

**MWH**

To: Kevin Eubanks, Larry Bazel **Date:** April 5, 2003
From: Chip Paulson **Reference:** 1700509.01180201
Subject: NDEP's Las Vegas Bay Phosphorus
 TMDL Methodology

This memorandum summarizes the methodology used by NDEP to establish the current TMDL for total phosphorus for Las Vegas Bay. Since we've been asked to report to NDEP on how the NPDES monitoring data supports or does not support the present 100 lb/day nonpoint total phosphorus allocation, it is important to understand how this TMDL was derived. The information on NDEP's methodology is taken from their report *Total Maximum Daily Loads for Waste Load Allocations for Las Vegas Bay, Rationale and Calculations*, May 1989.

Summary of TMDL Methodology

The total phosphorus TMDL for Las Vegas Bay was determined based on the following procedure.

- An allowable concentration of total phosphorus for Las Vegas Wash at Northshore Rd was derived by Dr. Richard French to be 0.64 mg/l. No supporting calculations or citation of a separate report is provided for derivation of this value.
- The average flow at Northshore Rd for the 1986-1988 water years was computed to be 126 cfs based on USGS flow records. It is assumed that this value includes all wet and dry weather periods, but the methodology or data used to derive this value is not provided in the report.
- A total maximum allowable load at Northshore Rd was calculated to be 434 lb/day, based on the above concentration and flow rate.
- The nonpoint source or background load was calculated to be 100 lb/day using the procedure described below, and the remaining load of 334 lb/day was allocated to the point sources in the watershed (i.e., the Clark County and City of Las Vegas wastewater treatment plants).

Based on the description provided in their report, NDEP carried out the following steps in computing the nonpoint TMDL for total phosphorus for Las Vegas Bay.

1. Obtained total phosphorus monitoring data collected between 1985 and 1987 at Northshore Road (below what is now Lake Las Vegas) by Clark County and USGS. The report does not give the actual data used, how samples were collected, or how frequently they were collected. It is likely

- that between one and four samples per month were available from USGS or Clark County, but this has not been confirmed.
2. Obtained average daily flow rates for the days on which water quality data was available. The source of this flow data is USGS records collected at the Northshore Road and Pabco gaging stations. Actual flow data used in the analysis was not reported.
 3. Calculated the total phosphorus daily load to Las Vegas Bay on the days samples were collected (flow rate times concentration).
 4. Eliminated data outside the April – September growing season.
 5. Eliminated total phosphorus load data points on sampling days on which the flow rate exceeded the average daily flow by 10% or more (5 data points were eliminated).
 6. For the remaining data, calculated nonpoint daily load by subtracting the wastewater treatment plant total phosphorus load (as reported by the wastewater dischargers) from the total load calculated in step 3.
 7. Calculated the monthly average total phosphorus nonpoint load (in lb/day) for each month in the study period (i.e., April to September in 1985, 1986 and 1987) as the average of the calculated daily load values available for that month.
 8. Calculated the yearly average total phosphorus nonpoint load (in lb/day) for 1985, 1986 and 1987 as the average of the monthly values for April to September in each year from step 7.
 9. Calculated the average annual total phosphorus nonpoint load (in lb/day) as the average of the three yearly values from step 8. This result was 90 lb/day.
 10. Added a 10% uncertainty factor (margin of safety) to get the adopted total phosphorus nonpoint load of 100 lb/day.

Application

Application of the above procedure by NDEP resulted in the monthly total phosphorus nonpoint source loads in the following table.

Month	TP (lb/day)	Month	TP (lb/day)	Month	TP (lb/day)
Apr-85	0	Apr-86	-15	Apr-87	-60
May-85	60	May-86	10	May-87	470
Jun-85	120	Jun-86	370	Jun-87	-10
Jul-85	300	Jul-86	-5	Jul-87	-25
Aug-85	-40	Aug-86	15	Aug-87	-55
Sep-85	220	Sep-86	40	Sep-87	0
Mean	110		69		53

Source: *Total Maximum Daily Loads for Waste Load Allocations for Las Vegas Bay, Rationale and Calculations*, May 1989, Figure 1.

The arithmetic average of the above total phosphorus load rates for the three years of analysis is 78 lb/day. This does not agree with the value of 90 lb/day (before the margin of safety was applied) stated in the report text. The loads calculated by NDEP show several months when total phosphorus loads are negative; that is, the computed load at Northshore Rd was less than the reported load from the wastewater

treatment plants. These data points are suspicious, but are not explained in the NDEP report. This phenomenon could be due to a number of factors, including inaccuracies in the total phosphorus sampling results, the fact that single day concentrations were assumed to apply to the entire month, inaccuracies in Las Vegas Wash flow estimates, uptake of phosphorus by biological processes in the lower Wash, deposition of phosphorus in bed sediments in the lower Wash, or other factors.

To attempt to understand how NDEP arrived at their value of 90 lb/day, negative values in the above table were set to zero and the average annual load rates were recalculated. This is shown in the table below.

Month	TP (lb/day)	Month	TP (lb/day)	Month	TP (lb/day)
Apr-85	0	Apr-86	0	Apr-87	0
May-85	60	May-86	10	May-87	470
Jun-85	120	Jun-86	370	Jun-87	0
Jul-85	300	Jul-86	0	Jul-87	0
Aug-85	0	Aug-86	15	Aug-87	0
Sep-85	220	Sep-86	40	Sep-87	0
Mean	117		73		78

The average of these annual load rates is 89 lb/day, which would be rounded to 90 lb/day. Thus it is possible that this is the approach taken by NDEP in their analysis, although this is not documented in their report.

Discussion

Several observations may be made regarding the NDEP methodology for computing nonpoint source loads for total phosphorus.

1. The procedure relies heavily on **averages**. The adopted nonpoint phosphorus allocation of 100 lb/day is based on an average of average yearly loads, which were derived from average monthly loads, which in turn were derived from average daily loads. Therefore, in our evaluation of the validity of the nonpoint source total phosphorus load, use of averages should be appropriate.
2. The nonpoint phosphorus allocation is based on **dry weather flow periods** only. Data from wet weather days was specifically excluded from the analysis. This would not appear to be consistent with NDEP's use of the average annual USGS gaged flow (i.e., including wet and dry weather periods) to derive the TMDL of 434 lb/day. Therefore, our evaluation should consider dry weather phosphorus loads only.
3. **Individual storm loads were not analyzed**, nor is any reference made to potential short-term impacts on total phosphorus loading due to runoff events. Therefore, determination of individual storm loads is not pertinent the nonpoint source TMDL evaluation (although it may be of interest for research into other issues such as the recent algae bloom in Las Vegas Bay).

4. The NDEP nonpoint phosphorus allocation was based only on water quality data collected in the **April-September** season. Therefore, if dry weather phosphorus loads differ between winter and summer, only the summer data should be used in the verification evaluation.