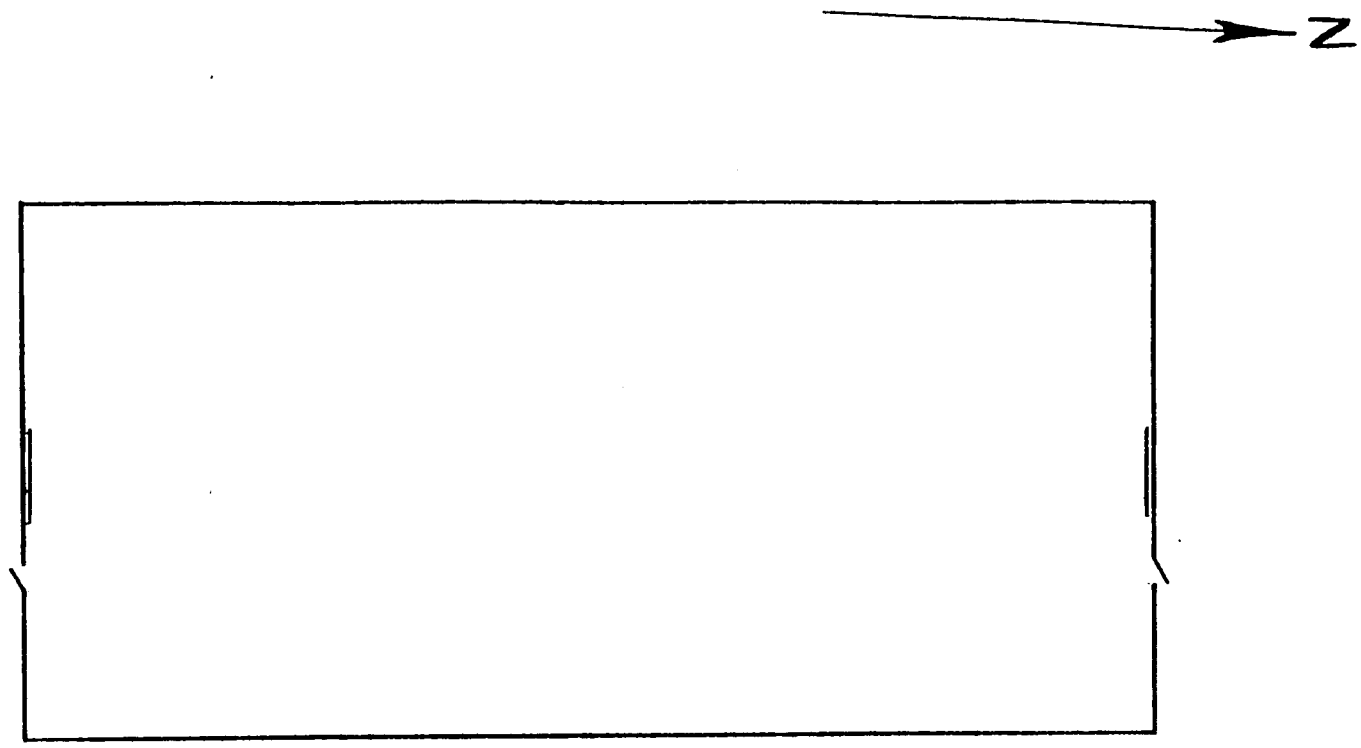
SCALE: 1" = 25'	APPROVED BY:	DRAWN BY Am
DATE: 3/6/90		REVISED

DEPT-102/112 MFG BLDG

DRAWING NUMBER
102030690



SHIELDALLOY METALLURGICAL CORP.			
SCALE: 1" = 25'	APPROVED BY: WFG		DRAWN BY AJM
DATE: 3/6/90			REVISED 10/25/90 AJM
DEPT-203 'A' WAREHOUSE			
REV 1	2		DRAWING NUMBER 203030690-C



SHIELDALLOY METALLURGICAL CORP.

SCALE: 1" = 25'	APPROVED BY:	DRAWN BY ATM
DATE: 3/6/90		REVISED

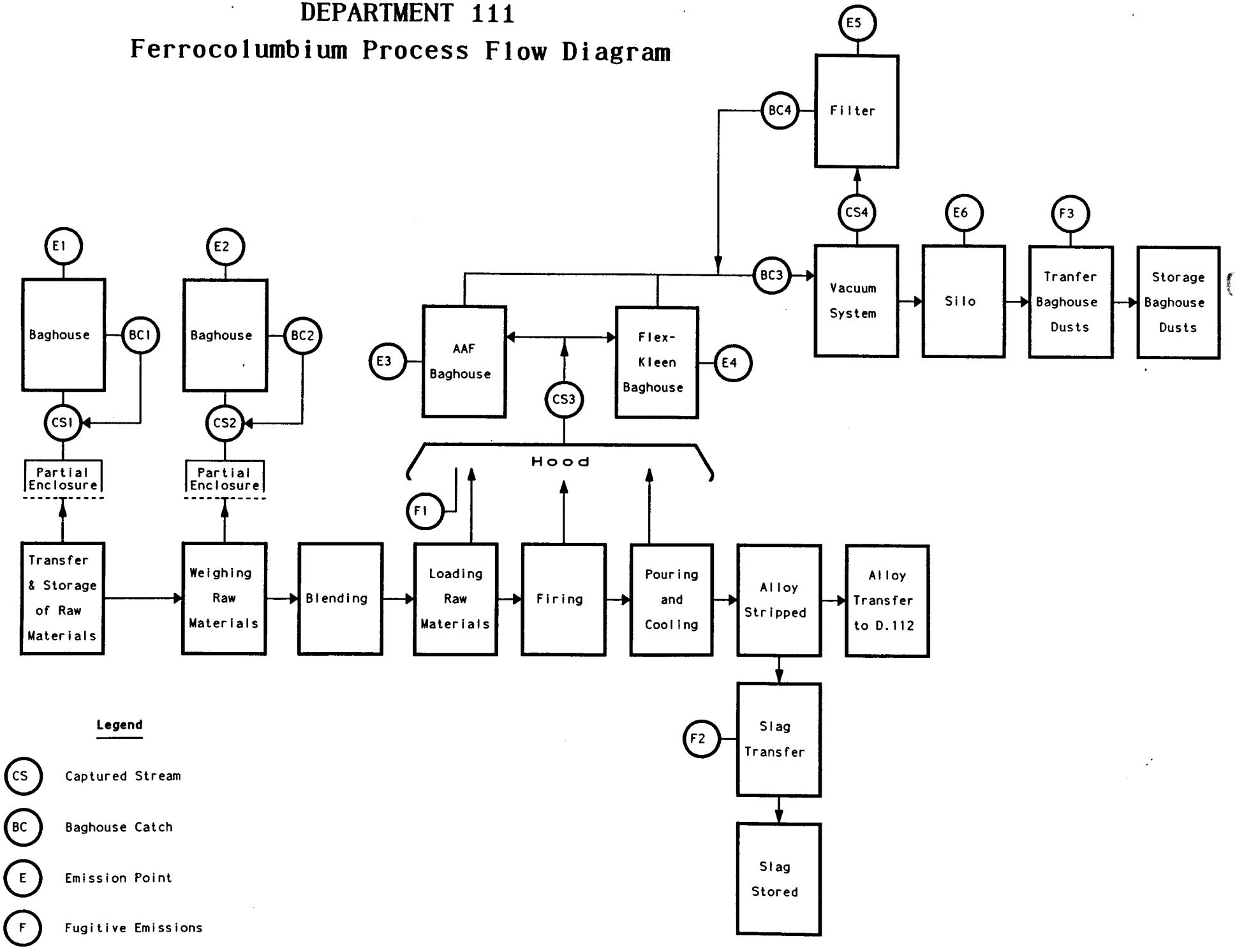
DEPT-203 'G' WAREHOUSE

DRAWING NUMBER 203030690-A

8½X11 PRINTED ON NO. 1000N CLEARPRINT

ATTACHMENT L

DEPARTMENT 111
Ferrocolumbium Process Flow Diagram



ATTACHMENT M

INTERNATIONAL TECHNOLOGY CORPORATION

BASELINE RADIOLOGICAL RISK ASSESSMENT FOR THE HUDSON'S BRANCH WATERSHED

Submitted to:

Shieldalloy Metallurgical Corporation
West Boulevard
Post Office Box 768
Newfield, New Jersey 08344

Submitted by:

C. D. Berger
IT Corporation/Nuclear Sciences
1133 21st Street, N.W., Suite 710
Washington, D. C. 20036
(202) 331-8510

Report No. IT/NS-92-116
November 3, 1992

9307080200 930629
PDR ADOCK 04007102
B PDR

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RISK ASSESSMENT 14

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DEFINITIONS

Baseline Risk Assessment - An assessment of potential risks to human health and the environment from current site conditions in the absence of remediation.

Committed Effective Dose Equivalent (CEDE) - The weighted sum of the dose equivalents to individual organs received over a 70-year lifetime. The magnitude of the weighting factor for each organ is determined by the risk of cancer induction in the individual organ (ICRP 1977).

Committed Dose Equivalent - The total dose equivalent averaged throughout a tissue in a specified time period after intake of a radionuclide into the body. For this assessment, a 50-year time period after intake is specified.

Dose Equivalent - A measure of the radiation effect obtained by multiplying the absorbed dose by the quality factor and other modifying factors. The common unit for dose equivalent is the "rem".

Dose Limits - Maximum dose rates permitted by regulations. Dose limits do not define a boundary between safe and hazardous conditions but rather they are conservatively established for regulatory purposes at levels that are not known to induce observable health effects in humans.

Exposure Pathway - A transport route and mechanism for human exposure to materials that have migrated from a source. An exposure pathway consists of a point of exposure in the environment, a receptor, a migration pathway, and a mechanism of entering the body (e.g., inhalation).

Migration Pathway - Mechanism for the transport of hazardous materials through environmental media.

Receptor - A person in the environment who may be exposed to hazardous materials.

INTRODUCTION

Shieldalloy Metallurgical Corporation (Shieldalloy) operates a manufacturing facility in Newfield, New Jersey (see Figure 1). This facility manufactures or has manufactured specialty steel and super alloy additives, primary aluminum master alloys, refractory and metal carbides, powdered metals, and optical surfacing products. Raw materials currently used at the facility include oxides of columbium (niobium), aluminum metal, titanium metal, strontium metal, zirconium metal, and fluoride (titanium and boron) salts. During the manufacturing processes, the facility generates slag, dross, bag house dust, and waste waters, among other waste streams.

Some of the materials received, used or stored by Shieldalloy at Newfield contain radioactive material which is classified as "source material" pursuant to Title 10, Code of Federal Regulations, Part 40. The U. S. Nuclear Regulatory Commission (USNRC) has issued a license to Shieldalloy to possess, use, and store source material at its Newfield site.

An evaluation of environmental radiological conditions at the Newfield site was completed in 1992 (IT 1992). For this evaluation, the following two specific tasks were performed:

1. Determine the whole body exposure rate at the boundary fence of the site; and

2. Obtain additional information on the potential for soil and sediment contamination at on-site locations, off-site portions of the Hudson's Branch watershed, and on South Haul Road.

The summary report, entitled "Assessment of Environmental Radiological Conditions at the Newfield Facility", indicated that elevated surface count rates were identified during walkover surveys due south of the Department 111 bag house.[1] Also, thorium and uranium concentrations in soil/sediment that are slightly in excess of background were noted outside of the Shieldalloy property boundaries in an area known as the Hudson's Branch Watershed. The most likely mechanism for transport of these radioactive materials outside of the property boundaries was through physical migration by way of storm water runoff, rather than movement through the groundwater. The Department 111 bag house (during silo-

[1] The Department 111 bag house contains low-concentration radioactive materials. The bag house silo is emptied periodically, and its contents are transported by open vehicle to the "lime pile", which is located in the southwestern corner of the storage yard. Fugitive emissions from this transfer operation may be the source of the elevated surface soil count rates identified in this area.

emptying operations) and the lime pile in the storage yard are considered to be the likely sources of physical migration of radioactive materials into the Hudson's Branch.

Shieldalloy intends to perform a feasibility study for remediation of the Hudson's Branch. As part of that effort, a baseline assessment of the radiological risk to members of the general population from the materials which currently exist in the Hudson's Branch was performed. This document contains a description of the approach and results of the risk assessment, and will form the basis for evaluating corrective measures for the Hudson's Branch.

APPROACH

The basic approach to completion of the baseline radiological risk assessment for the Hudson's Branch was to first identify the radioactive constituents of potential concern. The second step was to characterize the exposure setting and identify exposure pathways. The concentrations of contaminants at potential exposure points were assessed for both present and future time intervals. For the present time, direct measurements of radionuclide concentrations in soil, as reflected in the site characterization report, were used to determine exposure point concentrations. Environmental transport models were used to predict future concentrations.

After the pathways were identified and the radionuclide fate and transport were determined, a radiation dose assessment was performed. For this effort, the methodologies contained in "A Manual for Implementing Residual Radioactive Material Guidelines" (ANL 1989) were used to provide radiation dose estimates from radionuclides contained in soil and groundwater. To estimate the potential risks to humans from the calculated doses, the methods promulgated by the National Council on Radiological Protection and Measurement (NCRP) were used (NCRP 1987). For this report, risk is defined as the annual or lifetime probability of the development of fatal cancer from exposure to ionizing radiation, and is estimated by:

$$Risk = (D)\ (CF)$$

where D = the dose received by the maximally-exposed individual, and CF = a conversion factor based upon the linear, no-threshold hypothesis. The conversion factor that was used for this assessment is 1.25×10^{-4} fatal cancers per rem of radiation dose equivalent (NCRP 1987).

The final step in this risk assessment process was the development of conclusions for the no-action alternative for the radioactive materials in the Hudson's Branch. The remainder of this document contains the results of the risk assessment, including a description of the radionuclides of potential concern and their concentrations, a description and results of the dose assessment, an evaluation of risks, and a discussion of the uncertainties which are associated with the dose and risk assessment.

IDENTIFICATION OF RADIONUCLIDES

The assessment of potential human health risks associated with any site first requires identification of the contaminants of potential concern. The radionuclides identified in the Newfield site characterization report (IT 1992) are considered to be contaminants of potential concern under current and future land-use conditions for the Hudson's Branch Watershed. These contaminants are Thorium-232, Uranium-238, and Radium-226. However, the types and concentrations of contaminants used for this assessment are based on conditions as they existed during the 1991 sampling effort, with the effect of future releases not considered.

Contaminant Concentrations

The concentrations of thorium, uranium and radium in soil in and around the Hudson's Branch were measured and reported in the site characterization report (IT 1992), and are summarized in Table 1.[2] These data were used to develop a "mean concentration" for input into the dose and risk assessment.

Figure 3 depicts the frequency distribution of these data, which shows that the measured results cannot be adequately represented by a symmetric normal distribution. The data are actually skewed (asymmetrical) such that a log-normal distribution appears to be more a reasonable approximation of the true distribution.[3] Therefore, the mean concentration is estimated by:

$$Mean = \exp\left(\bar{y} + \frac{s^2}{2}\right)$$

where y = the arithmetic mean of transformed values where $y_i = \ln x_i$, and s = the variance.[4] Table 2 shows the mean concentrations for each contaminant of potential concern in the Hudson's Branch.

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[2] Figure 2 contains a map showing the grid locations referenced in Table 1. See (IT 1992) for specific information on radionuclide locations at each sampling location.

[3] Log-normal distributions of data are not untypical for environmental media (Horton 1980, Pinder 1975, McLendon 1975).

[4] Since runoff is a likely mechanism by which the radionuclides migrate, the range of their concentrations at various locations within the Hudson's Branch and at various times of the year is also assumed to be log-normally distributed about some mean value.

Evaluation of Background

The term "background" refers to the average level of radioactivity that would be present in the Hudson's Branch if the Shieldalloy operation had never existed. The site characterization report (IT 1992) contains soil concentrations for background locations that were similar to and representative of the Hudson's Branch. Table 3 shows a summary of those results.[5] Unlike the soil concentrations measured in the Hudson's Branch, the background concentrations do not follow an obvious geometric distribution. Therefore, for the purposes of this assessment, it is assumed that the range of background values at various locations and at various times of the year are normally distributed about some mean value.

The concentrations of radioactive materials in the Hudson's Branch that were used as input to the dose assessment were determined by subtracting the mean background concentration for each of the radionuclides of interest (Table 3) from the mean measured concentration in the Hudson's Branch (Table 2). The results are shown in Table 4.

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[5] See (IT 1992) for an explanation of the grid locations shown in Table 3.

DOSE ASSESSMENT

The general procedure for conducting the radiation dose assessment from radionuclides present in the Hudson's Branch Watershed consisted of the following:

- Characterization of the exposure settings;
- Identification of the exposure pathways; and
- Estimation of potential human intake of radionuclides and assessment of radiation dose equivalent.

Characterization of Exposure Settings

The majority of the Shieldalloy site is in active industrial use. Access to the industrial portion is controlled by a chain-link fence topped with barbed wire, a gate entrance, and a guard. The remainder of the property is undeveloped and has unrestricted access. However, there are currently no residents within approximately 50 yards of the property boundary.

The Hudson's Branch Watershed is located southwest of the Shieldalloy plant, and crosses the property boundary in an area that has unrestricted access. During the 1991 walk-over survey of the area, elevated surface count rates were noted only in the immediate vicinity of the Hudson's Branch. Outside of this small area, surface count rates and soil concentrations did not differ from background. Therefore, for this assessment, it was assumed that the soil area of interest is represented by a 135 m^2 land area, which was the area of interest for the site characterization report (IT 1992).

The city of Vineland has designated certain areas of the city as aquifer exclusion zones, requiring mandatory connection with public water systems and sealing of domestic and supply wells. However, residents located outside of this well restriction, primarily to the south of the Shieldalloy site, may use private wells as a potable drinking water source (TRC 1992). Therefore, both soil and groundwater are considered to be possible sources of human exposure to ionizing radiation from contaminants in the Hudson's Branch.

Identification of Exposure Pathways

Dose estimates for this assessment were based on a "farm family" scenario. In this scenario, a family is assumed to move onto 135 m^2 of property in the Hudson's Branch. Even though it is physically impossible for such a small land area to support a dwelling, livestock, and crops, it is assumed that the family builds a home, and raises crops and livestock for family

consumption. Consequently, these family members may incur a radiation dose by the following pathways:

- Direct radiation from radionuclides in the soil;
- Inhalation of re-suspended dust;
- Ingestion of food from crops grown in the contaminated soil;
- Ingestion of milk from livestock raised in the contaminated area;
- Ingestion of meat from livestock raised in the contaminated area;
- Ingestion of fish from a nearby (hypothetical) pond contaminated by water percolating through the contaminated zone; and
- Ingestion of water from a (hypothetical) well contaminated by water percolating through the contaminated zone.

The basis for selection of a resident farm family as the critical population for this dose assessment is that exposure of permanent residents is long-term in nature, generally involves a greater number of exposure pathways than for non-residents,[6] and results in a higher estimate of radiation dose.

Radiation Dose Assessment

To assess radiation dose to members of the hypothetical farm family, it was assumed that the entire area of the Hudson's Branch (135 m^2) is evenly contaminated with radioactive materials at the concentrations shown in Table 4. The computer code entitled RESRAD (ANL 1989) was used to model radionuclide fate and transport, and to assess the committed dose equivalent from these contaminants.

In the code, the concentrations in soil are assumed to decrease with time due to radioactive decay and leaching of the radionuclides into the subsurface soils and subsequently into the

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[6] The non-resident group most likely to receive exposure from radioactive materials contained in the Hudson's Branch consists of "scavengers". While scavenging can occur, this is not considered to be a likely scenario considering the lack of economic value of the contaminated materials in the Hudson's Branch. Furthermore, the exposure of scavengers is much smaller than that of a hypothetical permanent resident since the scavenger will spend less time at the Hudson's Branch than the resident.

regional aquifer. Dose calculations were performed for a period of time starting at initial placement of the material (t=0 years) and ending 1000 years later.[7]

Concentrations of radionuclides in food crops and forage were calculated by multiplying a single soil-to-vegetable transfer factor for each stable element by the calculated concentration in soil over time. Radionuclide concentrations in beef and milk were calculated by multiplying elemental transfer factors for forage-to-milk and forage-to-beef by the concentration in forage and the daily consumption rate of forage by cows.

External radiation doses from soil were calculated by assuming continuous occupancy. In addition, the receptor (farm family member) is assumed to be located at the center of a cylindrical waste area of 135 m^2, and that no shielding exists between the contaminated soil and the receptor.

In general, the input parameters to the RESRAD code, including Dose Conversion Factors, were selected from the RESRAD default values. Appendix A contains a listing of those parameters, and Appendix B contains a listing of the RESRAD pathways considered for this analysis.

Figure 4 shows the total dose to a member of the farm family for all radionuclides in the Hudson's Branch and all exposure pathways. The maximum dose of 14.18 millirem per year occurs within the first year after initial deposition of the radioactive materials in the Hudson's Branch.[8]

Table 5 shows the relative contribution of the various exposure pathways to the total dose. The majority of the dose (89%) received in the first year is attributed to external radiation exposure. However, it is important to note that the maximum measured exposure rate above background in the Hudson's Branch was 9 millirem per year (IT 1992).[9] The average

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[7] Even though active surveillance measures by Shieldalloy to prevent residency on the Hudson's Branch are likely to remain in effect for at least 50 years, and that it is not likely a family will build a house in a flood plain, it is nonetheless assumed that the farm family occupies the site at t=0, and that each member lives on or adjacent to the contaminated soil for 50 years.

[8] For comparison, the environmental radiological dose standard promulgated by the U. S. Nuclear Regulatory Commission is 100 millirem per year (NRC 1991). The standard promulgated by the U. S. Environmental Protection Agency (EPA 1991) is 25 millirem per year.

[9] Walkover survey measurements at a height of one meter above the ground surface revealed a maximum of 67 mR per year, and the average background for the Newfield area was 58 mR per year, for a net value of 9 mR per year.

measured dose rate did not differ significantly from background.[10] Therefore, the dose estimate produced by the RESRAD code is clearly conservative.

[10] Walkover survey measurements at a height of one meter above the ground surface revealed an average of 41.5 mR per year, which does not differ significantly from the average background for the Newfield area of 58 mR per year.

RISK ASSESSMENT

The principal adverse biological effects associated with ionizing radiation exposure from radioactive substances in the environment are carcinogenicity, mutagenicity, and teratogenicity.[11] Radiation may induce other deleterious effects at acute doses in excess of 100 rem (100,000 millirem), but doses of this magnitude are seldom associated with environmental radioactivity. Therefore, the basis for assessing the radiation-related human health risks for the hypothetical farm family in the Hudson's Branch is a risk factor for fatal cancers of 1.25×10^{-4} per rem (CEDE) of ionizing radiation (NCRP 1987).

For this assessment, the cancer risk attributed to exposure to radionuclides in the Hudson's Branch is estimated by multiplying the maximum total dose for all radionuclides in a particular pathway by the risk factor for fatal cancer of 1.25×10^{-4} per rem. The total risk from all pathways, based upon the maximum total risk value of 14.18 millirem per year at year t=0 is:

$$Risk = 14.18 \frac{mrem}{year} \times \frac{1\ rem}{1000\ mrem} \times 1.25x10^{-4} \frac{fatal\ cancers}{rem} = 1.77x10^{-6} \frac{fatal\ cancers}{year}$$

It is important to note that this rate only occurs at the time of initial placement of radioactive materials in the Hudson's Branch. The dose rate, and thus the risk rate, decreases with time. For comparison, the following is the risk estimate to an average member of the United States population from annual background radiation exposure:

$$Risk = 380 \frac{mrem}{year} \times \frac{1\ rem}{1000\ mrem} \times 1.25x10^{-4} \frac{fatal\ cancers}{rem} = 4.75x10^{-5} \frac{fatal\ cancers}{year}$$

Thus the hypothetical farm family's risk of fatal cancer associated with normal background radiation exposure is approximately 27 times greater than the risk associated with the radioactive materials in the Hudson's Branch.

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[11] Carcinogenicity is the ability to produce cancer. Mutagenicity is the property of being able to induce genetic mutation which may be in the nucleus of either body cells or reproductive cells. Teratogenicity refers to the ability of an agent to induce or increase the incidence of congenital malformations as a result of the permanent structure or functional deviations produced during the growth and development of the embryo.

UNCERTAINTY ANALYSIS

Uncertainties in the Assessment of Dose

Uncertainties associated with the dose assessment portion of this effort include those related to fate and transport modeling, the characterization of radiological constituents in the Hudson's Branch, and exposure parameters. A summary of the sources of uncertainty is contained in Table 6.

Uncertainties in the Assessment of Risk

Numerous references provide numeric estimates of the risk of fatal cancer induction from ionizing radiation. These are generally a function of CEDE, dose to a single organ, whole body dose, duration of exposure, or quantity of radioactive material ingested or inhaled. For this assessment, however, a single factor for lifetime risk of fatal cancer as a function of CEDE was selected. It was felt that the greater accuracy attributed to the use of multiple factors for specific exposure routes would be masked by the magnitude of the other uncertainties in estimating human intake of radionuclides.

The risk factor used for this assessment assumes full expression of cancer risk (which is unlikely to occur from exposure received late in life) and that the farm family "population" is normally distributed over age and sex. In other words, the risk factor used is an average for both sexes and for a normal population distribution between 18 and 60 years of age (NCRP 1987).

SUMMARY AND CONCLUSIONS

A recent site characterization effort at Shieldalloy Metallurgical Corporation's Newfield facility revealed the presence of radioactive materials outside of the Shieldalloy controlled area, in the Hudson's Branch Watershed. In order to guide remedial action decisions, a baseline assessment of the radiological risk from the materials which currently exist in the Hudson's Branch was performed. In general, the risk assessment was based on the methodologies contained in Gilbert, T. L., et al, "A Manual for Implementing Residual Radioactive Material Guidelines" (ANL 1989) and on cancer risk coefficients based on the recommendations of the NCRP (NCRP 1987).

The maximum radiation dose rate to a resident farm family as a result of the thorium, radium, and uranium which currently exists in the Hudson's Branch is 14.18 millirem per year, which occurs at the time of initial placement of the materials. The dose rate drops steadily thereafter, to a rate of less than 5 millirem per year after year 70. The risk of fatal cancer is 1.77×10^{-6} at the time of initial placement. This can be compared to a risk of 4.75×10^{-5} incurred by an average member of the United States population from annual background radiation exposure. The risk of fatal cancers to individuals who may frequent areas of the Hudson's Branch <u>outside</u> of the 135 m^2 area of interest is virtually zero.

There are a number of uncertainties associated with this assessment. In particular, the assumptions used in this baseline radiological risk assessment were clearly conservative. The following are examples of those assumptions which are likely to lead to over-estimations of the dose:

- Assuming a "farm family" scenario, even though it is not likely that a family would build a house directly within this flood plain.
- Assuming the soil area of interest was 135 m^2, even though it is not possible to support a farm family on this small plot of land.
- Assuming the contaminant level was assumed to be homogeneous, even though this is not supported by the walk-over survey data or the soil sampling results.

The true risk to a farm family member is likely to be significantly less than the exaggerated risk of 1.77×10^{-6} based upon these conservative assumptions. Consequently, if no remedial actions are taken, the human health risks associated with the radioactive materials which exist in the Hudson's Branch are acceptable.

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TABLE 1: RADIONUCLIDE CONCENTRATIONS IN SOIL

Grid Location	U-238 (pCi/g)	Th-232 (pCi/g)	Ra-226 (pCi/g)
0+10,10L	5.65	5.1	21
-0+10,10L	5.65	--	21
-0+20	1.75	3.17	0.8
-0+30	4.20	--	3.1
-0+50	1.36	1.94	1.6
-0+50(QC)	1.63	9.56	14
-0+60	3.14	3.41	19
-0+90	2.10	2.61	17
-3+50(QC)	1.63	--	14
0+20	2.57	1.38	2.4
0+30,10L	0.96	1.11	0.7
0+100 10L	5.71	8.86	34
1+10,10R	1.92	2.34	4.7
1+20	--	2.63	7.0
1+50,10R	1.27	1.56	2.1
1+80,10R	0.89	1.62	1.9
1+80L,10L	1.18	1.97	0.6
1+100,10L	2.55	--	12
2+20,10R	2.67	2.93	<1.4
2+30,10R	2.37	4.11	12
2+60,10L	1.10	1.31	0.5
2+70	2.25	3.73	11
2+80,10L	1.03	1.11	0.4
2+90,10L	0.77	1.68	0.6
3+80,10R (QC)	1.38	1.51	8.1

TABLE 2: CONTAMINANT CONCENTRATIONS

Radionuclide	**Mean Concentration in the Hudson's Branch (pCi/g)**
Thorium-232 Concentration in Soil	2.47
Uranium-238 Concentration in Soil	1.95
Radium-226 Concentration in Soil	4.17

TABLE 3: BACKGROUND RADIONUCLIDE CONCENTRATIONS

Grid Location:	Radionuclide Concentration in Soil		
	Th-232 (pCi/gram)	Ra-226 (pCi/gram)	U-238 (pCi/gram)
ORAU 1	0.3	0.5	1.3
ORAU 2	0.5	0.4	<0.4
ORAU 3	0.1	0.3	0.3
ORAU 4	0.1	0.2	<0.3
ORAU 5	0.4	0.7	<0.4
ORAU 6	0.5	0.9	0.4
ORAU 7	0.6	0.5	0.8
ENSR 1	1.48	0.6	0.83
ENSR 2	0.28	1.0	1.38
ENSR 3	1.91	0.82	1.37
ENSR 4	1.68	< 0.5	0.92
ENSR 5	1.19	0.85	1.04
ENSR 6	1.35	0.81	0.42
Mean $\pm$ σ	0.8 $\pm$ 0.6	0.6 $\pm$ 0.3	0.8 $\pm$ 0.4

TABLE 4: CONTAMINANT CONCENTRATIONS USED FOR THE RISK ASSESSMENT

Radionuclide	*Net Concentration in Soil (pCi/g)*
Thorium-232	*1.67*
Uranium-238	*1.14*
Radium-226	*3.57*

TABLE 5: FRACTION OF TOTAL DOSE IN YEAR ONE AFTER DEPOSITION

Pathway	Fraction
Ground	0.8926
Inhalation of Dust	0.0788
Radon	0.0044
Plant	0.0219
Meat	0.0001
Milk	0.0000
Soil	0.0021
Water	0.0000
Fish (Water-dependent pathway)	0.0000
Radon (Water-dependent pathway)	0.0000
Plant (Water-dependent pathway)	0.0000
Meat (Water-dependent pathway)	0.0000
Milk (Water-dependent pathway)	0.0000

TABLE 6: UNCERTAINTIES IN THE DOSE ASSESSMENT

Uncertainty	Effect on the Estimate of Risk (Low, Moderate, High)*
SITE CHARACTERIZATION:	
Sufficient numbers of samples were not taken to fully characterize the media being evaluated	High potential for over- or under-estimation of exposure
Surface soil samples used in the characterization of the Hudson's Branch were biased in that sample locations were selected based on high count rates on survey equipment	Low potential for over-estimation of exposure
EXPOSURE PARAMETER ESTIMATION:	
The contaminated ground surface was greater than 135 m^2 in area	High potential for over-estimation of exposure.
The standard assumptions regarding body weight, periods exposed, rates of intake, life span, etc. may not be representative of any actual exposure population	Low potential for over- or under-estimation of exposure
Use of conservative dose conversion factors to model radionuclide dose	Low potential for over-estimation of exposure
FATE AND TRANSPORT MODELING:	
All of the soil contained in the Hudson's Branch is assumed to be from a single, evenly-contaminated source	Moderate potential for over-estimation of exposure
Child is assumed to ingest soil for 274 days per year	High potential for over-estimation of exposure

Concentrations selected for soil assumed a normal distribution of sample concentrations about a mean value. The distribution of sample concentrations were not symmetrical around the mean, but highly skewed	Moderate potential for over-estimation of exposure
Assumption that the regional aquifer is homogeneous in composition	Low potential for over- or under-estimation of exposure
Selection of seepage velocities for the movement through the unsaturated soil into the aquifer	Low potential for over- or under-estimation of exposure
Assumption of a constant infiltration rate into the aquifer	Low potential for over- or under-estimation of exposure
Estimates of leachate concentration for groundwater transport	High potential for over- or under-estimation of exposure
Assumptions on the chemical and physical forms of contaminants and their effect on movement via groundwater	Moderate potential for over- or under-estimation of the arrival time at the receptor

- Low = could effect estimation of intake by less than one order of magnitude; Moderate = Could effect estimate of intake from one to two orders of magnitude; and High = Could effect estimation of intake by greater than two orders of magnitude.

FIGURE 1: Location of the Newfield Plant

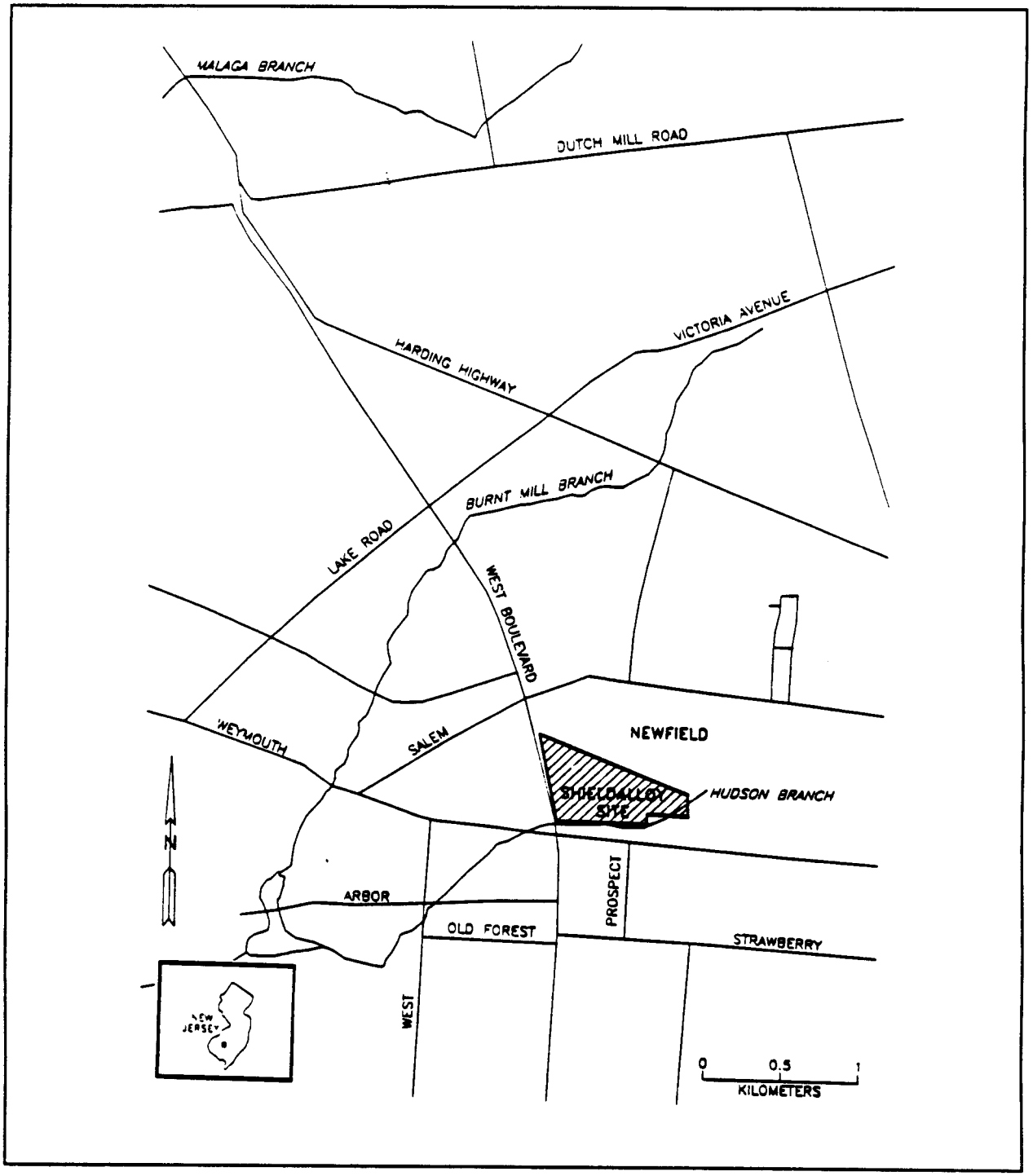


FIGURE 2: Grid Locations in the Hudson's Branch

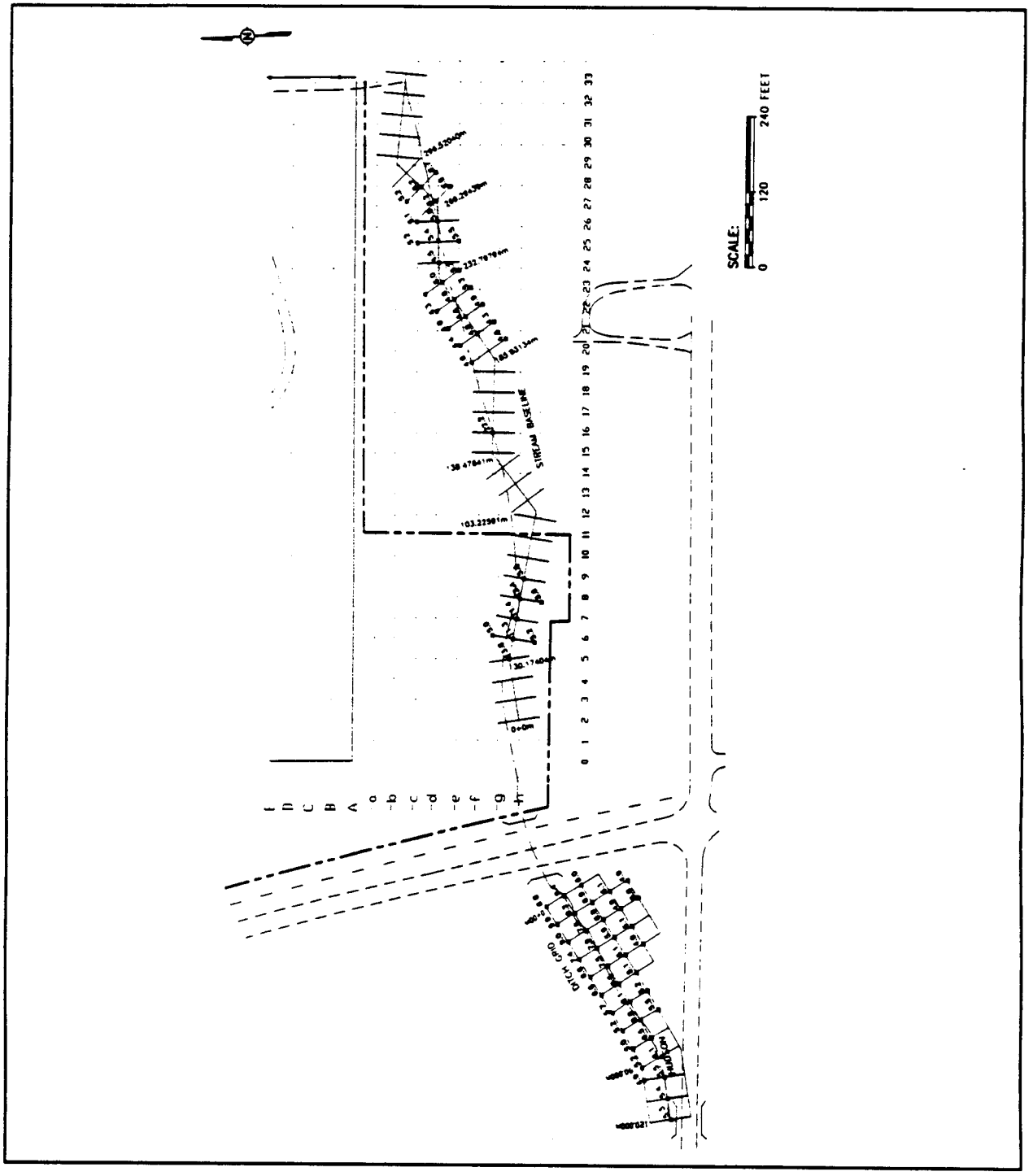


FIGURE 3: Frequency Distribution of Soil Concentrations

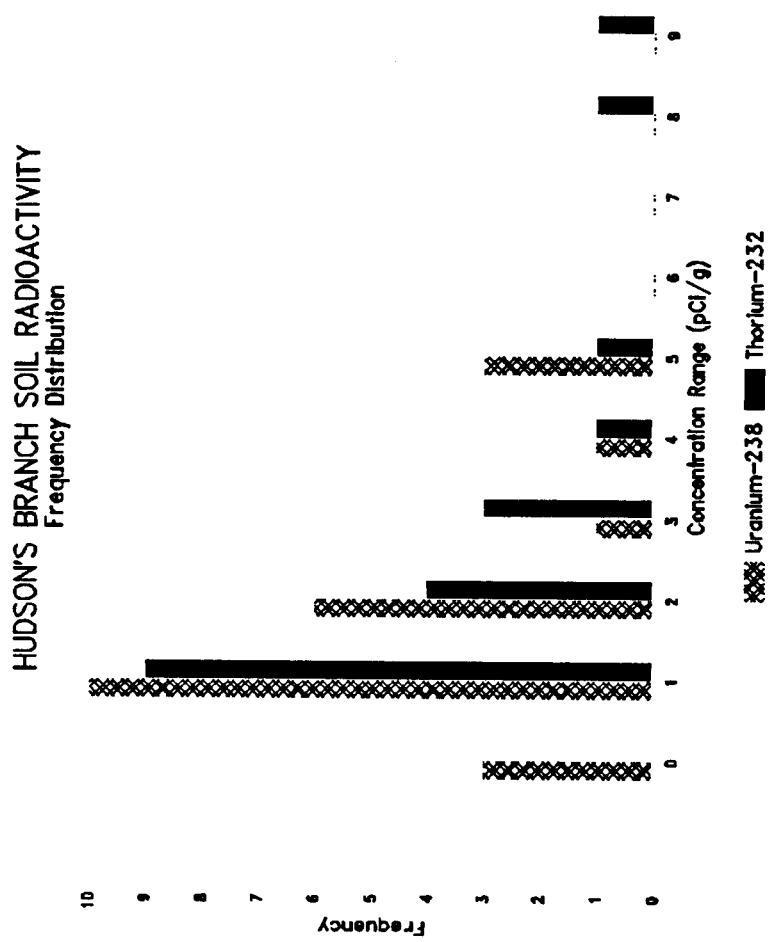
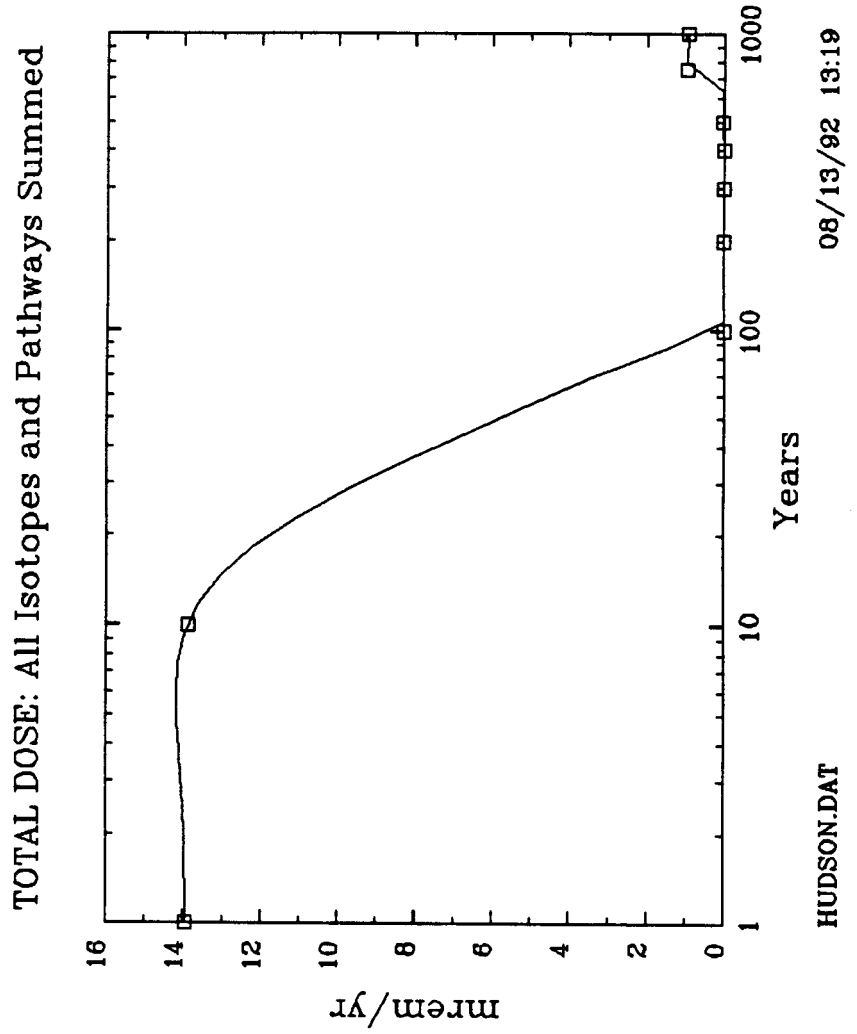


FIGURE 4: Total Dose from Radioactive Materials in the Hudson's Branch



APPENDIX A: PARAMETER VALUES USED FOR THE DOSE ASSESSMENT

Parameter	Input Value
Area of contaminated zone (m^2)	1.350E+02
Thickness of contaminated zone (m)	1.000E-01
Length parallel to aquifer flow (m)	1.000E+02
Basic radiation dose limit (mrem/yr)	1.000E+02
Time since placement of material (yr)	0.000E+00
Initial principal radionuclide (pCi/g ^{226}Ra)	3.570E+00
Initial principal radionuclide (pCi/g^{232}Th)	1.670E+00
Initial principal radionuclide (pCi/g ^{238}U)	2.320E+00
Cover depth (m)	0.000E+00
Density of contaminated zone (g/cm^3)	1.600E+00
Contaminated zone erosion rate (m/yr)	1.000E-03
Contaminated zone total porosity	4.000E-01
Contaminated zone effective porosity	1.000E-01
Contaminated zone hydraulic conductivity (m/yr)	1.000E+01
Contaminated zone b parameter	5.300E+00
Evapotranspiration coefficient	6.000E-01
Precipitation (m/yr)	1.000E+00
Irrigation (m/yr)	1.000E-01
Irrigation mode	Overhead
Runoff coefficient	2.000E-01
Watershed area for nearby stream or pond (m^2)	1.000E+06
Density of saturated zone (g/cm^3)	1.600E+00
Saturated zone total porosity	4.000E-01
Saturated zone effective porosity	2.000E-01
Saturated zone hydraulic conductivity (m/yr)	1.000E+02
Saturated zone hydraulic gradient	2.000E-02

Saturated zone b parameter	5.300E+00
Water table drop rate (m/yr)	1.000E-03
Well pump intake depth (m below water table)	1.000E+01
Model: Nondispersion (ND) or Mass Balance (MB)	ND
Individual's use of groundwater (m^3/yr)	1.500E+02
Number of unsaturated zone strata	1
Unsaturated zone 1, thickness (m)	4.000E+00
Unsaturated zone 1, soil density (g/cm^3)	1.600E+00
Unsaturated zone 1, total porosity	4.000E-01
Unsaturated zone 1, effective porosity	2.000E-01
Unsaturated zone 1, soil-specific b parameter	5.300E+00
Unsaturated zone 1, hydraulic conductivity (m/yr)	1.000E+02
Distribution coefficients for Ra-226:	
Contaminated zone (cm^3/g)	7.000E+01
Unsaturated zone 1 (cm^3/g)	7.000E+01
Saturated zone (cm^3/g)	7.000E+01
Leach rate (per year)	0.000E+00
Distribution coefficients for Th-232:	
Contaminated zone (cm^3/g)	6.000E+04
Unsaturated zone 1 (cm^3/g)	6.000E+04
Saturated zone (cm^3/g)	6.000E+04
Leach rate (per year)	0.000E+00
Distribution coefficients for U-238:	
Contaminated zone (cm^3/g)	5.000E+01
Unsaturated zone 1 (cm^3/g)	5.000E+01
Saturated zone (cm^3/g)	5.000E+01
Leach rate (per year)	0.000E+00
Distribution coefficients for daughter Pb-210:	
Contaminated zone (cm^3/g)	1.000E+02

Unsaturated zone 1 (cm^3/g)	1.000E+02
Saturated zone (cm^3/g)	1.000E+02
Leach rate (per year)	0.000E+00
Distribution coefficients for daughter Ra-228:	
Contaminated zone (cm^3/g)	7.000E+01
Unsaturated zone 1 (cm^3/g)	7.000E+01
Saturated zone (cm^3/g)	7.000E+01
Leach rate (per year)	0.000E+00
Distribution coefficients for daughter Th-228:	
Contaminated zone (cm^3/g)	6.000E+04
Unsaturated zone 1 (cm^3/g)	6.000E+04
Saturated zone (cm^3/g)	6.000E+04
Leach rate (per year)	0.000E+00
Distribution coefficients for daughter Th-230:	
Contaminated zone (cm^3/g)	6.000E+04
Unsaturated zone 1 (cm^3/g)	6.000E+04
Saturated zone (cm^3/g)	6.000E+04
Leach rate (per year)	0.000E+00
Distribution coefficients for daughter U-234:	
Contaminated zone (cm^3/g)	5.000E+01
Unsaturated zone 1 (cm^3/g)	5.000E+01
Saturated zone (cm^3/g)	5.000E+01
Leach rate (per year)	0.000E+00
Inhalation rate (m^3/yr)	8.400E+03
Mass loading for inhalation (g/m^3)	2.000E-04
Dilution length for airborne dust, inhalation (m)	3.000E+00
Occupancy factor, inhalation	4.500E-01
Occupancy and shielding factor, external gamma	6.000E-01
Shape factor, external gamma	1.000E+00

Fruits, vegetables and grain consumption (kg/yr)	1.600E+02
Leafy vegetable consumption (kg/yr)	1.400E+01
Milk consumption (l/yr)	9.200E+01
Meat and poultry consumption (kg/yr)	6.300E+01
Fish consumption (kg/yr)	5.400E+00
Other seafood consumption (kg/yr)	9.000E-01
Soil ingestion rate (g/yr)	3.650E+01
Drinking water intake (l/yr)	4.100E+02
Fraction of drinking water from site	1.000E+00
Fraction of aquatic food from site	5.000E-01
Livestock fodder intake for meat (kg/day)	6.800E+01
Livestock fodder intake for milk (kg/day)	5.500E+01
Livestock water intake for meat (l/day)	5.000E+01
Livestock water intake for milk (l/day)	1.600E+02
Mass loading for foliar deposition (g/m^3)	1.000E-04
Depth of soil mixing layer (m)	1.500E-01
Depth of roots (m)	9.000E-01
Drinking water fraction from ground water	1.000E+00
Livestock water fraction from ground water	1.000E+00
Irrigation fraction from ground water	1.000E+01
Total porosity of the building foundation	1.000E-01
Volumetric water content of the foundation	1.000E-02
Diffusion coefficient for radon gas (m/sec):	
In foundation material	2.000E-08
In contaminated zone soil	2.000E-06
Radon vertical dimension of mixing (m)	2.000E+00
Average annual wind speed (m/sec)	2.000E+00
Average building air exchange rate (l/hr)	1.000E+00
Height of the building (room) (m)	2.500E+00

Building interior area factor	1.000E+00
Bulk density of building foundation (g/cm^3)	2.400E+00
Thickness of building foundation (m)	1.500E-01
Building depth below ground surface (m)	1.000E+00
Fraction of time spent indoors	5.000E-01
Fraction of time spent outdoors (on site)	2.000E-01
Emanating power of Rn-222 gas	2.000E-01
Emanating power of Rn-220 gas	1.000E-01

APPENDIX B: RESRAD PATHWAY SELECTIONS

RESRAD Pathway	Selection Status
External gamma	Active
Inhalation	Active
Plant ingestion	Active
Meat Ingestion	Active
Milk Ingestion	Active
Aquatic foods	Active
Drinking water	Active
Radon	Active
Soil ingestion	Active

ATTACHMENT N

SHIELDALLOY METALLURGICAL CORPORATION

WEST BOULEVARD
P.O. BOX 768
NEWFIELD, NJ 08344
TELEPHONE (609) 692-4200
TWX (510) 687-8918
FAX (609) 692-4017
ENVIRONMENTAL DEPARTMENT FAX
(609) 697-9025

May 24, 1993

Mr. Donald F. Patterson
Division of Facility-Wide Enforcement
New Jersey Department of Environmental Protection and Energy
401 East State Street
CN-0422
Trenton, NJ 08625

RE: Freedom of Information Act Request for Shieldalloy Metallurgical Corporation (SMC), Newfield, New Jersey, APC Plant ID 55048

Dear Mr. Patterson:

In an effort to document SMC's air permit and NPDES compliance record, please provide copies of all records or reports from 1992 and 1993, NPDES permit and air permit inspections or investigations. This information will be used by the Nuclear Regulatory Commission in regards to an Environmental Report for this facility.

Please send your reply correspondence to my attention at the above address.

Thank you for your assistance in this matter. If you have any questions regarding this request, please contact me.

Sincerely,

Craig R. Rieman

Craig R. Rieman
Radiological Safety Manager

CRR:sae
CC: C. Scott Eves - SMC
David R. Smith - SMC
Gary Comfort - USNRC

ATTACHMENT O

INTERNATIONAL TECHNOLOGY CORPORATION

RADIATION DOSE ESTIMATES FOR MEMBERS OF THE GENERAL PUBLIC AT THE NEWFIELD, NEW JERSEY FACILITY

Submitted to:

Shieldalloy Metallurgical Corporation
West Boulevard
Post Office Box 768
Newfield, New Jersey 08344

By:

C. D. Berger
IT Corporation/Nuclear Sciences
1133 21st Street, N.W., Suite 710
Washington, D. C. 20036
(202) 331-8510

Report No. IT/NS-93-107
February 16, 1993

9307080204 930629
PDR ADOCK 04007102
B PDR

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INTRODUCTION

Shieldalloy Metallurgical Corporation (Shieldalloy) operates a manufacturing facility located in Newfield, New Jersey. This facility manufactures or has manufactured specialty steel and super alloy additives, primary aluminum master alloys, metal carbides, powdered metals, and optical surfacing products. Raw materials currently used at the facility include ores which contain oxides of columbium (niobium), vanadium, aluminum metal, titanium metal, strontium metal, zirconium metal, and fluoride (titanium and boron) salts. During the manufacturing process, the facility generates slag, dross, bag house dust, and waste waters, among other waste streams.

One of the materials received, used and stored by Shieldalloy contains radioactive material which his classified as "source material" pursuant to Title 10, Code of Federal Regulations, Part 40. It is pyrochlore, a concentrated ore containing columbium (niobium). The pyrochlore contains greater than 0.05% of natural uranium and natural thorium.

Shieldalloy currently holds a U. S. Nuclear Regulatory Commission (USNRC) License (No. SMB-743) allowing possession, use, and storage of source material. The most recent renewal of SMB-743 was granted in July, 1980. Prior to its expiration in July, 1985, Shieldalloy submitted an application for renewal, thus extending SMB-743 until the USNRC acts upon the renewal application. A revised renewal application was submitted on July 18, 1988, and again on June 2, 1992.

On December 15, 1992, the USNRC requested that Shieldalloy provide an analysis of the routine annual average atmospheric releases of radioactivity from the Newfield facility. They also advised that the source term should include significant atmospheric releases of radon and thoron from storage and process areas in addition to the routine radioactivity releases from the baghouses (Hickey, 1993). This report, which contains an evaluation of emission rates and off-site radiation doses, is intended to provide that information. It contains a description of the approach used to evaluate atmospheric releases, an estimate of maximum possible radiation doses to a maximally-exposed member of the general public, and

the regulatory/technical basis for Shieldalloy's atmospheric emissions surveillance and compliance program.

APPROACH

There are a number of license criteria and regulations which must be considered in design of the Shieldalloy effluent monitoring program. For example, the recent application for renewal of Source Material License No. SMB-743 contains a description of the Shieldalloy radiation protection program in the form of a Radiation Protection Program Plan (SMC, 1992). That Plan states that "Off-site dose assessment to the nearest member of the general public shall be completed at a frequency of no less than once per calendar year" (SMC, 1993). In addition, Title 10, Code of Federal Regulations, Part 20.1301 (NRC, 1992), upon which Shieldalloy's 1993 license renewal application is based, states that: "Each licensee shall conduct operations so that -- (1) The total effective dose equivalent to individual members of the public from the licensed operation does not exceed 0.1 rem in a year" (NRC, 1992). The USNRC also states, in 10 CFR 20.1302, that:

> "The licensee shall make or cause to be made, as appropriate, surveys of radiation levels in unrestricted and controlled areas and radioactive materials in effluents released to unrestricted and controlled areas to demonstrate compliance with the dose limits for individual members of the public in § 20.1301" (NRC, 1992); and that "A licensee shall show compliance with the annual dose limit in § 20.1301 by -- (1) demonstrating by measurement or calculation that the total effective dose equivalent to the individual likely to receive the highest dose from the licensed operation does not exceed the annual dose limit" (NRC, 1992).

In order to establish whether Shieldalloy meets the § 20.1301 annual dose limit for members of the general public, the calculational methodology permitted by § 20.1302 was used. The following is a description of the general approach:

- The quantity of airborne emissions from production buildings is estimated from the known efficiency of the dust collection system for ferrocolumbium operations.[1]

- The estimated quantity of airborne emissions from storage areas is estimated from known radionuclide concentrations in the radioactive materials deposited in the Storage Yard, and referenced ratios of radon emission to ^{226}Ra concentration.

- The estimated quantity of airborne emissions is used as input to the CAP88-PC computer model, which is a set of computer programs, databases, and associated utility programs for estimation of dose from radionuclide emissions to air as a demonstration of compliance under the National Emission Standards for Hazardous Air Pollutants (EPA, 1992).

ESTIMATION OF AIR EMISSIONS

Production Area Emissions Based on Baghouse Efficiency

As part of the quality control program for production operations, Shieldalloy has determined that of the total quantity (by weight) of feed material that goes into the ferrocolumbium production process in Building D-111, 34% is returned as product (ferrocolumbium alloy), and 58% is returned as slag. The remainder, or 8%, is assumed to enter the dust collection system. For an average production year, this results in approximately 8.01×10^5 pounds, or 3.64×10^5 kg, of material entering the bag house of the dust collection system (Rieman, 1991).

Pursuant to vendor specifications, the efficiency of the dust collection system is a nominal 99% under routine operating conditions.[2] If it is assumed that 1% of all of the material

---

[1] The estimated quantity of airborne emissions from this methodology was compared to emission measurements performed by Oak Ridge Associated Universities (ORAU) during a radiological survey of the Newfield site (Berger, 1988) as a measure of validity.

[2] A particulate-sensitive warning system is set to alarm if any bag leakage (breakthrough) occurs.

which enters the baghouse is released to the atmosphere, this results in an annual emission rate of 3.64×10^3 kg of dust.[3]

The maximum measured concentrations of ^{232}Th and ^{238}U in baghouse dust are 76.5 pCi/g and 20 pCi/g, respectively (Berger, 1988 and Teledyne, 1991). If it is assumed that these maximum concentrations apply to all baghouse dust released from D-111, this results in an annual release of approximately 2.78×10^{-4} Ci of ^{232}Th, and 7.28×10^{-5} Ci of ^{238}U.

Production Area Emissions Based on 1988 Stack Sampling Data

During a 1988 survey, ORAU performed stack effluent sampling in the ferrocolumbium production building (D-111). The results of that sampling effort were negative for air emissions above the detection sensitivity of the measurement/analysis methodology. The average of the results reported were less than 6.31×10^{-11} Ci/year for ^{232}Th, and less than 1.34×10^{-7} Ci/year for ^{238}U. These results confirm that radionuclide releases calculated from the specified efficiency of the D-111 bag house are gross over-estimates.

Storage Area Emissions Based on Radon Emanation Rates

In the Shieldalloy Storage Yard, there are, primarily, two slag piles which contain source material and one pile of bag-house dust (lime pile).[4] Each of these are considered to be separate sources of airborne emissions. Since no measurements of airborne emissions from these sources have been completed to date, they are estimated from the known concentration of radium in the piles (Berger, 1988 and Teledyne, 1991), and a referenced ratio for radon emission to ^{226}Ra concentration (UNSCEAR, 1988).

---

[3] A 1989 particle size study on D-111 bag house dust indicates that greater than 90% consists of particles greater than 45 μm in diameter (USTC, 1989). Referenced efficiency graphs for fabric filters comparable to those in use in the D-111 bag house show a 100% collection efficiency for particles with diameters greater than 5 μm (ASHRAE, 1989). Therefore, the assumption that 1% of all material that enters the D-111 bag house is released to the atmosphere is clearly conservative.

[4] There also exists a 10 m^3 slag pile which may contain radioactive constituents. Due to its relatively small size, it is not considered to be a significant contributor to the ^{222}Rn source term for the site.

The maximum measured concentration of ^{226}Ra in the piles is 6.9 x 10^{-11} Ci/g in the Hi-Ratio slag pile, 1.23 x 10^{-10} Ci/g in the Standard slag pile, and 1.91 x 10^{-11} Ci/g in the lime pile (Berger, 1988). The surface areas of the three piles are approximately 2,500 m^2, 10,000 m^2, and 2,500 m^2, respectively (Berger, 1988).[5] The referenced ratio of radon emission to radium concentration used for this assessment is 1.53 x 10^3 (UNSCEAR, 1988).[6] Application of this value to the slag and bag house dust at the Newfield plant indicates an annual ^{222}Rn release rate of 3.47 x 10^{-3} Ci/y from the Hi-Ratio pile, 2.48 x 10^{-2} Ci/y from the Standard pile, and 9.61 x 10^{-4} Ci/y from the lime pile.

ESTIMATION OF OFF-SITE DOSES

The CAP-88 (Clean Air Act Assessment Package-1988) computer model permits assessments of both collective population dose, and maximally exposed individual dose. CAP88-PC uses a modified Gaussian plume equation to estimate the average dispersion of radionuclides released from up to six sources, which may be either elevated stacks, such as the D-111 stack, or uniform area sources, such as the piles of slag and baghouse dust in the Shieldalloy storage yard (EPA, 1992b).

The program computes radionuclide concentrations in air, rates of deposition on ground surfaces, concentrations in food, and intake rates to people from ingestion of food produced in the assessment area. Estimates of the radionuclide concentrations in produce, leafy vegetables, milk and meat consumed by humans are made by coupling the output of the atmospheric transport models with the USNRC Regulatory Guide 1.109 Terrestrial food chain models. A library of meteorological data for most major cities is supplied with the code. The following assumptions were used as input to the code for estimating off-site doses from production area emissions at the Newfield Plant:

---

[5] The emission-to-concentration ratio is dependent upon soil density, water content, and a number of other factors. From the physical properties of the three piles, the ratio selected is considered to be a conservative value.

[6] The referenced ratio was determined for radium concentrations in soil.

- Wind data from Wilmington, Delaware (Wilmington International Airport) were deemed applicable to conditions at Newfield.
- The annual average rainfall amount is 111.8 cm per year (IT, 1992).
- The annual average temperature is 12°C (IT, 1992).
- The height and diameter of the production building stack are 7.62 and 3.05 meters, respectively (IT, 1992).
- A momentum plume rise was assumed, with a stack emission rate of 990 meters per minute (Berger, 1988).
- Agricultural usage was assumed to fit an "Urban" scenario, wherein over 90% of the milk, meat, and vegetables consumed are from the assessment area.
- The radionuclide release rates were 2.78×10^{-4} Ci/y of ^{232}Th, 2.78×10^{-4} Ci/y of <u>each</u> of the daughters in the thorium decay chain with the exception of ^{208}Tl, 8.1×10^{-9} Ci/y for ^{208}Tl, 7.28×10^{-5}Ci/y of ^{238}U, and 7.28×10^{-5} Ci/y of <u>each</u> of the daughters in the uranium decay chain.

The results of this assessment indicate a maximum annual radiation dose of 0.22 millirem to the maximally-exposed individual, which the computer code indicates is located 300 meters East Southeast of the D-111 stack. Appendix A contains the reports from the CAP88-PC output.

The following assumptions were used as input to the CAP88 code for estimating off-site doses from Storage Yard emissions at the Newfield site:

- Wind data from Wilmington, Delaware (Wilmington International Airport) were deemed applicable to conditions at Newfield.
- The annual average rainfall amount is 111.8 cm per year (IT, 1992).
- The annual average temperature is 12°C (IT, 1992).

- The area of the three sources of emissions are 2,500 m^2 for the Hi-Ratio slag pile, 10,000 m^2 for the Standard slag pile, and 2,500 m^2 for the lime pile (Berger, 1988).
- A momentum plume rise was assumed.
- Agricultural usage was assumed to fit an "Urban" scenario.
- The annual average ^{222}Rn release rate is 3.47×10^{-3} Ci/y from the Hi-Ratio pile, 2.48×10^{-2} Ci/y from the Standard pile, and 9.61×10^{-4} Ci/y from the lime pile.
- The dose contribution from radon daughters was included in the calculation.

The results of this assessment indicate a maximum annual radiation dose of 0.009 millirem to a member of the general public located 50 meters East Southeast of the Storage Yard. Appendix B contains the reports from this CAP88-PC output.

CONCLUSIONS

The emissions estimates and dose assessments presented herein have an associated error due, primarily, to the conservative nature of the assumptions used as input to the calculations. Perhaps the greatest contributor to the error is the estimate of emissions from the production building. The values used for this assessment were based upon specifications of baghouse efficiency which, when compared to measured emissions, results in an annual release rate that is at least three orders of magnitude higher than actually occurs. Consequently, the maximum off-site doses reported herein are also over-estimated by at least three orders of magnitude. However, this approach was selected in order to assure that under-estimations did not result.

In any event, it is clear that, even under these generous circumstances, the off-site doses to the maximally-exposed individual as a result of atmospheric releases from the Shieldalloy plant are negligible. Furthermore, if the basis for off-site dose estimates is baghouse efficiency combined with annual ferrocolumbium production rate, conservative values will

result. Consequently, routine emission measurements are not necessary in order for Shieldalloy to demonstrate conformance with USNRC regulations and license requirements.

REFERENCES

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Berger, 1988 — Berger, J. D. and A. D. Luck, "Radiological Survey of the Shieldalloy Corporation, Newfield, New Jersey", ORAU Report No. 88/G-75, July, 1988.

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NRC, 1992 — U. S. Nuclear Regulatory Commission, Title 10, Code of Federal Regulations, Part 20, "Standards for Protection Against Radiation", January 1, 1992.

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SMC, 1993 — Shieldalloy Metallurgical Corporation, "USNRC Source Material License No. SMB-743, Supplement to Application Dated June 2, 1992", February, 1993.

Teledyne, 1991 — Teledyne Isotopes , "Report of Analysis", September 18, 1991.

UNSCEAR, 1988 — United Nations Scientific Committee on the Effects of Atomic Radiation, "Sources, Effects and Risks of Ionizing Radiation", United Nations, 1988.

USTC, 1989 — United States Testing Company, Inc., Report of Test, Number 032243, March 15, 1989.

APPENDIX A: CAP88-PC Reports for Stack Emissions

C A P 8 8 - P C

Version 1.00

Clean Air Act Assessment Package - 1988

S Y N O P S I S R E P O R T

Non-Radon Individual Assessment
Jan 21, 1993 12:56 am

Facility: Shieldalloy Metallurgical Corporation
Address: West Boulevard
City: Newfield
State: NJ Zip: 08311

Effective Dose Equivalent
(mrem/year)

2.21E-01

At This Location: 300 Meters East Southeast
Source Category: USNRC Licensee
Source Type: Stack
Emission Year: 1991

Comments: Test Run

Dataset Name: Shieldalloy
Dataset Date: Jan 21, 1993 12:55 am
Wind File: WNDFILES\ILG1058.WND

MAXIMALLY EXPOSED INDIVIDUAL
(RN-222 Working Level Calculations Excluded)

Location Of The Individual: 300 Meters East Southeast
Lifetime Fatal Cancer Risk: 2.77E-06

ORGAN DOSE EQUIVALENT SUMMARY
(RN-222 Working Level Calculations Excluded)

Organ	Dose Equivalent (mrem/y)
GONADS	2.57E-02
BREAST	2.42E-02
R MAR	1.16E-01
LUNGS	1.25E+00
THYROID	2.42E-02
ENDOST	1.24E+00
RMNDR	3.03E-02
EFFEC	2.21E-01

RADIONUCLIDE EMISSIONS DURING THE YEAR 1991

Nuclide	Class	Size	Source #1 Ci/y	TOTAL Ci/y
TH-232	Y	1.00	2.8E-04	2.8E-04
RA-228	W	1.00	2.8E-04	2.8E-04
AC-228	Y	1.00	2.8E-04	2.8E-04
TH-228	Y	1.00	2.8E-04	2.8E-04
RA-224	W	1.00	2.8E-04	2.8E-04
RN-220	*	0.00	2.8E-04	2.8E-04
PO-216	W	1.00	2.8E-04	2.8E-04
PB-212	D	1.00	2.8E-04	2.8E-04
BI-212	W	1.00	2.8E-04	2.8E-04
TL-208	D	1.00	8.3E-05	8.3E-05
U-238	Y	1.00	7.3E-05	7.3E-05
TH-234	Y	1.00	7.3E-05	7.3E-05
PA-234	Y	1.00	7.3E-05	7.3E-05
U-234	Y	1.00	7.3E-05	7.3E-05
TH-230	Y	1.00	7.3E-05	7.3E-05
RA-226	W	1.00	7.3E-05	7.3E-05
RN-222	*	0.00	7.3E-05	7.3E-05
PO-218	W	1.00	7.3E-05	7.3E-05
PB-214	D	1.00	7.3E-05	7.3E-05
BI-214	W	1.00	7.3E-05	7.3E-05
PO-214	W	1.00	7.3E-05	7.3E-05
PB-210	D	1.00	7.3E-05	7.3E-05
BI-210	W	1.00	7.3E-05	7.3E-05
PO-210	W	1.00	7.3E-05	7.3E-05

SITE INFORMATION

Temperature: 12 degrees C
Precipitation: 112 cm/y
Mixing Height: 1000 m

SOURCE INFORMATION

Source Number:	1
Stack Height (m):	7.62
Diameter (m):	3.05
Plume Rise Momentum (m/s): (Exit Velocity)	1.65E+01

AGRICULTURAL DATA

	Vegetable	Milk	Meat
Fraction Home Produced:	0.076	0.000	0.008
Fraction From Assessment Area:	0.924	1.000	0.992
Fraction Imported:	0.000	0.000	0.000

Food Arrays were not generated for this run.
Default Values used.

DISTANCES USED FOR MAXIMUM INDIVIDUAL ASSESSMENT

50 100 200 300 400 500

C A P 8 8 - P C

Version 1.00

Clean Air Act Assessment Package - 1988

G E N E R A L D A T A

Non-Radon Individual Assessment
Jan 21, 1993 12:56 am

Facility: Shieldalloy Metallurgical Corporation
Address: West Boulevard
City: Newfield
State: NJ Zip: 08311

Source Category: USNRC Licensee
Source Type: Stack
Emission Year: 1991

Comments: Test Run

Dataset Name: Shieldalloy
Dataset Date: Jan 21, 1993 12:55 am
Wind File: WNDFILES\ILG1058.WND

VALUES FOR RADIONUCLIDE-DEPENDENT PARAMETERS

Nuclide	Clearance Class	Particle Size (microns)	Scavenging Coefficient (per second)	Dry Deposition Velocity (m/s)
TH-232	Y	1.0	1.12E-05	1.80E-03
RA-228	W	1.0	1.12E-05	1.80E-03
AC-228	Y	1.0	1.12E-05	1.80E-03
TH-228	Y	1.0	1.12E-05	1.80E-03
RA-224	W	1.0	1.12E-05	1.80E-03
RN-220	*	0.0	0.00E+00	0.00E+00
PO-216	W	1.0	1.12E-05	1.80E-03
PB-212	D	1.0	1.12E-05	1.80E-03
BI-212	W	1.0	1.12E-05	1.80E-03
TL-208	D	1.0	1.12E-05	1.80E-03
U-238	Y	1.0	1.12E-05	1.80E-03
TH-234	Y	1.0	1.12E-05	1.80E-03
PA-234	Y	1.0	1.12E-05	1.80E-03
U-234	Y	1.0	1.12E-05	1.80E-03
TH-230	Y	1.0	1.12E-05	1.80E-03
RA-226	W	1.0	1.12E-05	1.80E-03
RN-222	*	0.0	0.00E+00	0.00E+00
PO-218	W	1.0	1.12E-05	1.80E-03
PB-214	D	1.0	1.12E-05	1.80E-03
BI-214	W	1.0	1.12E-05	1.80E-03
PO-214	W	1.0	1.12E-05	1.80E-03
PB-210	D	1.0	1.12E-05	1.80E-03
BI-210	W	1.0	1.12E-05	1.80E-03
PO-210	W	1.0	1.12E-05	1.80E-03

VALUES FOR RADIONUCLIDE-DEPENDENT PARAMETERS

	DECAY CONSTANT (PER DAY)			TRANSFER COEFFICIENT	
Nuclide	Radio-active (1)	Surface	Water	Milk (2)	Meat (3)
TH-232	0.00E+00	5.48E-05	0.00E+00	5.00E-06	6.00E-06
RA-228	0.00E+00	5.48E-05	0.00E+00	4.50E-04	2.50E-04
AC-228	0.00E+00	5.48E-05	0.00E+00	2.00E-05	2.50E-05
TH-228	0.00E+00	5.48E-05	0.00E+00	5.00E-06	6.00E-06
RA-224	1.91E-01	5.48E-05	0.00E+00	4.50E-04	2.50E-04
RN-220	1.08E+03	5.48E-05	0.00E+00	0.00E+00	0.00E+00
PO-216	1.91E-01	5.48E-05	0.00E+00	3.50E-04	9.50E-05
PB-212	1.91E-01	5.48E-05	0.00E+00	2.50E-04	3.00E-04
BI-212	1.91E-01	5.48E-05	0.00E+00	5.00E-04	4.00E-04
TL-208	1.91E-01	5.48E-05	0.00E+00	2.00E-03	4.00E-02
U-238	0.00E+00	5.48E-05	0.00E+00	6.00E-04	2.00E-04
TH-234	2.88E-02	5.48E-05	0.00E+00	5.00E-06	6.00E-06
PA-234	2.48E+00	5.48E-05	0.00E+00	5.00E-06	1.00E-05
U-234	0.00E+00	5.48E-05	0.00E+00	6.00E-04	2.00E-04
TH-230	0.00E+00	5.48E-05	0.00E+00	5.00E-06	6.00E-06
RA-226	0.00E+00	5.48E-05	0.00E+00	4.50E-04	2.50E-04
RN-222	1.81E-01	5.48E-05	0.00E+00	0.00E+00	0.00E+00
PO-218	3.27E+02	5.48E-05	0.00E+00	3.50E-04	9.50E-05
PB-214	3.72E+01	5.48E-05	0.00E+00	2.50E-04	3.00E-04
BI-214	5.02E+01	5.48E-05	0.00E+00	5.00E-04	4.00E-04
PO-214	3.66E+08	5.48E-05	0.00E+00	3.50E-04	9.50E-05
PB-210	0.00E+00	5.48E-05	0.00E+00	2.50E-04	3.00E-04
BI-210	1.38E-01	5.48E-05	0.00E+00	5.00E-04	4.00E-04
PO-210	0.00E+00	5.48E-05	0.00E+00	3.50E-04	9.50E-05

FOOTNOTES:

(1) Effective radioactive decay constant in plume; set to zero if less than 1.0E-2

(2) Fraction of animal's daily intake of nuclide which appears in each L of milk (days/L)

(3) Fraction of animal's daily intake of nuclide which appears in each kg of meat (days/kg)

VALUES FOR RADIONUCLIDE-DEPENDENT PARAMETERS

Nuclide	CONCENTRATION UPTAKE FACTOR		GI UPTAKE FRACTION	
	Forage (1)	Edible (2)	Inhalation	Ingestion
TH-232	8.50E-04	3.64E-05	2.00E-04	2.00E-04
RA-228	1.50E-02	6.42E-04	2.00E-01	2.00E-01
AC-228	3.50E-03	1.50E-04	1.00E-03	1.00E-03
TH-228	8.50E-04	3.64E-05	2.00E-04	2.00E-04
RA-224	1.50E-02	6.42E-04	2.00E-01	2.00E-01
RN-220	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PO-216	2.50E-03	1.71E-04	1.00E-01	1.00E-01
PB-212	4.50E-02	3.85E-03	2.00E-01	2.00E-01
BI-212	3.50E-02	2.14E-03	5.00E-02	5.00E-02
TL-208	4.00E-03	1.71E-04	9.50E-01	9.50E-01
U-238	8.50E-03	1.71E-03	2.00E-03	2.00E-01
TH-234	8.50E-04	3.64E-05	2.00E-04	2.00E-04
PA-234	2.50E-03	1.07E-04	1.00E-03	1.00E-03
U-234	8.50E-03	1.71E-03	2.00E-03	2.00E-01
TH-230	8.50E-04	3.64E-05	2.00E-04	2.00E-04
RA-226	1.50E-02	6.42E-04	2.00E-01	2.00E-01
RN-222	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PO-218	2.50E-03	1.71E-04	1.00E-01	1.00E-01
PB-214	4.50E-02	3.85E-03	2.00E-01	2.00E-01
BI-214	3.50E-02	2.14E-03	5.00E-02	5.00E-02
PO-214	2.50E-03	1.71E-04	1.00E-01	1.00E-01
PB-210	4.50E-02	3.85E-03	2.00E-01	2.00E-01
BI-210	3.50E-02	2.14E-03	5.00E-02	5.00E-02
PO-210	2.50E-03	1.71E-04	1.00E-01	1.00E-01

FOOTNOTES: (1) Concentration factor for uptake of nuclide from soil for pasture and forage (in pCi/kg dry weight per pCi/kg dry soil)

(2) Concentration factor for uptake of nuclide from soil by edible parts of crops (in pCi/kg wet weight per pCi/kg dry soil)

DECAY CHAIN INGROWTH FACTORS

Nuclide	Parent(s)	Ingrowth Factor(s)
RA-228	TH-232	5.080E+00
AC-228	TH-232	3.580E+04
	RA-228	7.050E+03
TH-228	TH-232	1.300E+01
	RA-228	2.580E+00
RA-224	TH-232	2.340E+03
	RA-228	4.660E+02
	TH-228	1.810E+02
RN-220	TH-232	1.330E+07
	RA-228	2.650E+06
	TH-228	1.030E+06
PO-216	TH-232	4.940E+09
	RA-228	9.830E+08
	TH-228	3.810E+08
PB-212	TH-232	1.930E+04
	RA-228	3.850E+03
	TH-228	1.490E+03
BI-212	TH-232	2.040E+05
	RA-228	4.060E+04
	TH-228	1.570E+04
TL-208	TH-232	1.440E+06
	RA-228	2.880E+05
	TH-228	1.120E+05
PA-234	TH-234	2.961E+04
RA-226	TH-230	1.490E-02
PB-214	TH-230	6.915E+03
	RA-226	4.635E+05
	PO-218	1.138E-01
BI-214	TH-230	9.313E+03
	RA-226	6.240E+05
	PO-218	1.532E-01
	PB-214	1.347E+00
PO-210	PB-210	3.560E+01
	BI-210	3.621E-02

VALUES FOR RADIONUCLIDE-INDEPENDENT PARAMETERS

HUMAN INHALATION RATE	
Cubic centimeters/hr	9.17E+05
SOIL PARAMETERS	
Effective surface density (kg/sq m, dry weight) (Assumes 15 cm plow layer)	2.15E+02
BUILDUP TIMES	
For activity in soil (years)	1.00E+02
For radionuclides deposited on ground/water (days)	3.65E+04
DELAY TIMES	
Ingestion of pasture grass by animals (hr)	0.00E+00
Ingestion of stored feed by animals (hr)	2.16E+03
Ingestion of leafy vegetables by man (hr)	3.36E+02
Ingestion of produce by man (hr)	3.36E+02
Transport time from animal feed-milk-man (day)	2.00E+00
Time from slaughter to consumption (day)	2.00E+01
WEATHERING	
Removal rate constant for physical loss (per hr)	2.90E-03
CROP EXPOSURE DURATION	
Pasture grass (hr)	7.20E+02
Crops/leafy vegetables (hr)	1.44E+03
AGRICULTURAL PRODUCTIVITY	
Grass-cow-milk-man pathway (kg/sq m)	2.80E-01
Produce/leafy veg for human consumption (kg/sq m)	7.16E-01
FALLOUT INTERCEPTION FRACTIONS	
Vegetables	2.00E-01
Pasture	5.70E-01
GRAZING PARAMETERS	
Fraction of year animals graze on pasture	4.00E-01
Fraction of daily feed that is pasture grass when animal grazes on pasture	4.30E-01

VALUES FOR RADIONUCLIDE-INDEPENDENT PARAMETERS

ANIMAL FEED CONSUMPTION FACTORS	
Contaminated feed/forage (kg/day, dry weight)	1.56E+01
DAIRY PRODUCTIVITY	
Milk production of cow (L/day)	1.10E+01
MEAT ANIMAL SLAUGHTER PARAMETERS	
Muscle mass of animal at slaughter (kg)	2.00E+02
Fraction of herd slaughtered (per day)	3.81E-03
DECONTAMINATION	
Fraction of radioactivity retained after washing for leafy vegetables and produce	5.00E-01
FRACTIONS GROWN IN GARDEN OF INTEREST	
Produce ingested	1.00E+00
Leafy vegetables ingested	1.00E+00
INGESTION RATIOS:	
IMMEDIATE SURROUNDING AREA/TOTAL WITHIN AREA	
Vegetables	7.60E-02
Meat	8.00E-03
Milk	0.00E+00
MINIMUM INGESTION FRACTIONS FROM OUTSIDE AREA (Minimum fractions of food types from outside area listed below are actual fixed values.)	
Vegetables	0.00E+00
Meat	0.00E+00
Milk	0.00E+00
HUMAN FOOD UTILIZATION FACTORS	
Produce ingestion (kg/y)	1.76E+02
Milk ingestion (L/y)	1.12E+02
Meat ingestion (kg/y)	8.50E+01
Leafy vegetable ingestion (kg/y)	1.80E+01
SWIMMING PARAMETERS	
Fraction of time spent swimming	0.00E+00
Dilution factor for water (cm)	1.00E+00

C A P 8 8 - P C

Version 1.00

Clean Air Act Assessment Package - 1988

W E A T H E R D A T A

Non-Radon Individual Assessment
Jan 21, 1993 12:56 am

Facility: Shieldalloy Metallurgical Corporation
Address: West Boulevard
City: Newfield
State: NJ Zip: 08311

Source Category: USNRC Licensee
Source Type: Stack
Emission Year: 1991

Comments: Test Run

Dataset Name: Shieldalloy
Dataset Date: Jan 21, 1993 12:55 am
Wind File: WNDFILES\ILG1058.WND

HARMONIC AVERAGE WIND SPEEDS (WIND TOWARDS)

Dir	Pasquill Stability Class A	B	C	D	E	F	G	Wind Frequenc
N	1.535	2.214	3.336	4.143	3.210	1.476	0.000	0.077
NNW	1.289	2.309	3.335	3.918	2.965	1.449	0.000	0.034
NW	1.465	2.127	2.436	2.960	2.791	1.422	0.000	0.034
WNW	1.513	1.885	2.668	3.406	2.695	1.351	0.000	0.026
W	1.504	2.124	3.199	3.965	3.029	1.393	0.000	0.035
WSW	1.345	2.104	3.623	4.500	3.287	1.579	0.000	0.050
SW	1.273	2.252	3.195	4.253	3.030	1.456	0.000	0.038
SSW	1.251	1.913	2.911	3.896	3.236	1.458	0.000	0.041
S	1.513	1.990	2.960	3.748	3.228	1.562	0.000	0.059
SSE	1.166	2.057	3.171	4.230	3.298	1.543	0.000	0.058
SE	1.132	2.104	3.495	5.210	3.421	1.538	0.000	0.116
ESE	1.301	1.917	3.412	5.261	3.478	1.537	0.000	0.147
E	1.415	2.043	3.235	4.227	3.490	1.529	0.000	0.080
ENE	1.421	2.154	3.315	3.934	3.315	1.603	0.000	0.075
NE	1.330	2.021	3.428	4.042	3.158	1.510	0.000	0.072
NNE	1.238	1.939	3.020	3.703	2.981	1.477	0.000	0.059

ARITHMETIC AVERAGE WIND SPEEDS (WIND TOWARDS)

Dir	Pasquill Stability Class A	B	C	D	E	F	G
N	2.051	2.975	4.142	5.141	3.441	1.999	0.000
NNW	1.804	3.070	4.084	4.964	3.151	1.974	0.000
NW	1.989	2.851	3.255	3.816	2.915	1.948	0.000
WNW	2.032	2.660	3.348	4.389	2.772	1.874	0.000
W	2.024	2.799	3.915	4.985	3.231	1.919	0.000
WSW	1.868	2.825	4.195	5.594	3.523	2.087	0.000
SW	1.784	2.945	3.850	5.471	3.232	1.980	0.000
SSW	1.758	2.777	3.659	4.951	3.469	1.983	0.000
S	2.032	2.921	3.796	4.914	3.461	2.073	0.000
SSE	1.641	2.891	4.098	5.655	3.534	2.057	0.000
SE	1.590	2.925	4.392	6.655	3.657	2.053	0.000
ESE	1.818	2.767	4.302	6.665	3.711	2.052	0.000
E	1.941	2.988	4.158	5.574	3.722	2.046	0.000
ENE	1.948	2.956	4.082	5.031	3.552	2.105	0.000
NE	1.852	2.856	4.303	5.143	3.383	2.029	0.000
NNE	1.741	2.844	3.854	4.741	3.172	2.000	0.000

FREQUENCIES OF STABILITY CLASSES (WIND TOWARDS)

	Pasquill Stability Class						
Dir	A	B	C	D	E	F	G
N	0.0049	0.0383	0.0949	0.5717	0.1578	0.1324	0.0000
NNW	0.0203	0.0756	0.1507	0.5387	0.1256	0.0891	0.0000
NW	0.0209	0.0932	0.0953	0.4963	0.1544	0.1400	0.0000
WNW	0.0117	0.0642	0.0883	0.5988	0.1369	0.1003	0.0000
W	0.0065	0.0520	0.0739	0.7226	0.0870	0.0580	0.0000
WSW	0.0046	0.0372	0.0824	0.7517	0.0757	0.0484	0.0000
SW	0.0042	0.0443	0.1076	0.6747	0.0943	0.0749	0.0000
SSW	0.0103	0.0408	0.1165	0.5817	0.1388	0.1119	0.0000
S	0.0051	0.0483	0.1135	0.4899	0.1717	0.1714	0.0000
SSE	0.0050	0.0391	0.1223	0.4773	0.1434	0.2129	0.0000
SE	0.0047	0.0295	0.0998	0.5179	0.1487	0.1993	0.0000
ESE	0.0050	0.0397	0.1043	0.4790	0.1601	0.2118	0.0000
E	0.0096	0.0426	0.1097	0.3690	0.1991	0.2700	0.0000
ENE	0.0065	0.0481	0.1568	0.3367	0.2068	0.2451	0.0000
NE	0.0062	0.0457	0.1446	0.4202	0.1789	0.2043	0.0000
NNE	0.0066	0.0427	0.1132	0.4438	0.1638	0.2299	0.0000
TOT	0.0071	0.0445	0.1118	0.5049	0.1544	0.1774	0.0000

ADDITIONAL WEATHER INFORMATION

Average Air Temperature:	12.0 degrees C
	285.2 K
Precipitation:	111.7 cm/y
Lid Height:	1000 meters
Surface Roughness Length:	0.010 meters
Height Of Wind Measurements:	10.0 meters
Average Wind Speed:	4.277 m/s

Vertical Temperature Gradients:

STABILITY E	0.073 k/m
STABILITY F	0.109 k/m
STABILITY G	0.146 k/m

APPENDIX B: CAP88-PC Reports for Storage Yard Emissions

C A P 8 8 - P C

Version 1.00

Clean Air Act Assessment Package - 1988

S Y N O P S I S R E P O R T

Radon Individual Assessment
Jan 21, 1993 3:15 pm

Facility: Shieldalloy Metallurgical Corporation
Address: West Boulevard
City: Newfield
State: NJ Zip: 08311

Effective Dose Equivalent
(mrem/year)

8.71E-03

At This Location: 50 Meters East Southeast
Source Category: USNRC Licensee
Source Type: Area
Emission Year: 1991

Comments: Test Run

Dataset Name: smc-area
Dataset Date: Jan 21, 1993 3:15 pm
Wind File: WNDFILES\ILG1058.WND

RN-222 MAXIMALLY EXPOSED INDIVIDUAL

Location Of The Individual: 50 Meters East Southeast
Radon Concentration (pCi/l): 4.07E-04
Decay Product Concentration (WL): 1.09E-06
Lifetime Fatal Cancer Risk: 1.53E-06

RADIONUCLIDE EMISSIONS DURING THE YEAR 1991

Nuclide	Class	Size	Source #1 Ci/y	Source #2 Ci/y	Source #3 Ci/y	TOTAL Ci/y
RN-222	*	0.00	3.5E-03	2.5E-02	9.6E-04	2.9E-02

SITE INFORMATION

Temperature: 12 degrees C
Precipitation: 112 cm/y
Mixing Height: 1000 m

SOURCE INFORMATION

Source Number:	1	2	3
Source Height (m):	0.42	1.68	6.04
Area (sq m):	2.50E+03	1.00E+04	2.50E+03

Plume Rise Pasquill Cat:	A	B	C	D	E	F	G
Zero:	0.00	0.00	0.00	0.00	0.00	0.00	0.00

DISTANCES USED FOR MAXIMUM INDIVIDUAL ASSESSMENT

50 100 200 300 400 500

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Version 1.00

Clean Air Act Assessment Package - 1988

G E N E R A L D A T A

Radon Individual Assessment
Jan 21, 1993 3:15 pm

Facility: Shieldalloy Metallurgical Corporation
Address: West Boulevard
City: Newfield
State: NJ Zip: 08311

Source Category: USNRC Licensee
Source Type: Area
Emission Year: 1991

Comments: Test Run

Dataset Name: smc-area
Dataset Date: Jan 21, 1993 3:15 pm
Wind File: WNDFILES\ILG1058.WND

VALUES FOR RADIONUCLIDE-DEPENDENT PARAMETERS

Nuclide	Clearance Class	Particle Size (microns)	Scavenging Coefficient (per second)	Dry Deposition Velocity (m/s)
RN-222	*	0.0	0.00E+00	0.00E+00

VALUES FOR RADIONUCLIDE-DEPENDENT PARAMETERS

	DECAY CONSTANT (PER DAY)			TRANSFER COEFFICIENT	
Nuclide	Radio-active (1)	Surface	Water	Milk (2)	Meat (3)
RN-222	1.81E-01	5.48E-05	0.00E+00	0.00E+00	0.00E+00

FOOTNOTES:
(1) Effective radioactive decay constant in plume; set to zero if less than 1.0E-2

(2) Fraction of animal's daily intake of nuclide which appears in each L of milk (days/L)

(3) Fraction of animal's daily intake of nuclide which appears in each kg of meat (days/kg)

VALUES FOR RADIONUCLIDE-DEPENDENT PARAMETERS

	CONCENTRATION UPTAKE FACTOR		GI UPTAKE FRACTION	
Nuclide	Forage (1)	Edible (2)	Inhalation	Ingestion
RN-222	0.00E+00	0.00E+00	0.00E+00	0.00E+00

FOOTNOTES: (1) Concentration factor for uptake of nuclide from soil for pasture and forage (in pCi/kg dry weight per pCi/kg dry soil)

(2) Concentration factor for uptake of nuclide from soil by edible parts of crops (in pCi/kg wet weight per pCi/kg dry soil)

VALUES FOR RADIONUCLIDE-INDEPENDENT PARAMETERS

HUMAN INHALATION RATE	
Cubic centimeters/hr	9.17E+05
SOIL PARAMETERS	
Effective surface density (kg/sq m, dry weight) (Assumes 15 cm plow layer)	2.15E+02
BUILDUP TIMES	
For activity in soil (years)	1.00E+02
For radionuclides deposited on ground/water (days)	3.65E+04
DELAY TIMES	
Ingestion of pasture grass by animals (hr)	0.00E+00
Ingestion of stored feed by animals (hr)	2.16E+03
Ingestion of leafy vegetables by man (hr)	3.36E+02
Ingestion of produce by man (hr)	3.36E+02
Transport time from animal feed-milk-man (day)	2.00E+00
Time from slaughter to consumption (day)	2.00E+01
WEATHERING	
Removal rate constant for physical loss (per hr)	2.90E-03
CROP EXPOSURE DURATION	
Pasture grass (hr)	7.20E+02
Crops/leafy vegetables (hr)	1.44E+03
AGRICULTURAL PRODUCTIVITY	
Grass-cow-milk-man pathway (kg/sq m)	2.80E-01
Produce/leafy veg for human consumption (kg/sq m)	7.16E-01
FALLOUT INTERCEPTION FRACTIONS	
Vegetables	2.00E-01
Pasture	5.70E-01
GRAZING PARAMETERS	
Fraction of year animals graze on pasture	4.00E-01
Fraction of daily feed that is pasture grass when animal grazes on pasture	4.30E-01

VALUES FOR RADIONUCLIDE-INDEPENDENT PARAMETERS

ANIMAL FEED CONSUMPTION FACTORS	
Contaminated feed/forage (kg/day, dry weight)	1.56E+01
DAIRY PRODUCTIVITY	
Milk production of cow (L/day)	1.10E+01
MEAT ANIMAL SLAUGHTER PARAMETERS	
Muscle mass of animal at slaughter (kg)	2.00E+02
Fraction of herd slaughtered (per day)	3.81E-03
DECONTAMINATION	
Fraction of radioactivity retained after washing for leafy vegetables and produce	5.00E-01
FRACTIONS GROWN IN GARDEN OF INTEREST	
Produce ingested	1.00E+00
Leafy vegetables ingested	1.00E+00
INGESTION RATIOS:	
IMMEDIATE SURROUNDING AREA/TOTAL WITHIN AREA	
Vegetables	7.60E-02
Meat	8.00E-03
Milk	0.00E+00
MINIMUM INGESTION FRACTIONS FROM OUTSIDE AREA (Minimum fractions of food types from outside area listed below are actual fixed values.)	
Vegetables	0.00E+00
Meat	0.00E+00
Milk	0.00E+00
HUMAN FOOD UTILIZATION FACTORS	
Produce ingestion (kg/y)	1.76E+02
Milk ingestion (L/y)	1.12E+02
Meat ingestion (kg/y)	8.50E+01
Leafy vegetable ingestion (kg/y)	1.80E+01
SWIMMING PARAMETERS	
Fraction of time spent swimming	0.00E+00
Dilution factor for water (cm)	1.00E+00

EXPOSURE LEVELS FOR SHORT-LIFE PROGENY OF RN-222
AT VARIOUS LOCATIONS IN THE ENVIRONMENT

Wind Toward	Distance (Meters)	Exposure Level (Person WL) (.7 EQF)	Adjusted Equilibrium Fraction	Adjusted Exposure Level
N	50	1.481E-06	0.27	5.651E-07
N	100	5.148E-07	0.27	1.964E-07
N	200	2.333E-07	0.27	9.098E-08
N	300	1.212E-07	0.28	4.814E-08
N	400	7.229E-08	0.28	2.933E-08
N	500	4.818E-08	0.29	1.989E-08
NNW	50	1.265E-06	0.27	4.825E-07
NNW	100	3.366E-07	0.27	1.284E-07
NNW	200	1.110E-07	0.27	4.328E-08
NNW	300	4.496E-08	0.28	1.785E-08
NNW	400	2.672E-08	0.28	1.084E-08
NNW	500	1.778E-08	0.29	7.340E-09
NW	50	1.045E-06	0.27	3.987E-07
NW	100	3.259E-07	0.27	1.243E-07
NW	200	1.206E-07	0.27	4.705E-08
NW	300	6.247E-08	0.28	2.481E-08
NW	400	3.719E-08	0.28	1.509E-08
NW	500	2.477E-08	0.29	1.022E-08
WNW	50	1.037E-06	0.27	3.955E-07
WNW	100	2.965E-07	0.27	1.131E-07
WNW	200	8.894E-08	0.27	3.469E-08
WNW	300	4.100E-08	0.28	1.628E-08
WNW	400	2.441E-08	0.28	9.902E-09
WNW	500	1.626E-08	0.29	6.712E-09
W	50	1.028E-06	0.27	3.922E-07
W	100	3.091E-07	0.27	1.179E-07
W	200	8.783E-08	0.27	3.425E-08
W	300	4.158E-08	0.28	1.651E-08
W	400	2.476E-08	0.28	1.004E-08
W	500	1.650E-08	0.29	6.814E-09
WSW	50	1.175E-06	0.27	4.481E-07
WSW	100	3.421E-07	0.27	1.305E-07
WSW	200	1.002E-07	0.27	3.909E-08
WSW	300	4.959E-08	0.28	1.969E-08
WSW	400	2.952E-08	0.28	1.198E-08
WSW	500	1.968E-08	0.29	8.125E-09
SW	50	1.299E-06	0.27	4.955E-07
SW	100	4.318E-07	0.27	1.647E-07
SW	200	9.973E-08	0.27	3.890E-08
SW	300	4.655E-08	0.28	1.849E-08
SW	400	2.771E-08	0.28	1.124E-08
SW	500	1.846E-08	0.29	7.623E-09
SSW	50	1.620E-06	0.27	6.179E-07
SSW	100	5.615E-07	0.27	2.142E-07
SSW	200	1.321E-07	0.27	5.151E-08

EXPOSURE LEVELS FOR SHORT-LIFE PROGENY OF RN-222
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Wind Toward	Distance (Meters)	Exposure Level (Person WL) (.7 EQF)	Adjusted Equilibrium Fraction	Adjusted Exposure Level
SSW	300	6.101E-08	0.28	2.423E-08
SSW	400	3.633E-08	0.28	1.474E-08
SSW	500	2.420E-08	0.29	9.992E-09
S	50	2.099E-06	0.27	8.006E-07
S	100	8.209E-07	0.27	3.131E-07
S	200	2.069E-07	0.27	8.070E-08
S	300	1.045E-07	0.28	4.148E-08
S	400	6.227E-08	0.28	2.527E-08
S	500	4.149E-08	0.29	1.713E-08
SSE	50	2.413E-06	0.27	9.202E-07
SSE	100	1.138E-06	0.27	4.341E-07
SSE	200	2.457E-07	0.27	9.582E-08
SSE	300	1.110E-07	0.28	4.410E-08
SSE	400	6.629E-08	0.28	2.689E-08
SSE	500	4.417E-08	0.29	1.824E-08
SE	50	2.682E-06	0.27	1.023E-06
SE	100	1.347E-06	0.27	5.138E-07
SE	200	4.160E-07	0.27	1.622E-07
SE	300	2.060E-07	0.28	8.179E-08
SE	400	1.230E-07	0.28	4.990E-08
SE	500	8.198E-08	0.29	3.385E-08
ESE	50	2.849E-06	0.27	1.087E-06
ESE	100	1.278E-06	0.27	4.875E-07
ESE	200	5.208E-07	0.27	2.031E-07
ESE	300	2.710E-07	0.28	1.076E-07
ESE	400	1.618E-07	0.28	6.563E-08
ESE	500	1.078E-07	0.29	4.451E-08
E	50	2.617E-06	0.27	9.981E-07
E	100	1.005E-06	0.27	3.832E-07
E	200	3.799E-07	0.27	1.482E-07
E	300	1.806E-07	0.28	7.171E-08
E	400	1.078E-07	0.28	4.376E-08
E	500	7.187E-08	0.29	2.967E-08
ENE	50	2.235E-06	0.27	8.525E-07
ENE	100	8.902E-07	0.27	3.396E-07
ENE	200	3.204E-07	0.27	1.250E-07
ENE	300	1.562E-07	0.28	6.205E-08
ENE	400	9.321E-08	0.28	3.782E-08
ENE	500	6.208E-08	0.29	2.563E-08
NE	50	1.968E-06	0.27	7.507E-07
NE	100	8.220E-07	0.27	3.135E-07
NE	200	2.870E-07	0.27	1.119E-07
NE	300	1.403E-07	0.28	5.573E-08
NE	400	8.371E-08	0.28	3.396E-08
NE	500	5.576E-08	0.29	2.302E-08

EXPOSURE LEVELS FOR SHORT-LIFE PROGENY OF RN-222
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Wind Toward	Distance (Meters)	Exposure Level (Person WL) (.7 EQF)	Adjusted Equilibrium Fraction	Adjusted Exposure Level
NNE	50	1.775E-06	0.27	6.770E-07
NNE	100	6.616E-07	0.27	2.524E-07
NNE	200	2.622E-07	0.27	1.023E-07
NNE	300	1.275E-07	0.28	5.065E-08
NNE	400	7.613E-08	0.28	3.089E-08
NNE	500	5.074E-08	0.29	2.095E-08