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Revision 0

Medial Zone Rebound Test for Operable Unit 1-07B Test Area North

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Idaho Completion Project

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ABSTRACT

The New Pump and Treat Facility (NPTF) has been operating as the selected remedy for the medial zone of the Test Area North (TAN) trichloroethene (TCE) plume since October 2001. NPTF operations have resulted in TCE concentration reductions to less than 100 μg/L in the medial zone. The Record of Decision Amendment specifies that monitored natural attenuation (MNA) is the remedy for the distal zone, defined as that portion of the plume with TCE concentrations less than 1,000 μg/L. Given current medial zone contaminant trends, it is appropriate at this time to begin the process of evaluating whether MNA can become the remedy for the medial zone of the TAN plume, replacing the NPTF.

This report describes the purpose, objectives, and design of a rebound test that will measure trends in contaminant concentrations in response to placing the NPTF in standby mode. The planned duration of the test is 24 months, but the test will be dynamic in the sense that periodic monitoring data will be evaluated to determine its actual duration. Rebound to unacceptably high concentrations before the end of the 24-month test will result in termination of the rebound test and restart of the NPTF. Ultimately, the rebound test data will be evaluated to determine whether MNA can replace the NPTF as the medial zone remedy.

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ACRONYMS

ASTU	air stripper treatment unit
IRC	INEEL Research Center
ISB	in situ bioremediation
MCL	maximum contamination level
MNA	monitored natural attenuation
NPTF	New Pump and Treat Facility
OU	operable unit
RAWP	Remedial Action Work Plan
ROD	Record of Decision
SAP	Sampling Analysis Plan
TAN	Test Area North
TCE	trichloroethene
VOC	volatile organic compound

Medial Zone Rebound Test for Operable Unit 1-07B Test Area North

1. INTRODUCTION

The New Pump and Treat Facility (NPTF) has been operating as the selected remedy for the medial zone of the Test Area North (TAN) trichloroethene (TCE) plume since October 2001. The *New Pump and Treat Facility Remedial Action Work Plan for Test Area North Final Groundwater Remediation, Operable Unit 1-07B* (DOE-ID 2003a) establishes the design basis for the NPTF, as follows:

> …to capture and treat groundwater between the hot spot containment zone and the medial zone extraction wells…the design influent concentrations for VOCs were established; for TCE the design concentration is 1,100 µg/L.

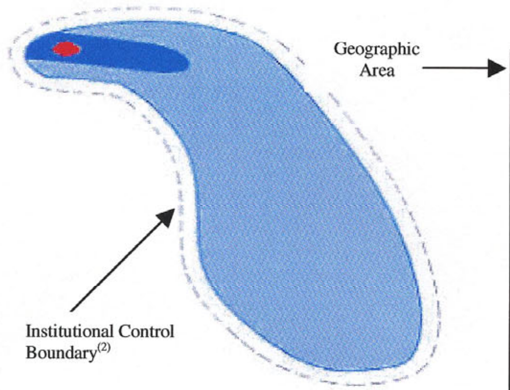
The *Record of Decision Amendment—Technical Support Facility Injection Well (TSF-05) and Surrounding Groundwater Contamination (TSF-23) and Miscellaneous No Action Sites, Final Remedial Action* (DOE-ID 2001) states that the NPTF will operate until concentrations of all volatile organic compounds (VOCs) are below maximum contaminant levels (MCLs) in the medial zone of the TAN plume. The Record of Decision (ROD) Amendment also specifies that monitored natural attenuation (MNA) is the remedy for the distal zone, defined as that portion of the plume with TCE concentrations less than 1,000 µg/L. Recent sampling results from the NPTF compliance monitoring have shown that medial zone influent TCE concentrations have decreased to less than 100 µg/L, which is an order of magnitude less than the concentration that MNA will treat as defined in the ROD Amendment (DOE-ID 2001).

Figure 1 presents illustrations of the Operable Unit (OU) 1-07 B multicomponent remedy at different points in time (the times specified in the figure are for illustrative purposes only). The upper illustration shows all three remedy components operating, which is the current status at TAN. The middle illustration represents the point in time at which the medial zone contaminant concentrations have been reduced below the concentration that meets MNA criteria, enabling a decision that the medial zone can become part of the distal zone remedy. In this case, MNA has become the remedy for the medial zone as well as the distal zone, and the NPTF would be placed in standby mode for an appropriate period of time. The lower illustration in Figure 1 shows the point in time at which in situ bioremediation (ISB) has remediated the hotspot and MNA becomes the remedy for the entire plume.

Given the current trends in medial zone concentrations, it is appropriate at this time to begin the process of evaluating whether MNA can become the remedy for the medial zone of the TAN plume. In other words, the medial zone contaminant data suggest that it is appropriate to begin evaluating whether the multicomponent remedy at OU 1-07B can transition from the upper illustration to the middle illustration depicted in Figure 1. Should this evaluation provide sufficient data to support a decision to transition from NPTF to MNA as the medial zone remedy, the appropriate regulatory documentation will have to be prepared to obtain approval for the transition. Thus, it is important that the evaluation of NPTF performance include sufficient monitoring and data analysis to support completion of the regulatory documentation.

2001-2015(1)

Operations during this period consist of ISB at the Hot Spot, NPTF at the Medial Zone, and MNA in the Distal Zone. It is assumed that ISB has successfully achieved the completion criteria for performance operations, which consist of stopping VOC flux from the Hot Spot.



Monitoring Program

Hot Spot	Medial Zone	Distal Zone	Remedy Component
ISB Performance ISB Compliance			ISB
NPTF Performance (NPTF Contingency)	NPTF Performance NPTF Compliance		NPTF
MNA(3) Performance (Radionuclide)	N/A	MNA (3) Performance	MNA

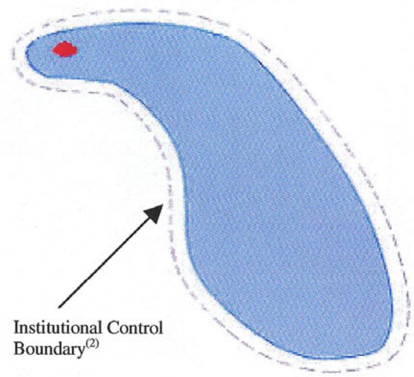
Operations during this period consist of ISB at the Hot Spot and MNA for the Distal Zone(4). It is assumed that the NPTF has successfully achieved the Medial Zone completion criteria and is in standby mode.

2016-2020(1)

Monitoring Program

Geographic Area →

Hot Spot	Medial Zone	Distal Zone	Remedy Component
ISB Performance ISB Compliance			ISB
N/A	N/A		NPTF
MNA Performance (Radionuclide)	MNA Performance(5)	MNA Performance	MNA



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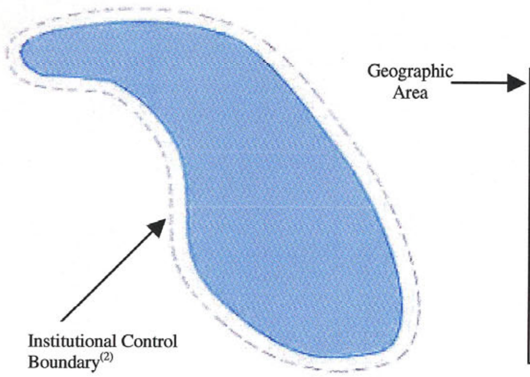
Operations during this period consist of MNA in the Distal Zone(4). It is assumed for this period that ISB has successfully achieved the completion criteria for long-term operations and not only has the flux been cutoff, but the source has been degraded.



Monitoring Program

Hot Spot(7)	Medial Zone	Distal Zone	Remedy Component
			ISB
			NPTF
MNA Performance(5) (Radionuclide)	MNA Performance(5)	MNA Performance	MNA

(1) The dates and the shape of the plume shown are for illustrative purposes only.
(2) The institutional control boundary extends 40% beyond the current dimensions of the plume: 30% to account for expansion and an extra buffer of 10%.
(3) MNA compliance requirements during this period consist of annual monitoring for at least the first 5 years.
(4) The Distal Zone is defined as the areal extent of the plume that is less than 1,000 µg/L TCE and greater than 5 µg/L TCE.
(5) The MNA monitoring program will be expanded to include additional wells to be monitored for MNA performance parameters.
(6) Assumes the Hot Spot has been removed.
(7) ISB or some yet to be determined technology will operate at the Hot Spot until Hot Spot RAOs are achieved.

Figure 1. OU 1-07B multi-component remedy.

1.1 Rebound Test Report Purpose

The purpose of this document is to define the elements of a test plan that will guide collection of detailed performance data to monitor rebound in the medial zone. Initiation of a rebound test at this time is advantageous for several reasons. First and foremost, it may ultimately provide the data that form the basis for replacing NPTF with MNA as the medial zone remedy, which represents a large cost savings. Secondly, a rebound test is technically defensible at this time, based on the current medial zone contaminant trends. Thirdly, although a rebound test will involve increased groundwater monitoring activities, the cost of the test is projected to be significantly less than the cost of continuous NPTF operations over the same time period.

1.2 Rebound Test Objectives

As described above, the ultimate goal of the rebound test is to provide data that will be used to determine whether MNA can replace pump and treat as the medial zone remedy. Execution of the rebound test represents the first of several steps in this evaluation process. Specific technical objectives for the medial zone rebound test include:

- Monitor TCE and tritium rebound in medial zone wells in response to placing the NPTF in standby mode
- Monitor upgradient concentrations to assess the contribution of TCE flux from the hotspot to any potential rebound that may occur during the test
- Attempt to quantify the portion of the observed medial zone concentration reduction that is temporary (i.e., the effect of capturing clean water from outside the plume) versus permanent.

1.3 Rebound Test Overview

This section provides an overview of the important components of the rebound test. These include (1) the test duration; (2) a summary of sampling locations, frequency, and analytes; and (3) a summary of the dynamic decision-making process that will be employed during the test. These elements are discussed further in subsequent sections of the document.

1.3.1 Rebound Test Duration

The planned duration for the rebound test is 24 months, but the test will be dynamic in the sense that periodic monitoring data will be evaluated to determine its actual duration. Assuming a groundwater velocity at TAN of 0.5 ft/day, the maximum distance that a volume of groundwater could move during the 24-month rebound test is approximately 365 ft. Since the distance between TAN-40 and TAN-38 is approximately 400 ft, any TCE rebound to unacceptable levels can easily be captured by restarting the NPTF even if the rebound test runs its full duration.

1.3.2 Rebound Test Sampling Location, Frequency, and Analytes

The test area will include five medial zone monitoring wells (TAN-33, TAN-36, TAN-41, TAN-43, and TAN-44), one upgradient well (TAN-29), and one downgradient well (TAN-48) (refer to Figure 2 for well locations). Analytes collected during the test will include VOCs and tritium. Monitoring will be conducted during the following four phases:

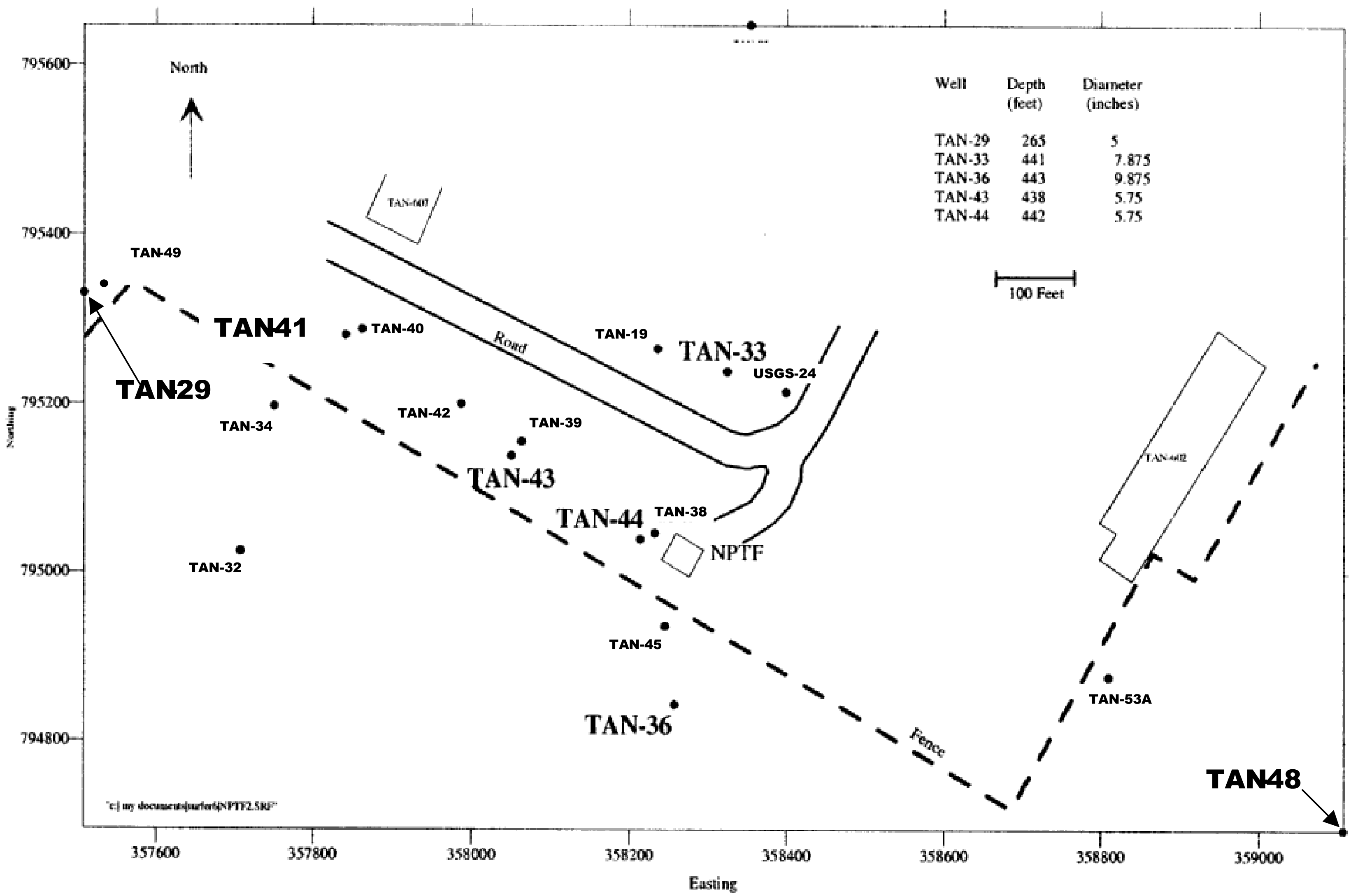


Figure 2. TAN medial zone showing rebound test monitoring wells in bold type.

- Baseline sampling (prior to NPTF shutdown)
- Initial rebound period
- Transition period
- Equilibrium period.

1.3.3 Dynamic Decision Criteria

Rebound test data evaluation will be conducted using two approaches: (1) a short-term approach and (2) a long-term approach. These are discussed in detail in Section 3.4. The short-term data evaluation approach incorporates a dynamic decision-making process that will allow for the duration of the medial zone rebound test to potentially change based on the results obtained during the test. The most important parameter for the dynamic decision-making process is TCE concentration from the five medial zone monitoring wells listed above. TCE rebound to near-original concentrations in these wells before the end of the 24-month test will result in termination of the rebound test and restart of the NPTF. If no unacceptably high rebound occurs during the 24-month planned duration of the rebound test, then the data will be evaluated to determine if an NPTF restart is warranted or if it can remain in standby mode for an additional period of time. Ultimately, the rebound test data will be evaluated using the long-term data evaluation approach to determine whether MNA can replace the NPTF as the medial zone remedy.

1.4 Document Organization

Section 1 of this document has provided an overview of the rebound test, its objectives, and its design. Section 2 discusses historical and current contaminant data from selected medial zone wells. These data are presented and discussed to provide the basis for initiating the rebound test at this time. Section 3 presents the details of the rebound test, including sampling locations, analytes, and frequencies. Section 3 also presents the dynamic decision criteria that will be used to potentially determine the duration of the rebound test, as well as the long-term data evaluation approach that ultimately will be used to determine whether MNA can become the medial zone remedy.

2. HISTORICAL AND CURRENT CONTAMINANT TRENDS

Substantial data are available to illustrate historical and current contamination levels in the medial zone. Beginning in 1996, yearly sampling events were conducted until initiation of NPTF operations in the medial zone in October 2001. Since the start of NPTF operations, routine performance and compliance monitoring have occurred and the data have been evaluated and reported in several annual reports. This section presents relevant data from these reports for several medial zone wells. It also discusses contaminant trends at Well TAN-29 in response to a different pump and treat unit—the air stripper treatment unit (ASTU), which can be used as an example of one potential response that may be observed during a rebound test.

2.1 Medial Zone Wells

Figure 2 presents a map of the OU 1-07B medial zone, including the location of several monitoring wells. Figure 3 presents the NPTF influent TCE concentrations over time, which were from samples collected from the SP-1 sample port located on NPTF piping upstream of the air strippers. The SP-1 data represent a composite TCE concentration from the three NPTF extraction wells (TAN-38, TAN-39, and TAN-40) depending on the operating strategy at the time. Although pre-NPTF data were collected from these three extraction wells, the SP-1 influent data cannot be interpreted as quantitatively representing trends at any single extraction well, except for operational periods when only one extraction well was pumping.

In addition to the NPTF influent data, samples have been regularly collected both before and during NPTF operations from several medial zone wells. TAN-33 and TAN-36 have been monitored to provide information regarding the width of the capture zone and the impact of the NPTF on the periphery of the medial zone. TCE and tritium data from these wells are presented in Figures 4 and 5.

Wells TAN-43 and TAN-44 have been monitored since the startup of NPTF in October 2001. These wells were located and constructed to provide surrogate monitoring for NPTF extraction wells TAN-39 and TAN-38, respectively (refer to Figure 2 for well locations). Therefore, it can be assumed that data from each of these well pairs can be combined for purposes of interpretation of medial zone contaminant trends. Figures 6 and 7 present TCE and tritium data from the TAN-39/43 and TAN-38/44 well pairs. In general, the pre-NPTF data were collected from the extraction wells TAN-38 and TAN-39, and all post NPTF data have been collected from the monitoring wells TAN-43 and TAN-44.

It should be noted that the third NPTF extraction well, TAN-40, was also monitored extensively prior to NPTF operations, but has not been monitored since NPTF operations began. Unlike the other extraction wells, the surrogate monitoring location for TAN-40 (TAN-41) was not included in the NPTF performance monitoring program. However, from October 2002 through November 2002, TAN-40 was the only NPTF extraction pump in operation, and, thus, the SP-1 data can be considered representative of TCE concentrations at TAN-40. Figure 8 shows the TCE and tritium data from TAN-40, with the post NPTF-data being from the SP-1 influent sampling results.

In all five cases (Figures 4 through 8), it can be seen that the NPTF has resulted in a significant decrease in TCE and tritium concentrations in all medial zone wells. Based on these concentration reductions, it is now appropriate to initiate a rebound test to assess the impact that NPTF has had on the medial zone and to determine whether MNA can become the medial zone remedy.

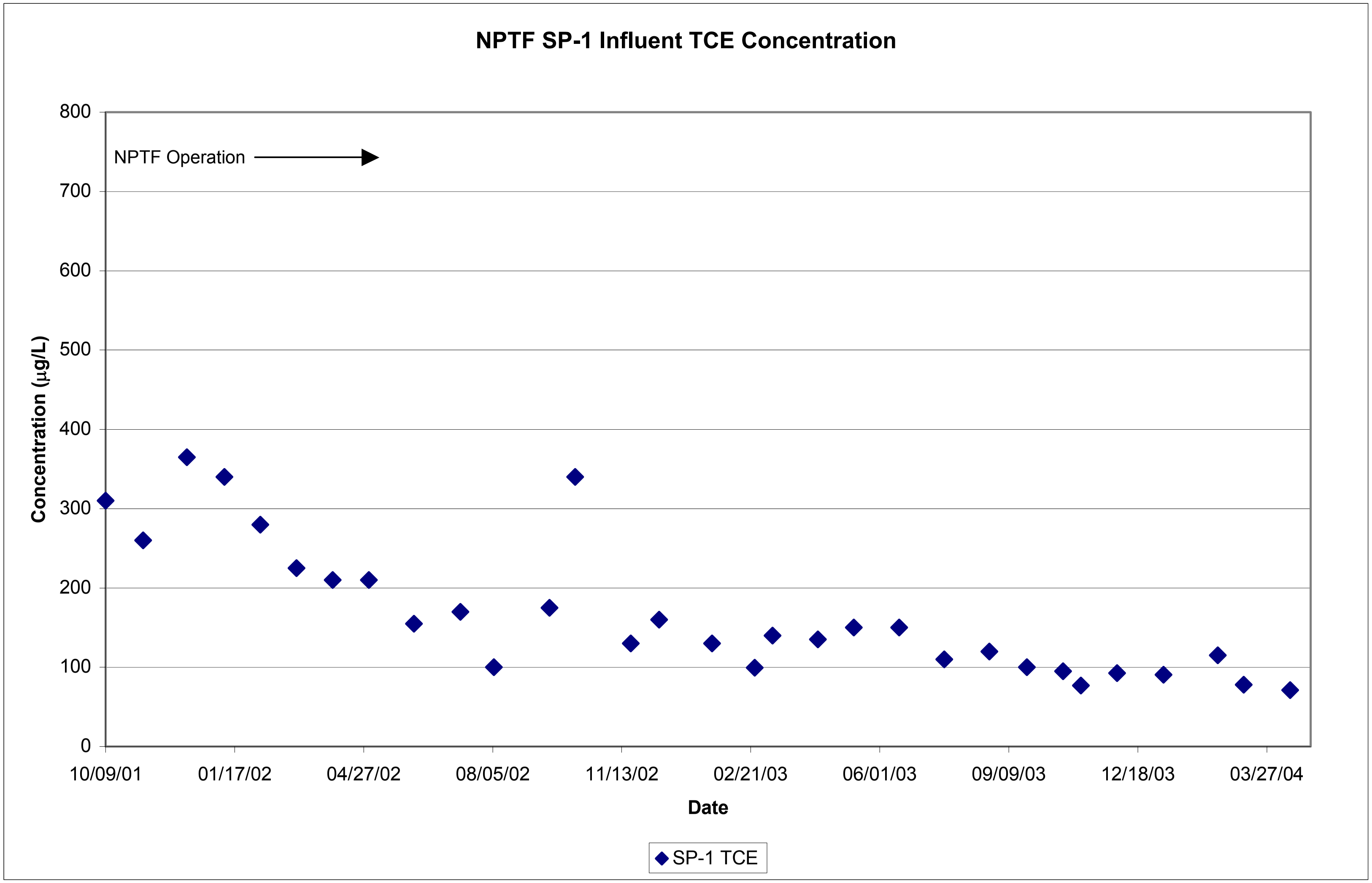


Figure 3. NPTF Influent TCE concentrations.

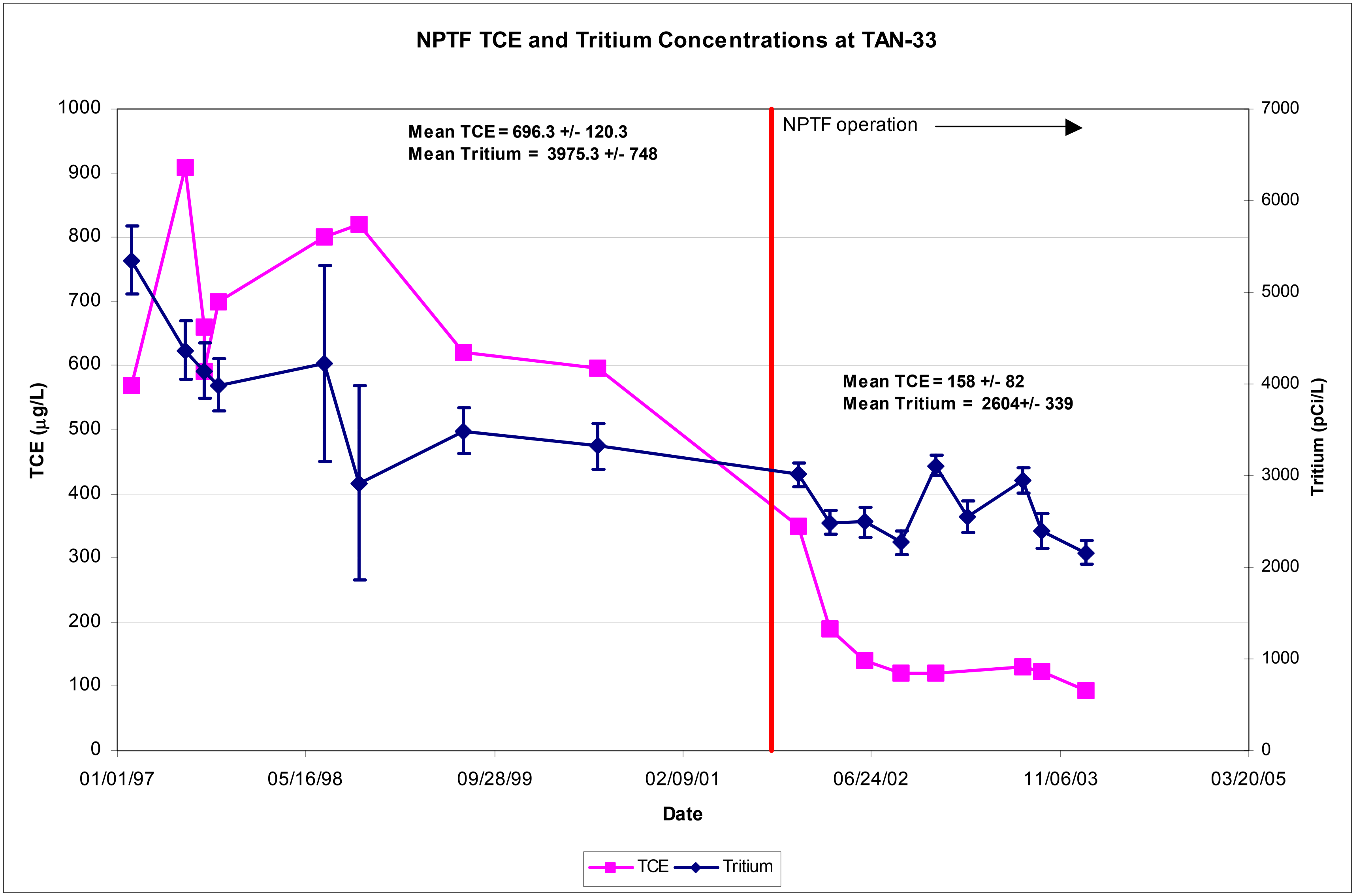


Figure 4. TAN-33 TCE and tritium concentrations.

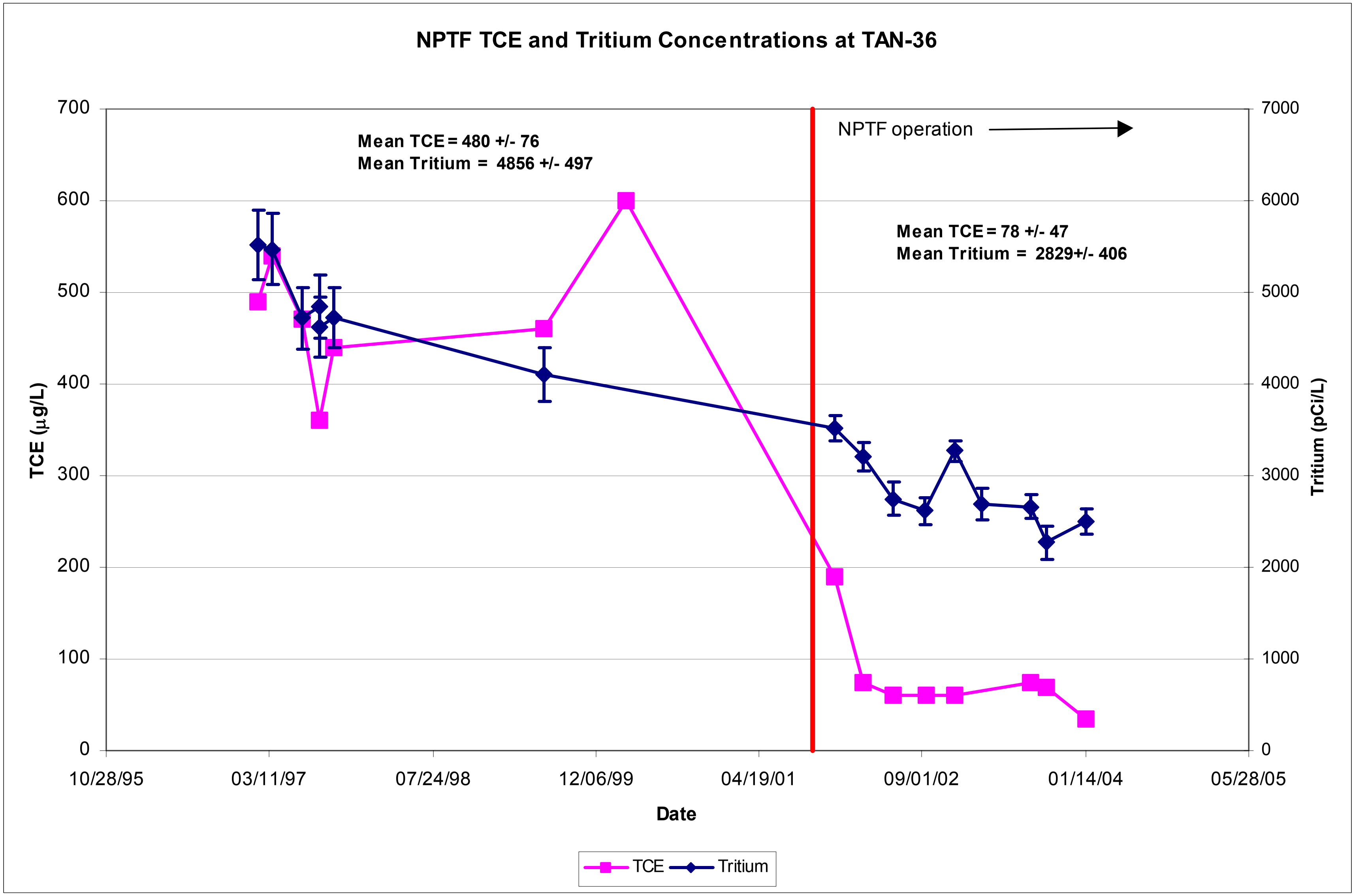


Figure 5. TAN-36 TCE and tritium concentrations.

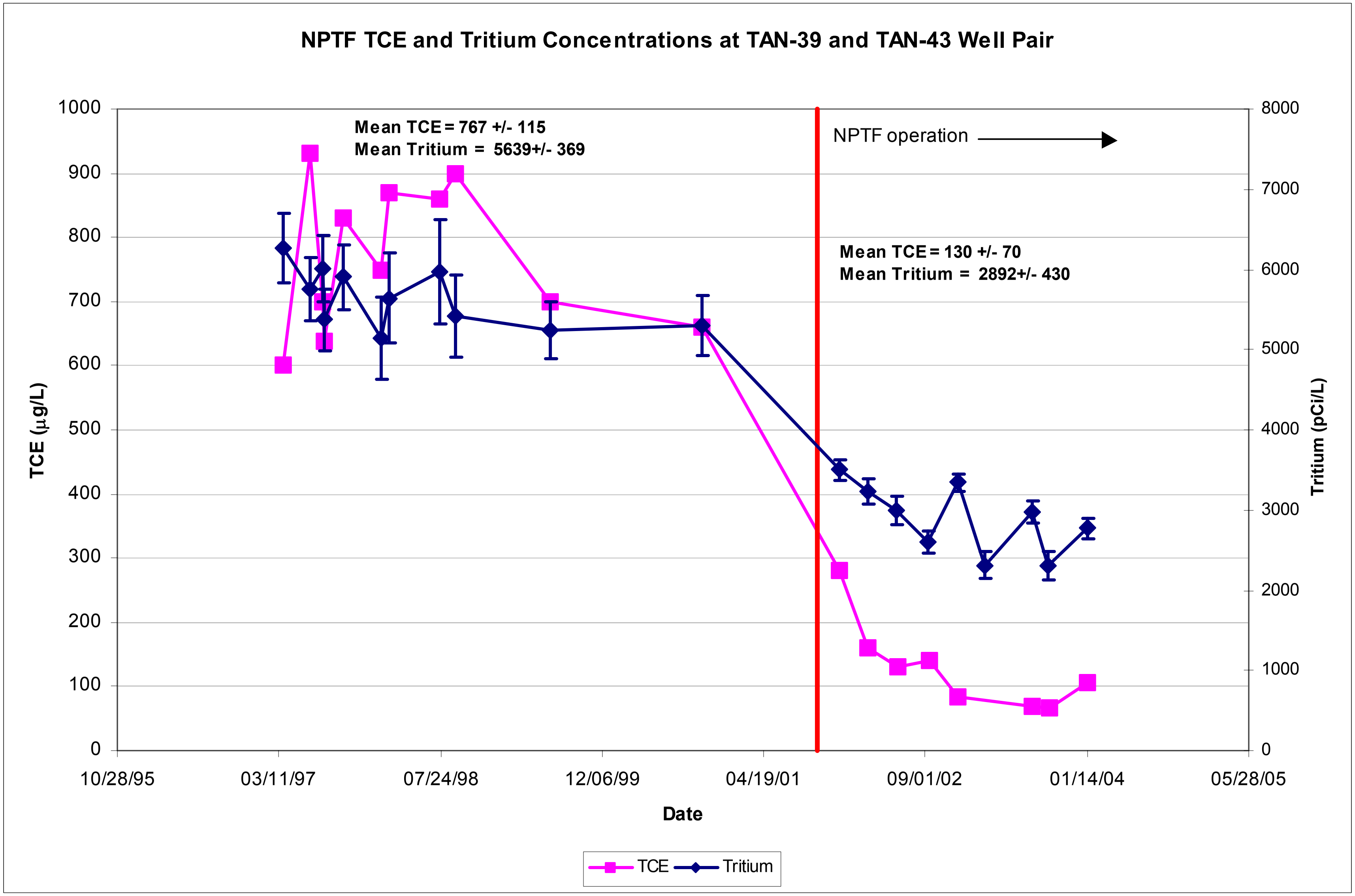


Figure 6. TAN-39/43 TCE and tritium concentrations.

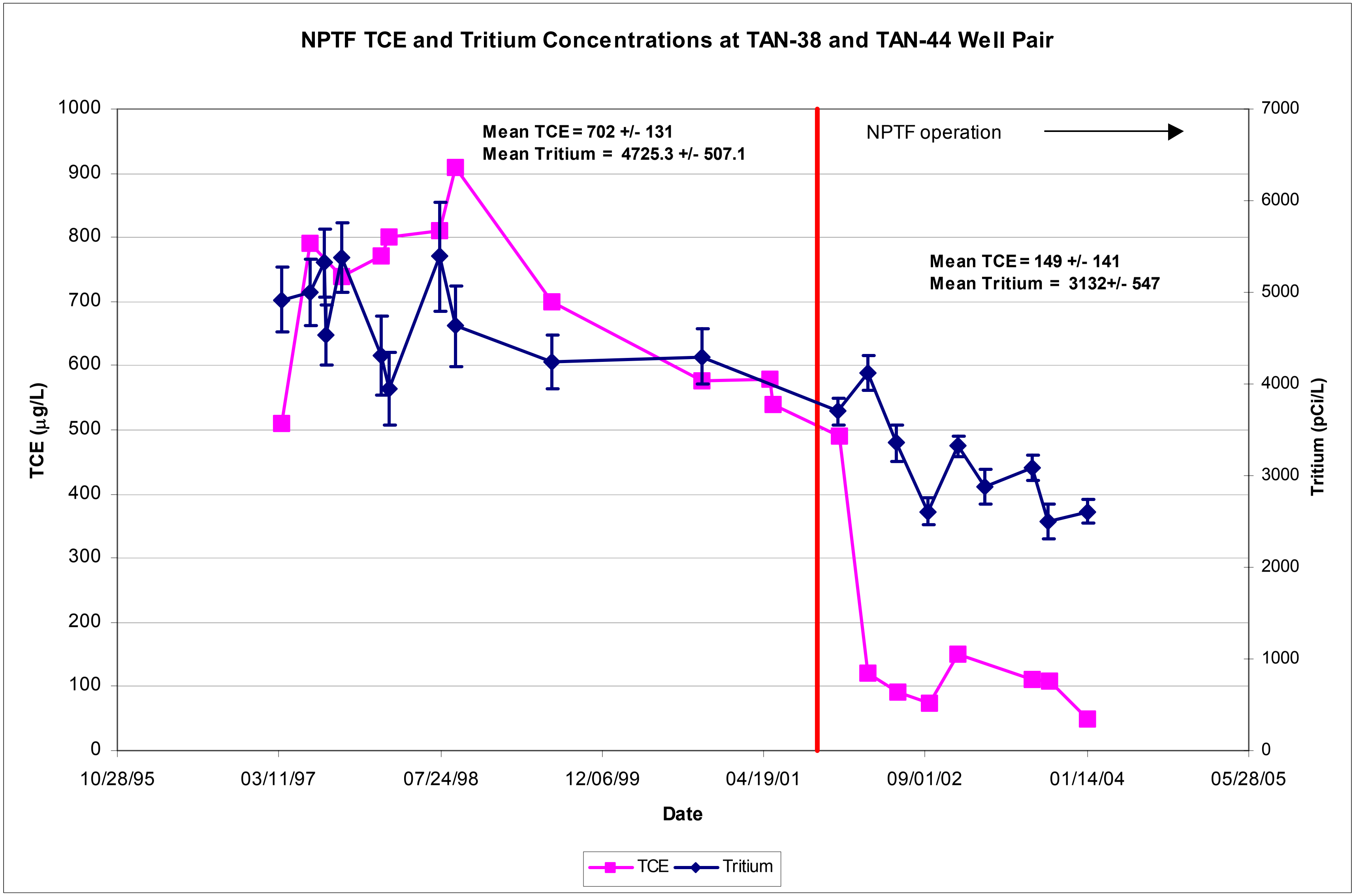


Figure 7. TAN-38/44 TCE and tritium concentrations.

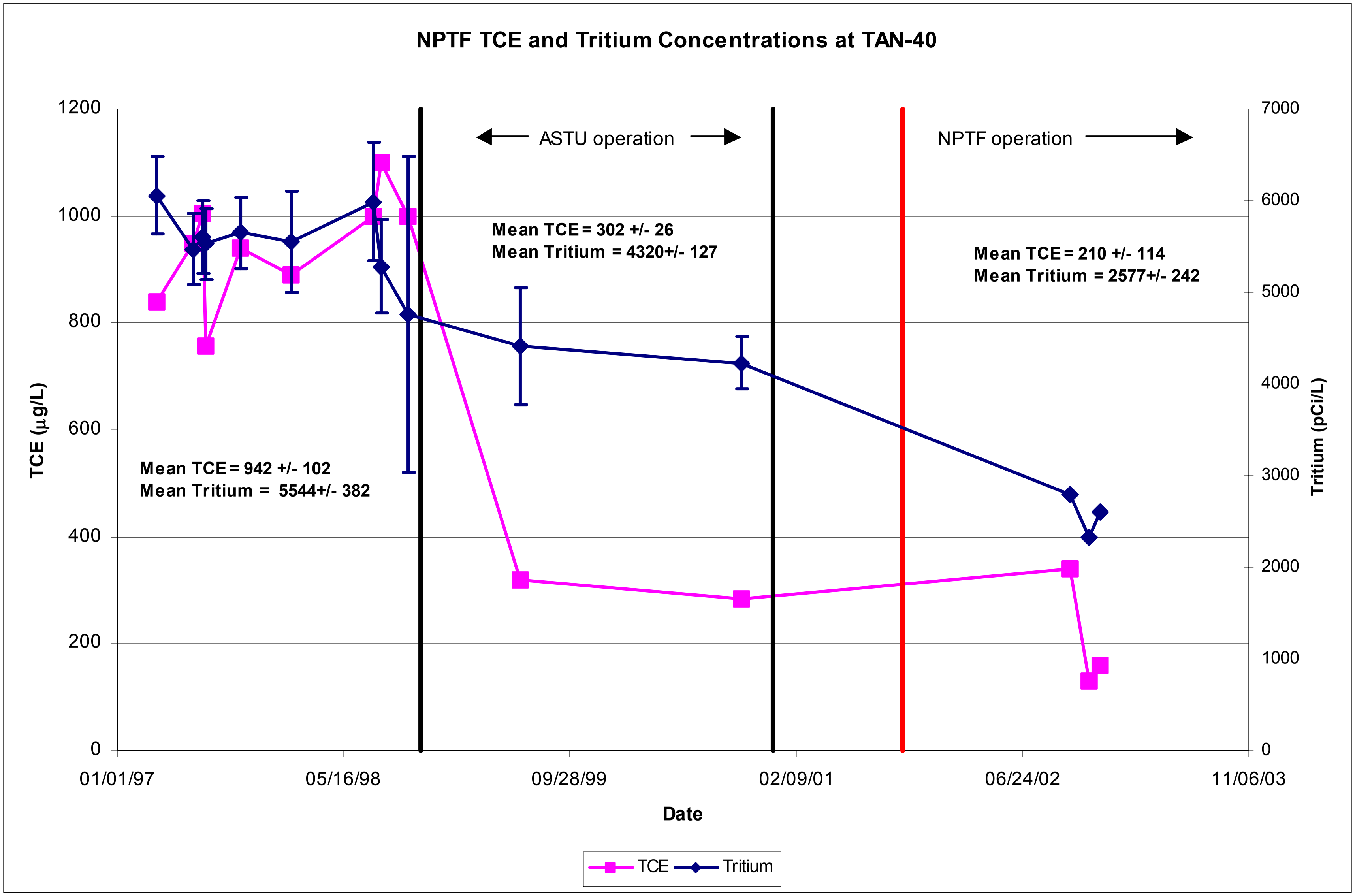


Figure 8. TAN-40 TCE and tritium concentrations.

2.2 Air Stripper Treatment Unit

Prior to the start of the NPTF at the medial zone, the ASTU (located 500 ft downgradient of the former injection well, TSF-05) was operated from November 1998 to December 2000. The ASTU extracted groundwater from TAN-29 at 50 gpm and reinjected treated water into TAN-49 (See Figure 2). The primary objective of the ASTU was to maintain hydraulic control during the ISB treatability study field test and to create a forced gradient through the hotspot to facilitate distribution of electron donor. Groundwater monitoring data are available prior to ASTU operations, during ASTU operations, and throughout the period following cessation of ASTU operations. These data can be used to support an analysis of the effect of ASTU operations and subsequent rebound at TAN-29.

Figure 9 illustrates the effect of ASTU on contaminant concentration at TAN-29. From Figure 9, the average pre-ASTU TCE concentration at TAN-29 was approximately 1,300 μg/L. At the end of ASTU operations, the TCE concentration was an order of magnitude lower, at 130 μg/L. Following ASTU shutdown, the TCE concentration rebounded at a relatively constant rate over the course of 12 to 18 months, until it reached a fairly constant value of approximately 700-800 μg/L. This represents a rebound to approximately one-half to two-thirds of historical values. The maximum TCE concentration measured at TAN-29 since the cessation of ASTU operations was 1,000 μg/L measured on August 18, 2003, which is still below the historical average.

Because of the proximity of the injection and extraction wells, the ASTU likely created a small recirculation zone around TAN-29 that had very low TCE concentrations. When ASTU operations were halted, this volume of low concentration water would have moved downgradient while higher concentration water moved toward TAN-29 from upgradient (i.e., from the hotspot). The invasion of this higher concentration water is likely the primary cause of rebound in TAN-29. However, as shown in Figure 9, TAN-29 did not fully rebound to historical levels. This is likely caused by the fact that the in situ bioremediation (ISB) remedy, which has been operating in the hotspot since January 1999, has likely reduced the flux of TCE that reaches TAN-29. The best example of TCE flux reduction due to ISB operations can be found at well TAN-37, which is located 140 ft downgradient of TSF-05. The *Annual Performance Report for In Situ Bioremediation Operations November 2002 to October 2003, Test Area North, Operable Unit 1-07B* (Armstrong et al. 2004) shows that recent TCE concentrations at the 37A and 37B monitoring locations are between 100 and 200 μg/L, compared to pre-ISB concentrations of over 800 μg/L. Although not as pronounced, concentration reductions have also been observed at TAN-28 located approximately 110 ft downgradient of TAN-37. At this well, pre-ISB TCE concentrations were 1500 to 2000 μg/L. Recent data indicate that TCE has dropped to approximately 1,000 μg/L (Armstrong et al. 2004).

Although the ASTU was designed and operated for a different purpose than the NPTF, the contaminant data can be used as an example of one potential response to cessation of a pump and treat system. It should be noted that although the less-than-full rebound observed at TAN-29 may be indicative of a potential response during the medial zone rebound test, the TAN-29 data do not preclude a full rebound in the medial zone in response to NPTF shutdown.

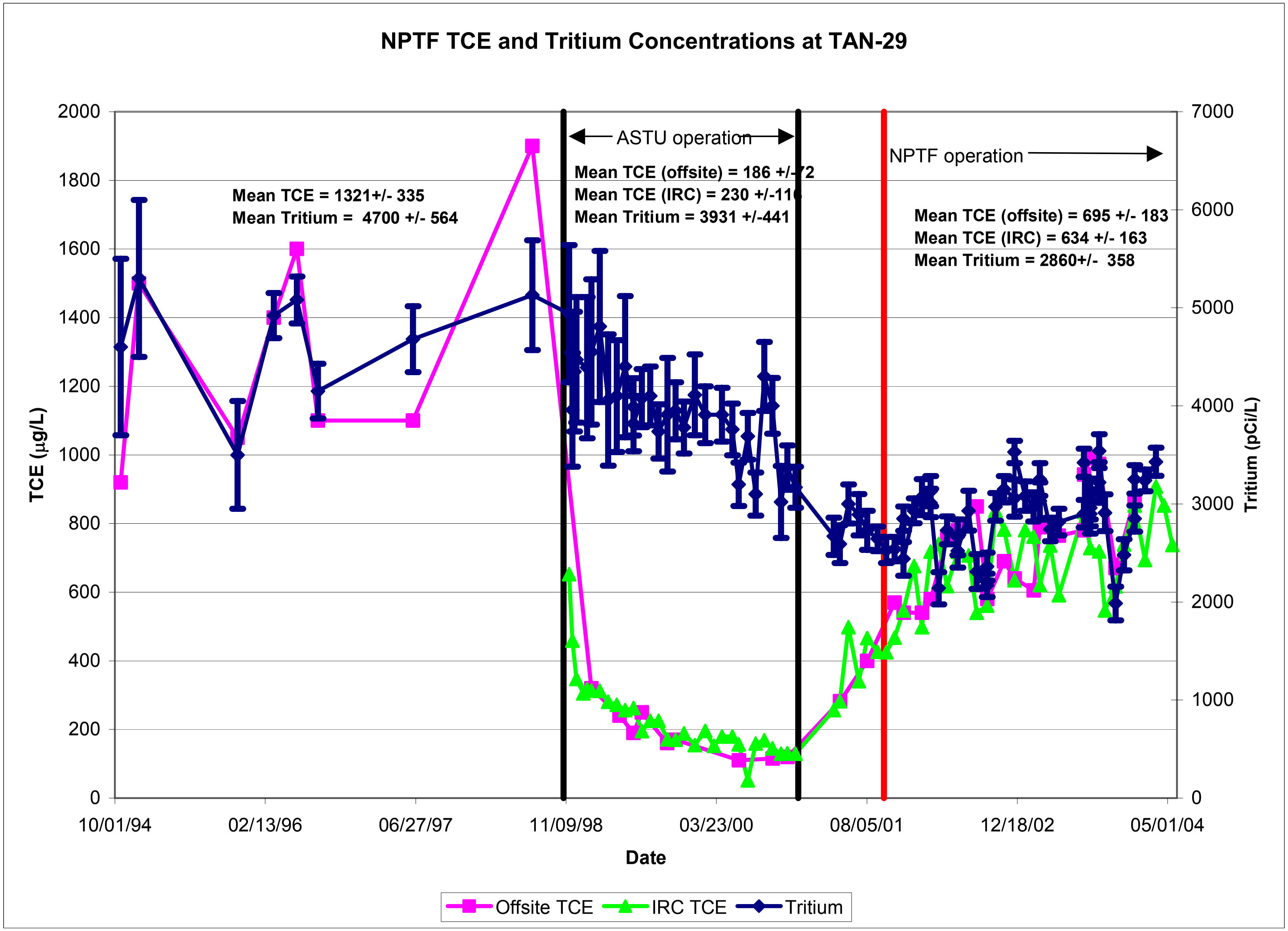


Figure 9. TAN-29 TCE and tritium concentrations.

3. REBOUND TEST DESIGN

The medial zone rebound test is designed to collect periodic data for evaluation of TCE rebound following placement of NPTF in standby mode. It is expected that the test will be dynamic in nature in that it will start with higher frequency sampling to monitor early rebound conditions and transition to less frequent sampling later in the test. Based on review of the rebound data, it will be possible to restart the NPTF at any point during the dynamic evaluation process. Hence, the NPTF will be able to capture any unexpected or sudden increases in concentration that could occur during the test.

The dynamic decision process will recognize that this data set will become the baseline for future rebound tests should it be necessary to restart the NPTF. Therefore, it is important that the sampling location, frequency, and analytes be specified, and that the criteria for NPTF restart decision-making be specified. The rebound test design is outlined below.

3.1 Monitoring Location, Frequency, and Analytes

The primary field activity during the medial zone rebound test will be groundwater monitoring. Monitoring wells have been selected upgradient, within, and downgradient of the NPTF capture zone to give as complete coverage as possible. The NPTF extraction wells (TAN-40, -39, -38) will not be sampled due to logistical access issues, but each of these has a surrogate monitoring well that will be included in the monitoring program. Sampling activities will be governed by a Sampling and Analysis Plan (SAP), which will be prepared upon agreement of the overall rebound test approach. This SAP will have provisions for adjusting the sampling schedule and frequency based on review of data. The initial sampling schedule is summarized in this section.

Table 3-1 lists the wells to be included in the medial zone rebound test. From Table 3-1, a total of seven monitoring wells will be included in the test: one upgradient, one downgradient, and five within the NPTF capture zone (refer to Figure 2 for well locations). Other wells considered for inclusion in the rebound test were TAN-42, TAN-45, and TAN-53A. These wells were not included in the test because in each case little or no historical data have been collected to which rebound test data could be compared. In addition, both the axial and transverse portions of the medial zone will be adequately covered by the other monitoring wells included in the rebound test. It should be noted that TAN-48 is equipped with a 7-port FLUTe™ multilevel sampling system. Initially, all seven ports will be sampled during each scheduled sampling round. The number of ports sampled per round may be reduced pending initial results.

Table 3-1. Medial zone rebound test monitoring locations.

Well	Location	Analytes
TAN-29	Upgradient	VOCs and tritium
TAN-41	NPTF Capture Zone – Axial	VOCs and tritium
TAN-43[a]	NPTF Capture Zone – Axial	VOCs and tritium
TAN-44[b]	NPTF Capture Zone – Axial	VOCs and tritium
TAN-33	NPTF Capture Zone – Transverse	VOCs and tritium
TAN-36	NPTF Capture Zone – Transverse	VOCs and tritium
TAN-48[c]	Downgradient	VOCs and tritium

a. Pre-NPTF data from TAN-39
b. Pre-NPTF data from TAN-38
c. FLUTe™ system installed; all ports will be sampled initially

The approximate sampling schedule for the rebound test is presented in Table 3-2. From this table, it can be seen that monitoring will be conducted in four phases:

- Baseline sampling (prior to NPTF shutdown)
- Initial rebound period
- Transition period
- Equilibrium period.

Table 3-2. Medial zone rebound test monitoring duration and frequency.

Test Period (months)	Monitoring Phase	Sampling Frequency
Prior to NPTF shutdown (estimated to be 11/04)	Baseline	Weekly for 3 weeks
11/04, 12/04, 1/05, 2/05, 3/05, 4/05, 5/05	Initial Rebound	Monthly
6/05, 8/05, 10/05, 12/05	Transition	Bimonthly
2/06, 5/06, 8/06, 11/06	Equilibrium	Quarterly

The purpose of baseline sampling is to confirm the trends in the NPTF performance monitoring wells and to establish variability in TCE and tritium concentrations observed in these trends. To accomplish this, the medial zone monitoring locations listed in Table 3-1 will be sampled once per week for three consecutive weeks before placing NPTF in standby mode, which is planned for November 2004. Given this, the baseline sampling will take place during three consecutive weeks in October.

Monthly samples will be collected starting in November 2004, during the same week NPTF is shut down, to monitor the initial rebound following cessation of NPTF operations. Bimonthly samples will be collected starting in June 2005 to monitor the transition to equilibrium concentrations. Quarterly samples will be collected starting in February 2006 to establish equilibrium concentrations. If at any time the data suggest that the frequency and/or location of monitoring is not sufficient, additional samples may be collected.

The frequency of sampling during the rebound test is a critical parameter from two perspectives. First, although rebound data at TAN-29 are available from the ASTU as a guide in evaluating sampling frequency, a rebound test has never been conducted in the medial zone; therefore, no basis exists to predict the shape or response time of the rebound. This is the primary reason for the need for dynamic decision-making (see Section 3.4.1). Secondly, if the data collected indicates that the NPTF should be restarted, it will be beneficial to have a good data set to use as a baseline for design of a second rebound test in the future. The recommended frequency and duration outlined below takes into consideration both perspectives.

3.2 Analytes and Analytical Methods

The analytes for the medial zone rebound test include VOCs and tritium. Volatile organic compound samples will be analyzed at the INEEL Research Center (IRC) using SPME-GC/FID. Tritium samples will be analyzed by an off-Site laboratory using liquid scintillation counting. The details of the analytical methods, sample collection, shipping requirements, and holding times will be presented in the SAP that will be prepared to govern this activity.

In addition to VOCs and tritium, purge parameters may be collected as part of the sampling protocol. However, these data will not be quantitatively used in the evaluation of rebound. It is possible that dissolved oxygen could be used to track influx of upgradient water; however, the precision of the measurement is rather low and, consequently, does not provide a useful tool for evaluating TCE rebound.

Water level measurements will not be collected as a part of the rebound test because past monitoring has shown that aquifer rebound in response to cessation of pumping is very rapid—within minutes to a few hours. The site conceptual model is complete and is not in need of an update; therefore, determining additional hydrologic parameters is not necessary. The existing transducer array will be left in place to monitor the capture zone during any potential future restart of the NPTF.

Lastly, monitoring for bioremediation parameters was considered, but again, these would be indicators of upgradient water flowing into the NPTF capture zone. An increase in TCE concentration is the most direct way to monitor this possibility. For completeness in developing the baseline data set, it may be worthwhile to collect one round of ISB parameters if TCE rebounds under “Rapid Rebound Criterion” defined below. This would allow for a determination as to whether the TCE is from the source area or from the medial zone because the geochemical signatures of groundwater originating from these two areas are distinct. Knowing this may have a significant impact on the conceptual model for the system.

3.3 Potential Rebound Responses

Figure 10 shows a hypothetical response to an operating pump and treat system and subsequent rebound test. This figure shows three potential responses in TCE concentration during the rebound test. These three cases are not intended to represent all possible scenarios, but they do encompass the range of potential responses. In Figure 10, TCE concentrations are normalized such that the current TCE concentration, represented as C, is equal to the pre-pump and treat concentration, represented as C_0. Thus, at time 0, C/C_0 is 1.00, at which point the pump and treat system is activated. Figure 10 shows that for this hypothetical system, pump and treat operations reduce TCE concentrations to roughly 10% of the initial concentrations, after which time the system is placed in standby and the rebound test is initiated. Case A represents the Rapid Rebound Criterion, defined as the normalized TCE concentration increasing to greater than or equal to 0.75 (i.e., 75% of the pre-pump and treat TCE concentrations) within the 24 month planned duration of the rebound test. Case B represents the Gradual Rebound Criterion, defined as the mean normalized TCE concentration increasing to greater than or equal to $0.25C_0$ but less than $0.75C_0$ (i.e., 25% to 75% of the pre-pump and treat TCE concentrations) within the 24-month planned duration of the rebound test. Case C represents the Little-to-No Rebound Criterion, defined as the mean normalized TCE concentration remaining less than 0.25 (i.e., less than 25% of the pre-pump and treat TCE concentrations) during the entire 24-month planned duration of the rebound test.

3.4 Data Evaluation

One of the objectives of the rebound test is to determine which of the three curves in Figure 10 describe the TAN medial zone. To make this assessment, data will be collected from seven wells as described in Section 3.1. Of these, the five NPTF capture zone wells will be used for evaluation of rebound, while wells TAN-29 and TAN-48 will be used for upgradient and downgradient monitoring, respectively. For each of the five NPTF capture zone wells, a pre-NPTF concentration has been established based on the mean of all historical data collected before NPTF startup. These values are presented in Table 3-3, with the error presented being the standard deviation. These concentrations will be the values to which all rebound test data will be normalized and are analogous to “C_o” in Figure 10. Thus, the first plotted point for each of the five wells will be 1.00 by definition, and all subsequent rebound test

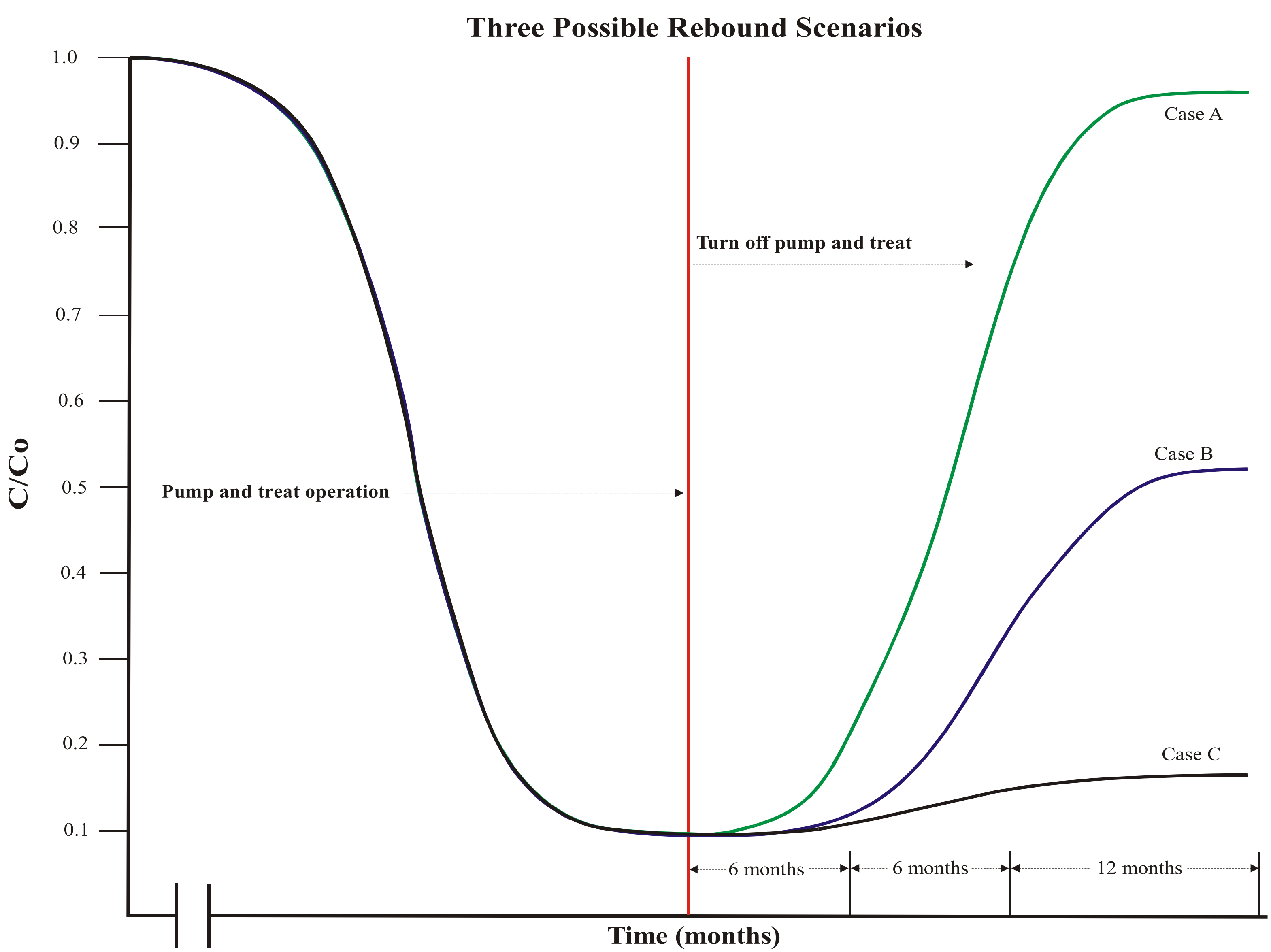


Figure 10. Possible rebound scenarios.

data will be normalized to C_o. In this way, one chart can be used to track TCE rebound for the five NPTF capture zone wells, and a second chart can be used to track tritium rebound for these same wells.

Table 3-3. Baseline trichlorethene and tritium concentrations for rebound test.

Well	C_o TCE - Baseline TCE Concentration (µg/L)	C_o Tritium - Baseline Tritium Concentration (pCi/L)
TAN-41	942 +/- 102	5,544+/- 382
TAN-43	767 +/- 115	5,636+/- 369
TAN-44	702 +/- 131	4,725+/- 507
TAN-33	696 +/- 120	3,975+/- 748
TAN-36	480 +/- 76	4,856+/- 497

The rebound test data will be evaluated using two approaches. The first approach examines the actual performance of the NPTF in reducing medial zone concentrations. This will be accomplished by comparing the observed TCE rebound to pre-NPTF TCE concentrations. This data evaluation method can be used in the short-term (i.e., on the order of the rebound test duration) to evaluate whether an immediate NPTF restart is needed because of unacceptable rebound within the 24-month test. The second approach is to evaluate the rebound test medial zone TCE concentrations in the context of what the MNA remedy can treat.

3.4.1 Short-Term Dynamic Decision-Making

The overall decision logic that incorporates both the short-term and long-term data evaluation approaches is shown in Figure 11. From Figure 11, the first approach for evaluating the rebound test data will be to compare measured TCE concentrations observed during the rebound test to pre-NPTF TCE concentrations. The purpose of this data evaluation approach is to make the short-term decision of whether to terminate the rebound test the end of the planned 24-month duration and restart the NPTF. Figure 11 shows that rebound test data will be collected per a future rebound test SAP. As data are received, TCE concentrations will be compared to the pre-NPTF concentrations defined in Table 3-3. If the mean normalized TCE concentration from the five NPTF extraction zone wells is greater than $0.75C_0$ (Rapid Rebound Criterion—Case A in Figure 10), then the rebound test will be terminated and NPTF will be immediately restarted. Because these data will be evaluated after each sampling round, the occurrence of the Rapid Rebound Criterion could result in a shorter than 24-month duration rebound test.

If the ongoing data evaluation shows that the Rapid Rebound Criterion is not met, then the rebound test will continue as outlined in Sections 3.1 and 3.2 (see Figure 11). It is important to note that the observed rebound responses could vary from well to well, and that more than one type of response could be observed at different wells. However, only the occurrence of the Rapid Rebound Criterion will result in a shorter than planned rebound test. As described in Section 3.4.2, if either of the other rebound criteria is met, the rebound test will run its full 24-month duration.

3.4.2 Long-Term Data Evaluation

From Figure 11, after completion of the 24-month rebound test, the data will be evaluated to determine whether the observed medial zone response meets the Gradual Rebound Criterion or the Little-to-No Rebound Criterion. If the Gradual Rebound Criterion (25% to 75% rebound) is met, then the rebound test data will be evaluated to determine whether an immediate NPTF restart is needed or if it can

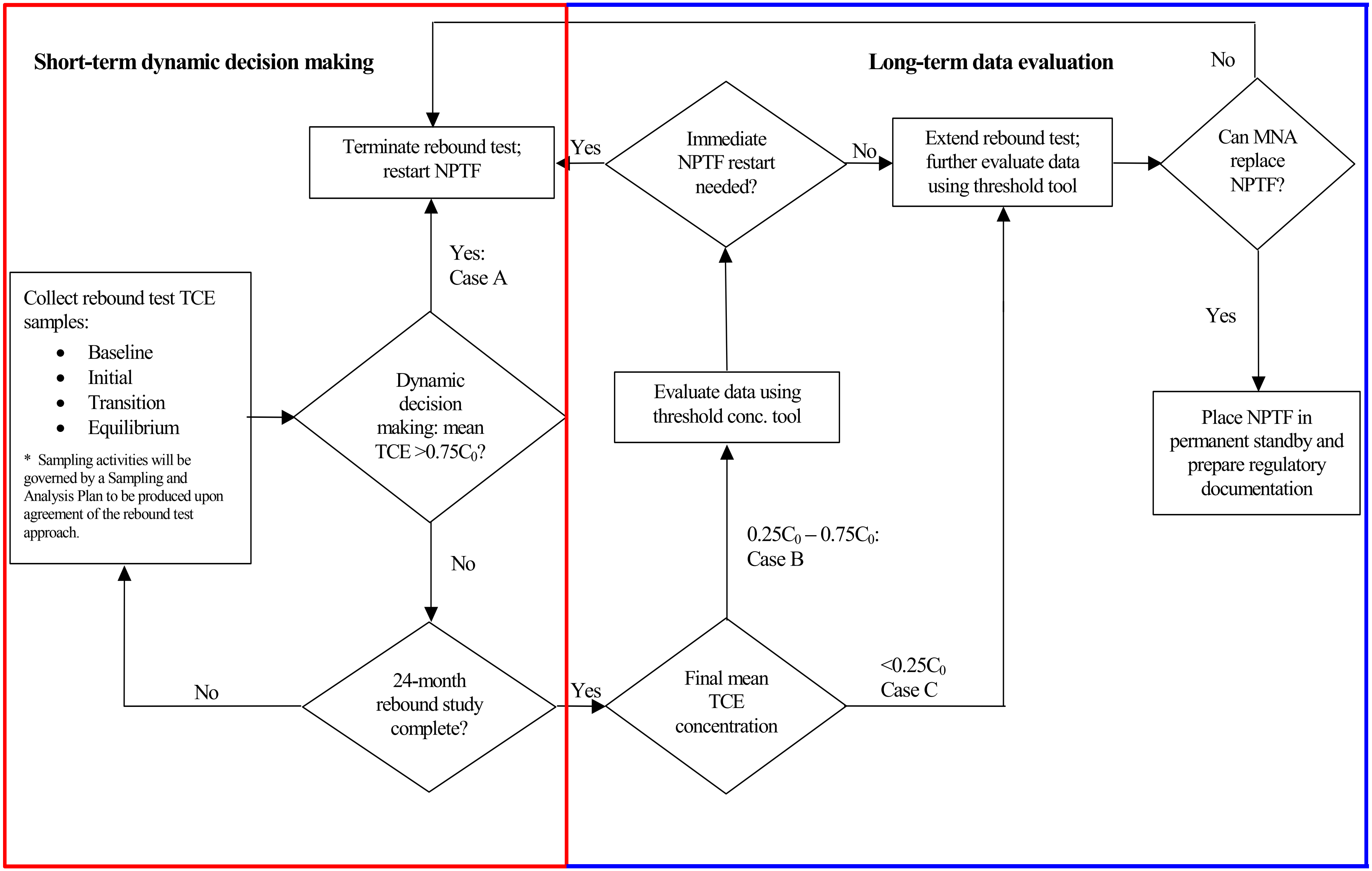


Figure 11. Rebound test decision logic.

remain in standby for an additional period of time. If the Little-to-No Rebound Criterion (<25% rebound) is met, then the NPTF will remain in standby mode for an additional period of time so that contaminant trends can be verified. In each case, the data will be evaluated using the long-term data evaluation approach described below.

The ROD Amendment (DOE-ID 2001) specified MNA as the remedy for the portion of the plume with TCE concentrations <1,000 μg/L. This was based on field observations that TCE was being aerobically degraded with a half-life of 9–21 years. The TCE degradation half-life was recently recalculated using monitoring data collected through 2002. The updated TCE degradation half-life was 12–15 years, with a best estimate of 13.2 years (DOE-ID 2003b).

A data evaluation tool is currently being developed that can be used to estimate the maximum TCE concentrations that will attenuate to below MCLs by 2095 based on the observed degradation half-life. This "threshold" TCE concentration is independent of location in the plume, and because it is calculated based on the degradation half-life, it decreases each year. The medial zone concentrations that are measured during the rebound test can be compared to the threshold concentration for the appropriate year to determine whether they fall above or below it. Concentrations that are below the threshold can be treated by MNA, which would support a conclusion that MNA can become the medial zone remedy. Another way to use the threshold tool is to examine the slope in medial zone concentrations with time and compare this slope to that of the threshold concentrations with time. If current medial zone concentrations are below the threshold concentration, but it becomes apparent they will intersect the threshold concentration at some future time, then this may support a decision to restart NPTF.

The disadvantage of the threshold concentration approach is that several years of data may be required following placement of NPTF in standby mode to adequately characterize medial zone contaminant trends. Therefore, the threshold approach cannot be used to make the short-term decision of whether to prematurely end the rebound test and restart NPTF due to unacceptable rebound (refer to Figure 11). The threshold approach will only be invoked if the observed rebound in the medial zone is less than 75% (i.e., Case B or C in Figure 10) and the rebound test runs its full duration.

The threshold concentration tool is still in development and will be presented in a future MNA strategy document. The completion of the 24-month rebound test and the MNA strategy document should coincide such that the threshold tool can be applied to the rebound test data according to the decision logic outlined in Figure 11. This ultimately would determine if MNA can become the medial zone remedy.

4. REFERENCES

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