DES-R-WD-02-8

TOTAL MAXIMUM DAILY LOAD (TMDL) STUDY FOR IRON IN WILLIAMS BROOK, NORTHFIELD, NH

September 2002

NEW HAMPSHIRE
DEPARTMENT OF
Environmental
Services

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CHAPTER 1

INTRODUCTION

1.1. BACKGROUND

Section 303(d) of the Clean Water Act (CWA) and EPA's Water Quality Planning Regulations (40 CFR Part 130) require states to develop total maximum daily loads (TMDLs) for water quality limited segments that are not meeting designated uses under technology-based controls for pollution. The TMDL process establishes the allowable loadings of pollutants for a waterbody based on the relationship between pollutant sources and instream water quality conditions, so that states can establish water quality based controls to reduce pollution from both point and nonpoint sources and restore and maintain the quality of their water resources (USEPA, 1991).

1.2 PURPOSE OF THIS STUDY

The purpose of this study is to develop a TMDL for Williams Brook located in Northfield, New Hampshire. This brook is included on the State's 303(d) list (File # 98) as a high priority because of iron concentrations that exceed State surface water quality criteria for the protection of aquatic life.

CHAPTER 2

PROBLEM STATEMENT

2.1 WATERBODY DESCRIPTION / FOCUS OF STUDY

Williams Brook is located in the Town of Northfield, New Hampshire and is part of the Merrimack River Basin. The brook has a total length of approximately 4.5 miles and flows from the south to north where it discharges to the Winnipesaukee River.

This study is focused on the lower portion of Williams Brook in the vicinity of the old Northfield Stump Dump (see Figure 2-1). The dump, which is located on Park Street on the east bank of Williams Brook, is approximately 130 wide by 200 feet long. In 1991, the Town conducted a hydrogeologic study of the site and in 1992 received a Groundwater Discharge Permit and Landfill Closure Construction Approval from the New Hampshire Department of Environmental Services (NHDES). In July of 1993, the Town completed construction of a landfill closure plan which consisted of capping the dump with a two foot deep earthen cover and vegetation. Since 1992, the Town has been collecting water samples from various monitoring wells, as well as two surface water sample sites in Williams Brook located up and downstream of the site.

The drainage area for the brook upstream of the Northfield Stump Dump is approximately 5.6 square miles with the vast majority (80 to 90 percent) being rural or undeveloped (see Figure 2-2). Included in the upstream headwaters is Knowles Pond which, until 1997, served as the Town's water supply.

2.2 APPLICABLE WATER QUALITY STANDARDS

2.2.1 Overview

Water Quality Standards determine the baseline water quality that all surface waters of the State must meet in order to protect their intended uses. They are the "yardstick" for identifying where water quality violations exist and for determining the effectiveness of regulatory pollution control and prevention programs. The standards are composed of three parts: classification, criteria, and antidegradation regulations.

Classification of surface waters is accomplished by state legislation under the authority of RSA 485-A:9 and RSA 485-A:10. By definition, (RSA 485-A:2, XIV), "surface waters of the state means streams, lakes, ponds, and tidal waters within the jurisdiction of the state, including all streams, lakes, or ponds, bordering on the state, marshes, water courses and other bodies of water, natural or artificial".

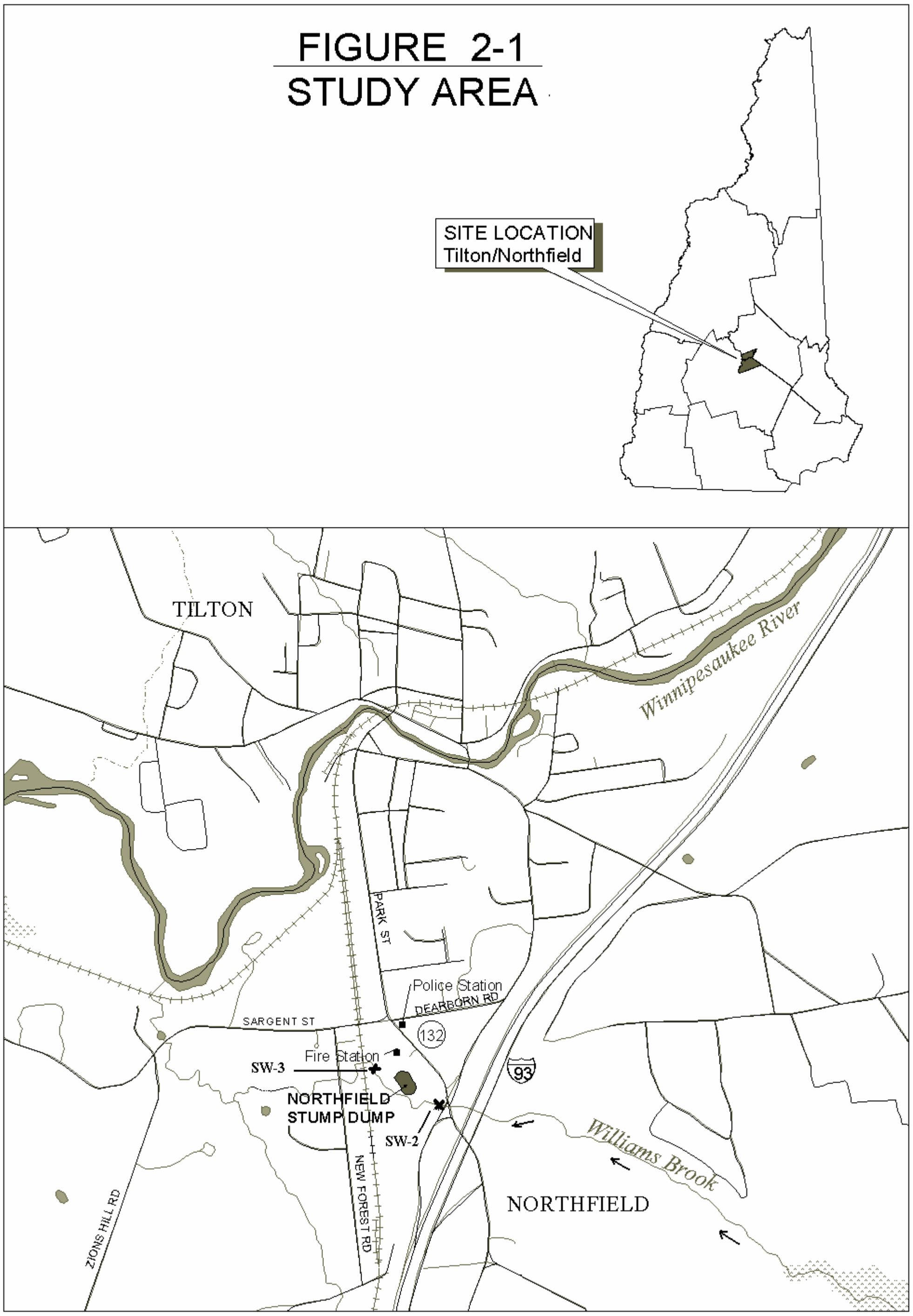
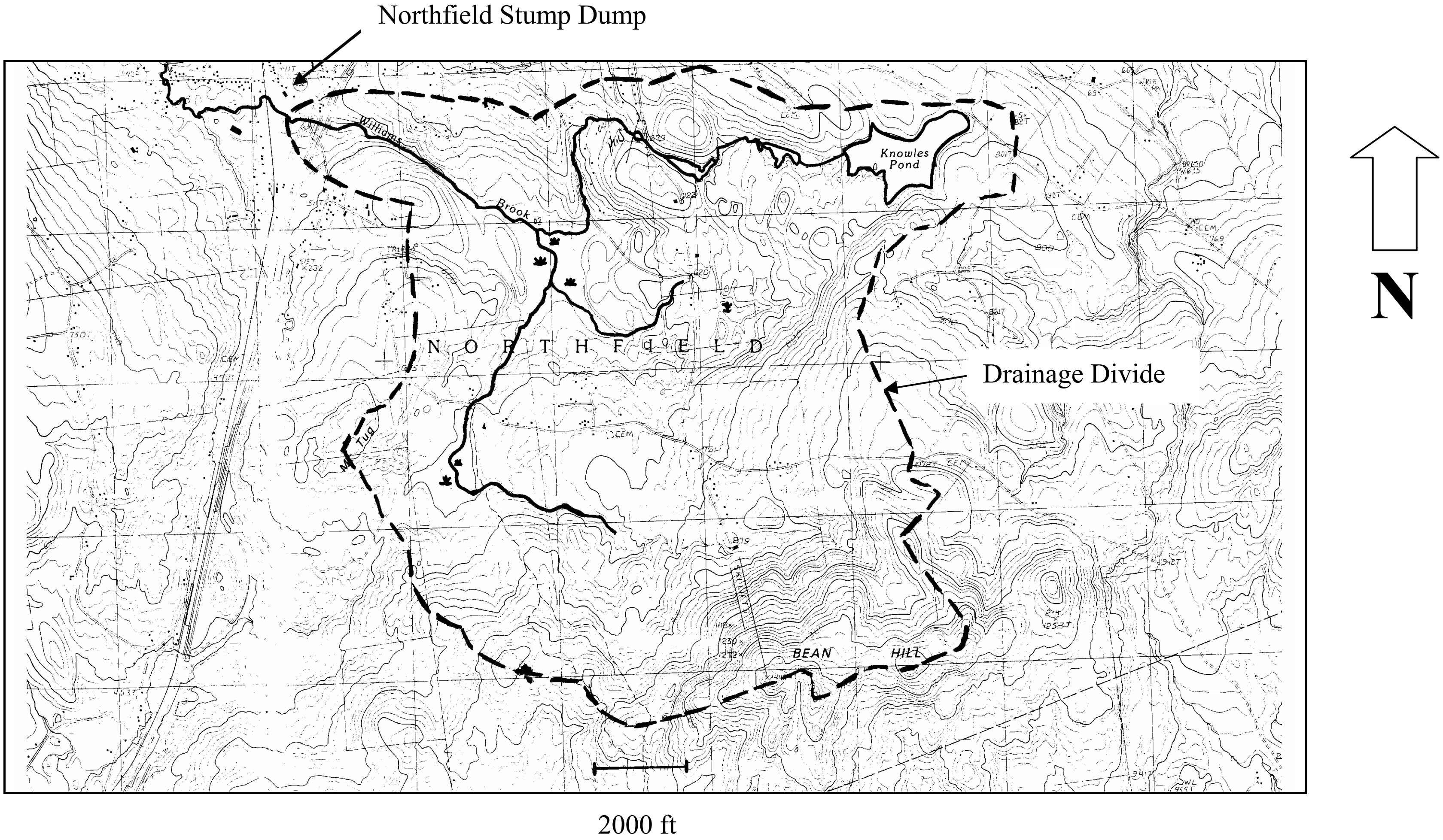


FIGURE 2-1

STUDY AREA

Figure 2-2
Williams Brook Drainage Area



All State surface waters are either classified as Class A or Class B, with the majority of waters being Class B. DES maintains a list which includes a narrative description of all the legislative classified waters. Designated uses for each classification may be found in State statute RSA 485-A:8 and are summarized below.

Classification	Designated Uses
Class A -	These are generally of the highest quality and are considered potentially usable for water supply after adequate treatment. Discharge of sewage or wastes is prohibited to waters of this classification.
Class B -	Of the second highest quality, these waters are considered acceptable for fishing, swimming and other recreational purposes, and, after adequate treatment, for use as water supplies.

The second major component of the water quality standards is the "criteria". These are numerical or narrative criteria which define the water quality requirements for Class A or Class B waters. Criteria assigned to each classification are designed to protect the legislative designated uses for each classification. A waterbody that meets the criteria for its assigned classification is considered to meet its intended use. Water quality criteria for each classification may be found in RSA 485-A:8, I-V and in the State of New Hampshire Surface Water Quality Regulations (Env-Ws 1700)

The third component of water quality standards are antidegradation provisions which are designed to preserve and protect the existing beneficial uses of the State's surface waters and to limit the degradation allowed in receiving waters. Antidegradation regulations are included in Part Env-Ws 1708 of the New Hampshire Surface Water Quality Regulations. According to Env-Ws 430.31, antidegradation applies to the following:

- all new or increased activity, including point and nonpoint source discharges of pollutants that would lower water quality or affect the existing or designated uses;
- a proposed increase in loadings to a waterbody when the proposal is associated with existing activities;
- an increase in flow alteration over an existing alteration; and
- all hydologic modifications, such as dam construction and water withdrawals.

2.2.2 Water Quality Standards Most Applicable to the Pollutant of Concern

The portion of Williams Brook under investigation for this study is a Class B waterbody. By statute, Class B waterbodies are to be acceptable for fishing, swimming and other recreational purposes, and, after adequate treatment, for use as water supplies. In practice, however, this segment of Williams Brook is not used as a public water supply.

There are numerous water quality criteria that could apply to iron, the pollutant of concern in this study. As discussed below, such criteria are necessary because of the many ways that iron can impact the designated uses of a waterbody.

Iron is the fourth most abundant, by weight, of all the elements that make up earth's crust, and, therefore, is a common element in many rocks and soils (especially clay soils) and surface waters. At low concentrations, it is beneficial as it is an essential trace element required by both plants and animals. At elevated concentrations, however, iron, can be toxic to aquatic organisms. Many metals, like iron, are most toxic in the dissolved form; however, the particulate form of iron (i.e., ferric hydroxide precipitates) can also be harmful to aquatic life as it can coat the gills of fish and settle to form iron deposits that can smother fish eggs and be detrimental to bottom dwelling fish food organisms.

In surface waters used as water supplies, elevated iron concentrations can cause objectionable tastes and can stain laundered clothes and plumbing fixtures. Suspended or settled yellow or red iron precipitates can also be aesthetically objectionable and interfere with recreational uses such as swimming.

To prevent pollutants such as iron from impairing the uses of a waterbody, the New Hampshire Surface Water Quality Regulations (Chapter Env-Ws 1700) include the following water quality criteria:

Env-Ws 1703.03 <u>General Water Quality Criteria</u>

(a) The presence of pollutants in the surface waters shall not justify further introduction of pollutants from point and/or nonpoint sources.
(c) The following physical, chemical and biological criteria shall apply to all surface waters:
    (1) All surface waters shall be free from substances in kind or quantity which:
        a. Settle to form harmful deposits;
        b. Float as foam, debris, scum or other visible substances;
        c. Produce odor, color, taste or turbidity which is not naturally occurring and would render it unsuitable for its designated uses;
        d. Result in the dominance of nuisance species; or
        e. Interfere with recreational activities.

Env-Ws 1703.08 <u>Benthic Deposits</u>

(b) Class B waters shall contain no benthic deposits that have a detrimental impact on the benthic community, unless naturally occurring.

Env-Ws 1703.10 <u>Color</u>

(b) Class B waters shall contain no color in such concentrations that would impair any existing or designated uses, unless naturally occurring.

Env-Ws 1703.21 Water Quality Criteria for Toxic Substances

(a) Unless naturally occurring, all surface waters shall be free from toxic substances or chemical constituents in concentrations or combinations that:
  (1) Injure or are inimical to plants, animals, humans or aquatic life; or
  (2) Persist in the environment or accumulate in aquatic organisms to levels that result in harmful concentrations in edible portions of fish, shellfish, other aquatic life, or wildlife which might consume aquatic life.

(b) Unless allowed in part Env-Ws 1707 or naturally occurring, concentrations of toxic substances in all surface waters shall not exceed the recommended safe exposure levels of the most sensitive surface water use shown in Table 1703.1, subject to the notes as explained in Env-Ws 1703.22, ...”

From Table 1703.1, the following numeric criteria for the protection of aquatic life and human health are listed for iron:

Use:	*Protection of Aquatic Life Freshwater Chronic*	*Protection of Human Health Water and Fish Ingestion*
Criteria:	1 part per million (ppm) Total Iron	0.3 ppm Total Iron

With regard to the numeric criteria for the protection of human health it is worth mentioning that it constitutes only a small fraction of the iron normally consumed by humans and is based on aesthetic rather than toxilogical significance. That is, this value was established in an effort to prevent objectionable tastes in drinking water and to prevent laundry staining and is less than that needed to protect public health.

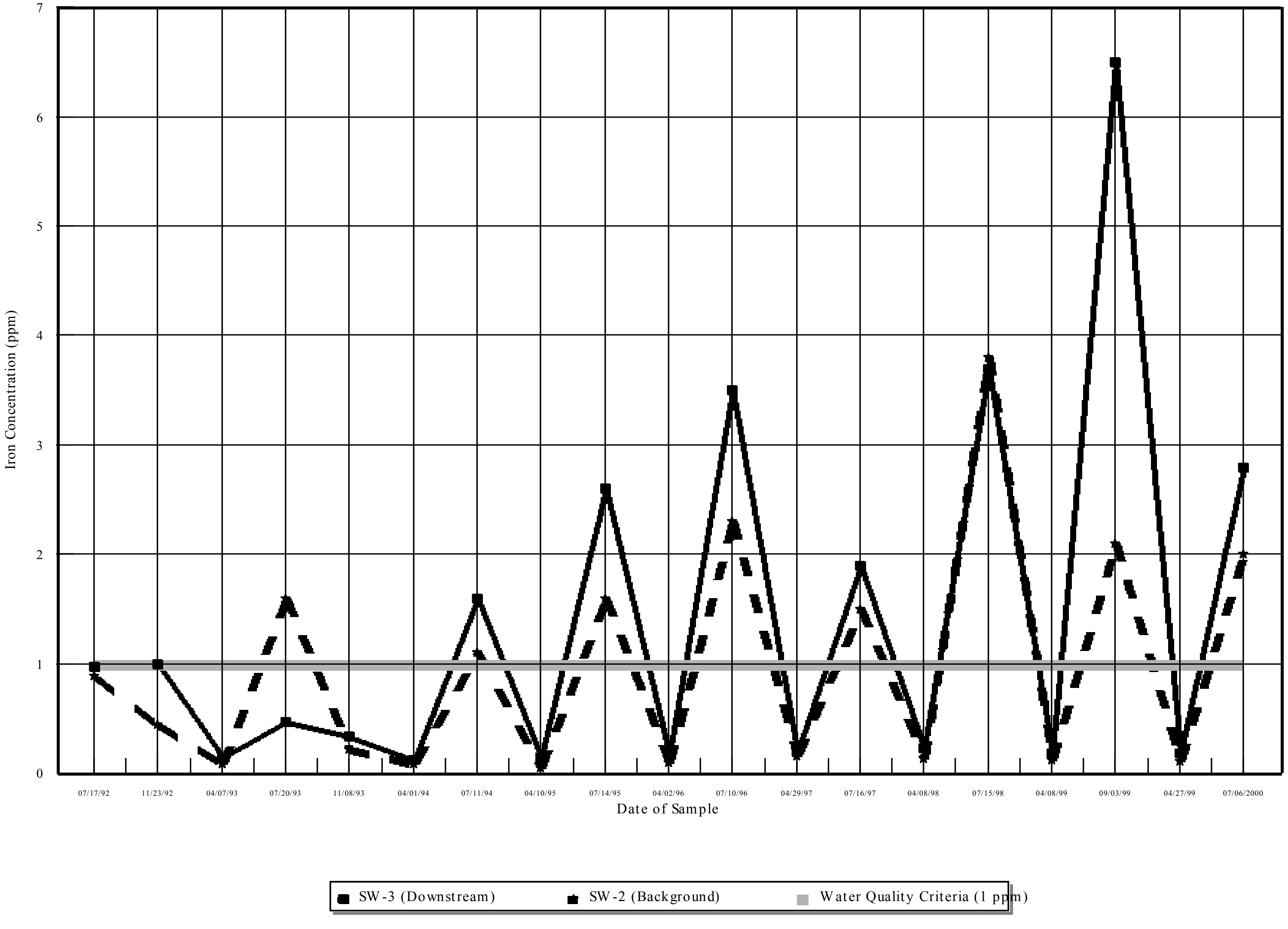
2.3 TARGETED WATER QUALITY GOALS

Since Williams Brook is not used as a drinking water supply, the target of this study was based on the numeric criteria for the protection of aquatic life (1 ppm total iron unless natural background levels are higher in which case the goal is to not exceed naturally occurring levels). As discussed in the following chapters, natural background levels have been found to exceed the limit of 1 ppm; therefore the goal of this TMDL will be not to exceed natural background concentrations for iron.

2.4 EVIDENCE OF WATER QUALITY IMPAIRMENT

Since 1992, the Town of Northfield has hired various consultants to take surface water samples along Williams Brook in the vicinity of the old Northfield Stump Dump. Sample results for iron are presented in Figure 2-3. Samples taken prior to 1995 represent dissolved iron and samples taken from 1995 to 2000 were analyzed for total iron. As shown on Figure 2-1, Station SW-2 and SW-3 are located approximately 200 to 300 feet upstream and downstream of the stump dump respectively. As indicated on Figure 2-3, numerous exceedances of the 1 ppm criteria have been documented.

Figure 2-3
Iron Concentrations in Williams Brook



CHAPTER 3

EXISTING POINT AND NONPOINT SOURCE LOADS

3.1 EXISTING POINT SOURCE LOADS

Point source discharges include discernible, confined, and discrete conveyances such as the discharge from the effluent pipes of wastewater treatment plants. All point source discharges must have a State Surface Water Discharge permit and a federal National Pollutant Discharge Elimination System (NPDES) discharge permit. In the Williams Brook watershed, there are no known point source discharges.

3.2 EXISTING NONPOINT SOURCE LOADS

In general, nonpoint sources (NPSs) of pollutants include all pollutant sources other than point sources. Compared to point sources, NPSs of pollution are much more diffuse and difficult to quantify. Examples of NPSs include stormwater runoff, atmospheric deposition, and pollutant loadings from such diffuse sources as failed septic systems or landfills.

In the portion of Williams Brook investigated for this study, the major NPSs are believed to be the stump dump and the natural background conditions. To understand why these are believed to be the primary sources, it is first necessary to review the interactions of iron in soils and water.

As mentioned in Chapter 2, iron is the fourth most abundant chemical in the earth's crust. Concentrations of iron found in solution are greatly influenced by the pH, and levels of dissolved oxygen and organic matter. As long as dissolved oxygen is present (aerobic conditions), organic concentrations are relatively low, and the pH is relatively high (above 5), solution of iron from soils or sediments usually does not occur in large amounts. Under these conditions, most of the iron in aquatic environments exists as insoluble ferric hydroxide complexes which precipitate to the bottom sediments. Consequently, iron concentrations in the water column under these conditions are usually relatively low. Typical concentrations of total iron in oxygenated surface waters (pH of 5 to 8) are approximately 0.05 to 0.2 ppm (Wetzel, 1975). Along the Sugar River in New Hampshire, for example, the average of twelve samples taken by NHDES in 1992, was 0.3 ppm with a range of 0.16 to 0.55 ppm (pH ranged from 6.5 to 8 and dissolved oxygen levels were at or above 8.4 ppm).

Under low pH (acidic) and low dissolved oxygen (anoxic) conditions, however, iron concentrations in the water column can increase significantly. Under such conditions, ferric iron (Fe +++) can be reduced to ferrous iron (Fe ++) and solution of the iron into water can occur relatively easily (Sawyer, C.N. and P.L. McCarty, 1967).

Organic matter in surface waters can also greatly alter the solubility and availability of iron and can accomplish this in several ways. Organics in soils and water can be from natural or man-made sources, but in a general way can be viewed as a mixture of plant and animal products in various stages of decomposition by microorganisms. In the process of degrading the organics, the microorganisms consume dissolved oxygen. In addition, byproducts of the decomposed material can be acidic and lower the pH of the surrounding environment. Consequently, the presence of organic material can cause conditions of low dissolved oxygen and/or pH which, as stated above, can result in more iron being released into solution.

In addition to the above, organics formed as part of the degradation process can also greatly affect the solubility and availability of iron. In general, organic matter can be divided into nonhumic and humic substances with nonhumic substances being the portion that are easily utilized and degraded by microorganisms. Because they are rapidly utilized, the instantaneous concentration of nonhumic organic substances in water is usually low.

Most of the organic matter in soils and waters are humic substances which are relatively resistant to microbial degradation and therefore tend to persist for long periods of time. Humic substances are brown or black in color and are present in most surface waters but are most prevalent in organic rich environments such as wetlands, marshes or bogs. If present in significant concentrations, humic substances can impart an intense yellow-brown color to the water. Humics can be divided into humic acids which precipitate upon acidification, fulvic acids which are soluble in acid and base, and humin which is insoluble in weak acids and bases.

Humic substances are important because they easily form complexes with iron. In particular are the water soluble fulvic acids which can bring into and maintain stable solutions of iron from practically insoluble hydroxides and oxides. The formation of such complexes can occur under conditions of either low or high pH or dissolved oxygen.

Typical concentration of iron in wetlands containing high levels of organic matter and low dissolved oxygen are shown in the Table 3-1. This data was collected by NHDES in 1994 in an effort to determine appropriate naturally occurring background levels of various pollutants in undisturbed wetland areas. This information was then used to help establish target goals for remediation efforts at the former Pease Air Force Base. As shown, total iron levels in the three wetlands that were tested, ranged from approximately 3 ppm to over 18 ppm. Dissolved oxygen levels ranged from approximately 1.2 to 3 ppm. These iron levels are much higher than levels typically found in oxygenated systems with low organics.

Table 3-1
Typical Iron Concentrations in New Hampshire Wetlands

Waterbody Name (Town)	**Dame Road Swamp (Durham)**	**Tuttle Swamp (Newmarket)**	**Packer Bog Swamp (Greenland)**
pH	**5.6**	**5.7**	**6.2**
Dissolved Oxygen (ppm)	**2.6**	**1.26**	**3.01**
Dissolved Iron (ppm)	**1.03**	**1.72**	**1.4**
Total Iron (ppm)	**3.17**	**8.29**	**18.2**

In Williams Brook, it is believed that the high iron levels are primarily due to decaying organic matter from the stump dump and from natural wetlands in the vicinity which complex with and cause iron levels in the brook to exceed water quality standards during low flow conditions when dilution is low. Evidence supporting this assumption is provided below. Dissolved oxygen was not measured but may also play a role since the presence of organics can cause oxygen levels to decrease which, in turn, can cause more iron to go into solution. It is not believed, however that the role of dissolved oxygen is as pronounced as that of organic matter and flow. Ambient pH was measured from 1992 to 2000 but does not appear to play a significant role as pH ranges were relatively high (6.5 to 7.5 at SW-2 and 5.9 to 7.1 at SW-3).

Flow is very important in aquatic environments. When flows are high, the concentration of pollutants in the water is often low as more water is available to dilute the pollutants. When stream flows are low, however, less dilution is available which causes the concentration of pollutants to increase. Consequently, one would expect flow to be inversely proportional to concentration.

This relationship appears to hold true for Williams Brook. Although flow was not measured in Williams Brook on the dates that samples were taken, it can be estimated by reviewing flows measured by the United States Geological Survey (USGS) from nearby rivers and streams on the same days that iron was sampled in Williams Brook. This was done for the West Branch of the Warner River (gage near Bradford), the Smith River (gage in Bristol) and the Soucook River (gage in Concord). Characteristics of these rivers and streams are shown in Table 3-2. Measured flows on the dates that samples were taken in Williams Brook are shown in Figure 3-1.

As shown in Figure 3-1, all three waterbodies exhibit the same pattern of flow for the dates given. This suggests that flows in Williams Brook most likely exhibited a similar pattern. To get an idea of the relationship between flow and concentration, the flows for the West Branch of the Warner River were superimposed on the graph of iron concentrations. Results are shown in Figure 3-2. The West Branch of the Warner River was selected since its drainage area (5.75 square miles) is very close to that of Williams Brook (5.5 square miles).

Table 3-2
Characteristics of Gaged Rivers in the Vicinity of Williams Brook

	West Branch Warner River	Soucook River	Smith River
USGS Gage Number	**1085800**	**1089100**	**1078000**
Flow Gage Location	**near Bradford**	**Concord**	**Bristol**
Drainage Area (square miles)	**5.75**	**81.9**	**85.8**
*** 7Q10 low flow (CFS)**	**0.16**	**7.78**	**6.09**

*** 7Q10 low flows are based on computations performed by NHDES in 1994.**
CFS = cubic feet per second

Figure 3-1
Flows in Gaged Rivers Near Williams Brook

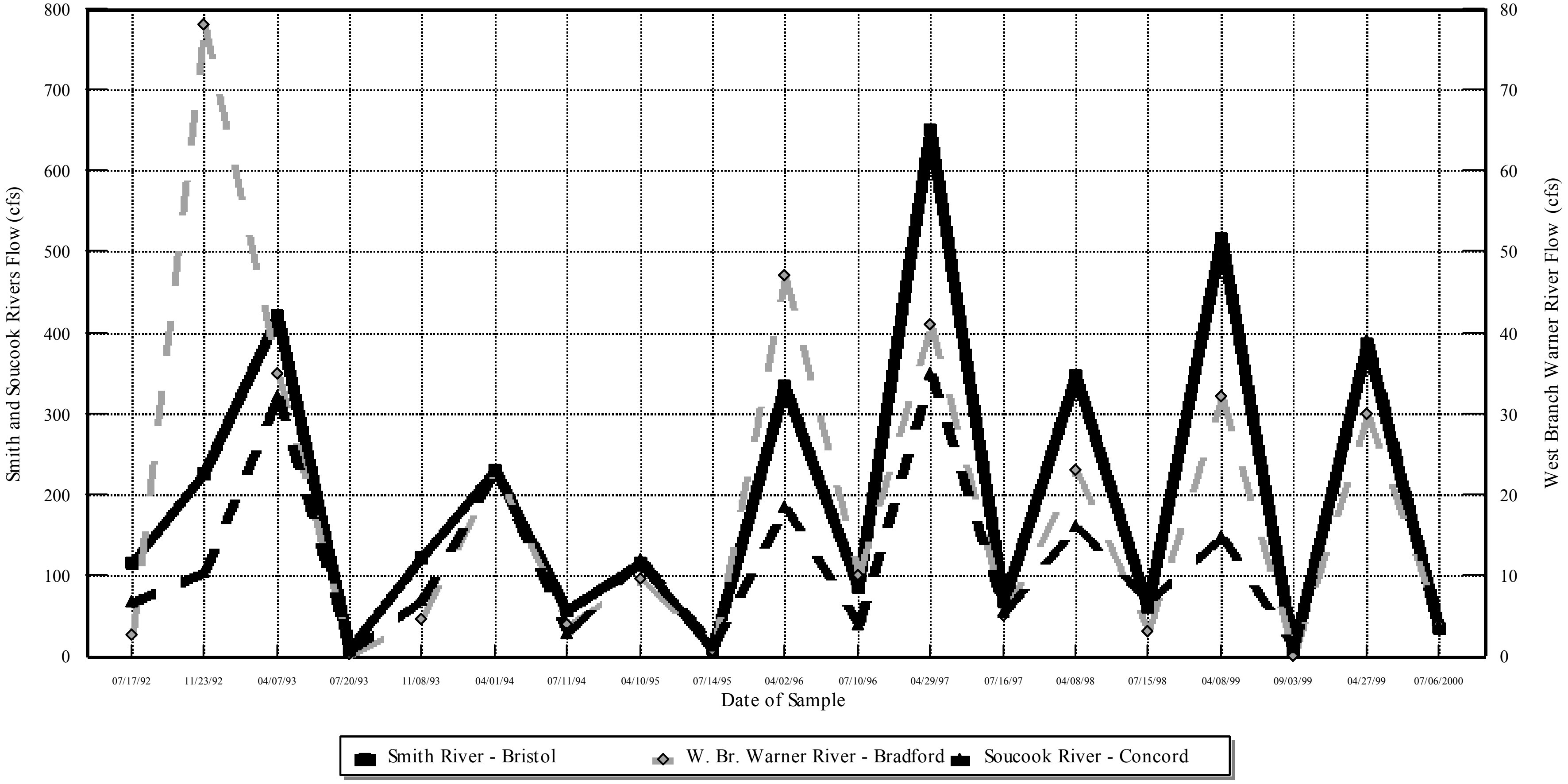
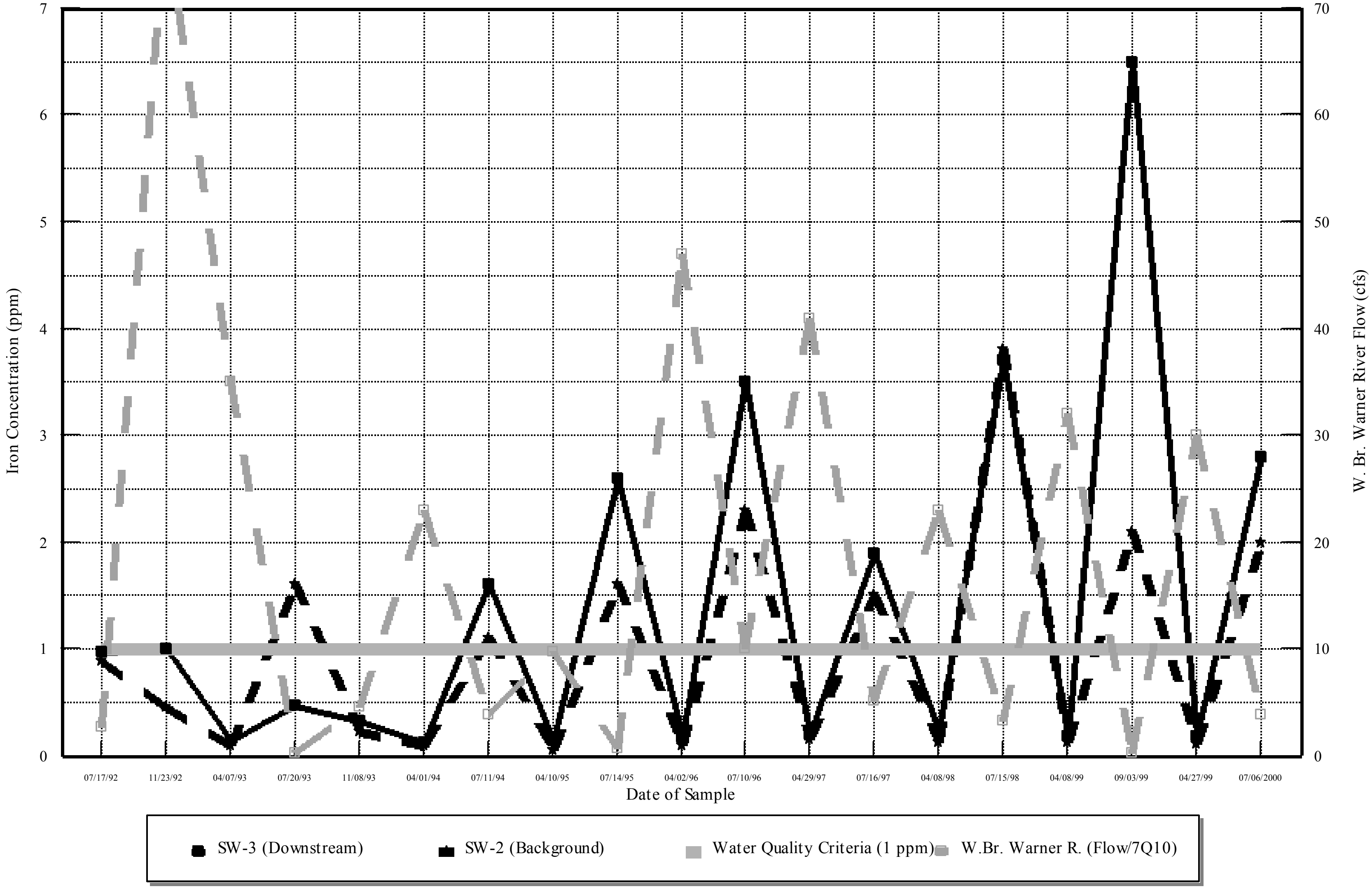


Figure 3-2
Relationship of Iron Concentration to Estimated Flow in Williams Brook



Since the drainage areas are so similar, flows for the West Branch of the Warner River probably closely approximate flows in Williams Brook. Assuming this is true, Figure 3-2 supports the relationship that flow is inversely proportional to concentration. In addition it suggests that the period of most concern is during the summer months (July and September) when flows are generally the lowest and iron concentrations are the highest.

Table 3-2 also shows the 7Q10 low flow for the gaged rivers. The 7Q10 low flow is the average 7 day low flow that occurs, on the average, once every ten years. This is of importance because water quality criteria only apply at flows at or above the 7Q10 flow. As shown in Figure 3-1, all three gaged rivers were above the 7Q10 low flow on the dates iron was sampled. This suggests that flow in Williams Brook was also above the 7Q10 on the dates that iron exceedances were recorded. Having established the importance of flow, reasons why organic matter is believed to be an important factor affecting iron concentrations in Williams Brook will be discussed next.

In the study area of Williams Brook there are two main sources of organics. The first is the Northfield Stump Dump located immediately adjacent to the main channel of the brook. By their very nature, stump dumps contain an abundance of decaying organic material (i.e., tree stumps). As previously discussed, as the organics degrade they produce humic substances which complex with iron and can create environments (i.e., anaerobic and/or acidic conditions) that further favor the release of iron into solution. Transport of the iron to nearby surface waters is provided by rain water filtering down and/or groundwater passing through the stump dump. Evidence supporting the theory that the stump dump has caused increased iron levels in the brook is supported by Figure 3-2 which shows that iron levels downstream of the stump dump have generally exceeded upstream condition.

In addition to the stump dump, however, naturally occurring organics are also believed to play an important role. As shown in Figure 3- 2, total iron concentrations downstream of the stump dump during the months of July ranged from 1.9 to 3.7 ppm. It is also interesting to note, however, that total iron concentrations upstream of the stump dump are in the same range (1.5 to 3.8 ppm). To understand why upstream concentrations were also high, soil maps were consulted.

According to maps developed by the United States Department of Agriculture, Soil Conservation Service in cooperation with the New Hampshire Agricultural Experiment Station (USDASCS, 1961), soils along the Williams Brook streambed upstream of the stump dump are primarily poorly drained soils that are flooded most of the time. From the stump dump upstream approximately 0.4 miles, soils along the streambed are classified as “Mixed Alluvial Land” (Mn) which are poorly drained soils. Approximately 0.9 miles upstream of the stump dump is a large wetland area. Soils in this wetland are classified as “Muck and Peat” which consist of deposits of organic matter that are generally more than 12 inches deep.

Soils upstream of the stump dump are therefore likely to contain significant amounts of organic matter (i.e., humic substances). These naturally occurring organics are believed to be the primary cause of elevated background levels of iron. This is further supported by Table 3-1, which shows measured iron levels for three wetlands in New Hampshire. As shown, the Dame Road swamp had a total iron concentration of approximately 3 ppm which is in the range of upstream total iron concentrations recorded in Williams Brook (1.5 to 3.8 ppm).

CHAPTER 4

TOTAL MAXIMUM DAILY LOAD AND ALLOCATIONS

4.1 DEFINITION OF A TMDL

According to the 40 CFR Part 130.2, the total maximum daily load (TMDL) for a waterbody is equal to the sum of the individual loads from point sources (i.e., wasteload allocations or WLAs), and load allocations (LAs) from nonpoint sources (including natural background conditions). Section 303(d) of the CWA also states that the TMDL must be established at a level necessary to implement the applicable water quality standards with seasonal variations and a margin of safety (MOS) which takes into account any lack of knowledge concerning the relationship between effluent limitations and water quality.

In equation form, a TMDL may be expressed as follows:

$$\text{TMDL} = \text{WLA} + \text{LA} + \text{MOS}$$

where:

WLA = Waste Load Allocation (i.e. loadings from point sources)

LA = Load Allocation (i.e., loadings from nonpoint sources including natural background)

MOS = Margin of Safety

TMDLs can be expressed in terms of either mass per time, toxicity or other appropriate measure [40 CFR, Part 130.2 (i)]. The MOS can be either explicit or implicit. If an explicit MOS is used, a portion of the total allowable loading is actually allocated to the MOS. If the MOS is implicit, a specific value is not assigned to the MOS. Use of an implicit MOS is appropriate when assumptions used to develop the TMDL are believed to be so conservative that they are sufficient to account for the MOS.

4.2 DETERMINATION OF TOTAL MAXIMUM DAILY LOAD (LOADING CAPACITY)

4.2.1 Seasonal Considerations/Critical Conditions

As stated in the previous section, TMDLs must be established at a level necessary to implement the applicable water quality standards with seasonal variations. Seasonal variations of iron in Williams Brook are presented in Figure 2-3. As shown, exceedances of the 1 ppm iron criteria occur only during the summer months which, as discussed in Chapter 3, appears to be strongly related to periods of low flow (see Figure 3-2). Therefore, the critical period for this TMDL is during periods of low flow which typically occur in the summer months.

4.2.2 TMDL Calculation and Load Allocation

Since the natural background conditions exceed the water quality criteria of 1 ppm total iron, the loading in Williams Brook cannot exceed natural background loadings. In other words, the loading from the stump dump is zero and the TMDL is equal to the natural background level or:

$$\text{TMDL} = \text{LA} = \text{Natural Background}$$

Natural background levels are going to vary depending largely on flow as shown in Figure 3-2. The lower the flow, the higher the background concentration. Consequently, rather than setting a specific load, the goal of this TMDL will be to ensure that concentrations downstream of the stump dump do not significantly exceed upstream natural levels. When this condition is met, the loading from the stump dump will essentially be equal to zero and water quality standards will have been met.

4.3 LOAD REDUCTIONS NEEDED TO ACHIEVE THE TMDL

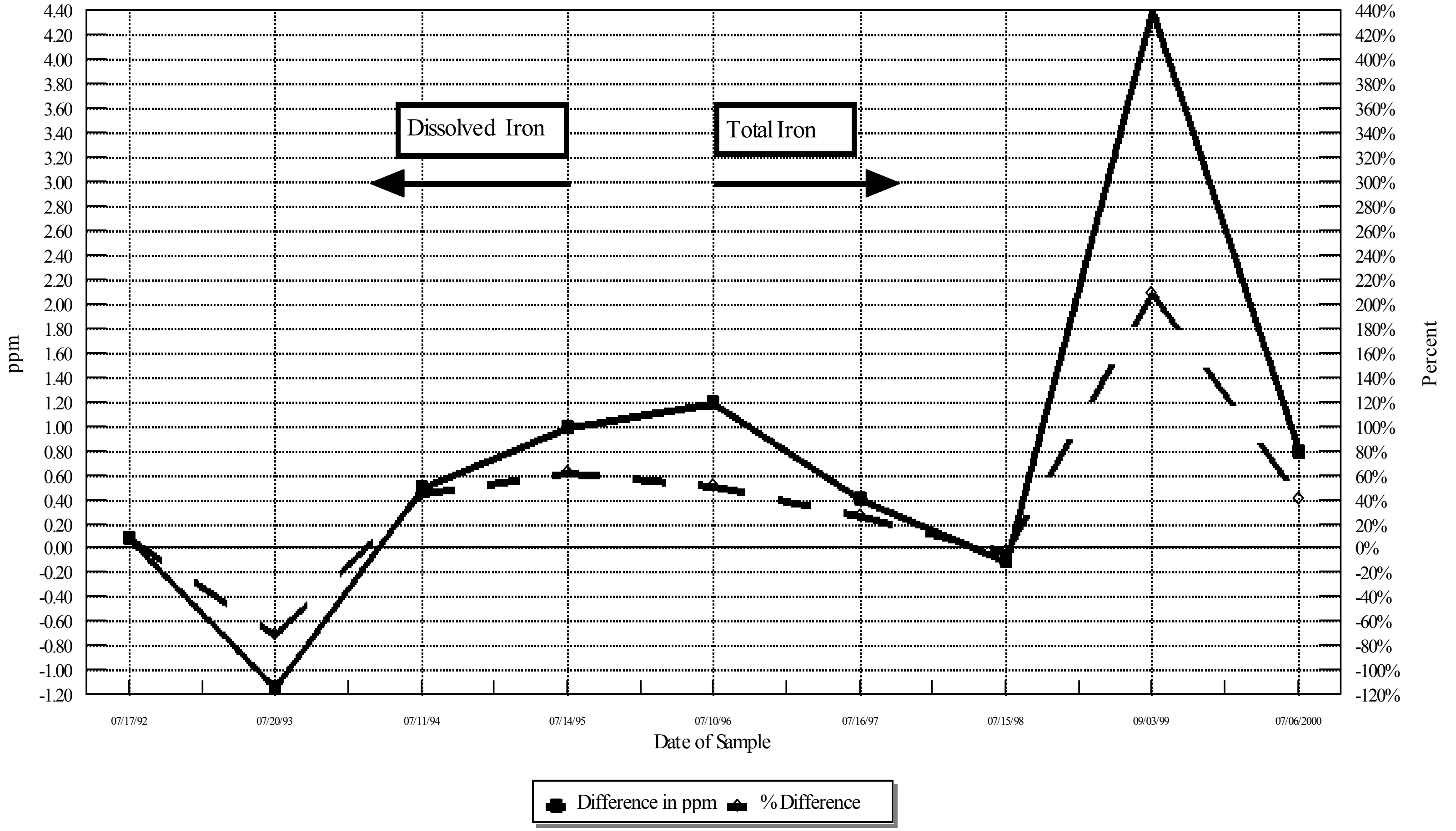
A relative idea of the load reduction needed before water quality standards will be met, can be determined from Figure 4-1 which is a plot of the difference between up and downstream iron concentrations versus time. Only concentrations for the months of July and September are shown as this is when iron concentrations exceeded 1 ppm.

From the graph it appears that the percent difference between upstream and downstream concentrations has steadily declined from 1995, when the downstream iron concentrations were about 60 percent higher than upstream levels, to essentially a zero percent difference in July, 1998. This is believed to be due to the installation of a two foot deep earthen cover over the landfill in 1993, which reduces the amount of water seeping into and out of the landfill.

On September 3, 1999, concentrations increased significantly, as did the difference between the upstream and downstream levels with downstream levels being significantly higher (4.4 ppm) than the upstream concentration. On July 6, 2000, however the concentrations and difference in concentrations decreased dramatically. This spike in concentrations is believed to be largely attributably to differences in flow. On September 3, 1999 the flow in the W. Branch Warner River was 0.17 cfs, which is just above the 7Q10 flow of 0.16 cfs. This compares to flows of 3.2 and 3.9 cfs on July 15, 1998 and July 6, 2000 respectively which are about 19 to 22 times higher than the flows recorded on September 3,1999. Assuming that flows in Williams Brook were similar to flows in the W. Branch Warner River, it is not surprising to see concentrations increase on September 3, 1999 since pollutant concentrations tend to increase during periods of low flow and dilution. The reason why downstream levels were so much higher than upstream levels on September 3, 1999 is probably due in part to the continued, but declining, influence of the stump dump on iron concentrations. However it may also be due to the difficulty in obtaining representative samples when flows are so low and conditions are essentially stagnant. Consequently, the September 3, 1999 may be an anomaly. Further sampling is needed to determine if this is the case.

Overall, the data suggests that conditions are improving. Over time, it is expected that the influence of the capped stump dump will become less and less apparent and that differences between natural upstream and downstream iron concentrations will decrease. Consequently reductions in iron loadings from the stump dump are underway and, under most flow conditions, have resulted in downstream concentrations which are very similar to upstream iron levels. As discussed in Chapter 5, additional sampling is recommended, especially during low flow conditions, to determine when water quality standards are met (i.e., when there is no significant difference between natural upstream and downstream concentrations).

Figure 4-1
Difference Between Downstream and Upstream Iron Concentrations for the months of July and September (1992-2000)



CHAPTER 5

IMPLEMENTATION / REASONABLE ASSURANCE

5.1 STATUTORY/REGULATORY REQUIREMENTS

Section 303(d)(1)(C) of the CWA provides that TMDLs must be established at a level necessary to implement the applicable water quality standard. The following is a description of activities that have been implemented to abate water quality concerns in Williams Brook.

5.2 DESCRIPTION OF ACITIVTIES TO ACHIEVE TMDL

5.2.1 Implementation Plan

The Northfield stump dump was closed and capped in 1993. Consequently best management practices to reduce the impact of the stump dump on Williams Brook have already been implemented. As discussed in the previous chapter, it appears that this has already had a positive impact on water quality in Williams Brook.

5.2.2 Monitoring

The Town of Northfield has monitored the surface water in Williams Brook, upstream and downstream of the capped landfill, bi-annually for eight years (from 1992 to 2000). The results of the monitoring indicate that under most flow conditions, there is a continued declining trend in iron in the brook downstream since the landfill was capped. It is recommended that the Town of Northfield (or their consultants) continue to sample, especially during periods of low flow, to determine when water quality standards are being achieved (i.e., when downstream iron concentrations are not significantly different from natural upstream iron concentrations). Depending on availability of resources, DES may be able to assist with monitoring efforts.

CHAPTER 6

PUBLIC PARTICIPATION

6.1 DESCRIPTION OF PUBLIC PARTICIPATION PROCESS

EPA regulations [40 CFR 130.7 (c) (ii)] requires that calculations to establish TMDLs be subject to public review. In accordance with this requirement, a draft of this report was made available for public comment on August 27, 2002. Comments were accepted until the end of business on September 17, 2002. A downloadable copy of the draft report was posted on the NHDES TMDL website, which includes a public feedback form for comments to be emailed directly to DES. Three (3) copies of the report were delivered to the Town of Northfield Town Hall, one for the Town Administrator, one for the Chairman of the Conservation Commission and one for the Town Clerk to make available to the public. DES also placed a legal notice in the Concord Monitor newspaper, the major local newspaper in the stakeholder area, on Saturday September 5, 2002.

6.2 PUBLIC COMMENT AND DES RESPONSE

NHDES did not receive any comments on the draft Williams Brook TMDL report.

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