START

0023430

Final

Meeting Minutes Transmittal/Approval
Unit Manager's Meeting: 1100-EM-1 Operable Unit
450 Hills St., Richland, Washington
July 30, 1992

FROM/APPROVAL: Robert K. Stewart Date 8/27/92
Robert K. Stewart, 1100-EM-1 Operable Unit Manager, RL

APPROVAL: [signature] Date 27 Aug 92
Dave Einan, 1100-EM-1 Unit Manager, EPA

APPROVAL: [signature] Date 8/27/92
Rich Hibbard, 1100-EM-1 Unit Manager, WA Department of Ecology

Meeting Minutes are attached. Minutes are comprised of the following:

- Attachment #1 - Meeting Summary/Summary of Commitments and Agreements
- Attachment #2 - Attendance List
- Attachment #3 - Agenda For 1100-EM-1 Meeting
- Attachment #4 - Action Items Status List
- Attachment #5 - 1100-EM-1 Operable Unit RI/FS Progress
- Attachment #6 - 1100-EM-1 Project Status
- Attachment #7 - Appendix _, 1100-EM-1 Operable Unit ARARs
- Attachment #8 - Table 2: Summary Analytical Results Walla Walla 1100-EM-1 May/June 1992 Sampling Round
- Attachment #9 - Site Development and Infrastructure Planning Overview
- Attachment #10 - Incremental Cancer Risk Estimates
- Attachment #11 - Statistics for Risk Assessment
- Attachment #12 - Groundwater Model Outline and Viewgraphs
- Attachment #13 - Clean-up Times and Pumping Durations for Selected Pump & Treat Scenarios

PREPARED BY: Suzanne E. Clarke Date 8/27/92
Suzanne Clarke, Kay Kimmel, GSSC (A4-35)

CONCURRENCE BY: John T. Stewart Date 27 Aug 92
John Stewart, USACE 1100-EM-1 Project Manager (A5-20)

Attachment #1

Meeting Summary and Summary of Commitments and Agreements
Unit Manager's Meeting: 1100-EM-1 Operable Unit
July 30, 1992

1 SIGNING OF THE JUNE 1100-EM-1 MEETING MINUTES - The June minutes were signed with no changes.

2 ACTION ITEM UPDATE (See Attachment #4)

3 NEW ACTION ITEMS (INITIATED July 30, 1992):

No new action items were presented at this meeting.

4 INFORMATION ITEMS:

- Project Status - John Stewart presented the 1100-EM-1 project status (see attachments #5 and #6).
- Site Development and Infrastructure Planning: Boyd Hathaway (WHC) presented an overview of the projected future land use (see attachment #9).
- Status of Combined RI/FS Report Activities:
    - ARARs - Wendell Greenwald presented the ARARs as an appendix. He asked that the regulators read the information and call him to discuss any areas of concern (see attachment #7).
    - Human Health Risk Assessments - Alden Foote announced that the human health risk assessment will be delivered to the regulators August 21, 1992. Recent calculations for the incremental cancer risk assessment comparing maximum and 95% UCL concentrations are shown in Attachment #10.
    - Data Evaluation: The statistical analyses for the human health risk assessment was presented by Karen Jones. K. Jones reported that evaluation of the analyst's report, attached to the data packages, revealed that there is no evidence for dieldrin at HRL (see attachment #11).
    - Groundwater Model: Mat Johansen presented an overview of the groundwater conceptual model. The purposes of model construction and use are to 1) provide a baseline for contaminant migration, 2) simulate the effectiveness of selected remediation alternatives, and 3) assist in optimizing and refining remediation designs. Hydraulic modeling parameters were reported and agree with pump test results and other reported site data. The model for the migration of the TCE plume was calibrated by matching the computer simulations with observed TCE data (1987 - 1992). The calibration process provided ranges of contaminant transport parameters and a source term of three separate releases at the SNP site to best match observed data. Future projections predict that the TCE plume, with no treatment, will attenuate to below 5ppb by 2007 to 2017 and not pass the George Washington Way diagonal

line in concentrations above 5ppb. Simulations of "pump, treat, & reinfiltrate" scenarios, with 200-1000 gpm treatment capacities and well placement just down gradient of HRL's east boundary, predicted TCE concentration reductions to below 5ppb by 2005 to 2012.

- Field Investigations
  - Validated Analytical Results May/June GW Sampling. See Attachment #8.

Attachment #2

1100-EM-1 Operable Unit Managers Meeting
Official Attendance Record
July 30, 1992

Please print clearly and use black ink

PRINTED NAME	SIGNATURE	ORGANIZATION	O.U. ROLE	TELEPHONE
Andree DeAngeles	Andree DeAngeles	PRC	EPA Support	206-624-2692
Mat Johansen	Mat Johansen	Corps	Corps - Tech.	509-522-6645
Alden Foot	[signature]	USACE	Env. Engr	509-522-6870
Karen Jones	[signature]	USACE	Env. Engr.	509 522-6836
DORIS MINOR	Doris Minor	for SPC	Consultant	206-781-7882
LOREN MAAS	Loren Maas	Siemens		509-375-8537
Janet Franco	Janet Franco	Oregon Dept. of Energy		(503) 378-3187
Boyd Hathaway	H. Boyd Hathaway	WHC Site Planning	5th Development Planner	(509) 376-7340
Jonathan Sprecher	[signature]	Brown and Caldwell	Ecology Support	(503) 244-7005
Wendell Greenwald	Wendell Greenwald	USACE	TM 1100-EM-1	509 376-1252
Steve Cross	[signature]	Ecology	CERCLA Unit	206 4596675
Ward Staubitz	[signature]	USGS	EPA Support	2065936510
Dennis Faulk	[signature]	EPA	Unit Manager	509-376-8631
Brian Drost	Brian Drost	USGS	EPA Support	206-593-6510
Bob Stewart	Robert K. Stewart	DOE-RL/ERD	DOE Unit Mgr	509-376-6192
KAY KIMMEL	Kay Kimmel	SWEC	GSSC	509-372-0610
Suzanne Clarke	Suzanne Clarke	SWEC	GSSC to RL	509-372-0630

AGENDA FOR 1100-EM-1 UNIT MANAGERS MEETING

July 30, 1992
8:00 to 9:30 am
450 Hills St./Rm. 47

8:00 - 8:05 Introduction / Minutes Signing

8:05 - 8:08 Overall Project Status

8:08 - 8:23 Hanford Site Development Update

8:23 - 9:25 Status of Combined RI/FS Report Activities

- ARARs
- Human Health Risk Assessments
- Vadose Zone Modeling
- Groundwater Modeling

9:25 - 9:27 Field Investigations

- Validated Analytical Results May/June GW Sampling

9:27 - 9:30 Action Item Status

Actions Items Status List

1100-EM-1 Operable Unit
July 30, 1992

9212661884

Item No.	Action/Source of Action	Status
11EM1.91	A level three change request is to be submitted for the revised schedule to show additional activities. Action: John Stewart (11/20/91).	Closed. Provided 6/25/92.
11EM1.101	USACE will prepare a level 3 change request for removal of the PNL method 7.40-39 from the beta emitter task. Action: John Stewart (4/22/92).	Closed. Provided 6/25/92.
11EM1.102	USACE to provide a Level 3 Change Request to reduce quantity of validated groundwater data. This will include cost savings analysis. Action: John Stewart (5/28/92).	Closed. Provided 6/25/92.

OPEN PLAN (R)

Report: GRAFBAR1
Project: 1100EM1B
Time Now: 30JUL92
Date: 29JUL92
Time: 10:37:58
Page: 1

1100-EM-1 Operable Unit RI/FS Progress

Walla Walla District, Corps of Engineers

Timescale: 01 APR 91 | 01 JUL 91 | 01 OCT 91 | 01 JAN 92 | 01 APR 92 | 01 JUL 92 | 01 OCT 92 | 01 JAN 93

← Timenow

ACTIVITY	
GW01	MONITORING WELL INSTALLATION *COMPLETE*
GW02	Coordinate Drilling *COMPLETE*
GW03	Install FF-5 Wells No. 7 & 8 *COMPLETE*
GW04	Install MW-19 thru MW-22 *COMPLETE*
GW05	GROUNDWATER SAMPLING *COMPLETE*
GW06	August Sampling *COMPLETE*
GW06A	November Sampling *COMPLETE*
GW07	Sample Analysis -
GW08	Sample Validation - Aug/Nov
GW09	September Sampling *COMPLETE*
GW10	Sample Analysis - Sep
GW11	Sample Validation - September
GW12	Summary and PARCC Evaluation
GW13	COMPILE & QUALIFY ANF GW
VZ01	GEOPHYSICAL INVESTIGATION *COMPLETE*
VZ02	Safety Documentation *COMPLETE*
VZ03	Field Work *COMPLETE*
VZ04	Preliminary Report *COMPLETE*
VZ05	Review Draft Report *COMPLETE*
VZ06	BURIED TRENCH INVESTIGATIONS *COMPLETE*
VZ07	Preparation for Field Work *COMPLETE*
VZ08	Safety Documentation *COMPLETE*
VZ09	Field Work *COMPLETE*
VZ10	Sample Analysis *COMPLETE*
VZ11	Sample Validation *COMPLETE*
VZ12	Report
ZRPT01	FINAL RI/FS REPORT *COMPLETE*
ZRPT03	Dev Vadose Zone
ZRPT05	Dev GW Conceptu
ZRPT06	Surveying and Mapping
ZRPT07	Fate and Transport Analys
ZRPT08	Risk Assessment
ZRPT09	Develop Contaminants of Con
ZRPT10	Develop Remedial Action Obj
ZRPT11	Dev. Screen, & Evaluate Alts
ZRPT12	Write Fin
ZRPT13	Proposed Plan
ZRPT14	CENPW Review and Cmt Resolutn
ZRPT15	CENPD Review and Cmt Resolutn
ZRPT16	Document Clearance
ZRPT17	DOE-RL/HQ Rev and Cmt Resolutn
ZRPT18	SUBMITTAL TO REGULATORS

Legend
- =In progress
- =Planned
- =Critical
- =Baseline

Bar Chart Key: Early Dates against Baseline

92126611885

Signatures
Prep: ______
Aprv: ______

1100-EM-1 PROJECT STATUS

- **Validation of Vadose Zone Samples** - Complete except for one data package which was incomplete and could not be validated. Validation will be completed when the required data has been provided by OSM and its laboratory contractor.

- **Validation of May/June Groundwater Samples** - Completed. Validated data provided in the July Unit Manager Meeting (TPA reporting date for regulators is August 25, 1992). Samples collected from wells S29-E12, MW-2, MW-4, MW-8, and SNP's GM-8 arrived at the lab with elevated temperatures. These wells were resampled and analyzed for all specified analities in June except for MW-4 (which was resampled and analyzed only for VOA and pesticides/PCB's) and the GM-8 which was not resampled. The pesticide/PCB sample for MW-19 was damaged in transit to the laboratory and was resampled in June.

- **Human Health Risk Assessment Report** : The computation of PCB concentrations will be an issue addressed at this Unit Manager Meeting. The report will be complete and ready for distribution by August 21, 1992.

- **Groundwater Modeling** - Some of the remedial scenarios have been modeled and the results reported at this Unit Manger Meeting.

APPENDIX _
1100-EM-1 OPERABLE UNIT APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

ARAR Overview

In accordance with Section 121 (d) of CERCLA and the Tri-Party Agreement, applicable or relevant and appropriate requirements under other laws (ARARs) are used to establish final cleanup or operating standards which must be met by the remedial alternative(s) selected. In general, cleanup levels are set by reasonably applying standards from federal, state, or public health laws. In the process of attaining these standards, remedial actions must also comply with ARARs.

Applicable requirements are those cleanup standards, standards of control, or other substantive environmental protection requirements, criteria, or limitations promulgated by law that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance found at a CERCLA site. Only those standards identified by a state in a timely manner and that are more stringent than federal requirements are applicable. "Applicability" implies that the remedial action or the circumstances at the site satisfy all of the jurisdictional prerequisites of a requirement (EPA 1987).

Relevant and appropriate requirements are those standards that address problems or situations sufficiently similar to those encountered at a CERCLA site; their use is well suited to the site in question. To determine relevance a comparison must be made between the action, location, or chemicals covered by the requirement and those encountered or anticipated at the specific site. To be determined appropriate, further comparison is made to establish if the requirement is well suited to the nature of the substances, the characteristics of the site, the circumstances of the release, or the proposed remedial action. Only those requirements that are both relevant and appropriate must be complied with (EPA 1987).

Other materials such as non-promulgated advisories or guidance issued by various agencies that are not legally binding and do not have status as ARARs, are to be considered. These materials are to be used on an "as appropriate" basis, however, they do not carry the same weight as ARARs and cannot be considered as required cleanup standards.

Types of ARARs

There are three types of ARARs applicable to CERCLA response actions. A description of each follows:

Ambient or chemical specific requirements which specify health or risked based exposure limits or ranges for contaminants in various media. An example would be the Safe Drinking Water Act (SDWA) Maximum Contaminant Levels (MCLs). Also, these could restrict the level of discharge of certain contaminants during remedial activities (*ie.*, air emission standards). As is the case with all ARARs, if a chemical has more than one applicable ARAR, the more stringent ARAR must be complied with.

Location specific ARARs limit activities based on the sites siting or environmental characteristics. The Endangered Species Act is an example.

Action specific ARARs regulate the activities related to the management, treatment, and disposal of hazardous substances at the site. The Resource Conservation and Recovery Act (RCRA) regulations would be an example of these.

Only substantive requirements such as effluent discharge standards must be complied with for on-site remedial actions and not administrative requirements such as permitting and administrative review. This allows the remedial action to proceed in an expeditious manner without potential delays which may be encountered during a permitting or review process.

In certain instances compliance with an ARAR may be waived by the regulatory agencies. As specified in the current guidance, waivers may be granted only under the following situations:

- Cases in which compliance with an ARAR will result in a greater risk to human health and the environment than an alternative option.

- Cases in which compliance with an ARAR is technically impracticable from an engineering standpoint.

- Cases in which an alternative treatment methods to those specified as ARARs have been shown to result in equivalent standards of performance.

- With respect to a State standard, requirement, criteria, or limitation, the State has not consistently applied procedures to establish a standard, requirement or criteria or demonstrated the intention to consistently apply the standard, requirement, criteria, or limitation in similar circumstances at other RAs.

The TPA specifies that the lead regulatory agency (EPA) will prepare the final list and prepare the rationale for the selection of ARARs as part of the Record of Decision. Until that time, the ARARs included here shall only be considered as "potential" ARARs. These ARARs were first developed and presented in the Phase I and II FS (DOE/RL-90-32). They were based on the contaminants of concern in soils and groundwater, the site specific environmental concerns, and the proposed remedial actions identified in the Phase I and II FS. The ARARs presented in this document consist of those ARARs updated to incorporate comments from EPA and Ecology. Additionally, ARARs have been added and existing ARARs reevaluated to specifically address the contaminants of concern identified by the Phase II RI and the Baseline Industrial Site Risk Assessment [(BISRA), JMM, 1992], and to address the specific remedial

9 3 1 2 5 1 1 8 8 8

actions identified in the Phase III FS. The resulting list is the potential ARARs that are specific to the cleanup of the 1100-EM-1 Operable Unit. The rationale for the inclusion of these ARARs in the Phase III FS follows. A summary table is provided at the end of this discussion.

<u>Ambient or Chemical Specific ARARs</u>

Drinking Water Standards (40 CFR 141 and 143, WAC 246-290-310)

Drinking water standards must be attained for any present or potential sources of drinking water. Primary drinking water MCLs for the contaminants of concern identified in the BISRA and the Groundwater Risk Assessment (PRC, 1991) are listed in Table A-1 and are considered "relevant and appropriate" requirements.

TABLE A-1 - PRIMARY DRINKING WATER CRITERIA AND STANDARDS

CHEMICAL	MCL (μg/l)
<u>Inorganics</u>	
Arsenic	50
Chromium	50
Nickel	0.1[1]
Nitrate (as N)	10,000
<u>Organics</u>	
BEHP	4[1]
Dieldrin	--
PCBs	0.5
TCE	5
<u>Radionuclides</u>	
Technetium^{99}	3790[1] pCi/l

<u>Notes:</u>
[1] Proposed MCLs.

In addition to these primary standards, secondary standards have been set to control the contaminants in drinking water that effect its aesthetic qualities. These standards are not enforceable, but are intended as guidelines, and they relate to the public acceptance of the drinking water. These standards "to be considered" are presented in Table A-2.

TABLE A-2 - SECONDARY DRINKING WATER CRITERIA AND STANDARDS	
CHEMICAL	MCL (mg/l)
<u>Inorganics</u>	
Chloride	250
Iron	0.3
Manganese	0.05
Sulfate	250
Zinc	5
Physical Characteristics	Miscellaneous Parameters
Color	15 Color Units
Corrosivity	Non-corrosive
Odor	3 Threshold Unit Numbers
pH	6.5-8.5
Total Dissolved Solids	500 mg/l
Specific Conductance	700 μmhos/cm
Foaming Agents	0.5 mg/l

Protection of Surface Waters (33 U.S.C. 1251, 40 CFR 116 and 117, WAC 173-201 and Quality Criteria for Water)

The ambient water quality of the Columbia River and the groundwater aquifer must be preserved to ensure the health and welfare of all aquatic plant and animal life, and to maintain the aesthetic and recreational value of the Columbia's shoreline and beaches. The Federal Water Pollution Control Act (Clean Water Act (CWA), 33 U.S.C. 1251) requires the EPA to publish and periodically update ambient water quality criteria. These values are published in the "Gold Book" (EPA 1986) and are intended to provide scientific data and guidance on the environmental effects of specific contaminants. These criteria are not regulatory cleanup levels; rather, they are used to derive regulatory requirements based on water quality impacts. However, Ecology has adopted this criteria (WAC 173-201) and for Class A waters (the Columbia) concentrations of contaminants shall be below those published in the "Gold Book." Also, Ecology's Model Toxic Control Act (MTCA) uses these as one of the criteria in establishing soil cleanup levels. Table A-3 lists the Water Quality Criteria which are "relevant and appropriate" for the contaminants of concern.

TABLE A-3 - WATER QUALITY CRITERIA

Chemical	Fresh Acute Criteria (μg/l)	Fresh Chronic Criteria (μg/l)
<u>Inorganics</u>		
Arsenic[1]	850	48
Chromium[2]	16	11
Nickel[3]	1,400	160
Nitrate (as N)[4]	-	-
<u>Organics</u>		
BEHP	-	-
Dieldrin	2.5	0.0019
PCBs	2.0	0.014
TCE	45,000	21,900

1 Speciation assumed as As(V).
2 Speciation assumed as Cr(VI).
3 Value is hardness dependent. Hardness assumed to be 100 mg/l.
4 Nitrate-nitrogen concentrations below 90 mg/l are reported to have no adverse effects on warm water fish (EPA Goldbook, 1986).

Hazardous substances are designated under the CWA (40 CFR 116) and the discharge of these contaminants to surface or ground waters shall not exceed the reportable quantity (RQ) specified (40 CFR 117). For the 1100-EM-1 Operable Unit, the potential contaminants of concern designated as hazardous and the reportable discharge quantity of each are PCBs with a RQ of one pound, and TCE with an RQ of 100 pounds. These requirements are "applicable."

Action and Cleanup Levels (40 CFR 264.521, OSWER 9355.4-01, and WAC 173-340-745 MTCA)

Soil action levels were proposed in 40 CFR 264.521 (FR Vol 55 30865, July 27,1990) to trigger corrective measure studies for solid waste management units at hazardous waste management facilities. If contamination below these levels is present, no action is required.

Contamination above these levels would require corrective action unless the owner/operator could demonstrate that the action is unnecessary (*ie.*, high levels of natural contamination prohibit groundwater from becoming a drinking water source). The determination of cleanup levels is also discussed for all medias of concern. In general, cleanup levels will be set at protective levels based on current and future uses. For carcinogens, levels must be set so that the lifetime cancer risk to humans is between 10^{-4} through 10^{-6}. For non-carcinogens, cleanup levels at which there are no adverse impacts to humans should be attained. For ground and surface waters, contaminant cleanup should be below MCLs if the water is a source or potential source of drinking water. For soil, remediation would be consistent with plausible future land use. These rules are not promulgated and are only "to be considered."

PCBs action levels are provided in OSWER Directives 9355.4-01. The action level for industrial sites should be in the range of 10-25 ppm. The actual level chosen is dependent on the site specific exposure assumptions. This directive is guidance and is "to be considered."

Ecology's MTCA contains promulgated cleanup regulations which are "applicable" to the contaminants of concern at the site. Cleanup levels prescribed are based on the designated land use. The Phase I RI concluded that "the land use within and immediately adjacent to the 1100-EM-1 Operable Unit is of a industrial and commercial nature that is primarily associated with the Hanford Site operations." These conclusions were made after extensive interviews with city, county and Hanford Site planners and associated review of the available land use plans during the Phase I RI. MTCA sets forth criteria which can be used to determine if the site land use is industrial. These criteria and a discussion of how each is met by the 1100-EM-1 Operable Unit follows:

I) **The site is zoned or has been otherwise officially designated for industrial use**. The 1100-EM-1 Operable Unit lies within the eastern half of the 1100 Area which is designated for heavy industrial use in the Benton County Comprehensive Land Use Plan. The western half of the 1100 Area falls within the city limits of Richland. The city of Richland zoning map shows this area as being zoned for heavy industrial use. *The Hanford Site Development Plan* (DOE/RL-92-20) designates the northern portion of the 1100 Area for research and development activities and the southern portion for operation support activities (both activities are consistent with industrial types of land use).

II) **The Site is currently used for industrial purposes or has a history of use for industrial purposes.** Industrial facilities consist of central warehousing, vehicle maintenance, and transportation distribution in support of the Hanford Site operations. The contaminated sites of the 1100-EM-1 Operable Unit are associated with these activities.

III) **Adjacent properties are currently used or designated for use for industrial purposes.** Properties adjacent to the 1100-EM-1 Operable Unit are administered by the city of Richland and are currently used or reserved for medium or heavy industrial use. Areas to the east, adjacent to the Columbia River, are designated for heavy industrial use. To the north, the operable unit is bounded by other lands within the Hanford Site which are also designated for heavy industrial use.

IV) **The site is expected to be used for industrial purposes for the foreseeable future due to site zoning, statutory or regulatory restrictions, comprehensive plans, adjacent land use, and other relevant factors.** As stated in the Phase I RI, in conversations with county, city and Hanford Site planning officials, they indicated that the current land use status of this area will remain unchanged as long as the Hanford Site exists. These conversations are summarized in the issue paper *Future Land Use Assumptions for the 1100-EM-1 Operable Unit* (Golder,1990). If control of the site is relinquished by the Government, which the planners believe to be unlikely, land use in the vicinity of the Operable Unit would remain unchanged due to the presence of established commercial and industrial facilities that could be readily utilized by the private sector.

Additionally, several recently published planning documents confirm that the proposed future land use in and adjacent to the 1100 Area will be industrial. The *Hanford Site Development Plan* (DOE/RL-92-20) shows that the 1100 Area will be used for operational support to include warehousing, vehicle maintenance, and office operations. The *Hanford 300 Area Development Plan* (DOE/RL-91-09) shows that the area north of Horn Rapids Road and east of Stevens Drive, which is downgradient of HRL, will be used for industrial uses. This area will be the site of office facilities and the proposed Environmental Molecular Science Laboratory. Heavier industrial operations will occupy the northern 300 Area. Also, the 600 Area, which includes areas north of HRL, is designated for use by research and development facilities which can be associated with light to medium industrial use.

V) **The clean up action provides for institutional controls implemented in accordance with WAC 173-340-440.** Both the city of Richland and DOE have institutional controls in place that protect against human exposure from the contaminated ground water. Within the Hanford Works Boundary, access and development are closely controlled. The city of Richland also controls exposure to the ground water by means of water well permits.

Because the site meets these criteria cleanup levels are based on Method C guidelines for both soils and groundwater. For carcinogens, this method gives a lifetime cancer risk of less than 1 in 100,000. For non-carcinogens, Method C cleanup levels will have no acute or chronic effects on human health and no significant adverse effects on the protection and propagation of aquatic and terrestrial organisms.

For soils, cleanup concentrations which are anticipated to result in no acute or chronic toxic effects on human health via direct contact with or ingestion of contaminated soil are determined using the following equation and standard exposure assumptions:

$$\text{Soil Cleanup Level (mg/kg)} = \frac{RFD \times ABW \times UCF2 \times HQ}{SIR \times AB1 \times FOC}$$

Where:

RFD = Reference dose as specified in WAC 173-340-708(7) (mg/kg-day)
ABW = Average body weight over the period of exposure (70 kg)
UCF2 = Unit conversion factor (1,000,000 mg/kg)
SIR = Soil ingestion rate (50 mg/day)
AB1 = Gastrointestinal absorption rate (1.0)
FOC = Frequency of contact (0.4)
HQ = Hazard quotient (1)

Concentrations for which the upper bound on the estimated excess cancer risk is less than or equal to 1 in 100,000 via direct contact with or ingestion of contaminated soil are determined using the following equation and standard exposure assumptions:

$$\text{Soil Cleanup Level (mg/kg)} = \frac{RISK \times ABW \times LIFE \times UCF1}{CPF \times SIR \times AB1 \times DUR \times FOC}$$

Where:

RISK = Acceptable cancer risk (1 in 100,000)
ABW = Average body weight over the period of exposure (70 kg)
LIFE = Lifetime (75 years)
UCF1 = Units conversion factor (1,000,000 mg/kg)
CPF = Carcinogenic potency factor as specified on WAC 173-340-708(8)
SIR = Soil ingestion rate (50 mg/day)
AB1 = Gastrointestinal absorption rate (1.0)
DUR = Duration of exposure (20 years)
FOC = Frequency of contact (0.4)

Calculated soil cleanup levels for the contaminants of concern are shown in Table A-4. MTCA states that where there is a potential for migration of contaminants from soils to ground or surface waters, these calculated values must be at least as stringent as 100 times the groundwater cleanup level calculated by Method C, or 100 times the surface water quality criteria. However, preliminary modeling of the vadose zone for the Phase II RI has shown that there is minimal recharge of the aquifer directly below the contaminated soil sites from precipitation and that there is no runoff from these sites due to the highly permeable surface soils. Therefore, there is adequate evidence to rule out these contaminant migration pathways and to base cleanup levels solely on the MTCA C soil equations.

For groundwaters, cleanup levels must be set at safe drinking water levels unless it is shown that there is no current or potential use of the groundwater as a drinking water source. To disqualify the groundwater as a drinking water source several MTCA criteria must be met. These criteria and a discussion of each as it pertains to the 1100-EM-1 Operable Unit are:

I) **The groundwater does not serve as a current source of drinking water.** The groundwater hydraulically downgradient, and within .5 miles upgradient of the HRL plume, does not currently serve as a drinking water source. Existing industrial facilities in the 1100 and 300 Areas obtain domestic water from the city of Richland water supply system. Existing domestic wells in the vicinity of these areas are used either for irrigation or for domestic heat pumps.

II) **The groundwater is not a potential source of drinking water.** Areas downgradient of the HRL plume are within the Hanford Site boundary and are strictly controlled by the DOE. Directly upgradient, the land falls within the city limits of Richland and is designated as in industrial area. Both the DOE and the city of Richland have institutional controls in place that would restrict the installation of wells for the consumption of water. Additionally, these groundwaters are hard and not suited to industrial or domestic use. Because the city's distribution system serves this area, all water for domestic consumption is anticipated to be supplied by the city.

III) **The department determines that it is unlikely that hazardous substances will be transported from the contaminated groundwater to groundwater that is a current or potential future source of drinking water at concentrations which exceed groundwater quality criteria.** The only wells that are used as a drinking water source are those operated by the city of Richland at their well field. The well field is approximately 2.0 miles southeast of the HRL plume and hydraulically at the same gradient. The city uses the well field to filter Columbia River water, which is softer than the groundwater. The city uses a recharge/withdrawal ratio of approximately 2-3/1. This maintains a hydraulic gradient sloping away from the well field. This has been confirmed by monitoring the groundwater elevations throughout the Phase II RI investigation. It is inconceivable that the contaminants from the HRL plume could be transported to this area.

Groundwater cleanup levels are therefore based on the fact that the groundwaters are not a current or future potential source of drinking water using Method C. Cleanup concentrations for which there is no acute or chronic toxic effects on human health are determined using the following equation and standard exposure assumptions from MTCA:

$$\text{Groundwater Cleanup Level } (\mu g/l) = \frac{RFD \times ABW \times UCF \times HQ}{DWIR \times INH}$$

Where:

RFD = Reference dose as defined in WAC 173-340-708(7) (mg/kg-day)
ABW = Average body weight during the period of exposure (70 kg)
UCF = Unit conversion factor (1,000 μg/mg)
HQ = Hazard quotient (1)
DWIR = Drinking water ingestion rate (2 liters/day)
INH = Inhalation correction factor as defined in WAC 173-340-720(7)

The following MTCA equation and standard assumptions are used to determine groundwater cleanup levels for known or suspected carcinogens which will reduce the upper bound on the estimated cancer risk to less than or equal to 1 in 100,000:

$$\text{Groundwater Cleanup Level } (\mu g/l) = \frac{RISK \times ABW \times LIFE \times UCF}{CPF \times DWIR \times DUR \times INH}$$

Where:

RISK = Acceptable cancer risk level (1 in 100,000)
ABW = Average body weight during the period of exposure (70 kg)
LIFE = Lifetime (75 years)
UCF = Unit conversion factor (1,000 μg/mg)
CPF = Carcinogenic potency factor as specified in WAC 173-340-708(8) (kg/mg-day)
DWIR = Drinking water ingestion rate (2.0 liters/day)
DUR = Duration of exposure (30 years)
INH = Inhalation correction factor as defined in WAC 173-340-720(7)

Table A-4 also shows the calculated groundwater cleanup levels for the contaminants of concern at the 1100-EM-1 Operable Unit.

TABLE A-4 MTCA CLEANUP LEVELS						
CHEMICAL	MEDIA	RfD (mg/kg-day)	CPF (kg-day/mg)	INH	CLEANUP LEVEL/ SOURCE	MAX CONTAMINANT CONC DETECTED
Arsenic	Soil	0.001	1.7	1	25.8 mg/kg / MTCA C[1]	6.6 mg/kg
BEHP	Soil	0.02	0.014	1	9,375 mg/kg / MTCA C[1]	25,046 mg/kg
Chromium	Soil	0.005	-	1	17,500 mg/kg / MTCA C[1]	1,250 mg/kg
Dieldrin	Soil	0.00005	16	1	8.2 mg/kg / MTCA C[1]	1.2 mg/kg
Nickel	Soil	0.02	-	1	70,000 mg/kg / MTCA C[1]	557 mg/kg
Nitrate-N	Groundwater	1.6	-	1	56 mg/l / MTCA C[2]	61.0 mg/l
PCBs	Soil	0.000007	7.7	1	17 mg/kg / MTCA C[1]	102 mg/kg
Technetium^{99}	Groundwater	-	-	-	3,790 pCi/l / SDWA MCL	149 pCi/l
TCE	Groundwater	-	0.011	2	39.8 μg/l / MTCA C[2]	110 μg/l

[1] MTCA C soil based on industrial land use with no potential migration to surface or groundwaters.
[2] MTCA C groundwater based on no current or potential use as a drinking water source.

Dangerous Waste Regulations (WAC 173-303)

Dangerous Wastes (DW) and Extremely Hazardous Wastes (EHW) are defined by WAC 173-303-081. A waste is hazardous if it is designated as such or if it exhibits the hazardous characteristics of reactivity, ignitability, corrosivity, or EP toxicity. These regulations also consider the toxicity, persistence and carcinogenicity of the waste. Contaminated soils on site which exhibit DW or EHW characteristics must be transported, treated, and disposed of in accordance with these "applicable" regulations.

Toxicity is determined by applying the formula given in WAC 173-303-101 and by utilizing the toxicity designations of WAC 173-303-9903 to develop an equivalent concentration. For the contaminants of concern in soils, only dieldrin - toxic category X, and BEHP - toxic category not determined, are listed. For the discolored soil site BEHP at a concentration of 25,046 ppm gives an equivalent concentration of 0.0025% based on a toxic category D for BEHP. Assuming a worst case for Horn Rapids Landfill soils containing 1200 ppb dieldrin and 1100 ppb BEHP, and toxic category D for BEHP, the equivalent concentration is 0.00012%. Based on these equivalent concentrations, the contaminated soils would not be designated as either DW or EHW for toxicity.

The soil contaminants of concern have no persistent characteristics, but do have carcinogenic characteristics in that they contain BEHP, dieldrin and PCBs. Wastes with concentrations of carcinogenic contaminants in excess of 1% are classified as EHW. A DW designation is given to wastes containing carcinogenic contaminants in excess of 0.01%. For the discolored soil site BEHP is present in soil at a concentration of 2.5% which gives a EHW designation. For the Horn Rapids Landfill, maximum PCBs concentration is 65,290 ppb, and the concentration of total carcinogens for a worst case scenario is 0.24%. Therefore, soils at the HRL are designated as DW.

Location Specific ARARs

Threatened and Endangered Species (50 CFR 17, WAC 232-12-011, and WAC 232-12-014)

The Hanford Reservation is known to be a nesting site for the Swainson's hawk and the long billed curlew, two bird species that are designated as sensitive by the Washington Department of Wildlife. Additionally, the Columbia River is in the migratory flyway of several species that are state or federally listed including the bald eagle, American white pelican, falcon, Aleutian Canada goose, ferruginous hawk, and sandhill crane. These regulations are "to be considered" before remedial action is undertaken to ensure that the habitat of these species is preserved.

Action Specific ARARs

Water Quality (40 CFR 122, 40 CFR 131, 40 CFR 141.13, WAC 173-216)

Point source discharges to surface waters shall meet "applicable" state and federal standards for water quality if the best available remedial technology requires such discharges (*ie.*, effluent from an air stripping column). The National Pollution Discharge Elimination System (NPDES) Program (40 CFR 122) requires that a permit be acquired for facilities discharging to surface waters. Discharges shall meet the water quality standards of the body of water based on its use or uses. Water quality data and information on discharges will be reviewed by the state to identify toxic pollutants that may adversely affect the water quality and its designated use (40 CFR 131). Because the Hanford Site is a federal facility, the NPDES permit will be administered by the EPA.

Point source discharges from remedial actions may effect the turbidity standards of the Columbia River. For cities using the Columbia as a source of drinking water, the MCL for turbidity at the entry point is one turbidity unit (TU) as determined by a monthly average. If turbidity does not interfere with disinfection or the maintenance of disinfecting agents, or interfere with the microbiological determination, up to five TU's may be allowed. Effluent water quality must meet these "relevant and appropriate" turbidity standards.

The state regulates the discharge of waste materials from industrial and commercial operations not covered by the NPDES Program into ground and surface waters of the state (WAC 173-216). These "applicable" regulations are intended to set pretreatment requirements to comply with the CWA.

Groundwater Quality (WAC 173-154, WAC 173-160, WAC 173-162 and WAC 173-218)

The groundwater aquifer underlying the 1100-EM-1 Operable Unit supplies wells for domestic, municipal, and industrial use. Municipal wells at the Richland Well Field , located east of the 1100 Area, draw water from the unconfined aquifer which is recharged with water from the Columbia River, to supply the municipality with a total output capacity of 15,000 to 23,000 m^3/day (4.0 to 6.1 MGD)(DOE-RL 1990). The well field is currently used to supplement the city water supply during times of peak seasonal demand. WAC 173-154 establishes policies and procedures in regard to the protection of the occurrence and availability of groundwater within the upper aquifers or upper aquifer zones of a multiple aquifer system. These regulations protect the aquifers from depletion, excessive water level declines or reductions in water quality, and are considered to be "relevant and appropriate."

Requirements for the operation of well drilling equipment and the construction of groundwater monitoring wells are set forth in WAC 173-160 and WAC 173-162. Wells shall be constructed in accordance with these regulations to prevent the degradation of the aquifer from current and future activities. When establishing a well in known or potential areas of contamination, procedures shall be in place to decontaminate the drilling equipment prior to and after drilling the well. Completed wells shall be protected and shall be tamper proof. Construction of the well shall be under the supervision of a Washington state licensed well driller. These requirements are considered "relevant and appropriate."

If the remedial alternative selected requires the reinjection of treated effluent into the aquifer, the effluent shall meet cleanup standards in order to preserve the aquifer for existing and future beneficial uses. Requirements for reinjection wells are provided in WAC 173-218 and are "applicable."

Air Quality (40 CFR 50, 40 CFR 58, 40 CFR 61, WAC 173-400, WAC 173-403, WAC 173-434, WAC 173-470, WAC 173-474, WAC 173-475, WAC 173-480, and WAC 173-490)

The EPA, State of Washington, and Tri-City Air Pollution Control Authority have set air pollution standards for the Hanford Reservation. Through the use of best available technologies (BAT), these standards are technically feasible and reasonably attainable. General standards for maximum emissions are outlined in WAC 173-400 and 40 CFR 50. Air emissions generated from handling of soils and treatment actions are subject to these and other applicable regional air quality standards in order to control or prevent the emission of air contaminants. These standards are considered "applicable." Specific guidance are listed and referenced below.

(1) Sulfur Dioxide

1-hr average (not more than once/year)	0.4 ppm
1-hr twice per week	0.25 ppm
24 hour average	0.10 ppm
Annual average	0.02 ppm

Reference: WAC 173-474

(2) Nitrogen Dioxide

Annual arithmetic mean	100 $\mu g/m^3$

Reference: WAC 173-475

(3) Suspended Particulates

The annual mean concentration shall not exceed 60 $\mu g/m^3$. If the annual mean background concentration exceeds 20 $\mu g/m^3$ due to rural fugitive dust, the standard becomes 40 $\mu g/m^3$ plus the background concentration.
Maximum 24-hour concentrations of 150 $\mu g/m^3$ of air are not to be exceeded

more than once a year. If the background concentration exceeds 30 $\mu g/m^3$ due to rural fugitive dust, the standard becomes 120 $\mu g/m^3$ plus the background concentration.

Reference: WAC 173-470

(4) Carbon Monoxide

Average concentrations over 8-hours shall not exceed 10 mg/m^3 more than once a year. Further, a concentration of 40 mg/m^3 averaged over a 1-hour period shall not be exceeded more than once a year.

Reference: WAC 173-475

(5) Ozone

Maximum hourly concentrations shall not exceed 0.12 ppm (235 $\mu g/m^3$) hourly concentration on more than 1.0 days per calendar year.

Reference: WAC 173-475

(6) Radionuclides

The maximum accumulated dose due to air emissions shall not exceed 25 mrems/yr to the whole body or 75 mrems/yr to a critical organ of any member of the public.

Reference: WAC 173-480

"Relevant and appropriate" procedures for the implementation of these regulations are set forth in WAC 173-403. After construction of the facility, air quality shall be monitored and reported in accordance with "applicable" requirements of 40 CFR 58. Monitoring stations will be required to ensure that air quality is preserved. Monitoring will be required for all contaminants listed above.

Specific regulations pertaining to solid waste incineration facilities are contained in WAC 173-434. These define the emission standards for the design and operation of such facilities and are considered to be "relevant and appropriate."

Fugitive dust from HRL may contain asbestos and therefore is a threat to air quality. Standards for inactive waste disposal sites containing asbestos are provided in 40 CFR 61 and are "relevant and appropriate." Asbestos containing waste shall be covered with non-asbestos containing material and compacted. These sites shall be fenced and signed to deter public access.

Controls for sources emitting volatile organic compounds (VOC's) are provided in WAC 173-490. Although this regulation targets specific stationary sources, it should be considered "relevant and appropriate." If air stripping is used to remove TCE from groundwater, controls will be required to prevent TCE emission to the air.

Hazardous Waste Generation (40 CFR 262)

Remedial actions having hazardous waste as a secondary waste stream shall meet the "applicable" standards for hazardous waste generators outlined in 40 CFR 262. The secondary waste stream must first be identified as hazardous or not. If the waste is hazardous, an EPA identification number must be obtained in order to store, treat or dispose of the waste. Records shall be kept for three years after the waste is transported off site.

Hazardous Waste Transportation (49 CFR Subchapter C, 40 CFR 263, and WAC 446-50)

Transportation of hazardous waste is regulated by the federal government through 49 CFR, Subchapter C and by the state through WAC 446-50. These regulations prohibit the transportation of hazardous materials in commerce unless the material is properly classed, described, packaged, labeled, and in a suitable condition for handling and shipment. The EPA has adopted these requirements as part of RCRA (40 CFR 263) to protect human health and the environment. These transportation requirements are "applicable" if wastes are to be transported off site.

General Storage and Treatment of Hazardous Waste (40 CFR 264, 42 U.S.C. 6901, and WAC 173-303)

A hazardous waste must be a analyzed and identified before an owner or operator of a storage, treatment, or disposal facility can handle it. If wastes are to be stored or disposed of as part of a remedial alternative these regulations would be "applicable." Owners of hazardous waste storage and treatment facilities must comply with RCRA (42 U.S.C. 6901) and 40 CFR 264 when handling these hazardous wastes. Ecology's dangerous waste regulations (WAC 173-303) also apply to storers or treaters of hazardous waste . Dangerous or extremely hazardous waste (as previously identified) to be disposed of through incineration, land treatment, or in a landfill are covered by this "applicable" regulation.

Treatment of Wastewater (WAC 173-240 and Richland City Ordinance 35-84)

Plans and specifications for groundwater treatment systems constructed as part of a remedial action that will discharge to surface or ground waters, or to a POTW will require review and approval by Ecology (WAC 173-240). These requirements are "relevant and appropriate." Additionally, if the wastewater from any remedial process is sent to the Richland sewage treatment plant for final disposal, it must meet the pretreatment standards set forth by City Ordinance 35-84. The contaminant of concern that is specifically banned by the Ordinance is dieldrin. Also, no discharge shall cause the influent concentrations at the plant to increase to more than 1.41 mg/l for chromium and 0.31 mg/l for nickel. These standards should be considered "applicable" for treatment options requiring discharge to the POTW.

Land Treatment (40 CFR 264.271)

If land treatment is selected as an alternative technology it must be demonstrated that the application of wastes containing the hazardous constituents can be treated. The treatment method must ensure that these constituents can be degraded, transformed, or immobilized within the treatment zone. The maximum depth of the treatment zone allowable is no more than 5-feet, and the zone must be at least 3-feet above the seasonal high water table in order to satisfy this "applicable" requirement.

Landfilling (40 CFR 264, 40 CFR 268 and WAC 173-304)

Remedial actions requiring the excavation of hazardous waste with ultimate disposal in an off site chemical waste landfill are subject to the "applicable" requirements of 40 CFR 264 and 268 under RCRA. Land disposal restrictions are in place for certain RCRA listed wastes. Contaminated soil and debris containing these listed wastes are subject to treatment standards prior to their disposal. Of the contaminants of concern, pretreatment standards of 0.13 mg/kg for dieldrin and 28 mg/kg for BEHP must be attained prior to landfilling these land banned contaminants. Landfilling requirements for PCB's will be discussed later.

"Applicable" requirements for the design, maintenance, and closure of solid waste handling facilities such as landfills are contained in WAC 173-304. If landfills are constructed on site for ultimate disposal of the contaminated soil and debris, these regulations would apply. Additionally, groundwater monitoring will be required under the "applicable" provisions of 40 CFR 264.90-109, which addresses the release of contaminants from solid waste management units.

Closure and Post-Closure (40 CFR 264.111, 40 CFR, 40 CFR 264.228, 40 CFR 264.258, 40 CFR 264.310, and WAC 173-304)

RCRA closure requirements for land disposal facilities will be triggered if the hazardous waste is consolidated and moved to an off site land disposal facility, or if the waste is excavated and removed from the operable unit, treated on site, and then redeposited. These closure requirements are set forth in 40 CFR 264.111 and 264.228 and are "applicable" to remediation alternatives requiring land disposal. Caps must be designed to provide long-term minimization of the infiltration of rainfall. Also, they must function with the minimum of maintenance, promote drainage, minimize abrasion or erosion of the cover, accommodate settling and subsidence, and have a permeability of less than 10^{-7} cm/sec.

Because of the arid climate of the Hanford Reservation, an alternate cap consisting of a geomembrane of at least 50 mil thickness is allowed under the "applicable" regulations of WAC 173-304. The geomembrane must be covered by a minimum of 6-inches of topsoil and seeded to dryland grass or other shallow rooted vegetation.

Requirements for PCB's (40 CFR 761)

"Applicable" requirements for the storage, treatment, and disposal of PCB's under the Toxic Substances Control Act are provided in 40 CFR 761. In general, concentrations of PCB's greater than 50 ppm present an unreasonable risk to human health and the environment for controlled access sites, while concentrations exceeding 25 ppm present unreasonable risk at uncontrolled access sites. Disposal of PCB's with concentrations from 50-500 ppm is allowed in chemical waste landfills or by incineration. For concentrations greater than 500 ppm, incineration is the only disposal alternative. Chemical waste landfills must meet specific requirements for soils, geomembranes, hydrologic conditions, flood protection, topography and monitoring systems as outlined in 40 CFR 761.75. Incinerators must meet the combustion and monitoring requirements of 40 CFR 761.70.

Regulations that cover the cleanup of PCB's spilled or leaked to the environment are "to be considered" and are found in 40 CFR 761.120. Items covered include the disposal of debris and materials used in the cleanup and the statistical sampling required to determine the completeness of the cleanup.

Incineration of Soils (40 CFR 264, Subpart O)

Incinerators used for the treatment of contaminated soil and debris are subject to the "applicable" requirements of 40 CFR 264, Subpart O. Contaminated waste feeds must be analyzed for characteristic RCRA wastes. Contaminated ash and residue must be properly disposed of. Destruction removal efficiencies for principal organic hazardous constituents and for PCB's and dioxins shall be 99.99% and 99.9999% respectively. Emissions of hydrogen chloride (HCl) gases shall not exceed 1.0 kg/hr or 1% of the HCl in the stack gases prior to entering any pollution control device. Provisions for monitoring combustion temperature, waste feed rate, combustion gas, and carbon dioxide formation shall be in place. Particulate emissions are not to exceed 0.08 grains/dry standard cubic foot. For the incineration of PCB contaminated soils, incineration requirements shall comply with requirements in 40 CFR 761.

Operation of Facilities (WAC 173-300)

WAC 173-300 sets forth requirements that are "applicable" to operators of landfills and incinerators. In general, operators must meet certain standards before they are certified to operate these facilities.

Non-Routine Releases (40 CFR 302)

Any non-routine release of hazardous substances in the process of a remedial investigation or action, shall be reported. Non-routine releases are not to exceed CERCLA/SARA/Ecology release limits and could be derived from a spill or discharge via liquid effluent stream. Permits are based on DOE and EPA requirements which set Environmental Control Limits. These regulations are "relevant and appropriate" to activities which will take place at the site.

Table 1. Listing of Federal and State Applicable or Relevant and Appropriate Requirements (ARAR's) for the 1100-EM-1 Operable Unit.

ARAR	Applicable	Relevant and Appropriate	To Be Considered	Rationale
1.0 Chemical Specific				
1.1 Drinking Water Standards				
1.1.1 Safe Drinking Water Act (SDWA) 42 U.S.C. 300 (f) 40 CFR part 141		x		Drinking water standards must be attained for any potential or future sources of drinking water. These sources must be protected against groundwater contamination from the 1100-EM-1 Operable Unit. Established maximum contaminant levels (MCL's) for the contaminants of concern are: arsenic 50 $\mu g/l$ PCB's 0.5 $\mu g/l$ chromium 50 $\mu g/l$ TCE 5 $\mu g/l$ nitrate (as N) 10 mg/l The following are proposed MCL's: nickel 0.1 $\mu g/l$ technetium^{99} 3790 pCi/l

Table 1. Listing of Federal and State Applicable or Relevant and Appropriate Requirements (ARAR's) for the 1100-EM-1 Operable Unit.

ARAR	Applicable	Relevant and Appropriate	To Be Considered	Rationale
1.1.2 40 CFR 143.3 Secondary Maximum Contaminant Levels for Drinking Water			x	National secondary drinking water standards are intended to control contaminants in drinking water that primarily effect the aesthetic qualities relating to the public acceptance of drinking water. The regulations are not federally enforceable, but are intended as guidelines for the state. Color 15 color units Corrosivity non-corrosive Odor 3 threshold odor numbers pH 6.5 - 8.5 Total dissolved solids 500 mg/l Sulfate 250 mg/l Chloride 250 mg/l Iron 0.3 mg/l Manganese 0.05 mg/l Zinc 5 mg/l Foaming agents 0.5 mg/l Specific Conductance 700 µmhos/cm

Table 1. Listing of Federal and State Applicable or Relevant and Appropriate Requirements (ARAR's) for the 1100-EM-1 Operable Unit.

ARAR	Applicable	Relevant and Appropriate	To Be Considered	Rationale
1.2 Protection of Surface Waters				
1.2.1 Clean Water Act (CWA) 33 U.S.C. 1251, and WAC 173-201		x		The ambient water quality of the Columbia River must be preserved for the protection of aquatic life. The Columbia is classified as a Class A water. The State has adopted the EPA's Federal Water Quality Criteria and concentrations of contaminants in Class A waters shall be below the following to prevent acute and chronic toxicity to freshwater organisms: Chemical — Acute Criteria — Chronic Criteria Arsenic (V) — 850 μg/l — 48 μg/l BEHP — -- — -- Chromium — 16 μg/l — 11 μg/l Dieldrin — 2.5 μg/l — 0.0019 μg/l Nickel — 1,400 μg/l — 160 μg/l Nitrate (as N)[1] — -- — -- PCBs — 2.0 μg/l — 0.014 μg/l TCE — 45,000 μg/l — 21,900 μg/l [1] Nitrate-Nitrogen concentrations below 90 mg/l are reported to have no adverse impact on warm water fish.
1.2.2 40 CFR 116 and 40 CFR 117 Designation of Hazardous Substances	x			The following contaminants of concern are listed as hazardous substances: trichloroethylene (TCE), and polychlorinated biphenyls (PCB's). Discharge of these contaminants to surface or ground waters shall not exceed reportable quantities of 100 lbs for TCE, and 1 lb for PCB's.
1.3 Action and Cleanup Levels				
1.3.1 40 CFR 264.521 Corrective Action for Solid Waste Management Units (SWMU's) at Hazardous Waste Management Facilities FR Vol 55 30865 July 27, 1990			x	Action levels to trigger corrective measure studies for soil are proposed in 264.521(a)(2)(i-iv), assuming exposure through ingestion of the soil contaminated with the constituent.

Table 1. Listing of Federal and State Applicable or Relevant and Appropriate Requirements (ARAR's) for the 1100-EM-1 Operable Unit.

ARAR	Applicable	Relevant and Appropriate	To Be Considered	Rationale
1.3.2 EPA Directive 9355.4 - FS 1990 A Guide on Remedial Actions at Superfund Sites With PCB Contamination			x	Recommended soil action levels for PCB's at an industrial site are from 10 to 25 mg/kg. The appropriate action level within the range will depend on site-specific factors affecting the exposure assumptions.
1.3.3 WAC 173-340-745 Model Toxic Control Act (MTCA) Cleanup Regulations		x		Ecology's Model Toxic Control Act (MTCA) contains promulgated cleanup regulations for the contaminants of concern at the site. For industrial sites, Method C equations give a lifetime cancer risk of 1 in 100,000 for carcinogens, and will have no chronic or acute effects on human health or the environment. Method C cleanup levels for soils are based solely on the MTCA equations which rule out contaminant migration to surface or groundwaters. Method C cleanup levels for groundwater do not consider SDWA MCLs because the groundwaters are not a current or potential future drinking water source. Cleanup levels for the contaminants of concern in their respective medias are: Soil: Arsenic 25.8 mg/kg; BEHP 9,375 mg/kg; Chromium 17,500 mg/kg; PCB's 17 mg/kg; Dieldrin 8.2 mg/kg; Nickel 70,000 mg/kg Groundwater: Trichloroethene (TCE) 39.8 μg/l; Nitrates (as N) 56 mg/l; Technetium[99] 3,790 pCi/l

Table 1. Listing of Federal and State Applicable or Relevant and Appropriate Requirements (ARAR's) for the 1100-EM-1 Operable Unit.
(Page 5 of 16)

ARAR	Applicable	Relevant and Appropriate	To Be Considered	Rationale
1.4 Dangerous Waste Regulations				
1.4.1 WAC 173-303 Dangerous Waste Regulations	x			Hazardous wastes may be characterized as Dangerous Waste (DW) or Extremely Hazardous Waste (EHW). Additional characteristics based on persistence, carcinogenicity, mutagenicity, teratogenicity, the concentration of certain compounds, and toxicity is required. Contaminated soils on site which exhibit DW or EHW characteristics must be transported, treated, and disposed of in accordance with these regulations. For the discolored soil site, soils contaminated with BEHP are classified as EHW based on carcinogenicity. For the HRL, assuming a worst case in which all carcinogenic contaminants of concern are present, soils are given a DW designation.
2.0 Location Specific				
2.1 Threatened and Endangered Species				
2.1.1 WAC 232-12-011 Wildlife classified as protected wildlife			x	The Swainson's hawk and long-billed curlew are proposed by the Department of Wildlife as sensitive, but are not formally protected as an endangered or threatened species. They are federally-designated candidate species.
2.1.2 Endangered Species Act 50 CFR 17 WAC 232-12-014 Wildlife classified as endangered species			x	The bald eagle, American white pelican, falcon, Aleutian Canada goose, ferruginous hawk, and sandhill crane are federal- and/or state- listed species. They are common migrants along the Columbia River and modifications of their habitat should be avoided.

Table 1. Listing of Federal and State Applicable or Relevant and Appropriate Requirements (ARAR's) for the 1100-EM-1 Operable Unit.

ARAR	Applicable	Relevant and Appropriate	To Be Considered	Rationale
3.0 Action Specific				
3.1 Water Quality				
3.1.1 40 CFR 122 Discharge of Treated Effluent	x			Applicable federal and state standards for water quality must be complied with if use of best available technology requires point-source discharge to surface waters of the United States. An application for new discharge must be made 180 days before discharge actually begins. Because Hanford is a federal facility, the NPDES Program will be administered by the EPA.
3.1.2 40 CFR 131 Water Quality Standards	x			Water quality standards designate the use or uses to be made of the water, and enforcement criteria. Water quality data and information on discharges will be reviewed by the state to identify toxic pollutants that may adversely affect water quality and its designated use.
3.1.3 40 CFR 141.13 Maximum Contaminant Levels for Turbidity		x		Treatment systems may discharge water into the Columbia River and affect turbidity standards. The MCL for turbidity in a water system used for drinking water, measured at the entry point, is 1 turbidity unit (TU) as determined by a monthly average. Up to five TU's may be allowed if higher turbidity does not: (1) interfere with disinfection; (2) prevent maintenance of the disinfectant agents; (3) interfere with microbiological determinations.
3.1.4 WAC 173-216-010 State Waste Discharge Permit Program	x			Implements RCW 90.48 water pollution control and RCW 90.52 Pollution Disclosure Act for the state permit program, applicable to the discharge of waste materials from industrial and commercial operations not covered under the NPDES Program into ground and surface waters of the state.

Table 1. Listing of Federal and State Applicable or Relevant and Appropriate Requirements (ARAR's) for the 1100-EM-1 Operable Unit.
(Page 7 of 16)

ARAR	Applicable	Relevant and Appropriate	To Be Considered	Rationale
3.2 Groundwater Quality				
3.2.1 WAC 173-154-020 Protection of Upper Aquifer Zones		x		Policies and procedures are outlined for the protection of groundwater within the upper aquifers or upper aquifer zones where there are multiple aquifer systems. In the 1100-EM-1 Operable Unit, groundwater volumes are discharged to water supply wells used for domestic, municipal, and industrial purposes. Municipal wells at the Richland Well Field, located east of the 1100 Area, draw water from the unconfined aquifer for municipal supply with a total output capacity of 15,000 to 23,000 m^3/day (4.0 to 6.1 million gallons/day) (DOE-RL 1990). The well field is currently used to supplement the city water supply during times of peak seasonal demand.
3.2.2 WAC 173-160 and 162 Ground Water Protection		x		Requirements are established for monitoring of groundwater to prevent degradation from current and future activities, and monitoring of clean-up activity. Groundwater monitoring wells shall be constructed in accordance with WAC 173-160 and WAC 173-162. Groundwater monitoring wells shall be operated in accordance with WAC 173-162 and 173-160 for resource protection wells.
3.2.3 WAC 173-218 Underground Injection Control Program	x			Groundwater may be used as a source of drinking water. Effluent from the treatment system should meet cleanup standards before being reinjected into the aquifer.

Table 1. Listing of Federal and State Applicable or Relevant and Appropriate Requirements (ARAR's) for the 1100-EM-1 Operable Unit.
(Page 8 of 16)

ARAR	Applicable	Relevant and Appropriate	To Be Considered	Rationale
3.3 Air Quality				
3.3.1 40 CFR 50 National Primary and Secondary Air Quality Standards WAC 173-400 General Regulations for Air Pollution Sources WAC 173-403 Implementation of Regulations for Air Contaminant Sources WAC 173-470 Ambient Air Quality Standards for Particulate Matter WAC 173-474 Ambient Air Quality Standards for Sulfur Oxide WAC 173-475 Ambient Air Quality Standards for Carbon Monoxide, Ozone and Nitrogen Dioxide WAC 173-480 Ambient Air Quality Standards and Emission Limits for Radionuclides WAC 173-490 Emission Standards and Controls for Sources Emitting Volatile Organic Compounds (VOC) Regional Air Quality Standards	x			EPA, State of Washington, and Tri-County Air Pollution Control Authority have set air pollution WAC standards at Hanford. These standards are technically feasible and reasonably attainable. Air emissions generated from handling of soils and treatment actions are subject to the applicable regional air quality standards in order to control or prevent the emission of air contaminants. (1) <u>Sulfur dioxide</u> 1-hr average: 0.4 ppm (not more than once a year) 1-hr twice per week 0.25 ppm 24-hr average: 0.1 ppm Annual average: 0.02 ppm Reference: WAC 173-474 (2) <u>Nitrogen dioxide</u> Annual arithmetic mean 100 $\mu g/m^3$ Reference: WAC 173-475 (3) <u>Suspended Particulates</u> Annual mean concentration shall not exceed 60 $\mu g/m^3$. If the annual mean background concentration exceeds 20 $\mu g/m^3$ due to rural fugitive dust, the standard becomes 40 $\mu g/m^3$ plus the background concentration.

Table 1. Listing of Federal and State Applicable or Relevant and Appropriate Requirements (ARAR's) for the 1100-EM-1 Operable Unit.

ARAR	Applicable	Relevant and Appropriate	To Be Considered	Rationale
3.3.1 (continued)				Maximum 24-hr concentrations of 150 μg/m³ of air are not to be exceeded more than once a year. If the background concentration exceeds 30 μg/m³ due to rural fugitive dust, the standard becomes 120 μg/m³ plus the background concentration. Reference: WAC 173-470 (4) Carbon monoxide Average concentrations over 8 hours shall not exceed 10 mg/m³ more than once a year. Further, a concentration of 40 mg/m³ averaged over a 1-hour period shall not be exceeded more than once a year. Reference: WAC 173-475 (5) Ozone 0.12 ppm (235 μg/m³) where the expected number of days with maximum hourly average concentrations above 0.12 ppm is equal to or less than 1. Reference: WAC 173-475 (6) Radionuclides Maximum accumulated dose due to air emissions shall not exceed 25 mrem/yr to the whole body or 75 mrem/yr to a critical organ of any member of the public.

Table 1. Listing of Federal and State Applicable or Relevant and Appropriate Requirements (ARAR's) for the 1100-EM-1 Operable Unit.
(Page 10 of 16)

ARAR	Applicable	Relevant and Appropriate	To Be Considered	Rationale
3.3.2 40 CFR 58 Ambient Air Quality Surveillance	x			Surveillance of ambient air quality includes requirements for monitoring and reporting of data. An owner or operator of a proposed emission source that could affect air quality is required to operate a sampling station for purposes of prevention of significant deterioration. Monitoring is required for sulfur dioxide, nitrogen dioxide, carbon monoxide, ozone, and particulate matter.
3.3.3 40 CFR 60 New Source Performance Standards (NSPS)		x		Emission standards for municipal incinerators are set for the following: (1) Sulphur dioxide and hydrogen chloride shall not exceed 50 ppm, corrected to 7% oxygen for an hourly average. (2) Total carbon monoxide, ozone, and nitrogen dioxide from combustion shall not exceed 100 ppm at stack exit, after volumes are corrected to 7% oxygen. (3) Particulate matter 0.23 gr/m^3 at standard condition (0.1 grain/dcsf) or 0.46 gr/m^3 at standard condition (0.2 gr/dscf).
3.3.4 40 CFR 61 National Emission Standards for Hazardous Air Pollutants		x		Fugitive dust coontaining asbestos may pose a threat to air quality. Asbestos containing waste shall be covered with a non-asbestos containing material and compacted. These sites shall be fenced and signed to deter public access.
3.3.5 WAC 173-400 General Regulations for Air Pollution	x			This chapter implements RCW 70.94 of the Washington Clean Air Act and establishes standards that are technically feasible and reasonably attainable for air pollution sources.
3.3.6 WAC 173-403 Supplementation of Regulations for Air Contaminant Sources		x		This section states the policy of the Department of Ecology under the authority of RCW Chapter 43.21.A to provide control of air pollution, where needed, and to establish procedures for the implementation of air quality rules and regulations.

Table 1. Listing of Federal and State Applicable or Relevant and Appropriate Requirements (ARAR's) for the 1100-EM-1 Operable Unit.
(Page 11 of 16)

ARAR	Applicable	Relevant and Appropriate	To Be Considered	Rationale
3.3.7 WAC 173-434 Solid Waste Incinerator Facilities		x		Emission standards for design and operation of solid waste incineration facilities are defined by this regulation.
3.3.8 WAC 173-490 Emission Standards for VOC's		x		This section sets controls for the emissions of volatile organic compounds (VOC's) from specific stationary sources. Emission of TCE from any air stripping operation for groundwater remediation would require similar controls.
3.4 Hazardous Waste Generation				
3.4 40 CFR 262 Standards for Generators of Hazardous Waste	x			A generator who generates, treats, stores, or disposes of hazardous waste on-site must comply with the following sections: Section 262.11 Determine whether or not waste is hazardous; Section 262.12 Obtain an EPA identification number for the accumulation of hazardous waste; and Section 262.40 Record keeping. (c) and (d)
3.5 Hazardous Waste Transportation				
3.5.1 CFR, subchapter C Transportation of Hazardous Materials WAC 446-50 Transport of Hazardous Material	x x			No person may transport a hazardous material in commerce unless the material is properly classed, described, packaged, labeled and in condition for handling and shipment in accordance with 49 CFR subchapter C; Hazardous Materials Regulations: Part 171, General information Part 172, Hazardous materials tables and hazardous materials communications regulations Part 173, General requirements for shipments and packages Part 174, Carriage by rail Part 175, Carriage by vessel Part 177, Carriage by highway

Table 1. Listing of Federal and State Applicable or Relevant and Appropriate Requirements (ARAR's) for the 1100-EM-1 Operable Unit.
(Page 12 of 16)

ARAR	Applicable	Relevant and Appropriate	To Be Considered	Rationale
3.5.2 40 CFR 263 Standards Applicable to Transporters of Hazardous Waste	x			EPA has adopted certain regulations from the Department of Transportation governing the transport of hazardous material. These regulations concern labeling, marking, placarding,recordkeeping, containers and reporting discharges. These regulations are adopted to protect human health and the environment.
3.6 General Storage and Treatment of Hazardous Waste				
3.6.1 40 CFR 264 Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities 42 U.S.C. 6901 Resource Conservation and Recovery Act	x			Hazardous waste must be analyzed before an owner or operator can treat, store, or dispose of it. Hazardous waste storage must be in compliance with RCRA under 40 CFR part 264, subpart I (Storage Containers), subpart J (Storage Tanks), subpart K (Surface Impoundments), and subpart L (Waste Piles).
3.6.2 WAC 173-303 Dangerous Waste Regulation	x			This regulation implements chapter 70.105 of the Revised Code of Washington (RCW) and regulates those solid wastes that are dangerous or extremely hazardous to the public health and environment. Dangerous or Extremely Hazardous waste to be disposed of through incineration, land treatment, or in a landfill is governed by these regulations.
3.7 Treatment of Wastewater				
3.7.1 WAC 173-240 Submission of Plans and Reports for Construction of Wastewater Facilities		x		Plans, reports, and specifications for wastewater treatment systems which discharge to POTW, surface or ground waters shall be submitted to Ecology for review under these regulations.
3.7.2 Richland City Ordinance 35-84 Publicly-Owned Treatment Works			x	Discharge of any liquid effluent to Richland's publicly owned treatment works must be in accordance with City Ordinance 35-84. Specific limits are set for chromium (1.41 mg/l) and nickel (0.31 mg/l). The contaminant of concern that is specifically banned is dieldrin. Limits on discharge are given to prevent damage to maintenance and operation of the facility.

Table 1. Listing of Federal and State Applicable or Relevant and Appropriate Requirements (ARAR's) for the 1100-EM-1 Operable Unit.
(Page 13 of 16)

ARAR	Applicable	Relevant and Appropriate	To Be Considered	Rationale
3.8 Land Treatment				
3.8 40 CFR 264.271 Land Treatment	x			Prior to land treatment, the waste must be treated to best demonstrated available technology (BDAT) levels or meet no migration standard. Treatment must ensure that hazardous constituents are degraded, transformed or immobilized within the treatment zone. The maximum depth of the treatment zone is no more than 5 feet from the soil surface and 3 feet above the seasonal high water table.
3.9 Landfilling				
3.9.1 40 CFR 264.300-317 Landfills	x			Contaminated soil that is excavated and placed in a landfill is subject to land disposal restrictions if the soil contains RCRA hazardous waste.
3.9.2 40 CFR 268.44 Land Disposal Restrictions	x			Dieldrin and BEHP will be subject to land disposal treatment standards if excavated material is moved to a new location and placed into a landfill, and if residue from a treatment option is to be land disposed. The contaminated material consists of soil and debris that contain these RCRA hazardous wastes. Pretreatment standards of 0.13 mg/kg and 28 mg/kg for dieldrin and BEHP respectively must be met prior to land disposal.
3.9.3 WAC 173-304 Minimum Functional Standards for Solid Waste Handling	x			This chapter implements RCW 70.95 regulations pertaining to solid waste handling facilities such as municipal landfills. Contains provisions for facility design, maintenance, and closure.
3.9.4 40 CFR 264.90-109 Releases from Solid Waste Management Units		x		Groundwater monitoring will be required if a new landfill is constructed to treat, store, or dispose of contaminated soils as part of a remedial action.

Table 1. Listing of Federal and State Applicable or Relevant and Appropriate Requirements (ARAR's) for the 1100-EM-1 Operable Unit.
(Page 14 of 16)

ARAR	Applicable	Relevant and Appropriate	To Be Considered	Rationale
3.10 Closure and Post-Closure				
3.10.1 40 CFR 264.111-120, 264.228 (D), 264.258 and 264.310 Closure and Post-Closure Care	x			Land disposal closure requirements under RCRA will apply if: (1) the waste at the contaminated site is consolidated and moved to another outside location for disposal; or (2) the waste is picked up from the unit and treated within the area of contamination, then redeposited into the unit. Closure of surface impoundment, waste pile, or landfill will require a cap or final cover designed to provide long-term minimization of the migration of liquids through the closure structure, function with minimum maintenance, promote drainage and minimize erosion or abrasion of the final cover, accommodate settling and subsidence, and have a permeability less than or equal to the permeability of a bottom-liner system or natural subsoils present. Specific restrictions are listed in subparts 264.228(a) surface impoundments, 264.258(b) waste piles and 310(a) landfills.
3.10.2 WAC 173-304 Minimum Functional Standards for Solid Waste Handling	x			This section provides for an alternate cap because of the arid climate of the Hanford Reservation. The cap shall consist of a geomembrane liner of at least 50-mil thickness covered by 6-inches of topsoil and seeded to dryland grass.
3.11 Requirements for PCB's				
3.11.1 40 CFR 761.30 PCB's Storage and Disposal 40 CFR 761.60 Alternative Technology to Incineration 40 CFR 761.70 Chemical Waste Landfill	x			Restrictions on the disposal of PCB's are established pursuant to section 6(e)(1) of Toxic Control Act. PCB concentration over 50 ppm presents an unreasonable risk of injury to health at controlled access sites and 25 ppm at uncontrolled access sites. PCB's at concentrations greater than 50 but less than 500 ppm must be disposed of in an incinerator or chemical waste landfill. Incinerators must comply with 40 CFR 761.70, and chemical waste landfills must comply with 761.75. PCB wastes containing greater than 500 ppm must be incinerated in accordance with the technical requirements in 40 CFR 761.70

Table 1. Listing of Federal and State Applicable or Relevant and Appropriate Requirements (ARAR's) for the 1100-EM-1 Operable Unit.
(Page 15 of 16)

ARAR	Applicable	Relevant and Appropriate	To Be Considered	Rationale
3.11.2 40 CFR 761.75 Chemical Waste Landfills	x			A chemical landfill used for the disposal of PCB's must meet specific requirements for soils, synthetic membrane liners, hydrologic conditions, flood protection, topography, and monitoring systems.
3.11.3 40 CFR 761.120 Requirement for PCB Spill Cleanup			x	Regulations provide for the proper corrective actions for cleanup of all spilled or leaked PCB's.
3.12 Incineration of Soils				
3.12.1 40 CFR 264 Subpart O Incineration of Soils	x			Soils treated through incineration are subject to specific requirements: (1) analyze waste feed for RCRA hazardous waste; (2) dispose of all hazardous waste and residue; (3) achieve a destruction removal efficiency of 99.99% for each principal organic hazardous constituent and 99.9999% for PCB's and dioxins; (4) reduce hydrogen chloride (HCL) emissions to 1.0 kg/hr or 1% of the HCl in stack gases before entering any pollution control devise; (5) monitor combustion temperature, waste-feed rate, combustion gas and carbon dioxide; (6) keep particulate matter to no more than 0.08 grains/dry standard cubic foot; and (7) follow special performance standards for PCB's in 40 CFR 761.70.
3.13 Operation of Facilities				
3.13.1 WAC 173-300 Certification of Operators of Solid Waste Incinerator and Landfill Facilities		x		This regulation sets forth certification requirements for operators of landfills and incinerators.

Table 1. Listing of Federal and State Applicable or Relevant and Appropriate Requirements (ARAR's) for the 1100-EM-1 Operable Unit.

ARAR	Applicable	Relevant and Appropriate	To Be Considered	Rationale
3.14 Non-Routine Releases				
3.14.1 40 CFR 302 EPA Designation, Reportable Quantities Notification Requirements for Hazardous Substances Under CERCLA		x		Environmental Control Limits (ECL's) requirements are based on permit limits as derived from DOE and EPA requirements. Any non-routine release of hazardous material must be reported. A release could be from a spill or discharge via liquid effluent stream. Non-routine releases are not to exceed CERCLA/SARA/Ecology release limits.

Table 2: Summary Analytical Results Walla Walla 1100-EM-1 May/June 1992 Sampling Round

Sample Date	Bottle/ Well ID	MULTI Lab#	VOA Neat ug/L	VOA dil ug/L	VOA TICs ug/L	PestCLP ug/L	NO2-N ug/L	NO3-N ug/L	OPO4-P ug/L	F ug/L	Cl ug/L	SO4 ug/L	Alk ug/L	NH3 ug/L	Ba ug/l	Be ug/l	Ca ug/l	Cr ug/l
		CRDL (ug/L)	1			varies	100	100	50	100	1000	2000	10000	50	50	1	5000	10
5/11/92	(B06251) S29-E11 MW-20	920512003	TCA (0.5) TCE (5)		ND	ND	ND	35000	31B	304	14500	85000	163000	ND	97	ND	91900	ND
5/11/92	(B06272) S29-E11 Fld Blk	920512004	ND		ND		ND	ND	ND	ND					ND	ND	ND	ND
5/11/92	(B06288) S29-E11 TB	920512005	ND		ND													
5/11/92	(B06252) S31-E10A MW-12	920512006	TCA (2) TCE * PCE (0.5)	TCE (57)	ND	ND	ND	47600	25B	371	22700	65000	167000	ND	111	ND	101000	ND
5/11/92	(B06253) S31-E10A DUP	920512007	TCA (2) TCE *	TCE (44)	ND	ND	ND	42900	26B	385	16600	65300	168000	ND	106	ND	99000	ND
5/11/92	(B06273) S31-E10A Fld Blk	920512008	ND		ND		ND	ND	ND	ND					ND	ND	ND	ND
5/11/92	(B06252MS) S31-E10A MS	920512009	NA	81-90%		114-142%	108%	99%	102%	108%	100%	99%	92%	97%	102%	101%	87%	96%
5/11/92	(B06252MSD) S31-E10A MSD	920512010	NA	79-92%		111-138%	104%	87%	103%	107%	99%	98%	92%	97%	101%	102%	85%	96%
5/11/92	(B06289) S31-E10A TB	920512011	ND		ND													
5/11/92	(B06254) S31-E11 MW-22	920512012	ND		ND	ND	ND	4100	ND	350	11400	34000	142000	ND	ND	ND	44600	ND
5/11/92	(B06274) S31-E11 Fld Blk	920512013	ND		ND		ND	ND	ND	ND					ND	ND	ND	ND
5/11/92	(B06290) S31-E11 TB	920512014	ND		ND													
5/12/92	(B06255) S31-E10C MW-14	920513006	TCA (2) TCE * PCE (0.5)	TCE (66)	ND	ND	ND	50900	24B	438	17400	70900	171000	ND	88	ND	103000	ND
5/12/92	(B06256) S31-E10C DUP	920513007	TCA (1) TCE *	TCE (56)	ND		ND	51600	23B	451								
5/12/92	(B06275) S31-E10C Fld Blk	920513008	ND		ND		ND	ND	ND	ND					ND	ND	ND	ND
5/12/92	(B06255MS) S31-E10C MS	920513009	NA	85-94%			105%	90%	100%	105%								
5/12/92	(B06255MSD) S31-E10C MSD	920513010	NA	80-90%			103%	88%	101%	105%								
5/12/92	(B06291) S31-E10C TB	920513011	ND		ND													
5/12/92	(B06257) S31-E10D MW-15	920513012	TCA (0.7) TCE *	TCE (38)	ND	ND	ND	26400	35B	685	14300	46900	160000	ND	69	ND	70600	ND
5/12/92	(B06276) S31-E10D Fld Blk	920513013	ND		ND		ND	ND	ND	ND					ND	ND	ND	ND
5/12/92	(B06292) S31-E10D TB	920513014	ND		ND													
5/13/92	(B06260) S30-E10A MW-10	920515018	TCA (1) TCE (4)		ND	ND	ND	46800	30B	317	26900	68600	161000	ND	97	ND	96300	21
5/13/92	(B06278) S30-E10A Fld Blk	920515019	ND		ND		ND	ND	ND	ND					ND	ND	ND	ND
5/13/92	(B06294) S30-E10A TB	920515020	ND		ND													
5/13/92	(B06261) S30-E10B MW-11	920515021	TCA (1) TCE (7)		ND	ND	ND	47200	27B	311	26000	72600	160000	ND	80	ND	96600	20
5/13/92	(B06279) S30-E10B Fld Blk	920515022	ND		ND		ND	ND	ND	ND					ND	ND	ND	ND
5/13/92	(B06295) S30-E10B TB	920515023	ND		ND													

Shading indicates analysis not scheduled

*=TCE overrange (quantitated in dilution); **=spike too low; NA=Not Analyzed; ND=Not Detected; B=Below CRDL but above IDL; TCA=1,1,1-TCA

ATTACHMENT #8
Page 2 of 4

Table 2: Summary Analytical Results Walla Walla 1100-EM-1 May/June 1992 Sampling Round

continued

Sample Date	Bottle/ Well ID	MULTI Lab#	Cu ug/l	Fe ug/l	Mg ug/l	Mn ug/l	Ni ug/l	K ug/l	Ag ug/l	Na ug/l	Sb ug/l	Pb ug/l	Cd ug/l	As ug/l	Hg ug/l	Tl ug/l	Temp Blank
		CRDL (ug/L)	10	100	100	15	15	2000	10	2000	5	2	0.5	5	0.2	5	
5/11/92	(B06251) S29-E11 MW-20	920512003	11	104	18300	22	ND	7610	ND	30500	ND	ND	ND	ND	ND	ND	4 deg
5/11/92	(B06272) S29-E11 Fld Blk	920512004	11	ND	231	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	
5/11/92	(B06288) S29-E11 TB	920512005															
5/11/92	(B06252) S31-E10A MW-12	920512006	ND	ND	20700	ND	ND	7980	ND	31100	ND	2	ND	6	ND	ND	4 deg
5/11/92	(B06253) S31-E10A DUP	920512007	ND	ND	20100	ND	ND	7710	ND	29900	ND	80	4	ND	ND	ND	
5/11/92	(B06273) S31-E10A Fld Blk	920512008	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	
5/11/92	(B06252MS) S31-E10A MS	920512009	98%	95%	**	97%	93%	96%	88%	92%	98%	109%	92%	100%	106%	95%	
5/11/92	(B06252MSD) S31-E10A MSD	920512010	99%	97%	**	97%	95%	95%	91%	90%	94%	110%	94%	92%	103%	93%	
5/11/92	(B06289) S31-E10A TB	920512011															
5/11/92	(B06254) S31-E11 MW-22	920512012	ND	ND	9010	ND	ND	4950	ND	20100	ND	ND	ND	6	ND	ND	6 deg
5/11/92	(B06274) S31-E11 Fld Blk	920512013	13	ND	182	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	
5/11/92	(B06290) S31-E11 TB	920512014															
5/12/92	(B06255) S31-E10C MW-14	920513006	ND	ND	21300	ND	18	7700	ND	31100	ND	ND	ND	5	ND	ND	8 deg
5/12/92	(B06256) S31-E10C DUP	920513007															
5/12/92	(B06275) S31-E10C Fld Blk	920513008	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	
5/12/92	(B06255MS) S31-E10C MS	920513009															
5/12/92	(B06255MSD) S31-E10C MSD	920513010															
5/12/92	(B06291) S31-E10C TB	920513011															
5/12/92	(B06257) S31-E10D MW-15	920513012	ND	ND	14500	ND	ND	6400	ND	24400	ND	ND	ND	7	ND	ND	9 deg
5/12/92	(B06276) S31-E10D Fld Blk	920513013	ND	ND	107	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	
5/12/92	(B06292) S31-E10D TB	920513014															
5/13/92	(B06260) S30-E10A MW-10	920515018	ND	172	20000	ND	20	7770	ND	30700	ND	8	ND	ND	ND	ND	9 deg
5/13/92	(B06278) S30-E10A Fld Blk	920515019	ND	ND	166	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	
5/13/92	(B06294) S30-E10A TB	920515020															
5/13/92	(B06261) S30-E10B MW-11	920515021	ND	ND	20800	16	ND	7870	ND	32000	ND	ND	ND	ND	ND	ND	6 deg
5/13/92	(B06279) S30-E10B Fld Blk	920515022	14	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	
5/13/92	(B06295) S30-E10B TB	920515023															

Shading indicates analysis not scheduled

9212661923

Table 2: Summary Analytical Results Walla Walla 1100-EM-1 May/June 1992 Sampling Round

continued

Sample Date	Bottle Label / Well ID	MULTI Lab#	VOA Neat ug/l	VOA dil ug/l	VOA TICs ug/l	PestCLP ug/l	NO2-N ug/l	NO3-N ug/l	OPO4-P ug/l	F ug/l	Cl ug/l	SO4 ug/l	Alk ug/l	NH3 ug/l	Ba ug/l	Be ug/l	Ca ug/l	Cr ug/l
5/18/92	(B06266) S37-E11 MW-6	920519021	ND		ND	ND	ND	3200	49B	288	12800	32900			ND	ND	45200	ND
5/18/92	(B06284) S37-E11 Fld Blk	920519022	ND		ND		ND	ND	ND	ND					ND	ND	ND	ND
5/18/92	(B061B0) S37-E11 TB	920519023	ND		ND													
5/18/92	(B06268) S41-E11 MW-1	920519024	ND		ND	ND	ND	3700	45B	296	15500	31800			ND	ND	54000	16
5/18/92	(B06268MS) S41-E11	920519025													101%	99%	95%	93%
5/18/92	(B06268MSD) S41-E11	920519026													103%	100%	100%	94%
5/18/92	(B06269) S41-E11 DUP	920519027													ND	ND	53700	17
5/18/92	(B06286) S41-E11 Fld Blk	920519028	ND		ND		ND	ND	ND	ND					ND	ND	ND	ND
5/18/92	(B061B2) S41-E11 TB	920519029	ND		ND													
6/3/92	(B06262) S31-E8 MW-8	920604008					ND	6500	39B	306	16000	29200	159000	ND	53	ND	51200	ND
6/3/92	(B06280) S31-E8 Fld Blk	920604009					ND	ND	ND	ND					ND	ND	1050B	ND
6/3/92	(B06296) S31-E8 TB	920604010																
6/3/92	(B06264) S32-E11 MW-19	920604011	ND		ND	broken	ND	3800	35B	336	11700	36000	142000	ND	ND	ND	44800	ND
6/3/92	(B06282) S32-E11 Fld Blk	920604012	ND		ND		ND	ND	ND	ND					ND	ND	ND	ND
6/3/92	(B06298) S32-E11 TB	920604013	ND		ND													
6/3/92	(B06265) S34-E10 MW-2	920604014	ND		ND	ND	ND	5400	32B	329	13000	41800	153000	ND	50	ND	51000	16
6/3/92	(B06283) S34-E10 Fld Blk	920604015	ND		ND		ND	ND	ND	ND					ND	ND	ND	ND
6/3/92	(B06299) S34-E10 TB	920604016	ND		ND													
6/3/92	(B06267) S38-E12A MW-4	920604022					ND	2100	27B	217	8600	21800			ND	ND	40900	13
6/3/92	(B06285) S38-E12A Fld Blk	920604023					ND	ND	ND	ND					ND	ND	ND	ND
6/3/92	(B061B1) S38-E12A TB	920604024																
6/4/92	(B06263) S29-E12	920605002	ND		ND	ND	ND	4300	22B	331	14900	33400	148000	ND	ND	ND	47100	ND
6/4/92	(B06281) S29-E12 Fld Blk	920605003	ND		Silanol		ND	ND	ND	ND					ND	ND	ND	ND
6/4/92	(B06297) S29-E12 TB	920605004	ND		ND													
6/4/92	(B06270) S41-E12 MW-3	920605005	ND		ND	ND	ND	870	583	153	103000	16400			198	ND	123000	2810
6/4/92	(B06270MS) S41-E12MS	920605006													95%	99%	90%	89%
6/4/92	(B06270MSD) S41-E12MSD	920605007													95%	99%	94%	9%
6/4/92	(B06271) S41-E12DUP	920605008													215	ND	124000	2950
6/4/92	(B06287) S41-E12 Fld Blk	920605009	ND		ND		ND	ND	ND	ND					ND	ND	ND	ND
6/4/92	(B061B3) S41-E12 TB	920605010	ND		ND													
6/10/92	(B061C3) S38-E12A MW-4	920611053	CHCl3 (0.6) TCA (0.9) PCE (0.7)		ND	ND												
6/10/92	(B061C4) S38-E12A Fld Blk	920611054	Acetone (11)		ND													
6/10/92	(B061C5) S38-E12A TB	920611055	ND		ND													
6/10/92	(B061C6) S32-E11 MW-19	920611056				ND												
6/10/92	(B061C7) S31-E8 MW-8	920611057	TCA (2)		ND	ND												
6/10/92	(B061C8) S31-E8 Fld Blk	920611058	ND		ND													
6/10/92	(B061C9) S31-E8 TB	920611059	ND		ND													
no run	(B06258) SNP-SPL	will not run																
no run	(B06259) SNP-SPL DUP	will not run																
no run	(B06277) SNP-SPL Fld Blk	will not run																
no run	(B06293) SNP-SPL TB	will not run																

*=TCE overrange (quantitated in dilution); **=spike too low; NA=Not Analyzed; ND=Not Detected; B=Below CRDL but above IDL; TCA=1,1,1-TCA

Table 2: Summary Analytical Results Walla Walla 1100-EM-1 May/June 1992 Sampling Round

continued

Sample Date	Bottle Label	Well ID	MULTI Lab#	Cu ug/l	Fe ug/l	Mg ug/l	Mn ug/l	Ni ug/l	K ug/l	Ag ug/l	Na ug/l	Sb ug/l	Pb ug/l	Cd ug/l	As ug/l	Hg ug/l	Tl ug/l	Temp Blank
5/18/92	(B06266) S37-E11	MW-6	920519021	ND	116	9790	ND	ND	4420	ND	23800	ND	ND	ND	5	ND	ND	4 deg
5/18/92	(B06284) S37-E11 Fld Blk		920519022	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	
5/18/92	(B061B0) S37-E11 TB		920519023															
5/18/92	(B06268) S41-E11	MW-1	920519024	ND	434	11200	ND	25	5830	ND	22100	ND	ND	ND	7	ND	ND	9 deg
5/18/92	(B06268MS) S41-E11		920519025	95%	90%	80%	94%	90%	93%	91%	98%	100%	100%	82%	107%	103%	90%	
5/18/92	(B06268MSD) S41-E11		920519026	96%	93%	114%	96%	92%	98%	95%	102%	88%	100%	80%	97%	103%	90%	
5/18/92	(B06269) S41-E11 DUP		920519027	ND	131	11100	ND	32	5700	ND	21900	ND	ND	ND	ND	ND	ND	
5/18/92	(B06286) S41-E11 Fld Blk		920519028	24	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	
5/18/92	(B061B2) S41-E11 TB		920519029															
6/3/92	(B06262) S31-E8	MW-8	920604008	ND	ND	12300	ND	ND	4400	ND	18400	ND	ND	ND	5	ND	ND	7 deg
6/3/92	(B06280) S31-E8 Fld Blk		920604009	16	ND	493	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	
6/3/92	(B06296) S31-E8 TB		920604010															
6/3/92	(B06264) S32-E11	MW-19	920604011	ND	ND	9060	ND	ND	5500	ND	19800	ND	ND	ND	9	ND	ND	5 deg
6/3/92	(B06282) S32-E11 Fld Blk		920604012	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	
6/3/92	(B06298) S32-E11 TB		920604013															
6/3/92	(B06265) S34-E10	MW-2	920604014	ND	ND	10800	ND	20	5530	ND	20200	ND	ND	ND	ND	ND	ND	4 deg
6/3/92	(B06283) S34-E10 Fld Blk		920604015	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	
6/3/92	(B06299) S34-E10 TB		920604016															
6/3/92	(B06267) S38-E12A	MW-4	920604022	ND	ND	8640	ND	ND	4350	ND	14200	ND	ND	ND	6	ND	ND	13 deg
6/3/92	(B06285) S38-E12A Fld Blk		920604023	ND	ND	ND	ND	ND	ND	ND	ND	ND	3	ND	ND	ND	ND	
6/3/92	(B061B1) S38-E12A TB		920604024															
6/4/92	(B06263) S29-E12		920605002	ND	ND	9460	ND	ND	5800	ND	21300	ND	ND	ND	6	ND	ND	5 deg
6/4/92	(B06281) S29-E12 Fld Blk		920605003	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	
6/4/92	(B06297) S29-E12 TB		920605004															
6/4/92	(B06270) S41-E12	MW-3	920605005	74	30900	26500	350	240	9140	ND	38500	ND	3	ND	63	ND	ND	4 deg
6/4/92	(B06270MS) S41-E12MS		920605006	90%	**	56%	99%	81%	92%	88%	96%	92%	102%	78%	99%	90%	90%	
6/4/92	(B06270MSD) S41-E12MSD		920605007	90%	**	81%	81%	78%	94%	91%	99%	92%	99%	78%	94%	89%	85%	
6/4/92	(B06271) S41-E12DUP		920605008	85	34300	26600	550	270	9000	ND	38800	ND	2	ND	73	ND	ND	
6/4/92	(B06287) S41-E12 Fld Blk		920605009	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	
6/4/92	(B061B3) S41-E12 TB		920605010															
6/10/92	(B061C3) S38-E12A	MW-4	920611053															2 deg
6/10/92	(B061C4) S38-E12A Fld Blk		920611054															
6/10/92	(B061C5) S38-E12A TB		920611055															
6/10/92	(B061C6) S32-E11	MW-19	920611056															2 deg
6/10/92	(B061C7) S31-E8	MW-8	920611057															4 deg
6/10/92	(B061C8) S31-E8 Fld Blk		920611058															
6/10/92	(B061C9) S31-E8 TB		920611059															
no run	(B06258) SNP-SPL		will not run															
no run	(B06259) SNP-SPL DUP		will not run															
no run	(B06277) SNP-SPL Fld Blk		will not run															
no run	(B06293) SNP-SPL TB		will not run															

*=TCE overrange (quantitated in dilution); **=spike too low: NA=Not Analyzed; ND=Not Detected; B=Below CRDL but above IDL; TCA=1,1,1-TCA

SITE DEVELOPMENT AND INFRASTRUCTURE PLANNING

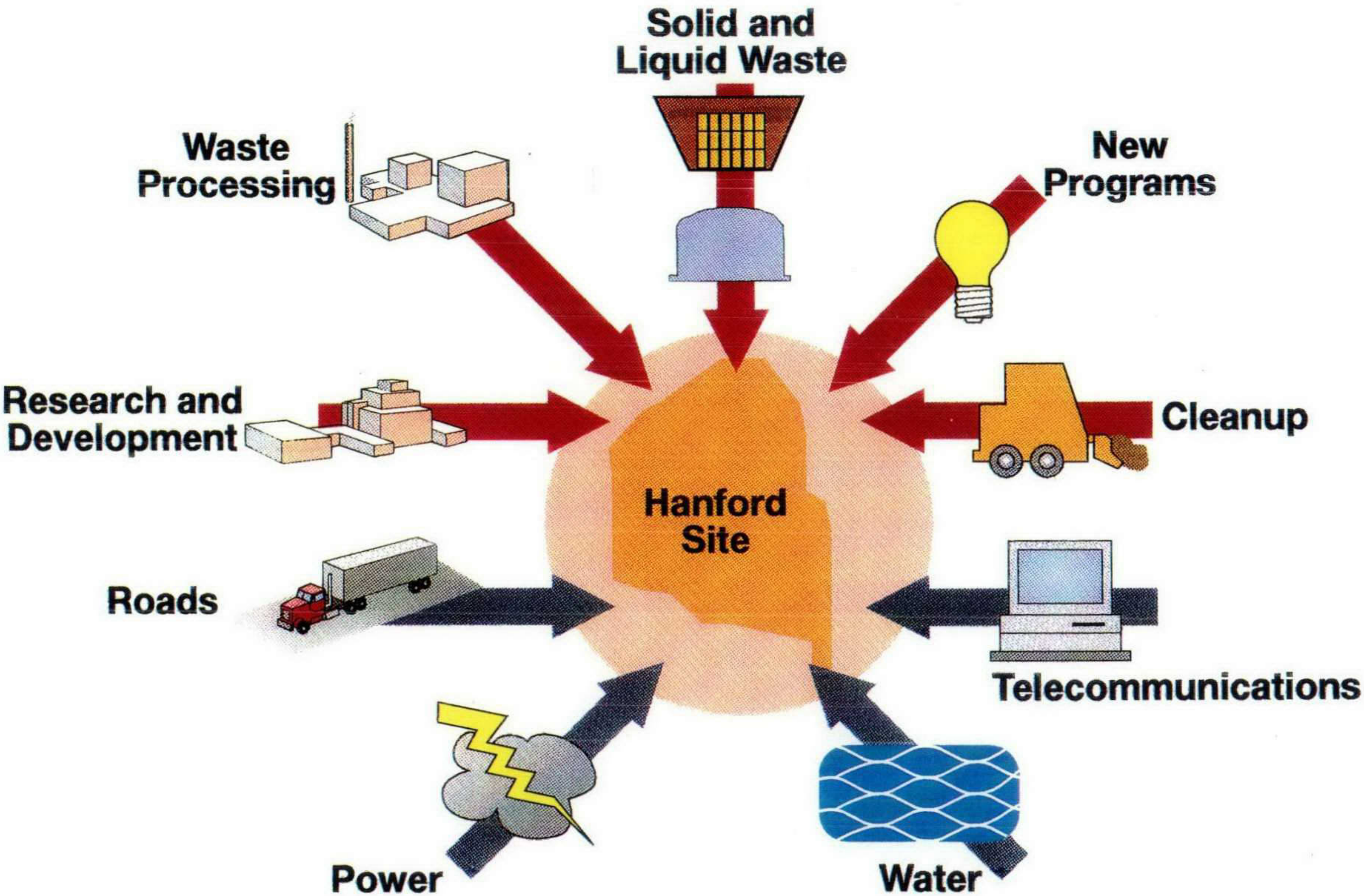
OVERVIEW

JULY 1992

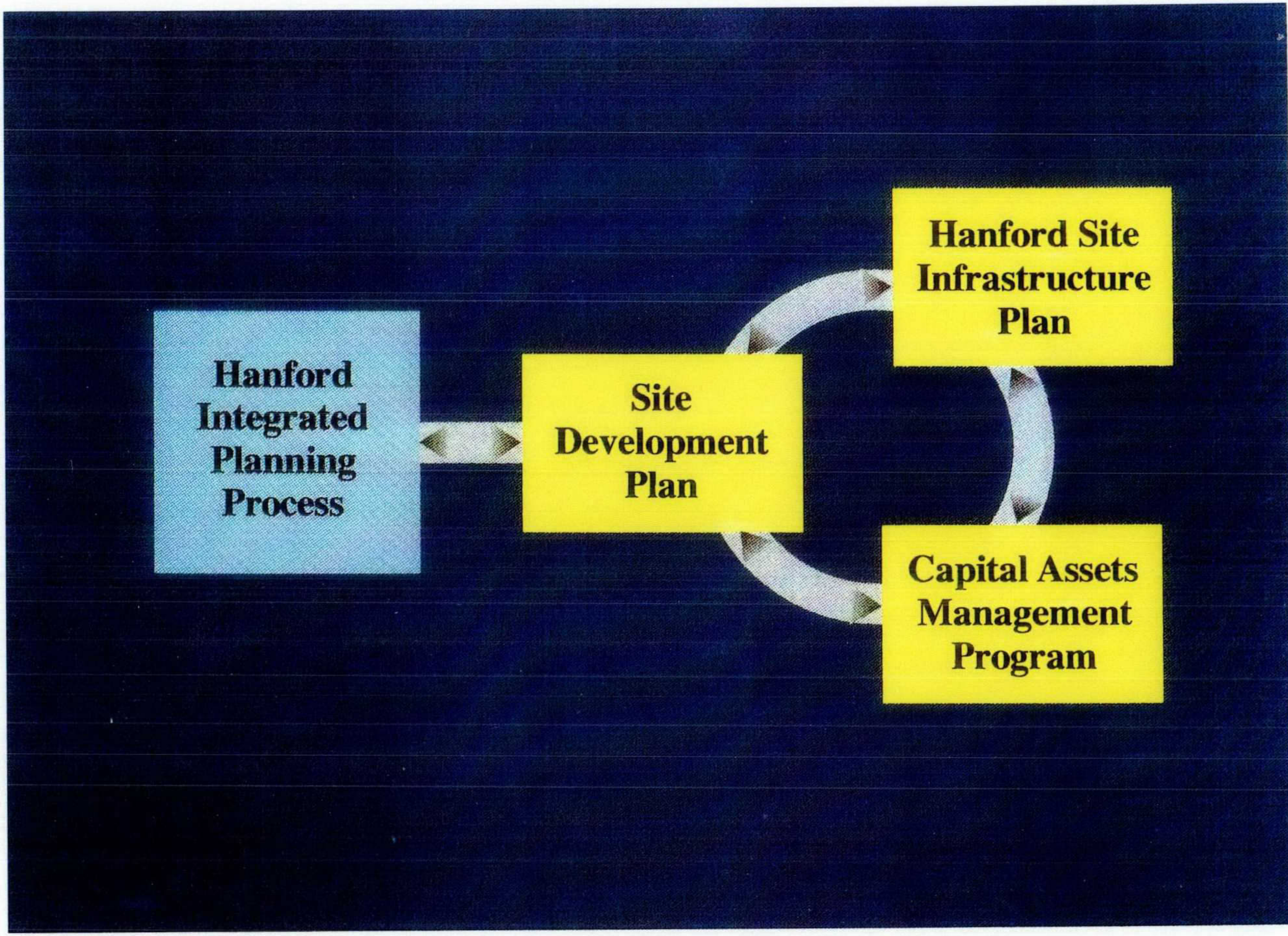
BOYD HATHAWAY, SITE DEVELOPMENT PLANNER

WESTINGHOUSE HANFORD COMPANY / SITE PLANNING

DOE Site Development Planning Process

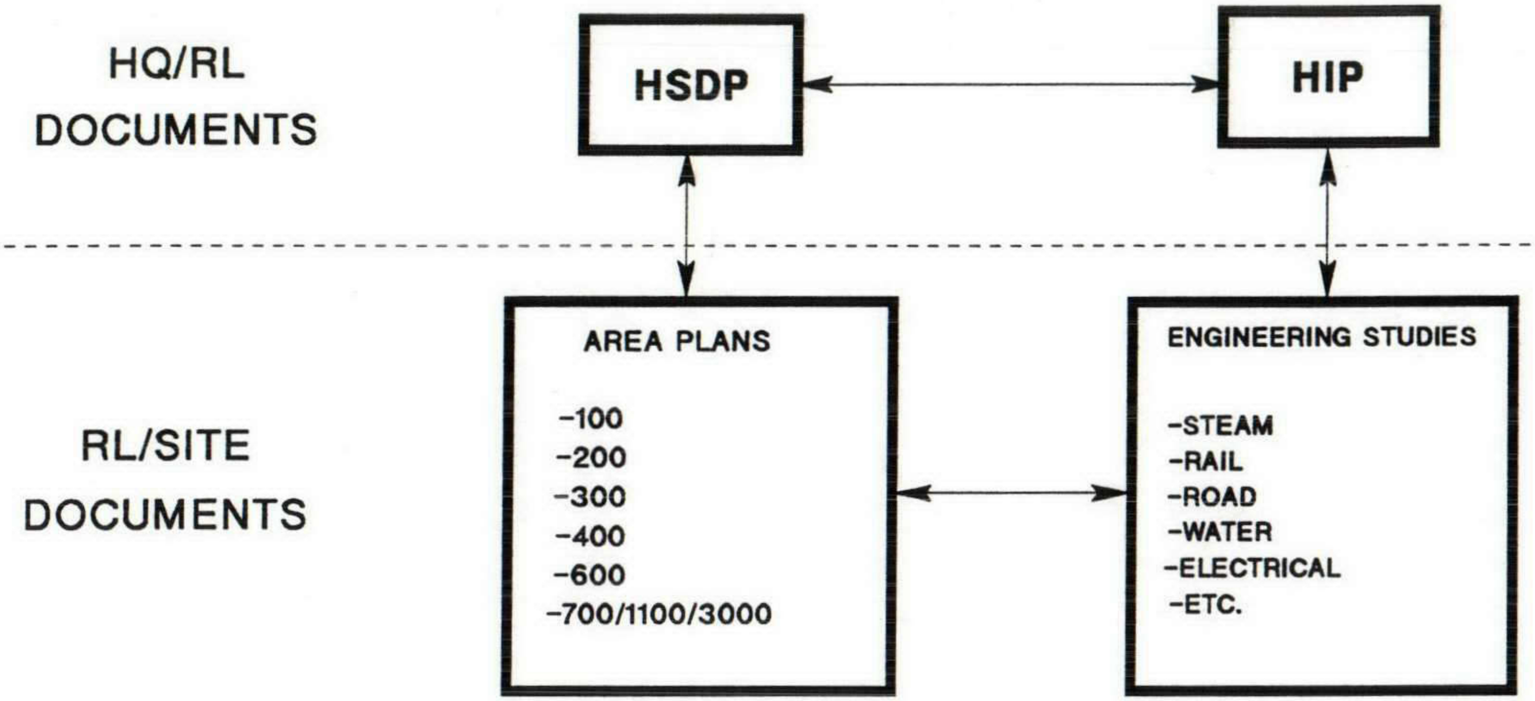


79203150.8


Hanford Integrated Planning Process
Site Development Plan
Hanford Site Infrastructure Plan
Capital Assets Management Program

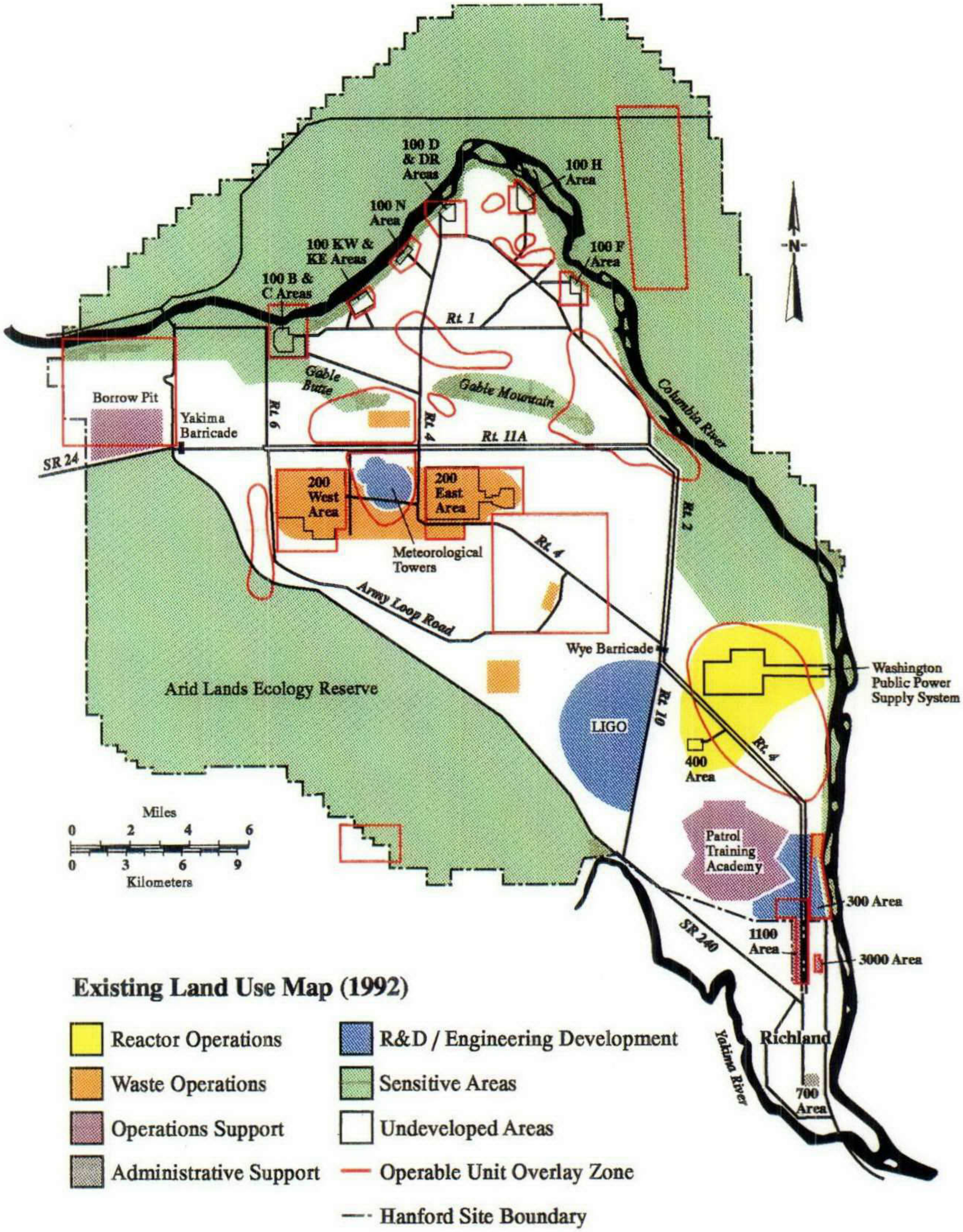
9212661929

DOE SITE DEVELOPMENT PLANNING DOCUMENTS

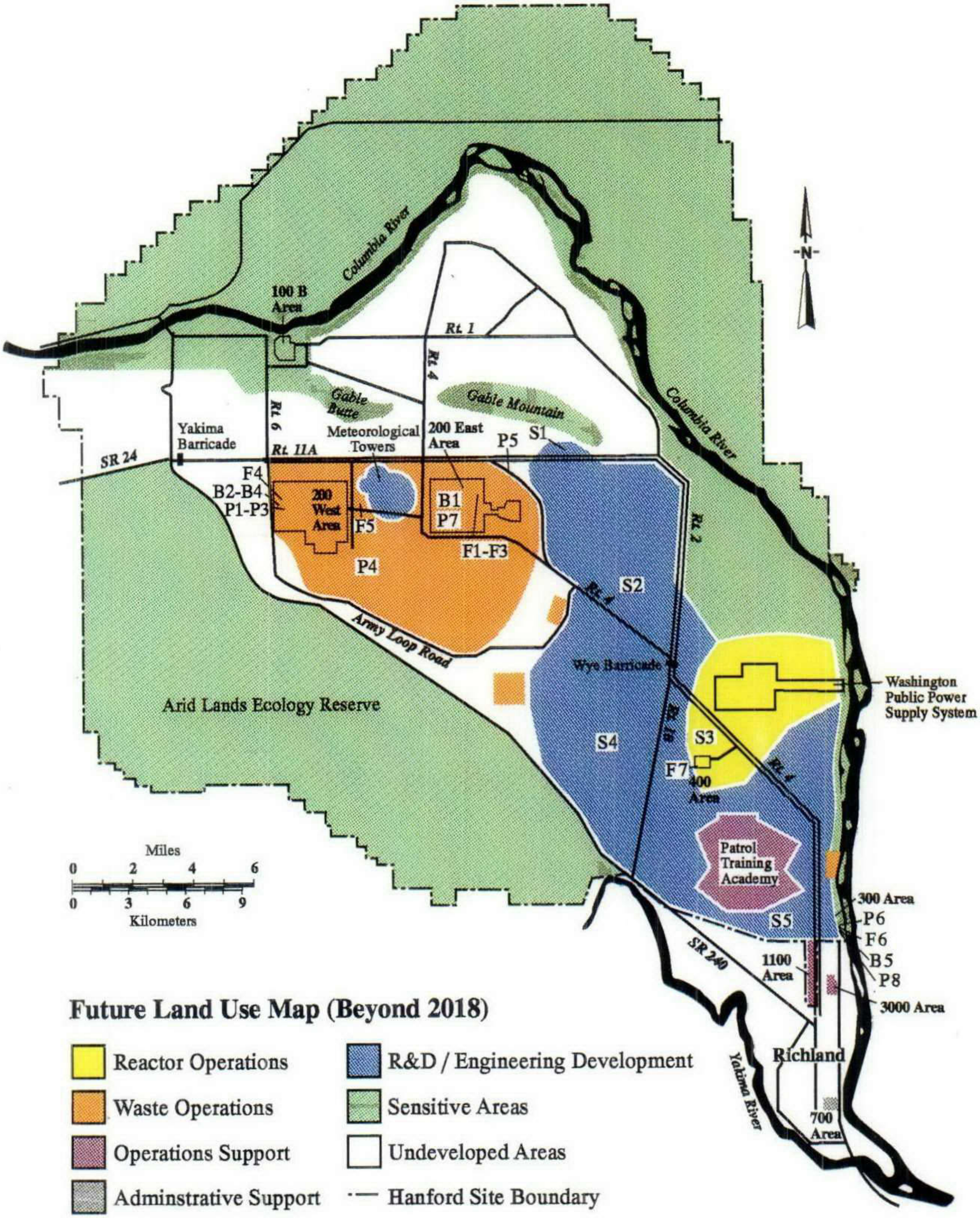


HSDP = HANFORD SITE DEVELOPMENT PLAN
HIP = HANFORD SITE INFRASTRUCTURE PLAN
HQ = DEPARTMENT OF ENERGY HEAD QUARTERS
RL = DEPARTMENT OF ENERGY RICHLAND FIELD OFFICE

9212651930



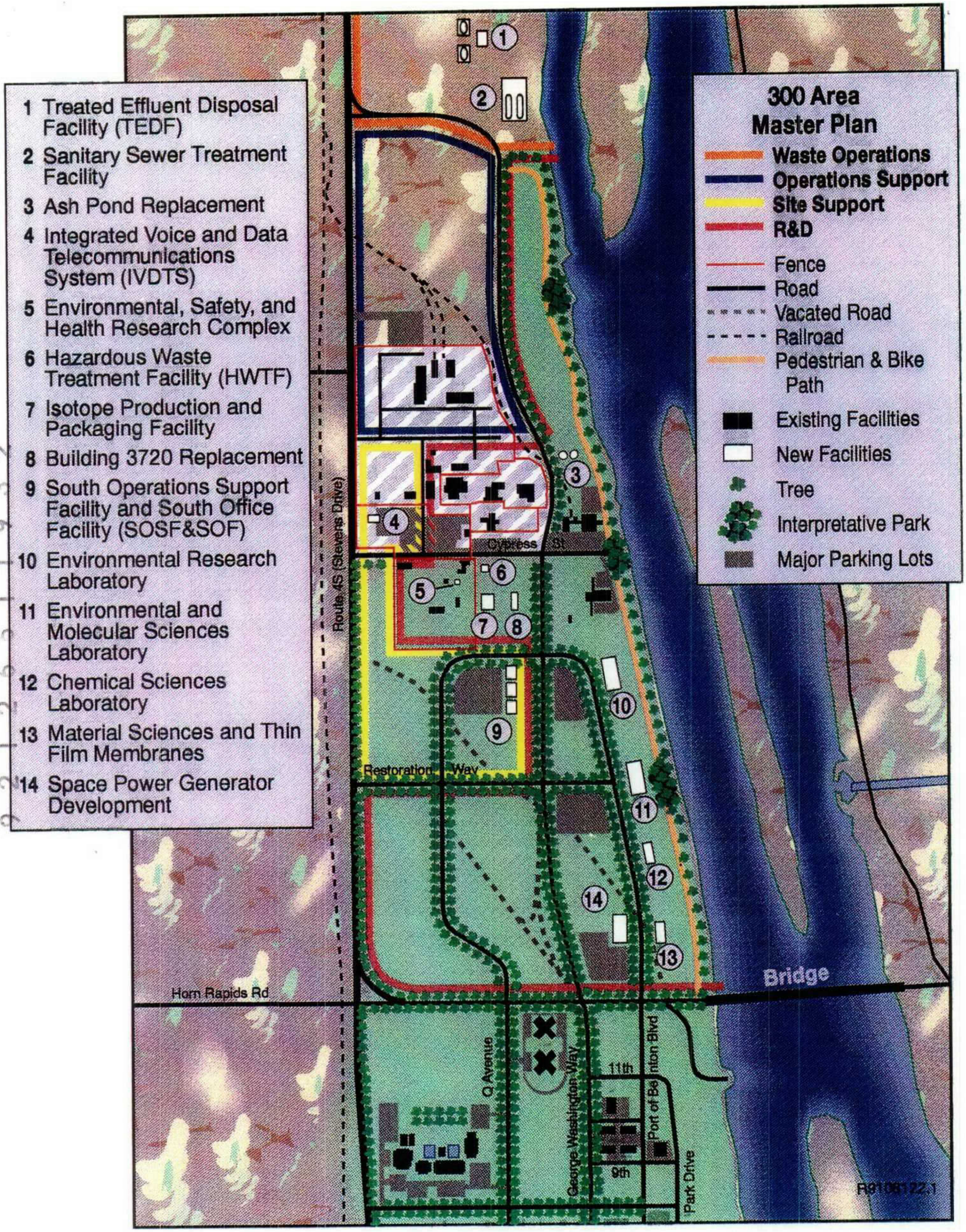
Existing Land Use Map (1992)



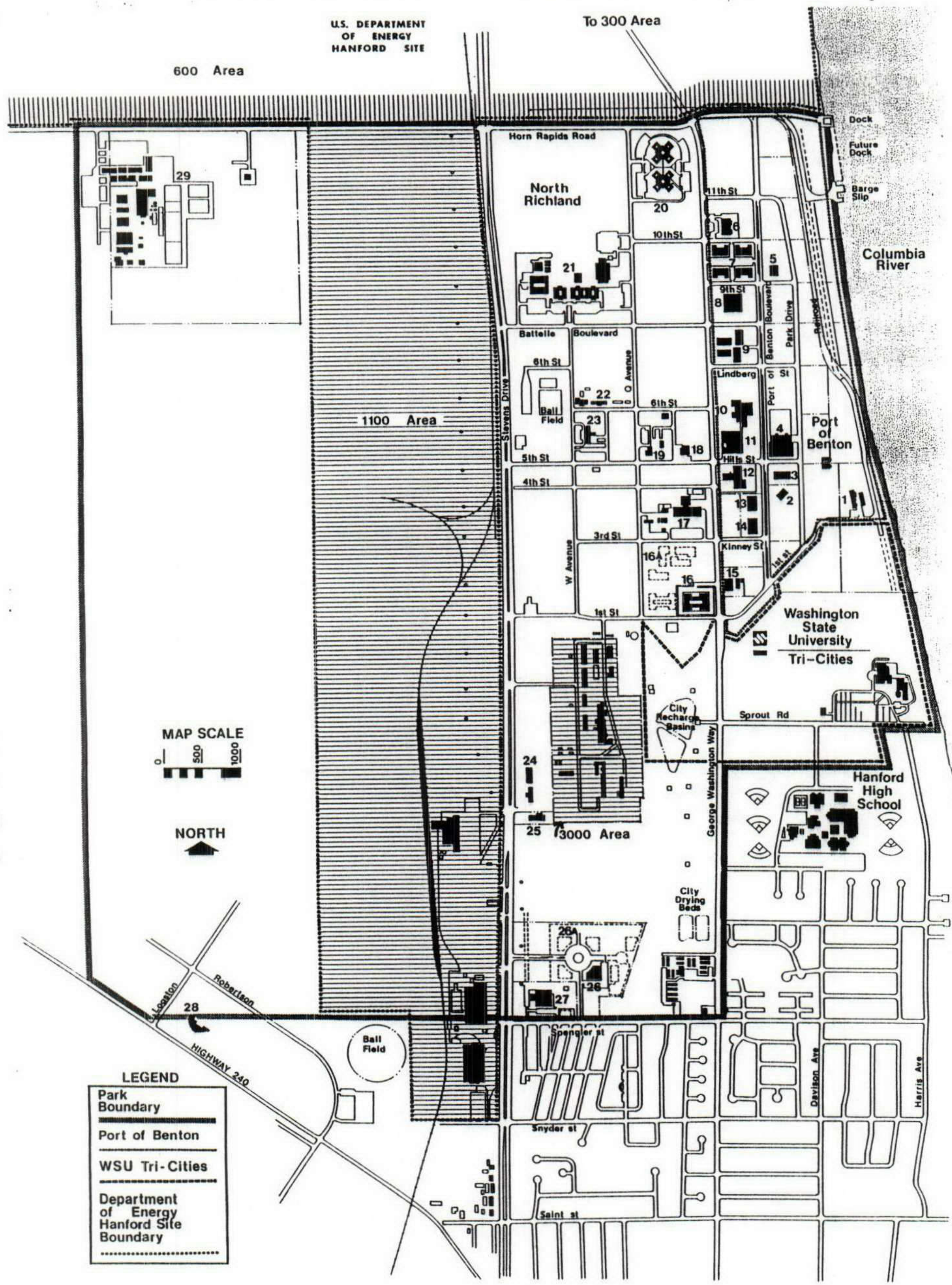
Future Land Use Map (Beyond 2018)

Note: • Refer to construction projects list for callouts (e.g., B1, F3, P2, and S1)

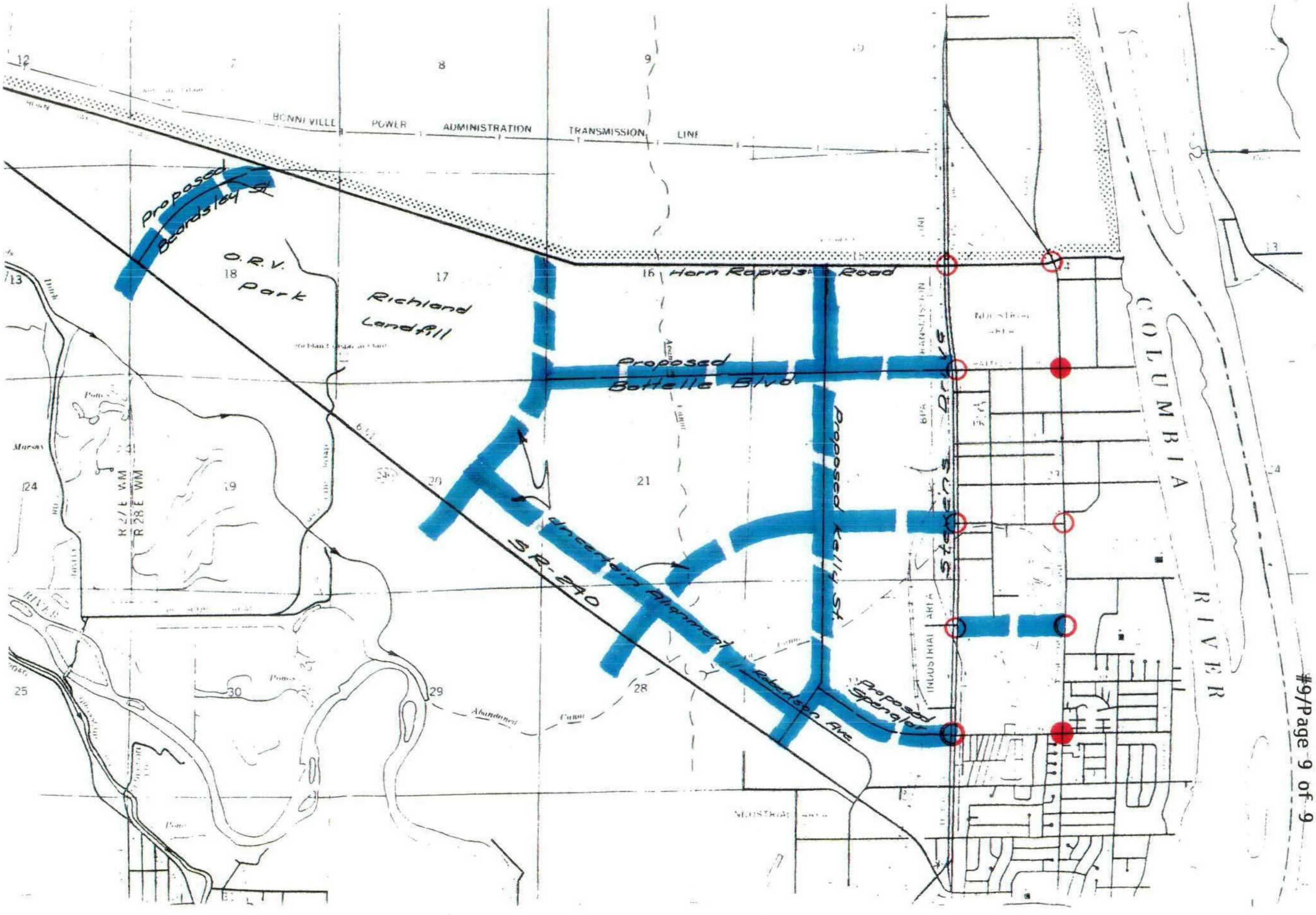
• The land uses identified in this map represent DOE's vision of future land uses based on existing and potential Hanford missions. This map will be updated annually to incorporate decisions made by the Hanford Remedial Action Environmental Impact Statement, other NEPA or regulatory decision documents, mission changes, and other sources as appropriate.



1 Treated Effluent Disposal Facility (TEDF)
2 Sanitary Sewer Treatment Facility
3 Ash Pond Replacement
4 Integrated Voice and Data Telecommunications System (IVDTS)
5 Environmental, Safety, and Health Research Complex
6 Hazardous Waste Treatment Facility (HWTF)
7 Isotope Production and Packaging Facility
8 Building 3720 Replacement
9 South Operations Support Facility and South Office Facility (SOSF&SOF)
10 Environmental Research Laboratory
11 Environmental and Molecular Sciences Laboratory
12 Chemical Sciences Laboratory
13 Material Sciences and Thin Film Membranes
14 Space Power Generator Development
300 Area Master Plan
Waste Operations
Operations Support
Site Support
R&D
Fence
Road
Vacated Road
Railroad
Pedestrian & Bike Path
Existing Facilities
New Facilities
Tree
Interpretative Park
Major Parking Lots
Route 4S (Stevens Drive)
Cypress St
Restoration Way
Horn Rapids Rd
Bridge
Q Avenue
George Washington Way
Port of Benton Blvd
11th
9th
Park Drive
R9108122.1


U.S. DEPARTMENT OF ENERGY HANFORD SITE
600 Area
To 300 Area
Dock
Future Dock
Barge Slip
Columbia River
Horn Rapids Road
North Richland
29
20
11th St
10thSt
21
9th St
Benton Boulevard
Park Drive
Railroad
Battelle
Boulevard
6th St
Ball Field
22
O Avenue
6th St
23
Stevens Drive
1100 Area
Lindberg
Port of St
Port of Benton
5th St
19
18
Hills St
4th St
17
3rd St
W Avenue
16A
16
Kinney St
15
1st St
Washington State University
Tri-Cities
City Recharge Basins
Sprout Rd
George Washington Way
MAP SCALE
0
500
1000
24
25
3000 Area
Hanford High School
NORTH
City Drying Beds
26A
26
27
Robertson
Logston
28
HIGHWAY 240
Ball Field
Spengler st
Davison Ave
Harris Ave
Snyder st
Saint st
LEGEND
Park Boundary
Port of Benton
WSU Tri-Cities
Department of Energy Hanford Site Boundary

9212661933


BONNEVILLE POWER ADMINISTRATION TRANSMISSION LINE
Proposed Beardsley St
O.R.V. Park
Richland Landfill
Horn Rapids Road
Proposed Battelle Blvd
Proposed Kelly St.
Stevens Drive
Uncertain Alignment
SR-240
Robinson Ave
Proposed Spengler
INDUSTRIAL AREA
COLUMBIA RIVER
R 27 E WM
R 28 E WM

Attachment #10

INCREMENTAL CANCER RISK ESTIMATES USING MAXIMUM AND 95% UCL CONCENTRATIONS FOR AVERAGE AND REASONABLE MAXIMUM EXPOSURE SCENARIOS

		95% UCL Concentration			Max Concentration		
Contaminant	Pathway	Conc	Ave	RME	Conc	Ave	RME
TCE	inhalation	75ppb	5E-06	2E-05	110ppb	7E-06	3E-05
	ingestion		2E-06	1E-05		2E-06	1E-05

CHRONIC HAZARD QUOTIENTS USING MAXIMUM AND 95% UCL CONCENTRATIONS FOR AVERAGE AND REASONABLE MAXIMUM EXPOSURE SCENARIOS

		95% UCL Concentration			Max Concentration		
Contaminant	Pathway	Conc	Ave	RME	Conc	Ave	RME
NO3-N	ingestion	45mg/l	<1	<1	61mg/l	<1	1

Attachment #11

Statistics for Risk Assessment

To calculate the 95% upper confidence limit (95% UCL), data were used that approximately represented the distribution of contaminant for each site. Data that were rejected by validation are not included in calculations. All data from the phase I and phase II RIs were considered. For a contaminant of potential concern (COPC), specific to a sub-unit, one-half the Sample Quantitation Limit (SQL) is used in the calculations when a COPC is not detected in a sample. Anywhere PCBs are detected, the concentrations, or one-half the SQL, are summed for all the Aroclors detected at that subunit.

95% UCL was calculated as follows:

95% UCL = Average + t * (Standard deviation/square root(n))
n = sample size
t = Student's t
a = 0.05
df = n-1

GROUNDWATER:

Trichloroethene (TCE)

Data from MW-12 to 15 were used for statistics, because concentrations of TCE were consistently detected over MCL (5ppb) at these wells.

Nitrate (as Nitrogen)

Statistics were performed on data from MW-10 to MW-15 and MW-20 because nitrate was detected above MCL (10ppm) at these wells.

HORN RAPIDS LANDFILL:

Arsenic and Beryllium

These contaminants were evenly distributed on the site. All data were included that were taken from the surface soil (0 to 15 feet).

Chromium and Nickel

In the borehole HRL-4 contaminants were found to be at significantly higher concentrations than any of the other samples on the site. In order to estimate the concentrations over the 15 foot soil column, data taken from all boreholes and trenches down to 15 feet were used in calculations.

Dieldrin

Recent data validation has revealed that concentrations reported for Dieldrin are associated with the X qualifier which indicates that the case narrative from the lab should be consulted. The analyst's opinion is that Dieldrin is actually a part of the Aroclor pattern. Dieldrin is therefore not considered a contaminant of potential concern.

PCBs

Elevated levels of PCB are mostly found in close proximity to HRL-4, therefore calculations were done using data from samples taken from this vicinity. Data used are from AH203, Borehole HRL-4 (0-2.8 feet), PCB-1 to PCB-4 and PCB-1A to PCB-4A .

UN-1100-6 (DISCOLORED SOIL SITE):

Bis(2-ethylhexyl)phthalate (BEHP) and Chlordane

Where alpha and gamma chlordane were detected the total chlordane concentration was used. Data for BEHP and Chlordane were treated in the same way since their distributions on the site were similar. BEHP was only detected in samples A6150S to A6155S and since these samples were all in close proximity to each other, data from these samples were used for statistics.

EPHEMERAL POOL:

Chlordane and PCBs

All data for these contaminants, collected from this site, were used in the calculations.

Statistics for Groundwater and Soil Sampling Data

GROUNDWATER

	TCE ppb	NO3–N ppm
WELLS	12–15	10–15,20
AVE	71	43
STD	13	8
n	39	58
t	1.68	1.67
95% UCL	75	45
MIN	34	24
MAX	110	61

SOIL SAMPLING

HORN RAPIDS LANDFILL:

	Arsenic mg/kg	Beryllium mg/kg	Chromium mg/kg	Nickel mg/kg	PCB'S ug/kg
AVE	1.2	0.5	44.3	25.2	28436
STD	0.8	0.3	170	75.4	25821
n	106	100	55	55	22
t	1.66	1.66	1.67	1.67	1.72
95% UCL	1.4	0.5	82.6	42.2	37905
MIN	0.0	0.1	3.2	2.6	1500
MAX	4.2	1.1	1250	557	100000

UN–1100–6:

	BEHP ug/kg	Chlordane ug/kg
AVE	13100000	1113
STD	5851496	513
n	6	6
t	2.01	2.01
95% UCL	17901615	1535
MIN	6700000	590
MAX	25000000	1860

EPHEMERAL POOL:

	Chlordane ug/kg	PCB's ug/kg
AVE	1559	9192
STD	869	15309
n	6	6
t	2.01	2.01
95%UCL	2272	21754
MIN	635	350
MAX	2800	42255

9212651933

SDG	Boring Loc.	Sample No.	Sample Depth	Arsenic mg/kg	Beryllium mg/kg	Chromium mg/kg	Nickel mg/kg	Total PCBs ug/kg
PHASE I DATA								
AH168S/ A1307S		AH168S	0–0.5	0.65 J	0.46	5.9	9.2	
		AH169S		1.5 J	0.09 U	9.2	11.2	
		AH170S		1.8 J	0.085 U	8.3	10.9	
		AH171S		2.1 J	0.42	13	14.3	
		AH172S		1.9	0.79	14.2	9.2	
		AH173S		0.67 J	0.105 U	5.8	5.4	
		AH174S		1.1 J	0.08 U	7	11.1	
		AH175S		1.6	0.08 U	7.6	10.9	
		AH176S		1.1	0.085 U	6.5	9.1	
		AH177S		1.7	0.22	11.4	10.2	
		AH178S		0.96 J	0.2	7.5	9.7	
		AH179S		1 J	0.085 U	9.5	12.1	
AH180S A1312S		AH180S		0.62	0.085 U	6.7	9.1	
		AH181S		2.3	0.83	17.1	11.3	
		AH184S		0.87	0.13	15	8.7	
		AH185S		3.6	0.67	13.9	10.4	
AH186S		AH186S		1.1	0.09 U	9.3	10.1	
		AH187S		1.3	0.085 U	8.4	11	
		AH188S		1.1	0.09 U	8	13.6	
		AH189S		1.8	0.095 U	12.1	13.8	
		AH190S		2.1	0.18 U	14.2	174	
		AH191S		1.4	0.08 U	7.6	11.2	
		AH192S		1.5	0.08 U	7.6	11.3	
		AH193S		1.2	0.09 U	7.1	8.9	
		AH194S		1.1	0.095 U	8.2	11.9	
		AH195S		1.8	0.095 U	12.2	11.3	
		AH196S		1.8	0.085 U	8.2	9.8	

9 2 1 2 5 1 1 9 3 9

SDG	Boring Loc.	Sample No.	Sample Depth	Arsenic mg/kg	Beryllium mg/kg	Chromium mg/kg	Nickel mg/kg	Total PCBs ug/kg
		AH197S		1.7	0.085 U	8.9	10.7	
		AH198S		2.2	0.09 U	9.7	11.2	
		AH199S		1.3	0.085 U	6.2	8.7	
		AH200S		1.5	0.08 U	9.9	9.3	
		AH201S		0.92	0.07 U	5.6	8.1	
		AH202S		1.9	0.08 U	13.7	14	
		AH203S		0.71	0.07 U	6.9	12	5000 J
		AH204S		1.9	0.08 U	8.7	9.1	
		AH205S		1.8	0.09 U	11	12.1	
AH206S		AH206S		1.9	0.62	8.2	10.2	
		AH207S		1.2 J	1.1	6.4	8.7	
		AH208S		1.6 J	1	5.1	7.8	
		AH209S		1.2 J	0.94	6.7	5.4	
		AH211S		1.9 J	0.85	10.4	8.1	
		AH212S		1.8 J	0.98	11.2	10	
		AH213S		1.4 J	1	10.4	12.2	
		AH214S		2.1 J	0.52	10.5	8.5	
		AH215S		NR	NR	NR	NR	
A1615S	HRL–2	A1802S	0–2.5	1.2	0.42	9	8.1 J	
		A1804S	5.1–7.9	1.3 J	0.52	6.6 J	8.3 J	
		A1805S	5.1–7.9	1.1 J	0.55	6 J	8.4 J	
		A1807S	9.8–12.3	0.67 J	0.57	5.1 J	7.6 J	
		A1810S	13.9–16.2	0.67 J	0.55	7.3 J	9.4 J	
A1901S	HRL–3	A2002S	0–2.5	2.2	0.59	13.2	12.2	
		A2004S	4.6–7.5	1.3	0.56	7.6 J	11.9	
		A2005S	4.6–7.5	1.8	0.69	6.6 J	7.8	
		A2007S	10.8–13	1.4 J	0.62	4.6	8.1	

Summary of Soil Sampling Data from HRL used for Statistics in RA

SDG	Boring Loc.	Sample No.	Sample Depth	Arsenic mg/kg	Beryllium mg/kg	Chromium mg/kg	Nickel mg/kg	Total PCBs ug/kg
A1901S	HRL-3	A2009S	14.5-17	1.4	0.78	7 J	9.6	
A1912S	HRL-4	A2202S	0-2.8	0.82 J	0.85	4.1	3.9 U	65000 J
		A2204S	5.4-8	1.5	0.97	7.4	9.7	
		A2205S	5.4-8	1.1	0.87	6.2	4.4 U	
		A2207S	10.5-13.6	1	1.1	10	3.8 U	
		A2209S	14.6-16.9	1.7	1.1	1250	557	
A1501W	HRL-5	A1502S	0-2.1	1.1 J	0.58	5.7 J	4.8 UJ	
		A1503S	3.8-6	0.56 J	0.54	4.1 J	3.9 UJ	
		A1504S	0.4-8.6	0.71 J	0.71	5.2 J	4.25 UJ	
		A1506S	9.4-11.6	0.79 J	0.8	6.1 J	5.25 UJ	
		A1507S	9.4-11.6	0.79 J	0.66	6.2 J	5.85 UJ	
		A1509S	13.1-15.5	0.76 J	0.73	81.5 J	39 J	
	HRL-6	A1601S	2.4-4.8	0.67 J	0.38	7.9 J	13.9 J	
		A1602S	4.8-7.1	0.81 J	0.58	7.8 J	6.15 UJ	
		A1604S	7.1-9.4	0.072 J	0.48	4.8 J	3.75 UJ	
		A1606S	9.4-11.6	0.91 J	0.33	5.8 J	5.55 UJ	
		A1607S	11.6-13.9	0.057 J	0.59	13.7 J	14.9 J	
		A1608S	11.6-13.9	0.72 J	0.52	8 J	4.6 UJ	
A2214S	HRL-7	A2301S	0-2.5	1.3 J	0.69	8.8	7.8	
		A2303S	4.8-7.2	0.94 J	0.28	7.6	7	
		A2304S	4.8-7.2	0.82 J	0.54	9.7	7	
		A2306S	8.9-11.2	4.2 J	0.76	6.5	7.8	
		A2310S	12.7-15.1	0.97 J	0.61	9.1	7.5	
A1401W	HRL-8	A1402S	0-2.5	1	0.95	16.2	17.4	
		A1404S	5.9-7.4	0.73	0.73	11.4	11.2	
		A1406S	8.7-10.9	0.2	1	284	135	
		A1408S	10.9-12.8	0.45	0.89	72	38	
		A1409S	15-17.3	1.1	1	119	55.6	

9212651941

Summary of Soil Sampling Data from HRL used for Statistics in RA

SDG	Boring Loc.	Sample No.	Sample Depth	Arsenic mg/kg	Beryllium mg/kg	Chromium mg/kg	Nickel mg/kg	Total PCBs ug/kg
A1615S	HRL–9	A1701S	0–2.5	0.76 J	0.44	5 J	6.6 J	
		A1704S	3.7–4.6	0.46 J	0.51	24.9 J	17.2 J	
		A1706S	6.8–9.1	0.58 J	0.62	14 J	12 J	
		A1707S	6.8–9.1	0.37 J	0.48	13.2 J	10.7 J	
		A1709S	10.9–13.1	0.48 J	0.42	4.7 J	4.8 J	
A1901S	HRL–10	A1901S	0–2.3	1.9	0.37	10.8 J	8.7	
		A1902S	2.3–4	1.7	0.61	17.6 J	13	
		A1905S	6.9–9.1	1.5	0.69	9.9 J	12.3	
		A1906S	6.9–9.1	1.8	0.6	9.6 J	12	
PHASE II DATA								
23	TP–11	BOOZ59	4	4.1	0.115 U	85.7 EN	31.6 *	
28	TP–3B	BOOZT3	7–7.5	R	R	4.9 J	15.4	
	TP–3B	BOOZT4	7–7.5	R	R	4.3 J	8.5	
	TP–3A	BOOZT7	5	R	R	3.7 J	R	
	TP–3A	BOOZT8	10	R	R	9.9 J	9.2	
	TP–4/5	BOOZV1	5	R	R	3.2 J	R	
	TP–4/5	BOOZV2	12	R	R	133 J	71.6	
29	TP–8	BOOZV3	5	0.74 BN	0.55 B	19.8 *	14	
27	TP–7	BOOZT2	5	2.9 J	0.115 U	9.8	57.3	
23	TP–1	BOOZT0	5	NA	NA	NA	NA	
	TP–1	BOOZT1	9	NA	NA	NA	NA	
30	B5–2	BOOZX5	1	NA	NA	NA	NA	
31	B5–3	BOOZX7	S	NA	NA	NA	NA	
	B5–3	BOOZY0	1'	NA	NA	NA	NA	
30	B4–1	BOOZW6	S	NA	NA	NA	NA	
	B4–1	BOOZW7 (Dup.)	1	NA	NA	NA	NA	
31	B5–3	BOOZX9	S	NA	NA	NA	NA	
6	B5–3	BOOGB0	0–1	1.2 NWJ	0.55 B	8.7	7.6 B	

9212651942

SDG	Boring Loc.	Sample No.	Sample Depth	Arsenic mg/kg	Beryllium mg/kg	Chromium mg/kg	Nickel mg/kg	Total PCBs ug/kg
6	B5-3	BOOGB1	1-2	1.2 NWJ	0.48 B	2.7 U	6.3 B	
	B5-2	BOOGB2	0-1	0.86 NWJ	0.42 B	7.3	10.5	
	B5-2	BOOGB3	1-2	0.76 NWJ	0.42 B	2.1 U	8 B	
	B4-1	BOOGB4 (Dup.)	0-1	1.8 NWJ	1 B	12.5	6.4 B	
	B4-1	BOOGB5	0-1	1.8 NWJ	1.1 B	12.9	7.4 B	
	B4-1	BOOGB7	1-2	1.2 NWJ	0.77 B	6.9	4.6 B	
	PCB-1	BOOG92	0-1	NA	NA	NA	NA	49000 DJ
	PCB-1	BOOG93	1-2	NA	NA	NA	NA	41000 DJ
	PCB-2	BOOG94	0-1	NA	NA	NA	NA	80000 DJ
	PCB-2	BOOG95	1-2	NA	NA	NA	NA	1E+05 DJ
	PCB-3	BOOG96	0-1	NA	NA	NA	NA	6100 J
	PCB-3	BOOG97	1-2	NA	NA	NA	NA	15000 DJ
	PCB-4	BOOG98	0-1	NA	NA	NA	NA	21000 DJ
	PCB-4	BOOG99	1-2	NA	NA	NA	NA	1500 J
30	PCB-2A	BOOZV4	1	NA	NA	NA	NA	8500 BD
	PCB-2A	BOOZV5	1.5	NA	NA	NA	NA	12000 BD
	PCB-3A	BOOZV6	S	NA	NA	NA	NA	3500 BD
	PCB-3A	BOOZV7	1	NA	NA	NA	NA	23000 BD
	PCB-3A	BOOZV8	20"	NA	NA	NA	NA	9700 BD
	PCB-4A	BOOZV9	S	NA	NA	NA	NA	16000 BD
30	PCB-2A	BOOZX6	1.5	NA	NA	NA	NA	2300 B
	PCB-4A	BOOZW1	S	NA	NA	NA	NA	36000 BD
	PCB-4A	BOOZW2	1	NA	NA	NA	NA	39000 BD
	PCB-1A	BOOZW3	S	NA	NA	NA	NA	20000 BD
	PCB-1A	BOOZW4	1	NA	NA	NA	NA	29000 BD
	PCB-1A	BOOZW5	1.5	NA	NA	NA	NA	43000 BD

Values associated with U Qualifier are one-half the SQL
NA = Analysis not performed or not available

Summary of Phase I Soil Sampling Data at UN–1100–6

SDG	Sample No.	Sample Depth, ft	BEHP ug/L	#Chlordane ug/L
S2139A	S6141A	0–0.5	67 BJ	320 U
	S6142A		67 BJ	320 U
	S6143A		100 BJ	320 U
	S6144A		630 U	320 U
	S6145A		78 BJ	320 U
	S6146A		71 BJ	320 U
	S6147A		650 U	320 U
	S6148A		610 BJ	320 U
	S6149A		76 BJ	320 U
S6150A	S6150A		2.50E+07 D	1860 J
	S6151A		6.70E+06 D	590 J
	S6152A		8.90E+06 D	1780 J
	S6153A		1.10E+07 D	820 J
	S6154A		1.30E+07 D	960 J
	S6155A		1.40E+07 D	670 J

#Chlordane = sum of Alpha and Gamma Chlordane

Summary of Phase I and Phase II Soil Sampling Data at the Ephemeral Pool

SDG	Boring Loc.	Sample No.	Sample Depth	Total PCBs ug/kg	#Chlordane ug/kg
PHASE I DATA					
S6150A	UNK	S6164A	0–0.5	4700	480
	UNK	S6165A	0–0.5	300 J	1810
PHASE II DATA					
BOOG51	E1	BOOG76	S	170 U	2800
	E2	BOOG51	S	42000	950
	E3	BOOG52	S	11000 XJ	700
	E4	BOOG53	S	165 U	540
	E4	BOOG54	S	170 U	730
	E5	BOOG77	S	175 U	2560
	E6	BOOG56	S	190 U	1710

Values associated with the U qualifier are one-half the SQL
#Chlordane is the sum of alpha and gamma chlordane

Attachment #12

OUTLINE

1. Brief overview of construction of groundwater model

    a. Grid
    b. Boundary Conditions
    c. Stratigraphy

2. Model Calibration

    a. Flow Calibration
        i. B.C's
        ii. Soil Parameters
        iii. Observed vs. Computed Heads (3)
        iv. Velocity Profiles

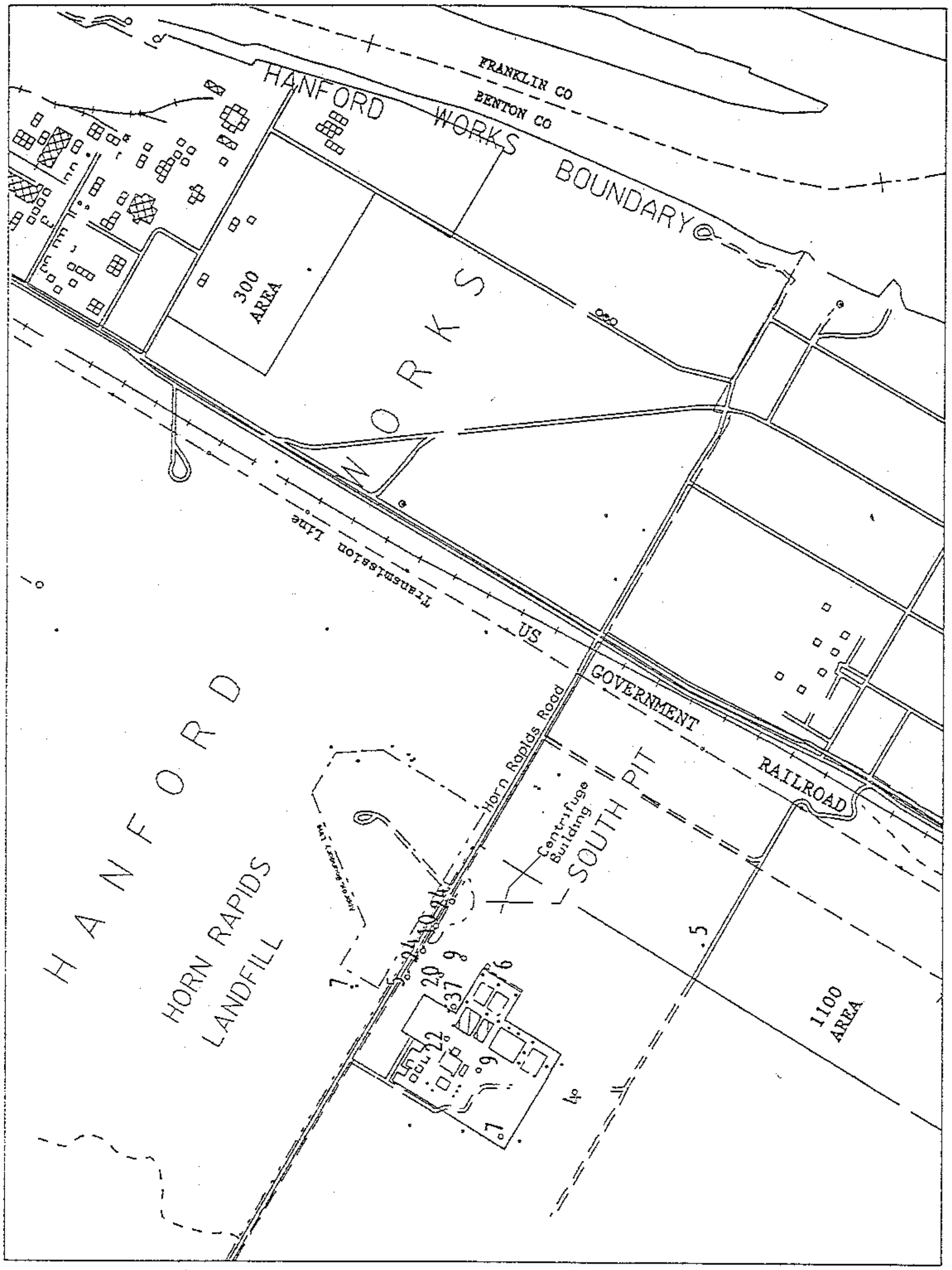
    b. Contaminant Transport Calibration
        i. Existing Data
        ii. Source
        iii. Transport Parameters

3. Pump and Treat Scenarios

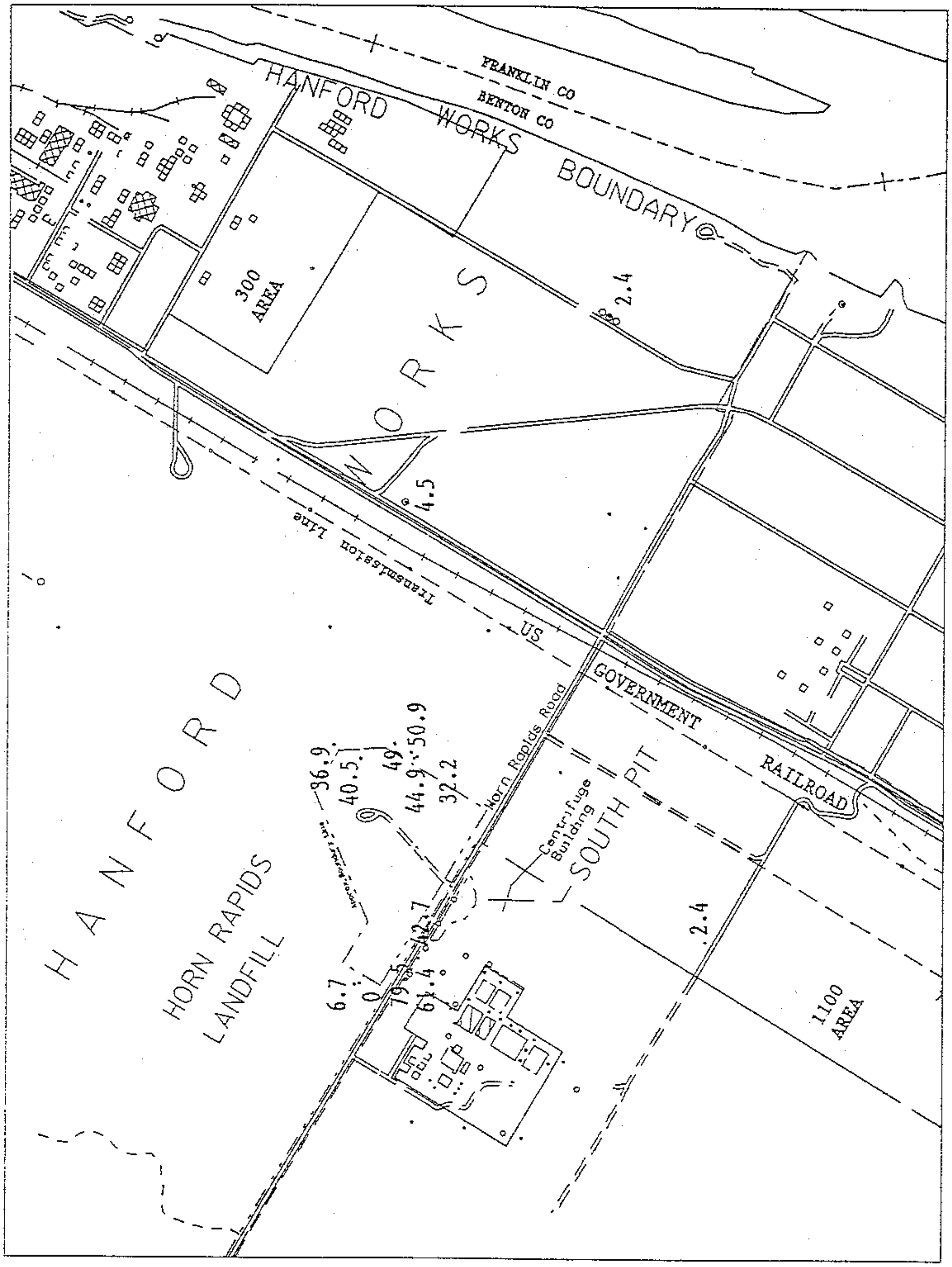
    a. Selected Scenarios
    b. Baseline

4. Summary

OBSERVED NITRATE ONCENTRATIONS 1992 (ppm)



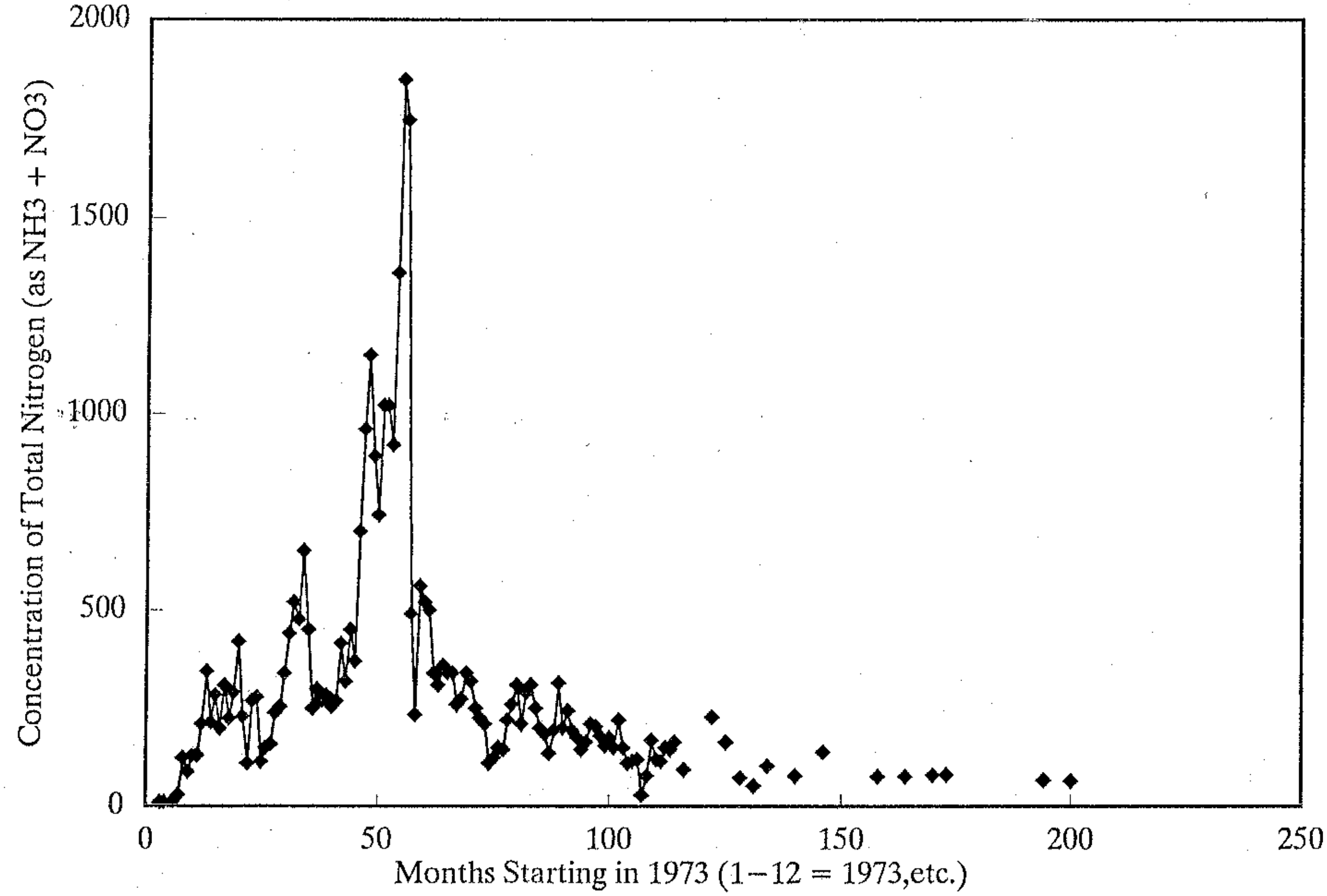
OBSERVED NITRATE CONCENTRATIONS 1990 (ppm)

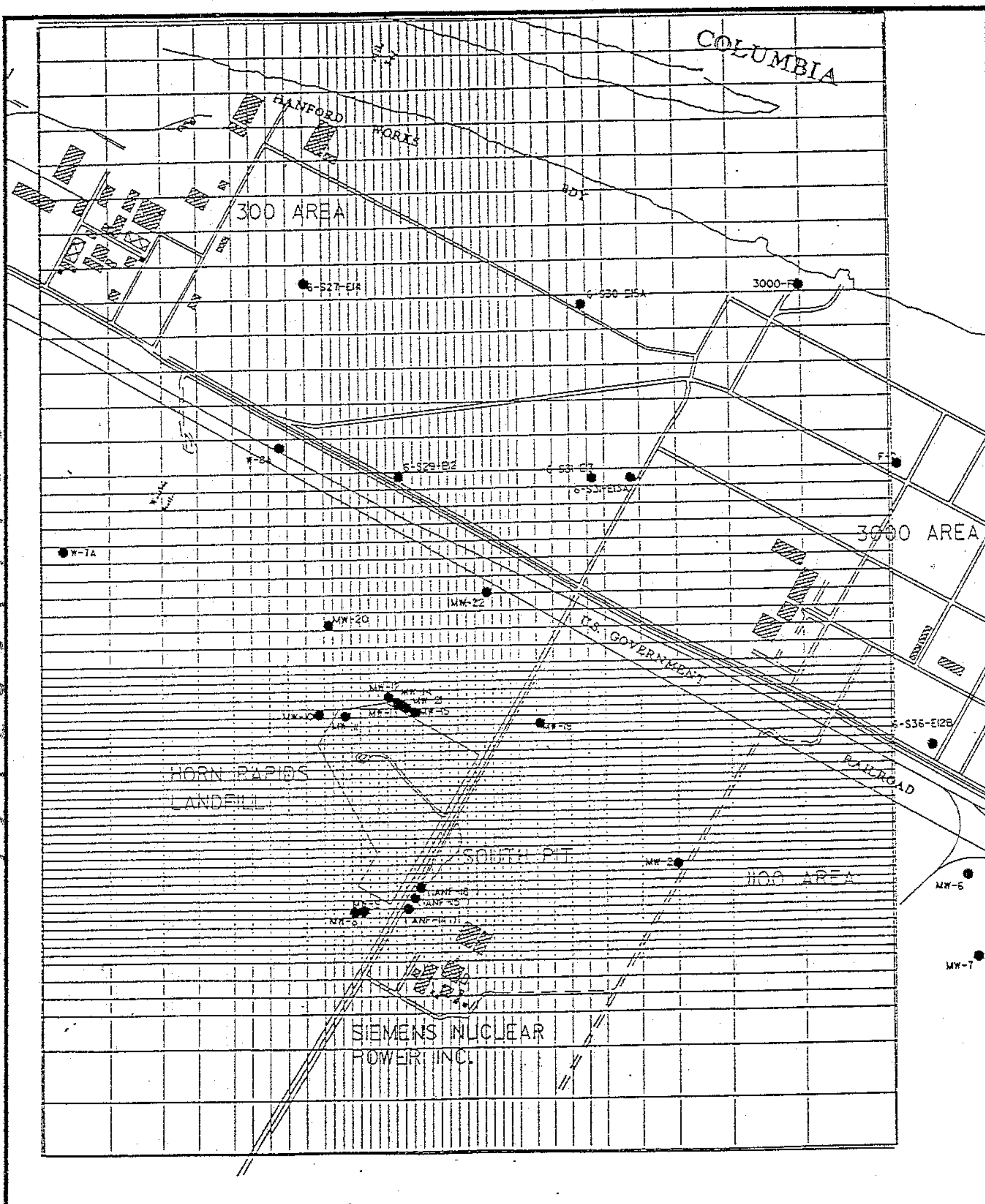


92125511943

Concentration of Total Nitrogen at SNP.

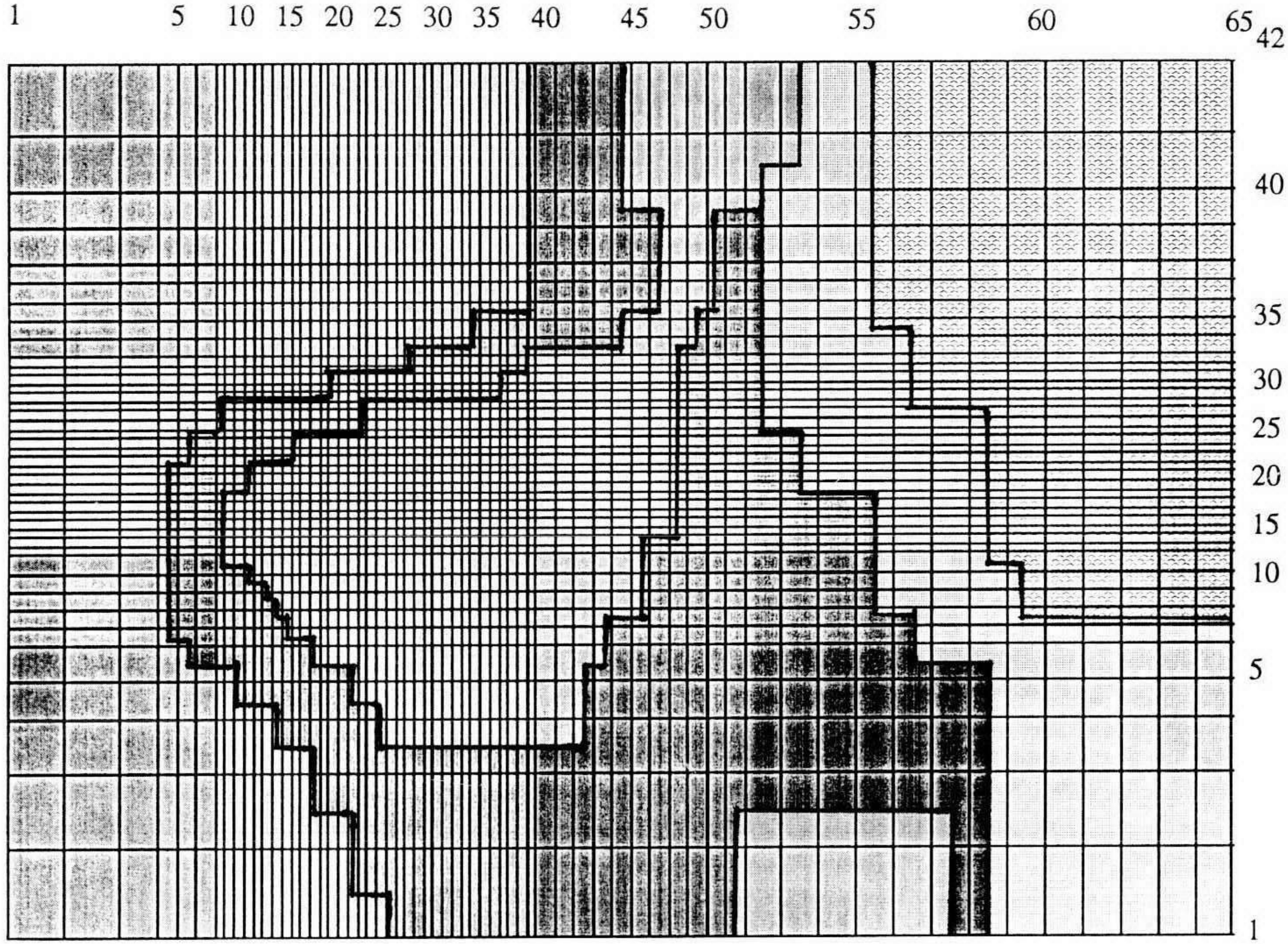
For Test Well #2



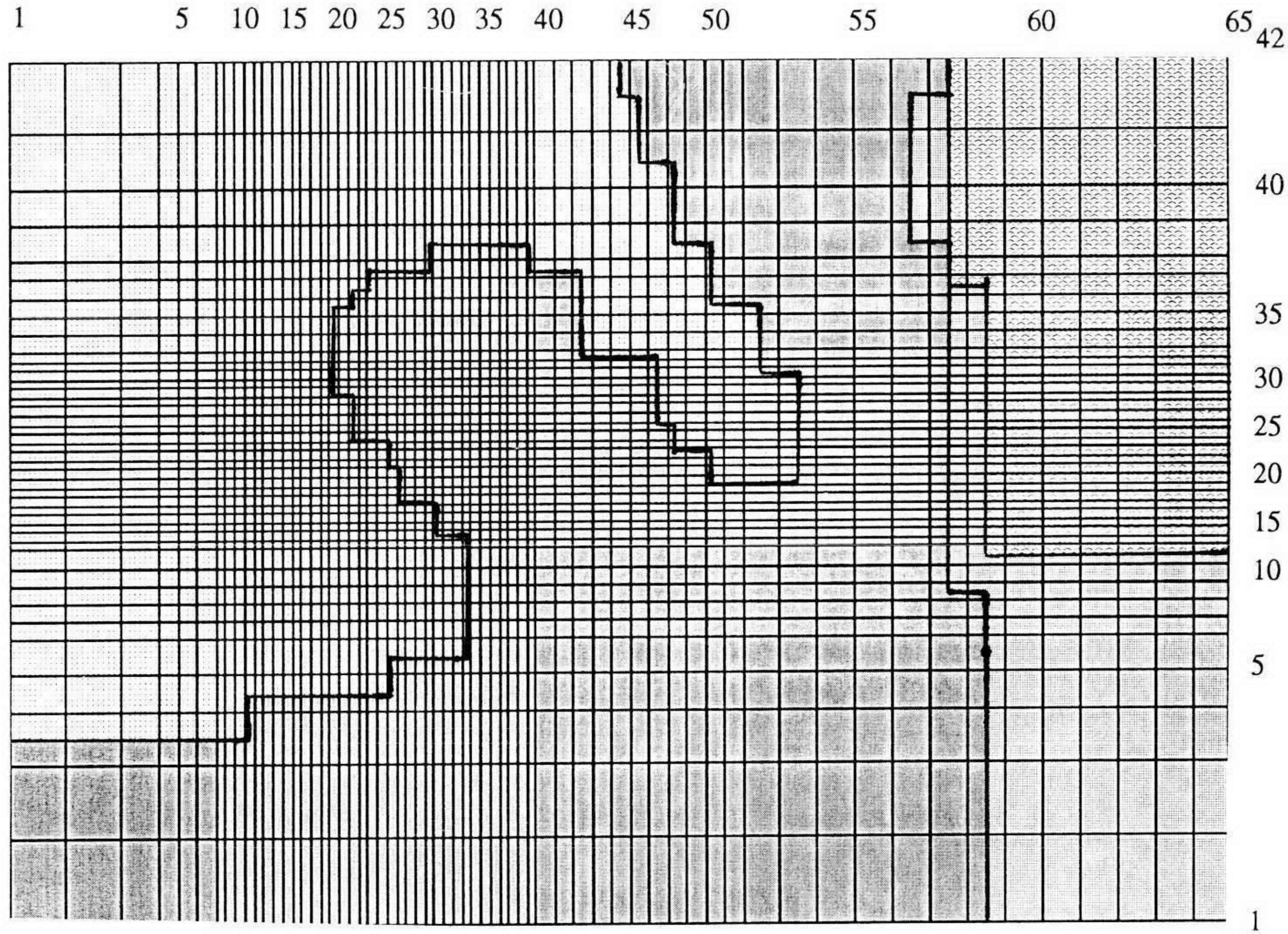

COLUMBIA
HANFORD WORKS BDY
300 AREA
3000 AREA
6-S27-E1A
6-S30-E15A
3000-F
F-
W-8A
6-S29-E12
6-S31-E7
6-S31-E13A
W-7A
MW-22
MW-20
U.S. GOVERNMENT
RAILROAD
6-S36-E12B
MW-19
HORN RAPIDS
LANDFILL
SOUTH PIT
MW-2
1100 AREA
MW-6
MW-7
SIEMENS NUCLEAR
POWER INC.

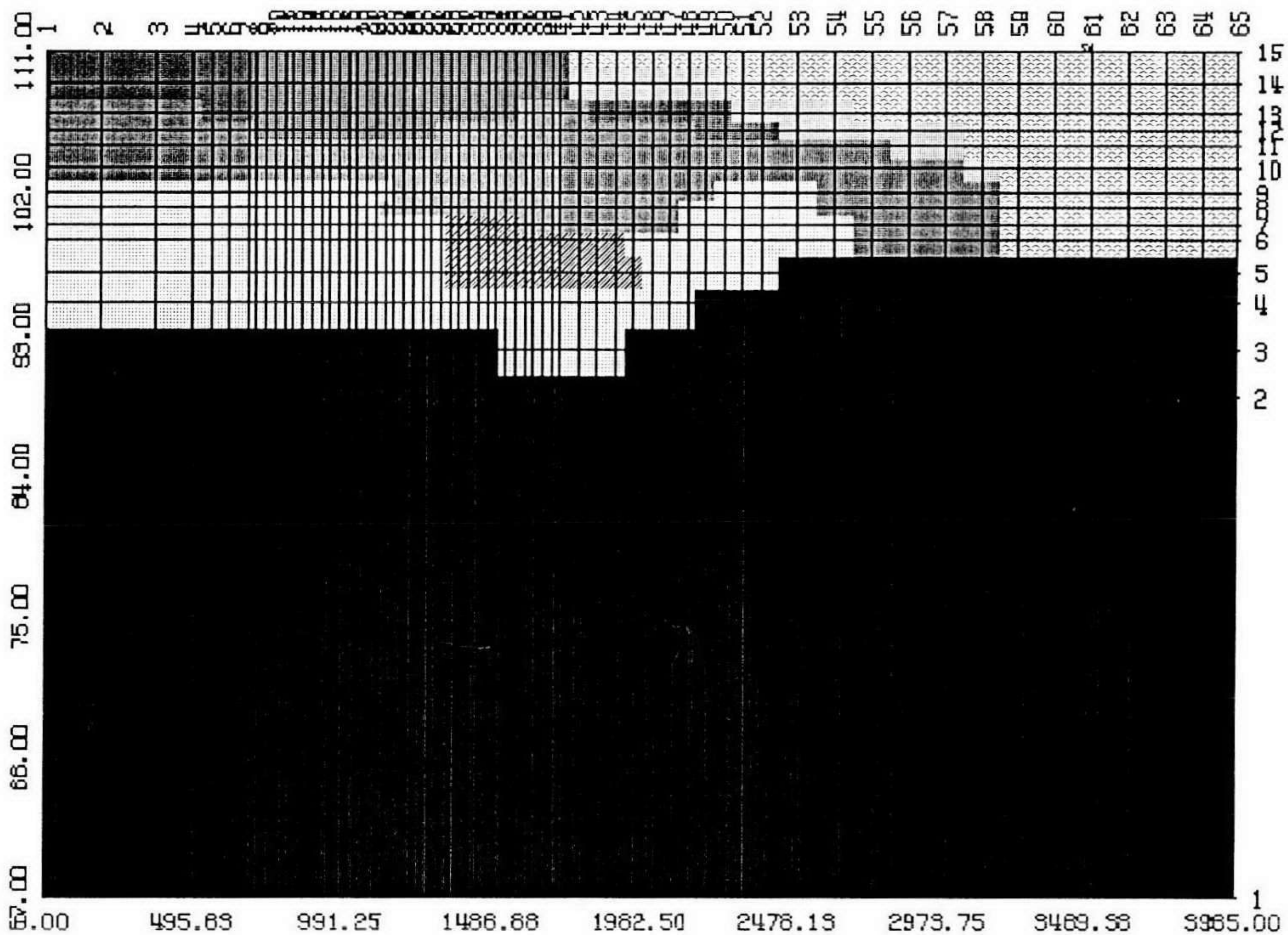
9212651950

ZONE DESIGNATION, LAYER 12

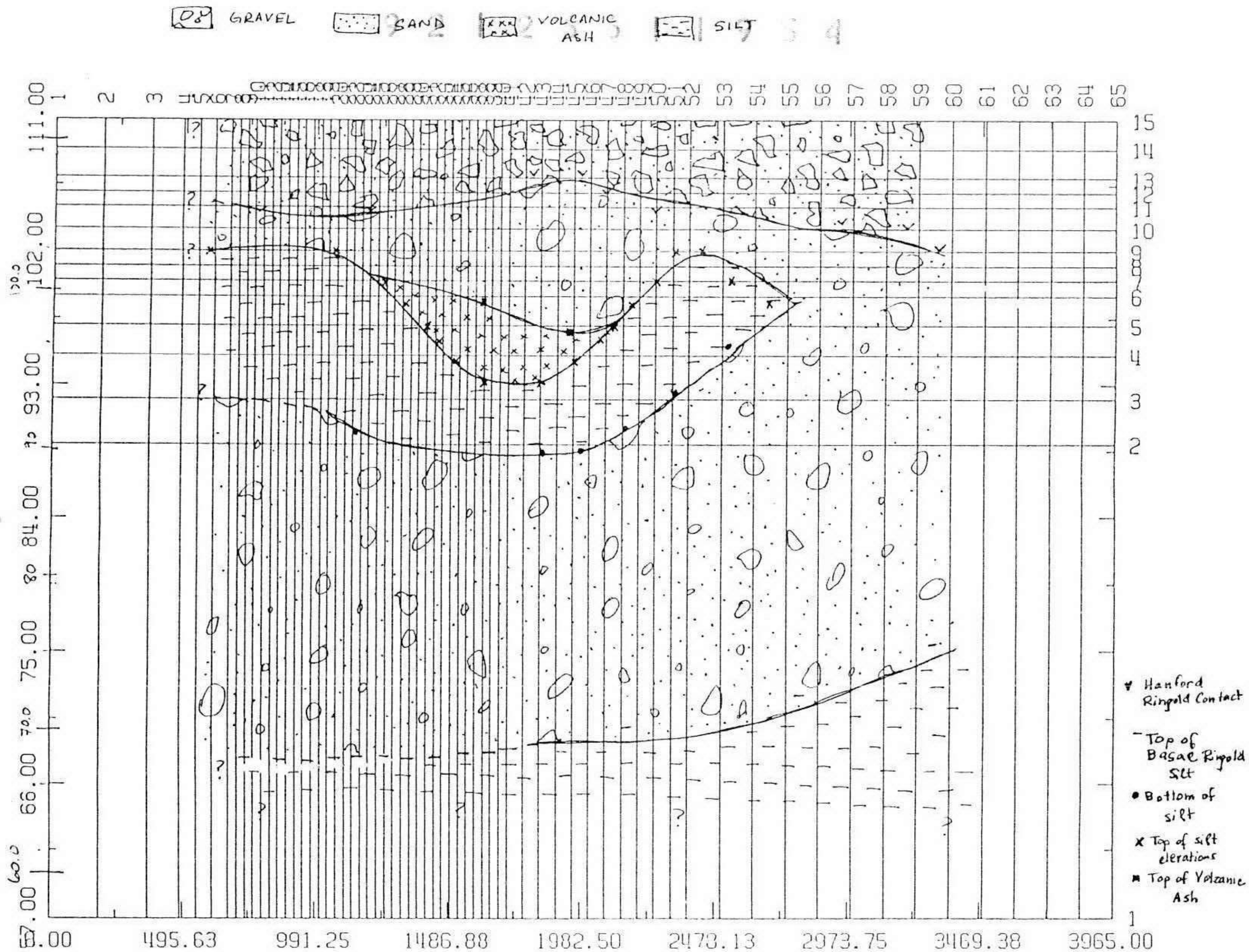


ZONE DESIGNATION, LAYER 8





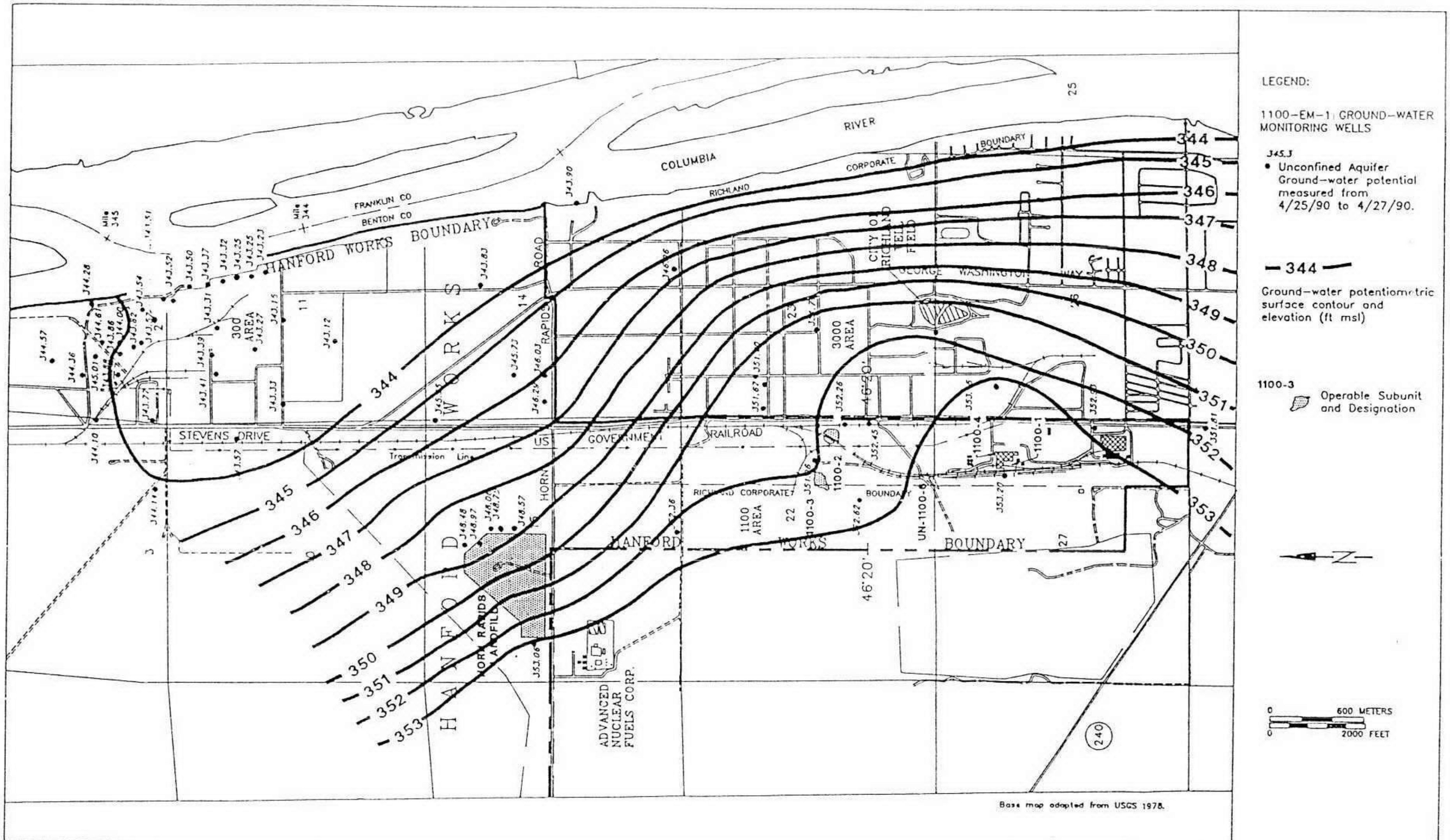
ZONE DESIGNATION XZ plane Row = 25



GRAVEL
SAND
VOLCANIC ASH
SILT
111.00
102.00
93.00
84.00
75.00
66.00
57.00
0.00
495.63
991.25
1486.88
1982.50
2478.13
2973.75
3469.38
3965.00
▼ Hanford Ringold Contact
– Top of Basal Ringold Silt
• Bottom of silt
x Top of silt elevations
■ Top of Volcanic Ash

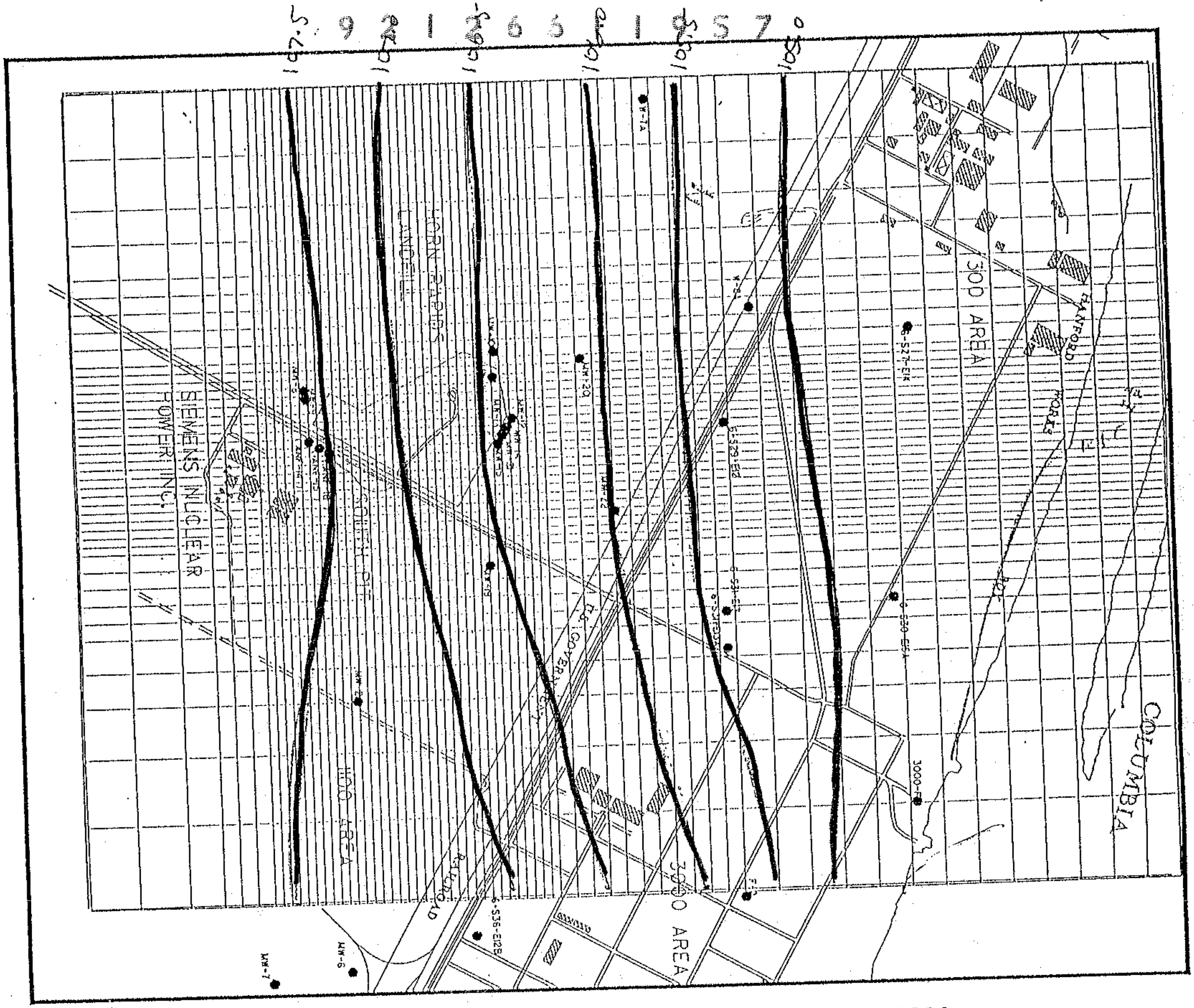
1100-EM-1 Groundwater Model Boundary Conditions

Location	Type	Range
Southwest Horizontal (Upgradient Boundary)	Constant Head Nodes	108.7 to 109.2 (Upper) 110.7 (Lower)
Southeast Horizontal	Constant Flux Nodes	0 to 0.45 meters/day
Northeast Horizontal (River)	Constant Head Nodes	105.3 to 105.65 (High) 104.35 to 104.7 (Avg.) 103.65 to 104.0 (Low)
Northwest Horizontal	Constant Flux and Constant Head Nodes	Flux = 0 C.H. same as River
Lower Vertical	Constant Flux	0.0005 meters/day
Upper Vertical	Constant Flux	0.0001 meters/day

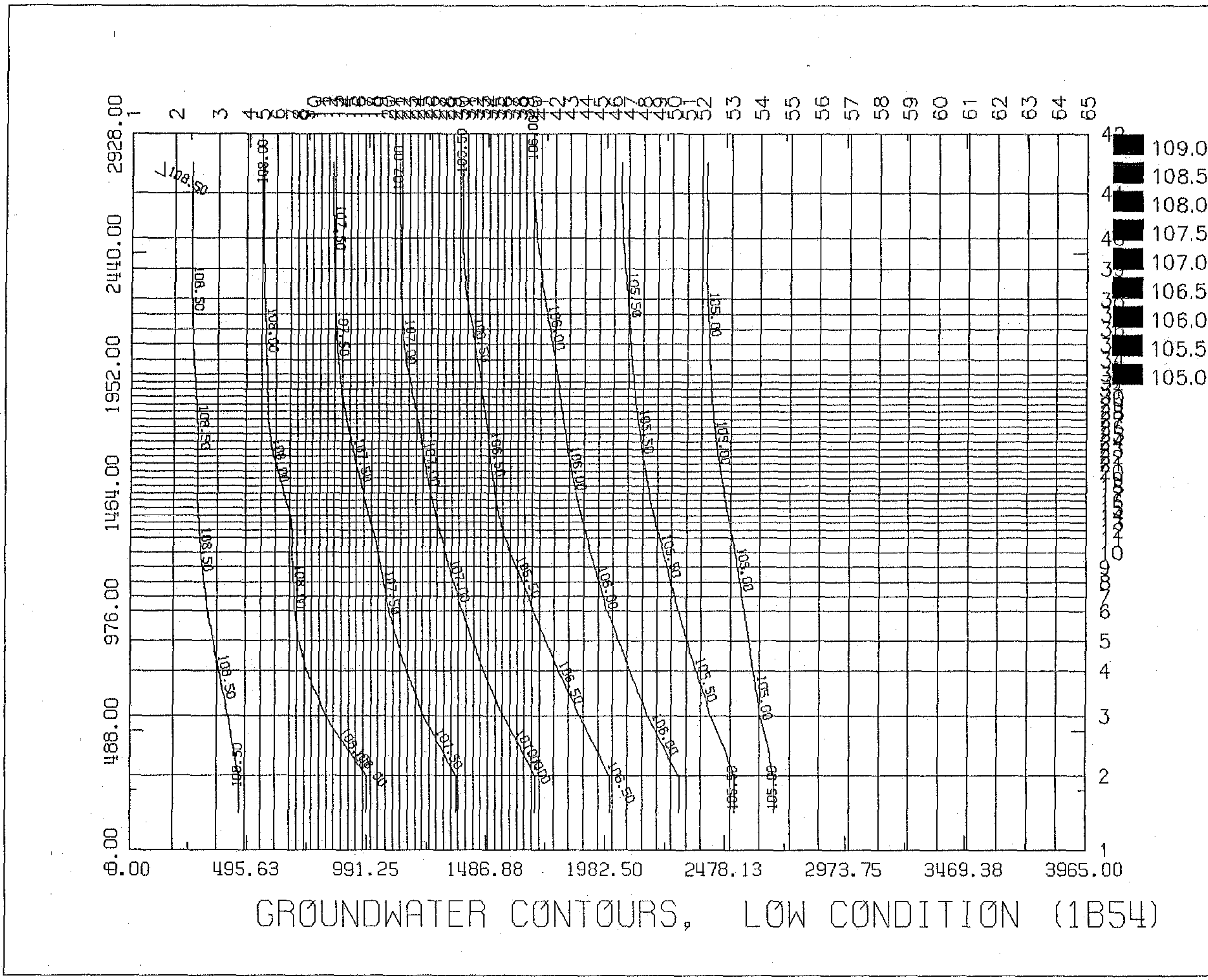


9031215\ 30852

Figure 5. Ground-Water Potentiometric Surface for the Unconfined Aquifer, April 25-27, 1990.

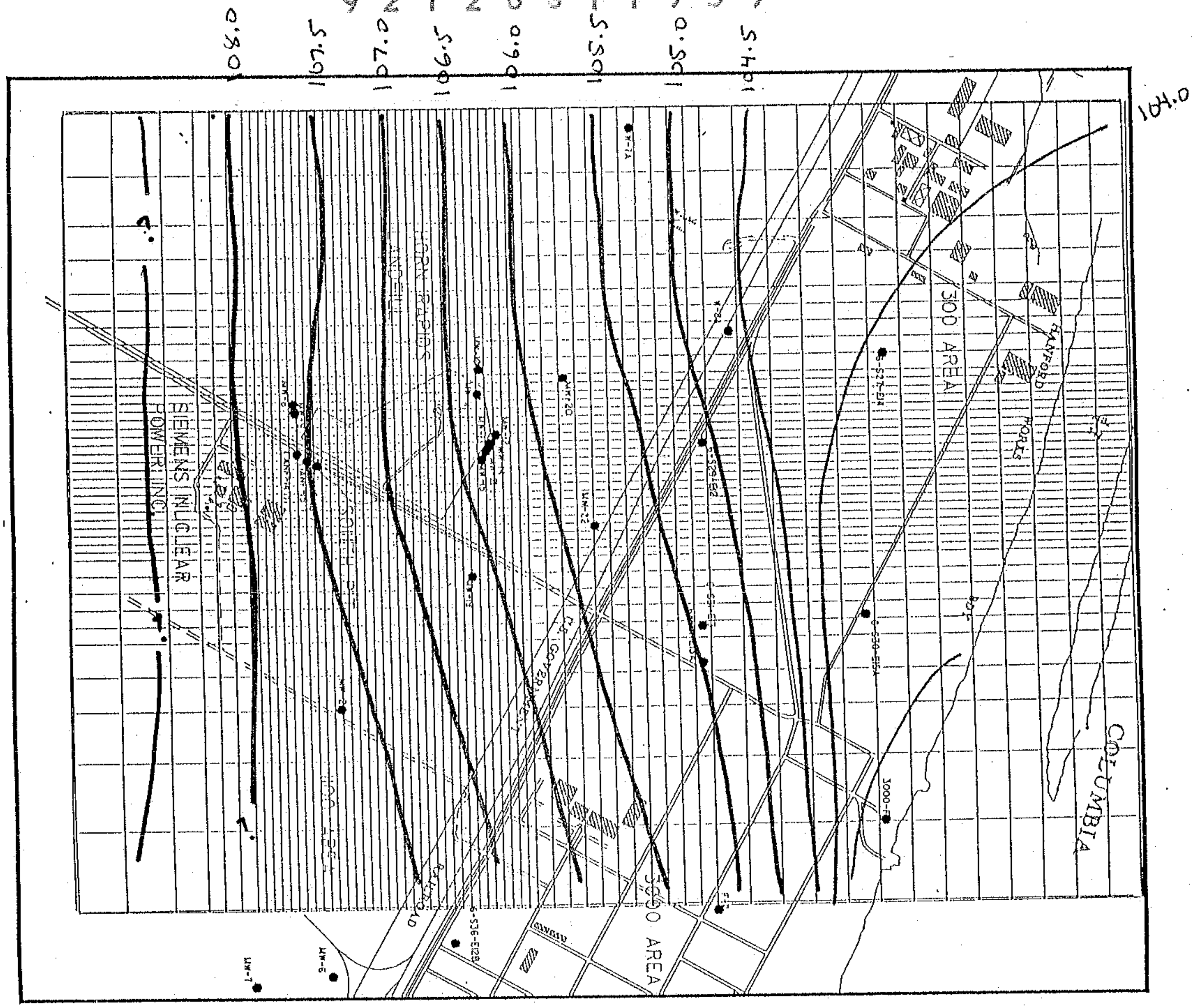


OBSERVED GROUNDWATER SURFACE - FEB 27- MAR 2, 1990

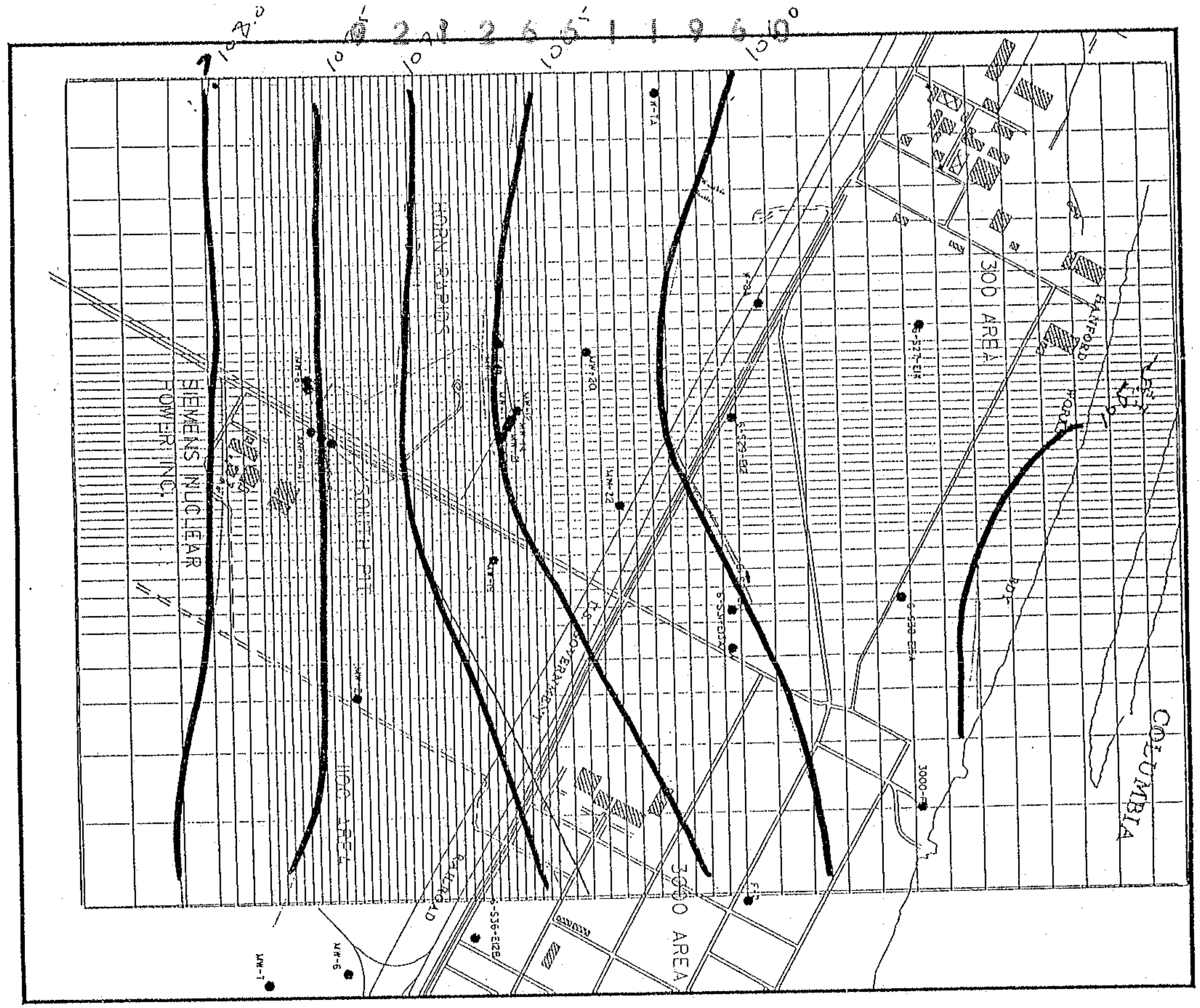


GROUNDWATER CONTOURS, LOW CONDITION (1B54)
0.00
495.63
991.25
1486.88
1982.50
2478.13
2973.75
3469.38
3965.00
488.00
976.00
1464.00
1952.00
2440.00
2928.00
109.00
108.50
108.00
107.50
107.00
106.50
106.00
105.50
105.00

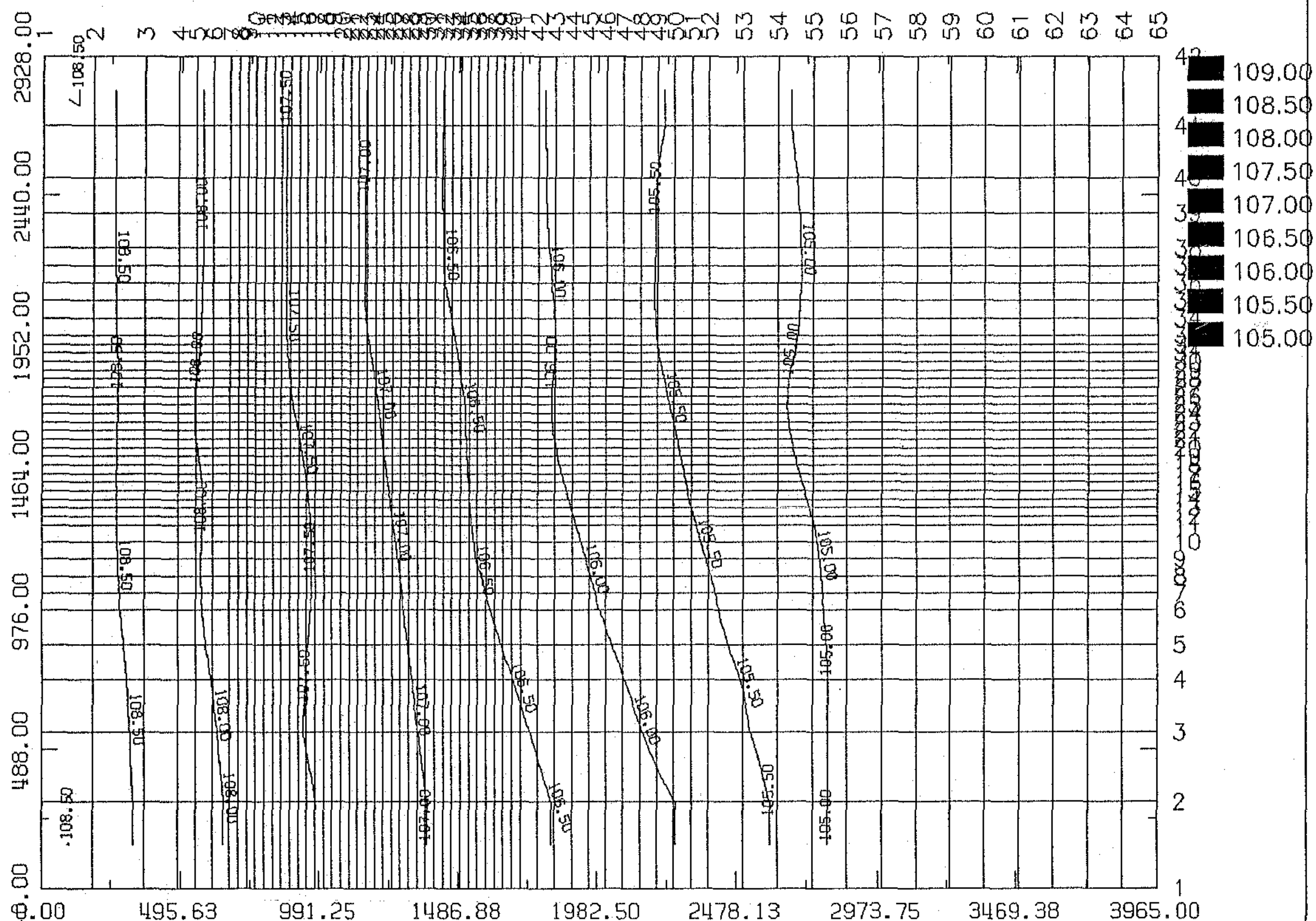
9 2 1 2 6 6 1 1 9 5 9



OBSERVED GROUNDWATER SURFACE - SEPT 24-27, 1990

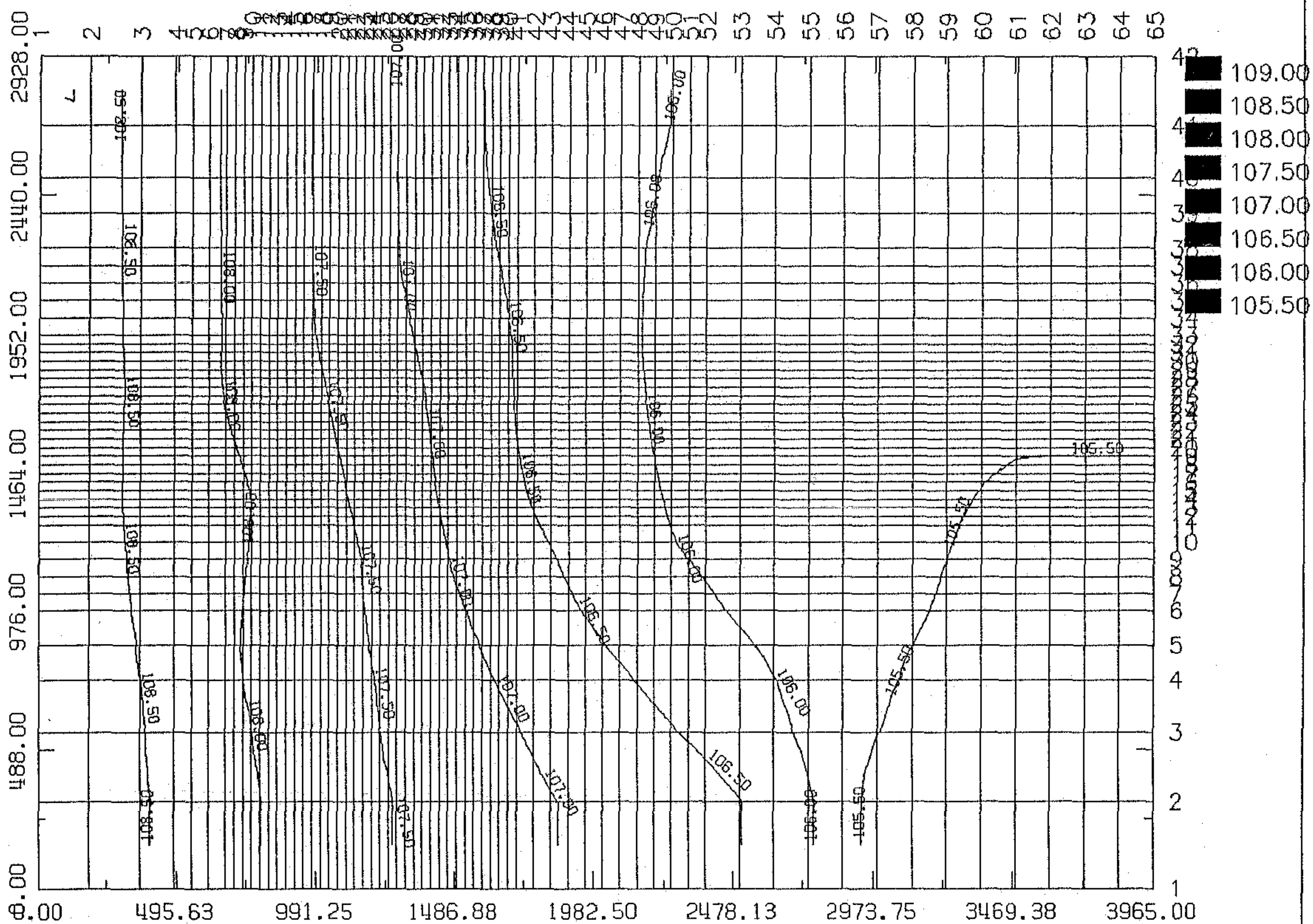


OBSERVED GROUNDWATER SURFACE - JUNE 25-27, 1990



GRØUNDWATER CØNTØURS, AVERAGE CØNDITIØN (1c54)

9 2 1 2 6 6 1 1 9 6 2



GROUNDWATER CONTOURS, HIGH CONDITION (1A54)

Observed Vs. Computed Total Pressure Heads
Average River Stage Condition, April 1990

Well #	Observed 04/90	Computed	Difference
30−47−18B	104.81	104.38	0.43
S30−E15	104.79	104.88	−0.09
S31−E13A	105.46	105.63	−0.17
S31−E13	105.37	105.59	−0.22
S32−E13B	105.54	105.75	−0.21
S29−E12	105.26	105.39	−0.13
MW−15	106.24	106.48	−0.24
MW−13	106.29	106.43	−0.14
MW−10	106.21	106.45	−0.24
S27−E14	104.58	104.74	−0.16
W−8A	104.72	105.16	−0.44
MW−8	107.61	107.54	0.07
399−4−10	104.61	104.71	−0.1

VELOCITIES (m9d2) 1 2 6 6 1 1 9 6 4

U,V @ TW-16 (23, 15)

		x	y	z					
L14									
	0.30000E+01	0.36432E+00	0.95399E-01	0.00000E+00	0.10713E+03	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+
L12		V̄ = .376 m/d							
	0.30000E+01	0.14555E+00	0.38092E-01	0.91553E-04	0.10713E+03	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+
L10									
	0.30000E+01	0.14523E+00	0.38024E-01	0.20741E-03	0.10713E+03	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+
L8		V̄ = .15 m/d							
	0.30000E+01	0.16960E-04	0.31468E-05	0.20736E-03	0.10750E+03	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+
L6									
	0.30000E+01	0.17935E-04	0.19111E-05	0.20729E-03	0.10792E+03	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+
L4									
	0.30000E+01	0.19924E-04	-0.54281E-06	0.20726E-03	0.10875E+03	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+
L2									
	0.30000E+01	0.20682E-01	-0.14533E-02	0.49996E-03	0.10906E+03	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+

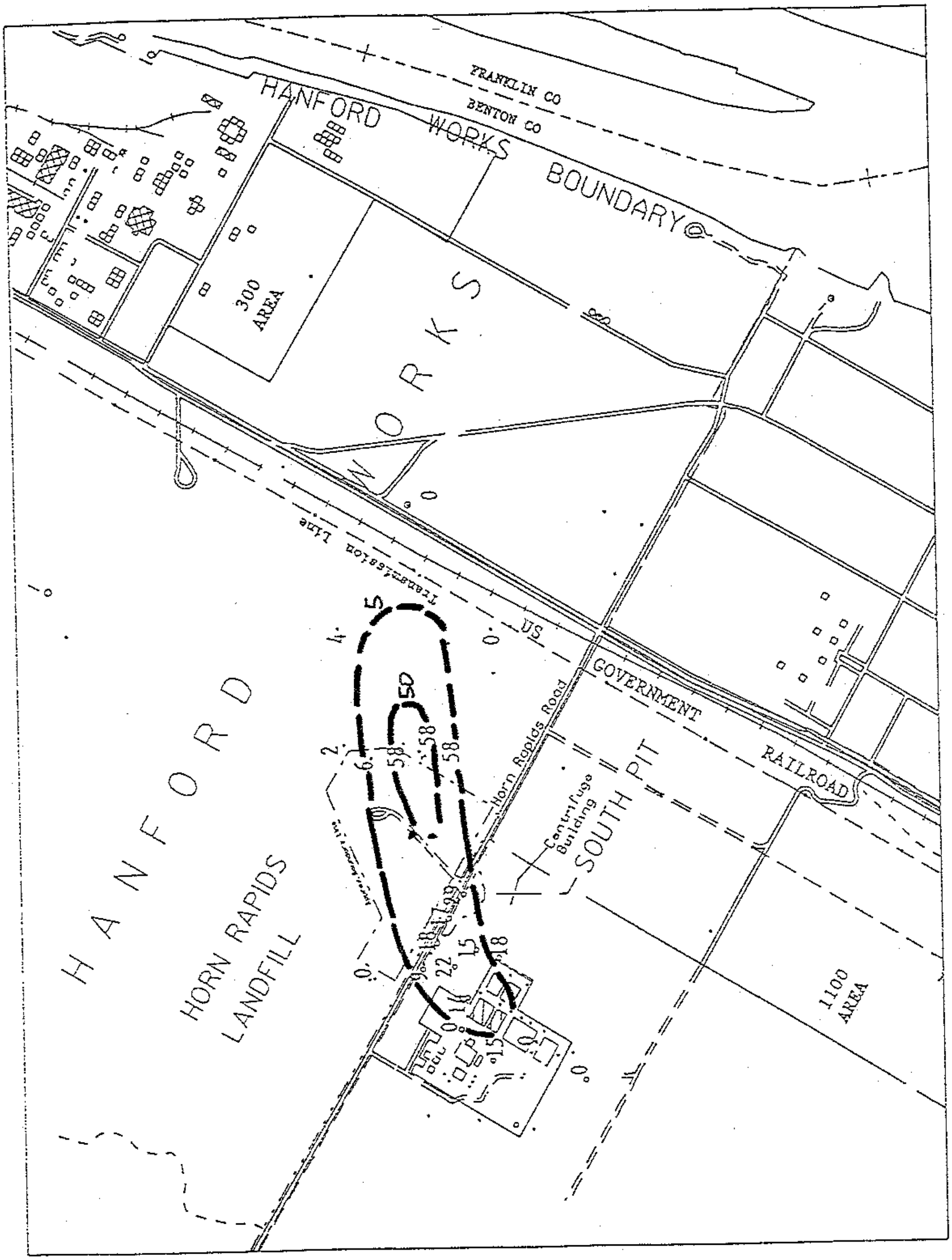
$V = ki$

	k	i	V
HANFORD	470 m/d	.0007	.25 m/d (LOW)
	365 m/d	.0009	.42 m/d (HIGH)
RINGOLD	54 m/d	.0020	.11 m/d (LOW)
	65 m/d	.0026	.17 m/d (HIGH)

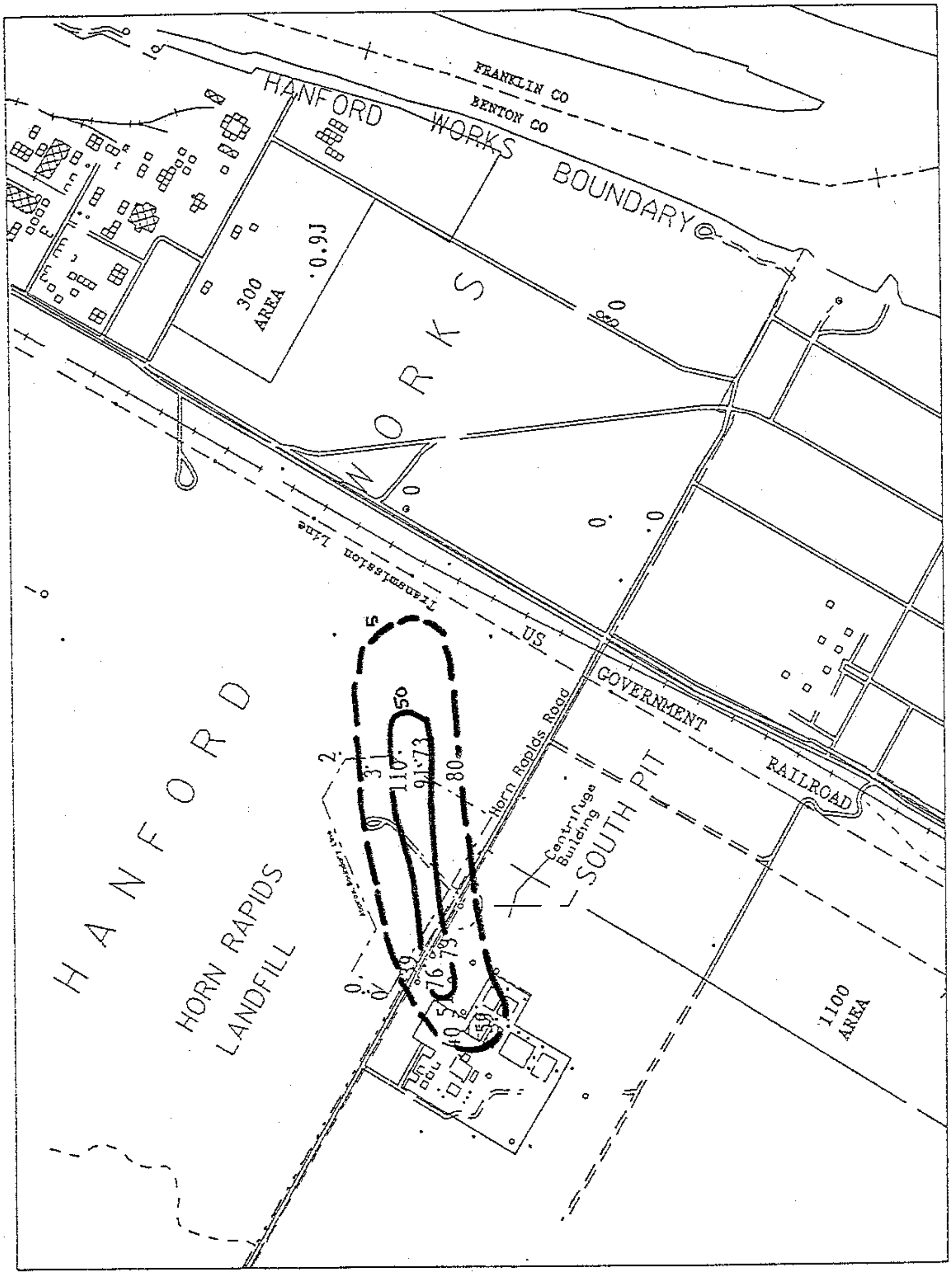
HYDRAULIC CONDUCTIVITIES

Hanford Formation -	450, 1000, 5000 m/d
Upper Ringold Sand and Gravel -	60 m/d
Upper Ringold Silt -	0.01 m/d
Ash -	0.05 m/d
Lower Ringold -	20 m/d

OBSERVED TCE CONCENTRATIONS 1992 (ppb)

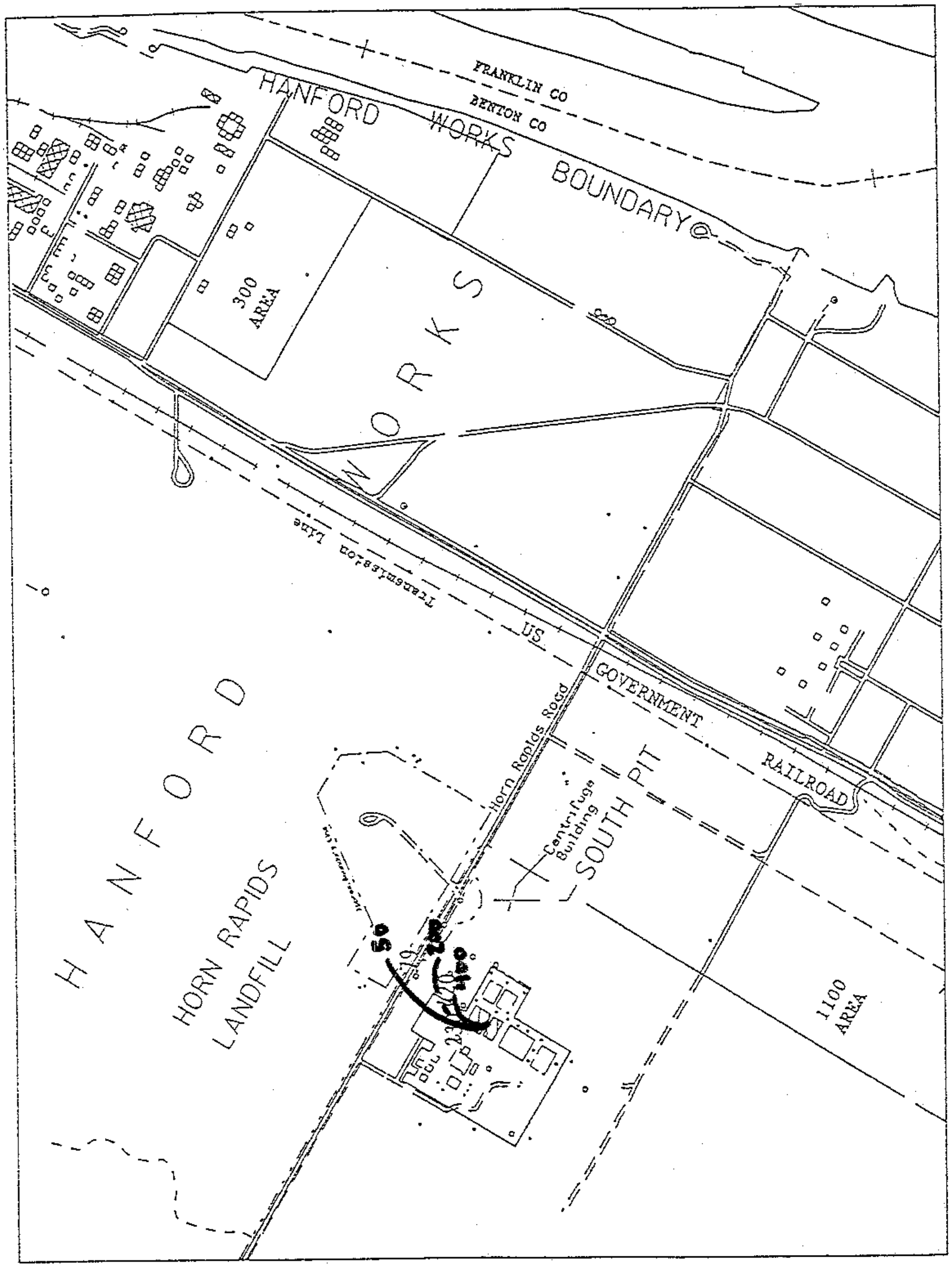


OBSERVED TCE CONCENTRATIONS 1990 (ppb)



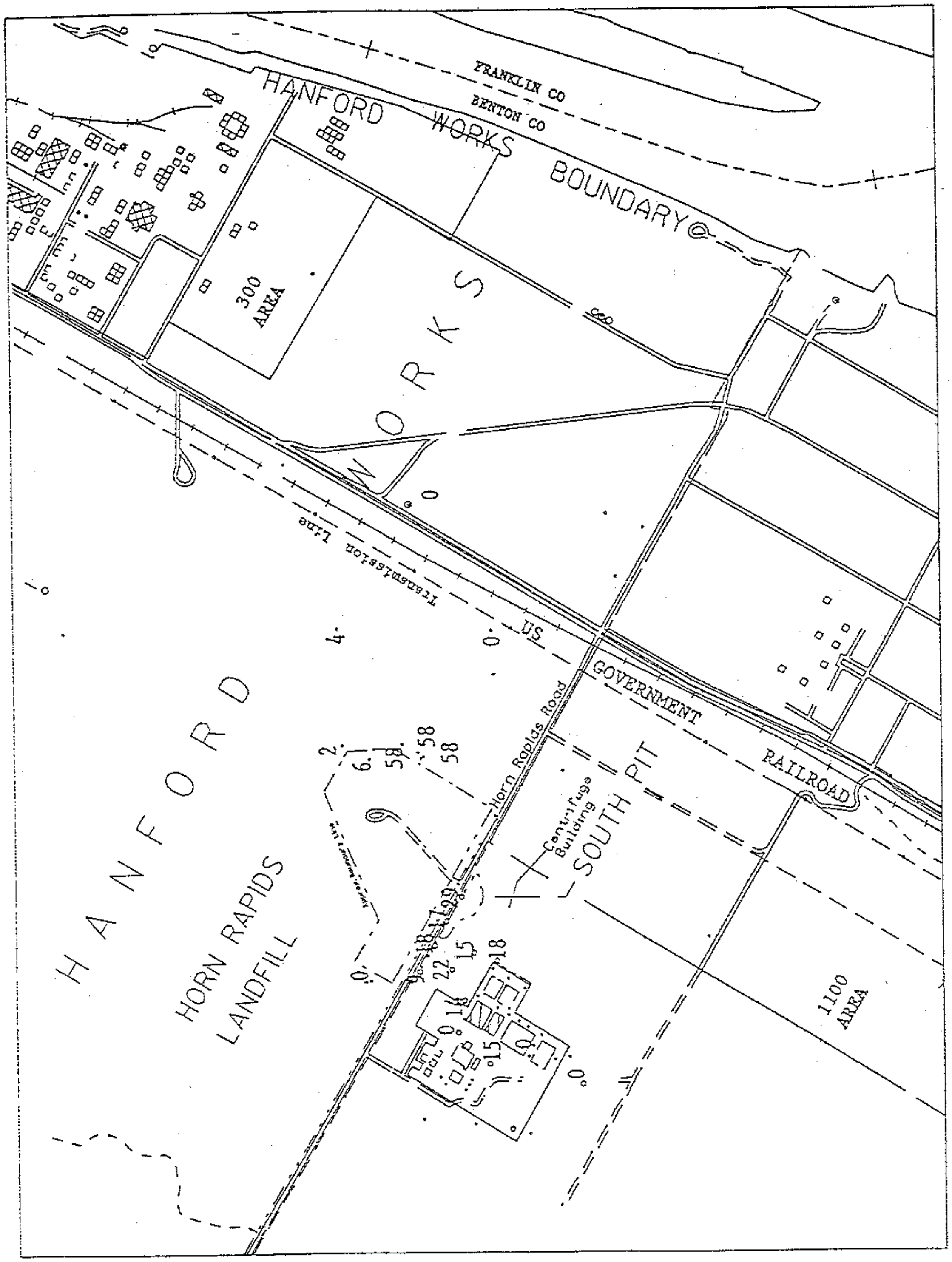
9212561967

OBSERVED TCE CONCENTRATIONS 1987 (ppb)



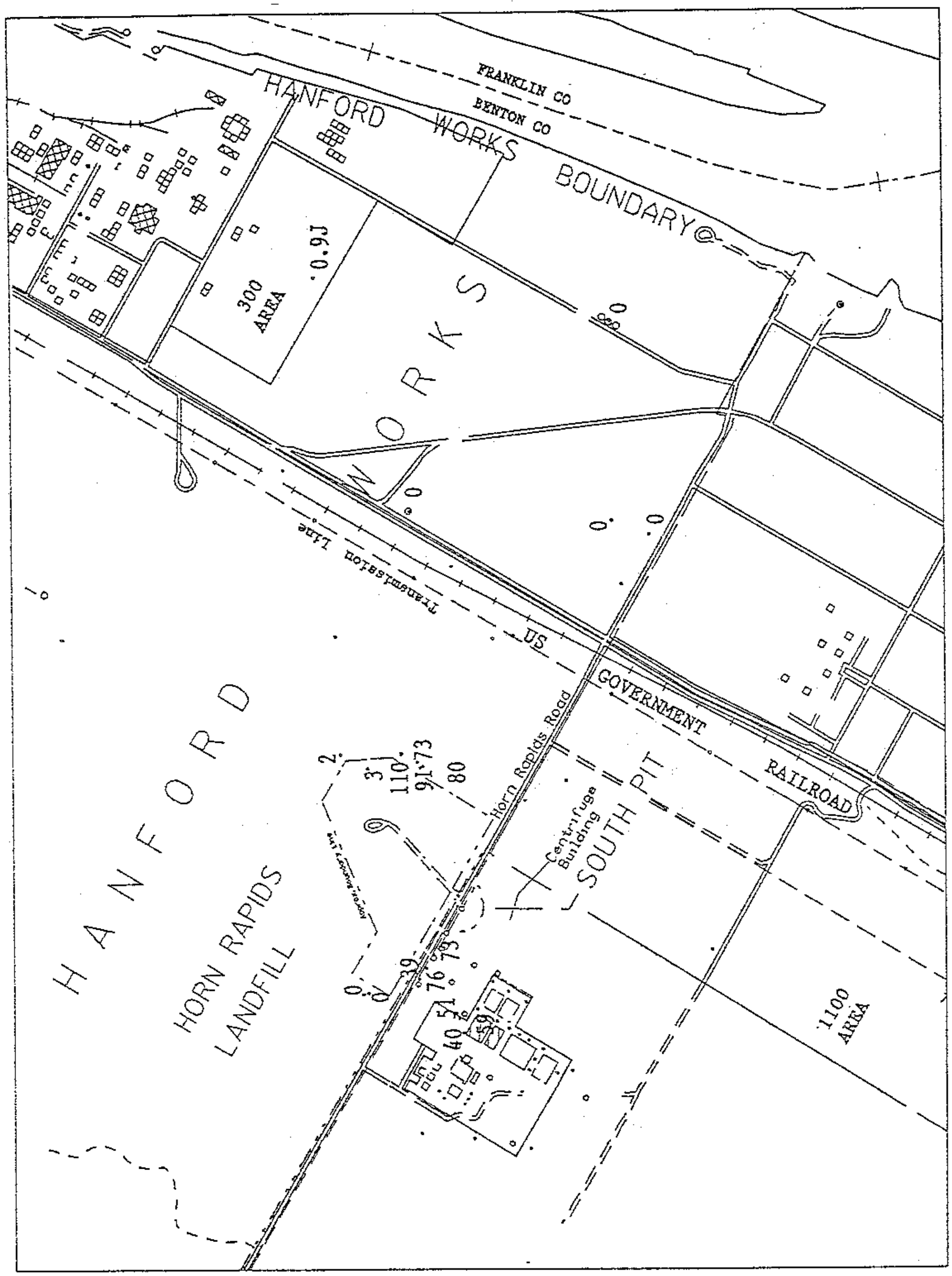
9212651963

OBSERVED TCE CONCENTRATIONS 1992 (ppb)

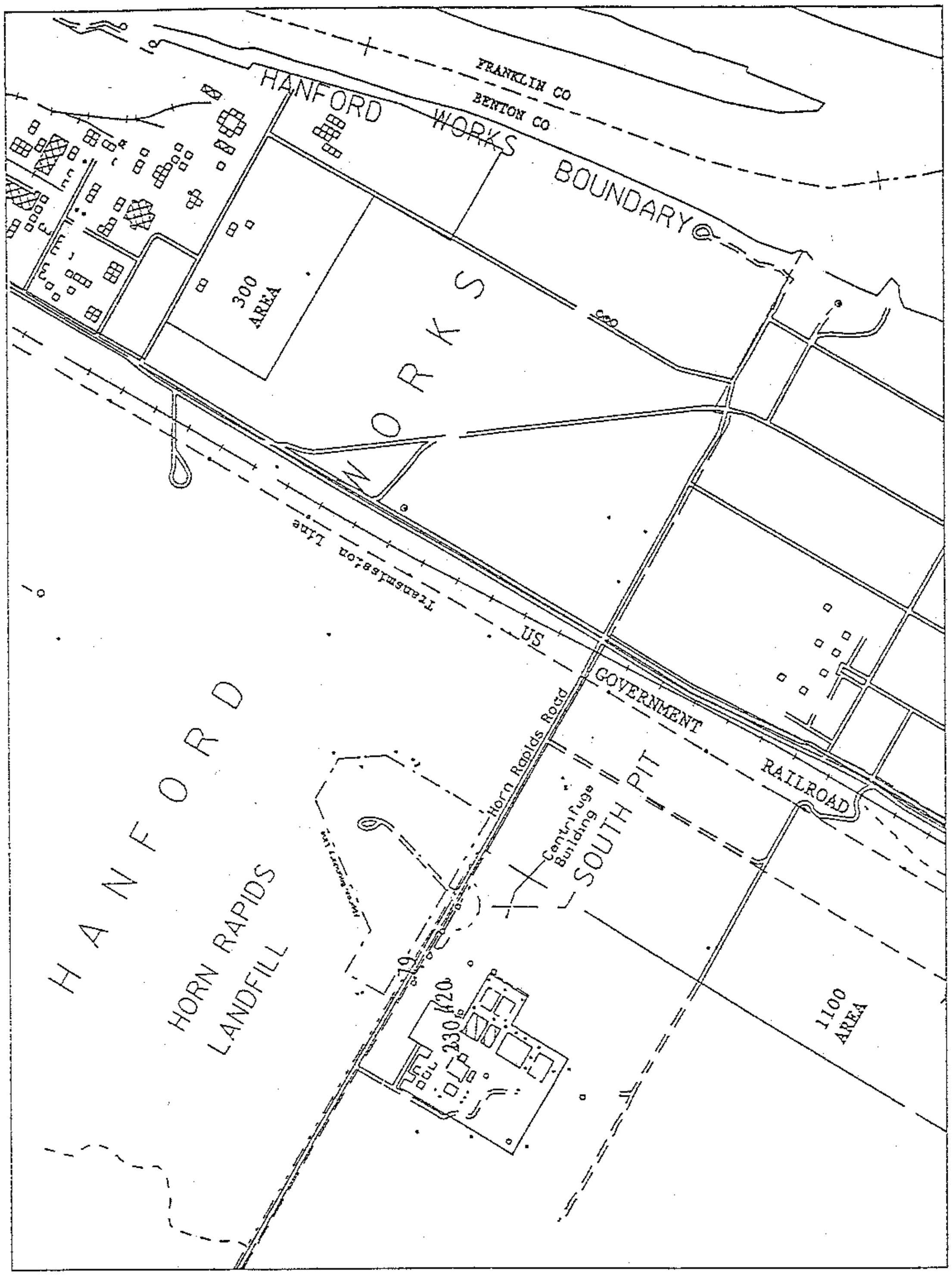


9212561969

OBSERVED TCE CONCENTRATIONS 1990 (ppb)

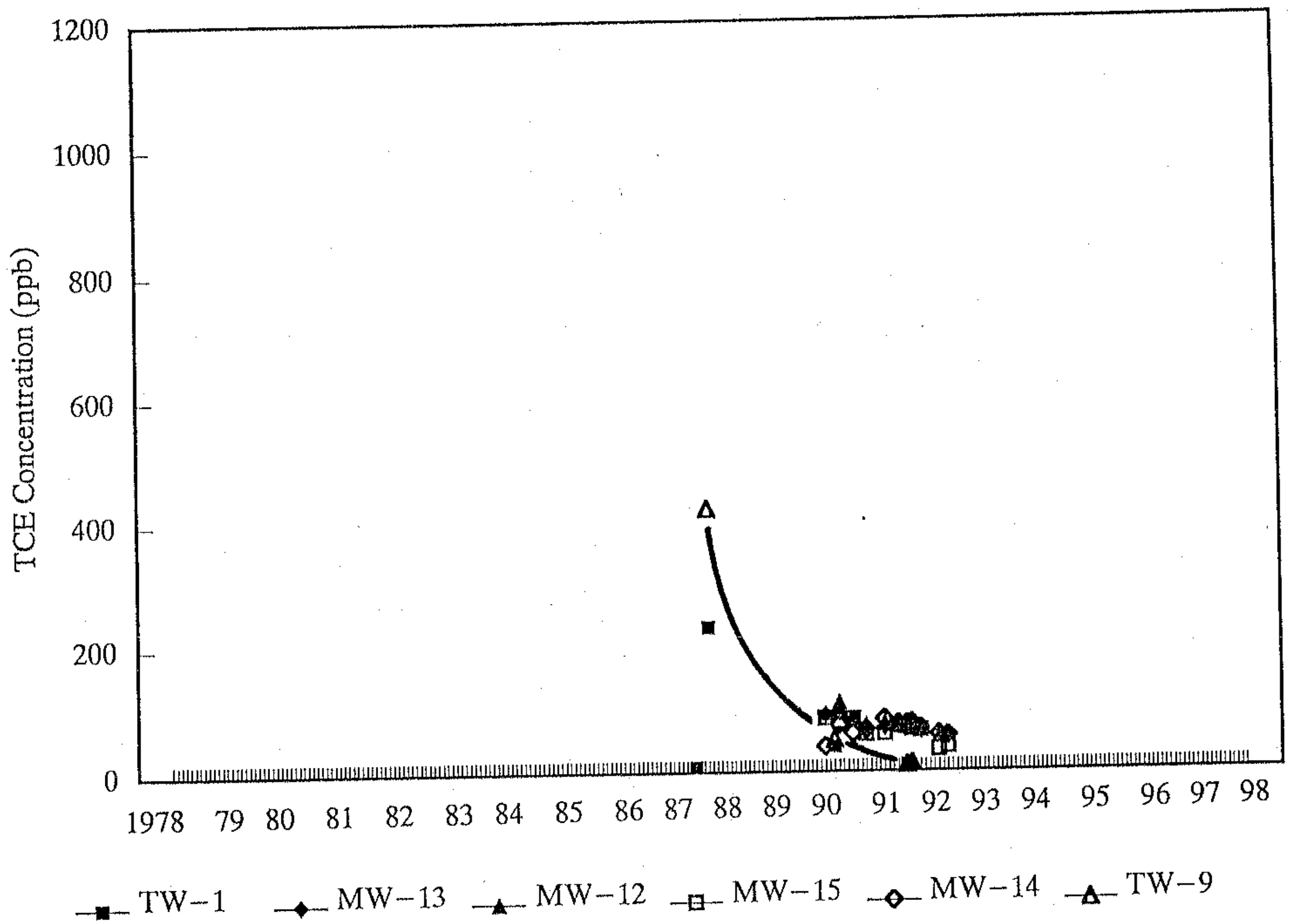


OBSERVED TCE CONCENTRATIONS 1987 (ppb)



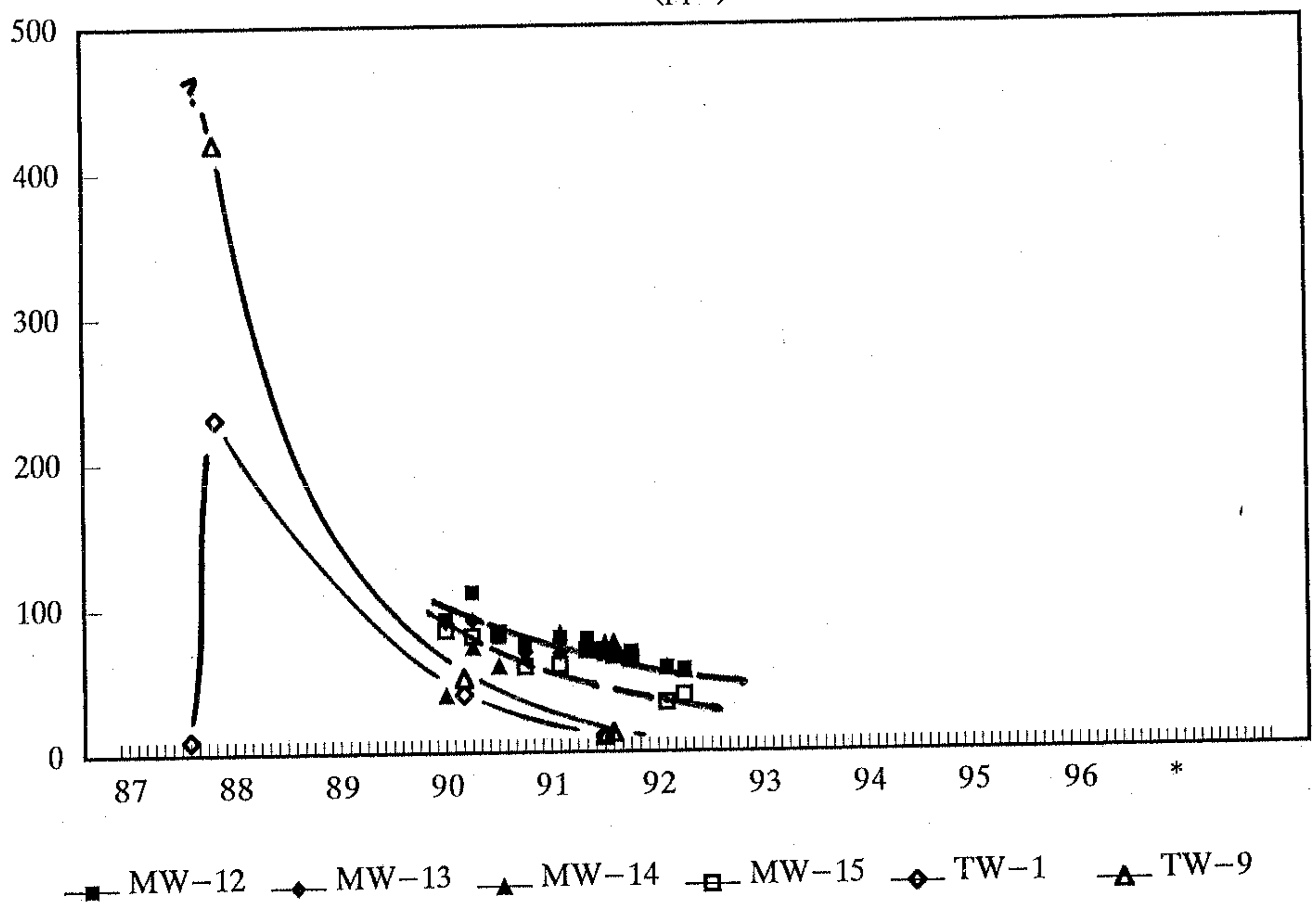
9212561971

OBSERVED TCE CONCENTRATIONS

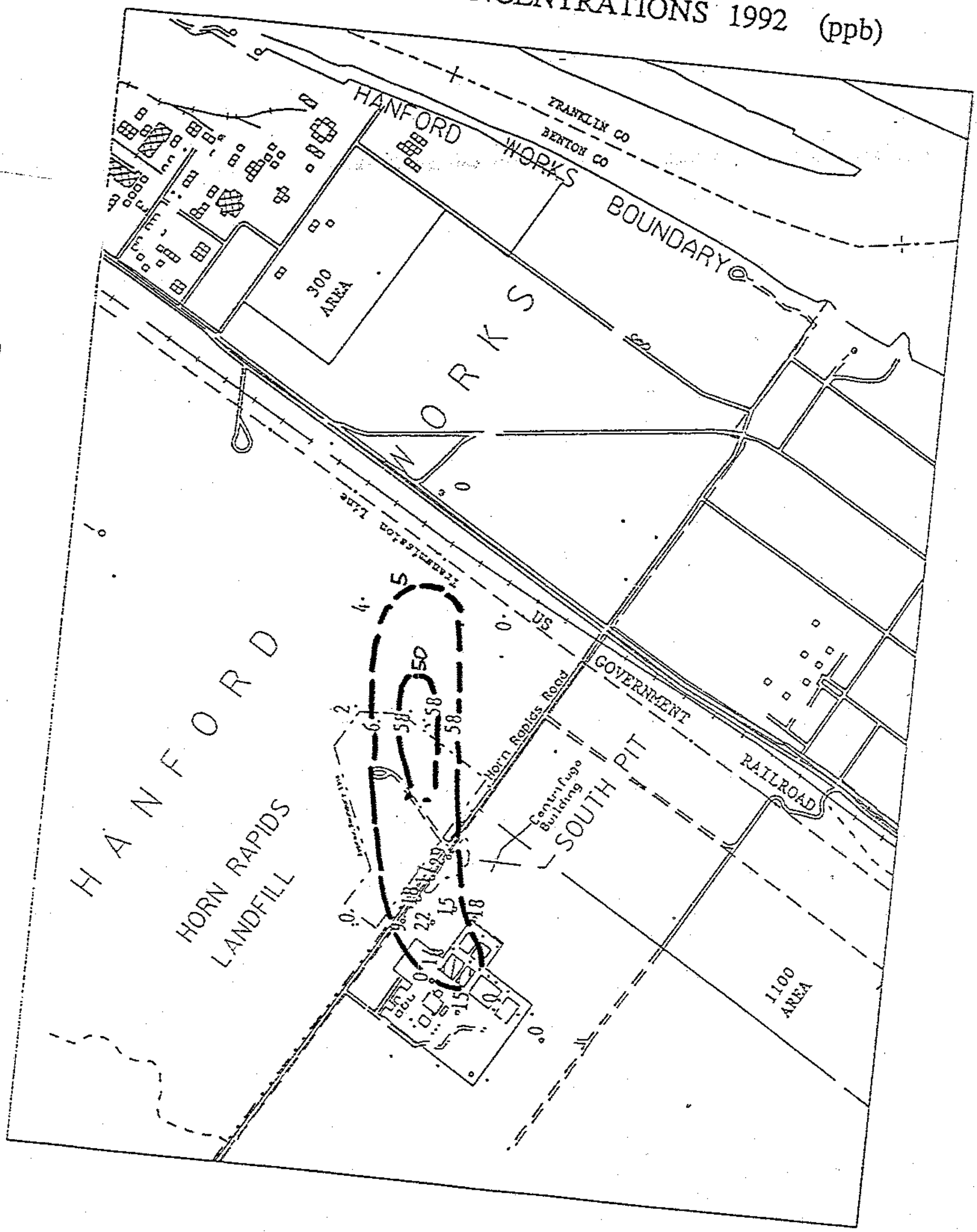


TCE CONCENTRATIONS

(ppb)



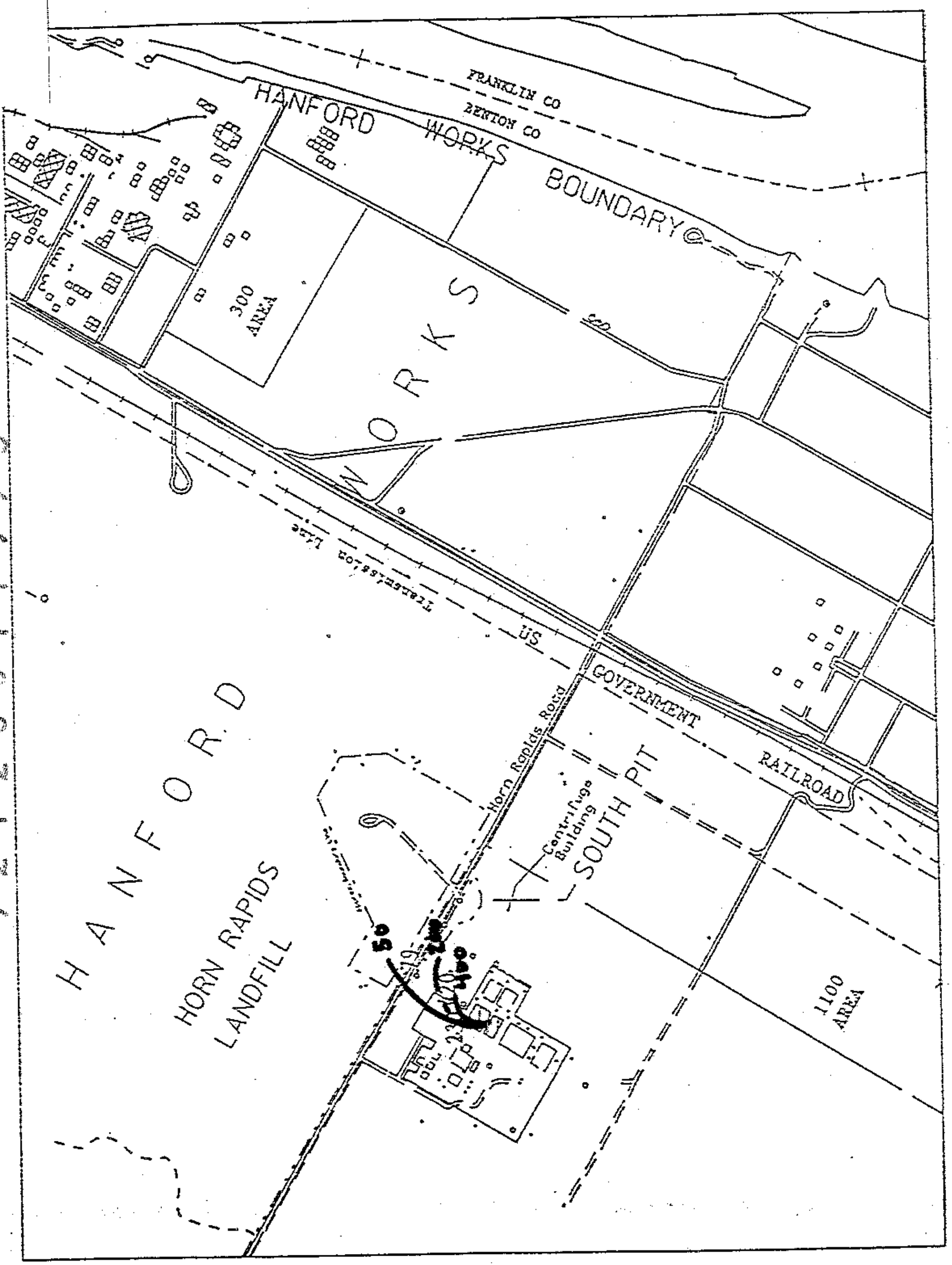
OBSERVED TCE CONCENTRATIONS 1992 (ppb)



92

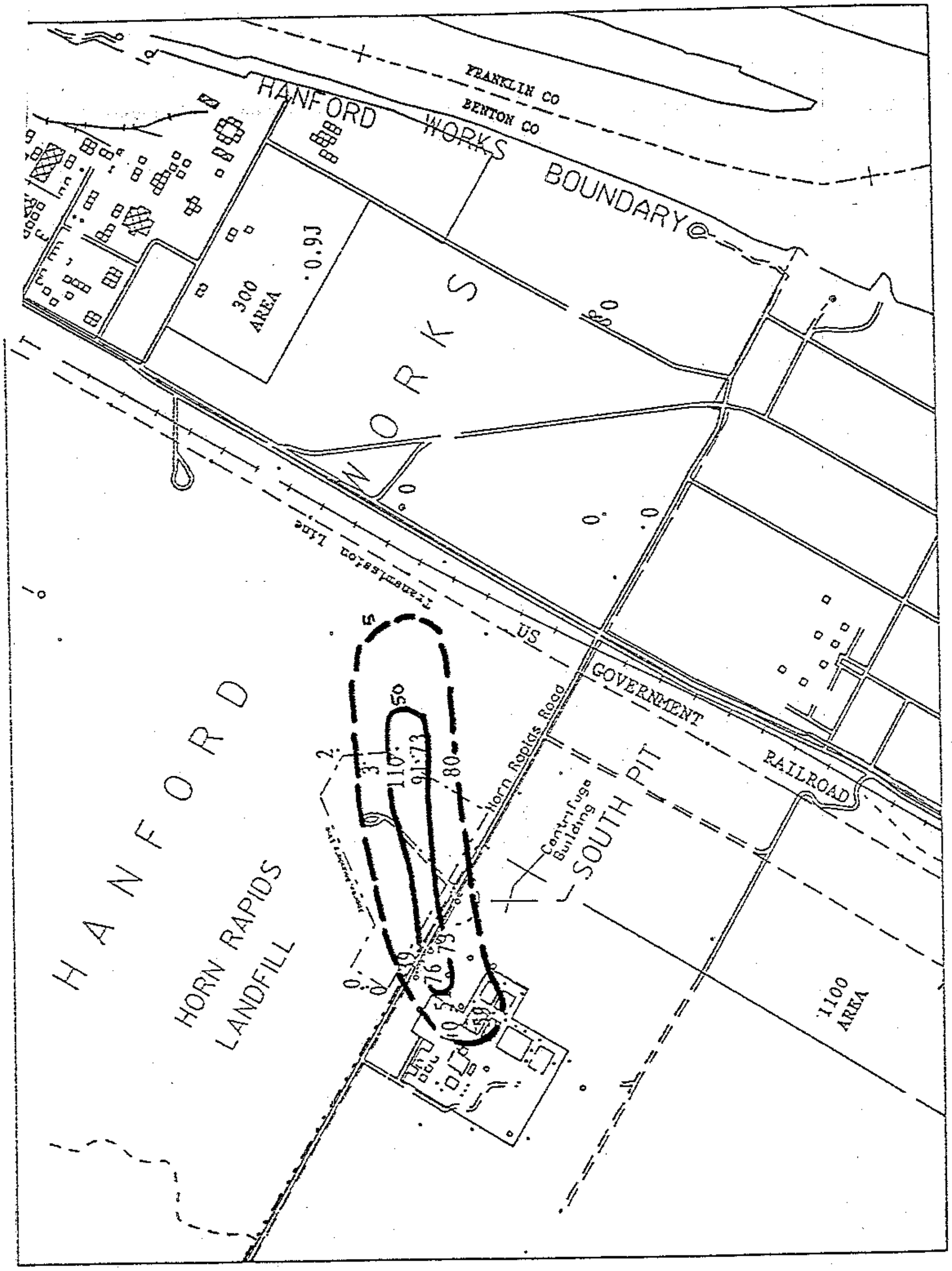
9212661974

OBSERVED TCE CONCENTRATIONS 1987 (ppb)

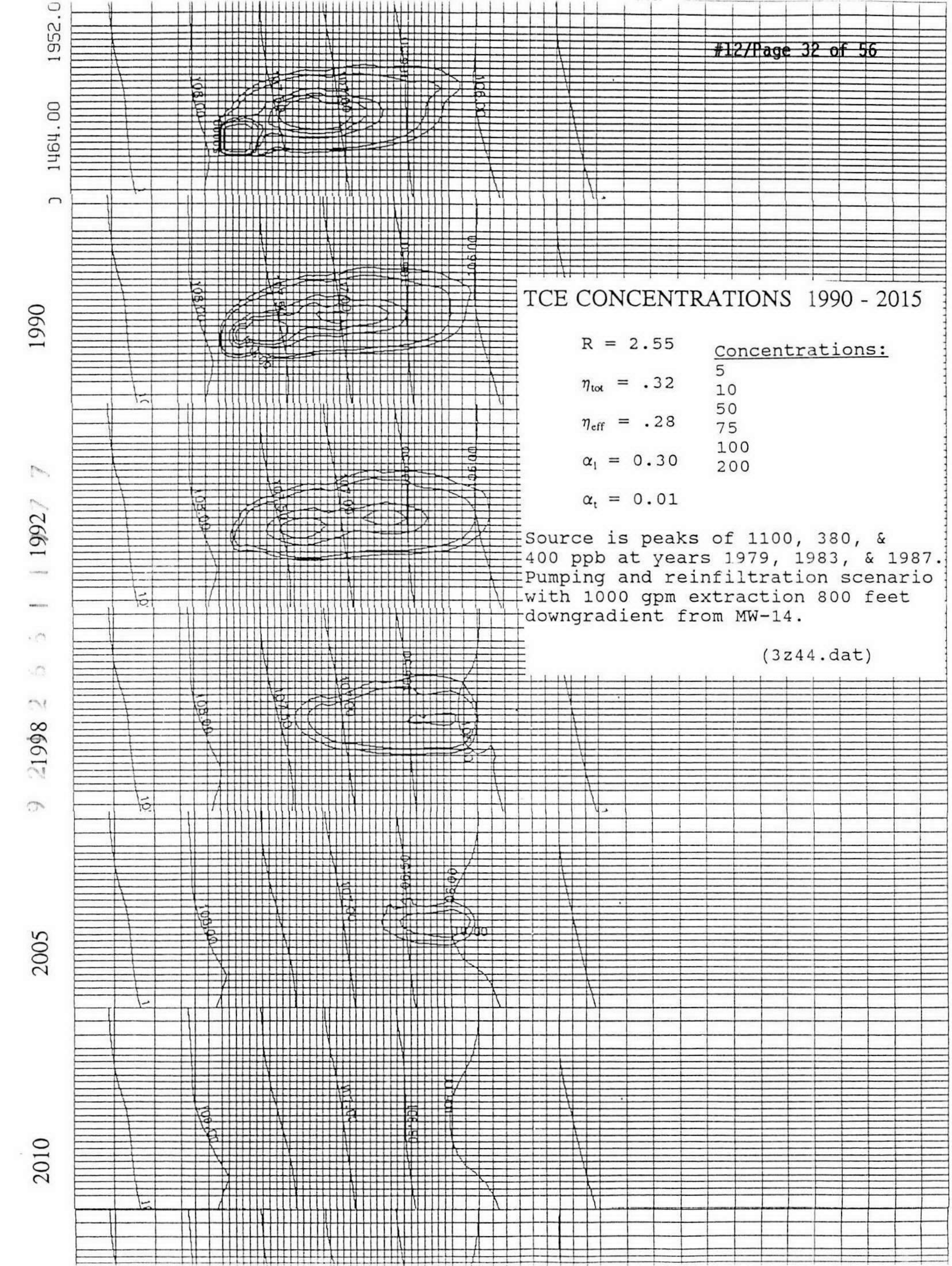


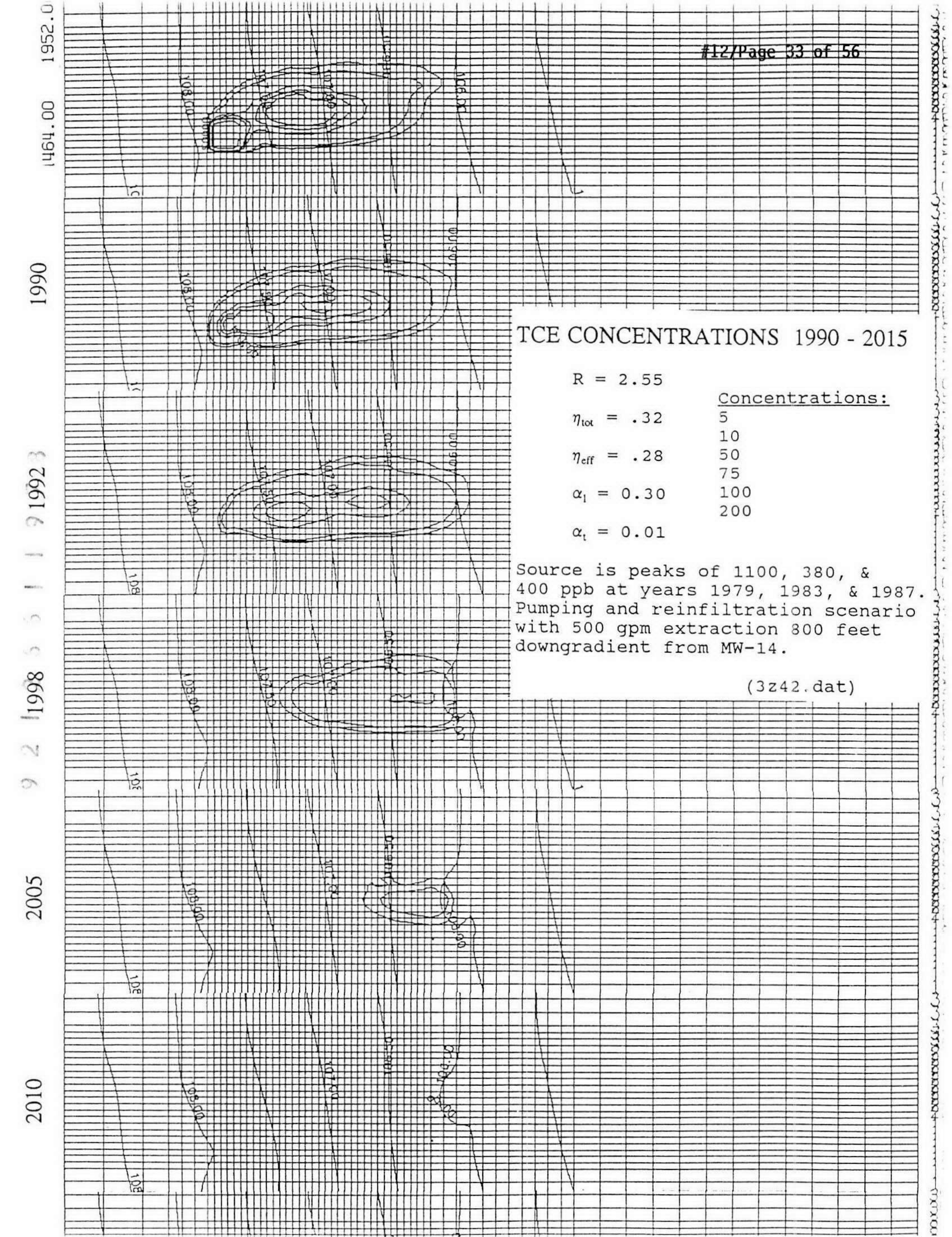
9212561975

OBSERVED TCE CONCENTRATIONS 1990 (ppb)



9212651976


TCE CONCENTRATIONS 1990 - 2015
R = 2.55
η_{tot} = .32
η_{eff} = .28
α_l = 0.30
α_t = 0.01
Concentrations:
5
10
50
75
100
200
Source is peaks of 1100, 380, & 400 ppb at years 1979, 1983, & 1987. Pumping and reinfiltration scenario with 1000 gpm extraction 800 feet downgradient from MW-14.
(3z44.dat)
1952.0
1464.00
1990
1992
1998
2005
2010



TCE CONCENTRATIONS 1990 - 2015

R = 2.55

η_{tot} = .32

η_{eff} = .28

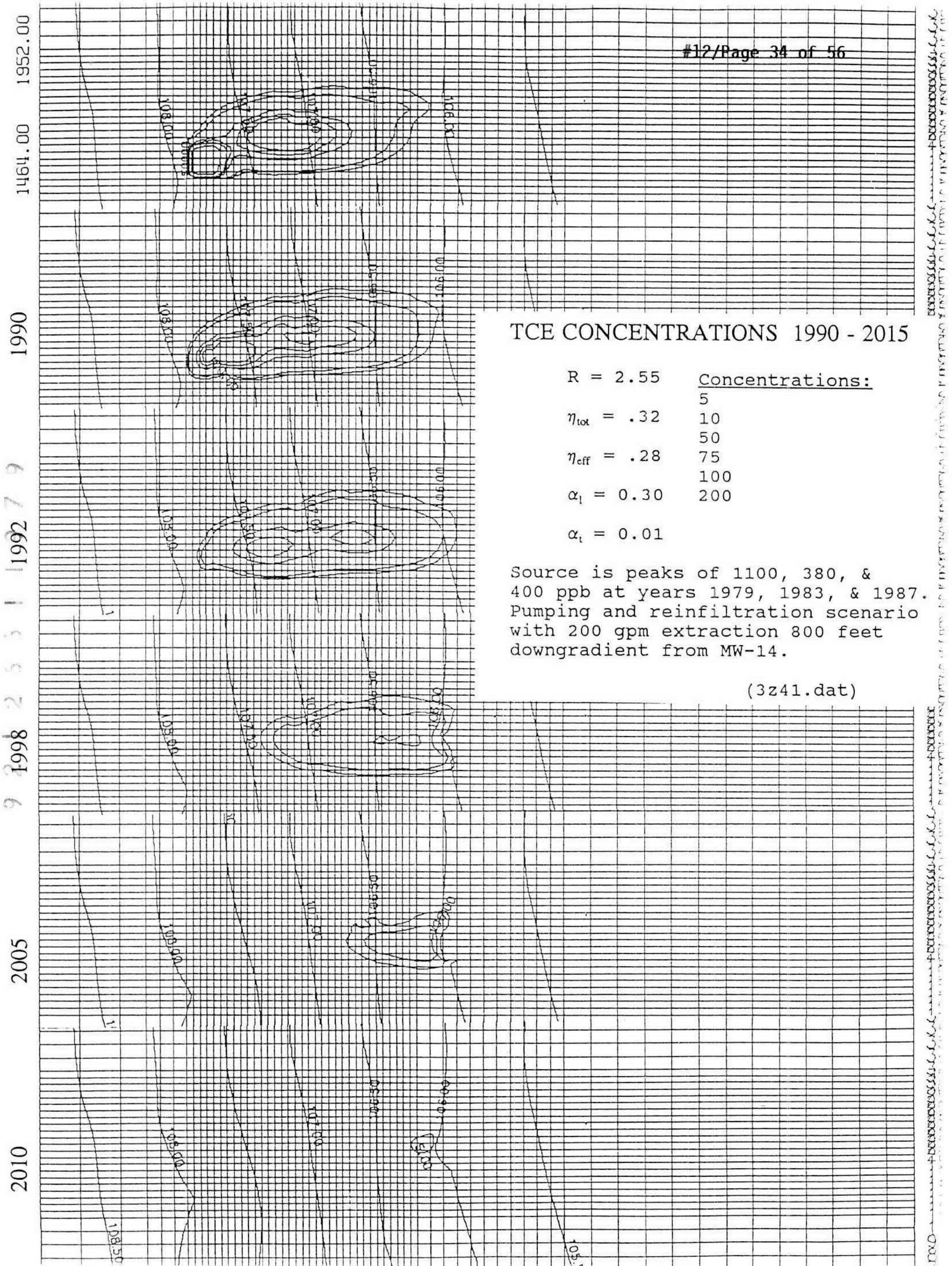
α_l = 0.30

α_t = 0.01

Concentrations:
5
10
50
75
100
200

Source is peaks of 1100, 380, & 400 ppb at years 1979, 1983, & 1987. Pumping and reinfiltration scenario with 500 gpm extraction 800 feet downgradient from MW-14.

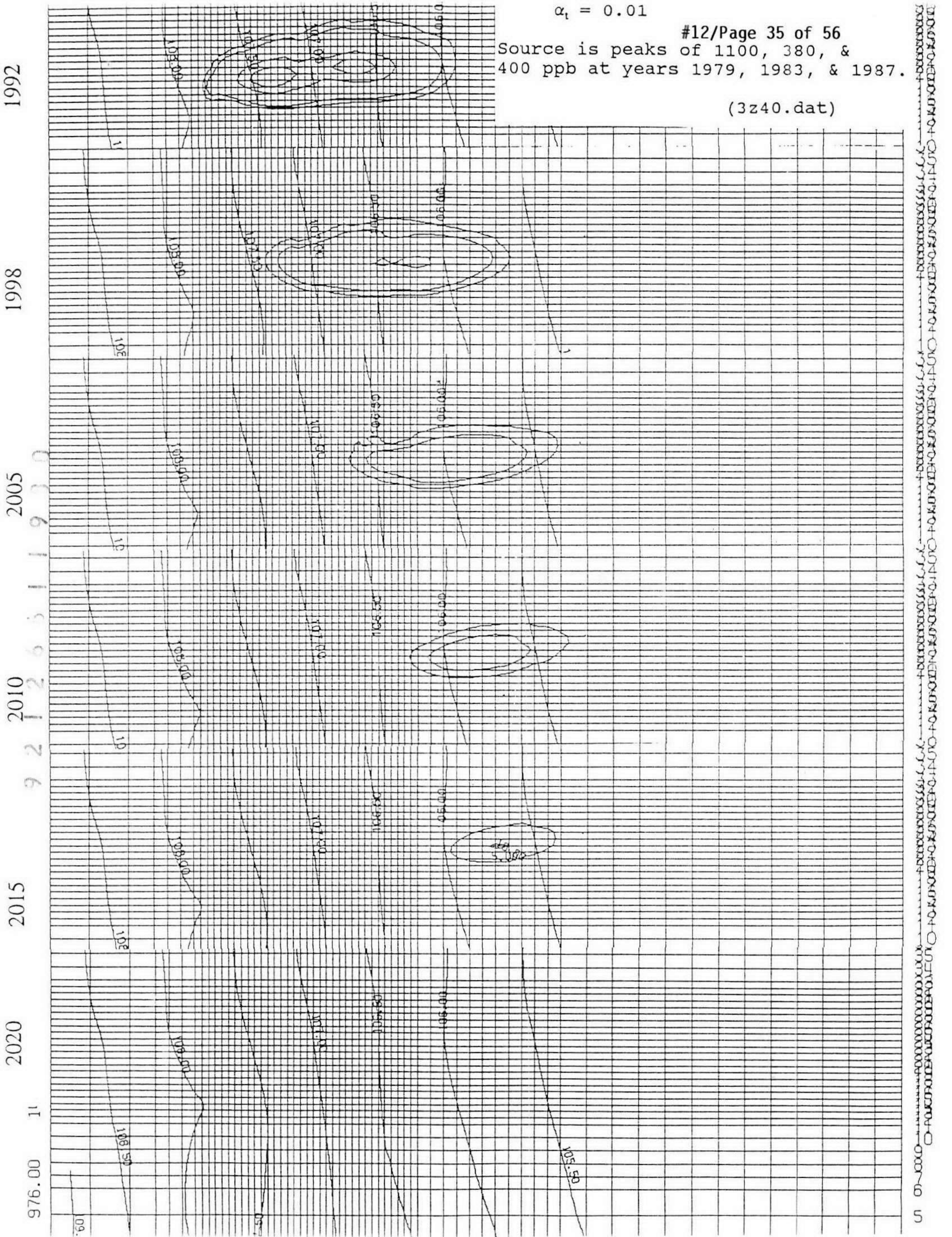
(3z42.dat)

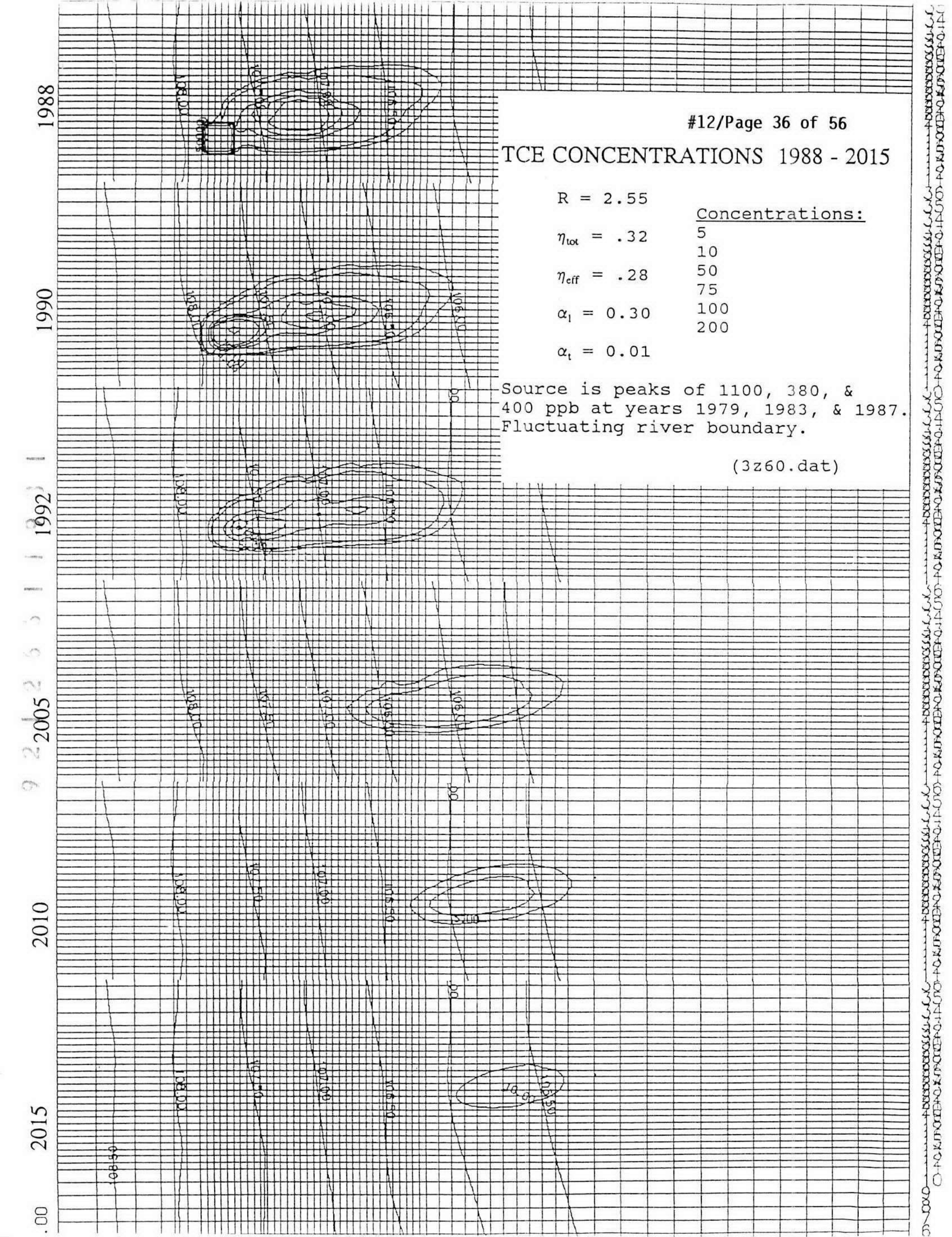

1952.00
1464.00
1990
1992
1998
2005
2010
TCE CONCENTRATIONS 1990 - 2015
R = 2.55
Concentrations:
5
10
50
75
100
200
η_{tot} = .32
η_{eff} = .28
α_l = 0.30
α_t = 0.01
Source is peaks of 1100, 380, & 400 ppb at years 1979, 1983, & 1987. Pumping and reinfiltration scenario with 200 gpm extraction 800 feet downgradient from MW-14.
(3z41.dat)

$\alpha_t = 0.01$

Source is peaks of 1100, 380, & 400 ppb at years 1979, 1983, & 1987.

(3z40.dat)




TCE CONCENTRATIONS 1988 - 2015
R = 2.55
η_{tot} = .32
η_{eff} = .28
α_l = 0.30
α_t = 0.01
Concentrations:
5
10
50
75
100
200
Source is peaks of 1100, 380, & 400 ppb at years 1979, 1983, & 1987.
Fluctuating river boundary.
(3z60.dat)
1988
1990
1992
2005
2010
2015
.00

CLEAN-UP TIMES AND PUMPING DURATIONS FOR SELECTED PUMP & TREAT SCENARIOS

TCE Clean-up Only:

Location	Start Pumping	Q,# Wells	End Pumping	C < MCL
1. 800 feet NE of MW-12,13,14,15 well cluster	Jan 1995	200 gpm,2	2010	2010

This scenario approaches clean-up by pumping the down-gradient front of the area of highest concentration and allowing the peripheral plume areas to disperse without treatment.

2. Same as 1.	Jan 1995	500 gpm,5	2005 - 2010	2005 - 2010

The pumping in this scenario is the approximately the lowest gpm that captures all of the 5 ppb plume up-gradient of the pump site. The TCE down-gradient of the pump site would disperse without treatment.

3. Same as 1.	Jan 1995	1000 gpm,10	2005 - 2010	2005 - 2010

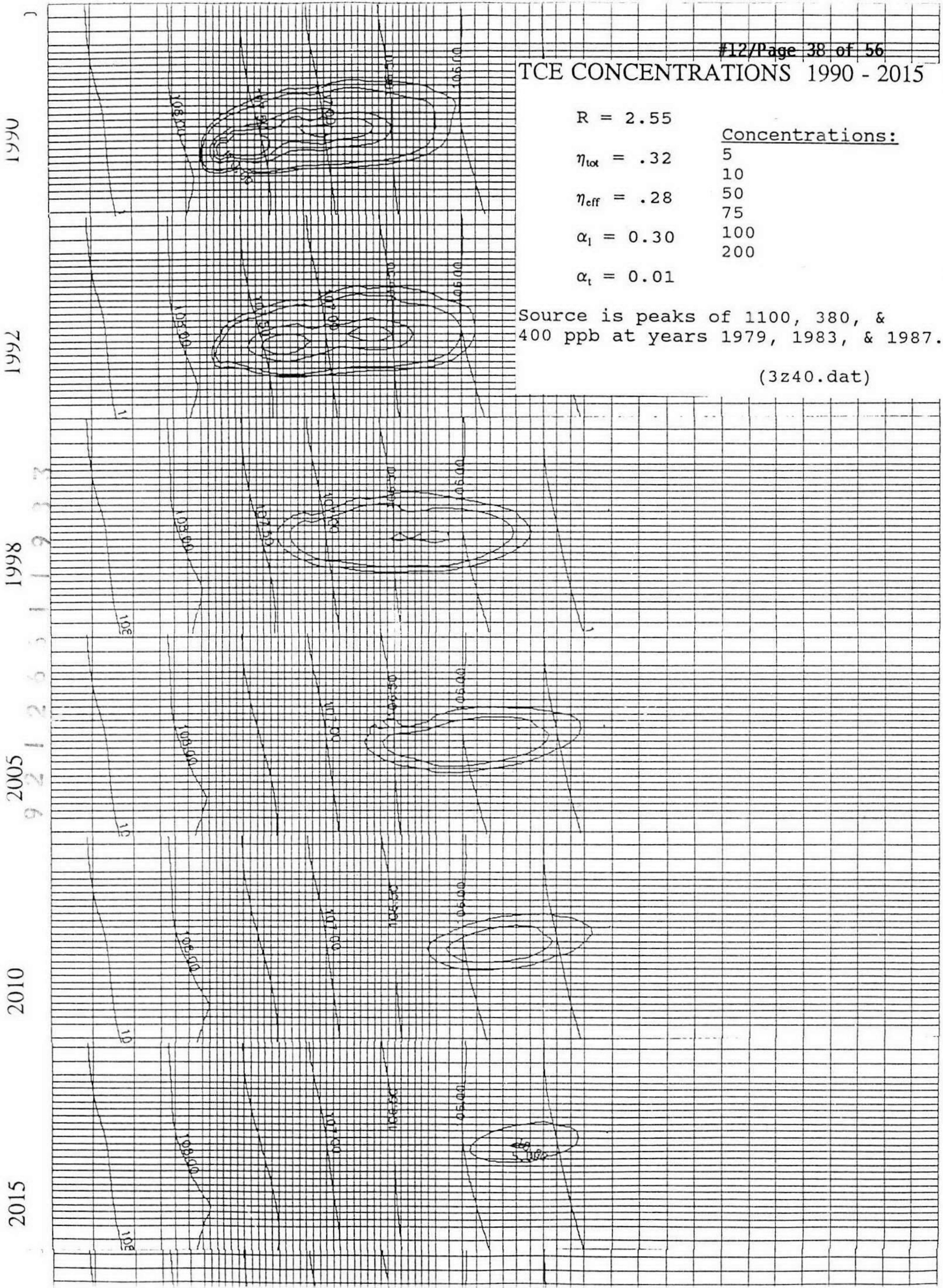
Similar to 1. and 2. but with 1000 gpm.

4. Just West of Stevens Drive	1995-2000	300 gpm,3	2007 - 2012	2007 - 2012

This scenario approaches clean-up by pumping the plume as it reaches Stevens Drive.

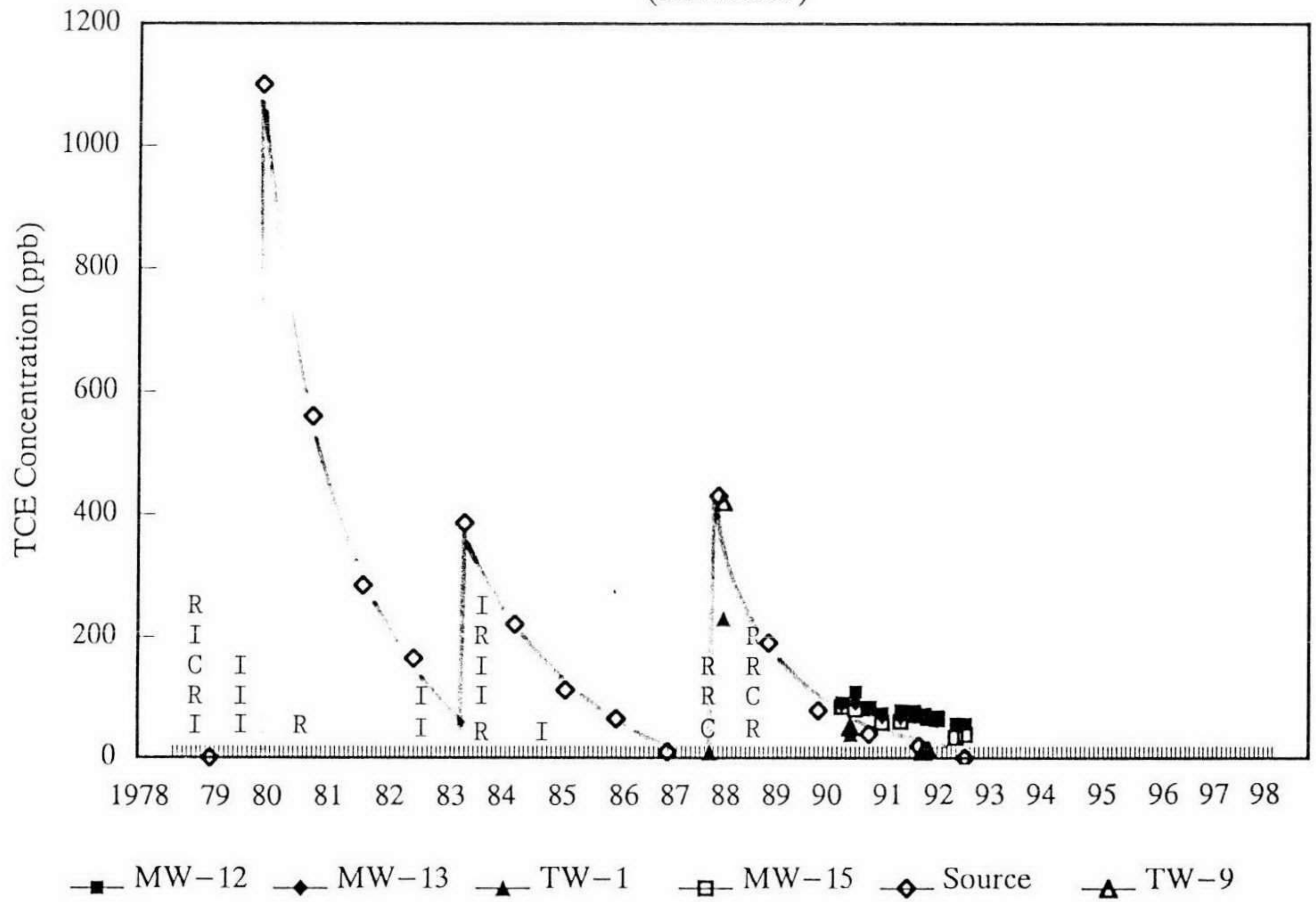
5. Parallel to, and just East of George Washington Way Diagonal.	NA	NA	NA	2007 - 2017

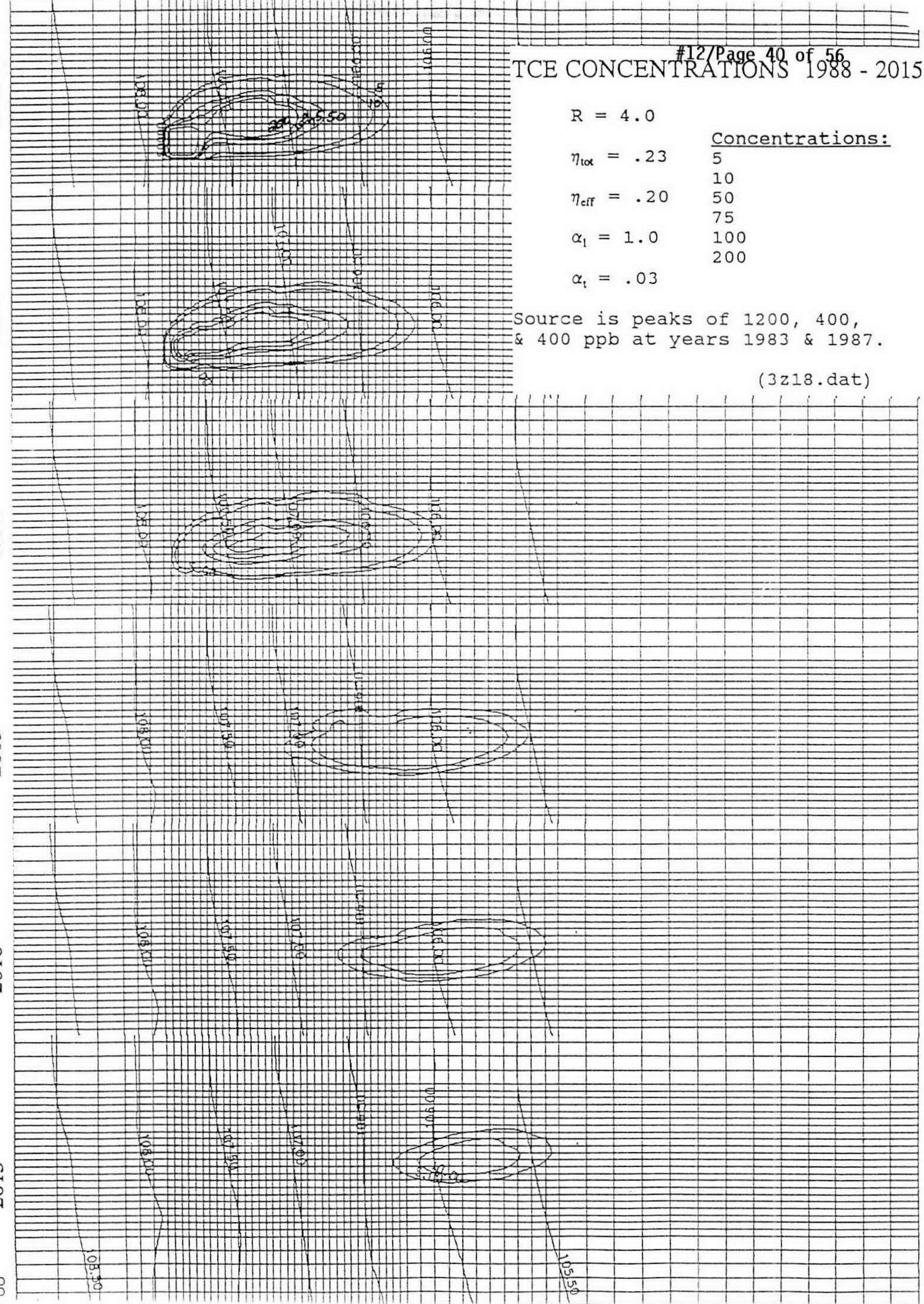
Even with conservative source and transport estimates, the computed contaminant plume did not reach this point in concentrations above 5 ppb.


TCE CONCENTRATIONS 1990 - 2015
R = 2.55
η_{tot} = .32
η_{eff} = .28
α_l = 0.30
α_t = 0.01
Concentrations:
5
10
50
75
100
200
Source is peaks of 1100, 380, & 400 ppb at years 1979, 1983, & 1987.
(3z40.dat)
1990
1992
1998
2005
2010
2015

TCE SOURCE CONCENTRATIONS

(3Z40.DAT)




TCE CONCENTRATIONS 1988 - 2015
R = 4.0
η_{tot} = .23
η_{eff} = .20
α_l = 1.0
α_t = .03
Concentrations:
5
10
50
75
100
200
Source is peaks of 1200, 400, & 400 ppb at years 1983 & 1987.
(3z18.dat)
1988
1990
1992
2005
2010
2015
00

TCE CONCENTRATIONS 1988 - 2015

$R = 2.0$

$\eta_{tot} = .33$

$\eta_{eff} = .30$

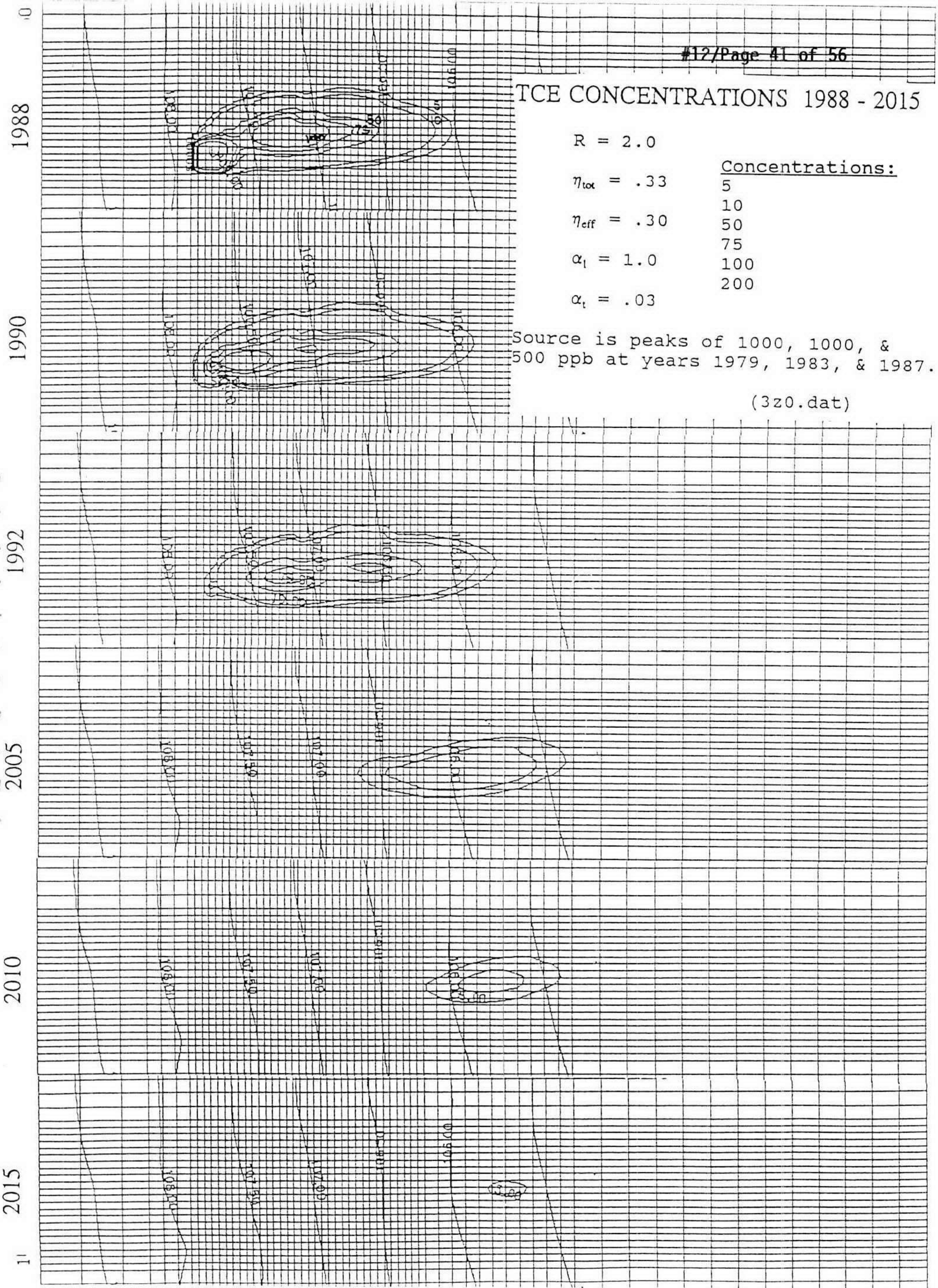
$\alpha_l = 1.0$

$\alpha_t = .03$

Concentrations:
5
10
50
75
100
200

Source is peaks of 1000, 1000, & 500 ppb at years 1979, 1983, & 1987.

(3z0.dat)



TCE CONCENTRATIONS 1988 - 2015

$R = 2.0$

$\eta_{tot} = 0.38$

$\eta_{eff} = 0.35$

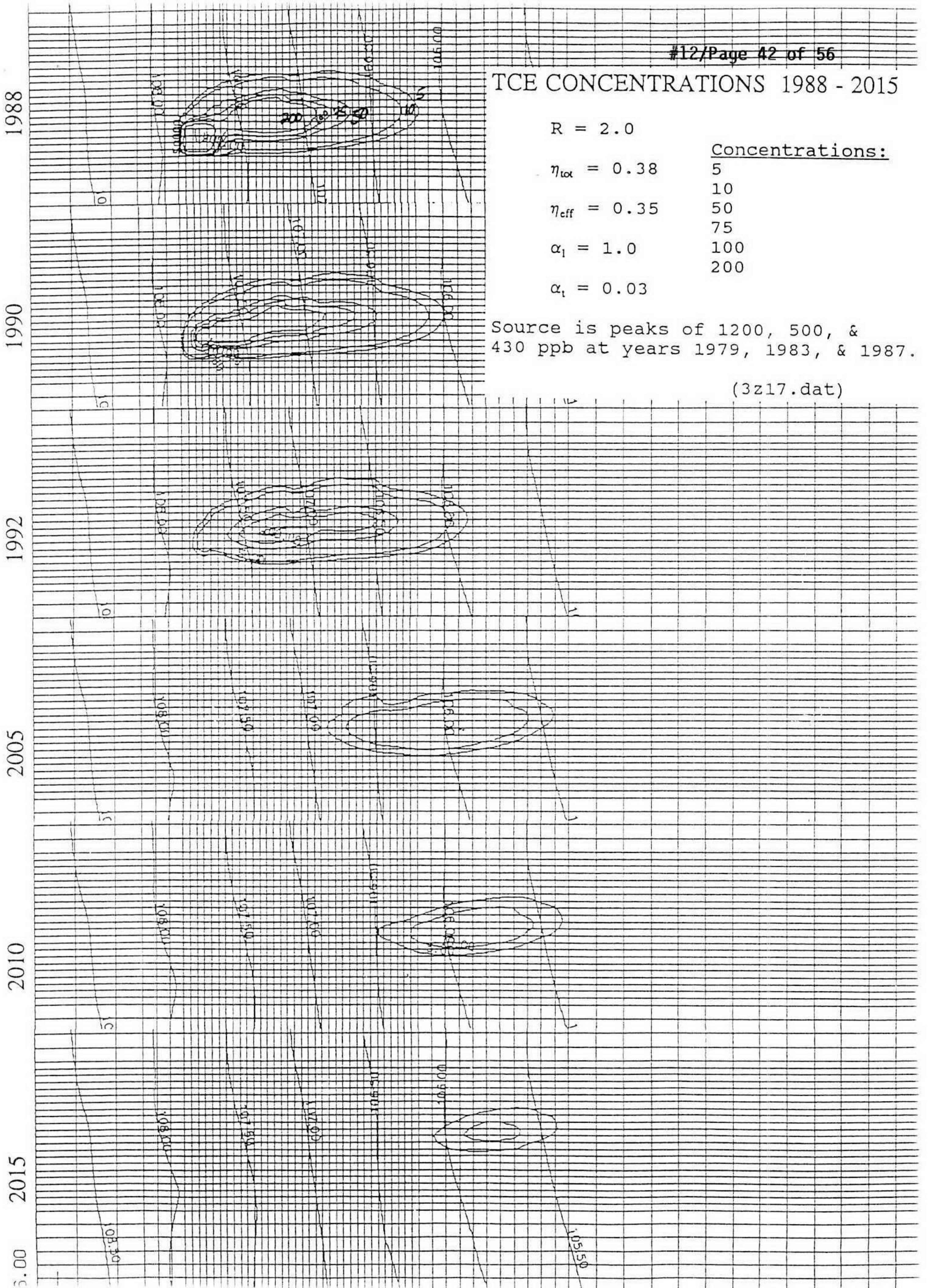
$\alpha_l = 1.0$

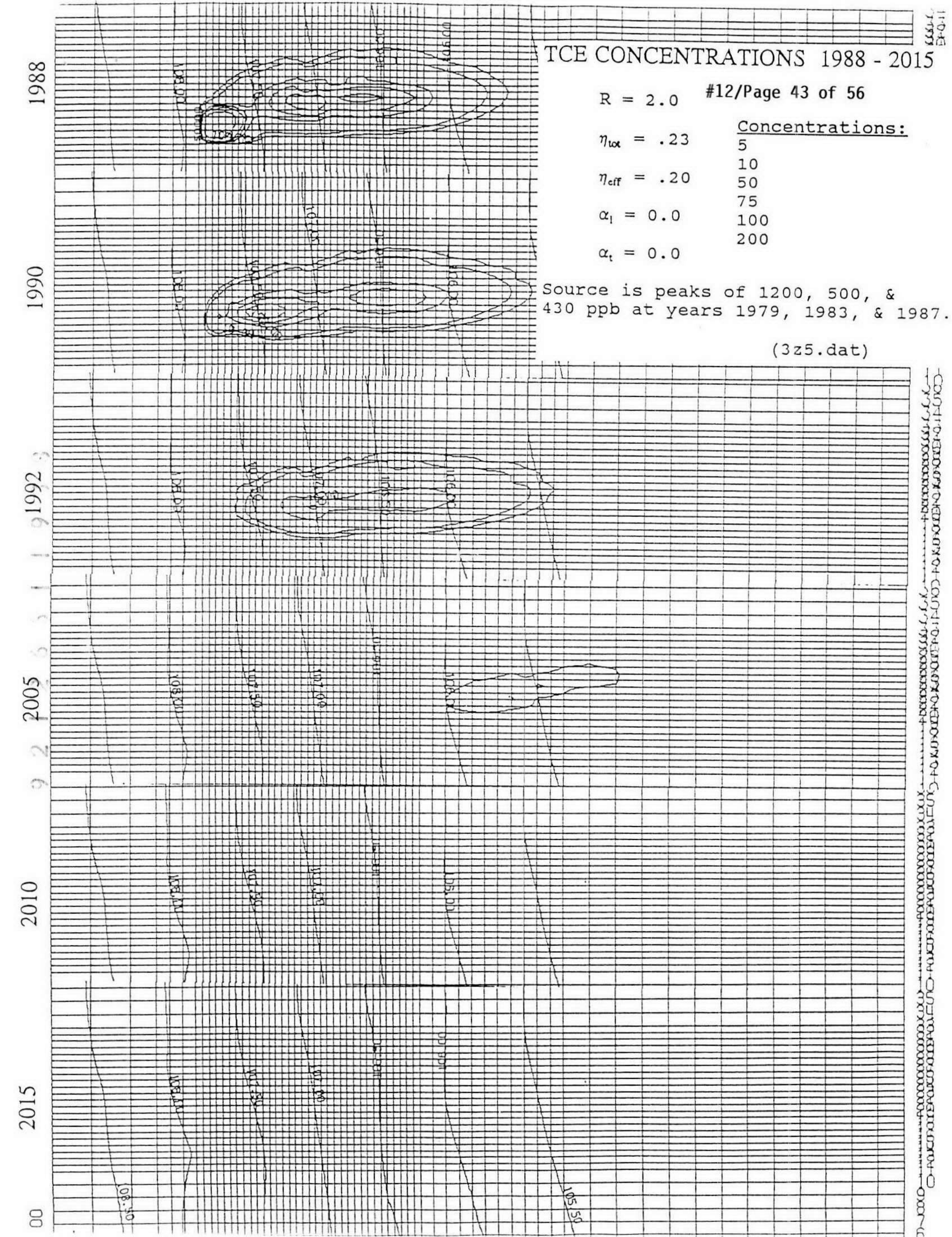
$\alpha_t = 0.03$

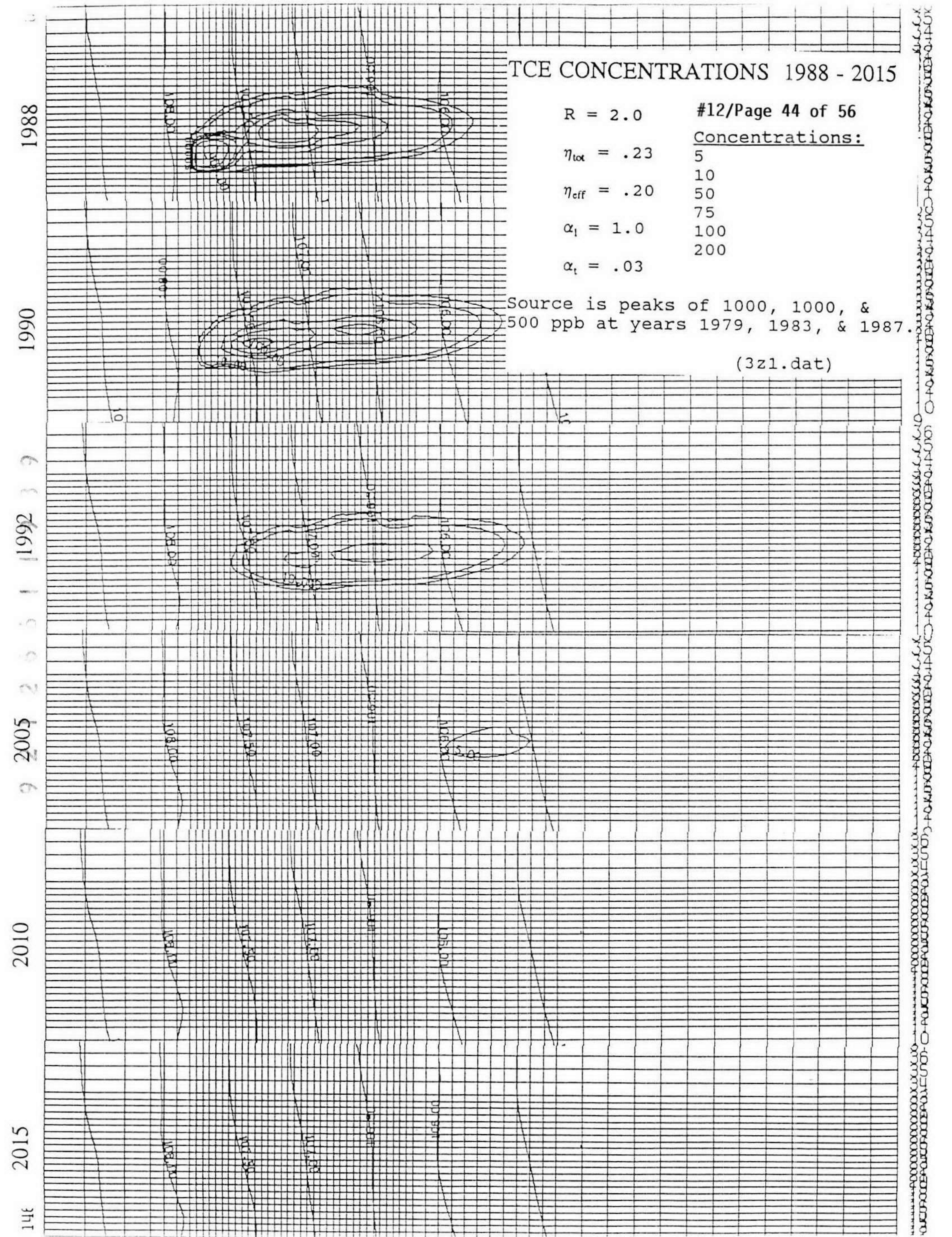
Concentrations:
5
10
50
75
100
200

Source is peaks of 1200, 500, & 430 ppb at years 1979, 1983, & 1987.

(3z17.dat)



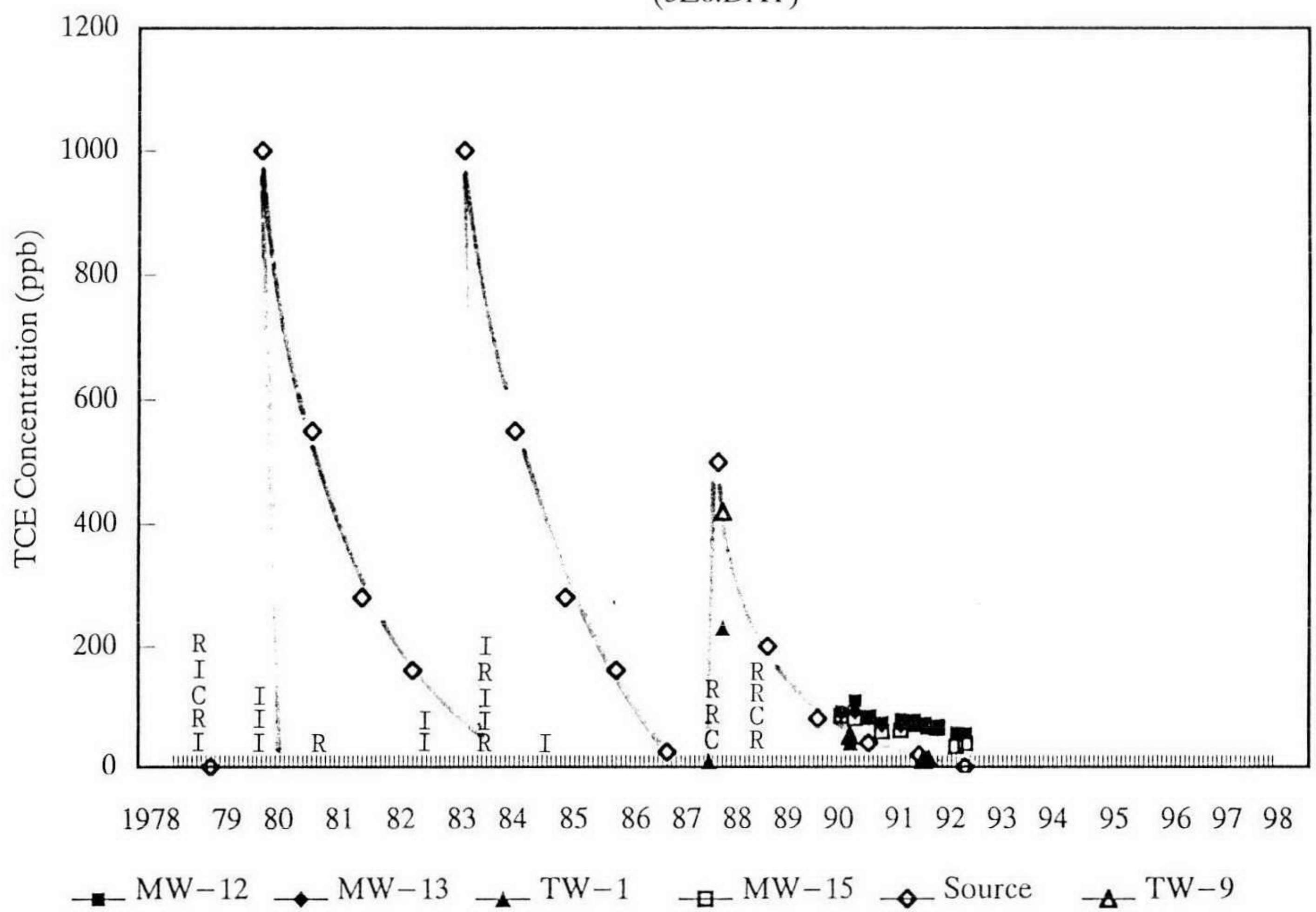

TCE CONCENTRATIONS 1988 - 2015
#12/Page 43 of 56
R = 2.0
η_{tot} = .23
η_{eff} = .20
α_l = 0.0
α_t = 0.0
Concentrations:
5
10
50
75
100
200
Source is peaks of 1200, 500, &
430 ppb at years 1979, 1983, & 1987.
(3z5.dat)
1988
1990
1992
2005
2010
2015
108.50
105.50


TCE CONCENTRATIONS 1988 - 2015
R = 2.0
#12/Page 44 of 56
η_{tot} = .23
Concentrations:
5
10
50
75
100
200
η_{eff} = .20
α_l = 1.0
α_t = .03
Source is peaks of 1000, 1000, &
500 ppb at years 1979, 1983, & 1987.
(3z1.dat)
1988
1990
1992
2005
2010
2015

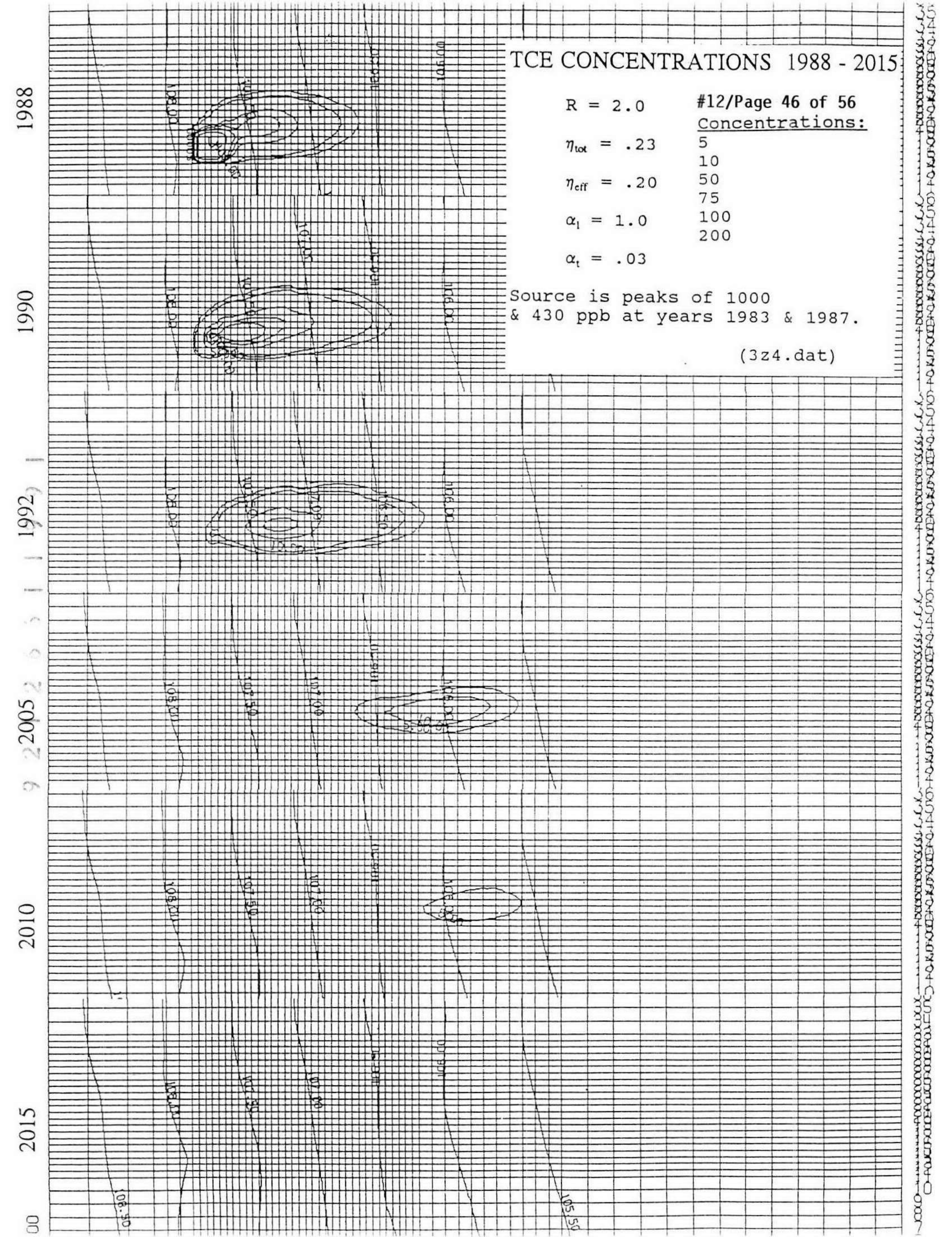
9 2 1 2 6 5 1 1 9 9 0

TCE SOURCE CONCENTRATIONS

(3Z0.DAT)

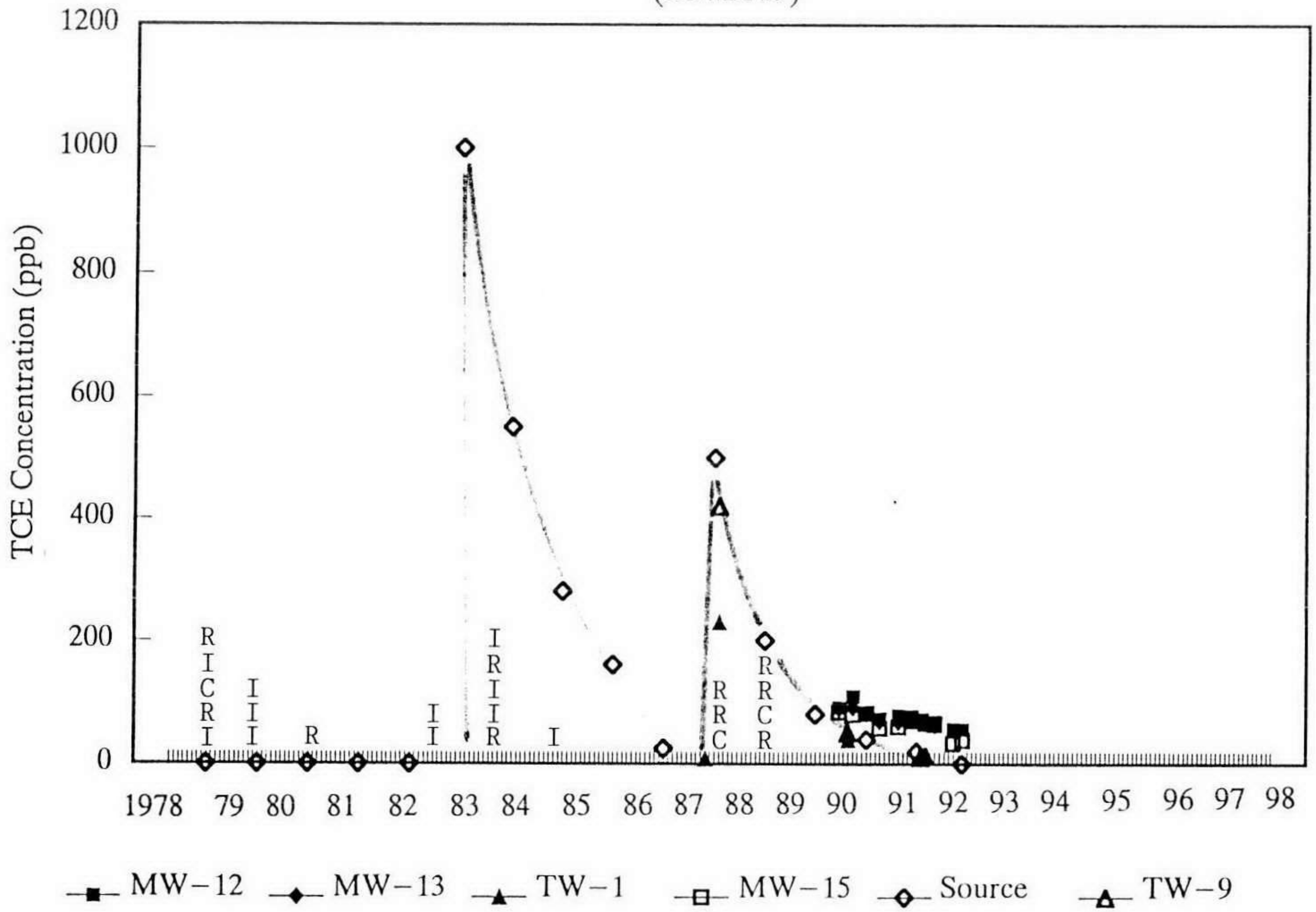


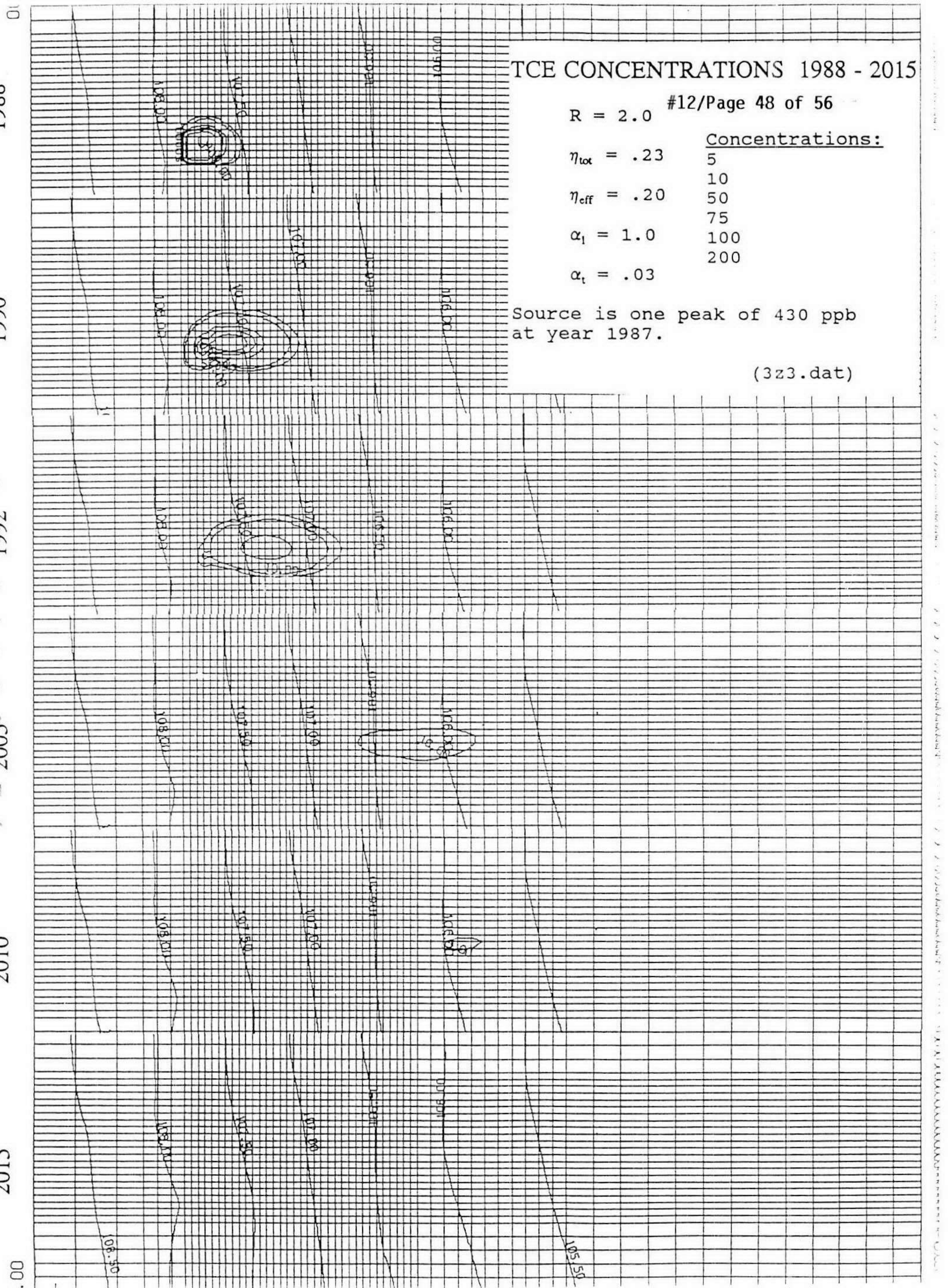
#12/Page 45 of 56


TCE CONCENTRATIONS 1988 - 2015
R = 2.0
η_tot = .23
η_eff = .20
α_l = 1.0
α_t = .03
#12/Page 46 of 56
Concentrations:
5
10
50
75
100
200
Source is peaks of 1000
& 430 ppb at years 1983 & 1987.
(3z4.dat)
1988
1990
1992
2005
2010
2015
108.00
107.50
107.00
106.50
106.00
108.50
105.50

TCE SOURCE CONCENTRATIONS

(3Z4.DAT)

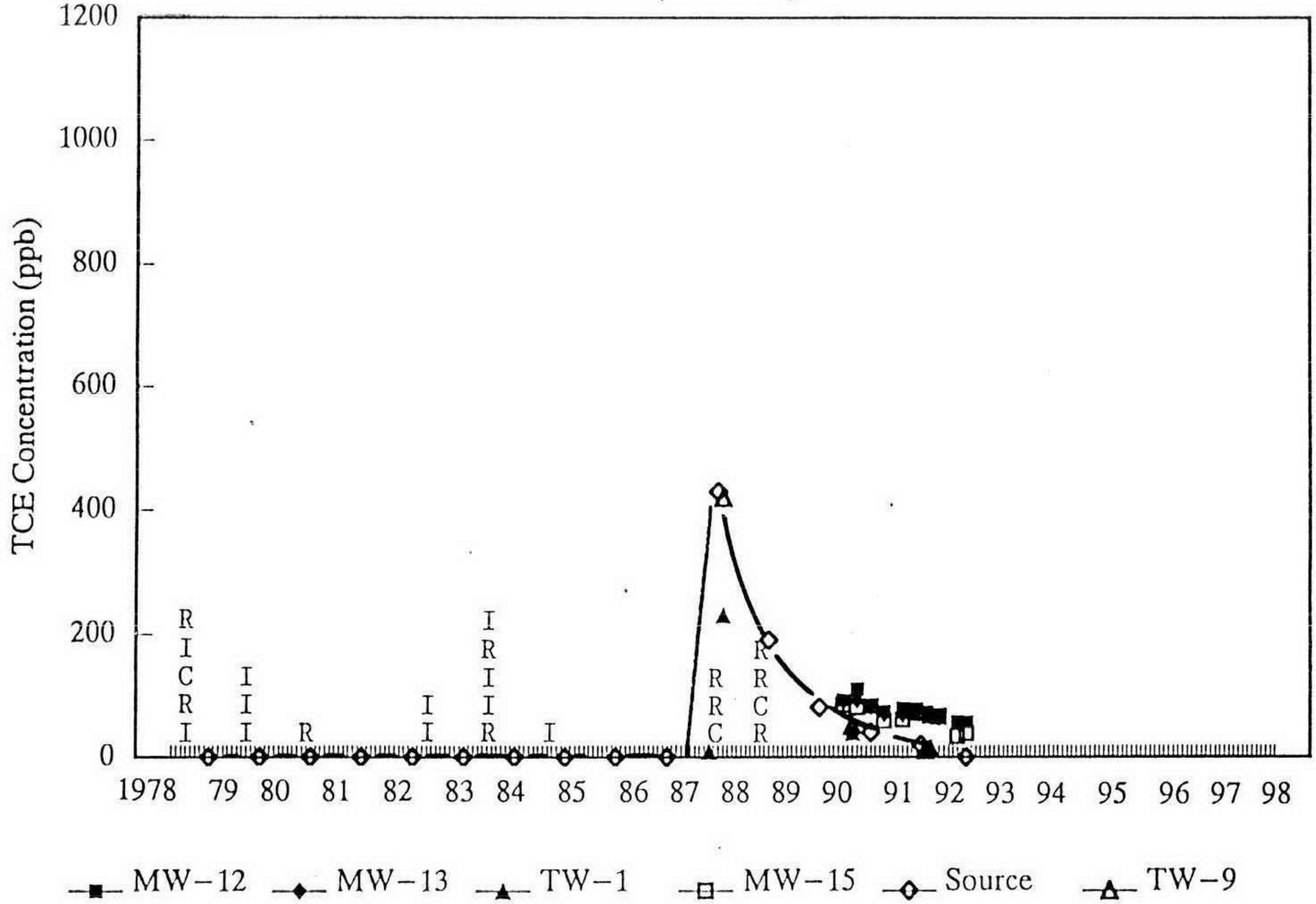



TCE CONCENTRATIONS 1988 - 2015
#12/Page 48 of 56
R = 2.0
η_{tot} = .23
η_{eff} = .20
α_l = 1.0
α_t = .03
Concentrations:
5
10
50
75
100
200
Source is one peak of 430 ppb at year 1987.
(3z3.dat)
1988
1990
1992
2005
2010
2015

9 2 1 2 3 5 1 1 9 9 4

TCE SOURCE CONCENTRATIONS

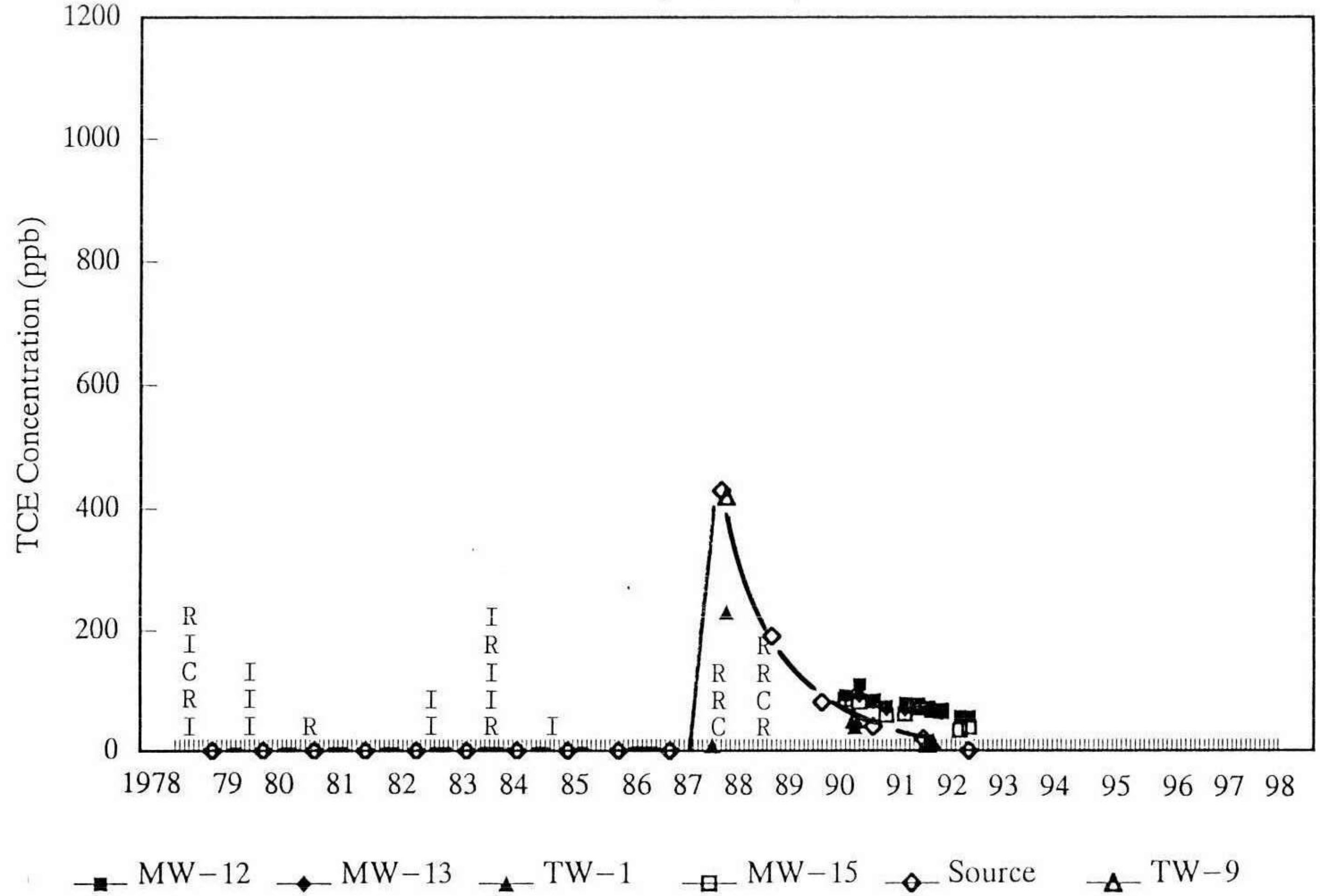
(3Z3.DAT)

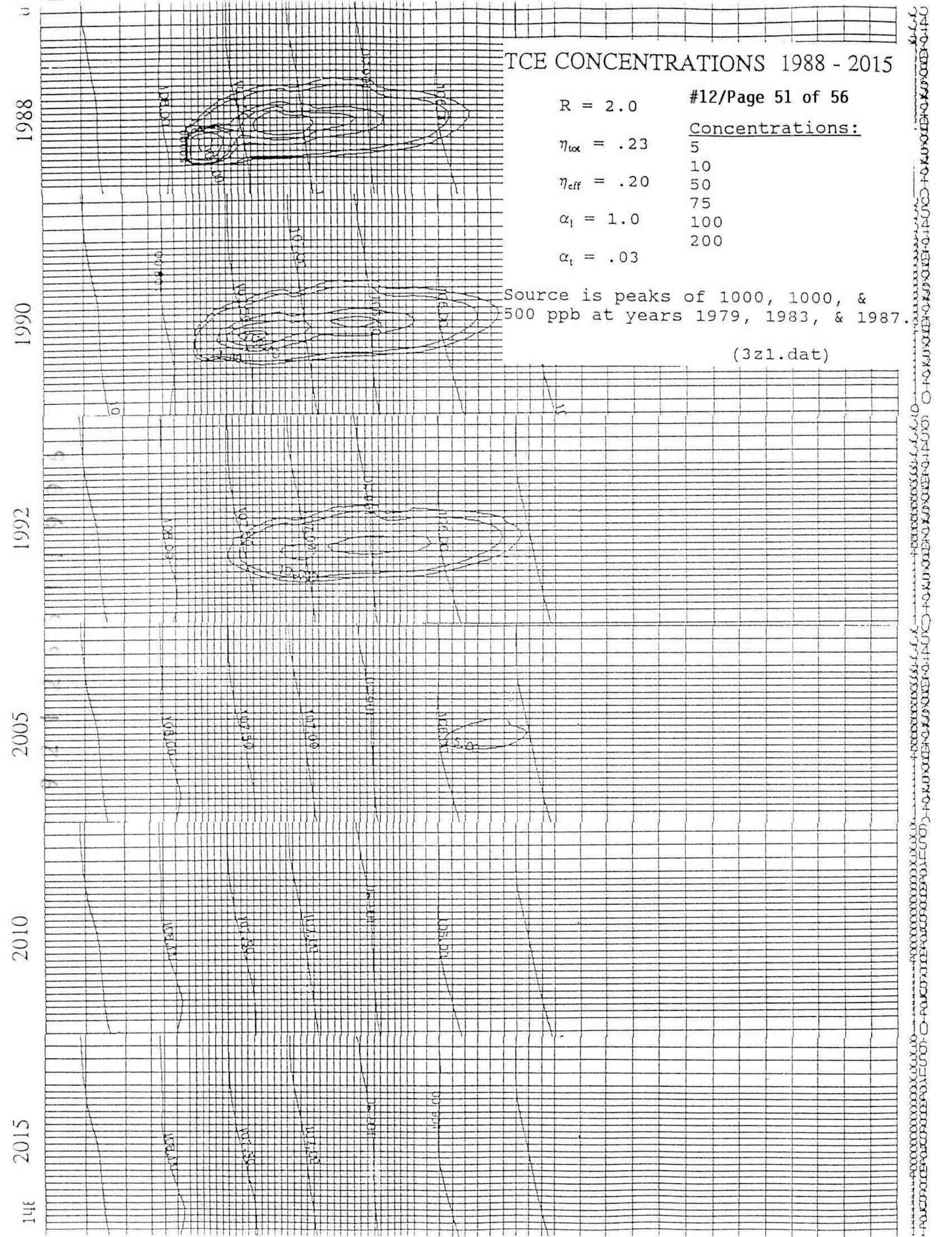


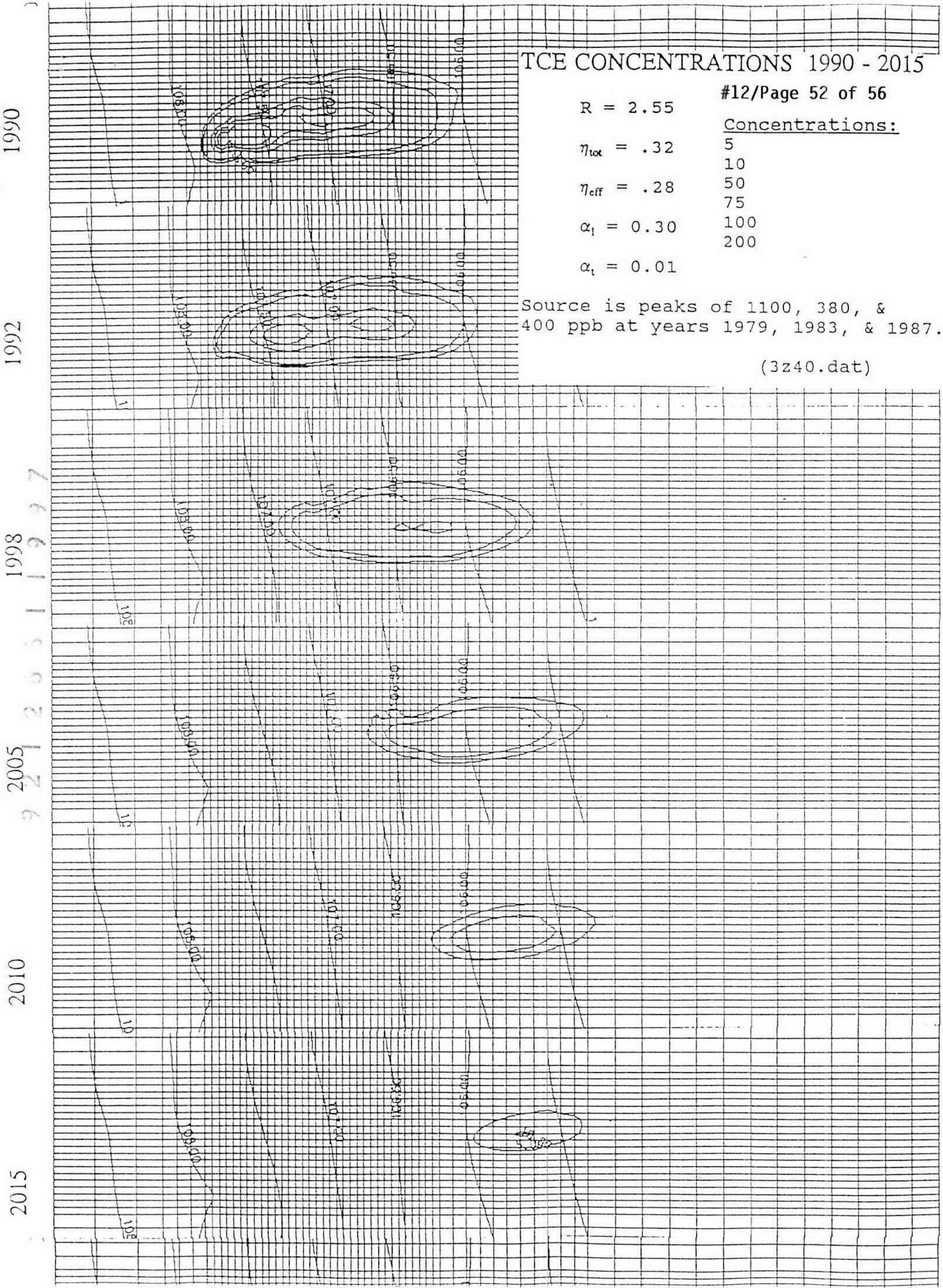
#12/Page 49 of 56

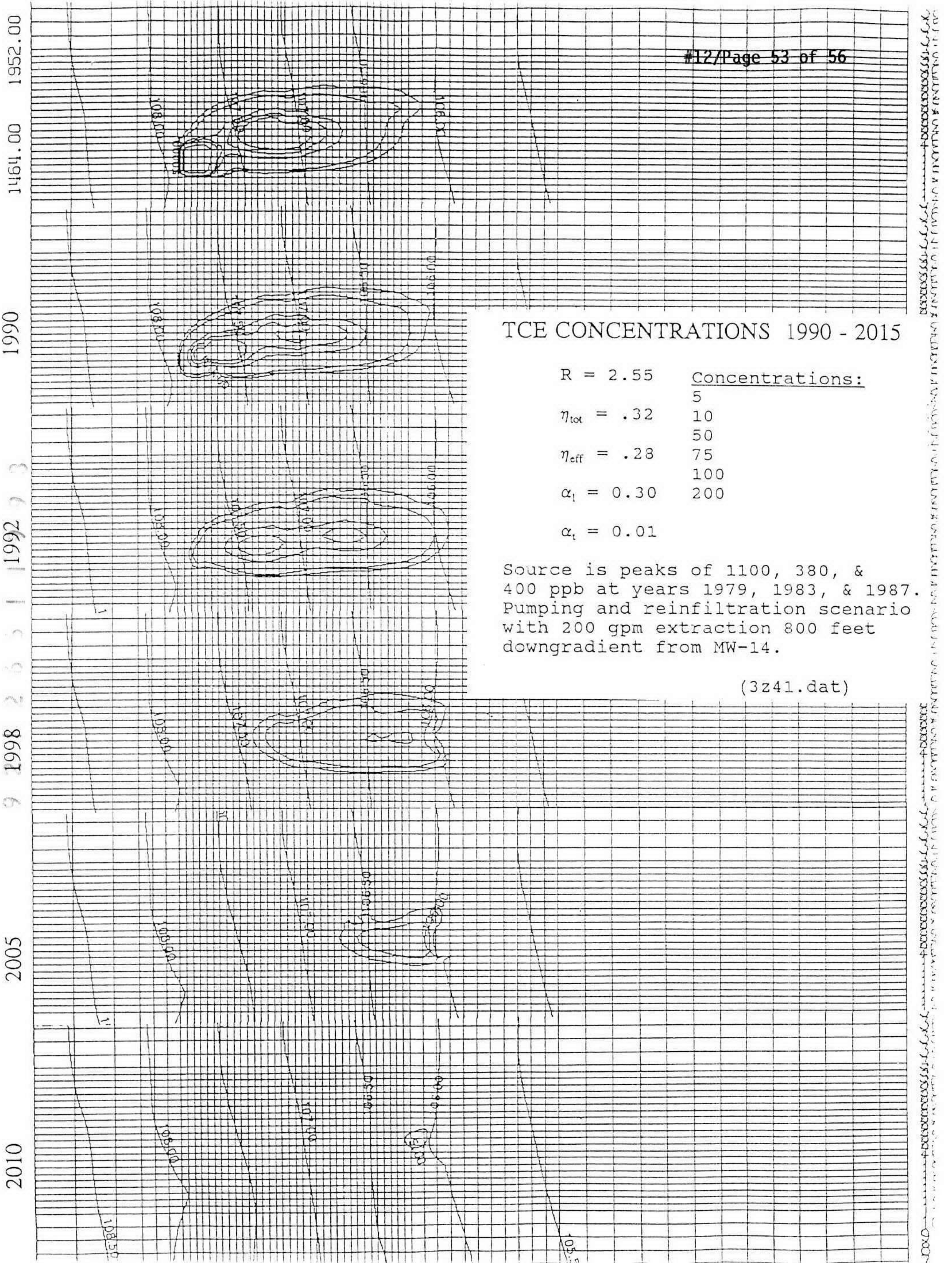
TCE SOURCE CONCENTRATIONS

(3Z3.DAT)




TCE CONCENTRATIONS 1988 - 2015
#12/Page 51 of 56
R = 2.0
η_{tot} = .23
η_{eff} = .20
α_l = 1.0
α_t = .03
Concentrations:
5
10
50
75
100
200
Source is peaks of 1000, 1000, & 500 ppb at years 1979, 1983, & 1987.
(3z1.dat)
1988
1990
1992
2005
2010
2015


TCE CONCENTRATIONS 1990 - 2015
#12/Page 52 of 56
R = 2.55
η_{tot} = .32
η_{eff} = .28
α_l = 0.30
α_t = 0.01
Concentrations:
5
10
50
75
100
200
Source is peaks of 1100, 380, & 400 ppb at years 1979, 1983, & 1987.
(3z40.dat)
1990
1992
1998
2005
2010
2015

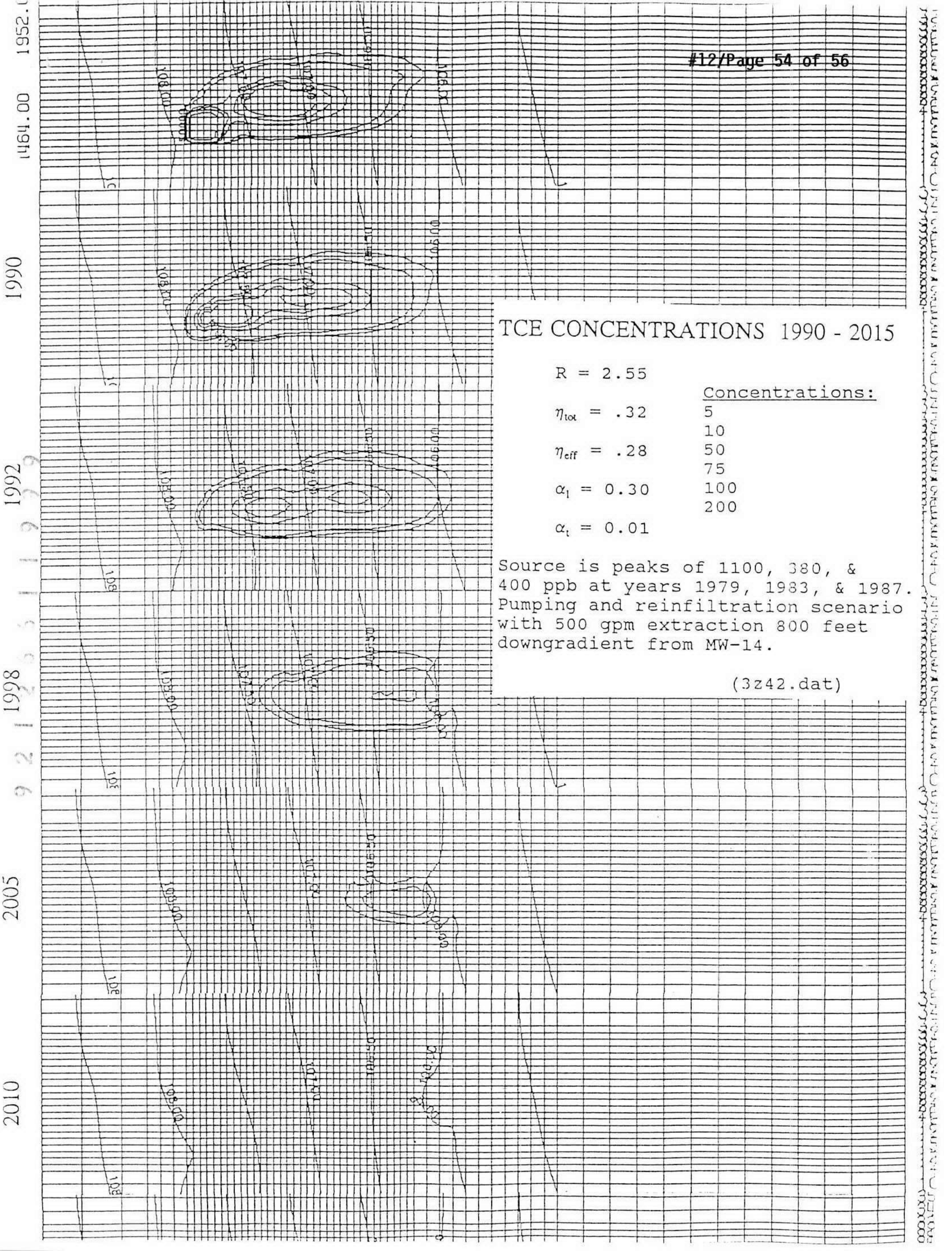


TCE CONCENTRATIONS 1990 - 2015

R = 2.55	<u>Concentrations:</u>
	5
η_{tot} = .32	10
	50
η_{eff} = .28	75
	100
α_l = 0.30	200
α_t = 0.01	

Source is peaks of 1100, 380, & 400 ppb at years 1979, 1983, & 1987. Pumping and reinfiltration scenario with 200 gpm extraction 800 feet downgradient from MW-14.

(3z41.dat)



TCE CONCENTRATIONS 1990 - 2015

$R = 2.55$

$\eta_{tot} = .32$

$\eta_{eff} = .28$

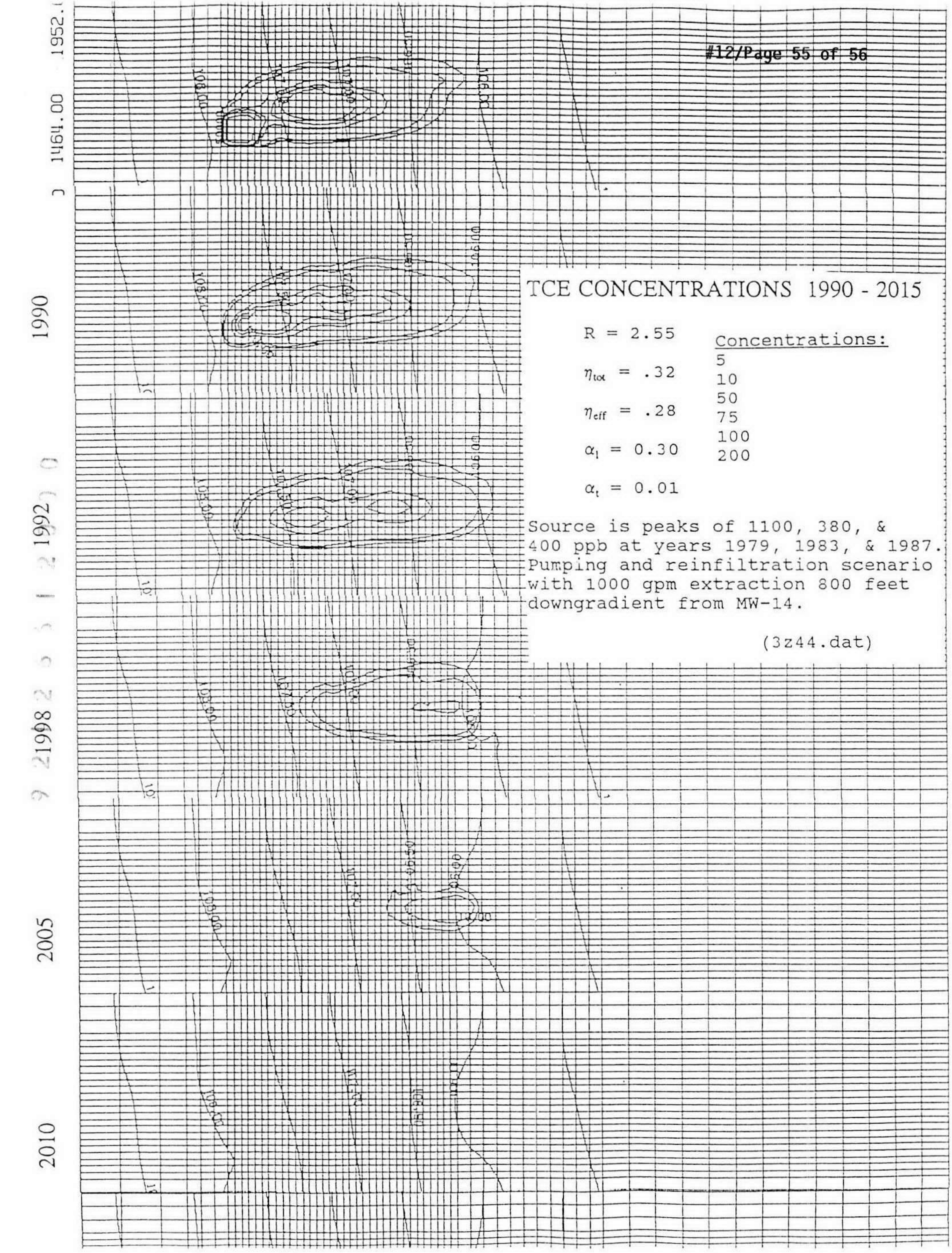
$\alpha_l = 0.30$

$\alpha_t = 0.01$

<u>Concentrations:</u>
5
10
50
75
100
200

Source is peaks of 1100, 380, & 400 ppb at years 1979, 1983, & 1987. Pumping and reinfiltration scenario with 500 gpm extraction 800 feet downgradient from MW-14.

(3z42.dat)


1952.
1464.00
1990
1992
1998
2005
2010
TCE CONCENTRATIONS 1990 - 2015
R = 2.55
η_{tot} = .32
η_{eff} = .28
α_l = 0.30
α_t = 0.01
Concentrations:
5
10
50
75
100
200
Source is peaks of 1100, 380, & 400 ppb at years 1979, 1983, & 1987. Pumping and reinfiltration scenario with 1000 gpm extraction 800 feet downgradient from MW-14.
(3z44.dat)

CLEAN-UP TIMES AND PUMPING DURATIONS FOR SELECTED PUMP & TREAT SCENARIOS

TCE Clean-up Only:

Location	Start Pumping	Q,# Wells	End Pumping	C < MCL
1. 800 feet NE of MW-12,13,14,15 well cluster	Jan 1995	200 gpm,2	2010	2010

This scenario approaches clean-up by pumping the down-gradient front of the area of highest concentration and allowing the peripheral plume areas to disperse without treatment.

2. Same as 1.	Jan 1995	500 gpm,5	2005 - 2010	2005 - 2010

The pumping in this scenario is the approximately the lowest gpm that captures all of the 5 ppb plume up-gradient of the pump site. The TCE down-gradient of the pump site would disperse without treatment.

3. Same as 1.	Jan 1995	1000 gpm,10	2005 - 2010	2005 - 2010

Similar to 1. and 2. but with 1000 gpm.

4. Just West of Stevens Drive	1995-2000	300 gpm,3	2007 - 2012	2007 - 2012

This scenario approaches clean-up by pumping the plume as it reaches Stevens Drive.

5. Parallel to, and just East of George Washington Way Diagonal.	NA	NA	NA	2007 - 2017

Even with conservative source and transport estimates, the computed contaminant plume did not reach this point in concentrations above 5 ppb.

Attachment #13

CLEAN-UP TIMES AND PUMPING DURATIONS FOR SELECTED PUMP & TREAT SCENARIOS

TCE Clean-up Only:

Location	Start Pumping	Q,# Wells	End Pumping	C < MCL
1. 800 feet NE of MW-12,13,14,15 well cluster	Jan 1995	200 gpm,2	2010	2010

This scenario approaches clean-up by pumping the down-gradient front of the area of highest concentration and allowing the peripheral plume areas to disperse without treatment.

2.Same as 1.	Jan 1995	500 gpm,5	2005 - 2010	2005 - 2010

The pumping in this scenario is the approximately the lowest gpm that captures all of the 5 ppb plume up-gradient of the pump site. The TCE down-gradient of the pump site would disperse without treatment.

3. Same as 1.	Jan 1995	1000 gpm,10	2005 - 2010	2005 - 2010

Similar to 1. and 2. but with 1000 gpm.

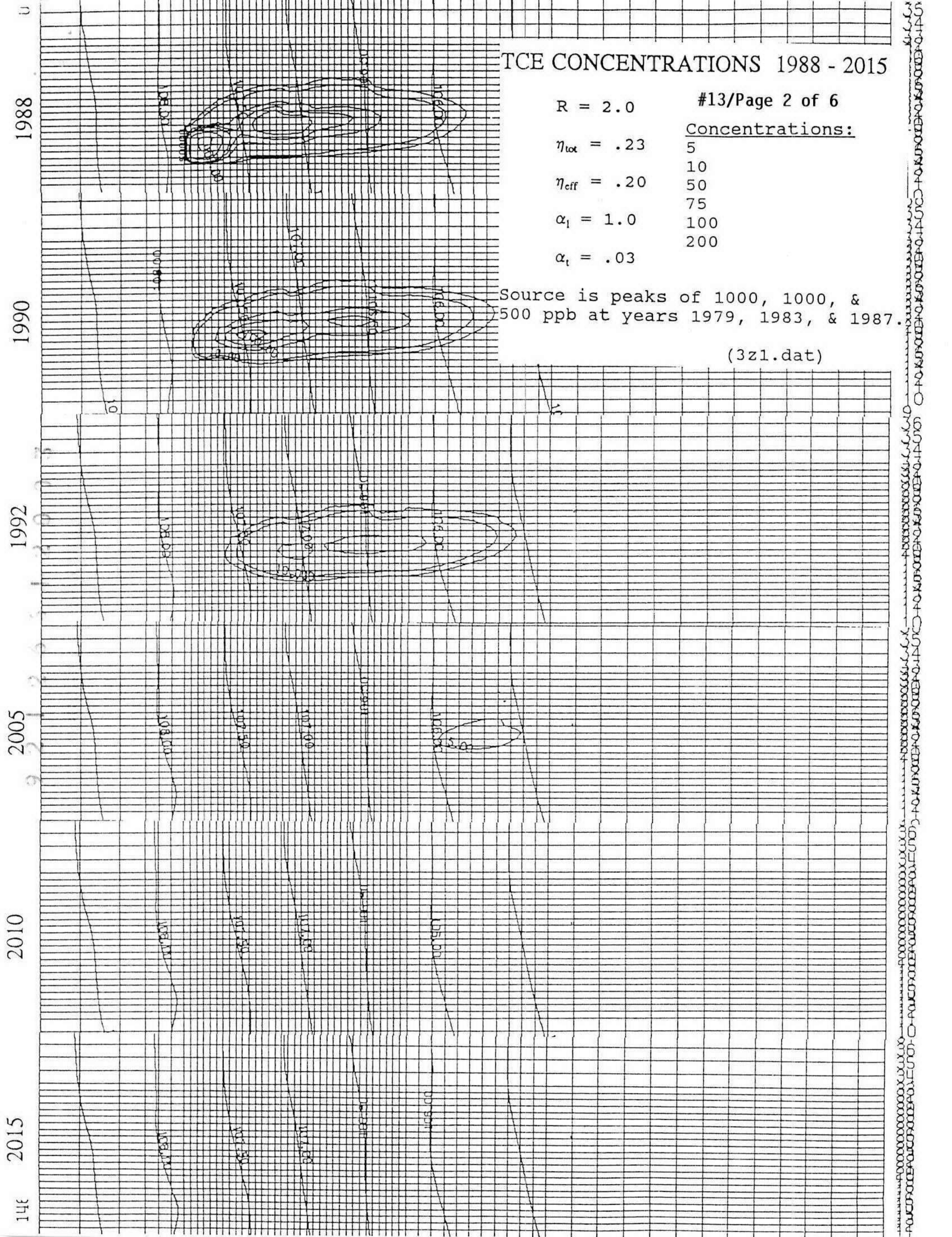
4. Just West of Stevens Drive	1995-2000	300 gpm,3	2007 - 2012	2007 - 2012

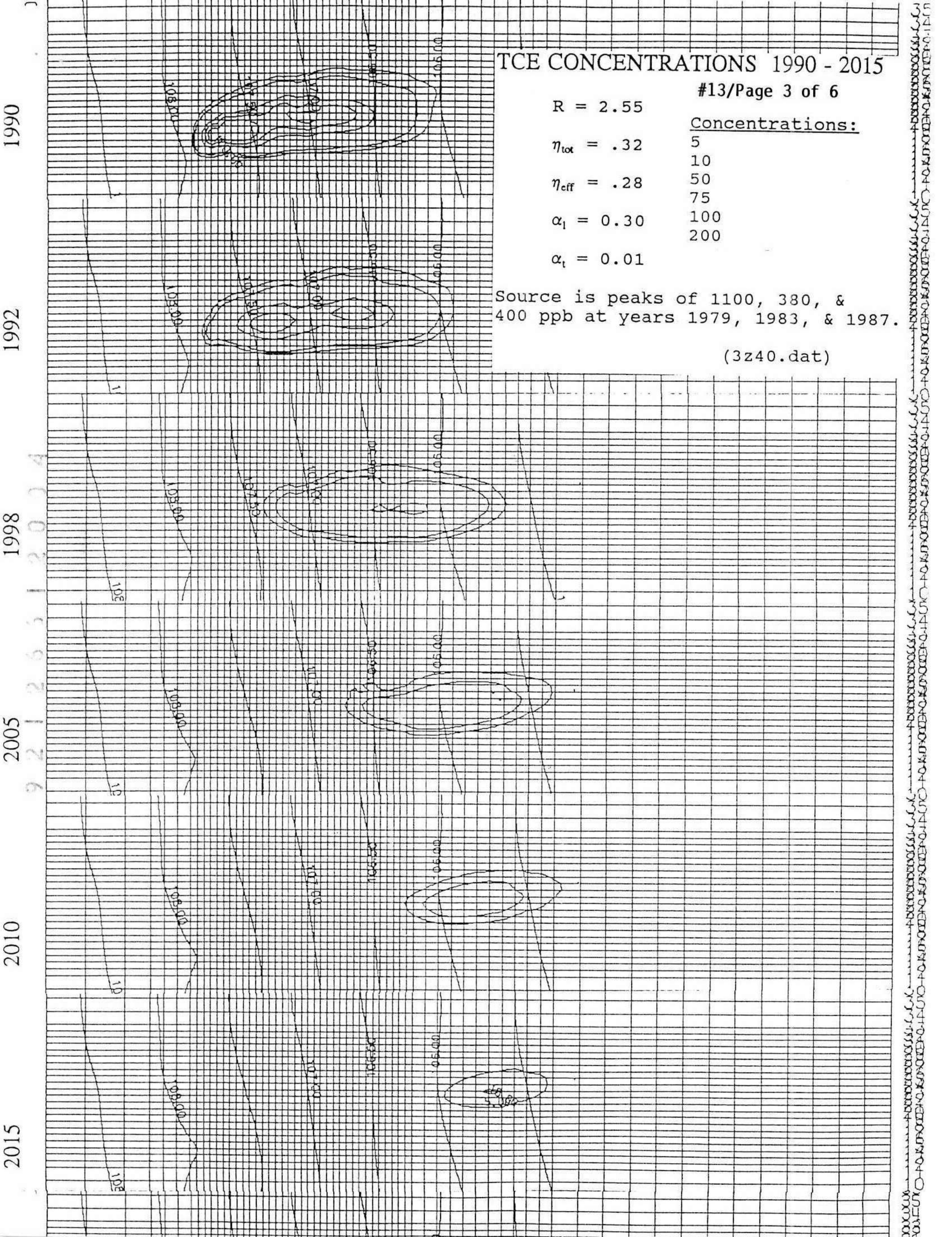
This scenario approaches clean-up by pumping the plume as it reaches Stevens Drive.

5.Parallel to, and just East of George Washington Way Diagonal.	NA	NA	NA	2007 - 2017

Even with conservative source and transport estimates, the computed contaminant plume did not reach this point in concentrations above 5 ppb.

TCE CONCENTRATIONS 1988 - 2015





TCE CONCENTRATIONS 1990 - 2015

#13/Page 3 of 6

$R = 2.55$

$\eta_{tot} = .32$

$\eta_{eff} = .28$

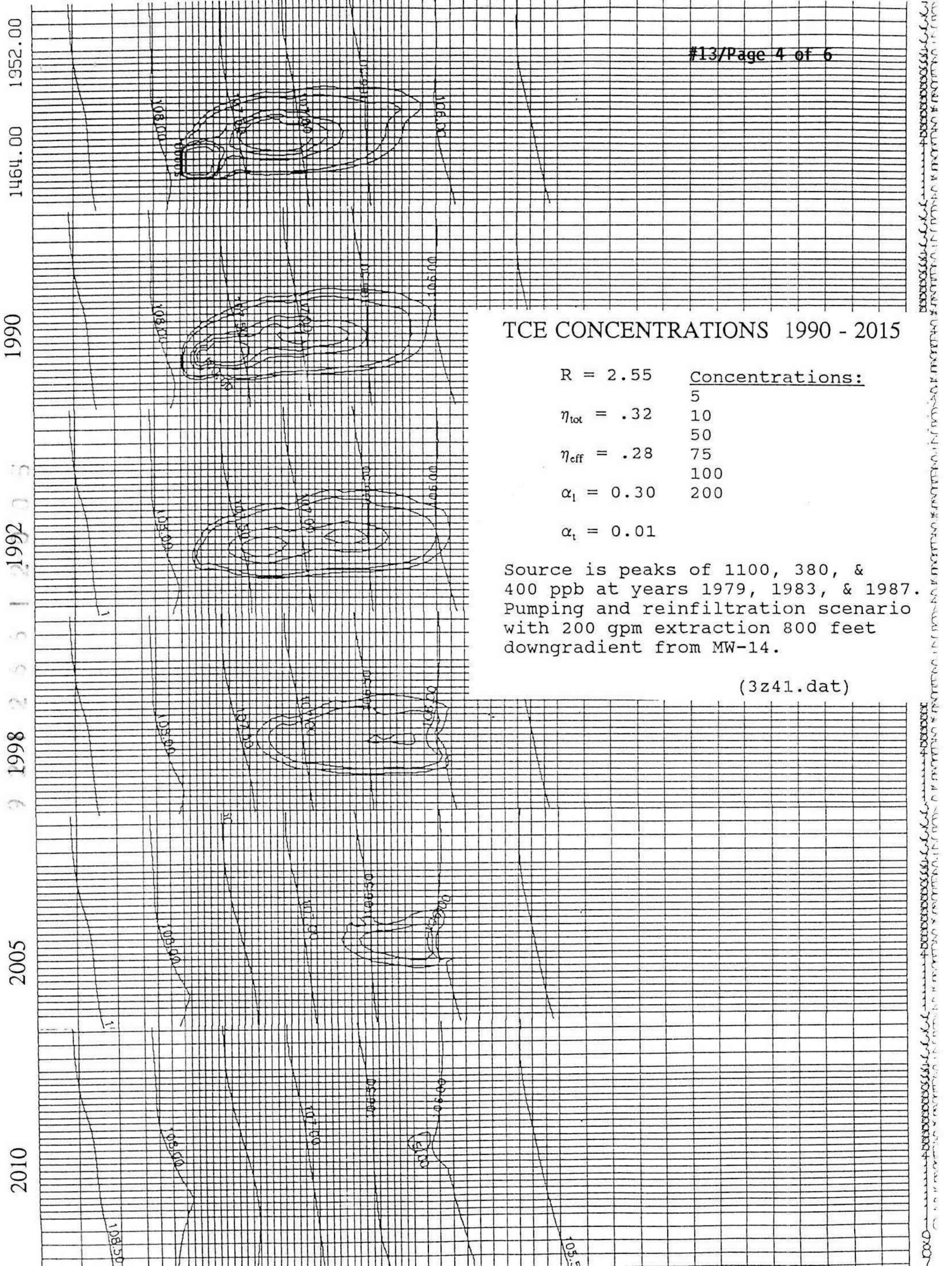
$\alpha_l = 0.30$

$\alpha_t = 0.01$

Concentrations:
5
10
50
75
100
200

Source is peaks of 1100, 380, & 400 ppb at years 1979, 1983, & 1987.

(3z40.dat)

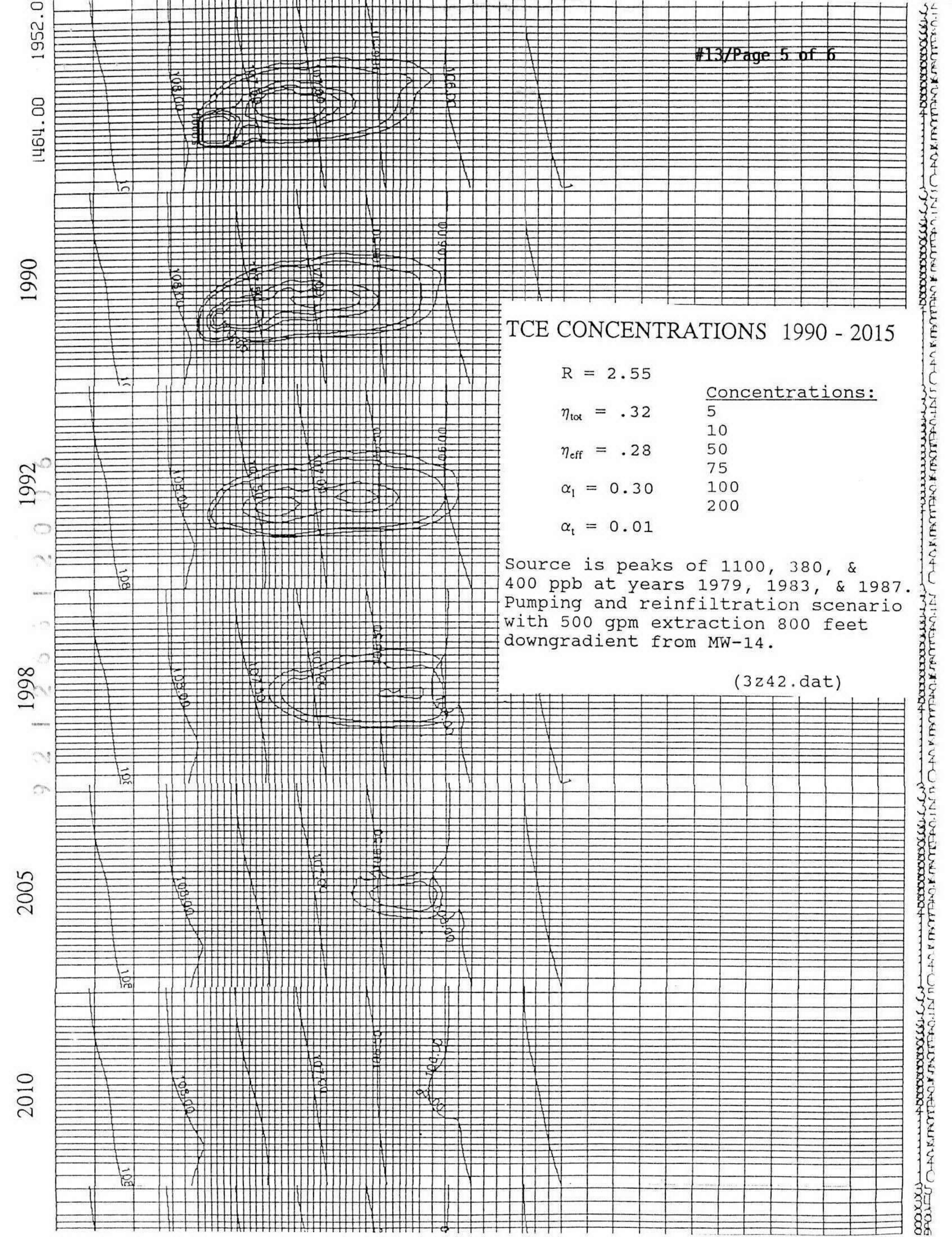


TCE CONCENTRATIONS 1990 - 2015

$R = 2.55$	<u>Concentrations:</u>
	5
$\eta_{tot} = .32$	10
	50
$\eta_{eff} = .28$	75
	100
$\alpha_l = 0.30$	200
$\alpha_t = 0.01$	

Source is peaks of 1100, 380, & 400 ppb at years 1979, 1983, & 1987. Pumping and reinfiltration scenario with 200 gpm extraction 800 feet downgradient from MW-14.

(3z41.dat)



TCE CONCENTRATIONS 1990 - 2015

$R = 2.55$

$\eta_{tot} = .32$

$\eta_{eff} = .28$

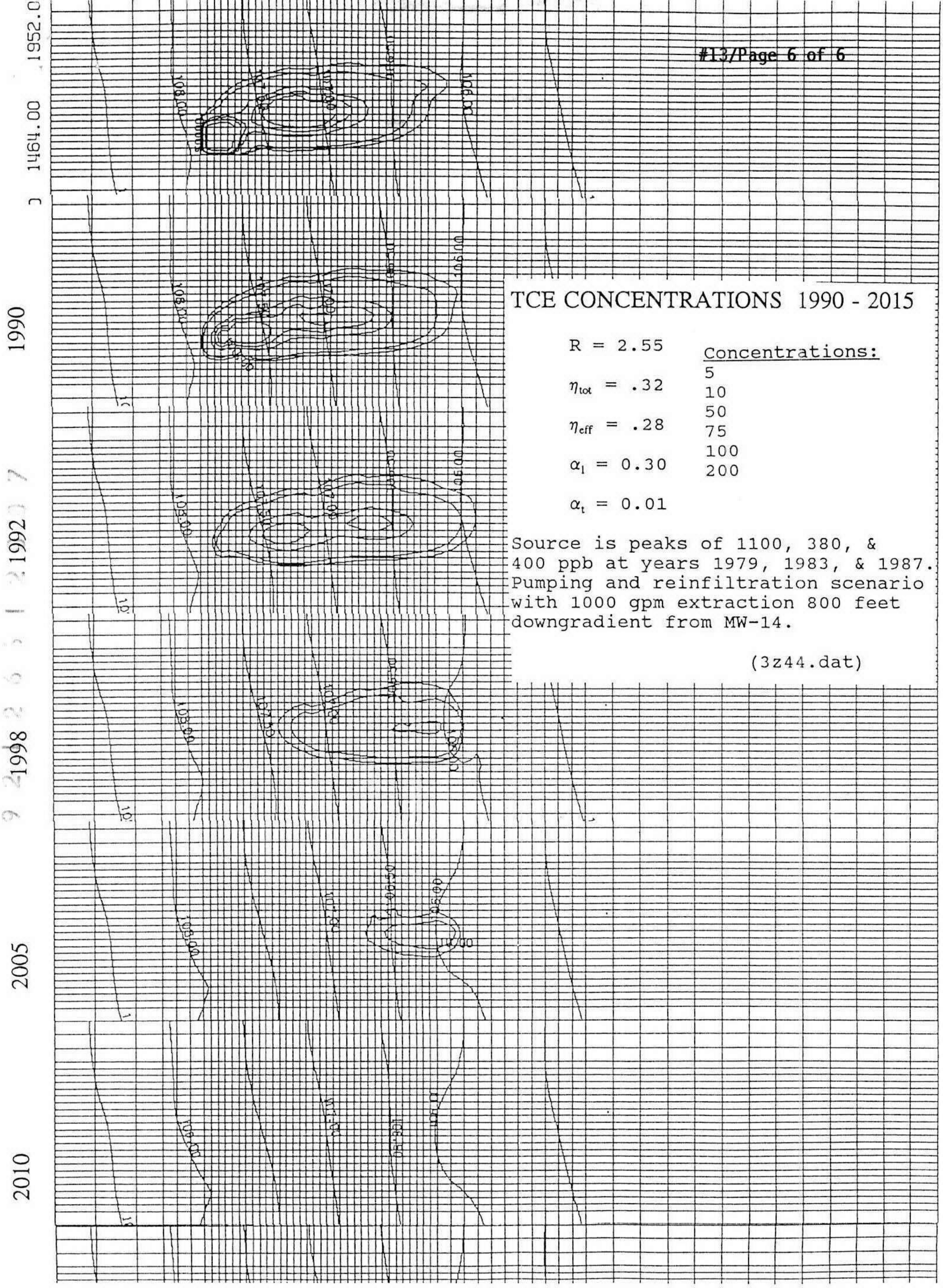
$\alpha_l = 0.30$

$\alpha_t = 0.01$

Concentrations:
5
10
50
75
100
200

Source is peaks of 1100, 380, & 400 ppb at years 1979, 1983, & 1987. Pumping and reinfiltration scenario with 500 gpm extraction 800 feet downgradient from MW-14.

(3z42.dat)



TCE CONCENTRATIONS 1990 - 2015

R = 2.55

η_{tot} = .32

η_{eff} = .28

α_l = 0.30

α_t = 0.01

Concentrations:
5
10
50
75
100
200

Source is peaks of 1100, 380, & 400 ppb at years 1979, 1983, & 1987. Pumping and reinfiltration scenario with 1000 gpm extraction 800 feet downgradient from MW-14.

(3z44.dat)

Distribution

Unit Manager's Meeting: 1100-EM-1 Operable Unit
July 30, 1992

Ronald D. Izatt	Director, DOE-RL, ERD (A5-15)
June M. Hennig	DOE-RL, WMD (A5-21)
Julie K. Erickson	Chief, DOE-RL, ERB (A5-19)
Roger D. Freeberg	Chief, Rstr. Br., DOE-RL, ERD (A5-19)
Steven H. Wisness	TPA Proj. Mgr., DOE-RL, EAP/TPA (A5-15)
Bob Stewart	Operable Unit Manager, DOE-RL, ERD (A5-19)
Mike Thompson	DOE-RL (A6-95)
Diane Clark	DOE-RL (A5-55)
Mary Harmon	DOE-HQ (EM-442)
Lisa Chetnik Treichel	DOE-HQ (EM-442)
John Stewart	1100-EM-1 Proj. Mgr., USACE (A5-20)
Raimo Liias	Env. Eng. Branch Chief, USACE, (Walla Walla)
Dave Einan	EPA (B5-01)
Ward Staubitz	USGS, Support to EPA
Audree DeAngeles	PRC, Support to EPA
Dib Goswami	WDOE (Kennewick)
Richard Hibbard	WDOE (Lacey)
Larry Goldstein	WDOE (Lacey)
Lynn Albin	Washington Dept. of Health
Chris Abraham	GAO (A1-80)
Lauren Maas	SNP
Clive Francis	SNP
Susan Keith	Geraghty & Miller
Thomas Wintczak (L4-92)	Prgm. Mgr. WHC

ADMINISTRATIVE RECORD: 1100-EM-1; Care of EDMC, WHC (H4-22)

This list has been updated. Please contact Suzanne E. Clarke (SWEC 372-0630) if further changes to the distribution list are needed.