Section 8

Westfield River Watershed

SECTION 8 – WESTFIELD RIVER WATERSHED

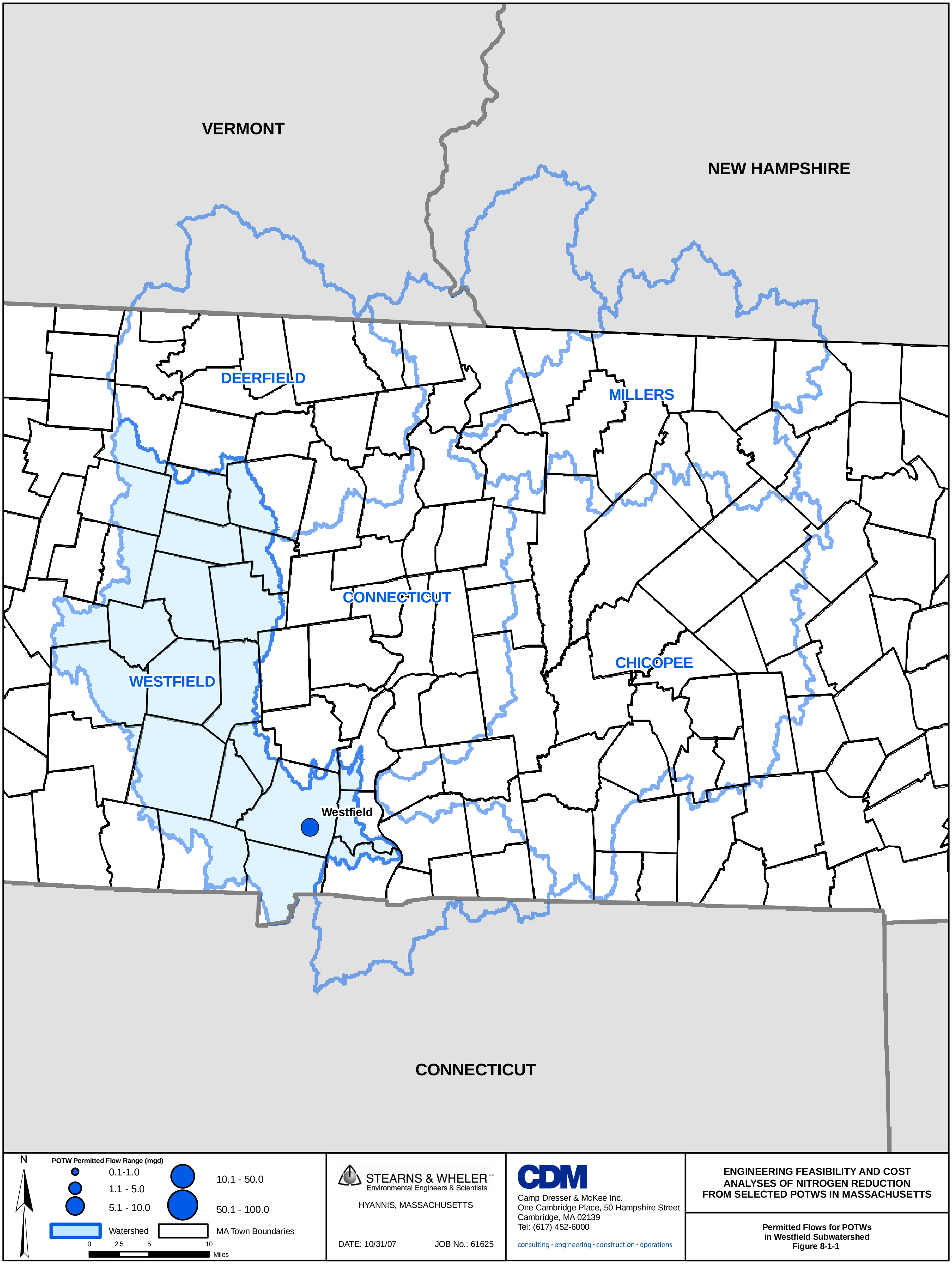
8.1 INTRODUCTION

The Westfield River drains the eastern portion of the Berkshires, flows through Westfield and then joins the Connecticut River in Agawam. The river is fed by a number of other area rivers including the North Branch, Middle Branch and West Branch. This study includes one POTW that discharges directly to the Westfield River – the Westfield WWTF.

Image from www.mass.gov

Figure 8.1-1 shows the Westfield River watershed and the facility mentioned above. The impact of nitrogen removal at this facility is presented in this section.

(continued)



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ENGINEERING FEASIBILITY AND COST ANALYSES OF NITROGEN REDUCTION FROM SELECTED POTWS IN MASSACHUSETTS

Permitted Flows for POTWs in Westfield Subwatershed
Figure 8-1-1

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8.2 WESTFIELD

A. **Introduction.** The Westfield wastewater treatment facility is located on Neck Road in Westfield, MA. The site is constructed in a designated flood way. It has a permitted annual average capacity of 6.1 mgd (based on a 12-month rolling average) and serves Westfield and a small portion of Southwick. Approximately 5% of the influent flow is industrial. It is not a combined collection system, but there is an issue with inflow and infiltration. The facility does accept a fairly high volume of septage: approximately 17,000 gallons per day on an average day but with slugs of flow as high as 30,000 gallons per day.

The current facility was built in 1973. A major expansion/upgrade was completed from 1998-2005. The design annual average capacity was increased from 4.0 mgd to 6.1 mgd based on the design-year 2020 projections. The permitted capacity of the facility also was increased to 6.1 mgd upon completion of the expansion. A third plug flow aeration train was added and the surface aerators were converted to a diffused aeration system. An additional aerated grit chamber, primary settling tank, final settling tank, and chlorine contact tank were also added, and the plant was updated with a new SCADA system. A new blower/sludge processing building was constructed, which houses the blowers and the new waste sludge storage tank. The new facilities are not shown in the aerial photo below.

B. **Existing Facilities.**

Aerial photo from www.google.com

1. **Description of Existing Facilities.** All flow is conveyed to the Westfield Wastewater Treatment Facility (WWTF) by gravity where it enters the Influent Pump Station. This structure contains the influent pumps and a screenings grinder with a manual bypass rack. From there, flow is conveyed to the aerated grit removal system.

After primary clarification, the primary effluent flows by gravity to the aeration tanks.

The facility has three aeration tanks with an anoxic zone at the head of each tank. Each tank is 246 ft long by 26 ft wide with a 12.4 ft sidewater depth. Each first stage anoxic zone is 86 ft long by 26 feet wide. Sodium aluminate is added at the beginning of the anoxic zones seasonally to meet a total phosphorus limit of 1.0 mg/L. Caustic soda is added in the winter to raise the pH. The aeration tanks are followed by three 12 ft deep, 80 ft diameter secondary clarifiers. Only two aeration tanks and two clarifiers are shown in the aerial photo since it was taken prior to the recent upgrades.

Secondary effluent receives chlorine disinfection and dechlorination with sodium bisulfite prior to being discharged to the Westfield River. An effluent pump station is available to pump effluent to the river if the water stage in the river is too high for the effluent to flow by gravity. A liquid process flow schematic is shown in Figure 8.2-1.

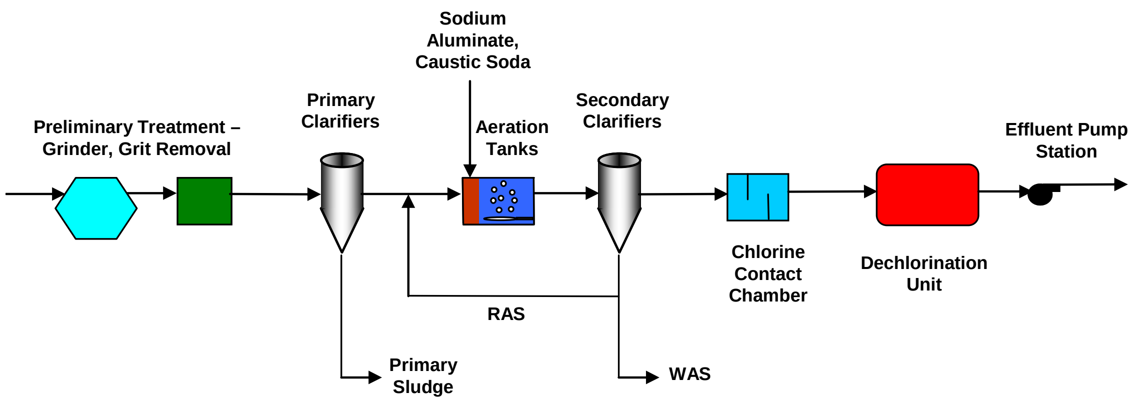


FIGURE 8.2-1: PROCESS FLOW SCHEMATIC – EXISTING FACILITY

Waste activated sludge is thickened with gravity belt thickeners. Thickened WAS and primary sludge are stored in a sludge tank and then hauled mostly to Synagro's facility in Waterbury, CT. Occasionally the combined sludge is dewatered with the belt filter presses and sent to a landfill in Seneca Meadows, NY.

All plant recycle flows are returned to the headworks. Septage is introduced to the wastewater stream at the headworks also. The influent flow meter includes the side stream flows, but the influent sampler does not include the loads since the sampler is upstream of where the sidestream is returned. The primary sampler is located downstream of where the side stream returns, thus all plant flows are part of the primary effluent loads.

All process tanks are operated under normal conditions. The first stage of the aeration tanks is being operated as an anoxic zone. Nitrification is not required in the winter but the effluent data indicates that varying levels of nitrification is occurring during the coldest months.

The plant has nine full-time employees: one superintendent, one deputy superintendent, four plant operators and three plant attendants.

There is essentially no open space left on the fenced in portions of the site due to the addition of the third treatment train. In addition, a US Army Corps of Engineers permit would be required to build on additional portions of the site since the plant is located in a flood way. If new structures were constructed, the foundations could be on spread footings.

2. **Summary of Plant Data.** Data from January 2004 through December 2006 was provided by the Town for this study. A summary of the monthly data is shown in Table 8.2-1.

(continued)

Table 8.2-1

WESTFIELD WWTF

Westfield, Massachusetts

Monthly Averages 2004-2006

GENERAL		INFLUENT											PRIMARY EFFLUENT			FINAL EFFLUENT											
DATE		INF	pH	BOD	TSS	TVSS	TKN	TEMP	DO	AMMONIA NITROGEN	NO2	NO3	pH	BOD	TSS	DO	pH	BOD	TSS	F. COLI	NO2	NO3	NO2 + NO3	TKN	TN	AMMONIA NITROGEN
MONTH	YEAR	MGD		MG/L	MG/L	MG/L	MG/L	DEG F	MG/L	MG/L	MG/L	MG/L		MG/L	MG/L	MG/L		MG/L	MG/L	# / 100ML	MG/L	MG/L	MG/L	MG/L	MG/L	MG/L
January	2004	4.7	6.9	172.0	184.0	168.0		9.6	5.6				6.8	135.4	89.0	8.7	7.0	17.4	11.8				1.6	16.6	14.1	
February	2004	3.6	6.9	212.0	192.0	177.0		22.8	5.6				6.8	170.7	96.6	8.7	7.2	29.6	19.4				2.3	37.1	18.5	
March	2004	3.7	6.8	173.0	188.0	170.0		46.8	6.2				6.8	134.1	89.9	9.4	7.0	15.8	15.5				0.8	29.0	10.0	
April	2004	6.2	6.7	131.0	147.0	132.0		60.0	5.7				6.7	93.7	77.7	9.1	6.9	13.9	4.5				1.8	13.0	9.4	
May	2004	3.8	6.8	220.0	229.0	202.0		72.8	5.0				6.8	132.7	79.8	8.9	7.0	21.2	9.8				2.2	7.8	13.0	
June	2004	2.9	6.7	220.0	240.0	205.0		77.9	4.6				6.7	139.1	79.4	8.7	6.8	14.9	9.3				1.1	19.0	18.0	
July	2004	2.6	6.7	245.0	294.0	252.0		65.8	4.2				6.6	147.7	98.7	7.9	6.7	12.1	8.4				0.4	19.0	10.0	
August	2004							32.0																		
September	2004	3.6	6.7	248.0	282.0	232.0		74.9	4.6				6.6	117.8	109.4	8.2	7.0	9.8	7.8				0.8	80.0	20.0	
October	2004	3.6	6.8	228.0	268.0	224.0		60.4	4.7				6.8	122.6	100.0	8.1	6.8	8.8	7.9				5.5	1.9	0.6	
November	2004																									
December	2004	4.4	7.1	235.8	259.0	226.0	35.0		4.0	14.0			7.1	137.3	65.9	8.5	6.9	16.1	10.7		8.4	1.4	4.9	11.0	8.6	8.6
January	2005	4.7	7.2	184.5	193.0	165.8	28.0		5.0	19.0	0.4	0.6	7.2	31.8	76.3	8.0	6.9	13.3	8.5		8.6		4.6	10.0	8.3	3.9
February	2005	4.5	7.1	157.6	497.1	231.0			5.7	24.0			7.1	106.8	81.6	7.5	7.0	14.1	11.5						13.0	13.0
March	2005	4.2	7.1	173.3	275.0	252.0	44.0		5.0	24.0	0.1		7.0	94.8	71.4	6.3	7.0	10.3	7.1		1.9	0.3	1.1	26.0	18.0	18.0
April	2005	5.6	7.0	115.5	289.0	247.0			5.0	24.0			7.0	86.1	93.1	8.2	6.9	2.5	4.3	40.5					7.5	7.5
May	2005		7.2	231.0	202.0	155.0			4.1	22.0			6.9	198.0	99.2	8.2	6.9	9.8	6.2	56.8						5.5
June	2005									9.5																1.5
July	2005	3.1	7.1	150.3	275.0	208.8			4.1	20.0			7.0	80.5	69.2	7.2	6.9	3.7	5.9	25.9					1.9	1.3
August	2005	2.6	6.7	129.7	225.1	172.5			2.8	31.0			6.9	102.1	53.6	7.0	7.0	4.5	9.8	74.2					1.2	0.8
September	2005	2.6	7.1	246.9	284.0	212.0			2.5	29.0			7.0	140.7	83.0	6.7	7.0	3.8	7.1	5.2					1.0	1.0
October	2005	5.6	7.0	156.1	327.0	245.0			3.0	16.0			6.8	87.5	75.6	7.7	6.9	3.6	6.1	48.8					1.2	0.3
November	2005	4.6	7.0	123.2	254.5	201.5			3.8	18.0			7.0	82.2	72.4	7.9	6.8	7.3	6.3							5.3
December	2005	4.2	7.2	144.9	292.6	245.8			3.9	25.0			7.0	78.4	80.1	8.4	6.8	8.0	80.1						1.0	1.0
January	2006	5.7	7.0	118.5	201.1	165.9			4.6				7.0	61.9	68.4	8.6	6.9	9.8	6.4							
February	2006	4.9	7.1	121.6	174.8	149.8			4.7	12.0			7.0	105.9	56.0	8.3	6.9	7.5	5.3							5.8
March	2006	3.4	7.2	178.7	314.2	256.8			4.5				7.1	95.8	83.8	7.6	7.0	12.1	8.3				7.7			
April	2006	3.5	7.3	200.8	333.5	288.6			4.4	24.0			7.1	106.9	109.1	7.2	7.0	10.1	8.5	34.6			16.8			21.0
May	2006	4.3	7.1	159.9	398.8	278.3			3.9	14.0			7.0	103.7	122.5	8.3	7.0	10.5	9.7	35.4			13.1			8.8
June	2006	4.0	7.1	129.3	251.6	196.7			3.9	15.0			7.0	92.8	90.5	8.6	7.0	5.9	5.1	3.4			9.0			6.1
July	2006	3.3	7.1	187.2	370.5	302.9			3.5	24.0			6.9	70.4	65.5	7.3	7.0	4.3	4.5	8.7			5.5			6.6
August	2006	2.8	7.2	229.2	319.6	258.2			3.2	18.0			7.0	79.9	69.1	6.1	7.1	6.4	5.6	12.1			9.1			17.0
September	2006	2.9	7.1	204.5	312.4	251.7			2.4	18.0			6.9	113.0	68.6	7.5	7.0	8.2	5.6	4.8			8.4			5.0
October	2006	3.5	7.1	232.2	294.5	233.9			1.9	35.0			6.8	116.4	72.1	8.4	6.9	10.4	5.0	44.8						1.2
November	2006	4.5	6.9	162.9	233.7	191.3			4.1	19.0			6.7	75.0	57.4	9.4	6.8	13.3	9.3							4.5
December	2006	3.6	7.0	192.7	322.3	264.6			13.9	18.0			6.8	111.4	72.2	8.0	6.9	17.6	10.4				10.3			8.8
Min. Month		2.6	6.7	115.5	147.0	132.0	28.0	9.6	1.9	9.5	0.1	0.6	6.6	31.8	53.6	6.1	6.7	2.5	4.3	3.4	1.9	0.3	0.4	1.9	0.6	0.3
Seasonal Average		**3.4**	**7.0**	**201.1**	**285.8**	**226.9**		**64.0**	**3.7**	**21.0**			**6.9**	**115.3**	**83.5**	**7.8**	**6.9**	**8.6**	**7.1**	**29.1**			**5.5**	**25.5**	**7.4**	**4.6**
Average Annual		**4.0**	**7.0**	**182.3**	**270.4**	**217.1**	**35.7**	**52.3**	**4.5**	**20.5**	**0.2**	**0.6**	**6.9**	**107.7**	**81.1**	**8.0**	**6.9**	**10.8**	**10.4**	**30.4**	**6.3**	**0.9**	**5.3**	**22.5**	**9.2**	**6.6**
Max. Month		6.2	7.3	248.0	497.1	302.9	44.0	77.9	13.9	35.0	0.4	0.6	7.2	198.0	122.5	9.4	7.2	29.6	80.1	74.2	8.6	1.4	16.8	80.0	20.0	21.0

Seasonal and annual averages for minimum and maximum month data are summarized in the table. With a current average daily flow of 4 mgd and a permitted capacity of 6.1 mgd, this facility is operating at approximately 66% of its permitted capacity. Based on the average BOD concentration of 182 mg/L and TSS concentration of 270 mg/L, this wastewater would be considered medium-high strength. Minimal influent TKN data is available for this plant.

3. **Permit Requirements and Current Performance.** The current permit for this facility has been in effect since November 14, 2001. Monthly permit limits that are relevant to this study are shown below in Table 8.2-2.

Table 8.2-2

SELECT MONTHLY PERMIT LIMITS

PARAMETER	LIMIT
BOD5	
November – May	30 mg/L
June - October	20 mg/L
TSS	
November – May	30 mg/L
June - October	20 mg/L
Ammonia Nitrogen	
November –May	Report
June - October	3 mg/L
Total Phosphorus	
November –May	Report
June - October	1 mg/L

The above BOD and TSS limits have been met in all months of the data collection period.

4. **Nitrogen Removal Performance.** The influent and effluent nitrogen data indicate they are nitrifying year-round, although they are not always meeting their ammonia permit. The process is new, so there may still be some adjustment to system operation occurring. The sampling frequency during June to October is once a week.

C. **Nitrogen Removal Alternatives.** The existing maximum month loads over the three-year data collection period were used to determine the BioWin input data. The primary effluent data which correspond to maximum-month loads is shown in the following Table 8.2-3 for each permitting scenario. The minimum temperature for the permit condition is also shown. In addition, due to a lack of influent nitrogen data, the TN/BOD ratio was estimated to be 0.18.

Table 8.2-3

EXISTING PRIMARY EFFLUENT PARAMETERS

PERMIT CONDITION	PARAMETER	VALUE
Annual Average	Flow, mgd	3.6
	BOD, mg/L	171
	TSS, mg/L	129
	TKN, mg/L	34
	Temperature, F	46
Seasonal	Flow, mgd	3.8
	BOD, mg/L	133
	TSS, mg/L	100
	TKN, mg/L	35
	Temperature, F	57

The existing plant data was then projected to the permitted capacity of the facility to develop model input parameters for the average annual and seasonal model runs. The resultant data is shown in Table 8.2-4.

Table 8.2-4

MODEL INPUT PARAMETERS AT PERMITTED CAPACITY

PERMIT CONDITION	PARAMETER	VALUE
Annual Average	Flow, mgd	5.5
	BOD, mg/L	171
	TSS, mg/L	129
	TN, mg/L	34
	Temperature, F	46
Seasonal	Flow, mgd	5.9
	BOD, mg/L	133
	TSS, mg/L	100
	TN, mg/L	35
	Temperature, F	57

The model input data was used to run uncalibrated simulations to determine planning level, order-of-magnitude costs for implementing different levels of nitrogen reduction at the facility. A discussion of operational changes or minor modifications that can be made to the facility to improve current nitrogen reduction performance as well as a presentation of the simulation results are presented in the following sections.

1. **Minor Modifications/Retrofits.** Since the plant is already operating a portion of its tank as an anoxic zone in a Ludzack-Ettinger configuration (anoxic followed by aerobic with no internal recycle), there are no additional minor modifications that could be made to improve nitrogen removal.

The plant should operate at as high an SRT as possible during the winter to maximize nitrification.

2. **Modifications Required to Meet TN of 8 mg/L.** The modifications to the facility that are required to meet an effluent TN of 8 mg/L on a seasonal and annual average basis are as follows.

a. **Seasonal.** At the assumed influent TN levels for this facility, an MLE process will not accomplish a seasonal effluent TN level of 8 mg/L at the facility's design capacity. The MLE process will yield a seasonal effluent TN of 10 mg/L. However, even at an MLSS of 4,000 mg/L, the required tank volume (2.15 MG) would exceed the existing tank sizes (1.78 MG), and there is no room for expansion. Thus, a 4-stage Bardenpho process with IFAS and methanol addition to the second anoxic zone is recommended as shown in the BioWin model in Figure 8.2-2 below.

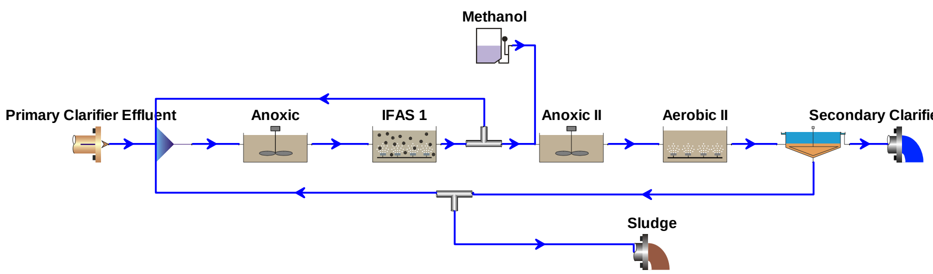
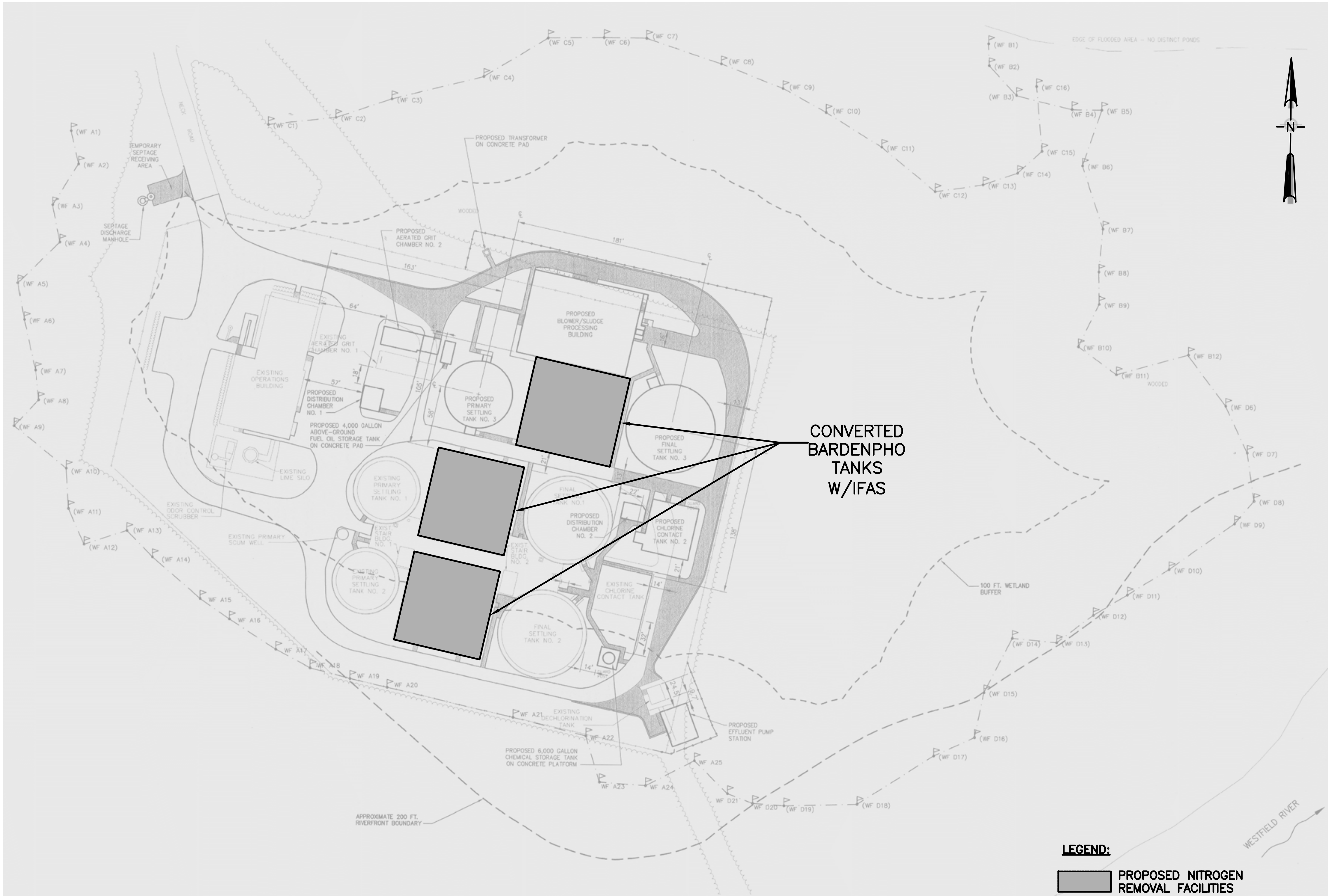


FIGURE 8.2-2: BIOWIN MODEL FOR SEASONAL TN LIMIT OF 8 mg/L

This process would fit in the existing tanks which would continue to operate in plug flow configuration as shown in the site plan in Figure 8.2-3. The existing tanks would be modified with partition walls to form parallel Bardenpho trains and IFAS media would be added. A methanol feed facility would be required. Additional blower capacity would be required due to the IFAS system. Nitrate recycle pumps would be added.



NOTE:

1. Background is from Drawing C-2 from Contract Documents entitled "EXPANSION AND UPGRADE OF WATER POLLUTION CONTROL PLANT" by METCALF & EDDY and dated 2005.

2. Auxiliary facilities associated with nitrogen removal processes are not shown.

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ENGINEERING FEASIBILITY AND COST ANALYSES OF NITROGEN REDUCTION FROM SELECTED POTWS IN MASSACHUSETTS

WESTFIELD, MASSACHUSETTS

FIGURE 8.2-3

It is also anticipated that no new clarifiers will be required to operate the facility at the resultant model MLSS concentration. A Bardenpho process with methanol addition and without IFAS would also work at this facility; however, it would require an additional clarifier to handle the higher MLSS concentration required. Due to the site constraints associated with the floodway, this would require one of the existing clarifiers to be demolished and stacked clarifiers and an intermediate pump station be installed. The IFAS alternative was selected for the study to reduce the solids loading and eliminate the need for additional clarifiers. It should be noted that the existing clarifiers at this facility are 12 feet deep. According to TR-16, clarifiers at nitrogen removal facilities should be a minimum of 13 feet deep. Because the clarifiers do not meet the minimum requirements set forth in the in Section 2, it is recommended that they be further evaluated to determine if they will require replacement or derating because of the shallow depth. The current method of wasting WAS from the RAS line through use of a control valve would have to be further evaluated to make sure the design SRT could be maintained with the IFAS system without exceeding the maximum MLSS concentration the existing clarifiers can handle.

Specific information regarding the design results is shown in Table 8.2-5 below.

Table 8.2-5

RESULTS FOR SEASONAL LIMIT OF 8 mg/L TN

PARAMETER	VALUE
Aerobic SRT	N/A
Total SRT	10.1 days
First Anoxic Fraction	24%
Total Anoxic Fraction	40%
Reaeration HRT	20 minutes
Total Volume	1.78 MG (existing)
RAS Rate	50%
Nitrate Recycle Rate	400%
Max MLSS at Loading Rate	2,900 mg/L
Effluent TN	7.0 mg/L
Methanol Addition	Yes; 1000 gpd (6 months)
Fixed Film Required?	Yes; 60% fill
Clarifiers?	No additional clarifiers
Effluent Filtration Required?	No

Other plant modifications may be needed including upgrades to sludge handling. However, all facilities outside of the activated sludge process are outside of the scope of this study.

b. **Annual Average.** At the assumed influent TN levels for this facility, an MLE process will not accomplish an average annual effluent TN level of 8 mg/L. The MLE process will yield a seasonal effluent TN of 10 mg/L. However, even at an MLSS of 4,000 mg/L, the required tank volume (2.95 MG) would far exceed the existing tank sizes (1.78 MG), and there is no room for expansion. Thus, a four-stage Bardenpho process with IFAS in the first aerobic zone is recommended as shown in the BioWin model in Figure 8.2-4 below.

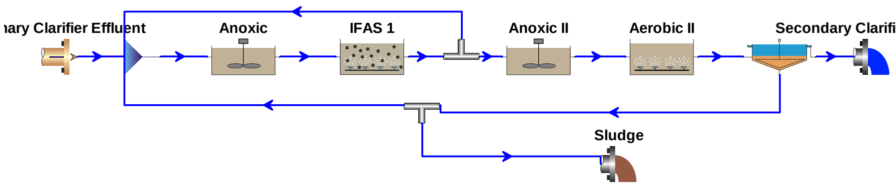

FIGURE 8.2-4:
BIOWIN MODEL FOR ANNUAL AVERAGE TN LIMIT OF 8 mg/L

This process would fit in the existing tanks which would continue to operate in plug flow configuration as shown in the site plan in Figure 8.2-3. The existing tanks would be modified with partition walls to form parallel Bardenpho trains and IFAS media would be added to the first aerobic zone. Additional blower capacity would be required due to the IFAS system. Nitrate recycle pumps would be added.

It is also anticipated that no new clarifiers will be required to operate the facility at the resultant model MLSS concentration. It should be noted that the existing clarifiers at this facility are 12 feet deep. According to TR-16, clarifiers at nitrogen removal facilities should be a minimum of 13 feet deep. Because the clarifiers do not meet the minimum requirements set forth in Section 2, it is recommended that they be further evaluated to determine if they will require replacement or derating because of the shallow depth. The current method of wasting WAS from the RAS line through use of a control valve would have to be further evaluated to make sure the design SRT could be maintained with the IFAS system without exceeding the maximum MLSS concentration the existing clarifiers can handle.

Specific information regarding the design results is shown in Table 8.2-6 below.

Table 8.2-6

RESULTS FOR ANNUAL AVERAGE LIMIT OF 8 mg/L TN

PARAMETER	VALUE
Aerobic SRT	N/A
Total SRT	8.5 days
First Anoxic Fraction	24%
Total Anoxic Fraction	40%
Reaeration HRT	12 minutes
Total Volume	1.78 MG (existing)
RAS Rate	50%
Nitrate Recycle Rate	400%
Max MLSS at Loading Rate	2,200 mg/L
Effluent TN	7.1 mg/L
Methanol Addition	No
Fixed Film Required?	Yes; 60% fill
Clarifiers?	No additional required
Effluent Filtration Required?	No

Other plant modifications may be needed including screening and upgrades to sludge handling. However, all facilities outside of the activated sludge process are outside of the scope of this study.

3. **Modifications Required to Meet a TN of 5 mg/L.** The modifications to the facility that are required to meet an effluent TN of 5 mg/L on a seasonal and annual average basis are as follows.

a. **Seasonal.** At the assumed influent TN levels for this facility, a four-stage Bardenpho process with IFAS in the aerobic zone and methanol addition to the second anoxic zone is recommended to achieve a seasonal effluent TN of 5 mg/L as shown in the BioWin model in the following Figure 8.2-5.

(continued)

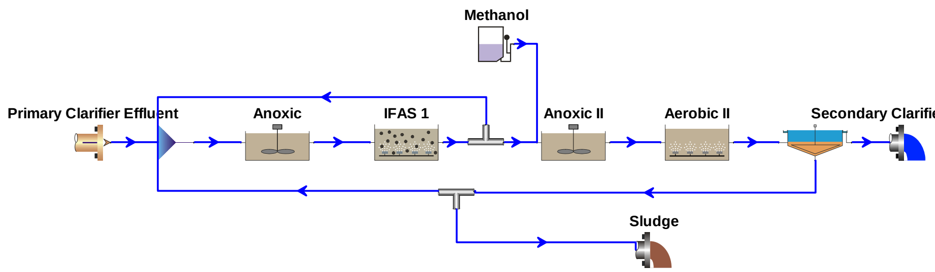

FIGURE 8.2-5: BIOWIN MODEL FOR SEASONAL TN LIMIT OF 5 mg/L

This process would fit in the existing tanks which would continue to operate in plug flow configuration as shown in the site plan in Figure 8.2-3. The existing tanks would be modified with partition walls to form parallel Bardenpho trains and IFAS media would be added. A methanol feed facility would be required. Additional blower capacity would be required due to the IFAS system. Nitrate recycle pumps would be added.

It is also anticipated that no new clarifiers will be required to operate the facility at the resultant model MLSS concentration. A Bardenpho process with methanol addition and without IFAS would also work at this facility; however, it would require an additional clarifier to handle the higher MLSS concentration required. Due to the site constraints associated with the floodway, this would require one of the existing clarifiers to be demolished and stacked clarifiers and an intermediate pump station be installed. The IFAS alternative was selected for the study to reduce the solids loading to the clarifiers. It should be noted that the existing clarifiers at this facility are 12 feet deep. According to TR-16, clarifiers at nitrogen removal facilities should be a minimum of 13 feet deep. Because the clarifiers do not meet the minimum requirements set forth in the in Section 2, it is recommended that they be further evaluated to determine if they will require replacement or derating because of the shallow depth. The current method of wasting WAS from the RAS line through use of a control valve would have to be further evaluated to make sure the design SRT could be maintained with the IFAS system without exceeding the maximum MLSS concentration the existing clarifiers can handle.

(continued)

Specific information regarding the design results is shown in Table 8.2-7 below.

Table 8.2-7

RESULTS FOR SEASONAL LIMIT OF 5 mg/L TN

PARAMETER	VALUE
Aerobic SRT	N/A
Total SRT	9.2 days
First Anoxic Fraction	24%
Total Anoxic Fraction	41%
Reaeration HRT	20 minutes
Total Volume	1.78 MG (existing)
RAS Rate	50%
Nitrate Recycle Rate	400%
Max MLSS at Loading Rate	2,800 mg/L
Effluent TN	4.9 mg/L
Methanol Addition	Yes; 1100 gpd (6 months)
Fixed Film Required?	Yes; 60% fill
Clarifiers?	No new clarifiers
Effluent Filtration Required?	No

Other plant modifications may be needed including upgrades to sludge handling. However, all facilities outside of the activated sludge process are outside of the scope of this study.

b. **Annual Average.** At the assumed influent TN levels for this facility, a 4-stage Bardenpho process with IFAS and methanol addition to the second anoxic zone is recommended to achieve an average annual effluent TN of 5 mg/L as shown in the BioWin model in Figure 8.2-6.

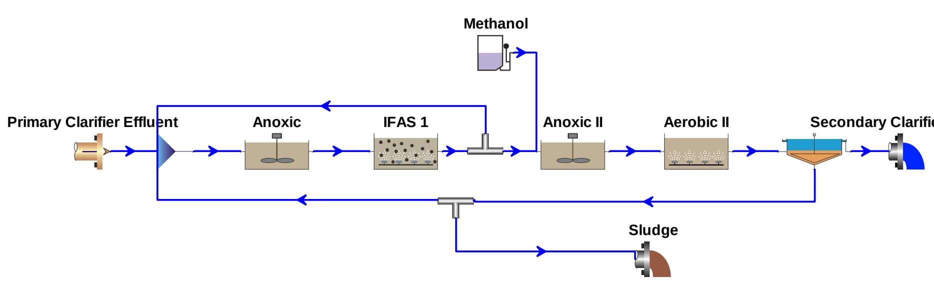

FIGURE 8.2-6: BIOWIN MODEL FOR ANNUAL AVERAGE TN LIMIT OF 5 mg/L

This process would fit in the existing tanks which would continue to operate in plug flow configuration as shown in the site plan in Figure 8.2-3. The existing tanks would be modified with partition walls form parallel Bardenpho trains and IFAS media would be added to the first aerobic zone. A methanol feed facility would be required. Additional blower capacity would be required due to the IFAS system. Nitrate recycle pumps would be added.

It is also anticipated that no new clarifiers will be required to operate the facility at the resultant model MLSS concentration. It should be noted that the existing clarifiers at this facility are 12 feet deep. According to TR-16, clarifiers at nitrogen removal facilities should be a minimum of 13 feet deep. Because the clarifiers do not meet the minimum requirements set forth in Section 2, it is recommended that they be further evaluated to determine if they will require replacement or derating because of the shallow depth. The current method of wasting WAS from the RAS line through use of a control valve would have to be further evaluated to make sure the design SRT could be maintained with the IFAS system without exceeding the maximum MLSS concentration the existing clarifiers can handle.

Specific information regarding the design results is shown in Table 8.2-8 below.

Table 8.2-8
RESULTS FOR ANNUAL AVERAGE LIMIT OF 5 mg/L TN

PARAMETER	VALUE
Aerobic SRT	N/A
Total SRT	10.3 days
First Anoxic Fraction	24%
Total Anoxic Fraction	40%
Reaeration HRT	20 minutes
Total Volume	1.78 MG (existing)
RAS Rate	50%
Nitrate Recycle Rate	400%
Max MLSS at Loading Rate	3,000 mg/L
Effluent TN	4.4 mg/L
Methanol Addition	Yes; 350 gpd
Fixed Film Required?	Yes; 60% fill
Clarifiers?	No additional clarifiers
Effluent Filtration Required?	No

Other plant modifications may be needed including screening and upgrades to sludge handling. However, all facilities outside of the activated sludge process are outside of the scope of this study.

D. **Plant and Cost Summary.**

Table 8.2-9 presents flow data for the Westfield WWTP as well as the current nitrogen removal performance of the plant. As shown, the facility is achieving nitrogen removal to almost 5 mg/L both seasonally and year-round with their current Ludzack-Ettinger process.

Table 8.2-9
PLANT FLOW AND EFFLUENT LIMIT SUMMARY

PARAMETER	VALUE
Permitted Flow (mgd)	6.1
Existing Flow (2004-6)	4.0
% of permitted capacity	65.6
Current average seasonal effluent TN (mg/L)[1]	7.4
Current average annual effluent TN (mg/L)[1]	9.2
Permit Limits	
Seasonal Nitrification (mg/L)	Yes (3)
Year-round nitrification (mg/L)	Report
Seasonal TN Limit	No
Annual TN Limit	No

Table 8.2-10 presents the nitrogen removal processes required to meet the four different permit conditions considered. Based on the BioWin modeling performed, the facility will need to convert to a Bardenpho process with IFAS and methanol addition to consistently meet both TN limits both seasonally and year-round. The BioWin models were run at permitted capacity in the existing tank volume which is the reason a change in process mode is required. It also should be noted that an assumed ammonia to BOD ratio was used since no influent nitrogen data was available.

(continued)

<u>TABLE 8.2-10</u>

NITROGEN REMOVAL PROCESS SUMMARY FOR WESTFIELD WWTF

EXISTING PROCESS	PROCESS TO ACHIEVE SEASONAL TN OF 8 MG/L	PROCESS TO ACHIEVE ANNUAL AVERAGE TN OF 8 MG/L	PROCESS TO ACHIEVE SEASONAL TN OF 5 MG/L	PROCESS TO ACHIEVE ANNUAL AVERAGE TN OF 5 MG/L
Ludzack-Ettinger	Bardenpho w/ IFAS and methanol addition	Bardenpho w/ IFAS	Bardenpho w/ IFAS and methanol addition	Bardenpho w/ IFAS and methanol addition

The modifications required at Westfield to convert to a new nitrogen removal process are summarized in Table 8.2-11. As noted, no minor modifications can be made to the treatment facility to improve nitrogen removal since they currently operate in a Ludzack-Ettinger mode and achieve removal in this configuration.

<u>TABLE 8.2-11</u>

REQUIRED MODIFICATIONS SUMMARY FOR WESTFIELD WWTF

MINOR MODIFICATIONS/ RETROFITS	MODIFICATIONS TO ACHIEVE SEASONAL TN OF 8 MG/L	MODIFICATIONS TO ACHIEVE ANNUAL AVERAGE TN OF 8 MG/L	MODIFICATIONS TO ACHIEVE SEASONAL TN OF 5 MG/L	MODIFICATIONS TO ACHIEVE ANNUAL AVERAGE TN OF 5 MG/L	SPECIAL CONDITIONS
None	Modify existing 3 aeration tanks; add IFAS system; increase blower capacity; nitrate recycle pumps; methanol feed facility	Modify existing 3 aeration tanks; add IFAS system; increase blower capacity; nitrate recycle pumps	Modify existing 3 aeration tanks; add IFAS system; increase blower capacity; nitrate recycle pumps; methanol feed facility	Modify existing 3 aeration tanks; add IFAS system; increase blower capacity; nitrate recycle pumps; methanol feed facility	Located in floodway; extremely space-limited site

The cost estimating procedures established in Section 2 were used to estimate capital, annual O&M, and 20-year present worth costs associated with the process changes and facility modifications summarized above. The cost estimates are included in Table 8.2-12. The cost to meet the seasonal permit is slightly less than the cost to meet the annual permit because the TKN/BOD ratio for the seasonal condition is significantly higher. This higher ratio equates to a greater methanol requirement for the seasonal condition than the annual condition. The table does not include costs for an MLE configuration since no additional volume could be added for either permit condition. An MLE process would require similar modifications as a Bardenpho process, and the cost differential cannot be determined for this level of study.

Table 8.2-12

COST SUMMARY FOR NITROGEN REMOVAL AT WESTFIELD WWTF[1]

LIMIT	CAPITAL COSTS (IN MILLIONS)	TOTAL ANNUAL COSTS[2] (IN THOUSANDS)	20-YR PRESENT WORTH (IN MILLIONS)
Minor Modifications/Retrofits	N/A	N/A	N/A
Seasonal Effluent TN of 8 mg/L	$17	$650	$25
Annual Average Effluent TN of 8 mg/L	$16	$380	$21
Seasonal Effluent TN of 5 mg/L	$17	$670	$25
Annual Average Effluent TN of 5 mg/L	$17	$600	$24

1. It should be noted that these costs represent one method by which this facility can achieve the stated TN goals. It is not intended to be the most cost effective method nor the recommended method, but it represents a planning tool for MassDEP to estimate the fiscal impacts of establishing total nitrogen limits.
2. Represents incremental increase over current conditions.