SECTION 11.0
WET WEATHER IMPACTS

11.1 INTRODUCTION

At each of the Water Pollution Control Centres (WPCCs), flows in excess of the peak dry weather flow are by-passed around the secondary treatment process. The ammonia control alternatives developed up this point in the Nitrification Study have been based on only the treatment of dry weather flows that enter the secondary process.

In this section, the need to provide for nitrification of the entire plant flow stream, including the wet weather flows that are currently by-passed around the secondary treatment process, has been assessed.

A year-round discharge of effluent with a uniform low ammonia concentration is generally very difficult and costly to achieve. Seasonal variations of flows and loads as well as variations in the wastewater temperature affect the nitrification process significantly. When the entire wet weather flow is passed through a secondary treatment process designed for nitrification, there will be some leak through of ammonia to the final plant effluent. This is because the nitrification process reacts slowly, especially when the temperature is low and the conditions are varying. High wet weather flow will also affect the performance of the down stream unit processes such as the final clarifiers. Therefore, a requirement to provide ammonia control of the wet weather flows will have a significant impact on the plant upgrade requirements. The various considerations in this respect are discussed in this section.

11.2 EFFLUENT CRITERIA FOR WET WEATHER CONDITIONS

During wet weather conditions, it would be rational to allow for some excursion in ammonia concentration above the dry weather targets because additional dilution is available in the rivers during wet weather conditions. Also, under some wet weather conditions, such as the spring, the pH level in the rivers is generally lower.

Obviously, the amount of excursion that is allowed during wet weather conditions has a direct impact on the cost of the facility; the lesser the excursion allowed, the higher the cost of the plant upgrade. If no excursion is allowed, the cost could become very high.

To determine rational effluent targets for wet weather conditions, the Ammonia Study team considered the format of the ammonia criteria likely to be included in any licence issued by Manitoba Conservation and also reviewed historic data for river flow conditions compared to plant effluent flows.

It is expected that any ammonia criteria imposed by Manitoba Conservation will be based on a 30 day averaging period. Therefore, for short term wet weather events such as summer rain storms (say 2 to 4 days in duration), some excursion during the rain storm events should be tolerable because it would not likely result in excursion of the monthly average value and presumably detrimental conditions in the rivers should not be created.

For longer term wet weather events, such as prolonged summer rainfall periods and the spring snowmelt period, the acceptable excursion would depend on the amount of additional dilution available in the river compared to dry weather periods. In order to provide an indication of the available dilution, historic records of river flows were compared with effluent flows for the NEWPCC and SEWPCC. For the period of 1984 to 1997, both river flow and plant effluent flow data were available. Over this period of record, the lowest river flow that occurred at various plant effluent flow rates was identified. From this, the lowest dilution ratios that have occurred over this period of record at various plant effluent flows were calculated by the Ammonia Study team.. The analysis for the NEWPCC and SEWPCC is summarized in the following tables:

Table 11.1: NEWPCC - Minimum Dilution Ratios under Different Plant Flow Conditions (1984 to 1997)

NEWPCC Flow (ML/d)	Minimum River Flow (m^3/s)	Minimum Dilution Ratio
250	16.3	5.6
320	22	5.9
384	71	16.0
547	118	18.6

Table 11.2: SEWPCC - Minimum Historic Dilution Ratios under Different Plant Flow Conditions (1984 to 1997)

SEWPCC Flow (ML/d)	Minimum River Flow (m^3/s)	Minimum Dilution Ratio
71	3.5	4.3
86	7.1	7.1
110	24.1	18.9

On the basis of the above, the followings conclusions were derived by the Ammonia Study team for the NEWPCC and the SEWPCC:

- Wet weather discharge conditions from both the NEWPCC and the SEWPCC typically coincide with higher river flows. As the WPCC effluent flow increases, river flow also tends to increase.

- The year 2041 ADWFs for NEWPCC and SEWPCC are projected to be 211 ML/d and 75 ML/d, respectively. During the critical dry weather periods, the dilution ratio (river flow to WPCC flow) at each plant is approximately between 4 and 6. This means that the effluent discharged to the river during dry weather periods will be diluted by a factor of four to six times once it enters the river and is mixed.
- The year 2041 Maximum Month Flows (MMF) (i.e., maximum flow over a 30 day running average) for the NEWPCC and SEWPCC are projected to be 418 ML/d and 150 ML/d, respectively. During extended wet weather periods (i.e., 30 days), as the plant effluent flows increase above the peak dry weather flow rates, the dilution ratio for both treatment plants will increase. The minimum dilution ratio during MMF conditions, using the period of record, would have been in the range of 16 to 19. More specifically, the dilution ratio is expected to increase by a factor of:
  - about 3 for the NEWPCC (18.6/5.6), and
  - about 4 for the SEWPCC (18.9/4.3).

The foregoing analysis is considered to be approximate, but very conservative. The calculated dilution ratios over the period of record are the minimum for the given plant effluent flow rate. On all other occasions, the dilution ratios are much higher. The important point is that there will be a substantial increase in dilution in the river during wet weather conditions.

Based on the foregoing, it can be concluded that the effluent ammonia concentration discharged to the Red River during the extended wet weather periods could be at least three times higher than the dry weather target for each level of control for the NEWPCC, without having any greater impact on the aquatic wildlife in the rivers due to the unionized ammonia content of the effluent. Similarly, for the SEWPCC, it can be concluded that the effluent ammonia concentrations could be at least four times higher during extended wet weather conditions compared to dry weather conditions.

Although an examination of Assiniboine River flows compared to WEWPCC effluent flows has not been completed by the Ammonia Study team, it is expected that a significant amount of dilution would be available during extended wet weather events. In addition, the lagoon system is available for polishing of the wet weather flows and buffering of the peaks in ammonia concentrations contained in the plant effluent, prior to discharge to the Assiniboine River. Therefore, it was concluded that no further assessment of the WEWPCC for wet weather conditions was warranted.

11.3 PLANT PERFORMANCE UNDER WET WEATHER LOADING

11.3.1 Predicted Plant Effluent Quality Under Wet Weather Loadings

The potential treatment options to achieve the various levels of ammonia control for each of the City's three WPCCs for dry weather conditions have been discussed in detail in previous sections of this report. In all cases, only the dry weather flow conditions have been analyzed, and the impacts of the wet weather flows that are by-passed around the secondary process have not been taken into account.

As a first step in assessing the impacts of wet weather flows, the ammonia concentration in the blended effluent (i.e., secondary plant effluent plus by-passed flows) has been calculated for each plant concept.

In the following paragraphs, the projected blended effluent quality (i.e., final effluent) discharged from the WPCCs under wet weather conditions for each level of ammonia control is presented. The wet weather flow conditions were evaluated using the BioWin™ model developed for each of the treatment plant configurations described in the previous sections of this report. In each case, the plant influent flow and loading profiles for wet weather conditions were used as the input to the model. In the model, the flows in excess of the dry weather capacity of each plant were by-passed around the secondary process. The final plant effluent, which consists of the blending of the secondary plant effluent and the by-passed flows was predicted by the model.

North End Water Pollution Control Centre (NEWPCC)

The projected blended effluent ammonia concentrations over a period of one year are shown in the various figures as indicated below. The vertical bandwidth of each parameter plotted on these figures is indicative of the daily diurnal variation of the parameter.

- For the Best Practicable Level of Control:
    - Figure 11.1: Presents hourly variations with a 7-day running average trend line.
    - Figure 11.2: Presents hourly variations with a 30-day running average trend line.
- For the High Level of Control:
    - Figure 11.3: Presents hourly variations with a 7-day running average trend line.
    - Figure 11.4: Presents hourly variations with a 30-day running average trend line.
- For the Modest Level of Control:
    - Figure 11.5: Presents hourly variations with a 7-day running average trend line.

- Figure 11.6: Presents hourly variations with a 30-day running average trend line.

South End Water Pollution Control Centre (SEWPCC)

The projected effluent ammonia concentrations for the SEWPCC are presented in the following figures:

- For the Best Practicable Level of Control:
  - Figure 11.7: Shows hourly variations with a 7-day running average trend line.
  - Figure 11.8: Shows hourly variations with a 30-day running average trend line.
- For the High Level of Control:
  - Figure 11.9: Shows hourly variations with a 7-day running average trend line.
  - Figure 11.10: Shows hourly variations with a 30-day running average trend line.
- For the Modest Level of Control:
  - Figure 11.11: Shows hourly variations with a 7-day running average trend line.
  - Figure 11.12: Shows hourly variations with a 30-day running average trend line.

West End Water Pollution Control Centre (WEWPCC)

For the Best Practicable Level of Control, the projected effluent ammonia concentrations are depicted in Figures 11.13 and 11.14. These figures show the projections of the hourly effluent ammonia concentrations with 7-day and 30-day running average trend lines.

As indicated in the previous section, to achieve the High and Modest Levels of Control at the WEWPCC, the effluent from the treatment plant can be discharged to the lagoons.

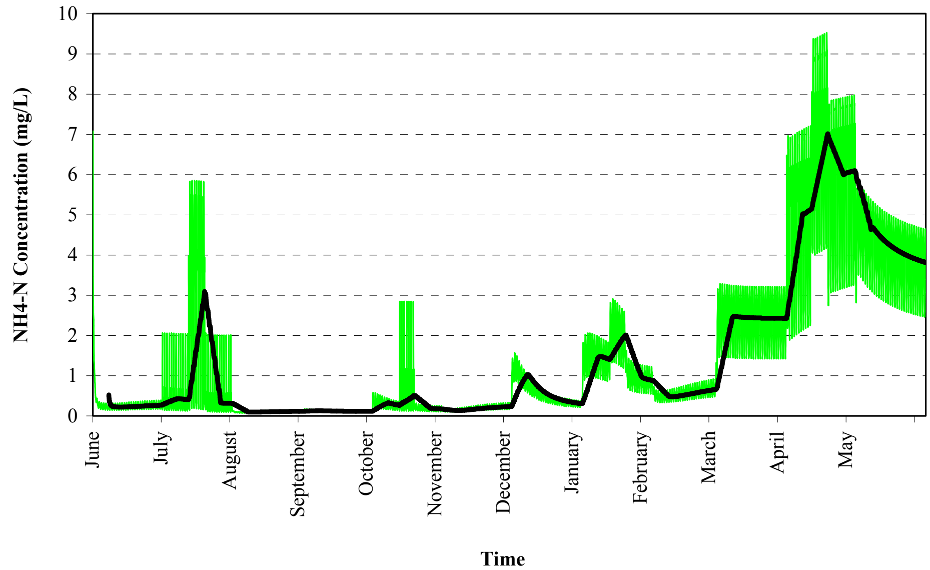

Figure 11.1: NEWPCC – Blended Effluent Ammonia Concentration With 7-day Trend Line [Best Practicable Level of Control – 2041]

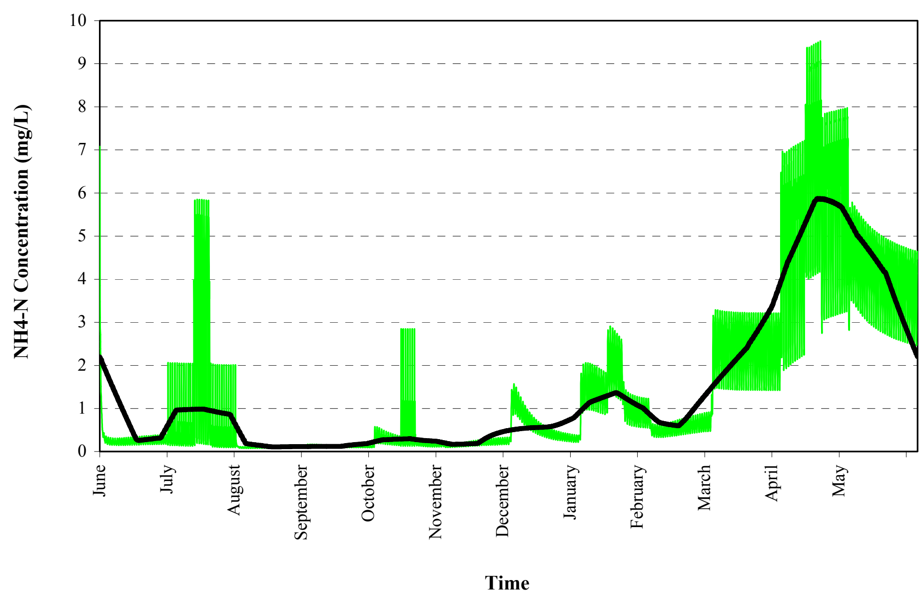

Figure 11.2: NEWPCC – Blended Effluent Ammonia Concentration With 30-day Trend Line [Best Practicable Level of Control – 2041]

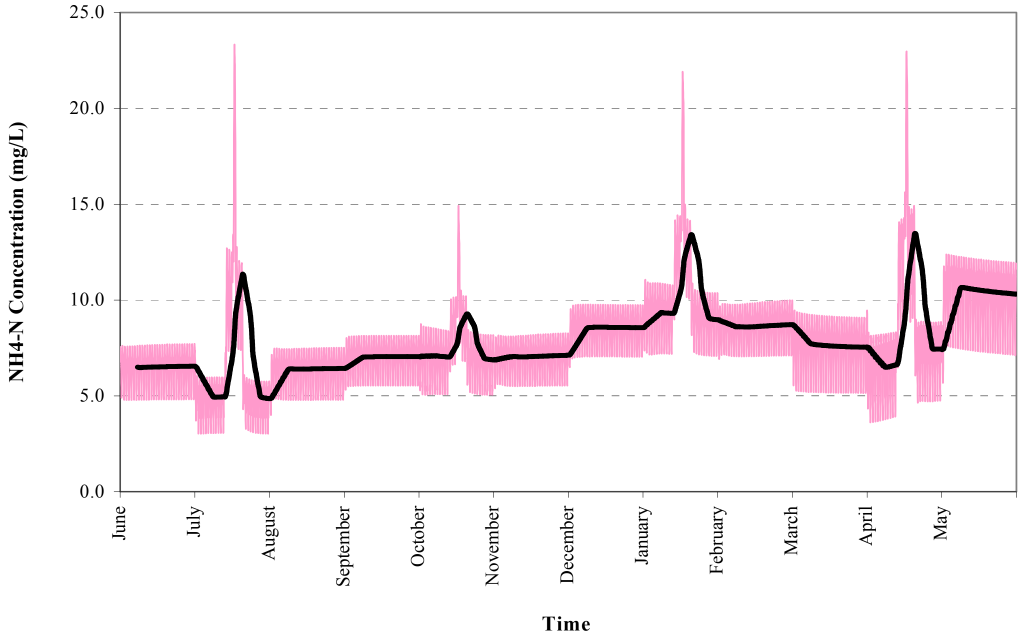

Figure 11.3: NEWPCC – Blended Effluent Ammonia Concentration With 7-day Trend Line [High Level of Control – 2041]

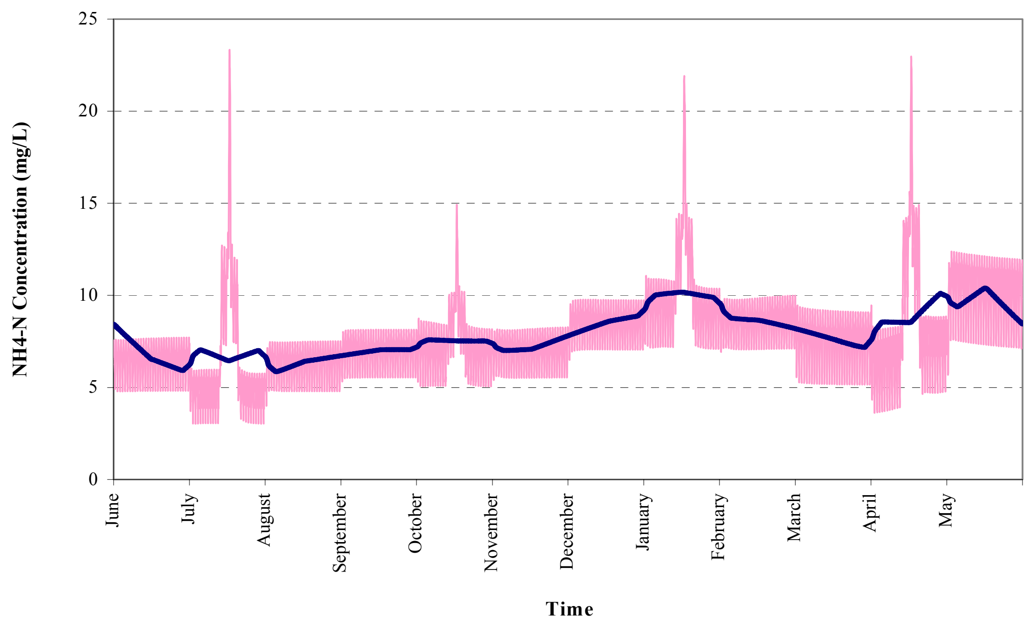

Figure 11.4: NEWPCC – Blended Effluent Ammonia Concentration With 30-day Trend Line [High Level of Control – 2041]

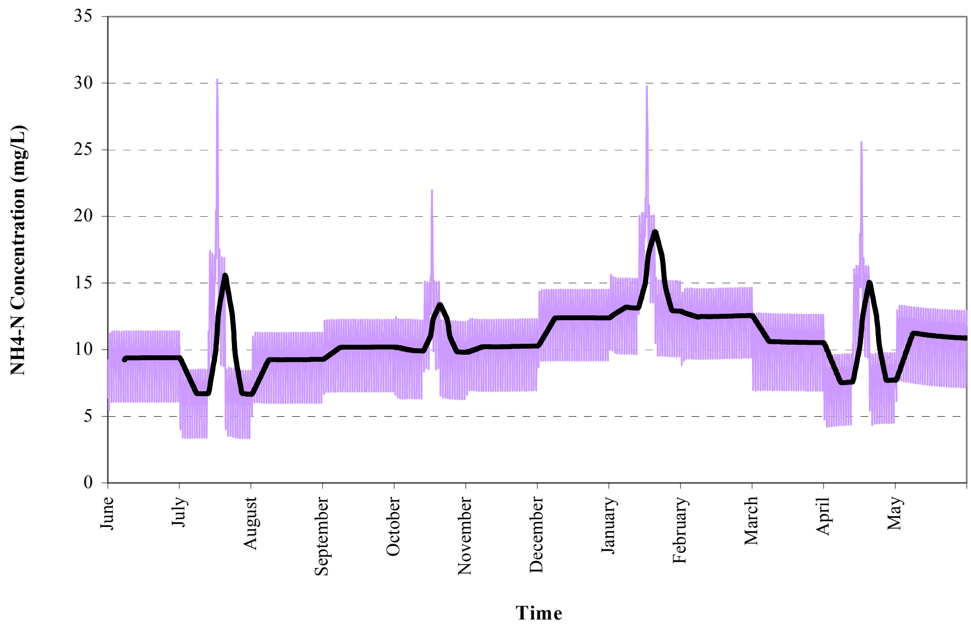

Figure 11.5: NEWPCC – Blended Effluent Ammonia Concentration With 7-day Trend Line [Modest Level of Control – 2041]

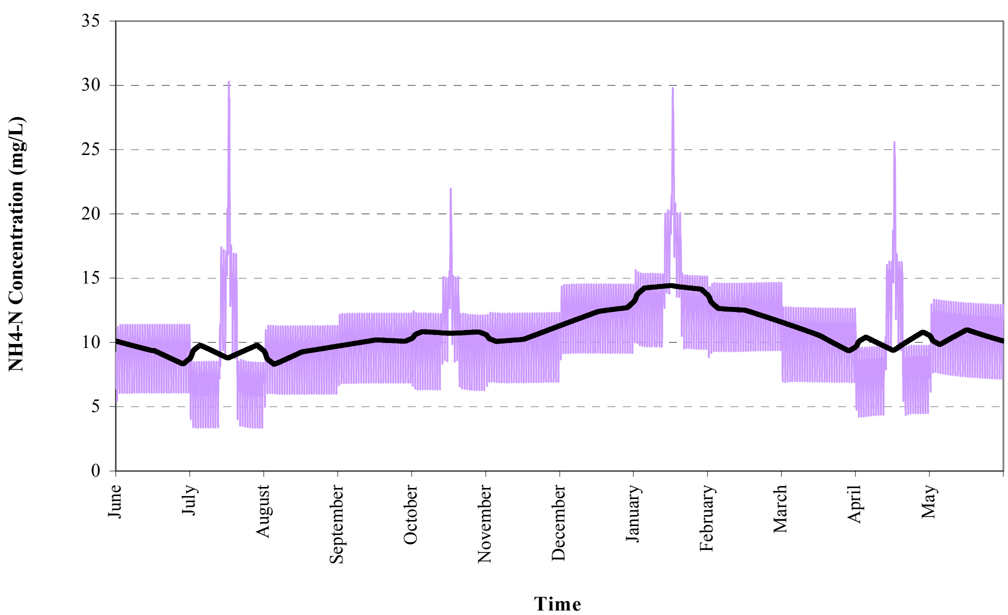

Figure 11.6: NEWPCC – Blended Effluent Ammonia Concentration With 30-day Trend Line [Modest Level of Control – 2041]

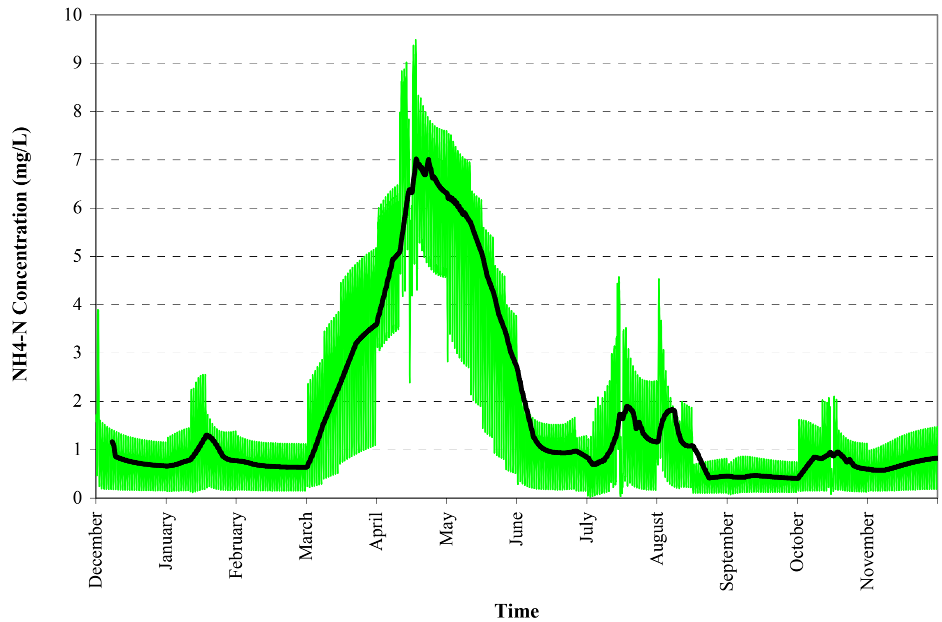

Figure 11.7: SEWPCC – Blended Effluent Ammonia Concentration With 7-day Trend Line [Best Practicable Level of Control – 2041]

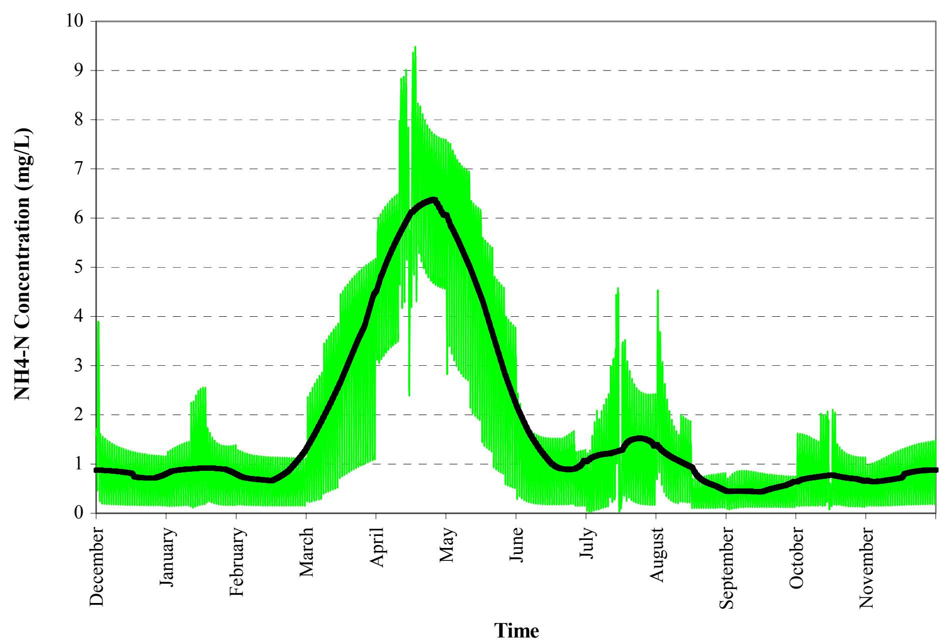

Figure 11.8: SEWPCC – Blended Effluent Ammonia Concentration With 30-day Trend Line [Best Practicable Level of Control – 2041]

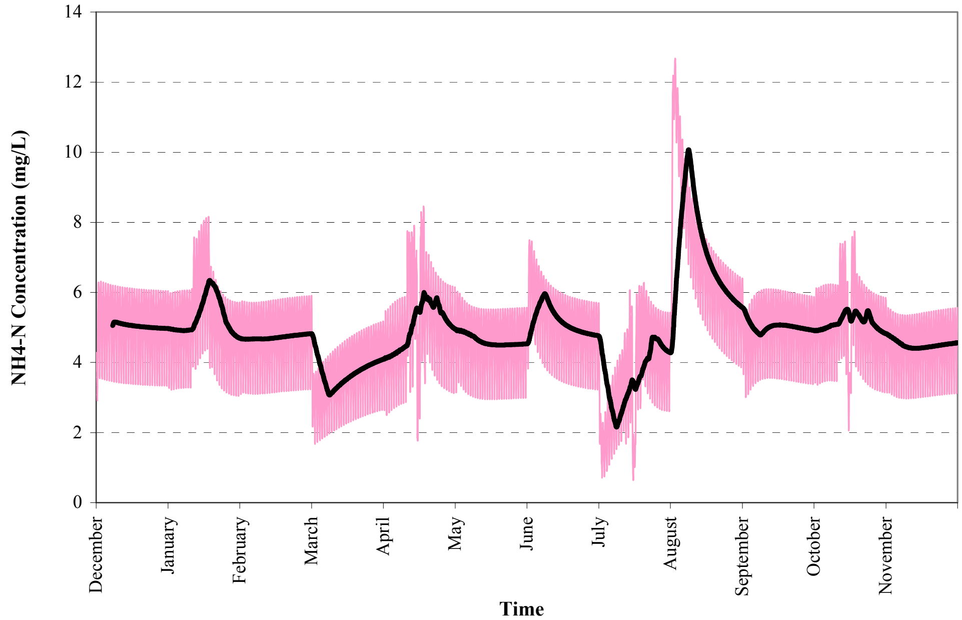

Figure 11.9: SEWPCC – Blended Effluent Ammonia Concentration With 7-day Trend Line [High Level of Control – 2041]

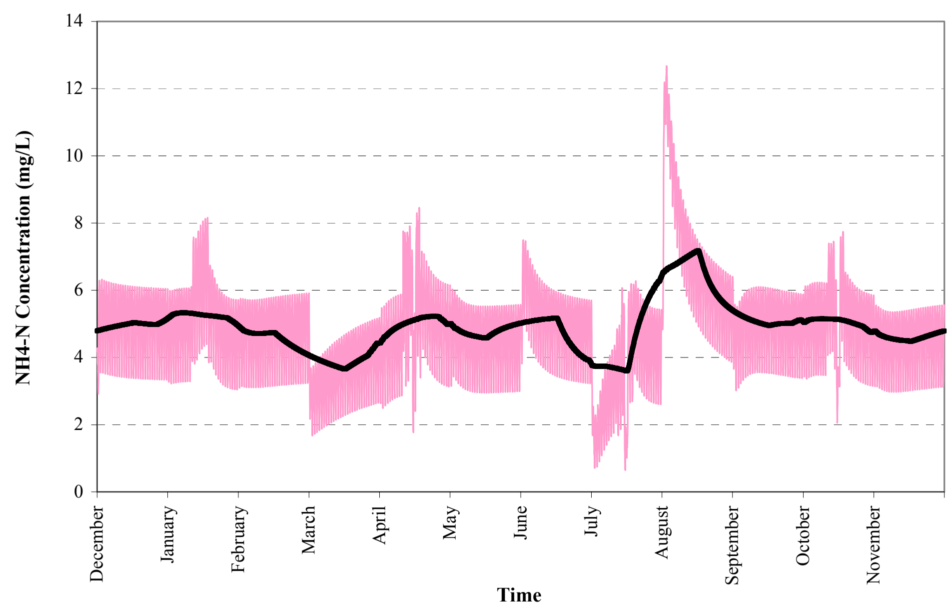

Figure 11.10: SEWPCC – Blended Effluent Ammonia Concentration With 30-day Trend Line [High Level of Control – 2041]

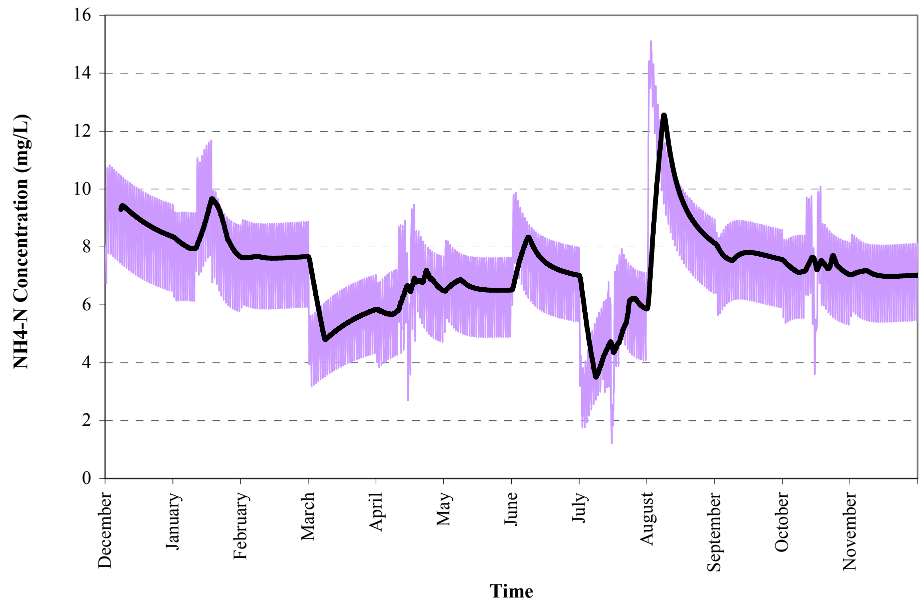

Figure 11.11: SEWPCC – Blended Effluent Ammonia Concentration With 7-day Trend Line [Modest Level of Control – 2041]

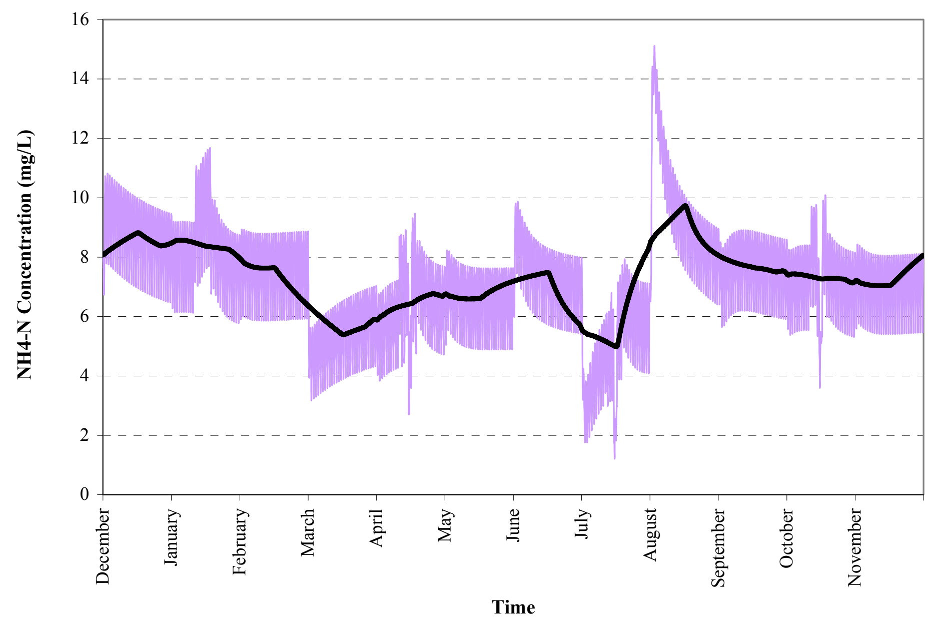

Figure 11.12: SEWPCC – Blended Effluent Ammonia Concentration With 30-day Trend Line [Modest Level of Control – 2041]

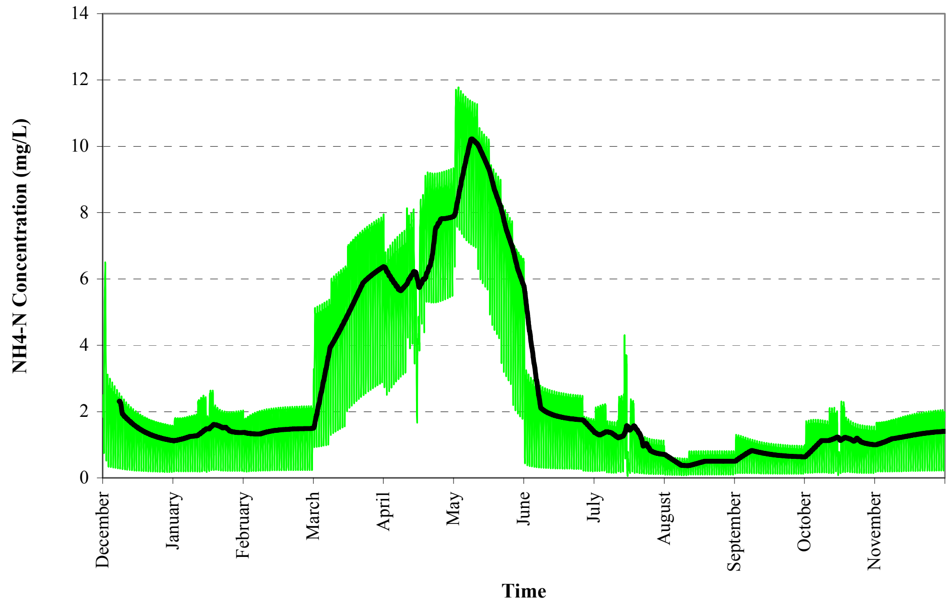

Figure 11.13: WEWPCC – Blended Effluent Ammonia Concentration With 7-day Trend Line [Best Practicable Level of Control – 2041]

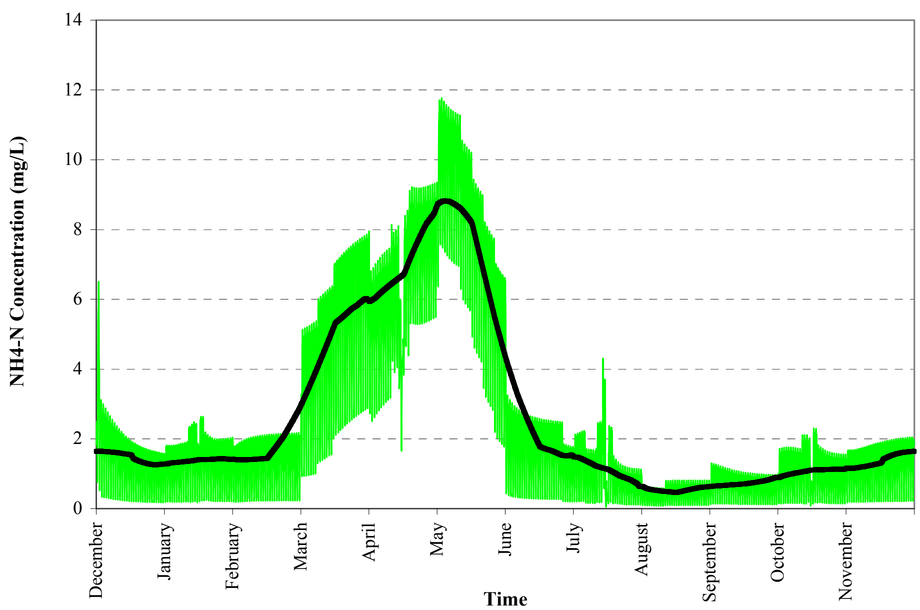

Figure 11.14: WEWPCC – Blended Effluent Ammonia Concentration With 30-day Trend Line [Best Practicable Level of Control – 2041]

Table 11.3 presents a summary of the maximum week (7-day running average) and maximum month (30-day running average) blended effluent ammonia concentrations for all three WPCCs. Summer conditions (which include short duration wet weather events) and spring snow melt runoff conditions (which include longer duration wet weather events) are both indicated. This table was developed based on visual interpretation of the 7-day and 30-day running average trend lines in the figures provided for each of the WPCCs.

Table 11.3: Projected Blended Effluent Ammonia Concentration for the Three WPCCs for Different Levels of Ammonia Control

WPCC	Summer Conditions						Spring Conditions					
	BPLOC (mg/L)		HLOC (mg/L)		MLOC (mg/L)		BPLOC (mg/L)		HLOC (mg/L)		MLOC (mg/L)	
	7-d	30-d	7-d	30-d	7-d	30-d	7-d	30-d	7-d	30-d	7-d	30-d
NEWPCC	3	2	12	8	16	10	7	6	14	11	16	11
SEWPCC	2	1.5	10	7	13	10	7	6.5	6	5	8	7
WEWPCC *	<2	<2	N/D	N/D	N/D	N/D	10	9	N/D	N/D	N/D	N/D

* Blended effluent ammonia concentration prior to discharge to the lagoons.
BPLOC = Best Practicable Level of Control
HLOC = High Level of Control
MLOC = Modest Level of Control
N/D = Not determined

11.3.2 Statistical Analysis

Statistical analyses were performed on the projected blended effluent ammonia concentrations produced by the BioWin computer simulations for all three levels of the ammonia control for the NEWPCC and SEWPCC. For the WEWPCC, the analysis was done for only the Best Practicable Level of Control. The procedure followed in the statistical analysis is similar to the procedure described in detail in Section 4.0. The results of the statistical analyses are summarized in Tables 11.4 through 11.10. Abbreviations used in the tables are defined as follows:

- AA = Arithmetic Average
- GM = Geometric Mean
- σ = Population Standard Deviation
- s = Sample Standard Deviation
- Exp (GM 95^{th}%) = the plant effluent ammonia concentration that will not be exceeded 95 percent of the time.

Table 11.4: NEWPCC- Results of Statistical Analysis on Blended Effluent Ammonia (Year 2041 – Best Practicable Level of Control)

Month	Monthly AA (mg/L)	Ln (GM)	σ/GM	σ	$s_{(30\ days)}$	GM of 30 day averages	95^{th}% 30 day GM	Exp (GM 95^{th}%)
June	0.31	-1.35	0.12	-0.162	0.030	-1.337	-1.289	0.28
July	0.99	-0.89	0.18	-0.160	0.029	-0.878	-0.829	0.44
August	0.11	-2.25	0.12	-0.270	0.049	-2.215	-2.134	0.12
September	0.12	-2.13	0.06	-0.128	0.023	-2.122	-2.084	0.12
October	0.30	-1.43	0.09	-0.129	0.023	-1.422	-1.383	0.25
November	0.19	-1.72	0.06	-0.103	0.019	-1.715	-1.684	0.19
December	0.57	-0.70	0.06	-0.042	0.008	-0.690	-0.687	0.50
January	1.36	0.22	0.04	-0.009	0.002	0.220	0.233	1.25
February	0.57	-0.59	0.06	-0.035	0.006	-0.589	-0.579	0.56
March	2.42	0.86	0.04	-0.034	0.006	0.861	0.871	2.39
April	5.80	1.69	0.06	-0.101	0.019	1.695	1.725	5.61
May	4.17	1.42	0.04	-0.057	0.010	1.422	1.439	4.21

Table 11.5: NEWPCC- Results of Statistical Analysis on Blended Effluent Ammonia (Year 2041 – High Level of Control)

Month	Monthly AA (mg/L)	Ln (GM)	σ/GM	σ	$s_{(30\ days)}$	GM of 30 day averages	95^{th}% 30 day GM	Exp (GM 95^{th}%)
June	6.52	1.87	0.12	0.224	0.041	1.894	1.962	7.11
July	6.47	1.78	0.18	0.320	0.058	1.830	1.926	6.86
August	6.38	1.84	0.12	0.221	0.040	1.864	1.930	6.89
September	7.03	1.94	0.06	0.116	0.021	1.947	1.982	7.25
October	7.53	2.00	0.09	0.180	0.033	2.016	2.070	7.92
November	7.07	1.95	0.06	0.117	0.021	1.957	1.992	7.33
December	8.54	2.14	0.06	0.128	0.023	2.148	2.187	8.90
January	10.18	2.30	0.04	0.092	0.017	2.304	2.332	10.30
February	8.66	2.15	0.06	0.129	0.024	2.158	2.197	9.00
March	7.62	2.02	0.04	0.081	0.015	2.023	2.047	7.75
April	8.53	2.08	0.06	0.125	0.023	2.088	2.125	8.37
May	10.39	2.33	0.04	0.093	0.017	2.334	2.362	10.61

Table 11.6: NEWPCC- Results of Statistical Analysis on Blended Effluent Ammonia (Year 2041 – Modest Level of Control)

Month	Monthly AA (mg/L)	Ln (GM)	σ/GM	σ	$s_{(30\ days)}$	GM of 30 day averages	95^{th}% 30 day GM	Exp (GM 95^{th}%)
June	9.35	2.22	0.12	0.266	0.049	2.254	2.334	10.32
July	8.81	2.07	0.18	0.373	0.068	2.137	2.249	9.48
August	9.22	2.21	0.12	0.265	0.048	2.244	2.324	10.21
September	10.18	2.31	0.06	0.139	0.025	2.319	2.361	10.60
October	10.71	2.35	0.09	0.212	0.039	2.372	2.435	11.42
November	10.24	2.31	0.06	0.139	0.025	2.319	2.361	10.60
December	12.36	2.51	0.06	0.151	0.027	2.521	2.566	13.02
January	14.42	2.65	0.04	0.106	0.019	2.655	2.687	14.69
February	12.51	2.52	0.06	0.151	0.028	2.531	2.576	13.15
March	10.57	2.34	0.04	0.094	0.017	2.344	2.372	10.72
April	9.40	2.17	0.06	0.130	0.024	2.178	2.217	9.18
May	10.98	2.38	0.04	0.095	0.017	2.384	2.413	11.17

Table 11.7: SEWPCC- Results of Statistical Analysis on Blended Effluent Ammonia (Year 2041 – Best Practicable Level of Control)

Month	Monthly AA (mg/L)	Ln (GM)	σ/GM	σ	$s_{(30\ days)}$	GM of 30 day averages	95^{th}% 30 day GM	Exp (GM 95^{th}%)
June	1.01	-0.18	0.12	-0.022	0.004	-0.180	-0.173	0.84
July	1.28	-0.16	0.18	-0.029	0.005	-0.160	-0.151	0.86
August	0.93	-0.41	0.12	-0.049	0.009	-0.409	-0.394	0.67
September	0.43	-1.00	0.06	-0.060	0.011	-0.998	-0.980	0.38
October	0.77	-0.53	0.09	-0.048	0.009	-0.529	-0.515	0.60
November	0.71	-0.51	0.06	-0.031	0.006	-0.510	-0.500	0.61
December	0.81	-0.41	0.06	-0.025	0.004	-0.410	-0.402	0.67
January	0.91	-0.31	0.04	-0.012	0.002	-0.310	-0.306	0.74
February	0.66	-0.58	0.06	-0.035	0.006	-0.579	-0.569	0.57
March	2.69	0.80	0.04	0.032	0.006	0.800	0.810	2.25
April	6.11	1.78	0.06	0.107	0.019	1.786	1.818	6.16
May	4.39	1.36	0.04	0.054	0.010	1.361	1.378	3.97

Table 11.8: SEWPCC- Results of Statistical Analysis on Blended Effluent Ammonia (Year 2041 – High Level of Control)

Month	Monthly AA (mg/L)	Ln (GM)	σ/GM	σ	$s_{(30\ days)}$	GM of 30 day averages	95th% 30 day GM	Exp (GM 95th%)
June	5.17	1.62	0.12	0.194	0.035	1.638	1.697	5.46
July	3.60	1.18	0.18	0.212	0.039	1.202	1.266	3.55
August	7.17	1.93	0.12	0.232	0.042	1.956	2.025	7.58
September	4.96	1.59	0.06	0.095	0.017	1.594	1.623	5.07
October	5.13	1.61	0.09	0.145	0.026	1.620	1.664	5.23
November	4.49	1.48	0.06	0.089	0.016	1.484	1.510	4.53
December	5.02	1.60	0.06	0.096	0.018	1.604	1.633	5.12
January	5.26	1.63	0.04	0.065	0.012	1.632	1.652	5.22
February	4.74	1.54	0.06	0.092	0.017	1.544	1.572	4.82
March	3.66	1.26	0.04	0.050	0.009	1.261	1.276	3.58
April	5.12	1.60	0.06	0.096	0.018	1.604	1.633	5.12
May	4.57	1.50	0.04	0.060	0.011	1.502	1.520	4.57

Table 11.9: SEWPCC- Results of Statistical Analysis on Blended Effluent Ammonia (Year 2041 – Modest Level of Control)

Month	Monthly AA (mg/L)	Ln (GM)	σ/GM	σ	$s_{(30\ days)}$	GM of 30 day averages	95th% 30 day GM	Exp (GM 95th%)
June	7.48	2.00	0.12	0.240	0.044	2.028	2.100	8.17
July	4.99	1.55	0.18	0.279	0.051	1.588	1.671	5.32
August	9.71	2.25	0.12	0.270	0.049	2.285	2.366	10.66
September	7.66	2.03	0.06	0.122	0.022	2.037	2.074	7.96
October	7.27	1.97	0.09	0.177	0.032	1.985	2.038	7.68
November	7.04	1.94	0.06	0.116	0.021	1.947	1.982	7.25
December	8.82	2.17	0.06	0.130	0.024	2.178	2.217	9.18
January	8.37	2.11	0.04	0.084	0.015	2.113	2.139	8.49
February	7.65	2.03	0.06	0.122	0.022	2.037	2.074	7.96
March	5.40	1.67	0.04	0.067	0.012	1.672	1.692	5.43
April	6.43	1.84	0.06	0.110	0.020	1.846	1.879	6.55
May	6.60	1.88	0.04	0.075	0.014	1.883	1.905	6.72

Table 11.10: WEWPCC- Results of Statistical Analysis on Blended Effluent Ammonia (Year 2041 – Best Practicable Level of Control)

Month	Monthly AA (mg/L)	Ln (GM)	σ/GM	σ	$s_{(30\ days)}$	GM of 30 day averages	95^{th}% 30 day GM	Exp (GM 95^{th}%)
June	1.81	0.43	0.12	0.052	0.009	0.431	0.447	1.56
July	1.13	-0.15	0.18	-0.027	0.005	-0.150	-0.142	0.87
August	0.46	-0.93	0.12	-0.112	0.020	-0.924	-0.890	0.41
September	0.71	-0.50	0.06	-0.030	0.005	-0.500	-0.491	0.61
October	1.11	-0.11	0.09	-0.010	0.002	-0.110	-0.107	0.90
November	1.30	0.11	0.06	0.007	0.001	0.110	0.112	1.12
December	1.55	0.24	0.06	0.014	0.003	0.240	0.244	1.28
January	1.40	0.17	0.04	0.007	0.001	0.170	0.172	1.19
February	1.44	0.21	0.06	0.013	0.002	0.210	0.214	1.24
March	5.28	1.59	0.04	0.064	0.012	1.592	1.611	5.01
April	6.70	1.87	0.06	0.112	0.020	1.876	1.910	6.75
May	8.22	2.06	0.04	0.082	0.015	2.063	2.088	8.07

11.4 CONCLUSIONS

Based on the foregoing analysis, the following conclusions can be reached:

- During wet weather conditions, it is expected that the minimum dilution available in the Red River at the NEWPCC will be about three times higher than during dry weather conditions, and about four times higher at the SEWPCC (based on the analysis completed by the Ammonia Study team). Although detailed analysis was not performed for the WEWPCC, a significant amount of additional dilution is also expected on the Assiniboine River during wet weather conditions.
- The additional dilution will mean that higher concentrations of ammonia could be present in the effluent from the three WPCCs during wet weather conditions without creating any difference in the impact on the rivers with respect to ammonia. The increase in ammonia concentration would be proportional to the increase in dilution. Thus, the target wet weather ammonia concentrations could be three to four times higher than the dry weather discharge criteria.
- As can be seen from Table 11.3, the 7 day running average values for ammonia concentration in the plant effluents are expected to exceed the objectives for some of the levels of control. However, the 30-day running average values for the summer conditions are predicted to be within the objectives. Thus, it would appear that the impact of the shorter duration rain storm events will not cause an excursion above the effluent ammonia criteria for each level of control, assuming that the criteria will be based on a 30 day average.

- For extended wet weather conditions such as spring conditions, it is predicted that the 30 day running average ammonia concentrations will often exceed the ammonia objective for each level of control. However, the additional dilution available in the river during extended wet weather periods will mean that even with the deterioration in effluent quality during longer duration wet weather loadings to the WPCCs, there will be no greater threat to the aquatic wildlife in the river due to ammonia discharged from the WPCCs.
- The statistical analysis indicates that 95 percent of the time, the blended effluent during wet weather conditions is expected to be less than the following values:

	Wet Weather Season (Spring) (95th Percentile Concentration)		
	BPLOC (mg/L)	**HLOC (mg/L)**	**MLOC (mg/L)**
NEWPCC	5.61	10.61	11.17
SEWPCC	6.16	5.12	6.72
WEWPCC*	8.07	-	-

* Prior to discharge to lagoons

In all cases, when the three to four times dilution is taken into account, there will be no greater threat to the aquatic wildlife in the river due to ammonia discharged from the WPCCs.

- Therefore, it is concluded that the plant configurations developed for the plants for dry weather conditions can also provide adequate ammonia control under wet weather conditions, even when the impact of blending the by-passed flows is taken into account.