Attachment F – Scientific Peer Review

F-1 Dr. John A. Dracup

F-2 Dr. Rhea Williamson

F-3 Dr. David Jenkins

Attachment F – Scientific Peer Review

F-1 Dr. John A. Dracup

MEMORANDUM 14 February 2002

To: John H. Robertus

From: John A. Dracup

Subject: Scientific peer review for the Draft Staff Report of the Rainbow Creek Total Maximum Daily Loads for (TMDL) for Nutrients

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In your letter dated 20 November 2001, you asked that I answer the following questions in my review of the Draft Staff Report of the Rainbow Creek TMDL for Nutrients:

1. *Does the staff report adequately and correctly address the effects of nutrients in the freshwater stream?*

   Yes.

2. *Are nutrient dynamics, including physical and chemical processes, and biological uptake and assimilation adequately and correctly addressed?*

   Yes.

3. *Is the role of algae and its response to nutrients and other limiting factors adequately and correctly addressed?*

   The role of algae and its response to nutrients and other limiting factors is explained well. However, how to distinguish between "eutrophic conditions" and "excessive algal growth" was not clear. Does "excessive algal growth" have to be recurrent before "eutrophic conditions" can be declared? Or do fish kills, excess decomposition of plant matter, and/or DO depletion to below 5.0 mg/L have to be observed to warrant a declaration that the creek is "eutrophic"?

4. *Based on existing information, has the hydrology of the watershed been adequately and correctly addressed?*

   The hydrology of the watershed seems adequately and correctly addressed.

5. *Does the staff report adequately and correctly address the sources of nutrients in the watershed?*

   The staff's report on nutrient sources in the watershed appears to be adequate and correctly addressed.

6. *Are data used in the report reliable and appropriate, and is the treatment of the data defensible?*

   The data appear to be reliable and appropriate. The staff has sufficiently treated the data in a defensible manner.

7. *Please comment on the general validity of the approach used to calculate nutrient loading to the creek.*

The approach presented in Sections 4.0 and 5.0 on the calculation of nutrient loading to the creek seems valid and reasonable given the available data. It is clear and easy to follow. The uncertainties about linking the mass loading throughout the watershed to observed concentrations of nitrogen and phosphorus in the creek are explained well. The decision to implement an iterative approach to determine appropriate load reductions of nitrogen and phosphorus seems reasonable.

8. *Is the approach used to assign load allocations reasonable?*

The approach sets the TMDL = ΣWLA + ΣLA + Background + MOS. The reservation of 10 percent of the TMDL to MOS seems reasonable. The approach for computing background versus ΣLA raises question. Why were developed land areas included in the background computation? This method implies a 0.9 (0.1) kg/ha/yr nitrogen (phosphorous) load reduction for developed lands, even though these background loads can theoretically never occur while the lands remain developed (i.e. other loading factors for developed lands apply to these lands, as reported in Tables 4-1 and 4-3). For each nutrient constituent, it seems more reasonable to base the background load on the present area of undeveloped land. If you followed this approach, the background load allocation would decrease and the ΣLA would increase. The result is a more flexible load allocation for developed landowners without reducing the total TMDL goals.

9. *Have the correct data gaps been identified for groundwater and septic system issues?*

The set of data gaps presented in Section 9.5.1.1 seems comprehensive and should provide sufficient information to clarify groundwater and septic system issues. It is also a reasonable set of gaps to investigate during Tier I of the Nutrient Reduction and Management Plan (NRMP).

10. *Overall, is the submitted material scientifically sound and thorough, and does it support the Regional Board's proposed action?*

The material is scientifically sound and thorough and will provide good support for the Regional Board's proposed actions. Toward this end, it is recommended that the following comments be addressed during preparation of the Final Report.

(a) The biostimulatory objective (Section 2.5) is more restrictive than the drinking water objective, in terms of NO_3-N concentration allowed in the creek. It is clear that the drinking water objective is mandated by the MCL set forth in California Code of Regulations, Title 22. However, it is not clear what regulation mandates the biostimulatory objective set forth in this TMDL. If there is no regulation, you should state this in the report. Also, if there is no regulation, it is not made clear what would legally compel responsible parties that are existing land users with non-point-source loads to modify their activities to meet the biostimulatory objectives.

(b) Are Sections 3.2 and 2.5 consistent when discussing the total nitrogen objective? Section 2.5 says that the Basin Plan does not state a threshold value for nitrogen and that a weight-to-weight ratio of 10:1 between total-N:total-

P was adopted during the preparation of this draft TMDL to set the total-N threshold. Section 3.2 says that the total nitrogen target is a "numeric goal set forth in the Basin Plan." Which is correct?

(c) At the end of the last paragraph before Section 4.1, you might list all potential sources "not found to be a significant source of either nitrogen or phosphorous," just to be complete. Currently you only mention CalTrans operations as one of those potential sources determined to not be significant.

(d) On p. 36, 2nd paragraph, you state that landowners/land users (such as homeowners, nurseries, businesses, etc.) are identified as responsible parties and are required to comply with all local, state, and federal laws and regulations. From the report, it is not clear which laws would force existing land owners in unincorporated areas to change their management practices if their nutrient loads were non-point-sources. Could they be taxed or fined? Could they have land-use permits revoked? The preceding discussion in Section 9.4 was helpful, but it seemed to address control over land use changes rather than static development.

(e) In the Draft Amendment (20 November 2001), under "Total Maximum Daily Loads for Rainbow Creek," the TMDL for biostimulatory nutrients in Rainbow Creek is set equal to 1,507 kg/yr for total nitrogen. In footnote 1, you say that this value equals the present annual load estimate from undeveloped land, leaving zero load allocation for developed land uses. However, based on the reasoning for load allocation present in Section 6.0 of the Draft Report, even if the entire watershed were undeveloped, the background load to the creek would still be 2,403 kg/yr. How is it reasonable to set the TMDL for biostimulatory nutrients equal to 1,507 kg/yr when it doesn't seem to be theoretically possible based on your loading factor assumptions?

Attachment F – Scientific Peer Review

F-2 Dr. Rhea Williamson

21 January 2002

Lisa Brown
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Please find attached my comments on nutrients in Rainbow Creek located in San Diego County, California. Concerns about the draft staff report and attachments are summarized in general, followed by page/paragraph specific comments. Comments are meant to be constructive. The documents reviewed were as follows:

- Draft Staff Report for Nutrient Total Maximum Daily Load for Rainbow Creek. November 20, 2001. Prepared by Lisa Brown and Kyle Olewnik.

- Miscellaneous attachments.

General Comments: Draft Staff Report: Total Maximum Daily Load for Nutrients.

In general, the document provides a good review of the problem, the regulatory compliance issues, data summary, assumptions used, load calculations and areas of uncertainty. There are, however, considerable data gaps, assumptions and omissions that need correction or clarification. Many of the references cited are not provided in the reference list, or are incomplete. These are identified as noted. In general, the scientific issues identified in Attachment 2 (effects of nutrients in freshwater stream systems, nutrient dynamics, role of algae, watershed hydrology, sources of nutrients in the watershed, reliability and treatment of the data, validity of approach to nutrient loading calculations, assignment of load allocations, and data gaps) are addressed, but not always adequately: These are noted in the specific comments section that follows.

Specific Comments: Attachment 1: page 2.

Discussions related to second tier load reductions should indicate that nutrients will be reduced to concentrations **less than** the biostimulatory substances targets.

Specific Comments: Draft Staff Report: Total Maximum Daily Load for Nutrients.

Page	Comment
2	Section 2.1. The description of sources of nitrogen is incomplete. Organic nitrogen is omitted from discussion. Nitrogen fixation by actinomycetes (soil bacteria) and cyanobacteria (blue-green algae) results in the utilization of nitrogen in the form of nitrogen gas. Discussion of the required oxygen environments is not addressed.
3	Section 2.2. Paragraph 3. The reaches of the creek (described as upper and lower portions) are inconsistent with Figure A-3. MGT1 and RGT1 are not in either reach. The entire "middle reach of the creek is not assessed.
4	Section 2.3. Paragraph 1. The annual average for 1986 includes the single 1985 data point, which was one of the highest recorded values recorded (Table B-1). This will artificially elevate the 1986 annual average.
5	Top paragraph. Two areas are identified as having excessive algae growth in the lower reached. Was this assessment determined visually or was it based on water quality data such as pH and dissolved oxygen? The former can be misleading.
	Paragraph 2. The assumption of elevated historic phosphorus concentrations should be avoided unless knowledge of the fertilizer types is available. The presence of eutrophic downstream conditions does not mean that phosphorus levels are elevated. The assumption being made is that the creek is a phosphorus limited system. In addition, data (*e.g.*, diel dissolved oxygen, pH values; evidence of fish kills) are needed to support the statement that eutrophic conditions exist.
	Section 2.4. Paragraph 1. Table B-2 does not include data for Station 1 (Jubilee Way). This station is important in that it is lthe most upstream site and includes land uses that are different (*e.g.*, the prison) from the other stations.
	Section 2.4. Paragraph 2. Data for 1998-1999 are compared to 2000, however the historical data table does not include the 1998-1999 data for review. It is difficult, as a result, to know how different the values in these two data sets are. Movement of the Oak Crest station 0.2 miles more downstream may or may not place it below the unnamed tributary on Figure A-2.
	There is also no attempt to address the precipitation effect (assumed to be insignificant?) on a seasonal or annual basis, or when comparing different years. Details of this type are important when assessing the validity of the decision to use 2000 data for determination of load allocations.

Section 2.4. Paragraph 3. The average nitrate nitrogen concentration is based on data collected between August and October from the Oak Crest location; this means that the peak months of February to July are not assessed. Data from this site are "expected to be representative" of water quality throughout the Rainbow Valley Basin, yet this site has the lowest nitrate nitrogen concentrations and the highest ortho-phosphate concentrations of all the creek stations (Table B-2). In addition, groundwater surfaces at this location, making it non-representative of stations above the site.

6 Paragraph 2. The statement that there does not appear to be the same degree of seasonal variation in nutrients may be premature. Seasonal variation (based on percent difference) of nitrate nitrogen (97%) and phosphate phosphorus (75%) is quite high at Willow Glen-4. Both nutrient parameters fluctuate considerably. Reasons may also include erosion events leading to increased turbidity.

Section 2.5. Bottom Paragraph. The allowable levels of un-ionized ammonia have been amended (CFR, 1999) such that allowable levels are now based on the presence and/or absence of salmonid fish. This section should be updated to reflect the amendments.

7 Top. It is stated that ammonia has not been found in reportable quanitities. What were the reporting limits used? Levels less than 25 μg/L are considered toxic. If reporting limits are set at 0.1 mg/L, as is often the case, then ammonia will never be found at reportable levels.

8 Last paragraph. Unclear. Does Camp Pendleton rely entirely in groundwater, or on surface waters for its drinking water supply.

9 Paragraph 1. Add to this section that eutropic conditions can result in an increase in pH that can result in the dissociation of ammonium to form the toxic ammonia species.

Paragraph 1. Last sentence. The formation of un-ionized ammonia is not restricted to the decomposition of organic matter. In addition, such decompostion yields ammonium; the transformation to ammonia requires a pH increase.

Paragraph 2. It is stated that eutrophic conditions in Rainbow Creek have not been observed and that dissolved oxygen concentrations are not expected to fall below 5 mg/L. This statement is based on limited data and on assumptions. What time period is included in this assessment? Were the dissolved oxygen concentrations taken to assess oxygen sag conditions measured at several locations? in pool and riffle areas? in locations with and without flow, algae, light, substrate for attachment? Data for 1997 are not included in Table B-1, which should include all historic data for the creek. These data may answer some of the questions above. Importantly, the lack of a fish kill DOES NOT indicate that dissolved oxygen levels are above 5 mg/L. Dissolved oxygen concentrations can vary spatially; the fish will

migrate from areas with low dissolved oxygen. ADDITIONAL DISSOLVED OXYGEN DATA ARE NEEDED.

10 Paragraph 2. In the discussion of the insect population, inpacts of nutrients, herbicides, and pesticides are mentioned. Have there been any analyses of other pollutants, sedimentation, scouring, and other impacts in the Creek?

12 Section 3.2. Paragraph 1. Add substrate for attachment to the criteria that affect the growth of algae in creeks. The targets SHOULD include dissolved oxygen. This document does not provide the data needed to substantiate the claim that "DO concentrations exist below tolerance levels for the designated beneficial use".

14 Table 4-1. The reference should be for Boynton, *et.al.*, 1993.
Nitrogen export coefficients are for coastal regions in California. Were more appropriate values available from the Natural Conservation and Resources Service (NCRS) specific to the area?

15 References. San Diego County, 1994; San Diego County, 2001; SANDAG, 2001, Dames and Moore, 1996 are all missing from the reference list.

Paragraph 2. Are the numbers for nitrogen loss via denitrification specific to the soil types in the region? This is very important, particularly given the fact that the area is not conducive to septic systems and leach fields as a means of waste treatment and that losses may be much lower. Also note that for denitrification to occur, anaerobic conditions must exist.

16 Paragraph 1. Use of 3150 kg/yr may be an underestimate. Information on the prison impacts should be included. Thousands of percolation pond systems exist (as well as design equations) from which estimates of nitrogen loading can be made.

Paragraph 2. Nitrogen in ground water is not removed via transpiration. It is removed via active transport and uptake by the plants. Uptake rates are specific to a plant species. In addition, uptake does not result in a loss from the system, but rather a transformation of form (unless the plant is harvested and removed from the site).

Paragraph 3. Groundwater reaching the creek is not limited to that that surfaces at Oak Crest 3. The estimated load to the creek from groundwater is potentially an underestimate. What about irrigation return flows, inputs from upstream and other contributing sources to Oak Crest 3 during dry weather?

Last paragraph. The assumption that flows at Willow Glen are the same as at Oak Crest ignores the

impacts of several tributaries, of groundwater intrusion between the two sites and other sources of water. This may result in an overestimate of the load.

17 Paragraph 2. The use of the mean to estimate the nitrogen load from groundwater to Rainbow Creek does not make sense. Dry weather conditions exist for 3-4 months. A weighted average using this information could be determined.

References. Chesapeake Bay Program is missing from the reference list.

20 Section 4.2.2. What is the concentration of phosphorus in Rainbow Creek at Oak Crest in the summer?. Summer data of this type for nitrogen were used to estimate groundwater loads of nitrogen. The assumption that all phosphorus is adsorbed to soil particles is erroneous. Note that the highest levels of P were during the early part of the monitoring period.

Table 4-4. Disagree that the load from groundwater is 0.

21 Paragraph 3. The iterative approach can be difficult to apply with parameters that vary temporally (seasonal and diel) and spatially (depth, location). This approach needs to be considered carefully in that reliable data can take years to collect.

Section 5.1. Paragraph 1. The current estimated load of 5,740 kg/yr may be an underestimate. Using Willow Glen-4 station data, the estimated load would be 11,815 kg/yr based on the mean of 9.1 mg/L and the flow of 0.3 cfs.

The estimate of a 28% reduction of nitrate nitrogen assumes that the load, which is based on total nitrogen, consistently results in the same proportion of nitrate nitrogen. This is not likely. Contributions to the total nitrogen load from organic decomposition, runoff and other sources will vary seasonally and spatially.

22 Section 5.2. Paragraph 1. The phosphorus mass load reduction should be 573 not 576 kg/yr. The statement that the reduction is near zero should be corrected. The allowable load is 22 kg/yr.

Table 5-1. The last column should be labeled the Interim Load Capacity.

24 Paragraph 3. The number for background loads for undeveloped land needs a reference. In addition,the calculation for background sources assumes that there is a background load for the areas of the watershed that are already developed. Approximately 62% of the watershed is undeveloped (Figure A-2) resulting in a background of 1560 kg/yr and not of 2403 kg/yr. This change effectively increases the

allocation for nonpoint sources (LAs) to 2157 kg/yr. All of these numbers assume the the TMDL of 4,130 kg/yr is properly estimated.

25 Top paragraph. It is stated that nitrogen contributions from parks, urban areas, and preserves are relatively insignificant. These land uses represent an insignificant percentage of the total watershed, however loads from these areas have not been assessed.

Table 6-1. If the annual load allocations are increased to 2157 kg/yr for the reasons stated above, then the percent reduction is reduced to 52%.

28 Figure 7-1. Data in Figure 7-1 reveal the impact of land uses on nitrate nitrogen concentrations in the creek. Jubilee and RGT-1 are both surrounded by mostly vacant lands, and are least impacted by irrigated fields and orchards. Levels at these sites are relatively low. WGT-1 and VMT-1 receive orchard drainage; nitrate levels are quite high. Riverhouse and Stagecoach are similarly impacted heavily by orchards. Riverhouse levels are high year round, possibly a result of tributary effects and orchard input. Willow Glen has seasonally elevated winter concentrations, followed by a reduction in the late summer months. Sources, loads and seasonal variations at these sites are needed.

29 Paragraph 1. Controls on nutrient loading should be implemented all year long. The sediments act as a sink for phosphorus, so controls that reduce P-loading are essential. Sediments can also act as a sink for nitrogen compounds. In addition, algae growth is year round in Rainbow Creek. Availability of plentiful nutrients during the initial growth period can result in accumulations of algae later in the year.

37 Paragraph 3. Add the sentence to the end of the paragraph: If monitoring data indicate that load reductions are not adequate to result in the nutrient target concentrations, then load allocations will be reevaluated and reduced.

Section 9.5.1. The numbered measures or alternatives are stated as being equally effective in meeting the 28% reduction. The items help assess, plan, develop regulations and the like, but none of the items actually reduce the nitrogen or phosphorus load.

38 Bullet 2nd from the bottom. Transpiration rates are not used to describe nitrogen removal.

44 Table 9-1. Tier I (A) should require interim reports 2 years after USEPA approval.

45 Section 9.7.1. Paragraph 1. Targets for biostimulatory substances should be collected year round for the reasons stated above.

Paragraph 2. The Margarita Glen Tributary should be retained as a site. This site has very high total nitrogen and nitrate nitrogen (Table B-2). A long reach of the creek getween Oak Crest-3 and Willow Glen-4 is not assessed. Major differences in nutrient concentrations exist between these two sites

(Based on the averages for 8/22/00-10/10/00, TN and nitrate are 10.8 and 8.9 mg/L at Oak Crest and are 3.8 and .3. at Willow Glen. Phosphate was always less than 0.5 mg/L at Oak Crest, but was 0.37 at Willow Glen per Table B-2). For this reason, a station should be added on Rainbow Creek between these two stations and below the agricultural fields.

47 Table 9-2. Add turbidity to the surface water monitoring. Change the type of sample from grab to field for pH, dissolved oxygen, and conductivity for both surface and groundwater monitoring. Investigate use of chlorophyll (planktonic and attached) for the algae growth quantification.

Attachment F – Scientific Peer Review

F-3 Dr. David Jenkins

UNIVERSITY OF CALIFORNIA, BERKELEY

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2001 DEC 31 A 11:32
SAN DIEGO REGIONAL
WATER QUALITY
CONTROL BOARD

December 23, 2001

Dear Mr. Robertus,

Enclosed please find a marked up copy of the Draft Staff Report on the Rainbow Creek Nutrient TMDL. I have made many handwritten comments. Those marked with asterisks are substantive and are summarized later. The others are to improve the readability of the report. In addition to these extensive comments I would like to make the following general comments that impact on the approach taken in the TMDL.

1. Nowhere in the report is there any proof or data showing whether N, P or both are limiting to algal growth.

2. The approach to meeting the municipal water supply NO_3-N limit of 10 mg N/L in the initial step of the TMDL is reasonable.

3. An arbitrary assumption that the P limit should be one-tenth of the N limit is absolutely insupportable, bordering on the ridiculous! Reductions in P and further reductions in NO_3-N must be justified on the basis of determining which limits algal growth in the Creek.

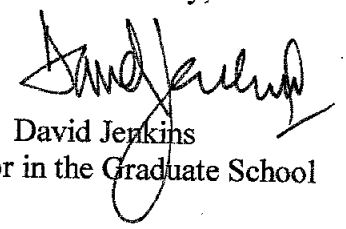
4. The report should show historic trends of all nutrient forms being addressed (NO_3-N, total N, ortho P, total P).

5. The report confuses NO_3-N and total N in many places. This confusion seems to stem from an inadequate initial definition of terms.

6. There is no justification to have a lower initial % N reduction for septic systems (70%) than for agriculture and residential (75%)... especially since the septic system N estimated contribution is the largest of these. Certainly the argument given "to balance the equation" is silly.

Respectfully submitted,

Yours sincerely,



David Jenkins
Professor in the Graduate School

Summary of asterisked comments

p.2	•	nutrients are both organic and inorganic
	•	most ammonification and nitrification does not involve, or follow from, N fixation
	•	P in rocks is already PO_4
	•	N_2 gas is an insignificant part of the N cycle issue
p.3	•	"wastewater effluents", not "untreated wastewater"
p.5	•	confusion between NO_3-N and total N. Please define each clearly and use the correct terms throughout
p.6	•	give "less than" values
p.7	•	give "less than" values
p.8	•	where are the data on emergent plant and algal numbers to support your statement that these are both "excessive"
p.11	•	Total N/ NO_3-N confusion and inconsistency
	•	repetition "ad nauseum"
p.12	•	logic is unclear
	•	nothing said about emergent plant growth
	•	otherwise from what?
p.16	•	N is not lost by transpiration - just water
p.20-2	•	5.0 Linkage Analysis... entire section needs a rewrite in plain non-repetitive english
p.21	•	NO_3-N/total N confusion throughout
p.25	•	"balancing the equation" is indefensible
p.26	•	last sentence is unintelligible (to me)
p.28-9	•	make symbols consistent between Figures 7-1 and 7-2
p.38	•	vague sentence
p.39	•	vague sentence again
p.43	•	meaning unclear

p.45
- be specific about which "biostimulatory substances"
- what is "quantified algae abundance"

p.46
- key statement about not knowing what nutrient limits algae (?plant) growth is hidden away here. You must be up-front, loud and clear about this or you will lose all credibility
- what is a "biodynamic analysis" - please provide a method so that it can be done by the County of San Diego

p.47
- several comments in Table 9-2