
**Technical Impracticability Waivers:
Guidelines for Site Applicability
and the Application Process**

Phase I Final Report

Prepared by:

**MALCOLM
PIRNIE**

For the:

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**1. Summary of Phase I
Research Activities**

1. Summary of Phase I Research Activities

A draft of the final guidance document “Technical Impracticability Waivers: Guidelines for Site Applicability and the Application Process” is presented in this report. The purpose of the final document is to present information on technical impracticability (TI) waivers, including the definition of “technical impracticability”, the regulatory implications of a TI Waiver, the TI application process, review process and final documentation of TI Decisions. The guidance document will use case studies from sites that have already obtained TI Waivers to illustrate how this process works in reality, how it may vary with individual sites and how it may vary within different EPA regions.

In order to develop a focused guidance document in a cost-effective manner, the scope of work for the guidance document was divided into Phase I and Phase II. This document presents the results of Phase I Activities. During Phase I, considerable research was performed to identify and obtain pertinent TI Waiver documents and identify and contact EPA experts on the TI Waiver process. This information was then synthesized into an extensive outline of Phase II work.

An in-depth summary of the Phase I Research Activities conducted follows, including the extent of the literature search and information collection and the extent of communication with EPA and state personnel.

1.1 Literature Search

Library and online library searches were performed to identify and obtain copies of all documents containing information about the TI Waiver application and approval processes. The search focused initially on EPA documents containing any information on technical impracticability. This search was broadened to library and Internet-wide searches to obtain leads on technical impracticability waiver processes and sites that had obtained or applied for TI Waivers. In addition, copies of documents and regulations relevant to the TI process were obtained.

Next the research efforts were extended to identify all sites that had obtained TI Waivers in the past. A preliminary list of CERCLA sites with waivers incorporated into the Records of Decision was obtained from EPA Headquarters. Research on these sites was performed, yielding both general and TI Waiver-specific site information. EPA Regional offices were contacted for more information. Site-specific documents that were not available online were ordered from EPA libraries or directly from site contacts.

A copy of the Superfund Public Information System (SPIS) CD was obtained from the EPA, which will facilitate gathering additional site-specific references. This CD contains the full text of all Records of Decision (RODs) issued between 1982 and 2001, as well as 177 Explanations of Significant Differences (ESDs) and 118 Record of Decision Amendments. As explained in Section 4 of this guidance document, TI Waivers are documented in either the original RODs, ROD amendments or ESDs. This tool will therefore enable us to be comprehensive in our identification of sites with TI Waivers. In addition, it will greatly facilitate our research into sites that have obtained TI Waivers. Technical Impracticability evaluations are sometimes appended to the Records of Decision, especially for recent sites. Written

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justifications for approving the TI Waiver are included in the Records of Decision, ranging in length from a paragraph to several pages.

All documents were reviewed and compiled for this guidance document draft. A complete set of references is included in Section 4 of this report. References include interview data (personal communication) text of regulations, EPA publications, journal articles, site-specific documents and World Wide Web sites.

1.2 Key Persons Identified and Contacted

In addition to our search for written documentation of TI Waivers, and often complimenting that search, persons in the EPA, state hazardous waste division offices and other organizations were identified and contacted. Other Malcolm Pirnie employees were consulted for further information on TI Waivers. After compiling a list of project managers for CERCLA sites, each manager was contacted for additional information. Site-specific documents were requested, as well as information on region-wide TI Waiver policy. This often resulted in referral to one or several other persons associated with the site waiver, who were also contacted. Persons selected for interview were identified and contacted. A summary of the activity conducted is shown in Table 1-1.

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Table 1-1: Contact History for Phase 1 Activities

Site # ¹	EPA Region	EPA Site Manager	Contact History	Contact Response	Sent Site Documents?	Follow-Up Referral? ²
1	1	Roger Duwart	Y	Y	N	Y
1	1	Larry Brill	N	-	-	-
2	1	Mike Daly	Y	Y	Y	Y
3	1	Terrence Connelly	Y	N	N	N
4	1	Ed Hathaway	Y	Y	N	Y
5	1	Dave Lederer	Y	Y	Y	N
6	1	Almerinda Silva	Y	Y	N	Y
6	1	Bill Brandon	Y	Y	N	N
7	2	Pat Hamlett	Y	N	-	-
8	2	Alison Hess	Y	Y	Y	Y
8	2	Vince Pitruzzello	N	-	-	-
9	2	Damian Duda	Y	Y	Y	N
10	2	Rick Robinson	Y	Y	Y	N
11	3	Maria de los A Garcia	Y	N	-	-
12	3	John Banks	Y	Y	Y	N
13	3	Gregory Ham	Y	N	-	-
14	3	Randy Sturgeon	Y	Y	N	Y
15	3	John Banks	Y	Y	N	N
16	3	Frank Vavra	Y	Y	N	Y
16	3	Kathy Davies	N	-	-	-
16	3	Bhupi Khona	N	-	-	-
17	3	Donna Santiago	Y	N	-	-
18	3	Jill Lowe	Y	Y	N	Y
19	3	Richard Watman	Y	Y	N	Y
20	3	Christopher J. Corbett	Y	Y	N	N
21	3	Monica McEaddy	Y	N	-	-
22	4	David Lloyd	Y	Y	-	Y
22	4	Bill Ostein	Y	Y	-	-

¹ Site numbers correspond to individual sites that have obtained TI Waivers. See Table 2-1 for site identification.

² Referred to additional EPA contacts for information

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Site # ¹	EPA Region	EPA Site Manager	Contact History	Contact Response	Sent Site Documents?	Follow-Up Referral? ²
22	4	Mindy Carreras	Y	Y	-	-
23	5	Matt Mankowski	Y	Y	N	Y
23	5	Pat Likins	Y	Y	Y	-
24	6	Stephen Tzhone	Y	Y	Y	Y
24	6	Kathleen Aisling	N	-	-	-
25	6	Chris Villarreal	Y	Y	Y	Y
25	6	Matt Charsky	N	-	-	-
26	6	Vincent Malott	Y	N	-	-
27	6	Shawn Ghose	Y	N	-	-
29	7	Dave Drake	Y	Y	Y	Y
29	7	Craig Smith	N	-	-	-
30	8	Victor Ketellapper	Y	Y	Y	Y
30	8	Austin Buckingham	N	-	-	-
31	8	Russ Forba	Y	Y	Y	Y
31	8	Kevin Kirley	Y	Y	Y	-
31	8	Dale Vodehnal	Y	Y	N	N
32	8	Armando Saenz	Y	N	-	-
33	8	Gwen Hooten	Y	Y	N	Y
33	8	Bert Garcia	Y	Y	N	Y
33	8	Norvil Shanehouse	N	Y	-	-
33	8	Rebecca Thomas	Y	Y	N	Y
34	8	-	-	-	-	-
35	9	Charles Berrey	Y	Y	Y	N
36	9	Jeff Dhont	Y	Y	Y	Y
36	9	John Kemmerer	N	-	-	-
37	9	Beatriz Bofill	Y	Y	-	Y
37	9	Travis Cain	N	-	-	-
38	9	Mark Ripperda	N	-	Y	-
39	9	Eugenia Chow	Y	Y	N	Y
39	9	Harry Ball	Y	Y	N	N
40	9	Rose Marie Caraway	Y	Y	N	Y
40	9	Herb Levine	N	Y	N	N
41	9	Beatriz Bofill	Y	Y	Y	-

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Site # ¹	EPA Region	EPA Site Manager	Contact History	Contact Response	Sent Site Documents?	Follow-Up Referral? ²
42	10	Mary Jane Nearman	Y	N	-	-
-	8	Gene Taylor	Y	Y	N	Y
-	5	Tom Barounis	Y	Y	N	Y
-	5	Marty McCleery	N	-	-	-
-	3	Ken Lovelace	Y	Y	Y	-

During this process, names of a few EPA staff involved in sites that did not receive TI Waivers were identified. Several EPA project managers for sites considering applying for a TI Waiver were identified. EPA Branch library staff were contacted so that additional documents could be obtained through Freedom of Information Act (FOIA) Requests.

A select number of people identified and contacted during Phase I activities were contacted regarding the possibility of an interview during Phase II.

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**2. Scope of Phase II
Activities**

2. Scope of Phase II Activities

Three primary tasks were identified as part of the Phase II scope of work:

- Compiling and analyzing the site-specific data gathered during Phase I
- Conducting interviews with EPA staff and synthesizing this information
- Writing the full text of the Final Guidance Document

2.1 Site-Specific Data Compilation and Analysis

During Phase I research activities, CERCLA sites that have obtained TI Waivers in the past were identified. A summary of the sites identified so far is shown in Table 2-1.

Information on each CERCLA site listed in Table 2-1 has been gathered as part of the scope of work for Phase I of this project. Documents gathered include the original TI Evaluations for some sites, Records of Decision documenting the TI Waiver (and often explaining why the waiver was approved), Site Fact Sheet Summaries documenting remedial activities at each site, and other site documents or correspondence. Personal communication with all identified EPA Remedial Project Managers has often yielded additional details on sites.

A brief synopsis of this information was prepared for each CERCLA site identified so far (Section 2.1.2). The description includes:

- Location and site setting
- Main reason(s) a TI Waiver was approved
- Contaminants for which ARARs were waived
- Alternative Remedial Strategy used at the site

Using these short summaries, the most relevant sites will be identified for future research during Phase II of the project. A sample of an in-depth site summary (to be developed for each relevant site during Phase II) is attached in Section 2.1.3 for the Koppers Co, Inc. Superfund Site located in Oroville, CA.

The detailed site summary for CERCLA sites studied in Phase II will include:

- Site facts (site name, location, EPA region, EPA ID, date of TI Decision)
- Timing of the TI Waiver application (post-implementation or front end)
- Regulatory agencies involved
- Form of TI Waiver documentation and supporting documents
- Extent of site characterization/remedial activities prior to the TI Waiver
- A timeline of site activity leading up to the waiver
- Other alternatives to a TI Waiver that were considered

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- A description of the impracticable nature of the site – what about the site was TI?
- Whether a TI Evaluation report was prepared and submitted to the EPA, and if not, a description of the TI approval process
- Contaminants included in the waiver and contaminants present on-site
- Spatial extent of contamination and the designated TI Zone
- Description of the detail included in the TI Evaluation report for the Conceptual Site Model
- A description of the data upon which the TI Evaluation report was based.
- An estimation of the timeframe for remediation required with and without a TI Waiver
- Cost estimates – cost savings if the waiver is approved and costs of remedial alternatives
- Summary of the alternative remedial strategies suggested for the site
- Primary EPA contact for the site
- Primary EPA headquarters contact and other EPA staff involved in the decision
- Timeframe for the TI Waiver approval process
- Final reasons for granting the TI Waiver
- Review of remedial system performance data required for the site after TI approval
- Other comments summarizing special site conditions

Information from the detailed site summary can then be used to generate statistics and examples for the final version of the document.

The development of detailed site summaries is dependent on the amount of data that is available for each site. Much of this information is unavailable or limited, particularly for sites with TI Waivers instituted prior to 1993, when formal TI Evaluations were not yet required.

Our primary sources of reference are EPA site documents (available online, from EPA libraries by special order, or through EPA contacts) and personal communication with project managers.

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Table 2-1: Comprehensive Record of All CERCLA Sites That Have Obtained TI Waivers³

Site #	EPA Region	ROD Date	Site Name	City/County	State	EPA ID #
1	1	02/03/1997	South Municipal Water Supply Wells	Peterborough/ Hillsboro Cnty	NH	NHD980671069
2	1	09/26/1995	Pease Air Force Base	Portsmouth, Newington, Greenland/ Rockingham Cnty	NH	NH7570024847
3	1	09/01/1995	Tansitor Electronics, Inc.	Bennington/ Bennington Cnty	VT	VTD000509174
4	1	09/29/1990	Old Springfield Landfill	Springfield/ Windsor Cnty	VT	VTD000860239
5	1	06/28/1989	Sullivan's Ledge	Bristol/New Bedford Cnty	MA	MAD9807343
6	1	05/30/1989	Pinette's Salvage Yard	Washburn/Aroostook Cnty	ME	MED980732291
7	2	09/29/1995	Niagra Mohawk Power Co	Saratoga Springs/Saratoga Cnty	NY	NYD980664361
8	2	10/06/1994	G.E. Moreau	South Glen Falls/Saratoga Cnty	NY	NYD980528335
9	2	05/15/1991	Love Canal ⁴	Niagara Falls/Niagara Cnty	NY	NYD000606947
10	2	09/28/1989	Caldwell Trucking Company	Fairfield Twp/Essex Cnty	NJ	NJD048798953
11	3	09/30/1999	Rodale Manufacturing Company	Borough of Emmaus/ Lehigh Cnty	PA	PAD981033285
12	3	06/30/1995	Brodhead Creek	Stroudsburg/Monroe Cnty	PA	PAD981033285
13	3	07/01/1994	Aladdin Plating	Scott & South Abington Twps, Lackawanna Cnty	PA	PAD075993378
14	3	09/29/1993	E.I. DuPont (Newport Landfill)	Newport/New Castle Cnty	DE	DED980555122

³ Comprehensive for sites with ROD dates between 1987 and 1998. Post-1998 sites identified through research efforts.

⁴ Identification as having obtained a TI Waiver is tentative.

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Site #	EPA Region	ROD Date	Site Name	City/County	State	EPA ID #
15	3	08/02/1993	Hunterstown Road	Gettysburg/Adams Cnty	PA	PAD980830897
16	3	06/01/1992	Westinghouse Elevator Plant	Gettysburg/Adams Cnty	PA	PAD043882281
17	3	03/31/1992	Lindane Dump	Harrison Twp, near Natron(a)/Allegheny Cnty	PA	PAD980712798
18	3	09/30/1991	Dorney Road	Mertztown/Lehigh Cnty	PA	PAD980508832
19	3	09/30/1991	Heleva Landfill	Coplay (Ironton Willage)/Lehigh Cnty	PA	PAD980537716
20	3	12/31/1990	Whitmoyer Laboratories	Myerstown/Lebanon Cnty	PA	PAD003005014
21	3	12/17/1990	Middletown Air Field ⁵	Middletown/Dauphin Cnty	PA	PAD980538763
22	4	06/01/1992	Yellow Water Road Dump	Baldwin/ Duval Cnty	FL	FLD980844179
23	5	09/30/1998	Continental Steel Corp.	Kokomo/Howard Cnty	IN	IND001213503
24	6	09/01/2000	Highway 71/72 Refinery Site	Bossier City/Bossier Parish	LA	LAD981054075
25	6	03/19/1997	Crystal Chemical Company	Harris Cnty	TX	TXD990707010
26	6	09/01/1995	Vertac, Inc.	Jacksonville/Pulaski Cnty	AR	ARD000023440
27	6	02/20/1993	Popile, Inc.	El Dorado/Union Cnty	AR	ARD008052508
28	6	11/22/1989	Hardage/Criner	Criner/McClain Cnty	OK	OKD000400093
29	7	08/20/1997	Cherokee County	Cherokee Cnty	KS	KSD980741862
30	8	09/28/2001	Summitville Mine	Rio Grande Cnty	CO	COD983778432
31	8	09/29/ 1994	Silver Bow Creek/Butte Area	Silver Bow Creek/ Deer Lodge Cnty	MT	MTD980502777
32	8	03/24/1992	Broderick Wood Products	Denver/Adams Cnty	CO	COD 000110254
33	8	03/30/1990	Whitewood Creek	Whitewood/Lawrence, Mead,Butte Cntys	SD	SDD980717136
34	8	11/22/1989	East Helena	East Helena/Lewis & Clark Cnty	MT	MTD006230346
35	9	09/23/1999	Koppers Industries, Inc.	Oroville/Butte Cnty	CA	CAD009112087

⁵ Identification of having obtained a TI Waiver is tentative.

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Site #	EPA Region	ROD Date	Site Name	City/County	State	EPA ID #
36	9	03/30/1999	Montrose/Del Amo	Torrance/Los Angeles Cnty	CA	CAD029544731/CAD008242711
37	9	03/27/1998	J.H. Baxter & Co.	Weed/Siskiyou Cnty	CA	CAD000625731
38	9	11/01/1997	Schofield Barracks	Oahu	HI	HI7210090026
39	9	09/30/1997	Tucson International Airport Area	Tucson/Pima Cnty	AZ	AZD980737530
40	9	10/16/1991	Westinghouse Electric	Sunnyvale/Santa Clara Cnty	CA	CAD001864081
41	9	09/30/1985	Del Norte Pesticide Storage	Crescent City/Del Norte Cnty	CA	CAD000626176
42	10	9/29/1998	Eielson Air Force Base	Fairbanks/N Star Borough	AK	AK1570028646

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2.1.1 Brief Site Synopses

There is no tracking of TI Waivers at RCRA Corrective Action Sites on a national level. However, TI Waivers are rarely implemented at RCRA sites since the regulatory structure is more flexible and updating the facility permit can accommodate most situations. For CERCLA sites, thirty TI Waivers were issued between 1989 and 1998. This comprehensive list has been supplemented with cases of post-1998 TI Waiver approvals, and is summarized in Table 2-1. Selected case study summaries are described below, organized by EPA Region and the date each TI Decision was granted.

#1. South Municipal Water Supply Well Site, Peterborough, NH – February 1997

One of the city's water supply wells was contaminated with VOCs from the neighboring New Hampshire Ball Bearings (NHBB) manufacturing facility. The well was taken out of service and institutional controls were implemented. Technical impracticability of restoring groundwater to drinking water quality was published in an Explanation of Significant Differences (ESD) to the 1989 ROD. Groundwater extraction and treatment were instituted.

#2. Pease Air Force Base, Portsmouth, NH – 1995

DNAPLs from an underground TCE storage tank were determined to be technically impracticable to remediate after 10 years of gathering site characterization data. This was the first front-end TI Waiver in EPA Region 1 to be granted. Containment of the source was approved, using vertical and hydraulic barriers.

#3. Tansitor Electronics, Bennington, VT - 1995

During the 1960s and 1970s, electronic capacitor manufacturing waste was disposed of in drums on the property. This resulted in plumes of 1,1,1-TCA, vinyl chloride and other VOCs. Institutional controls and monitoring was selected for a groundwater remediation strategy. More information is needed about the TI Waiver obtained for this site.

#4. Old Springfield Landfill, Springfield, VT – 1990

A trailer park was located on top of a municipal/industrial landfill until 1990, until VOC contamination was found in neighboring springs and wells. Due to the impracticability of PCE quantification, a TI Waiver was approved for the state PCE standard (set at the quantification limit) as part of the 1990 ROD without a formal application procedure. Groundwater and leachate are collected and treated. The landfill has been capped.

#5. Sullivan's Ledge, Bristol, MA – June 1989

Sullivan's Ledge is a former granite quarry used as a disposal area by the city for hazardous and non-hazardous material. PCBs, VOCs and PAHs were present in the soil and groundwater in the disposal area and a nearby marsh. Federal and state MCLs were waived due to the presence of high concentrations of DNAPLs in bedrock fractures as deep as 150 ft.

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#6. Pinette's Salvage Yard, Washburn, ME – May 1989

TI Waiver language was approved as part of the 1989 ROD for state maximum exposure guidelines for PCBs at this site. A 1,000-gallon spill of dielectric fluid containing PCBs occurred in 1979. Private and municipal wells were located nearby. Excavation and other remedial actions were undertaken in 1983. Groundwater extraction and treatment were begun as well as institutional controls.

#7. Niagara Mohawk Power Co, Saratoga Springs, NY – 1995

Contamination from coal tars included DNAPL contamination in the form of concentrated tar-saturated soil at this former gas manufacturing facility. A TI Waiver was approved as part of the 1995 Record of Decision for shallow groundwater. A clay confining layer located at 20 ft bgs prevented vertical migration of the tar. The selected remedy was a combination of excavation of soil and sediment, containment with subsurface barriers, institutional controls and monitoring.

#8. GE Moreau Site, South Glen Falls, NY – 1994

Active remediation of a waste pit containing PCBs, TCE, solvents, oil and other wastes was estimated to take 190-400 years and cost \$17 million. The proposed alternative (natural flushing) was estimated to take 240-540 years and cost \$1.5 million. Containment, treatment of surface water, removal of contaminant hot spots, and institutional controls were also implemented, using an ESD.

#9. Love Canal, Niagara Falls, NY – 1991

This identification of having obtained a TI Waiver is tentative.

#10. Caldwell Trucking Company, Fairfield Twp, NJ – 1989

Residential and industrial septic waste was disposed of in unlined pits and underground storage tanks on this site. Consequently, groundwater contamination with metals, PAHs, PCBs and VOCs resulted. Over 300 private wells and the Passaic River were affected. A TI Waiver was written into the 1989 ROD for federal and state MCLs, based on an estimated timeframe for remediation greater than 100 years.

#11. Rodale Manufacturing Company, Emmaus Borough, Lehigh County, PA – 1999

Due to difficulty in cleanup, a TI Waiver was granted for TCE in groundwater and also for TCE/PCE in soil as part of the 1999 ROD. Groundwater remedial activities had been ongoing since 1984. Institutional controls and groundwater use restrictions were included for the Probable DNAPL Zone (TI Zone).

#12. Brodhead Creek Site, Stroudsburg, PA – 1995

Like the Niagara Mohawk Power Co site, the Brodhead Creek site also contained coal tar wastes in an open pit. Complete removal of coal tar residues was determined to be technically impracticable because of site constraints, including a flood control levee and on-site wetlands. An underground slurry wall was installed for containment; removal was achieved using hot water injection, pumping and treatment known as the CROW process (Contained Recovery of Oily Waste).

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#13. Aladdin Plating, Scott & South Abington Twps, PA – 1994

This site was the location of an electroplating facility that used process chemicals sulfuric acid, chromic acid, cyanide, nickel, copper and chromium. Unlined lagoons for holding rinse water and sludge were present as well as stored stock materials. After a fire in 1982, the facility closed. In 1987, the EPA began cleanup. Thirty years of monitoring was required for shallow groundwater, contaminated primarily with chromium. Deed restrictions prevent the water from being used as a drinking water source.

#14. E.I. DuPont (Newport Landfill), Newport, DE – 1993

The TI Waiver approved for DuPont was not applied to groundwater. Instead zinc levels in the nearby Christina River exceeded surface water quality standards. Actions were taken to contain groundwater discharges to the river. However, stream discharges from another site made meeting the zinc standard technically impracticable.

#15. Hunterstown Road, Gettysburg, Adams County, PA – 1993

The TI Waiver was granted for groundwater contaminated with DNAPLs at depths greater than 800 feet. Groundwater to the depth of 800 feet was extracted and treated to remove VOCs using air stripping. This was followed by on-site discharge and subsequent air cleaning via catalytic oxidation.

#16. Westinghouse Elevator Plant, Gettysburg, PA – 1992

Fifteen years of experience with a limited pump and treat system combined with the inferred presence of DNAPLs (80 ppm VOCs) in highly fractured sedimentary bedrock was used as justification for a TI Waiver at this site. The state ARAR of cleaning water to background (0.0 ppb VOCs) within 10 yrs was waived. Offsite wells were pumped less aggressively as part of the waiver, acting to contain the plume rather than remediate it. Pump-and-treat will continue until MCLs are met.

#17. Lindane Dump, Harrison Township, near Natrona, PA – 1992

Between 1850 until 1980, this site was used for waste disposal of mine tailings, sulfuric acid, cinders and slag, followed by pesticides, construction wastes and industrial wastes. Contaminants of concern include benzene and other VOCs, DDT, Lindane, phenols, arsenic and lead. An ARAR Waiver of Pennsylvania state MCLs for Lindane and benzene was based on technical impracticability. Complex hydrogeologic conditions, combined with subsidence and contaminant migration arguments prevented the city from implementing pump-and-treat as a remedial strategy.

#18. Dorney Road Landfill, Mertztown, PA – 1991

The Dorney Road Landfill is a former open-pit iron mine that was converted to a landfill. The TI Waiver was granted for state MCL ARARs and applied to off-site groundwater. The progress of natural attenuation was a justification for the waiver. Further justification is documented in the OU2 ROD.

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#19. Heleva Landfill, North Whitehall Township, PA – 1991

The Heleva Landfill was closed by the state of Pennsylvania in 1981, due to denied requests for solid waste permits and refusal to implement a biostimulation project. Prior to that, municipal and industrial wastes, including TCE was disposed of in the landfill. Approximately 150 people within a quarter of a mile used the groundwater under the site as a drinking water source (until 1986). After closing the landfill, the state found VOCs and DNAPLs in the groundwater in exceedance of both state and federal drinking water requirements. Contaminants included benzene, PCE, TCE, toluene and xylenes. Remediation consisted of source investigation, institutional controls (extending piping from an alternative water supply and capping the area), and containment of the plume via pump-and-treat. Downgradient water was also pumped out and treated. A TI Waiver of state and federal MCLs was approved for organics in the groundwater close to the source.

#20. Whitmoyer Laboratories, Myerstown, PA – 1990

State ARARs for benzene, TCE, PCE and arsenic were waived due to the technical impracticability of reaching background levels. A TI Waiver was included for SDWA MCLs should the contingency plan be implemented. Contamination is the result of laboratory activities. Extensive removal of solid hazardous waste has occurred at the site, as well as the operation of a groundwater extraction and treatment system.

#21. Middletown Air Field, Middletown, PA – 1990

In a situation similar to the Dorney Road Landfill, a waiver for state groundwater ARARs was proposed. A TI Waiver was reportedly prepared for the site but withdrawn because the Commonwealth did not concur. More investigation is necessary to determine if the site received a TI Waiver. Contamination consists primarily of VOCs (primarily TCE), PAHs and metals. Land was used as an army training camp, army/air force airfield. Industrial operations were also conducted by the air force.

#22. Yellow Water Road Dump, Baldwin, FL – 1992

The site was intended to be a salvage operation for transformers, where PCB contaminated fluids would be removed and incinerated. While waiting for the incineration permit, however, over 150,000 gallons of PCB-contaminated fluids were stored onsite and leaked into the soil and groundwater. Remediation consisted of building demolition, excavation, pump-and-treat, and offsite incineration and disposal. A TI Waiver for the SWDR MCL of 0.5 µg/L PCBs was obtained for the spill area. Institutional controls and monitoring were required.

#23. Continental Steel Corporation, Kokomo, IN – 1998

One of six sites on this property (operable unit 01) was granted a TI Waiver for intermediate and lower groundwater aquifers in fractured bedrock containing base neutral acids, dioxins/dibenzofurans, inorganics, manganese, PAHs, PCBs, pesticides and VOCs.

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#24. Highway 71/72 Refinery, Bossier City, Bossier Parish, LA – 2000

This site is located in the downtown area of Bossier City (pop. 56,461, 2000 census). Due to extensive development on site and to community requests, the removal of the sources of groundwater contamination was not incorporated into the Record of Decision. Due to this constraint, a TI Waiver was granted for all areas that did not meet drinking water standards – essentially the entire 215 acres of property, throughout the depths of the shallow aquifer (10 to 60 ft bgs). The waiver encompasses LNAPL contaminants resulting from refinery activities and non-site related activities. The EPA has banned the use of site groundwater as drinking water. The TI Waiver was incorporated into the Record of Decision about one year after the completion of the RI/FS for the site.

#25. Crystal Chemical Company, Harris Cnty, TX – 1997

This front-end TI Waiver was granted for arsenic. Geologic, hydrogeologic and geochemical conditions at the site made it technically impracticable to reach 50 µg/L concentrations of arsenic in groundwater. The Crystal Chemical Company manufactured arsenical herbicides, discharging their wastewater to onsite ponds. Much of the field investigation data used to support the TI Evaluation was obtained from remedial design studies. A minimum of 650 years treatment operation was expected before the 50 µg/L standard for arsenic could be reached. Isolation of the TI Zone with a slurry wall was implemented as the alternative remedial strategy.

#26. Vertac, Inc., Jacksonville, AR – 1995

Herbicide production wastes including dioxin, Agent Orange and chlorinated hydrocarbons are present on site, as a result of inadequate production and disposal methods. Litigation was filed against PRPs Vertac Chemical Company and Hercules, Incorporated. Bankruptcy ensued and the EPA took the lead on site cleanup. The TI Waiver for MCLs was obtained for dioxins in groundwater due to the presence of NAPLs and the nature of the hydrogeology (tilted, fractured bedrock). A hydraulic containment system was implemented.

#27. Popile, Inc., El Dorado, AR – 1993

Popile is a wood treatment site with primary contaminants of concern pentachlorophenol (PCP) and creosote. As part of the 1993 ROD, in-situ bioremediation was selected for soil and shallow groundwater contaminants. The USEPA and US Army Corps of Engineers conducted bioremediation studies. The plume will be successfully stabilized by natural attenuation, based on modeling results using EPA's BioPlume III. More information is needed about the TI Waiver obtained at the site.

#28. Hardage/Criner Superfund Site, Criner, OK – 1989

This site was operated as an industrial and hazardous waste disposal facility. Waste was disposed of in unlined pits. When the pit capacity was filled, temporary holding ponds and sludge mounds were used. The Oklahoma State Department of Health (OSDH) revoked the facility permit and remedial activities began. According to the ROD Abstract, a TI Waiver was approved in the 1989 ROD due to geological

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constraints to remediation. A trench system was installed to intercept groundwater migration in the bedrock zone.

#29. Cherokee County Site, Cherokee County, KS – 1997, 1989

TI Waivers were granted for two of six different subsites in this former mining area. The first waiver was applied to OU 05, the Galena subsite, for acid mine drainage in the shallow groundwater. The second waiver was applied to the Baxter Springs and Treece subsites (18,000 acres collectively), due to the fact that compliance would be “inordinately costly” (\$93 M 1994 dollars). The Cherokee County site is part of the Tri-State Mining District, which was mined for approximately 100 years.

#30. Summitville Mine, Rio Grande County, CO – 2001

At another abandoned mine, cyanide, acid and metal-laden water flows into the Alamosa River. Remediation actions are currently underway, under the direction of the State of Colorado. State surface-water standards have been waived for pH, aluminum, iron and aquatic life, due to the presence of naturally occurring minerals that contribute metals and acidity. Site-wide response actions may exceed \$160 million by the end of 2001.

#31. Silver Bow Creek, Butte Area, Deer Lodge County, MT – 1994

Mine waste, creosote and arsenic contaminated this site. A TI Waiver of state surface water concentrations for arsenic and mercury were waived at the beginning of the river. Instead, concentrations of 2 mg/l arsenic and 0.2 µg/L mercury were used. The waiver was issued for the Mine Flooding operable unit of the site.

#32. Broderick Wood Products, Denver, CO – 1992

This wood treatment site stored process wastes into two unlined surface impoundments. Waste seepage became so extensive that the waste was burned off, beginning in 1954. Four additional ponds were occasionally used. Contamination was discovered in solid waste disposal areas, during the investigation that followed the closure of the facility in 1981. A chemical-specific ARAR waiver was obtained for groundwater due to technical impracticability. More research on this TI Waiver is necessary.

#33. Whitewood Creek, Whitewood, SD – 1990

Arsenic from mining wastes is the primary contaminant at this site. The wastes were discharged directly into the creek. Mine tailings continue to leach metal-laden water into surface and subsurface waters. A TI Waiver was obtained for both groundwater and surface water. Remediation actions have consisted of removing or covering contaminated soil in residential areas and implementing institutional controls to reduce exposure to arsenic.

#34. East Helena Superfund Site, East Helena, MT – 1989

East Helena was a lead smelting facility. Elevated lead and arsenic levels were found in the area. State surface water requirements were waived for arsenic and mercury due to TI.

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#35. Koppers Company, Inc., Oroville, Butte County, CA – 1999

A post-implementation TI Waiver was granted at a wood treatment facility after 10 years of remedial activities. The TI Zone is 4 acres, and contains multiple contaminants including dioxins, PAHs (creosote) and pentachlorophenol (PCP). Monitoring wells were required in the TI Zone and downgradient of the area. Continued operation of pump-and-treat will be required if contamination escapes the TI Zone. Outside of the TI Zone, enhanced in-situ bioremediation is now being used for (PCP) degradation.

#36. Montrose/Del Amo Site, Los Angeles, CA – March 1999

These two sites have commingled groundwater contamination including DDT, TCE, PCE, benzene and chlorobenzene. Groundwater contamination extends to a depth of 300 feet, with a mile long plume of chlorobenzene (DNAPL chemical) and benzene (LNAPL chemical). In a dual-site groundwater ROD, the US EPA waived MCLs as cleanup requirements for a 4-acre Del Amo waste pit and authorized a containment zone instead, with institutional controls and monitoring.

#37. J.H. Baxter and Company Wood Treatment Plant, Weed, Siskiyou County, CA – 1990

The original remedial actions prescribed for the site, which included pump-and-treat, were amended with a TI Waiver for a large area of groundwater impacted with DNAPLs. The DNAPL-impacted area was isolated with a subsurface slurry to create a containment zone. Offsite mitigation measures were approved to compensate for the loss of beneficial uses of the contained groundwater.

#38. Schofield Barracks, Oahu, HI – 1997

This site obtained a TI Waiver for a TCE plume that was 500 to 700 feet deep in a fractured lava formation on a Hawaii army base. The justification for TI included the extreme depth to the contaminated groundwater, difficulties in identifying the multiple contamination sources and the complex geology. These factors combined to present “inordinately costly” situation. In addition, the TCE plume was shown to be contained. Air stripping treatment of all well water is required, in addition to monitoring of all wells downgradient of the plume.

#39. Tucson International Airport Area, Tucson, AZ – 1997

Chromium and TCE were both present at the site, due to historical and current electroplating and solvent usage. Elevated chromium levels were found in the municipal water supply. Residents using private wells complained of a foul chemical odor. Unsafe levels of TCE were revealed after testing. A five-mile long plume was found under the site.

#40. Westinghouse Electric, Sunnyvale, CA – 1991

Transformer manufacturing resulted in contamination with PCBs and mineral oil. The TI Waiver of MCL standards for PCBs was granted in the Record of Decision and explained in the FS. The waiver was applied to the source area where DNAPL occurred. Soil was excavated down to 8 ft and institutional controls were implemented for soil and groundwater within the TI Zone.

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#41. Del Norte Pesticide Storage Area, Crescent City, CA – 1985

Cleanup to 10 µg/L action levels was waived for a groundwater plume of 1,2-Dichloropropane (1,2 DCP) present at concentrations up to 38 µg/L. Asymptotic levels of 1,2-DCP were obtained after four years of groundwater extraction system operation. Plume reduction data and the inability of treatment systems to reduce 1,2 DCP concentrations formed the skeleton of the TI Evaluation.

#42. Eielson Air Force Base, Fairbanks, AK – 1998

This Alaskan Air Force Base Superfund Site encompasses 19,700 acres. Remediation is being addressed for five separate units, distinguished from one another by the contamination source. A TI Waiver was obtained for lead action levels and was applied to areas that formerly contained buried drums. The waiver was granted based on the reasoning that lead was essentially immobile in the groundwater. Institutional controls and monitoring are currently in place.

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2.1.2 Sample Detailed Site Summary: Koppers Co, Inc. Superfund Site

The following summarizes relevant details for a CERCLA site that obtained a TI Waiver. This summary serves as an example of the depth of investigation that will be performed during Phase II.

Site Information:

Koppers Industries, Inc, Oroville/Butte CA, EPA Region 9, EPA ID# CAD009112087

Site Setting:

This is a wood treatment site, still in operation. Groundwater is contaminated with pentachlorophenol (PCP) both on- and off-site. PCP was detected in neighboring drinking water wells (2 miles away). The identified potentially responsible party (PRP) is Beazer East. The Process Area will be remediated when the plant closes. Pumping from an off-site well was discontinued because contamination was no longer reaching the well, and the system was only treating clean groundwater. The off-site plume had shrunk naturally.

Date of TI Decision:

09/23/1999

Post-Implementation or Front End:

Post-Implementation

Regulatory Agency(s) Involved:

EPA was the lead agency. DTSC, C RWQCB, Central Valley were also involved. The state issued the cleanup orders.

Documentation of Waiver:

ROD: EPA/541/R-99/094. The TI Decision was part of a ROD amendment.

Extent of Site Investigation Prior to Waiver:

Ten years for groundwater investigation (1989 to 1999 ROD amendment).

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Timeline of Site Remedial Activities:

Date	Action
1986	Provided an alternative water supply.
1986	Built cap to stabilize source, after a fire.
1994	Built an on-site landfill.
1995-	Dioxins hindered choices for remedial actions.
1989	ROD and selection of remedy - GW: pump and treat w/ GAC, re-inject into aquifer. Soil: In-situ remediation w/ capping.
1989-	Treatability studies showed no alternative worked for ALL contaminants in the soil.
1995	FS submitted by PRP.
1995	Off-property P&T was taken offline – no contaminants reaching it anymore.
1996	ROD amendment: on-site landfilling and revised cleanup standard to industrial use levels (accompanied by deed restrictions).
1997	Five-yr remedy review concluded remedy was protective.
1999	ROD amendment #2: TI Waiver for DNAPL on 4 acres/200 total. Also added enhanced in-situ bio to the remedy for PCP and added MNA as contingency.

Also, in 1995, a pilot-scale biotreatment system was started for the TI Zone. The system removed 160 gallons of creosote and 220 gallons of creosote emulsion out of potential million gallons of free product. This took 3 1/2 years.

Other Options Considered for the Site:

Other remedial alternatives were considered, but none met drinking water standards. Remedial strategies were evaluated based on protectiveness of human health and environment, etc: 1) no action 2) grout curtain wall 3) thermal 4) steam enhanced P&T 5) continue P&T and 6) monitor containment and set up TI Zone (selected). No remedy met drinking water standards. Some protected human health & the environment better than others. Alternative 6 was the most cost effective.

What was TI about the site?

DNAPL was present in low permeability clay. No technology existed to clean the aquifer to drinking water standards.

TI Application?

Yes – copy obtained from EPA library.

TI Zone/Zone of Contamination:

The TI Zone is 4 acres out of 200 total. It includes the Former Creosote Pond and Cellon Blowdown areas.

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Contaminants for which ARARs were waived:

Dioxin (PCDDs/PCDFs), cPAHs and PAHs, and PCP (lower health threat) – also known as creosote, dioxin, & PCP.

Other contaminants?

Furans and heavy metals including copper, chromium, and arsenic were also present.

Volume and depth of contamination:

Contamination exists below the excavated surface layer (13 ft, 10 ft in TI Zone areas) to a depth of 125 – 250 ft. Area = 4 acres. This represents 50 yrs of contamination.

CSM? How detailed is it?

~ 3 pages. The CSM includes the geology of TI Zone and fate and transport of the contaminants to date. Evidence of DNAPL is related in the description. The amount of degradation occurring naturally is discussed as well.

Data Basis for the Decision?

The decision is based on the extent of creosote contamination in the TI Zone and concentration data collected in this area. The general behavior of DNAPLs is included, as well as a summary about each contaminant. Clay layer geology was reported in the TI Zone. No downgradient detections have occurred.

Treatability studies for bioremediation, soil washing and soil fixation were conducted, as well as a leachability study of the soil into groundwater. Source removal was demonstrated. The site was compared to the Brodhead Creek Site and other Superfund sites where pilot studies were conducted.

Estimated Timeframe? Cost Estimates?

Their analysis indicated only 20-30 years. However, they also compared the site to the JH Baxter Superfund site, in which 3000 years were calculated for pump&treat alone (50-400 years if bioremediation was considered). A longer timeframe is expected at the Koppers site. Cost = \$20-67 M vs. \$0.25 M for TI Zone approval. Cost comparison between the existing (\$2.9 M present worth) and proposed remedies (\$ 0.8 M) was presented.

Alternative Remedial Strategy?

For areas outside of the TI Zone, enhanced bioremediation was chosen. This remedy was shown to be faster than the current P&T operation. Within the TI Zone, semi-annual monitoring, monitoring of the TI Zone for containment and the installation of one new well were required. Contingency P&T containment was also required, should monitoring reveal that natural containment was not working. Deed restrictions were placed on the property. An annual review of industrial activity around the TI Zone was required.

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EPA Contact?

Charles Berrey, Project Manager

EPA HQ Contact?

Signed by Keith Takata, Director of the Superfund Division. He has the authorizing signature that approved the TI Waiver.

How long was the process?

The TI Evaluation was first submitted in December 1997. A revised TI Evaluation was submitted in June 1998, and the final evaluation on March 1999. The ROD Amendment was signed in September 1999.

Reason for granting TI Waiver:

No surface soil contamination was present (source removal was demonstrated), containment was achieved (shown through groundwater monitoring data), and technical impracticability of removing DNAPL within the saturated zone (30-300 ft bgs) was demonstrated. The creosote contained in underlying clay layers was modeled, illustrating that it was trapped. The low solubility of creosote was also pointed out.

What review was required?

Review within 5 years and monitoring was required. Nothing was mentioned about a technology review in the future.

Formal Summary of Reasons?

Yes, in the ROD Amendment.

Organizational Comments:

The TI Evaluation is very structured and fairly well presented. The main points are that 1) the area is well-contained (10 ft/yr migration of contamination vs. 500 ft/yr groundwater migration) 2) the source has been effectively removed – surface soils are now gone and no groundwater contamination has resulted from the soil that remains in place, beyond 500 ft from the source 3) Costs to remove the remaining contaminant mass are high 4) Removing mass will not result in lower concentration and 5) Deed restrictions, monitoring etc. are considered protective for preventing people from contacting contaminated water directly under the source.

2.2 Interview with EPA

The information contained in this section will be further refined before the interviews are conducted as part of Phase II. Preliminary interview questions and a list of contacts are presented here.

The information obtained from the interviews will be used primarily in Section 4 of the guidance document. Knowledge gained through this personal communication will be used to explain the decision-making process for each region. Examples of the decision-making process for a few selected sites will be

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incorporated into the guidance document. Interview contacts may also be helpful in identifying sites that are currently in the process of TI Waiver review or sites that are considering applications. Sites that applied for TI Waivers but did not receive them may also be identified. Contact persons may be able to summarize the reasons why the waiver was not granted.

Limitations to this approach include the ability to identify key contacts within each region. In some cases, a regional coordinator for TI Waivers does not exist for the region.

2.2.1 Contacts Identified for Interview

The people identified as key contacts in the TI Waiver approval process represent a cross-section of the various parties concerned with the TI implementation process. They include project managers, state contacts, regional contacts (waivers are ultimately approved at a regional level), staff at EPA headquarters (who work with project managers and regional contacts) and technical specialists (such as hydrogeologists) who review TI Evaluation Reports. One contact is a TI Waiver applicant, responsible for co-writing the TI Evaluation for the Highway 71/72 Refinery site in Region 6.

Table 2-2 contains the contacts identified for the interview portion of this report. These people will be contacted and interviewed for a short 30-minute interview by the Malcolm Pirnie project team.

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Table 2-2: EPA and State Contacts for Interview

EPA Region	Contact Name	Contact Title	Contact Information
1	Mike Daly	Remedial Project Manager	(617) 918-1386 daly.mike@epamail.epa.gov
1	Bill Brandon	Hydrogeologist (Technical Review)	(617) 918-1391 Brandon.bill@epamail.epa.gov
1	Larry Brill	Region 1 TI Contact	(617) 918-1301 brill.larry@epa.gov
1	Ken Lovelace	EPA Headquarters Contact	(703) 603-8787 lovelace.kenneth@epa.gov
2	Alison Hess	Remedial Project Manager	(212) 637-3959 hess.Alison@epa.gov
3	Kathy Davies	Region 3 TI Contact	(215) 814-3315 davies.kathryn@epa.gov
3	Frank Vavra	Remedial Project Manager	(215) 814-3221 vavra.frank@epa.gov
4	Bill Ostein	Groundwater Expert (Technical Review)	(404) 562-8645
5	Pat Likins	State of Indiana Contact (State-Lead Project)	(317) 234-0357 plikins@dem.state.in.us
6	Kathleen Aisling	TI Waiver Applicant, Region 6	(214) 665-8509
7	Craig Smith	Region 7 TI Contact	(913) 551-7683 Smith.Craig@epa.gov
8	Austin Buckingham	State of Colorado Contact (State-Lead Project)	(303) 692-3435
9	John Kemmerer	Region 9 Branch Chief	(415) 744-2421 Kemmerer.john@epa.gov
9	Jeff Dhont	Remedial Project Manager	(415) 744-2399 dhont.jeff@epa.gov
9	Herb Levine	Hydrogeologist (Technical Review)	(415) 744-2312
9	Tom Kremer	Groundwater Policy Expert	(415) 744-2257
9	Keith Takata	Director of the Superfund Division, Region 9	(415) 744-1730 Takata.keith@epa.gov
10	Mary Jane Nearman	Remedial Project Manager	(206) 553-6642 Nearman.maryjane@epa.gov

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2.2.2 Interview Questions

A list of questions for contact persons is presented below. The list will be refined during Phase I Review to focus the scope of the Phase II interviews. Some questions are site-specific (appropriate for project managers) while others are more appropriate for regional or headquarters contacts.

TI Waiver Applications:

1. What has been the application rate for TI Waivers in your region, to the best of your knowledge? Have any sites in the region been denied TI Waivers, to your knowledge? How many applications have been denied? What reasons were given for the denial?
2. Why have so few sites requested TI Waivers (or been granted waivers), considering the extent of DNAPL contamination in the US, and the large number of sites at which remedial actions are not working?
3. Has a TI Waiver been granted for sources that are still in place?
4. Are you aware of sites that are currently involved in the TI Waiver process or are likely to obtain TI Waivers? How many applications are in review? In your opinion, are there sites to which a TI Waiver would apply?

TI Decision-Making:

5. If a TI Waiver was received by someone in your region, whom would it go to? Who is the EPA Headquarters contact for TI Waivers for your region? What is the chain of approval for the region? Who is involved in the decision? Who makes the final decision? Is an EPA Technical Resource Team involved in the review process? How long is the review process?
6. When is the state involved in a CERCLA site?
7. Are you aware of any sites during which the role of the public was significant / altered the outcome of the TI decision?
8. What does the EPA consider a demonstration of technical impracticability, especially for front-end implementation TI Evaluations? How much documentation and study is required for a TI Waiver?

Site-Specific:

9. What was the main reason the TI Waiver was granted?
10. Are you aware of any TI Waivers reviewed or granted after 1998 in your region? Do you know of EPA project managers of these sites?

2.3 Preparation of Final Report

Using the data gathered from the site-specific analysis and the interviews with EPA staff members and other persons involved in the TI Waiver process, we will write the full text of the Guidance Document. In order to best convey the proposed structure of the Final Guidance Document, and communicate the types of analyses and data that the final report will contain, an outline and extended outline were prepared during Phase I Activities. Preliminary text and ideas are presented in the form of an extended outline in Section 3 of this document.

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**3. Outline of Phase II
Final Report**

Outline of Phase II Final Report

1. TECHNICAL IMPRACTICABILITY (TI) WAIVERS - DEFINITION AND CONTEXT
 - 1.1. Groundwater Cleanup History
 - 1.1.1. Cleanup Requirements
 - 1.1.2. Remedial Technologies
 - 1.2. Definition of TI Waiver - Site-Specific Waiver of ARARs or MCSs (CERCLA 121(d)(4), RCRA Subpart S)
 - 1.3. Development of EPA Guidance Document, 1993
 - 1.4. Comprehensive List of Sites with TI Waivers
 - 1.5. Important Aspects of TI Waivers
 - 1.5.1. Subject to Future Review
 - 1.5.2. Contaminant-Specific
 - 1.5.3. Location-Specific
 - 1.5.4. Distinct Process From Setting Alternate Concentration Limits (ACLs)

2. TI WAIVERS – WHEN AND WHERE DO THEY APPLY?
 - 2.1. Timing of TI Waiver Application
 - 2.1.1. Front End
 - 2.1.2. Post-Implementation
 - 2.2. General Site Characteristics
 - 2.2.1. Nature of the Contaminant
 - 2.2.2. Hydrogeologic Limitations

3. REQUESTING A TI WAIVER – EPA GUIDELINES
 - 3.1. Site-Specific Checklist for Impracticability
 - 3.1.1. Site Characterization and CSM Development
 - 3.1.2. EPA Consultation
 - 3.1.3. TI Evaluation Report Components

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- 3.2. TI Evaluation Report
 - 3.2.1. Identify ARAR/Media Cleanup Standard For Which TI is Sought
 - 3.2.2. TI Zone
 - 3.2.3. Conceptual Site Model
 - 3.2.4. Restoration Potential
 - 3.2.4.1. Source Control
 - 3.2.4.2. Performance/Suitability of Ongoing or Completed Remedial Actions
 - 3.2.4.3. Remediation Timeframe Estimate
 - 3.2.4.4. Technical Impracticability Demonstration
 - 3.2.5. Costs of Existing Or Proposed Remediation Strategy
 - 3.3. Alternative Remedial Strategy (Optional)
 - 3.3.1. Nine CERCLA/RCRA Criteria
 - 3.3.2. Exposure Pathways, Source Control and Plume Remediation
4. REGULATORY DECISION-MAKING PROCESS
- 4.1. Decision Makers - EPA vs. State EPA and/or Local Agencies
 - 4.1.1. CERCLA Sites
 - 4.1.2. RCRA Corrective Action Sites
 - 4.2. Required Elements for Review
 - 4.2.1. TI Evaluation Report
 - 4.2.2. Supplemental Performance Data
 - 4.3. EPA Review
 - 4.3.1. Evaluation of Technical Feasibility of Remediation
 - 4.3.2. Preparation of Final Decision
 - 4.4. Public Comment Period
 - 4.5. Final EPA Decision and Documentation
5. FINAL TI WAIVER CONTENT
- 5.1. Alternative Remedial Strategy
 - 5.2. Site Restrictions and Controls

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5.3. Periodic Review of Site

6. CONCLUSIONS

7. REFERENCES

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**4. Extended Outline of
Phase II Final Report**

4. Extended Outline of Phase II Final Report

1. Technical Impracticability (TI) Waivers - Definition and Context

The goals of this section are to:

- Introduce and define technical impracticability (TI) waivers.
- Identify all sites that have received TI Waivers to date.
- Clarify exactly what is waived when a TI Waiver is approved (including the legal restrictions on a application of a TI Waiver) and summarize the amount of attention still required at a site if a waiver is obtained.
- Use site-specific information to illustrate situations that have constituted technical impracticability in the past.
- Explain why TI Waivers are a necessary option for Superfund (CERCLA) sites, due to technical difficulties encountered during cleanup.

To accomplish our goals for this section, we will discuss the origin of TI Waivers and the underlying purpose of granting the TI Waiver, in the context of groundwater cleanup history. This discussion will explain why clean-up goals can be impractical to attain.

We will introduce the EPA's primary guidance document on TI Waivers, which established the application procedure. Important terms such as ARARs, ACLs and TI will be introduced to avoid confusion about their legal definitions.

A table will be created with pertinent site information for all CERCLA sites that are identified as having received TI Waivers. Site examples will illustrate general principles described in the EPA Guidance document as well as the types of contaminants and geological formations waivers have applied to.

This document will focus on TI Waivers obtained at CERCLA sites but will also explain the process for RCRA sites as well. (This decision is based on the small number of RCRA sites that have obtained TI Waivers and on the intended application of this document to CERCLA sites).

There are limitations to identifying all sites that have received TI Waivers. There is no comprehensive tracking on a national level of CERCLA sites that have obtained TI Waivers after 1998. Between 1989 and 1998, a table listing Records of Decision (ROD) containing TI Waivers was compiled by EPA Headquarters. This list has been supplemented by extensive research into Superfund site documents, Internet sources and publications concerning technical impracticability and also through personal communication with EPA staff.

The primary information sources used in this section include the EPA Guidance document (EPA, 1993); a groundwater cleanup history reference (NRC, 1994); the ACL process (DOE, 1999; EPA, 1987; cited regulations); ARARs (EPA, 1990; EPA, 1991b; EPA, 1998b); and selected case studies of TI implementation.

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1.1. Groundwater Cleanup History

The Resource Conservation and Recovery Act (RCRA) and the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) are the two major Federal legislations passed in the 1970s and 1980s to address subsurface contamination. RCRA established land disposal restrictions and regulations regarding the generation, handling, treatment, storage and disposal of hazardous waste at facilities that are currently permitted. Areas at currently operating facilities may be designated Corrective Action Sites under RCRA, in which case remediation may be required. CERCLA authorized federal response to identify, investigate, prioritize and remediate abandoned or closed hazardous waste sites.

1.1.1. Cleanup Requirements

At CERCLA sites, applicable or relevant and appropriate requirements (ARARs) are used to determine cleanup requirements. If no ARARs are identified, risk-based cleanup levels are set. For RCRA sites, media cleanup standards (MCSs) are used. Historically, cleanup requirements were set at drinking water or background levels, yet this is often not practicable with current technology.

1.1.2. Remedial Technologies

The most common remedial technology for groundwater contamination in the 1970s and 1980s was pump-and-treat. The technical limitations of pump-and-treat are now recognized. Despite the development of newer technologies, the feasibility of groundwater remediation is still problematic at specific sites. This has led to the implementation of TI Waivers at approximately forty to fifty CERCLA sites nationwide and an undocumented number of RCRA sites.

1.2. Definition of TI Waiver - Site-Specific Waiver of ARARs or MCSs (CERCLA 121(d)(4), RCRA Subpart S)

A TI Waiver is a site-specific waiver of ARARs or MCSs for a specific contaminant. The ARAR/MCS to be waived is typically a standard for final cleanup levels. The term “technical impracticability” is originally used in the CERCLA and RCRA regulations as one of six bases for waiving ARARs at CERCLA sites, and one of three ways to justify waiving RCRA MCSs. Additional history of the TI waiver can be researched and incorporated into the final report.

1.3. Development of EPA Guidance Document, 1993

Experience with ineffective pump-and-treat remediation systems led the EPA to recognize the need for TI Waivers at specific sites. To clarify and standardize the process of granting TI Waivers, the EPA published a guidance document on TI Waivers in 1993 (EPA, 1993). The guidance document emphasizes site characteristics where technical impracticability may apply, the application procedure,

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and the review process. This document recognized the technical limitations to restoration, and established procedures for addressing them.

1.4. Comprehensive List of Sites with TI Waivers

A list of the sites that have obtained TI Waivers of groundwater ARARs will be finalized and included here in the Phase II text. The preliminary list of sites can be found in the Site-Specific Data section of this draft report, along with brief (one paragraph) synopses of the site-specifics.

1.5. Important Aspects of TI Waivers

The TI Waiver can be misconceived as a loophole in site remediation requirements - a way to avoid meeting cleanup requirements. The EPA emphasizes the amount of documentation and study required for a TI Waiver. The EPA also differentiates between the TI process of waiving an ARAR and the process of setting alternate concentration limits (ACLs).

1.5.1. Subject to Future Review

A TI Waiver that is granted (a TI Decision) is subject to future review. Site monitoring is also required. At a CERCLA site, an alternative remedial strategy will be approved to protect human health and the environment as part of the TI Decision. Review of this remedial strategy will determine if conditions of protectiveness are being met. If they are not, the EPA will require additional remedial actions. At sites where contamination is high enough to restrict site use, review occurs every five years. Specific review schedules are determined in the TI Decision.

At a RCRA site, a TI Decision is part of the facility permit, so it is subject to continual review. Additional review by the EPA may be specified in the TI Decision to ensure protectiveness. If future advances in technology make MCSs attainable, the EPA may require implementation of these technologies.

1.5.2. Contaminant-Specific

A TI Waiver is granted for a specific contaminant. If multiple contaminants exist in an area that is difficult to remediate, but only one contaminant is technically impracticable to remediate, then only one contaminant will be considered for the waiver. Remedial actions must still be taken to remove the other contaminants.

1.5.3. Location-Specific

A TI Waiver is granted for a designated area of the site, known as the TI Zone. This zone is spatially defined and may consist of a geological unit or geographical area where remediation is not practicable. Contamination outside of the TI Zone is still subject to ARARs/ MCSs.

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1.5.4. Distinct Process from Setting Alternate Concentration Limits (ACLs)

The process of requesting a TI Waiver is a separate process from setting ACLs for a CERCLA or RCRA site. The two are mutually exclusive – one need not obtain a TI Waiver if ACLs are approved and vice versa. ACLs are less stringent risk-based concentrations that provide less protection. To qualify for CERCLA ACLs, a site must have 1) known points of entry of the contaminated groundwater into surface water; 2) no statistically significant increases in contamination downstream of the discharge point; and, 3) preventable exposure⁶. In summary, ACLs are less strict cleanup concentrations that apply only to groundwater meeting the above three requirements. A TI Waiver can apply to a wider range of scenarios, and may waive a cleanup requirement entirely or raise the acceptable concentration.

For ACLs at a RCRA site, 1) groundwater contamination plumes should not increase in size or concentration above allowable health or environmental exposure levels; 2) increased facility property holdings should not be used to allow a greater ACL; and, 3) ACLs should not be established so as to contaminate off-site groundwater above allowable health or environmental exposure levels (EPA, 1987).

2. TI Waivers – When and Where Do They Apply?

The goals of this section are to:

- Answer the question: Could a TI Waiver apply to a particular site?
- Convey the types of situations that constitute “technical impracticability”, highlighting some of the main reasons TI Waivers have been granted at sites.
- Determine whether a TI Waiver request can be submitted for review immediately or if further characterization/remedial feasibility studies should be done.
- Quantify how common it is to approve TI Waivers before full-scale remedial technologies have been implemented.

This section will include a variety of site-specific examples to provide the reader with a better grasp of situations in which a TI waiver could apply.

Both case studies and the EPA guidance document will be used to identify what precedents have been set for “technical impracticability” at sites, and what contaminants, geology and other factors have contributed to the determination of technical impracticability. These ideas will be quantified and presented in figures and tables. Examples may include the number of front-end vs. post-implementation TI Waivers, the timeframe and extent of site characterization, interim measures and/or remedial actions taken at each site and the number of sites containing DNAPL contamination.

This major factors identified in determining the TI Waiver will be discussed in detail. For example, if DNAPL contamination is identified at 85% of the sites as a main reason behind the TI decision, a

⁶ CERCLA section 121(d)(2)(B)(ii)

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discussion of DNAPL contamination will follow. Although the presence of DNAPL is not enough to justify a TI Waiver, DNAPL contamination may be present at a majority of the sites.

The primary information sources used in this section include the EPA Guidance document (EPA, 1993); DNAPLs (EPA, 1991; EPA, 1992); other EPA documents and site-specific documents.

2.1. Timing of TI Waiver Application

Applications for a TI Waiver can be considered at any stage of the regulatory process, as long as data are sufficient to support the claim of technical impracticability. Typically, TI Waivers are classified as either *front-end* or *post-implementation*, depending on whether or not full-scale remedial activities have been implemented at the site.

2.1.1. Front-End

Front-End TI Waivers are based on data gathered during the RI/FS (CERCLA) or RFI/CMS (RCRA). Front-end TI applications are based on a strong Conceptual Site Model (CSM), which is supported by extensive site characterization for the RI/FS (CERCLA) or RFI/CMS (RCRA). Interim remedial measures performance data or pilot-scale treatment performance data are used as justification. If the data indicate that cleanup is impracticable, the front-end TI Waiver may be the most appropriate action for the site. The TI Waiver is incorporated into the Record of Decision (ROD)/Statement of Basis.

2.1.2. Post-Implementation

Post-implementation TI Waivers are granted after a full-scale remedial strategy has been in place, and has proved ineffective. Many treatment systems must operate for years to collect enough information to justify technical impracticability. In particular, it must be shown that the treatment system failure is not due to faulty design or operation.

2.2. General Site Characteristics

TI Waivers apply to sites where technical impracticability of restoration to ARAR/MCS levels can be demonstrated. Technical impracticability includes remedial actions that are technically feasible but cannot be completed within a reasonable timeframe (sometimes defined for RCRA sites as 130 years, but always examined on a case-by-case basis).

In general, technical impracticability is linked to problematic contaminants, particularly dense nonaqueous phase liquids (DNAPLs), or complex hydrogeologic conditions, such as fractured bedrock, karst formations or low permeability aquifers.

2.2.1. Nature of the Contaminant

Chemical and physical characteristics of a contaminant may limit the possibility of remediation. These include a high potential for sorption, low volatility, low rate of decay by

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biotic or abiotic means, and low solubility. Other relevant characteristics of the contaminant include the amount and duration of the release and the volume and depth of contamination.

DNAPLs are particularly difficult to remediate because they may collect in pools of free-phase product that are hard to identify, and slowly dissolve into groundwater over time. DNAPLs can also collect in rock fractures or other non-connected pore space and leach out into groundwater over hundreds of years.

2.2.2. Hydrogeologic Limitations

Hydrogeologic properties of the site may also influence technical impracticability. Complex hydrogeologic settings make remediation more difficult.

3. Requesting a TI Waiver – EPA Guidelines

The goals of this section are to:

- Outline the formal steps a PRP should take when requesting a TI Waiver, based on the guidelines presented in the EPA 1993 Guidance Document.
- Compare actual TI Waiver requests with the format specified by the EPA to see how closely the two compare and how succinct or extensive TI Evaluations have been in the past.
- Use actual TI Evaluations from case studies to better define the extensiveness of TI Evaluation components such as the Conceptual Site Model or the demonstration of technical impracticability.
- Provide cost data on the TI Waiver process and cost savings in site remediation if a waiver is granted.
- Discuss why a PRP would choose to research and request a TI Waiver, and under what circumstances an alternative approach would be desirable.

Our approach will chronologically follow the formal application process, as explained in the Guidance Document. The process will be continually compared with the actual process followed at sample sites. The guidance document will form the framework for the section, with case study data incorporated as examples or possibly counterexamples of how the formal process is applied. For example, TI Zones should be strictly defined by a spatial volume or geological formation,, yet they may have been designated by the changing volume of a plume contour in the past. How have source removal or containment been demonstrated at each site? How have sites developed their conceptual site models? How has “technical impracticability” been demonstrated?

Ideas for conveying and presenting site information within the format of the TI Evaluation Report will be included in this section.

In addition, the possible motivations and choices of the PRP when considering a TI Waiver will be discussed. Although cost savings are significant for many sites that obtain TI Waivers, this may not always be the case. Alternatives to TI Waivers that were considered by project managers/PRPs will be

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researched. This information will hopefully be supplemented by personal communication with PMs/PRPs.

Limitations to the preparation of this section include the amount of information that is available for sites that have obtained TI Waivers using the post-1993 TI Evaluation procedure. Cost data estimates may not be available for all sites. The final investigation into alternatives to the TI process and PRP motivations is dependent on the identification of Superfund sites that have considered TI Waivers but did not apply.

The primary information sources used in this section include guidance documents (EPA, 1993; DOE, 1998); CSM references (EPA, 2000), personal communication obtained through interview(s) and site-specific documents.

3.1. Site-Specific Checklist for Impracticability

The application process for a TI Waiver is time-consuming and resource intensive. The party requesting the TI Waiver should review the components of the application to determine if sufficient site data exist and then consult with the EPA. The application process is described in the EPA Guidance Document.

3.1.1. Site Characterization and CSM Development

Site characterization data should be incorporated into a detailed and thorough CSM. Collecting site characterization data and developing a CSM is an iterative process, with the results of one guiding future development of the other.

3.1.2. EPA Consultation

If a potentially responsible party (PRP) or site owner/operator is considering a TI Waiver request, the EPA should be notified and consulted throughout the application process. The EPA has a contact at their headquarters and may have designated regional contacts. Site-specific documents may be requested to supplement the application. Early agreement between the EPA and the party preparing the report will facilitate the TI Waiver process.

3.1.3. TI Evaluation Report Components

The PRP or owner/operator is required to submit a document known as a TI Evaluation Report. The components of the report, both required and suggested, are described in Section 3.2. These components should be reviewed prior to beginning the application process, to see if site characterization work is sufficient to justify a TI Waiver.

3.2. TI Evaluation Report

Required report components are listed here. The lead agency for the site is responsible for preparing and submitting the report. For a CERCLA site, this is often the PRP; for a RCRA site, it is the owner or operator.

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3.2.1. Identify ARAR/Media Cleanup Standard For Which TI is Sought

TI Waivers are generally only applicable to chemical-specific ARARs or state cleanup requirements. The contaminant(s) should be identified in this section as well as the requirement to be waived.

3.2.2. TI Zone

The zone of technical impracticability is the spatial extent of the site over which the TI Waiver applies. This should be delineated with respect to landmarks, latitude and longitude, volume, aerial footprint and proximity to other aquifers.

3.2.3. Conceptual Site Model

The CSM incorporates useful site characterization data to give a detailed picture of the site contamination. The CSM will identify the source of contamination, important exposure pathways, and fate and transport mechanisms. It lays the conceptual and quantitative framework for evaluating remedial alternatives and assessing risk associated with the contamination. Building a CSM is often an iterative process that both guides and reincorporates site characterization data.

3.2.4. Restoration Potential

Demonstrating that restoration of groundwater to ARAR/MCS cleanup standards is technically impracticable must be supported with available remedial/pilot system performance data. The supporting information should be *site-specific*, and at a minimum, address the following subjects:

3.2.4.1. Source Control

According to the EPA Guidance Document, contaminant sources must be identified and demonstrated to have been removed or contained to the extent “practicable”. Subsurface NAPLs are considered sources because they release contamination over a long period of time. It will be informative to investigate what the term “practicable” means to regulators. This will be accomplished by reviewing case studies of sites that obtained TI Waivers in the past.

3.2.4.2. Performance/Suitability of Ongoing or Completed Remedial Actions

The party preparing the report should use performance results of past remedial action to demonstrate that the EPA-approved remedial strategy is not effective. This section applies to post-implementation waivers. For front-end waiver requests, a description of any pilot-scale activity and the results should be presented.

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3.2.4.3. Remediation Timeframe Estimate

The timeframe required to attain cleanup requirements using available technologies should be estimated.

3.2.4.4. Technical Impracticability Demonstration

Other remedial technologies, including innovative ones, should be reviewed, showing that remediation is not technically practicable within a “reasonable timeframe” (on the order of 100 years).

3.2.5. Costs of Existing or Proposed Remediation Strategy

Costs associated with continued operation of the current remedial strategy are estimated, if the TI waiver request is post-implementation. Sometimes, costs are presented as a function of time until the TI Waiver is approved. Estimates should include construction and O&M costs. If the TI Waiver request is front-end, costs are estimated for any proposed alternative remedial strategy.

3.3. Alternative Remedial Strategy (Optional)

The EPA will approve an alternative remedial strategy if the TI Waiver is granted. Although the decision is the responsibility of the EPA, the PRP or owner/operator is free to submit a proposed alternative remedial strategy with the TI Evaluation Report. The strategy could be as minor as post-monitoring and institutional controls, or it could entail remedial actions (including monitored natural attenuation) determined to be protective of human health and the environment. At a minimum, the alternative should be technically practicable and include the following items:

3.3.1. Nine CERCLA/RCRA Criteria

The nine CERCLA remedy selection criteria are listed in Table 3.1, along with the four general and five remedy-specific standards for RCRA sites. These should be evaluated to determine the appropriate remedial strategy for the site.

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Table 3.1: CERCLA/RCRA Remedy Selection Criteria

	CERCLA Remedy Selection Criteria⁷	RCRA Remedy Selection Factors⁸
1.	Overall protection of human health and the environment	Overall protection of human health and the environment
2.	Compliance with ARARs	Attainment of MCSs
3.	Long-term effectiveness and permanence	Long-term reliability and effectiveness
4.	Reduction of toxicity, mobility or volume through treatment	Reduction of toxicity, mobility or volume through treatment
5.	Short-term effectiveness	Short-term effectiveness
6.	Implementability	Implementability
7.	Cost	Cost
8.	State acceptance	Appropriate management of remediation wastes
9.	Community acceptance	Source control

3.3.2. Exposure Pathways, Source Control and Plume Remediation

The alternative remedial strategy must prevent exposure to the contaminants. It must address the containment, removal and/or remediation of the contamination source and plume. It should also evaluate further risk reduction measures such as establishing new cleanup goals that are as low as possible. Additional remedy selection criteria include the timeframe required for remediation, cost, and potential risk of exposure.

4. Regulatory Decision-Making Process

The goals of this section are to:

- Identify who makes the TI Decision and who contributes to this decision (including the role of the party who is requesting the waiver, the state, regulatory agencies, technical EPA experts and the public).
- List the types of resources used when reviewing TI Evaluation Reports and making the decision.

⁷ 40 CFR 300.430(e)(9)(iii)(A)-(I)

⁸ Proposed 40 CFR 264.525(a) and (b)

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- Discuss regional differences in the approval process, and address the possibility of regional differences in decision outcomes.
- Research the reasons given for granting or denying TI Waivers.

This section incorporates information obtained from interviews with EPA contacts and utilizes written justifications of TI Waiver decisions. Regional differences in the approval process will be obtained through question and answer sessions with staff from each of nine regions that have obtained TI Waivers. Although the EPA issued a memorandum to standardize the TI Waiver approval process (EPA, 1995), the small number of TI Waivers approved in each region made this plan unnecessary.

Case study data will be synthesized to illustrate and quantify the regional distribution of sites across the country. The possible reasons for high-density areas of TI Waiver approval will be investigated, including the total number of Superfund sites in the area, types of contamination present at the sites, the geology of the area, and differences in TI Waiver policy between different regions.

Although some data may be collected on the number of people who have applied for waivers, this data is not likely to be forthcoming. Additional limitations to this study include the types of responses received during interviews.

The primary information sources used in this section include personal communication obtained through interviews, the guidance document (EPA, 1993), EPA Memorandum (EPA, 1995) and site-specific documents including RODs and FSs.

4.1. Decision Makers - EPA vs. State EPA and/or Local Agencies

The decision makers reviewing the TI Evaluation report will be Federal and/or state agencies. Typically, a regional point of contact within EPA will submit the final TI Decision, and EPA regional staff with experience in site characterization and remediation will provide technical review support. Experts within EPA on topics such as modeling or bioremediation may be called upon, as well as consultants from the EPA Headquarters.

4.1.1. CERCLA Sites

For CERCLA sites, an EPA Regional Administrator from the Superfund Office of Emergency and Remedial Response (OERR) will make the TI decision. The state will be notified if the ARAR being waived is a state requirement.

4.1.2. RCRA Corrective Action Sites

For RCRA Corrective Action Sites, the state may be authorized under the Hazardous and Solid Waste Amendments (HSWA) to make TI Decisions. Even if the state has primary authority, however, the federal EPA works with the state to promote consistent TI Decisions.

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4.2. Required Elements for Review

The decision-maker will review the TI Evaluation Report and any supplemental performance data regarding the site. The documents will be examined for completeness and accuracy.

4.2.1. TI Evaluation Report

The TI Evaluation Report (Section 3.2) is the main document on which the EPA bases the decision. For front-end TI Waivers, the report will be read to see if a technical constraint to meeting requirements exists and if it poses a “critical limitation to the effectiveness” (EPA, 1993) of remediation strategies.

4.2.2. Supplemental Performance Data

The EPA may request that additional site data be submitted for review. This could involve more analysis of existing data or the collection of new information.

4.3. EPA Review

This is done by technical review panel of scientists from several disciplines, including hydrogeology, engineering and risk assessment.

4.3.1. Evaluation of Technical Feasibility of Remediation

The engineering feasibility and the reliability of the technology is considered when determining if remediation is technically impracticable. Cost of remediation is not considered as much as the engineering practicability, although “inordinately costly”⁹ remedies are considered impracticable by definition.

4.3.2. Preparation of Final Decision

The EPA may choose to grant or deny the TI Waiver. If it is granted, it may be granted in part or in full.

4.4. Public Comment Period

The EPA or state agency is required to notify the public of a proposed TI Waiver. For RCRA sites, the public comment period lasts 45 days. If a state ARAR is waived, the decision-makers must notify the state 30 days before the decision and provide an explanation for the waiver. For CERCLA sites, any amendments to RODs require 30 days public notice, extended to 60 days by request. Public hearings must also be granted, if requested.

⁹ NCP Preamble, 55 FR 8748

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4.5. Final EPA Decision and Documentation

Once a TI Waiver is granted, it is documented in one of several forms. For a CERCLA site, a TI Decision will be documented in the original ROD (front-end TI Waiver), a RI/FS report (front-end) or a modified ROD (post-implementation). Occasionally, a response to a front-end TI application will include a contingency statement in the final ROD or RI/FS, stating that TI is a future contingency of the remedy. If such language is used, the reasons for implementing the contingency TI waiver will be specified. If previously written TI contingency plans are implemented, this is documented in an Explanation of Significant Differences (ESD).

For a RCRA site, the intended EPA decision is documented in a Statement of Basis. After the public comment period, the final TI Decision is incorporated into the facility permit or is presented in an order describing the final remedy. Contingency TI Waiver language is generally avoided.

The process of reviewing and approving or denying a waiver may take from 1 to 3 years for a CERCLA site, and from 3 to 12 months for a RCRA site (Hazardous Waste Consultant, 1997).

5. Final TI Waiver Content

The goals of this section are to:

- Summarize the appropriate remedial alternatives for a site once restoration has been determined to be technically impracticable.
- List and discuss common types of monitoring and institutional controls that are approved as part of a TI Waiver.
- Describe future reviews of the sites to evaluate the protectiveness of human health and the environment, as well as new technological advances.

This section will synthesize information from TI Waivers that have already granted, defining the attention required at a site after a TI Waiver is in place. Cost savings will be calculated based on the available data. The format and frequency of future reviews will be described for sample sites.

The primary information sources used in this section include personal communication obtained through interviews and site-specific documents including review reports.

5.1. Alternative Remedial Strategy

If a TI Waiver is approved, the EPA will select an alternative remedial strategy that is technically practicable and protective of human health and the environment. The strategy will address exposure control, remediation of sources and remediation of plumes. Several options may be combined to form an overall strategy.

5.2. Site Restrictions and Controls

Future restrictions may be placed on the land use, including well construction/use limitations, deed restrictions and institutional controls.

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5.3. Periodic Review of Site

A full assessment of a CERCLA site is conducted every five years. RCRA sites are subject to continual oversight and review as part of the facility permit. Site-specific details of the review and requirements for monitoring and reporting will be specified in the TI Decision. Additional remedial requirements may be necessary in the future if new practicable technology becomes available or if protectiveness is no longer maintained with the alternative remedial strategy.

6. Conclusions

The TI Waiver application and review process will be summarized here succinctly. Information gleaned from reviewing case study data will also be summarized. Common trends in the data will be identified. A discussion of pending issues concerning TI Waivers will be included, addressing any foreseeable changes in the TI Waiver process and new sites for which TI Waivers may be approved.

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Region 2 – NY, NJ, Puerto Rico, Virgin Islands

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Region 4 – MS, GA, AL, KY, TN, NC, SC, FL

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Region 5 – WI, MI, IL, IN, MN, OH

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Region 6 – TX, OK, LA, NM, AR

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Region 7 – KS, MO, NE, IA

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Region 8 – MT, CO, UT, ND, SD, WY

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Region 9 – CA, NV, AZ, HI

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Region 10- AK, WA, OR, ID

- EPA ID# AK1570028646. Eielson Air Force Base Superfund Site, Fairbanks, AK – General Fact Sheet, April 2001. Available online at <http://www.yosemite.epa.gov/r10/nplpad.nsf>.
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**5. Cost Summary for
Phase II Activities**

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5. Cost Summary for Phase II Activities

Table 5-2: Cost Estimate for Phase II TI Waiver Guidance Document

Task Description	Staff	Hours	Billable Rate (d)	Subtotal	Total
Phone Interviews					
	E Hawley	24	85	\$2,040	
	R O'Laskey	24	130	\$3,120	
	R Deeb	8	135	\$1,080	
	M Kavanaugh	8	250	\$2,000	
	Subtotal	64			\$8,240
Site Summaries					
	E Hawley	160	85	\$13,600	
	R O'Laskey	24	130	\$3,120	
	Subtotal	184			\$16,720
Draft Document Preparation					
	E Hawley	80	85	\$6,800	
	R O'Laskey	40	130	\$5,200	
	R Deeb	24	135	\$3,240	
	F Stanin	8	145	\$1,160	
	M Kavanaugh	16	250	\$4,000	
	Subtotal	168			\$20,400
Additional Data Collection					
	E Hawley	24	85	\$2,040	
	Subtotal	24			\$2,040
Response to Comments/ Final Document Preparation					
	E Hawley	40	85	\$3,400	
	R O'Laskey	16	130	\$2,080	
	R Deeb	16	135	\$2,160	
	F Stanin	4	145	\$580	
	M Kavanaugh	12	250	\$3,000	
	Subtotal	88			\$11,220
Project Management					
	R Deeb	16	135	\$2,160	
	M Mackay	8	65	\$520	
	Subtotal	24			\$2,680
	Total	552			\$61,300

**Appendix A.
Site-Specific Data**

APPENDIX A. SITE-SPECIFIC DATA

This section presents preliminary results of extensive research efforts to identify all CERCLA sites that have obtained TI Waivers in the past. A summary of the sites identified so far is shown in Table A-1.

Information on each CERCLA site listed in Table 1 has been gathered as part of the scope of work for Phase I of this project. Documents gathered include the original TI Evaluations for some sites, Records of Decision documenting the TI Waiver (and often explaining why the waiver was approved), Site Fact Sheet Summaries documenting remedial activities at each site, and other site documents or correspondence. Personal communication with all identified EPA Remedial Project Managers has often yielded additional details on sites.

A brief synopsis of this information is given for each CERCLA site identified so far. The description includes:

- Location and site setting
- Main reason(s) a TI Waiver was approved
- Contaminants for which ARARs were waived
- Alternative Remedial Strategy used at the site

Using these short summaries, the most relevant sites can be identified for future research during Phase II of the project. A sample of an in-depth site summary (to be developed for each relevant site during Phase II) is attached for the Koppers Co, Inc. site located in Oroville, CA.

The detailed site summary for CERCLA sites studied in Phase II will include:

- Site facts (site name, location, EPA region, EPA ID, date of TI Decision)
- Timing of the TI Waiver application (post-implementation or front end)
- Regulatory agencies involved
- Form of TI Waiver documentation and supporting documents
- Extent of site characterization/remedial activities prior to the TI Waiver
- A timeline of site activity leading up to the waiver
- Other alternatives to a TI Waiver that were considered
- A description of the impracticable nature of the site – what about the site was TI?
- Whether a TI Evaluation report was prepared and submitted to the EPA, and if not, a description of the TI approval process
- Contaminants included in the waiver and contaminants present on-site
- Spatial extent of contamination and the designated TI Zone
- Description of the detail included in the TI Evaluation report for the Conceptual Site Model
- A description of the data upon which the TI Evaluation report was based.
- An estimation of the timeframe for remediation required with and without a TI Waiver
- Cost estimates – cost savings if the waiver is approved and costs of remedial alternatives

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- Summary of the alternative remedial strategies suggested for the site
- Primary EPA contact for the site
- Primary EPA headquarters contact and other EPA staff involved in the decision
- Timeframe for the TI Waiver approval process
- Final reasons for granting the TI Waiver
- Review of remedial system performance data required for the site after TI approval
- Other comments summarizing special site conditions

Detailed summaries will be developed for each site included in the Phase II study. This information can then be used to generate statistics and examples for the final version of the document.

The development of detailed site summaries is dependent on the amount of data that is available for each site. Much of this information is unavailable or limited, particularly for sites with TI Waivers instituted prior to 1993, when formal TI Evaluations were not yet required.

Our primary sources of reference are EPA site documents (available online, from EPA libraries by special order, or through EPA contacts) and personal communication with project managers.

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Table A-3: Comprehensive Record of All CERCLA Sites That Have Obtained TI Waivers¹⁰

Site #	EPA Region	ROD Date	Site Name	City/County	State	EPA ID #
1	1	02/03/1997	South Municipal Water Supply Wells	Peterborough/Hillsboro Cnty	NH	NHD980671069
2	1	09/26/1995	Pease Air Force Base	Portsmouth, Newington, Greenland/Rockingham Cnty	NH	NH7570024847
3	1	09/01/1995	Tansitor Electronics, Inc.	Bennington/Bennington Cty	VT	VTD000509174
4	1	09/29/1990	Old Springfield Landfill	Springfield/Windsor Cnty	VT	VTD000860239
5	1	06/28/1989	Sullivan's Ledge	Bristol/New Bedford Cty	MA	MAD9807343
6	1	05/30/1989	Pinette's Salvage Yard	Washburn/Aroostook Cnty	ME	MED980732291
7	2	09/29/1995	Niagra Mohawk Power Co	Saratoga Springs/Saratoga Cnty	NY	NYD980664361
8	2	10/06/1994	G.E. Moreau	South Glen Falls/Saratoga Cnty	NY	NYD980528335
9	2	05/15/1991	Love Canal ¹¹	Niagara Falls/Niagara Cnty	NY	NYD000606947
10	2	09/28/1989	Caldwell Trucking Company	Fairfield Twp/Essex Cnty	NJ	NJD048798953

¹⁰ Comprehensive for sites with ROD dates between 1987 and 1998. Post-1998 sites identified through research efforts.

¹¹ Identification as having obtained a TI Waiver is tentative.

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Site #	EPA Region	ROD Date	Site Name	City/County	State	EPA ID#
11	3	09/30/1999	Rodale Manufacturing Company	Borough of Emmaus/ Lehigh Cnty	PA	PAD981033285
12	3	06/30/1995	Brodhead Creek	Stroudsburg/Monroe Cnty	PA	PAD981033285
13	3	07/01/1994	Aladdin Plating	Scott & South Abington Twps, Lackawanna Cnty	PA	PAD075993378
14	3	09/29/1993	E.I. DuPont (Newport Landfill)	Newport/New Castle Cnty	DE	DED980555122
15	3	08/02/1993	Hunterstown Road	Gettysburg/Adams Cnty	PA	PAD980830897
16	3	06/01/1992	Westinghouse Elevator Plant	Gettysburg/Adams Cnty	PA	PAD043882281
17	3	03/31/1992	Lindane Dump	Harrison Twp, near Natron(a)/Allegheny Cnty	PA	PAD980712798
18	3	09/30/1991	Dorney Road	Mertztown/Lehigh Cnty	PA	PAD980508832
19	3	09/30/1991	Heleva Landfill	Coplay (Ironton Willage)/Lehigh Cnty	PA	PAD980537716
20	3	12/31/1990	Whitmoyer Laboratories	Myerstown/Lebanon Cnty	PA	PAD003005014
21	3	12/17/1990	Middletown Air Field ¹²	Middletown/Dauphin Cnty	PA	PAD980538763

¹² Identification of having obtained a TI Waiver is tentative.

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Site #	EPA Region	ROD Date	Site Name	City/County	State	EPA ID#
22	4	06/01/1992	Yellow Water Road Dump	Baldwin/ Duval Cnty	FL	FLD980844179
23	5	09/30/1998	Continental Steel Corp.	Kokomo/Howard Cnty	IN	IND001213503
24	6	09/01/2000	Highway 71/72 Refinery Site	Bossier City/Bossier Parish	LA	LAD981054075
25	6	03/19/1997	Crystal Chemical Company	Harris Cnty	TX	TXD990707010
26	6	09/01/1995	Vertac, Inc.	Jacksonville/Pulaski Cnty	AR	ARD000023440
27	6	02/20/1993	Popile, Inc.	El Dorado/Union Cnty	AR	ARD008052508
28	6	11/22/1989	Hardage/Criner	Criner/McClain Cnty	OK	OKD000400093
29	7	08/20/1997	Cherokee County	Cherokee Cnty	KS	KSD980741862
30	8	09/28/2001	Summitville Mine	Rio Grande Cnty	CO	COD983778432
31	8	09/29/1994	Silver Bow Creek/Butte Area	Silver Bow Creek/ Deer Lodge Cnty	MT	MTD980502777
32	8	03/24/1992	Broderick Wood Products	Denver/Adams Cnty	CO	COD 000110254
33	8	03/30/1990	Whitewood Creek	Whitewood/Lawrence, Mead,Butte Cntys	SD	SDD980717136
34	8	11/22/1989	East Helena	East Helena/Lewis & Clark Cnty	MT	MTD006230346
35	9	09/23/1999	Koppers Industries, Inc.	Oroville/Butte Cnty	CA	CAD009112087

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Site #	EPA Region	ROD Date	Site Name	City/County	State	EPA ID#
36	9	03/30/1999	Montrose/Del Amo	Torrance/Los Angeles Cnty	CA	CAD029544731 CAD008242711
37	9	03/27/1998	J.H. Baxter & Co.	Weed/Siskiyou Cnty	CA	CAD000625731
38	9	11/01/1997	Schofield Barracks	Oahu	HI	HI7210090026
39	9	09/30/1997	Tucson International Airport Area	Tucson/Pima Cnty	AZ	AZD980737530
40	9	10/16/1991	Westinghouse Electric	Sunnyvale/Santa Clara Cnty	CA	CAD001864081
41	9	09/30/1985	Del Norte Pesticide Storage	Crescent City/Del Norte Cnty	CA	CAD000626176
42	10	9/29/1998	Eielson Air Force Base	Fairbanks/N Star Borough	AK	AK1570028646

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A.1. Brief Synopses of TI Waiver Implementation¹³

There is no tracking of TI Waivers at RCRA Corrective Action Sites on a national level. However, TI Waivers are rarely implemented at RCRA sites since the regulatory structure is more flexible and updating the facility permit can accommodate most situations. For CERCLA sites, thirty TI Waivers were issued between 1989 and 1998. This comprehensive list has been supplemented with cases of post-1998 TI Waiver approvals, and is summarized in Table A-1. Locations of all CERCLA sites are illustrated in Figure A-1. Selected case study summaries are described below, organized by EPA Region and the date each TI Decision was granted.

A.1.1 South Municipal Water Supply Well Site, Peterborough, NH – February 1997

One of the city's water supply wells was contaminated with VOCs from the neighboring New Hampshire Ball Bearings (NHBB) manufacturing facility. The well was taken out of service and institutional controls were implemented. Technical impracticability of restoring groundwater to drinking water quality was published in an Explanation of Significant Differences (ESD) to the 1989 ROD. Groundwater extraction and treatment were instituted.

A.1.2 Pease Air Force Base, Portsmouth, NH – 1995

DNAPLs from an underground TCE storage tank were determined to be technically impracticable to remediate after 10 years of gathering site characterization data. This was the first front-end TI Waiver in EPA Region 1 to be granted. Containment of the source was approved, using vertical and hydraulic barriers.

A.1.3 Tansitor Electronics, Bennington, VT - 1995

During the 1960s and 1970s, electronic capacitor manufacturing waste was disposed of in drums on the property. This resulted in plumes of 1,1,1-TCA, vinyl chloride and other VOCs. Institutional controls and monitoring was selected for a groundwater remediation strategy. More information is needed about the TI Waiver obtained for this site.

A.1.4 Old Springfield Landfill, Springfield, VT – 1990

A trailer park was located on top of a municipal/industrial landfill until 1990, until VOC contamination was found in neighboring springs and wells. Due to the impracticability of PCE quantification, a TI Waiver was approved for the state PCE standard (set at the quantification limit) as part of the 1990 ROD without a formal application procedure. Groundwater and leachate are collected and treated. The landfill has been capped.

A.1.5 Sullivan's Ledge, Bristol, MA – June 1989

Sullivan's Ledge is a former granite quarry used as a disposal area by the city for hazardous and non-hazardous material. PCBs, VOCs and PAHs were present in the soil and

¹³ Case studies will be selected for in-depth analysis based on available data.

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groundwater in the disposal area and a nearby marsh. Federal and state MCLs were waived due to the presence of high concentrations of DNAPLs in bedrock fractures as deep as 150 ft.

A.1.6 Pinette's Salvage Yard, Washburn, ME – May 1989

TI Waiver language was approved as part of the 1989 ROD for state maximum exposure guidelines for PCBs at this site. A 1,000-gallon spill of dielectric fluid containing PCBs occurred in 1979. Private and municipal wells were located nearby. Excavation and other remedial actions were undertaken in 1983. Groundwater extraction and treatment were begun as well as institutional controls.

A.1.7 Niagara Mohawk Power Co, Saratoga Springs, NY – 1995

Contamination from coal tars included DNAPL contamination in the form of concentrated tar-saturated soil at this former gas manufacturing facility. A TI Waiver was approved as part of the 1995 Record of Decision for shallow groundwater. A clay confining layer located at 20 ft bgs prevented vertical migration of the tar. The selected remedy was a combination of excavation of soil and sediment, containment with subsurface barriers, institutional controls and monitoring.

A.1.8 GE Moreau Site, South Glen Falls, NY – 1994

Active remediation of a waste pit containing PCBs, TCE, solvents, oil and other wastes was estimated to take 190-400 years and cost \$17 million. The proposed alternative (natural flushing) was estimated to take 240-540 years and cost \$1.5 million. Containment, treatment of surface water, removal of contaminant hot spots, and institutional controls were also implemented, using an ESD.

A.1.9 Love Canal, Niagara Falls, NY – 1991

This identification of having obtained a TI Waiver is tentative.

A.1.10 Caldwell Trucking Company, Fairfield Twp, NJ – 1989

Residential and industrial septic waste was disposed of in unlined pits and underground storage tanks on this site. Consequently, groundwater contamination with metals, PAHs, PCBs and VOCs resulted. Over 300 private wells and the Passaic River were affected. A TI Waiver was written into the 1989 ROD for federal and state MCLs, based on an estimated timeframe for remediation greater than 100 years.

A.1.11 Rodale Manufacturing Company, Emmaus Borough, Lehigh County, PA – 1999

Due to difficulty in cleanup, a TI Waiver was granted for TCE in groundwater and also for TCE/PCE in soil as part of the 1999 ROD. Groundwater remedial activities had been ongoing

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since 1984. Institutional controls and groundwater use restrictions were included for the Probable DNAPL Zone (TI Zone).

A.1.12 Brodhead Creek Site, Stroudsburg, PA – 1995

Like the Niagara Mohawk Power Co site, the Brodhead Creek site also contained coal tar wastes in an open pit. Complete removal of coal tar residues was determined to be technically impracticable because of site constraints, including a flood control levee and on-site wetlands. An underground slurry wall was installed for containment; removal was achieved using hot water injection, pumping and treatment known as the CROW process (Contained Recovery of Oily Waste).

A.1.13 Aladdin Plating, Scott & South Abington Twps, PA – 1994

This site was the location of an electroplating facility that used process chemicals sulfuric acid, chromic acid, cyanide, nickel, copper and chromium. Unlined lagoons for holding rinse water and sludge were present as well as stored stock materials. After a fire in 1982, the facility closed. In 1987, the EPA began cleanup. Thirty years of monitoring was required for shallow groundwater, contaminated primarily with chromium. Deed restrictions prevent the water from being used as a drinking water source.

A.1.14 E.I. DuPont (Newport Landfill), Newport, DE – 1993

The TI Waiver approved for DuPont was not applied to groundwater. Instead zinc levels in the nearby Christina River exceeded surface water quality standards. Actions were taken to contain groundwater discharges to the river. However, stream discharges from another site made meeting the zinc standard technically impracticable.

A.1.15 Hunterstown Road, Gettysburg, Adams County, PA – 1993

The TI Waiver was granted for groundwater contaminated with DNAPLs at depths greater than 800 feet. Groundwater to the depth of 800 feet was extracted and treated to remove VOCs using air stripping. This was followed by on-site discharge and subsequent air cleaning via catalytic oxidation.

A.1.16 Westinghouse Elevator Plant, Gettysburg, PA – 1992

Fifteen years of experience with a limited pump and treat system combined with the inferred presence of DNAPLs (80 ppm VOCs) in highly fractured sedimentary bedrock was used as justification for a TI Waiver at this site. The state ARAR of cleaning water to background (0.0 ppb VOCs) within 10 yrs was waived. Offsite wells were pumped less aggressively as part of the waiver, acting to contain the plume rather than remediate it. Pump-and-treat will continue until MCLs are met.

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A.1.17 Lindane Dump, Harrison Township, near Natrona, PA – 1992

Between 1850 until 1980, this site was used for waste disposal of mine tailings, sulfuric acid, cinders and slag, followed by pesticides, construction wastes and industrial wastes. Contaminants of concern include benzene and other VOCs, DDT, Lindane, phenols, arsenic and lead. An ARAR Waiver of Pennsylvania state MCLs for Lindane and benzene was based on technical impracticability. Complex hydrogeologic conditions, combined with subsidence and contaminant migration arguments prevented the city from implementing pump-and-treat as a remedial strategy.

A.1.18 Dorney Road Landfill, Mertztown, PA – 1991

The Dorney Road Landfill is a former open-pit iron mine that was converted to a landfill. The TI Waiver was granted for state MCL ARARs and applied to off-site groundwater. The progress of natural attenuation was a justification for the waiver. Further justification is documented in the OU2 ROD.

A.1.19 Heleva Landfill, North Whitehall Township, PA – 1991

The Heleva Landfill was closed by the state of Pennsylvania in 1981, due to denied requests for solid waste permits and refusal to implement a biostimulation project. Prior to that, municipal and industrial wastes, including TCE was disposed of in the landfill. Approximately 150 people within a quarter of a mile used the groundwater under the site as a drinking water source (until 1986). After closing the landfill, the state found VOCs and DNAPLs in the groundwater in exceedance of both state and federal drinking water requirements. Contaminants included benzene, PCE, TCE, toluene and xylenes. Remediation consisted of source investigation, institutional controls (extending piping from an alternative water supply and capping the area), and containment of the plume via pump-and-treat. Downgradient water was also pumped out and treated. A TI Waiver of state and federal MCLs was approved for organics in the groundwater close to the source.

A.1.20 Whitmoyer Laboratories, Myerstown, PA – 1990

State ARARs for benzene, TCE, PCE and arsenic were waived due to the technical impracticability of reaching background levels. A TI Waiver was included for SDWA MCLs should the contingency plan be implemented. Contamination is the result of laboratory activities. Extensive removal of solid hazardous waste has occurred at the site, as well as the operation of a groundwater extraction and treatment system.

A.1.21 Middletown Air Field, Middletown, PA – 1990

In a situation similar to the Dorney Road Landfill, a waiver for state groundwater ARARs was proposed. A TI Waiver was reportedly prepared for the site but withdrawn because the Commonwealth did not concur. More investigation is necessary to determine if the site received a TI Waiver. Contamination consists primarily of VOCs (primarily TCE), PAHs and

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metals. Land was used as an army training camp, army/air force airfield. Industrial operations were also conducted by the air force.

A.1.22 Yellow Water Road Dump, Baldwin, FL – 1992

The site was intended to be a salvage operation for transformers, where PCB contaminated fluids would be removed and incinerated. While waiting for the incineration permit, however, over 150,000 gallons of PCB-contaminated fluids were stored onsite and leaked into the soil and groundwater. Remediation consisted of building demolition, excavation, pump-and-treat, and offsite incineration and disposal. A TI Waiver for the SWDR MCL of 0.5 µg/L PCBs was obtained for the spill area. Institutional controls and monitoring were required.

A.1.23 Continental Steel Corporation, Kokomo, IN – 1998

One of six sites on this property (operable unit 01) was granted a TI Waiver for intermediate and lower groundwater aquifers in fractured bedrock containing base neutral acids, dioxins/dibenzofurans, inorganics, manganese, PAHs, PCBs, pesticides and VOCs.

A.1.24 Highway 71/72 Refinery, Bossier City, Bossier Parish, LA – 2000

This site is located in the downtown area of Bossier City (pop. 56,461, 2000 census). Due to extensive development on site and to community requests, the removal of the sources of groundwater contamination was not incorporated into the Record of Decision. Due to this constraint, a TI Waiver was granted for all areas that did not meet drinking water standards – essentially the entire 215 acres of property, throughout the depths of the shallow aquifer (10 to 60 ft bgs). The waiver encompasses LNAPL contaminants resulting from refinery activities and non-site related activities. The EPA has banned the use of site groundwater as drinking water. The TI Waiver was incorporated into the Record of Decision about one year after the completion of the RI/FS for the site.

A.1.25 Crystal Chemical Company, Harris Cnty, TX – 1997

This front-end TI Waiver was granted for arsenic. Geologic, hydrogeologic and geochemical conditions at the site made it technically impracticable to reach 50 µg/L concentrations of arsenic in groundwater. The Crystal Chemical Company manufactured arsenical herbicides, discharging their wastewater to onsite ponds. Much of the field investigation data used to support the TI Evaluation was obtained from remedial design studies. A minimum of 650 years treatment operation was expected before the 50 µg/L standard for arsenic could be reached. Isolation of the TI Zone with a slurry wall was implemented as the alternative remedial strategy.

A.1.26 Vertac, Inc., Jacksonville, AR – 1995

Herbicide production wastes including dioxin, Agent Orange and chlorinated hydrocarbons are present on site, as a result of inadequate production and disposal methods. Litigation was filed against PRPs Vertac Chemical Company and Hercules, Incorporated. Bankruptcy

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ensued and the EPA took the lead on site cleanup. The TI Waiver for MCLs was obtained for dioxins in groundwater due to the presence of NAPLs and the nature of the hydrogeology (tilted, fractured bedrock). A hydraulic containment system was implemented.

A.1.27 Popile, Inc., El Dorado, AR – 1993

Popile is a wood treatment site with primary contaminants of concern pentachlorophenol (PCP) and creosote. As part of the 1993 ROD, in-situ bioremediation was selected for soil and shallow groundwater contaminants. The USEPA and US Army Corps of Engineers conducted bioremediation studies. The plume will be successfully stabilized by natural attenuation, based on modeling results using EPA's BioPlume III. More information is needed about the TI Waiver obtained at the site.

A.1.28 Hardage/Criner Superfund Site, Criner, OK – 1989

This site was operated as an industrial and hazardous waste disposal facility. Waste was disposed of in unlined pits. When the pit capacity was filled, temporary holding ponds and sludge mounds were used. The Oklahoma State Department of Health (OSDH) revoked the facility permit and remedial activities began. According to the ROD Abstract, a TI Waiver was approved in the 1989 ROD due to geological constraints to remediation. A trench system was installed to intercept groundwater migration in the bedrock zone.

A.1.29 Cherokee County Site, Cherokee County, KS – 1997, 1989

TI Waivers were granted for two of six different subsites in this former mining area. The first waiver was applied to OU 05, the Galena subsite, for acid mine drainage in the shallow groundwater. The second waiver was applied to the Baxter Springs and Treece subsites (18,000 acres collectively), due to the fact that compliance would be "inordinately costly" (\$93 M 1994 dollars). The Cherokee County site is part of the Tri-State Mining District, which was mined for approximately 100 years.

A.1.30 Summitville Mine, Rio Grande County, CO – 2001

At another abandoned mine, cyanide, acid and metal-laden water flows into the Alamosa River. Remediation actions are currently underway, under the direction of the State of Colorado. State surface-water standards have been waived for pH, aluminum, iron and aquatic life, due to the presence of naturally occurring minerals that contribute metals and acidity. Site-wide response actions may exceed \$160 million by the end of 2001.

A.1.31 Silver Bow Creek, Butte Area, Deer Lodge County, MT – 1994

Mine waste, creosote and arsenic contaminated this site. A TI Waiver of state surface water concentrations for arsenic and mercury were waived at the beginning of the river. Instead, concentrations of 2 mg/l arsenic and 0.2 µg/L mercury were used. The waiver was issued for the Mine Flooding operable unit of the site.

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A.1.32 Broderick Wood Products, Denver, CO – 1992

This wood treatment site stored process wastes into two unlined surface impoundments. Waste seepage became so extensive that the waste was burned off, beginning in 1954. Four additional ponds were occasionally used. Contamination was discovered in solid waste disposal areas, during the investigation that followed the closure of the facility in 1981. A chemical-specific ARAR waiver was obtained for groundwater due to technical impracticability. More research on this TI Waiver is necessary.

A.1.33 Whitewood Creek, Whitewood, SD – 1990

Arsenic from mining wastes is the primary contaminant at this site. The wastes were discharged directly into the creek. Mine tailings continue to leach metal-laden water into surface and subsurface waters. A TI Waiver was obtained for both groundwater and surface water. Remediation actions have consisted of removing or covering contaminated soil in residential areas and implementing institutional controls to reduce exposure to arsenic.

A.1.34 East Helena Superfund Site, East Helena, MT – 1989

East Helena was a lead smelting facility. Elevated lead and arsenic levels were found in the area. State surface water requirements were waived for arsenic and mercury due to TI.

A.1.35 Koppers Company, Inc., Oroville, Butte County, CA – 1999

A post-implementation TI Waiver was granted at a wood treatment facility after 10 years of remedial activities. The TI Zone is 4 acres, and contains multiple contaminants including dioxins, PAHs (creosote) and pentachlorophenol (PCP). Monitoring wells were required in the TI Zone and downgradient of the area. Continued operation of pump-and-treat will be required if contamination escapes the TI Zone. Outside of the TI Zone, enhanced in-situ bioremediation is now being used for (PCP) degradation.

A.1.36 Montrose/Del Amo Site, Los Angeles, CA – March 1999

These two sites have commingled groundwater contamination including DDT, TCE, PCE, benzene and chlorobenzene. Groundwater contamination extends to a depth of 300 feet, with a mile long plume of chlorobenzene (DNAPL chemical) and benzene (LNAPL chemical). In a dual-site groundwater ROD, the US EPA waived MCLs as cleanup requirements for a 4-acre Del Amo waste pit and authorized a containment zone instead, with institutional controls and monitoring.

A.1.37 J.H. Baxter and Company Wood Treatment Plant, Weed, Siskiyou County, CA – 1990

The original remedial actions prescribed for the site, which included pump-and-treat, were amended with a TI Waiver for a large area of groundwater impacted with DNAPLs. The DNAPL-impacted area was isolated with a subsurface slurry to create a containment zone. Offsite mitigation measures were approved to compensate for the loss of beneficial uses of the contained groundwater.

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A.1.38 Schofield Barracks, Oahu, HI – 1997

This site obtained a TI Waiver for a TCE plume that was 500 to 700 feet deep in a fractured lava formation on a Hawaii army base. The justification for TI included the extreme depth to the contaminated groundwater, difficulties in identifying the multiple contamination sources and the complex geology. These factors combined to present “inordinately costly” situation. In addition, the TCE plume was shown to be contained. Air stripping treatment of all well water is required, in addition to monitoring of all wells downgradient of the plume.

A.1.39 Tucson International Airport Area, Tucson, AZ – 1997

Chromium and TCE were both present at the site, due to historical and current electroplating and solvent usage. Elevated chromium levels were found in the municipal water supply. Residents using private wells complained of a foul chemical odor. Unsafe levels of TCE were revealed after testing. A five-mile long plume was found under the site. The TI Waiver was obtained for ...

A.1.40 Westinghouse Electric, Sunnyvale, CA – 1991

Transformer manufacturing resulted in contamination with PCBs and mineral oil. The TI Waiver of MCL standards for PCBs was granted in the Record of Decision and explained in the FS. The waiver was applied to the source area where DNAPL occurred. Soil was excavated down to 8 ft and institutional controls were implemented for soil and groundwater within the TI Zone.

A.1.41 Del Norte Pesticide Storage Area, Crescent City, CA – 1985

Cleanup to 10 µg/L action levels was waived for a groundwater plume of 1,2-Dichloropropane (1,2 DCP) present at concentrations up to 38 µg/L. Asymptotic levels of 1,2-DCP were obtained after four years of groundwater extraction system operation. Plume reduction data and the inability of treatment systems to reduce 1,2 DCP concentrations formed the skeleton of the TI Evaluation.

A.1.42 Eielson Air Force Base, Fairbanks, AK – 1998

This Alaskan Air Force Base Superfund Site encompasses 19,700 acres. Remediation is being addressed for five separate units, distinguished from one another by the contamination source. A TI Waiver was obtained for lead action levels and was applied to areas that formerly contained buried drums. The waiver was granted based on the reasoning that lead was essentially immobile in the groundwater. Institutional controls and monitoring are currently in place.

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A.2 Detailed CERCLA Site Summary

The following summarizes relevant details for a CERCLA site that obtained a TI Waiver. This summary serves as an example of the depth of investigation that will be performed during Phase II.

Site Information:

Koppers Industries, Inc, Oroville/Butte CA, EPA Region 9, EPA ID# CAD009112087

Site Setting:

This is a wood treatment site, still in operation. Groundwater is contaminated with pentachlorophenol (PCP) both on- and off-site. PCP was detected in neighboring drinking water wells (2 miles away). The identified potentially responsible party (PRP) is Beazer East. The Process Area will be remediated when the plant closes. Pumping from an off-site well was discontinued because contamination was no longer reaching the well, and the system was only treating clean groundwater. The off-site plume had shrunk naturally.

Date of TI Decision:

09/23/1999

Post-Implementation or Front End:

Post-Implementation

Regulatory Agency(s) Involved:

EPA was the lead agency. DTSC, C RWQCB, Central Valley were also involved. The state issued the cleanup orders.

Documentation of Waiver:

ROD: EPA/541/R-99/094. The TI Decision was part of a ROD amendment.

Extent of Site Investigation Prior to Waiver:

Ten years for groundwater investigation (1989 to 1999 ROD amendment).

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Timeline of Site Remedial Activities:

<i>Date</i>	<i>Action</i>
1986	Provided an alternative water supply.
1986	Built cap to stabilize source, after a fire.
1994	Built an on-site landfill.
1995-	Dioxins hindered choices for remedial actions.
1989	ROD and selection of remedy - GW: pump and treat w/ GAC, re-inject into aquifer. Soil: In-situ remediation w/ capping.
1989-	Treatability studies showed no alternative worked for ALL contaminants in the soil.
1995	FS submitted by PRP.
1995	Off-property P&T was taken offline – no contaminants reaching it anymore.
1996	ROD amendment: on-site landfilling and revised cleanup standard to industrial use levels (accompanied by deed restrictions).
1997	Five-yr remedy review concluded remedy was protective.
1999	ROD amendment #2: TI Waiver for DNAPL on 4 acres/200 total. Also added enhanced in-situ bio to the remedy for PCP and added MNA as contingency.

Also, in 1995, a pilot-scale biotreatment system was started for the TI Zone. The system removed 160 gallons of creosote and 220 gallons of creosote emulsion out of potential million gallons of free product. This took 3 1/2 years.

Other Options Considered for the Site:

Other remedial alternatives were considered, but none met drinking water standards. Remedial strategies were evaluated based on protectiveness of human health and environment, etc: 1) no action 2) grout curtain wall 3) thermal 4) steam enhanced P&T 5) continue P&T and 6) monitor containment and set up TI Zone (selected). No remedy met drinking water standards. Some protected human health & the environment better than others. Alternative 6 was the most cost effective.

What was TI about the site?

DNAPL was present in low permeability clay. No technology existed to clean the aquifer to drinking water standards.

TI Application?

Yes – copy obtained from EPA library.

TI Zone/Zone of Contamination:

The TI Zone is 4 acres out of 200 total. It includes the Former Creosote Pond and Cellon Blowdown areas.

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Contaminants for which ARARs were waived:

Dioxin (PCDDs/PCDFs), cPAHs and PAHs, and PCP (lower health threat) – also known as creosote, dioxin, & PCP.

Other contaminants?

Furans and heavy metals including copper, chromium, and arsenic were also present.

Volume and depth of contamination:

Contamination exists below the excavated surface layer (13 ft, 10 ft in TI Zone areas) to a depth of 125 – 250 ft. Area = 4 acres. This represents 50 yrs of contamination.

CSM? How detailed is it?

~ 3 pages. The CSM includes the geology of TI Zone and fate and transport of the contaminants to date. Evidence of DNAPL is related in the description. The amount of degradation occurring naturally is discussed as well.

Data Basis for the Decision?

The decision is based on the extent of creosote contamination in the TI Zone and concentration data collected in this area. The general behavior of DNAPLs is included, as well as a summary about each contaminant. Clay layer geology was reported in the TI Zone. No downgradient detections have occurred.

Treatability studies for bioremediation, soil washing and soil fixation were conducted, as well as a leachability study of the soil into groundwater. Source removal was demonstrated. The site was compared to the Brodhead Creek Site and other Superfund sites where pilot studies were conducted.

Estimated Timeframe? Cost Estimates?

Their analysis indicated only 20-30 years. However, they also compared the site to the JH Baxter Superfund site, in which 3000 years were calculated for pump&treat alone (50-400 years if bioremediation was considered). A longer timeframe is expected at the Koppers site. Cost = \$20-67 M vs. \$0.25 M for TI Zone approval. Cost comparison between the existing (\$2.9 M present worth) and proposed remedies (\$ 0.8 M) was presented.

Alternative Remedial Strategy?

For areas outside of the TI Zone, enhanced bioremediation was chosen. This remedy was shown to be faster than the current P&T operation. Within the TI Zone, semi-annual monitoring, monitoring of the TI Zone for containment and the installation of one new well were required. Contingency P&T containment was also required, should monitoring reveal that natural containment was not working. Deed restrictions were placed on the property. An annual review of industrial activity around the TI Zone was required.

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EPA Contact?

Charles Berrey, Project Manager

EPA HQ Contact?

Signed by Keith Takata, Director of the Superfund Division. He has the authorizing signature that approved the TI Waiver.

How long was the process?

The TI Evaluation was first submitted in December 1997. A revised TI Evaluation was submitted in June 1998, and the final evaluation on March 1999. The ROD Amendment was signed in September 1999.

Reason for granting TI Waiver:

No surface soil contamination was present (source removal was demonstrated), containment was achieved (shown through groundwater monitoring data), and technical impracticability of removing DNAPL within the saturated zone (30-300 ft bgs) was demonstrated. The creosote contained in underlying clay layers was modeled, illustrating that it was trapped. The low solubility of creosote was also pointed out.

What review was required?

Review within 5 years and monitoring was required. Nothing was mentioned about a technology review in the future.

Formal Summary of Reasons?

Yes, in the ROD Amendment.

Organizational Comments:

The TI Evaluation is very structured and fairly well presented. The main points are that 1) the area is well-contained (10 ft/yr migration of contamination vs. 500 ft/yr groundwater migration) 2) the source has been effectively removed – surface soils are now gone and no groundwater contamination has resulted from the soil that remains in place, beyond 500 ft from the source 3) Costs to remove the remaining contaminant mass are high 4) Removing mass will not result in lower concentration and 5) Deed restrictions, monitoring etc. are considered protective for preventing people from contacting contaminated water directly under the source.

**Appendix B.
Interview Data**

APPENDIX B. INTERVIEW DATA

The information contained in this section will be further refined before the interviews are conducted as part of Phase II. Preliminary interview questions and a list of contacts are presented here.

The information obtained from the interviews will be used primarily in Section 4 of the guidance document. Knowledge gained through this personal communication will be used to explain the decision-making process for each region. Examples of the decision-making process for a few selected sites will be incorporated into the guidance document. Interview contacts may also be helpful in identifying sites that are currently in the process of TI Waiver review or sites that are considering applications. Sites that applied for TI Waivers but did not receive them may also be identified. Contact persons may be able to summarize the reasons why the waiver was not granted.

Limitations to this approach include the ability to identify key contacts within each region. In some cases, a regional coordinator for TI Waivers does not exist for the region.

B.1. Interview Contacts

The people identified as key contacts in the TI Waiver approval process represent a cross-section of the various parties concerned with the TI implementation process. They include project managers, state contacts, regional contacts (waivers are ultimately approved at a regional level), staff at EPA headquarters (who work with project managers and regional contacts) and technical specialists (such as hydrogeologists) who review TI Evaluation Reports. One contact is a TI Waiver applicant, responsible for co-writing the TI Evaluation for the Highway 71/72 Refinery site in Region 6.

Table B-1 contains the contacts identified for the interview portion of this report. These people will be contacted and interviewed for a short 30-minute interview by the Malcolm Pirnie project team.

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Table B-1: EPA and State Contacts for Interview

EPA Region	Contact Name	Contact Title	Contact Information
1	Mike Daly	Remedial Project Manager	(617) 918-1386 daly.mike@epamail.epa.gov
1	Bill Brandon	Hydrogeologist (Technical Review)	(617) 918-1391 Brandon.bill@epamail.epa.gov
1	Larry Brill	Region 1 TI Contact	(617) 918-1301 brill.larry@epa.gov
1	Ken Lovelace	EPA Headquarters Contact	(703) 603-8787 lovelace.kenneth@epa.gov
2	Alison Hess	Remedial Project Manager	(212) 637-3959 hess.Alison@epa.gov
3	Kathy Davies	Region 3 TI Contact	(215) 814-3315 davies.kathryn@epa.gov
3	Frank Vavra	Remedial Project Manager	(215) 814-3221 vavra.frank@epa.gov
4	Bill Ostein	Groundwater Expert (Technical Review)	(404) 562-8645
5	Pat Likins	State of Indiana Contact (State-Lead Project)	(317) 234-0357 plikins@dem.state.in.us
6	Kathleen Aisling	TI Waiver Applicant, Region 6	(214) 665-8509
7	Craig Smith	Region 7 TI Contact	(913)551-7683 Smith.Craig@epa.gov
8	Austin Buckingham	State of Colorado Contact (State-Lead Project)	(303) 692-3435
9	John Kemmerer	Region 9 Branch Chief	(415) 744-2421 Kemmerer.john@epa.gov
9	Jeff Dhont	Remedial Project Manager	(415) 744-2399 dhont.jeff@epa.gov
9	Herb Levine	Hydrogeologist (Technical Review)	(415) 744-2312
9	Tom Kremer	Groundwater Policy Expert	(415) 744-2257
9	Keith Takata	Director of the Superfund Division, Region 9	(415) 744-1730 Takata.keith@epa.gov
10	Mary Jane Nearman	Remedial Project Manager	(206) 553-6642 Nearman.maryjane@epa.gov

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B.2. Interview Questions

A list of questions for contact persons is presented below. The list will be refined during Phase I Review to focus the scope of the Phase II interviews. Some questions are site-specific (appropriate for project managers) while others are more appropriate for regional or headquarters contacts.

TI Waiver Applications:

1. What has been the application rate for TI Waivers in your region, to the best of your knowledge? Although fewer than 50 TI Waivers have been granted to date at Superfund sites, how many applications have been denied?
2. Have any sites in the region been denied TI Waivers, to your knowledge? What reasons were given for the denial?
3. Why have so few sites requested TI Waivers (or been granted waivers), considering the extent of DNAPL contamination in the US, and the large number of sites at which remedial actions are not working?
4. Has a TI Waiver been granted for sources that are still in place?
5. Are you aware of sites that are currently involved in the TI Waiver process?

TI Decision-Making:

6. If a TI Waiver was received by someone in your region, whom would it go to? What is the chain of approval for the region? Who is involved in the decision? Who makes the final decision? Is an EPA Technical Resource Team involved in the review process? How long is the review process?
7. Who is the EPA Headquarters contact for TI Waivers for your region?
8. When is the state involved in a CERCLA site?
9. Are you aware of any sites during which the role of the public was significant / altered the outcome of the TI decision?
10. What does the EPA consider a demonstration of technical impracticability, especially for front-end implementation TI Evaluations? How much documentation and study is required for a TI Waiver?

Site-Specific:

11. What was the main reason the TI Waiver was granted?
12. Are you aware of any TI Waivers reviewed or granted after 1998 in your region? Do you know of EPA project managers of these sites?

**APPENDIX C. SUMMARY
OF RESEARCH ACTIVITIES**

APPENDIX C. SUMMARY OF RESEARCH ACTIVITIES

Considerable research has already been performed to identify all documents pertaining to the TI Waiver application process, the review process and the documentation of TI Decisions. In addition, information has been collected for sites that have obtained TI Waivers in the past.

Our primary sources for research include written documents and personal communication with EPA and state personnel.

C.1. Literature Search

Library and online library searches were performed to identify and obtain copies of all documents containing information about the TI Waiver application and approval processes. The search focused initially on EPA documents containing any information on technical impracticability. This search was broadened to library and Internet-wide searches to obtain leads on technical impracticability waiver processes and sites that had obtained or applied for TI Waivers. In addition, copies of documents and regulations relevant to the TI process were obtained.

Next the research efforts were extended to identify all sites that had obtained TI Waivers in the past. A preliminary list of CERCLA sites with waivers incorporated into the Records of Decision was obtained from EPA Headquarters. Research on these sites was performed, yielding both general and TI Waiver-specific site information. EPA Regional offices were contacted for more information.

Documents that were not available online were ordered from EPA libraries or directly from site contacts. All documents were reviewed and compiled for this guidance document draft. A complete set of references is included in Section 7 of this report.

In addition, an electronic copy of the full text of Records of Decision (RODs) issued between 1982 and 2001 was obtained from the EPA (Superfund Public Information System (SPIS) CD). The SPIS CD also contains 177 Explanations of Significant Differences (ESDs) and 118 ROD Amendments. This tool will enable us to be comprehensive in our identification of sites with TI Waivers. In addition, it will greatly facilitate our research into the TI Waiver approval process.

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C.2. Key Persons Identified and Contacted

In addition to our search for written documentation of TI Waivers, and often complimenting that search, persons in the EPA, state hazardous waste division offices and other organizations were identified and contacted. Other Malcolm Pirnie employees were consulted for further information on TI Waivers. After compiling a list of project managers for CERCLA sites, each manager was contacted for additional information. Site-specific documents were requested, as well as information on region-wide TI Waiver policy. This often resulted in referral to one or several other persons associated with the site waiver, who were also contacted. Persons selected for interview were identified and contacted. A summary of the activity conducted is shown in Table C-1.

Table C-1: Contact History for Phase 1

Site #	EPA Region	EPA Site Manager	Contact History	Contact Response	Sent Site Documents?	Follow-Up Referral?
1	1	Roger Duwart	Y	Y	N	Y
1	1	Larry Brill	N	-	-	-
2	1	Mike Daly	Y	Y	Y	Y
3	1	Terrence Connelly	Y	N	N	N
4	1	Ed Hathaway	Y	Y	N	Y
5	1	Dave Lederer	Y	Y	Y	N
6	1	Almerinda Silva	Y	Y	N	Y
6	1	Bill Brandon	Y	Y	N	N
7	2	Pat Hamlett	Y	N	-	-
8	2	Alison Hess	Y	Y	Y	Y
8	2	Vince Pitruzzello	N	-	-	-
9	2	Damian Duda	Y	Y	Y	N
10	2	Rick Robinson	Y	Y	Y	N
11	3	Maria de los A Garcia	Y	N	-	-
12	3	John Banks	Y	Y	Y	N
13	3	Gregory Ham	Y	N	-	-
14	3	Randy Sturgeon	Y	Y	N	Y
15	3	John Banks	Y	Y	N	N
16	3	Frank Vavra	Y	Y	N	Y
16	3	Kathy Davies	N	-	-	-
16	3	Bhupi Khona	N	-	-	-
17	3	Donna Santiago	Y	N	-	-
18	3	Jill Lowe	Y	Y	N	Y
19	3	Richard Watman	Y	Y	N	Y
20	3	Christopher J. Corbett	Y	Y	N	N
21	3	Monica McEaddy	Y	N	-	-
22	4	David Lloyd	Y	Y	-	Y
22	4	Bill Ostein	Y	Y	-	-
22	4	Mindy Carreras	Y	Y	-	-

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Site #	EPA Region	EPA Site Manager	Contact History	Contact Response	Sent Site Documents?	Follow-Up Referral?
23	5	Matt Mankowski	Y	Y	N	Y
23	5	Pat Likins	Y	Y	Y	-
24	6	Stephen Tzhone	Y	Y	Y	Y
24	6	Kathleen Aisling	N	-	-	-
25	6	Chris Villarreal	Y	Y	Y	Y
25	6	Matt Charsky	N	-	-	-
26	6	Vincent Malott	Y	N	-	-
27	6	Shawn Ghose	Y	N	-	-
28	6	-	-	-	-	-
29	7	Dave Drake	Y	Y	Y	Y
29	7	Craig Smith	N	-	-	-
30	8	Victor Ketellapper	Y	Y	Y	Y
30	8	Austin Buckingham	N	-	-	-
31	8	Russ Forba	Y	Y	Y	Y
31	8	Kevin Kirley	Y	Y	Y	-
31	8	Dale Vodehnal	Y	Y	N	N
32	8	Armando Saenz	Y	N	-	-
33	8	Gwen Hooten	Y	Y	N	Y
33	8	Bert Garcia	Y	Y	N	Y
33	8	Norvil Shanehouse	N	Y	-	-
33	8	Rebecca Thomas	Y	Y	N	Y
34	8	-	-	-	-	-
35	9	Charles Berrey	Y	Y	Y	N
36	9	Jeff Dhont	Y	Y	Y	Y
36	9	John Kemmerer	N	-	-	-
37	9	Beatriz Bofill	Y	Y	-	Y
37	9	Travis Cain	N	-	-	-
38	9	Mark Ripperda	N	-	Y	-
39	9	Eugenia Chow	Y	Y	N	Y
39	9	Harry Ball	Y	Y	N	N
40	9	Rose Marie Caraway	Y	Y	N	Y
40	9	Herb Levine	N	Y	N	N
41	9	Beatriz Bofill	Y	Y	Y	-
42	10	Mary Jane Nearman	Y	N	-	-
-	8	Gene Taylor	Y	Y	N	Y
-	5	Tom Barounis	Y	Y	N	Y
-	5	Marty McCleery	N	-	-	-
-	3	Ken Lovelace	Y	Y	Y	-

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In addition, a few contacts for sites that did not receive TI Waivers were uncovered during this process. Several contacts for sites considering application for a TI Waiver were identified. EPA Branch library staff was contacted so that additional documents could be obtained through Freedom of Information Act (FOIA) Requests.

A select number of people identified and contacted during Phase I activities will be interviewed during Phase II of the study. More site-specific documents can be obtained from EPA libraries with help from site remedial project managers.

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