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MEMORANDUM
March 1, 1984

To: Carl Nuechterlein

From: Bill Yake BJ

Subject: Assessment of Potential Impact of Dayton STP Effluent on the Touchet River, with Recommended Permit Limits for Ammonia and Chlorine

Introduction

This memorandum is written in response to your request of December 22, 1983 asking for an assessment of the potential impacts of chlorine and ammonia from the Dayton STP on the Touchet River.

Most of the Touchet River system (including the stretch affected by the Dayton STP discharge) is Class A. From three miles upstream of Dayton, the North Fork of the Touchet River is Class AA. Both of these classifications provide for the protection of characteristic uses, including:

> "Salmonid migration, rearing, spawning and harvesting.
> Other fish migration, rearing, spawning and harvesting."

A brief assessment of fisheries resources in the area was made by contacting Curt Leigh of the Washington State Department of Game. Gamefish present in the Touchet River in the vicinity of Dayton include steelhead, rainbow trout, brown trout, and possibly smallmouth bass.

Brown trout are planted in this stretch of the Touchet River and are fished year-round. In addition, rainbow trout are native to the stream and a portion of planted steelhead remain in the system throughout their life cycle.

Spawning migrations bring steelhead through the reach from February to May, with spawning peaking in May. Spawning occurs upstream of Dayton, although smolt-rearing areas probably include the Touchet River near Dayton. Out-migration by smolts lasts from February to March. Enhancement of these steelhead runs by increased planting from the Lyons Ferry Hatchery is a major priority as part of the compensation for the construction of dams on the Snake River.

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It is clear that the affected reach of the Touchet River maintains a valuable fisheries resource. This, in addition to the Class A status of the reach, dictates that the NPDES permit conditions on the Dayton STP discharge assure that receiving water standards and criteria for the protection of this resource not be exceeded. As stated in the state Water Quality Standards (WAC 173-201-045[2][c][vii]):

> "Toxic, radioactive, or deleterious material concentrations shall be below those which adversely affect public health during characteristic uses, or which may cause acute or chronic toxic conditions to the aquatic biota, or which may adversely affect characteristic water uses."

Assessment

River Flow

To predict the impacts of pollutants on the Touchet River, it is first necessary to determine the range of river flows expected in the Touchet at Dayton. The nearest USGS gaging station with adequate flow data is the Touchet River at Bolles (Station 14017000). This station is at river mile 40.1, while the Dayton STP discharge is at river mile 52.6. To adapt the data available at Bolles to the flow regime at Dayton, the relationship between WY 1975 daily flows at Bolles and a WDOE water quality station (32B120, river mile 49.6) near Dayton were plotted (Figure 1). Because this analysis is concerned primarily with low flows, only flows less than 400 cfs were plotted.

The regression between flows at these two sites yielded the following relationship (r^2 = .99541).

Equation 1: $X = (y + 9.47)/1.136$

where: y = flow at Bolles
x = flow at Dayton

Using this relationship, data from USGS statistical printouts of Bolles data ("Monthly and annual mean discharge exceedence probabilities based on log-Pearson III analysis") were converted to apply to the Dayton stretch. Table 1 summarizes the monthly data.

The 7-day, 10-year low flow at Dayton based on this analysis is 19.9 cfs. Based on the Dayton STP design flow of 0.49 MGD, this gives a low-flow dilution ratio of about 26:1.

FIGURE 1. TOUCHET RIVER FLOWS: BOLLES VS. DAYTON, WATER YEAR 1975

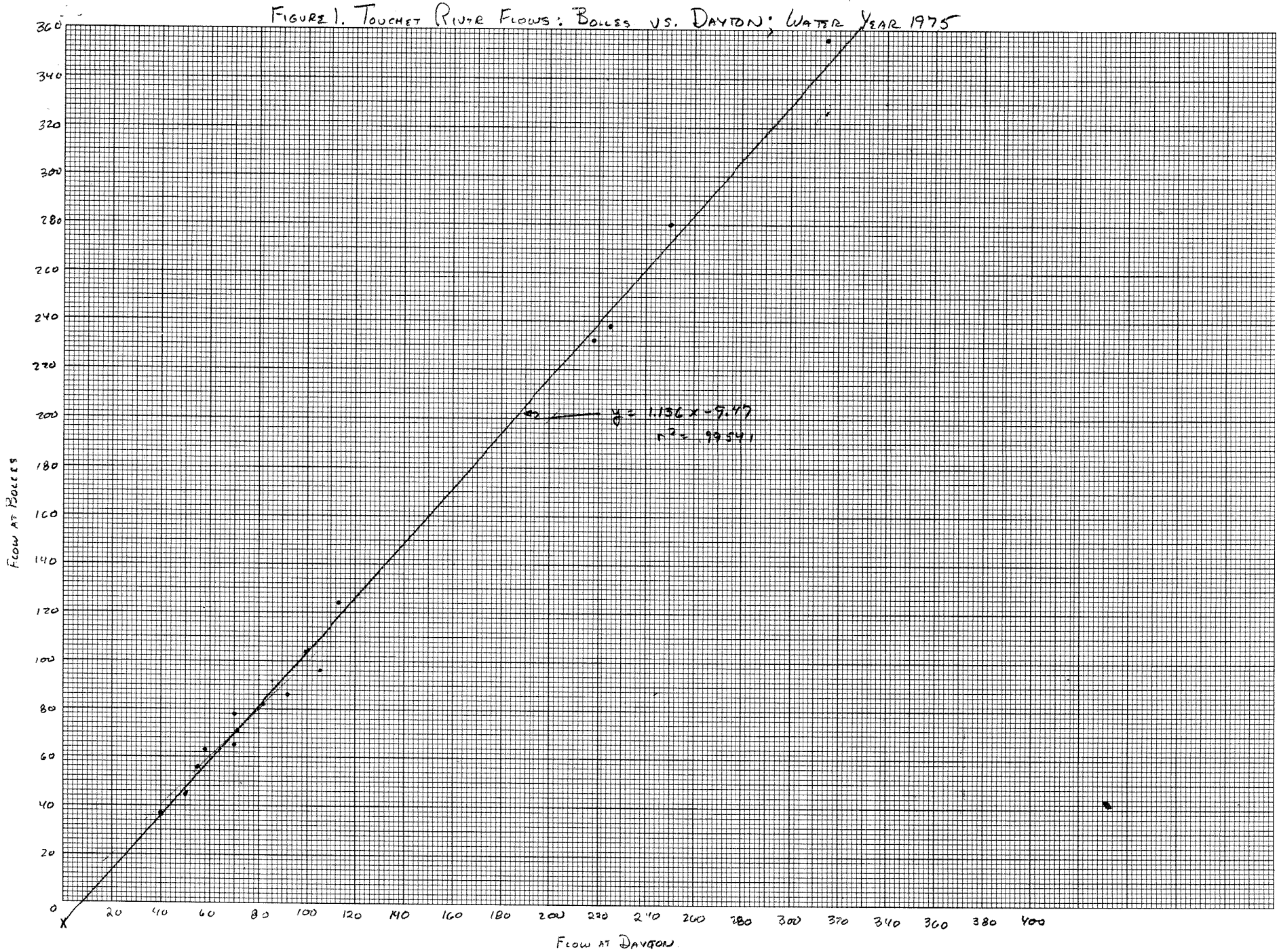

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Table 1. Monthly low flows at specified recurrence intervals; Touchet River near Dayton (all flows in cfs).

Recurrence Interval (years)	Month											
	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
20	69.4	103	144	168	102	46.5	25.7	23.7	34.6	49.3	57.8	66.3
10	87	143	175	208	130	56.5	30.1	26.5	37.0	51.2	64.9	82.5
5	144	205	221	254	170	71.9	36.3	30.4	40.1	54.2	76.0	109
2	298	362	342	374	262	114	50.5	38.9	47.1	62.8	110	196

Nutrients

As noted in the 1981 Class II inspection and receiving water study (Chase and Cunningham, 1981), the Dayton STP discharge is responsible for a large percentage of the phosphorus and nitrogen load to the Touchet River during the algal growth season. During this inspection, the total phosphate-P load was 20.8 lbs/day and the total inorganic nitrogen (NH_3-N + NO_2-N + NO_3-N) load was 60.8 lbs/day. Figures 2 and 3 display downstream nutrient concentrations in the Touchet River at two flow regimes assuming (1) complete mixing between effluent and river, and (2) upstream T-P and TIN concentrations of zero. Figure 4 displays the impact of nutrients in the Dayton effluent in another way. Here Dayton STP nutrient loads are compared to the average monthly loads detected downstream (water years 1974 and 1975) at ambient monitoring station 32B120 (Touchet River near Dayton).

These figures reveal that:

1. The Dayton STP effluent alone can raise in-stream concentrations of T-P by .03 to .10 mg/L and TIN by .10 to .29 mg/L during the growing season, even during average monthly flows. During low-flow years, the effect is even more marked.

2. Although the relative impact of Dayton effluent nutrients is relatively insignificant during high-flow periods (winter and spring), it is substantial during the growing season--being responsible for up to 80 percent of the nutrient load downstream.

There are no clear criteria for nutrient concentrations in flowing water which lead to adverse impacts. Nutrients accelerate the growth of aquatic plants including rooted macrophytes and attached

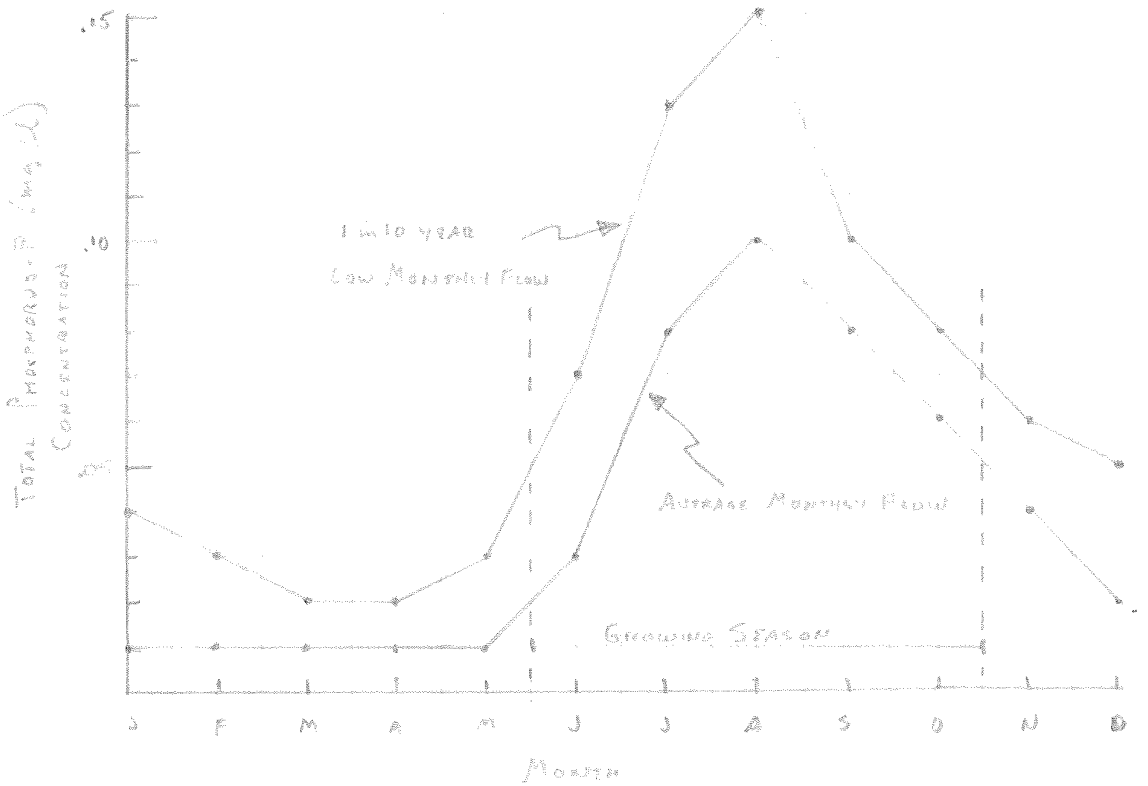

FIGURE 2.: INCREASE IN TOUCHET RIVER T-P CONCENTRATIONS ATTRIBUTABLE TO DAYTON STP.

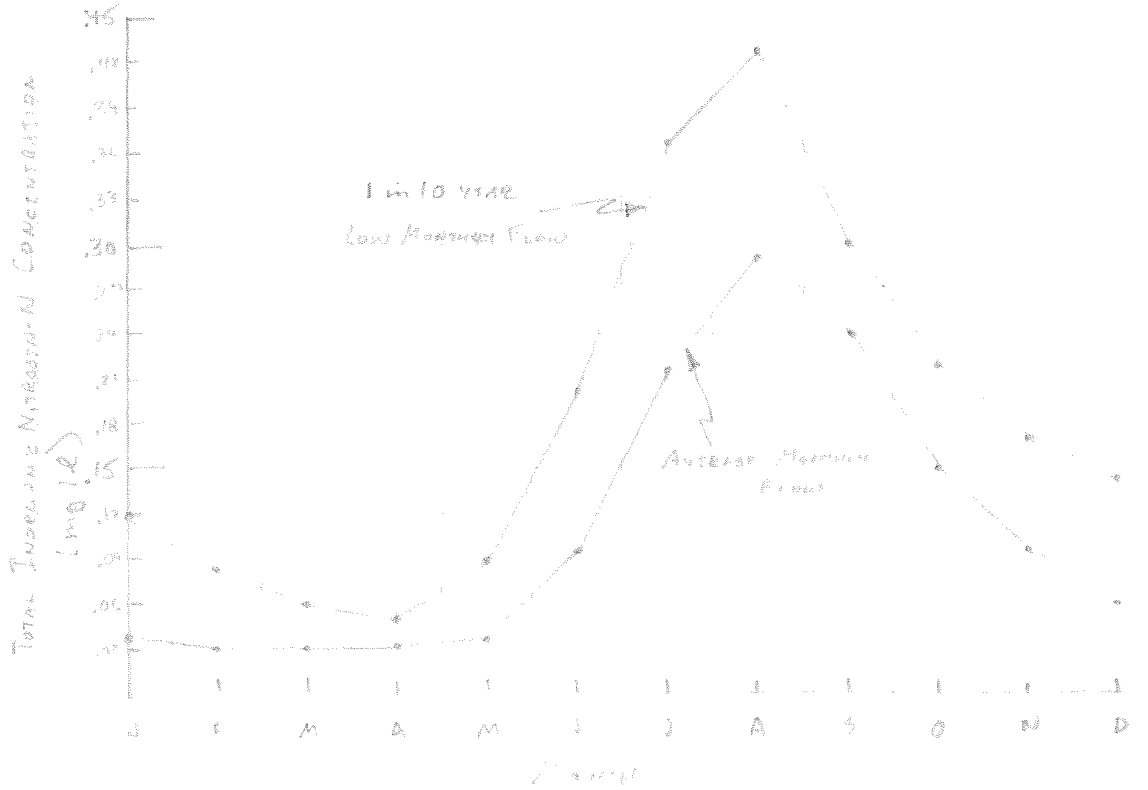

FIGURE 3.: INCREASE IN TOUCHET RIVER TOTAL INORGANIC NITROGEN CONCENTRATIONS ATTRIBUTABLE TO DAYTON STP

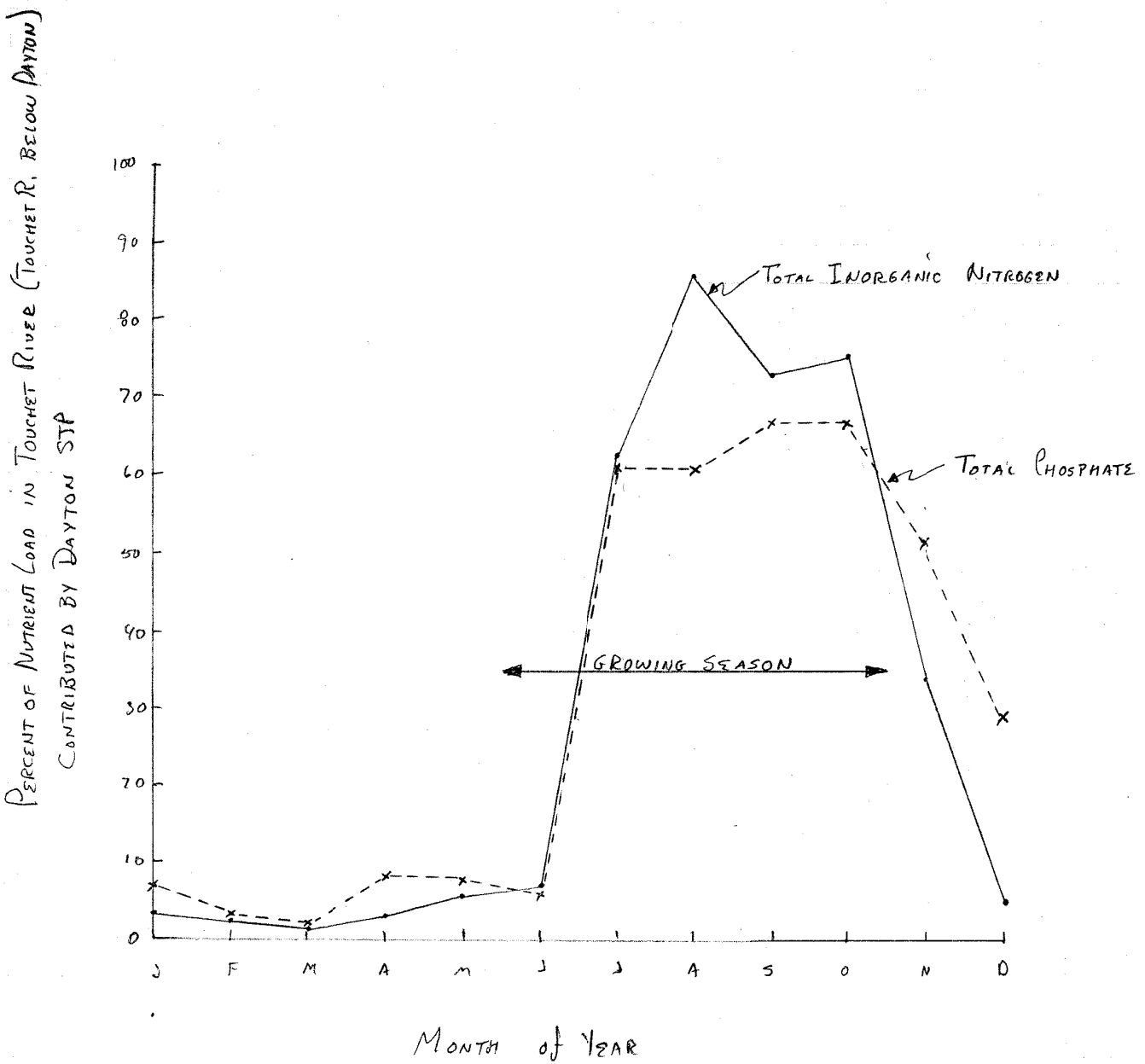

Figure 4. Dayton STP Nutrient Loads as a Percentage of Average Monthly Nutrient Loads Recorded Downstream

2. River flow data used are the 1- in 10-year low monthly flows in Table 1.

3. Use 10 percent exceedence values for percent un-ionized ammonia.

4. Assume upstream ammonia concentrations equal to zero.

5. Assume a dilution zone equal to 15 percent of the river flow. Establish effluent limits to meet the acute criteria at the edge of the dilution zone.

6. Establish limits which also meet the chronic criteria after dilution with 100 percent of river flow.

The methods and assumptions used here are in essential agreement with Al Newman's draft un-ionized ammonia policy.

This approach indicates a need for permit limits on total ammonia for four months out of the year (June through September). These limits are expressed in terms of lbs/day of total ammonia-nitrogen. These limits are given in Table 2.

Table 2. Ammonia limits for Dayton STP effluent (lbs/day NH_3-N).

Criteria	Acute	Chronic
Dilution Assumption	15% of River Flow	100% of River Flow
June	55	67
July	25	26
August	25	27
September	67	76

Although the limits necessary to meet the acute and chronic criteria are quite similar, the acute limits are slightly lower and thus become the recommended limits. Table 3 translates these load limits into concentrations for the three plant flows indicated in your memorandum.

algae (diatoms, etc.). In pools, nutrients can accelerate growth of suspended or floating algae. Indirect impacts include effects on dissolved oxygen, pH, and turbidity. The degree to which any of these effects are expressed in a given system is a function of the velocity of flow, substrate type, and stream shading.

Although adequate nutrient criteria for free-flowing streams are generally not available, the water quality index (WQI) developed by EPA Region 10 and used by WDOE may provide some perspective. The WQI uses three consecutive growing season months of nutrient data to assess "eutrophication potential." A concentration of 0.10 mg T-P/L or 0.30 mg TIN/L equates to 20 WQI points. Twenty WQI points is set as the dividing line between waters which meet the goal of "fishable and swimmable waters" and waters which are marginal with respect to meeting this goal. The Dayton effluent alone could raise the eutrophication rating of the Touchet River by approximately 18 points.

In addition, a recent publication (Horner, Welch, and Veenstra, 1983) suggests that nuisance periphyton growths may be associated with "soluble reactive phosphorus" (SRP) concentrations of greater than .015 mg/L. As is apparent in Figure 2, the Dayton STP discharge alone would raise phosphate-P concentrations to about 50 percent of this concentration in an average flow growing season.

Full assessment of the impacts of Dayton STP nutrients on the Touchet River would require a comprehensive and potentially complex receiving water study.

Ammonia

The need for limitations on effluent ammonia at the Dayton STP was assessed using a modification of a method described by Yake and James (1983). The modification consists of using the most recent chronic un-ionized ammonia criteria available from USEPA. These criteria (USEPA, 1983) are variable with respect to pH and temperature. During critical (low flow, high temperature, high pH) months, the change has the effect of raising the chronic criteria from the old value of 0.020 mg NH_3^o/L (0.0165 mg NH_3^o-N/L) to 0.031 mg NH_3^o/L (0.0255 mg NH_3^o-N/L). The 1983 EPA document also includes acute criteria.

In applying these criteria to the Dayton discharge, I have used the following data and assumptions:

1. Receiving water data for pH, temperature, and percent un-ionized ammonia were obtained from the Touchet River at Touchet station (32B070) which has the most complete and current set of data for the Touchet River system.

Table 3. Effluent concentrations necessary to meet NH_3-N load limits (concentrations expressed in mg/L).

Plant Flow	.34 MGD	.49 MGD	.64 MGD
June	19.4	13.5	10.3
July	8.8	6.1	4.5
August	8.8	6.1	4.5
September	23.6	16.4	12.6

Total Chlorine Residual

The current EPA criterion for total residual chlorine is .002 mg/L for the protection of salmonid fishes. This criterion is being revised by EPA and will be replaced by criteria of .0066 mg/L for chronic effects and .015 mg/L for acute effects. As of the time of this writing, these proposed criteria will shortly be published in the Federal Register, and this will begin a 90-day period for public review and comment. Because of the uncertain status of these criteria, an analysis was made using both the current and proposed criteria. In both cases the need for dechlorination is evident.

In this analysis (as in the ammonia analysis above), I have made the assumption that acute criteria must be met at the edge of the dilution zone (15 percent of river flow) and chronic criteria must be met after dilution with the complete river flow. However, in the absence of a specific policy for chlorine, I have used the 7-day, 10-year low flow to determine the volume of receiving water available for dilution as specified in the dilution zone guidelines (WDOE, 1978). In addition, I have treated the current .002 mg/L criteria as a chronic criterion. Based on these assumptions, Table 4 presents the poundage limits for total chlorine residual, as well as equivalent concentrations at the three requested flows.

Table 4. Proposed total chlorine residual limits, Dayton STP.

	Current Criterion	Proposed Criteria	
	Chronic (.002 mg/L)	Chronic (.0066 mg/L)	Acute (.015 mg/L)
Load Limit (lbs/day)	0.22	0.73	0.25
Concentration Limits (mg/L)			
at .34 MGD	.078	.26	.088
at .49 MGD	.054	.18	.061
at .64 MGD	.041	.14	.047

Using the proposed criteria, limits based on the acute criterion (and 15 percent of river flow) are more restrictive and thus controlling. These limits are essentially equivalent to those calculated using the current chronic criterion (and 100 percent of river flow). In either case, effluent TCR concentrations must be between about .05 and 0.1 mg/L to meet the in-stream criteria. To do this, while simultaneously meeting fecal coliform limits, will probably require dechlorination.

Although a case might be made for seasonal limits (allowing higher effluent TCR loads during periods of higher river flow), the cost benefits of this approach are marginal. Once dechlorination facilities are constructed, operating costs are low. Thus a single year-round limit--possibly .05 mg/L--would probably be adequate.

Diffuser

The analyses made here assume that the effluent undergoes rapid initial dilution with the Touchet River. Conditions such as those experienced by Chase and Cunningham (1981); that is, poor dilution and dispersion with the plume tracking the south bank, are generally not acceptable. Without proper initial dilution, more stringent ammonia and chlorine limitations would be required to assure maintenance of in-stream criteria.

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