City of Santa Rosa RESPONSES (in RED) to Regional Board Request for Information for the City's Nutrient Offset Proposal for Nunes Ocean View Dairy. November 14, 2012

I have reviewed the City's Nutrient Offset Proposal for the Nunes Ocean View Diary. I have the following questions and requests:

1. The proposal mentions on page 3, paragraph 4, that a "detailed crediting summary" that is to be provided under separate cover. I did not receive any documents other than the Project Description.

   The Nunes Ocean View Dairy Summary of Best Management Practice Reduction Estimation Methods for City of Santa Rosa Nutrient Offset Program Credits is being submitted under separate cover.

2. The site assessment completed by Erickson Engineering is said to estimate that there are 3-5 five years of forage production in the manure stockpiles. Does this estimate account for the presence of only 6 dairy cows? Does the low number of dairy cows present over the minimum 4 year crediting period affect the nutrient balance (i.e., will the low number of grazing animals reduce the removal of nitrogen out of the system)?

   Manure stockpiles represent years of dairy production manure accumulation for an animal herd ranging between three hundred to four hundred head. Manure stockpiles were not adequately managed in a manner that accomplished annual land application of the produced manure either onsite or offsite. Thus, the large stockpiles are from historic production. Manure from the remaining six breeding stock to be left on-site will be managed appropriately and separately from proposed BMP crediting practices addressing remaining historic stockpiles.

   As such, the manure production from the six head is not factored into the credit life estimate, but will be land applied using agronomic rates. The minimum four-year time estimate accounts for on-site application at agronomic rates of only the historic/existing manure accumulated in the stockpiles. No credits are assigned to the six head. The proposed crediting period for the historic stockpiles represents a conservative credit life assumption. Application of this manure on available fields at agronomic rates will require portions to be applied across three to five years according to the Erickson Engineering, Inc., report. In addition, the calculations in the Erickson report do not include the land application of manure from the lagoons that will also need to be agronomically applied. Consideration of this additional manure makes the estimated credit life of four years a conservative estimate.

   The pasture uptake of nutrients from both the lagoons and separated solids piles will be adequate if operated for hay or silage production during the crediting period which is stated in the proposal to be a minimum of four years. Harvesting the biomass will remove the nutrients at rates similar to or greater than that of grazed pastures. The credit estimate does not include additional nutrient reductions for the continued site exclusion of a dairy herd during the project life. As such, 1) the credit life is a reasonable minimum period given the volume of separated solids, scraping the pens and emptying the manure lagoons; 2) the credit life will not be extended due to the additional amount of manure generated by the six head during the project period; and, 3) all credits awarded are based on historic applications and none are based on applications that will occur from the six head.

3. The 2012 site examination conducted by Erickson Engineering is used as a reference for rainfall runoff and information related to the nutrient balance. Can you provide a copy of the Erickson Engineering report, or the relevant parts of the report?

   The Erickson Engineering, Inc., site assessment report was based in part upon an Excel workbook entitled "20309 Ocean View" and this file accompanies this response. In this workbook, the worksheet "Ocean View" presents the rainfall calculations in columns A through J, rows 77 through 82. This workbook also provides the basis for the manure separated solids volume and lagoon capacity estimations.

4. Each year during the project the reduced accumulated volume of waste in the manure ponds lessens the potential that the remaining contents of the pond will discharge to surface waters. I note that there is a 40% discount factor for nitrogen and 30% for phosphorus for years 2-4. Do these discount factors account for the lower potential for discharge and wouldn't the discount factors increase each year given the lower potential each year through the end of the project?

   Yes, the discount factors in years 2 through 4 acknowledge a reduction in nutrient concentrations. Although the concentrations are expected to diminish, there is no equation available to calculate the rate of decrease. Therefore, the same conservative factors were applied in years 2 through 4. However, additional margins of safety were built into the calculations to account for this uncertainty. Therefore, the discount factors and overall credit calculation method reflect a conservative credit estimate.

   Several factors contribute to the potential decrease in concentration, including the fact that no new manure will be added to the manured open lots during the credit generation period (the dairy will not be operating). In addition, the concentration could decrease due to the possibility of reduced solids transport and a reduction in the nitrogen concentration of the manure if the top of the lagoon becomes temporarily aerobic.

   With the cattle being excluded, the lagoons would only receive legacy manure from open lot facilities on the dairy site. The proposed project will remove manure from these open concrete and unpaved corrals, as well as establish appropriate perennial cover for protection of the lagoons during their temporary closure. The nutrient load reduction estimates consider the combination of open lot BMPs and the proper management of existing manure within the lagoons (removal and land application). Erickson Engineering estimated that stormwater flow from manured open lots (corrals and pens) contributes 71.9 percent of the total waste volume requiring lagoon storage. The current lagoons only provide 41 percent of the needed capacity to store a waste volume associated with the previous herd size. As a result, flow from the manured areas would enter the lagoon system and overtop the lagoons, even without the addition of the barn flushing system and parlor wash water.

Without cattle on the site, over time the nutrient concentration in the flow from manured open lots will diminish. A study by Gilley *et al*. (2012)[1] indicated that nutrients from consolidated feedlot surfaces exposed to stormwater runoff have a nearly constant rate of phosphorus loss. The same study found that total nitrogen loading increases in linear fashion with flow rates. Both of these findings assumed a constant source of manure. However, when runoff events occurred on plots where new manure was not added, this controlled study observed a reduction in loading. A literature review completed by Koelsch *et al*. (2006)[2] further characterized open lot runoff loading. This review found that runoff from open beef cattle lots averaged 5,800 ppm TN and 1,200 ppm TP. Waste from dairy cattle has a higher strength than waste from beef cattle. Using the average concentrations gathered in this review, the nutrient loading from open lot runoff associated with an operating Nunes dairy site would generate approximately 51,000 pounds of phosphorus and 246,000 pounds of nitrogen annually.

As stated earlier, with the cattle removed and no new manure inputs, this initial loading is expected to diminish over time. However, there are no reliable estimates regarding the rate of decrease and therefore 30 percent and 40 percent were applied to all years 2 through 4. This inability to estimate annual decreases in nutrient concentration from open lot runoff is compensated for by conservative estimates that were built into the reduction estimation and credit calculation process. The manure areas initially generate nutrient loading that is more than 1.55 times the load estimate provided in the proposal, before a discount is applied. The combined implicit and explicit margins of safety result in an edge-of-field loading estimate that in subsequent years is 62 percent lower for nitrogen and 55 percent lower for phosphorus compared to the initial nutrient loading estimates. Therefore, although the annual loading estimate does not reflect a reduced load each year, using the discount factors as an average for all three years remains conservative approach to crediting this BMP application.

In summary:

- The lagoon cleanout and land application will include removal of accumulated manure in open lots from the previous herd and establishment of conservation cover as appropriate
- Without the proper management provided by this project, the manured area would continue to generate stormwater that has come in contact with manure
- The nutrient content of the stormwater from these areas is expected to diminish over time as the herd has been removed
- An estimation method is not available to specifically calculate the annual decrease for years two, three and four
- A implicit margin of safety was applied to the stormwater loading entering the lagoon in years two, three and four
- An additional explicit discount factor of 40 percent further reduction for nitrogen and 30 percent further reductions of phosphorus is applied

---

[1] Gilley, J.E., Vogel, J.R, Eigenberg, R.A., Marx, D.B., Woodbury, B.L. 2012. Nutrient losses in runoff from feedlot surfaces as affected by unconsolidated surface materials. J. of Soil and Water Conservation. May-June 2012. Vol. 67, pp 211-217

[2] Koelsch, R.K., Lorimer, J., Mankin, K. 2006. Vegetative Treatment Systems for Open Lot Runoff: Review of Literature. *Conference Presentations and White Papers: Biological Systems Engineering.* Paper 5. http://digitalcommons.unl.edu/biosysengpres/5

- The estimation process applies a cumulative reduction of 62 percent for nitrogen and 55 percent for phosphorus as an average result across all subsequent years

5. Is the proposal to completely empty the manure ponds and remove the stacks of manure? If all manure is not removed at the end of the project, can storm water contacting the manure remaining in the stacking area and collecting in the manure ponds still be considered agricultural storm water, as suggested on page 8, paragraph 2?

   The crediting is based on full removal of all liquids and solids in the lagoons, plus full removal of all separated solids in the stacking piles and establishment of a perennial cover in the stacking area. The six cows present on the site would generate a minor amount of additional solids that can be incorporated into the separated solids pile during the beginning of the operation. In future years, the site would switch to an approved solids management system based on the WMP and NMP requirements.

6. In credit calculations for BMP No. 3, the current condition is compared to an after-project condition, which includes the "natural re-establishment of the riparian corridor buffer." Because the City is not proposing to re-establish the riparian corridor, the City should not include the nutrient removal that results for the "natural" process.

   The credit calculations do not credit the benefits of a riparian corridor buffer. The project schedule will implement interim BMPs preventing a discharge of runoff that has been in contact with manure solids (e.g., berms, solids pile relocation to a safer area and/or perennial cover on the stacking area). The physical characteristics of the site create a riparian corridor. The features include the Windsor Creek flood plain area and adjacent bluff slope that rises up to the production area of the dairy. BMPs will protect this corridor during the crediting period. In addition, a Waste Management Plan (WMP) will be created within the project period that will specify adequate long-term operation of the dairy to prevent production area discharges. The owner will be responsible for compliance with the WMP. The proposal reference to "natural re-establishment of the riparian corridor buffer" refers to the natural occurrence of vegetation growth in setback areas even though the area does not have enhanced management for plantings and is not assigned any treatment value.

7. In crediting methods for BMP No. 3 (Attachment A), it's not clear to me how the values for "Eroded/Particulate Attached" are calculated. My calculation (tons/ac-yr)(kg/ton)(lb/kg)(acres) results values ½ the values calculated in the spreadsheet. Please explain.

   The calculation includes a nutrient enrichment ratio. In the Pennsylvania method, Evans (2002)[3], provides guidance that phosphorus enrichment should be a factor of two. Examining other approaches to enrichment factors shows that this is a conservative estimate. The PA enrichment equations are documented in CREAMS[4] (A Field Scale Model for Chemicals,

---

[3]Evans, B.M., 2002. Development of an Automated GIS-Based Modeling Approach to Support Regional Watershed Assessments. Ph.D. dissertation in the Dept. of Crop and Soil Sciences, Penn State University, 231 pp.

[4]Kinsel, W. G., et. al. 1980. CREAMS : Chemicals, Runoff, and Erosion from Agricultural Management Systems. Volume 1 Model Documentation.

Runoff, and Erosion from Agricultural Management Systems) model documentation. This documentation states that organic nitrogen forms associated with soils enrich at even higher rates than the phosphorus forms associated with soils. The Michigan DEQ document entitled "Pollutant Controlled Calculation and Documentation for Section 319 Watersheds Training Manual" (1999)[5] indicates the enrichment of nitrogen associated with soil erosion at 9 tons/acre to be three times that for peat soils. Peat is used in this comparison due to the high organic material content. The EPA Region 5 Load Estimation Spreadsheet Model (2009)[6] is based on this Michigan document. Based on this assessment of other enrichment factors, multiplying by a factor of two is considered conservative.

8. Can you provide an excerpt of the document "Manure Characteristics: Manure Management System Series" to verify that the values used in the spreadsheet and to document that any assumptions for using the numbers have been met.

The requested excerpts are provided below. The Nunes Ocean View proposal section entitled "Proposed Credit Generating Practices" provides the entire list of references used. In addition, nutrient content variability from site to site or time to time can be substantial. The potential for variation in nutrient concentrations has been acknowledged, and the City has collected representative site-specific soil and manure samples, as described in the proposal (and results are pending):

> "Attachment A to this document presents a summary of the credit calculations examined for these proposed practices at this dairy. These calculations assume nutrient content and concentration values based on published animal livestock research. The publications that were used to supply these estimates are widely recognized as the industry's leading source of accurate information and/or are developed for assessing and designing livestock environmental controls in other states. Site-specific sampling is being pursued by the City and thus, credit calculations may be adjusted and later communicated with the Regional Board."

The manure characteristics used in the calculations are provided in the following Tables 1, 6 and 7 from the Midwest Plan Service document.

Table 1. Variations in unagitated lagoons.
Case studies from one swine and one dairy single-stage lagoon. Sampling depths of 2 feet and 14 feet. Lagoon depth is 18 to 20 feet. Based on data presented in *Livestock Waste: A Renewable Resource*, 1980, pg. 254 to 256.

		Swine		Dairy	
Component	Unit	2 ft Depth	14 ft Depth	2 ft Depth	14 ft Depth
Total solids (TS)	lbs per 1,000 gal	20	170	135	265
Volatile solids (VS)	lbs per 1,000 gal	10	85	90	177
Nitrogen (N)	lbs per 1,000 gal	4	10	3	7
Ammonical Nitrogen (NH_4-N)	lbs per 1,000 gal	3	6	3	2
Phosphorus (P_2O_5)	lbs per 1,000 gal	2	15	4	7
Potassium (K_2O)	lbs per 1,000 gal	5	8	6	8

[5] Michigan Department of Environmental Quality. 1999. Pollutants Controlled Calculation and Documentation For Section 319 Watersheds Training Manual. Accessed November 14, 2012 at: http://www.michigan.gov/documents/deq/deq-wb-nps-POLCNTRL_250921_7.pdf
[6] US EPA. 2009. Region 5 Load Estimation Spreadsheet Model. Accessed November 14, 2012 at: http://it.tetratech-ffx.com/steplweb/models$docs.htm

Table 6. Daily manure production and characteristics, as-excreted (per head per day)[a].

Values are as-produced estimations and do not reflect any treatment. Use these values only for planning purposes. The actual characteristics of manure for individual situations can vary ± 30% or more from table values due to genetics, dietary options and variations in feed nutrient concentration, animal performance, and individual farm managment.

	Size[a]	Total manure[b]			Water[c]	Density[c]	TS[d]	VS[c]	BOD_5	Nutrient content		
Animal	**(lbs)**	**(lbs)**	**(cu ft)**	**(gal)**	**(%)**	**(lb/ft³)**	**(lb/day)**	**(lb/day)**	**(lb/day)**	**(lbs N)[d]**	**(lbs P_2O_5)[d]**	**(K_2O)**
Dairy												
Calf	150	12	0.18	1.38	88	65	1.4	1.2	0.19	0.06	0.01[c]	0.05
	250	20	0.31	2.30	88	65	2.4	2.0	0.31	0.11	0.02[c]	0.09
Heifer	750	45	0.70	5.21	88	65	6.7	5.7	0.69	0.23	0.08[c]	0.23
	1,000	60	0.93	6.95	88	65	8.9	7.6	0.92	0.30	0.10[c]	0.31
Lactating cow	1,000	111	1.79	13.36	88	62	14.3	12.1	1.67	0.72	0.37[c]	0.40
	1,400	155	2.50	18.70	88	62	20.0	17.0	2.34	1.01	0.52[c]	0.57
Dry cow	1,000	51	0.82	6.14	88	62	6.5	5.5	0.75	0.30	0.11[c]	0.24
	1,400	71	1.15	8.60	88	62	9.1	7.7	1.04	0.42	0.15[c]	0.33
	1,700	87	1.40	10.45	88	62	11.0	9.3	1.27	0.51	0.18[c]	0.40
Veal	250	6.6	0.11	0.79	96	62	0.26	0.11	0.04	0.03	0.02	0.05[d]
Beef												
Calf (confinment)	450	48	0.76	5.66	92	63	3.81	3.20	1.06	0.20	0.09	0.16
	650	69	1.09	8.18	92	63	5.51	4.63	1.54	0.29	0.13	0.23
Finishing	750	37	0.59	4.40	92	63	2.97	2.42[d]	0.60	0.27	0.08	0.17
	1,100	54	0.86	6.46	92	63	4.35	3.55[d]	0.89	0.40	0.12	0.25
Cow (confinment)	1,000	92	1.46	10.91	88	63	11.0	9.38	2.04	0.35	0.18	0.29
Swine												
Nursery	25	1.9	0.03	0.23	89	62	0.21	0.17	0.06	0.02	0.01	0.01
	40	3.0	0.05	0.37	89	62	0.33	0.27	0.10	0.03	0.01	0.02
Finishing	150	7.4	0.12	0.89	89	62	0.82	0.65	0.23	0.09	0.03	0.04
	180	8.9	0.14	1.07	89	62	0.98	0.78	0.28	0.10	0.04	0.05
	220	10.9	0.18	1.31	89	62	1.20	0.96	0.34	0.13	0.05	0.06
	260	12.8	0.21	1.55	89	62	1.41	1.13	0.41	0.15	0.05	0.08
	300	14.8	0.24	1.79	89	62	1.63	1.30	0.47	0.17	0.06	0.09
Gestating	300	6.8	0.11	0.82	91	62	0.61	0.52	0.21	0.05	0.03	0.04
	400	9.1	0.15	1.10	91	62	0.82	0.70	0.28	0.06	0.04	0.05
	500	11.4	0.18	1.37	91	62	1.02	0.87	0.35	0.08	0.05	0.06
Lactating	375	17.5	0.28	2.08	90	63	1.75	1.58	0.58	0.17	0.11	0.13
	500	23.4	0.37	2.78	90	63	2.34	2.11	0.78	0.22	0.15	0.18
	600	28.1	0.45	3.33	90	63	2.81	2.53	0.93	0.27	0.18	0.21
Boar[c]	300	6.2	0.10	0.74	91	62	0.57	0.51	0.20	0.04	0.03	0.03
	400	8.2	0.13	0.99	91	62	0.75	0.67	0.26	0.06	0.05	0.05
	500	10.3	0.17	1.24	91	62	0.94	0.84	0.33	0.07	0.06	0.06
Poultry												
Broiler	2	0.19	0.003	0.023	74	63	0.050	0.038	0.011	0.0021	0.0014	0.0010
Layer	3	0.15	0.002	0.017	75	65	0.037	0.027	0.008	0.0026	0.0008	0.0012
Turkey (female)	10	0.47	0.007	0.056	75	63	0.117	0.088	0.034	0.0078	0.0051	0.0034
Turkey (male)	20	0.74	0.012	0.088	75	63	0.186	0.139	0.054	0.0111	0.0074	0.0048
Duck	4	0.44	0.007	0.053	73	62	0.118	0.089	0.016	0.0043	0.0034	0.0026
Sheep												
Feeder lamb[c]	100	4.1	0.06	0.5	75	63	1.05	0.91	0.10	0.04	0.02	0.04
Horse												
Sedentary	1,000	54.4	0.88	6.56	86[d]	62	7.61	6.5	1.52	0.18	0.06	0.06[d]
Intense exercise	1,000	55.5	0.90	6.70	86[d]	62	7.78	6.6	1.56	0.30	0.15	0.23[d]

TS = total solids; VS = volatile solids; BOD_5 = the oxygen used in the biochemical oxidations of organic matter in five days at 68 F, which is an industry standard that shows wastewater strength.

[a] Use linear interpolation to obtain values for weights not listed in the table.

[b] Calculated using TS divided by the solids content percentage.

[c] Based on MWPS historical data.

[d] Values calculated or interpreted using diet based formulas being considered for the ASAE Standards D384: *Manure Production and Characteristics.*

Table 7. Estimated liquid pit manure characteristics.
Use only for planning purposes. These values should not be used in place of a regular manure analysis

Livestock Stages	Production						Concentration			
	Manure	Total N	NH_3-N	P_2O_5	K_2O	Units	Total N	NH_3-N	P_2O_5	K_2O
	(lb/yr)						lbs/1,000 gallons of manure			
Farrowing	11,500	21	11	17	15	per pig space	15	8	12	11
Nursery	1,000	3	2	2	3	per pig space	25	14	19	22
Grow-Finish (deep pit)	3,500	21	14	18	13	per pig space	50	33	42	30
Grow-Finish (wet/dry feeder)	2,500	17	12	13	12	per pig space	58	39	44	40
Grow-Finish (earthen pit)	3,500	13	10	9	8	per pig space	32	24	22	20
Breeding-Gestation	9,100	27	13	27	26	per pig space	25	12	25	24
Farrow-Finish	37,500 2,000	126 7	72 4	108 6	103 6	per production sow per pig sold per year	28 28	16 16	24 24	23 23
Farrow-Feeder	10,000	25	13	22	23	per production sow	21	11	18	19
Dairy Cow	54,000	200	39	97	123	per mature cow	31	6	15	19
Dairy Heifer	25,000	96	18	42	84	per head capacity	32	6	14	28
Dairy Calf	6,000	19	4	10	17	per head capacity	27	5	14	24
Veal Calf	3,500	11	9	9	17	per head capacity	26	21	22	40
Dairy Herd	73,000	271	53	131	193	per mature cow	31	6	15	22
Beef Cows	30,000	72	25	58	86	per mature cow	20	7	16	24
Feeder Calves	13,000	39	12	26	35	per head capacity	27	8	18	24
Finishing Cattle	25,500	89	24	55	79	per head capacity	29	8	18	26
Broilers	83	0.63	0.13	0.40	0.29	per bird space	63	13	40	29
Pullets	49	0.35	0.07	0.21	0.18	per bird space	60	12	35	30
Layers	130	0.89	0.58	0.81	0.51	per bird space	57	37	52	33
Tom Turkeys	282	1.79	0.54	1.35	0.98	per bird space	53	16	40	29
Hen Turkeys	232	1.67	0.56	1.06	0.89	per bird space	60	20	38	32
Ducks	249	0.45	0.24	0.36	0.33	per bird space	22	5	15	8