

after a wet period. In general it appears that typical years have about 15 days of measurable runoff, and that values between 10 and 20 days per year are common.

Concentrations from NPDES Sampling

The 2001-2002 NPDES Municipal Stormwater Permit Annual Report provides median concentrations for total phosphorus (TP) for all the wet and dry weather samples collected over the history of the NPDES sampling program (Table 2-11). For wet weather samples the median of all samples is 0.97 mg/l. For dry weather samples, the median of all samples is <0.05 mg/l (many of the sample analyses had a detection limit of 0.05 mg/l). Data collected by SNWA in October 2000 – October 2001 had an average of 0.06 mg/l. For this analysis we will adopt a median dry weather concentration for all samples of 0.05 mg/l.

Figure 1 summarizes NPDES wet weather total phosphorus data for Las Vegas Creek, Duck Creek, Sloan Channel and Las Vegas Wash, and also shows population increase in Las Vegas Valley from 1992 to 2002. Figures 2a and 2b show NPDES dry weather total phosphorus data at major tributary sampling points. These figures show that TP peaked at the end of sampling period for Duck Creek for both wet and dry weather flows, but in general concentrations have not increased in response to increased urbanization. It appears reasonable to assume that future TP concentrations will be similar to recent sampling data.

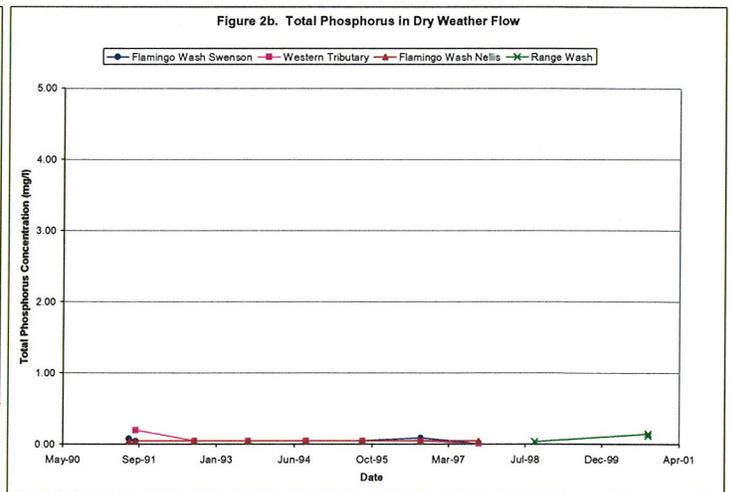
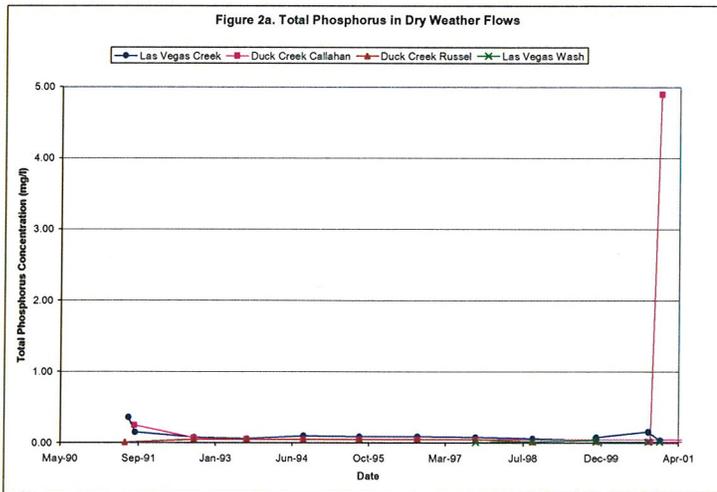
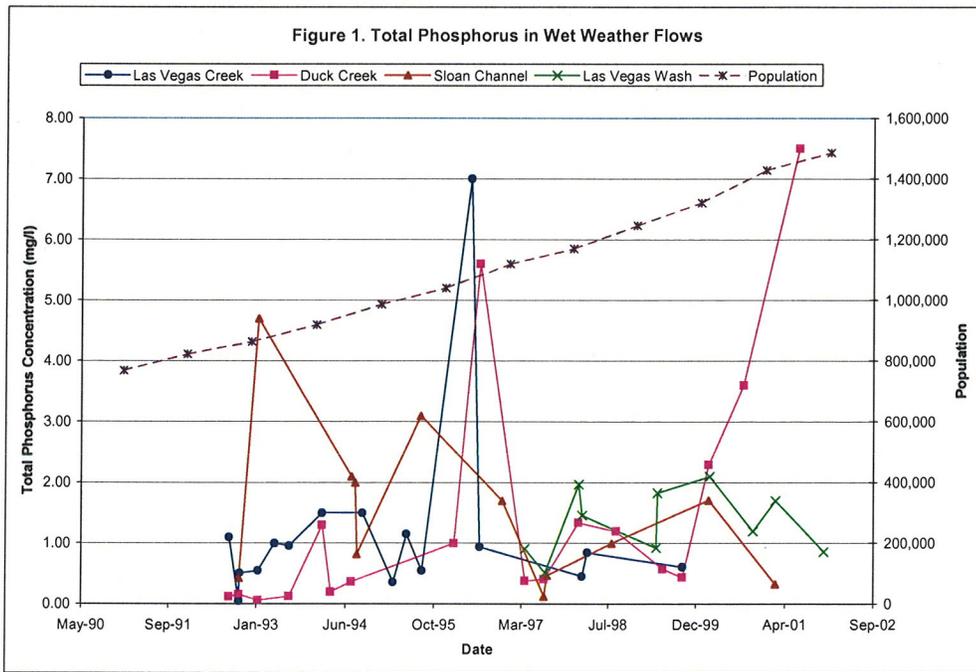
Loads Based on NPDES Sampling

Based on the flow volumes and median phosphorus concentrations given above, wet and dry weather total phosphorus loads were computed and are summarized in Table 1. Although wet weather flow volume is significantly less than dry weather non-wastewater baseflows, the higher wet weather concentration results in storm flow making up the majority of annual loading during all but the driest years.

Table 1. Total Phosphorus Load Estimates Based on NPDES Sampling

	Average Year	Wet Year	Dry Year
<i>Wet Weather Load</i>			
Averaged over full year	51 lb/day	111 lb/day	6 lb/day
Averaged over 10 runoff days	1846 lb/day	4062 lb/day	211 lb/day
Averaged over 15 runoff days	1231 lb/day	2708 lb/day	141 lb/day
Averaged over 20 runoff days	933 lb/day	2031 lb/day	106 lb/day
<i>Dry Weather Load</i>			
Annual baseflow volume	12 lb/day	28 lb/day	6 lb/day
<i>Total Load (averaged over full year)</i>	63 lb/day	139 lb/day	12 lb/day

NDEP allocated 100 lb/day to non-point sources (combined wet and dry weather flows). The above results indicate that if wet weather loads are averaged over the entire year, this allocation is sufficient in dry and average years, but is exceeded in wet years. Results also indicate that during individual days with measurable storm runoff, this allocation is always exceeded.



Load Based on UNLV Pollutant Modeling

MWH prepared a GIS-based watershed model of Las Vegas Valley that computed annual wet weather pollutant loads based on annual rainfall amounts, land use, and unit pollutant loading factors for land use types. This model was upgraded by UNLV to compute monthly pollutant loads based on monthly rainfall amounts (Microbiological, Limnological, and Nutrient Evaluations of the Las Vegas Wash/Bay System, February 2002). Unit pollutant loading factors were calibrated using NPDES sampling data. The model was applied by UNLV to 2000 and 2001 hydrologic conditions; results for TP are summarized in Table 2. UNLV also computed a range of potential dry weather TP load for 1995 - 2000 using measured streamflows in lower Las Vegas Wash and typical TP concentrations of 0.05 mg/l, 0.10 mg/l and 0.15 mg/l. This result is given in Table 3.

Table 2. Total Phosphorus Wet Weather Load Estimates from UNLV Pollutant Load Modeling

Year	Annual Load	Averaged over Full Year	Averaged over 10 Runoff Days	Averaged over 15 Runoff Days	Averaged over 20 Runoff Days
2000	23,854 lb	65 lb/day	2,385 lb/day	1,590 lb/day	1,193 lb/day
2001	19,232 lb	53 lb/day	1,923 lb/day	1,282 lb/day	962 lb/day

Table 3. Total Phosphorus Dry Weather Load Estimates from UNLV Analysis

Year	Concentration = 0.05 mg/l	Concentration = 0.10 mg/l	Concentration = 0.15 mg/l
1995	2,274 lb/day	4,459 lb/day	6,823 lb/day
1996	2,478 lb/day	4,956 lb/day	7,434 lb/day
1997	3,101 lb/day	6,202 lb/day	9,302 lb/day
1998	2,760 lb/day	5,519 lb/day	8,279 lb/day
1999	2,400 lb/day	4,800 lb/day	7,200 lb/day
2000	1,029 lb/day	2,058 lb/day	3,088 lb/day
Annual Average	2,340 lb/day	4,666 lb/day	7,021 lb/day
Daily Average	6 lb/day	13 lb/day	19 lb/day

Results from the UNLV modeling are similar to those described previously for the MWH data analysis. Wet weather loads for TP significantly exceed dry weather loads. When wet weather loads are averaged over the entire year, the total non-point load is less than the 100 lb/day allocation in the NDEP TMDL determination. However, on specific wet weather days the total non-point load significantly exceeds 100 lb/day.