

**Redwood Shores Lagoon
November 2016
Monthly Water Quality Monitoring Report**



Prepared for

**Redwood City
Public Works Services Department
1400 Broadway
Redwood City, CA 94063-2594**

Prepared by

**Clean Lakes, Inc.
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December 2016

City of Redwood City staff Richard Chaffey performed the November monthly monitoring on November 16, 2016. Weather conditions were sunny, the air temperature was 52 F, and light winds were recorded.

General water quality measurements for dissolved oxygen, clarity (as turbidity), salinity, pH, and temperature were recorded at Sites R-1 thru R-5. Nutrients, nitrate as N, and dissolved ortho-phosphate as P were sampled at R-1 thru R-5 via laboratory analysis. Water samples were collected for Fecal Coliform analysis at Sites R-1 and R-2. During each sample visit observations are noted for floatables, oil/grease films and scum, water discoloration, algae and aquatic plant growth, and any presence of dead birds or fish. Water Quality Objectives for Redwood Shores Lagoon is provided below as well Dissolved Oxygen (DO) requirements in Non-Salmonid waters by which to compare field and laboratory results.

Table 1. Redwood Shores Lagoon Water Quality Objectives

Parameter	Criteria
pH	6.5 – 8.5
Dissolved oxygen	Minimum of 5.0 mg/L
Chlorophyll-a	50.0 ug/l
Fecal coliform bacteria	A median not to exceed 240 MPN/100 mL in 5 consecutive samples with no single sample exceeding 1,000 MPN/100 mL
Color	No significant increase over that in sloughs
Oil, grease, and visable films	None
Floatables	None
Aquatic growths	None sufficient to cause nuisance conditions
Turbidity in Belmont, Steinberger and Bay sloughs that receive lagoon discharge	<u>Background Levels</u> <u>Max. Incremental Increase</u>
	50 NTU 5 NTU
	50-100 NTU 10 MTU
	100 NTU 10 % of background

II. NON-SALMONID WATERS	DO mg/l
A. Early life stages	
No production impairment	6.5
Slight production impairment	5.5
Moderate production impairment	5
Severe production impairment	4.5
Limit to avoid acute mortality	4
B. Other life stages	
No production impairment	6
Slight production impairment	5
Moderate production impairment	4
Severe production impairment	3.5
Limit to avoid acute mortality	3

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RESULTS - Water quality results for each site is provided below in Table format for 2016 to allow comparison of results from month to month.

SITE R-1

				Fecal		Dissolved						
	Ortho		Fecal	Coliform	Water	Oxygen	DO		PH	PH		
	Phosphate	Nitrate as N	Coliform	MPN/100 ml	Temp	(DO)	mg/l		Lower	Upper	Salinity	Turbidity
Months	mg/l	mg/l	MPN/100 ml	Limit	C°	mg/l	Limit	PH	Limit	Limit	ppt	NTU
1.16	0.11	ND	7.8	1,000	13.3	11.87	5	8.2	6.5	8.5	28.17	2.93
2.16	0.17	ND	2	1,000	16.1	8.06	5	8.2	6.5	8.5	34.56	9.02
3.16	0.12	ND	17	1,000	16.8	5.37	5	8.1	6.5	8.5	35.33	5.97
4.16	0.11	ND	ND	1,000	20.2	7.11	5	7.9	6.5	8.5	32.41	9.69
5.16	0.13	ND	4.5	1,000	23.1	7.76	5	7.7	6.5	8.5	26.95	3.38
6.16	0.14	ND	ND	1,000	22.7	7.25	5	7.8	6.5	8.5	24.36	4.03
7.16	0.13	ND	6.8	1,000	23.9	7.02	5	7.9	6.5	8.5	27.47	3.7
8.16	0.16	ND	7.8	1,000	23.2	6.96	5	7.7	6.5	8.5	26.45	5.93
9.16	0.15	ND	ND	1,000	21.3	7.39	5	7.8	6.5	8.5	25.75	3.3
10.16	0.19	ND	ND	1,000	19.4	6.67	5	7.9	6.5	8.5	25.94	5.74
11.16	0.18	ND	11	1,000	17.2	6.88	5	7.8	6.5	8.5	31.99	8.77
12.16				1,000			5		6.5	8.5		

SITE R-2

				Fecal		Dissolved						
	Ortho		Fecal	Coliform	Water	Oxygen	DO		PH	PH		
	Phosphate	Nitrate as N	Coliform	MPN/100 ml	Temp	(DO)	mg/l		Lower	Upper	Salinity	Turbidity
Months	mg/l	mg/l	MPN/100 ml	Limit	C°	mg/l	Limit	PH	Limit	Limit	ppt	NTU
1.16	ND	ND	11	1,000	14	10.43	5	1	6.5	8.5	35.41	12.7
2.16	0.2	ND	7.8	1,000	15.4	4.25	5	7.6	6.5	8.5	38.66	16
3.16	0.24	ND	4.5	1,000	15.8	4.58	5	7.8	6.5	8.5	39.78	24
4.16	0.3	ND	23	1,000	19.9	3.95	5	7.6	6.5	8.5	35.45	33.5
5.16	0.27	ND	7.8	1,000	22.4	3.05	5	7.8	6.5	8.5	32.25	18.4
6.16	0.37	ND	ND	1,000	22.1	4.11	5	7.8	6.5	8.5	31.82	19.2
7.16	0.35	ND	33	1,000	23.3	5.17	5	7.7	6.5	8.5	32.38	22.9
8.16	0.33	ND	ND	1,000	22.5	5.73	5	7.3	6.5	8.5	27.03	19.8
9.16	0.31	ND	17	1,000	20.5	4.88	5	7.6	6.5	8.5	27.63	10.4
10.16	0.25	ND	6.8	1,000	18.8	5.01	5	7.7	6.5	8.5	30.97	17.8
11.16	0.26	ND	ND	1,000	17.1	3.73	5	7.4	6.5	8.5	31.78	20
12.16				1,000			5		6.5	8.5		

SITE R-3

				Dissolved						
	Ortho		Water	Oxygen	DO		PH	PH		
	Phosphate	Nitrate as N	Temp	(DO)	mg/l		Lower	Upper	Salinity	Turbidity
Months	mg/l	mg/l	C°	mg/l	Limit	PH	Limit	Limit	ppt	NTU
1.16	0.19	ND	11.9	9.51	5	5.3	6.5	8.5	35.79	26
2.16	0.15	ND	13.7	8.76	5	8	6.5	8.5	34.56	23.7
3.16	0.17	ND	13.5	7.71	5	8.2	6.5	8.5	38.33	44.6
4.16	0.2	ND	17.6	7.72	5	8	6.5	8.5	31.91	26.3
5.16	0.25	ND	20.5	4.1	5	7.6	6.5	8.5	29.56	53.6
6.16	0.29	ND	20.3	5.03	5	8	6.5	8.5	30.51	48.7
7.16	0.22	ND	20.6	6.55	5	8.1	6.5	8.5	30.97	27.5
8.16	0.34	ND	21.7	6.13	5	8	6.5	8.5	31.21	38.7
9.16	0.34	ND	22.3	7.83	5	7.1	6.5	8.5	29.73	26.7
10.16	0.28	ND	18.3	6.13	5	8	6.5	8.5	31.44	48.9
11.16	0.3	ND	16.3	5.88	5	7.6	6.5	8.5	32.11	47.3
12.16					5		6.5	8.5		

SITE R-4

				Dissolved						
	Ortho		Water	Oxygen	DO		PH	PH		
	Phosphate	Nitrate as N	Temp	(DO)	mg/l		Lower	Upper	Salinity	Turbidity
Months	mg/l	mg/l	C°	mg/l	Limit	PH	Limit	Limit	ppt	NTU
1.16	ND	ND	13.8	4.61	5	6.1	6.5	8.5	35.98	10.1
2.16	0.19	ND	15.5	4.01	5	7	6.5	8.5	42.08	7.64
3.16	0.25	ND	16.4	3.35	5	7.7	6.5	8.5	36.32	25.9
4.16	0.27	ND	20.1	5.6	5	7.8	6.5	8.5	37.61	23.5
5.16	0.23	ND	22.6	4.53	5	7.9	6.5	8.5	32.58	9.45
6.16	0.29	ND	21.6	4.49	5	7.9	6.5	8.5	32.75	11.4
7.16	0.35	ND	23.3	4.97	5	7.6	6.5	8.5	36.85	16.4
8.16	0.34	ND	21.6	5.59	5	7.8	6.5	8.5	30.14	17.5
9.16	0.34	ND	21.2	5.11	5	7.4	6.5	8.5	30.69	15.6
10.16	0.28	ND	19.1	3.71	5	7.5	6.5	8.5	33.03	32.7
11.16	0.29	ND	16.7	3.23	5	7.4	6.5	8.5	31.69	38
12.16					5		6.5	8.5		

				Dissolved						
	Ortho		Water	Oxygen	DO		PH	PH		
	Phosphate	Nitrate as N	Temp	(DO)	mg/l		Lower	Upper	Salinity	Turbidity
Months	mg/l	mg/l	C°	mg/l	Limit	PH	Limit	Limit	ppt	NTU
1.16	ND	ND	13.5	11.4	5	2.4	6.5	8.5	34.67	11.6
2.16	0.17	ND	15	5.8	5	7.8	6.5	8.5	42.63	12.7
3.16	0.19	ND	15.9	5.36	5	7.9	6.5	8.5	40.19	28.3
4.16	0.26	ND	19.3	5.32	5	8.1	6.5	8.5	38.75	32.2
5.16	0.22	ND	21.4	6.73	5	8	6.5	8.5	32.93	19.6
6.16	0.29	ND	20.7	7.33	5	7.7	6.5	8.5	33.01	21.6
7.16	0.29	ND	21.8	6.13	5	7.9	6.5	8.5	40.52	18.3
8.16	0.31	ND	20.7	5.65	5	7.8	6.5	8.5	30.35	21
9.16	0.28	ND	19.5	4.41	5	7.7	6.5	8.5	30.83	18.3
10.16	0.24	ND	18.5	4.72	5	7.7	6.5	8.5	32.06	21
11.16	0.26	ND	17.3	9.14	5	8	6.5	8.5	31.21	22.3
12.16					5		6.5	8.5		

NUTRIENTS – Orthophosphate as P (ORP) was detected in all of the sites in a range between 0.18 and 0.30 mg/l. The lowest site for ORP was at R-1 measuring 0.18 mg/l, while R-3 measured 0.30 mg/l. ORP concentration increased at every site except R-1, in comparison to October. Nitrate as N was not detected at any site in November.

Phosphorus and nitrogen are essential nutrients for the plants and animals that make up the aquatic food web. Since phosphorus is the nutrient in short supply in most fresh waters, even a modest increase in phosphorus can, under the right conditions, set off a whole chain of undesirable events in a stream including accelerated plant growth, algae blooms, low dissolved oxygen, and the death of certain fish, invertebrates, and other aquatic animals.

There are many sources of phosphorus, both natural and human. These include soil and rocks, wastewater treatment plants, runoff from fertilized lawns and cropland, failing septic systems, runoff from animal manure storage areas, disturbed land areas, drained wetlands, water treatment, and commercial cleaning preparations.

Inorganic nitrate as N should be less than 0.3 mg/L to avoid algal blooms. Excessive concentrations of nitrate in lakes and streams greater than about 5 milligrams per liter (measured as nitrogen), depending on the water body, can cause excessive growth of algae and other plants, leading to accelerated eutrophication or "aging" of lakes, and occasional loss of dissolved oxygen. Animals and humans cannot use inorganic forms of nitrogen.

Since phosphorus is often scarce in freshwater ecosystems, it is typically a limiting nutrient, meaning that it limits the amount of life the system can sustain. When humans add phosphate-rich sewage or agricultural runoff, algae growth may no longer be limited by the scarcity of phosphorus in its environment and may grow out of control. In order to control algae growth, the EPA recommends that phosphate levels not exceed 0.05 milligrams per liter for streams discharging into lakes or reservoirs, 0.1 milligrams per liter for lakes and reservoirs, and 0.1 milligrams per liter for other streams and rivers.

FECAL COLIFORM - The fecal coliform levels were measured at 11 MPN/mL and Non-Detect for sites R-1 and R-2, respectively. Coliform levels increased in R-1 and decreased in R-2 in comparison to October 2016. Fecal coliform did not exceed established limits. Single sample results over 1,000 MPN/mL are considered to exceed limits.

GENERAL WATER QUALITY ANALYSIS – The Dissolved Oxygen (DO) levels in November exceeded the 5.0 mg/l threshold in every site except R-2 and R-4. DO was highest at Site R-5 (9.14 mg/l) and lowest at Site R-4 (3.23 mg/l). Water temperature decreased at every site during November, with temperatures ranging from 16.3 to 17.3 C. PH measurements were within the limit at every site, ranging from 7.4 to 8.0. Salinity measurements varied from approximately 31.21 ppt. to a maximum of 32.11 ppt. Turbidity was within limits and varied between 8.77 and 47.3 NTU. It was noted in the field data sheet that the pumps were running in both R-4 and R-5 during the time of sampling.

Field Results

Redwood Shores Lagoon
Monthly Water Quality Monitoring Field Data

Date: <u>11/16/16</u>	Name(s) of Field Personnel: <u>Richard Chaffey</u>
Weather Conditions	Air Temperature: <u>52°</u>
Wind Conditions: <u>Light</u> / Moderate / High	Percent Cloud: <u>0 %</u>
Field Measurements	

Sampling Station	Time	Maximum Depth (ft)	Sample Depth (ft)	Water Temp°C	Dis. Oxy. Mg/l	pH units	Salinity ppt	Turbidity NTU
R-1	1200	4.0'	2.0'	17.2	6.88	7.8	31.99	8.77
R-2	1100	5.0'	2.5'	17.1	3.73	7.4	31.78	20.0
R-3	0907	2.0'	1.0'	16.3	5.88	7.6	32.11	47.3
R-4	0822	5.0'	2.5'	16.7	3.23	7.4	31.69	38.0
R-5	1003	5.0'	2.5'	17.3	9.14	8.0	31.21	22.3

<p>Samples for the following test will be collected for laboratory analyses</p> <ul style="list-style-type: none"> Nitrate-N Ortho-P04-P (preservative required, do not rinse bottle) Fecal Coliform Bacteria (R-1 and R-2 only)
<p>Notes & Observations about floatables, oil & grease, films, scum water discoloration, algae, aquatic plant growth and presence of dead wildlife:</p> <p>R-1- _____ _____</p> <p>R-2- _____ _____</p> <p>R-3- _____ _____</p> <p>R-4- <u>Pumps on at time of sample.</u> _____</p> <p>R-5- <u>Pumps on at time of sample.</u> _____</p>

Laboratory Results



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Redwood City, City of - Redwood Shores
1400 Broadway Street
Redwood City, CA 94063

Project Manager: Brandon Gilmore
Project: Redwood Shores Lagoon
Project Number: Monthly Monitoring

Reported:
12/01/16 10:58

	Result	Reporting Limit	Dilution	Batch	Prepared	Analyzed	Method	Note
R-1 (16K1607-01)		Sample Type: Water			Sampled: 11/16/16 12:00			
Conventional Chemistry Parameters: by APHA/EPA Methods:								
Orthophosphate as P	0.18 mg/L	0.10	1	AK63630	11/17/16 09:00	11/17/16 13:38	SM4500-PE	
Anions: by EPA Method 300.0								
Nitrate as N	ND mg/L	5.0	25	AK63692	11/18/16 01:51	11/18/16 01:51	EPA 300.0	R-01
Microbiological Parameters: by APHA Standard Methods:								
Fecal Coliforms	11 MPN/100mL	1.8	1	AK63777	11/16/16 18:00	11/19/16 19:00	SM9221	
R-2 (16K1607-02)		Sample Type: Water			Sampled: 11/16/16 11:00			
Conventional Chemistry Parameters: by APHA/EPA Methods:								
Orthophosphate as P	0.26 mg/L	0.10	1	AK63630	11/17/16 09:00	11/17/16 13:38	SM4500-PE	
Anions: by EPA Method 300.0								
Nitrate as N	ND mg/L	5.0	25	AK63692	11/18/16 02:07	11/18/16 02:07	EPA 300.0	R-01
Microbiological Parameters: by APHA Standard Methods:								
Fecal Coliforms	ND MPN/100mL	1.8	1	AK63777	11/16/16 18:00	11/19/16 19:00	SM9221	
R-3 (16K1607-03)		Sample Type: Water			Sampled: 11/16/16 09:07			
Conventional Chemistry Parameters: by APHA/EPA Methods:								
Orthophosphate as P	0.30 mg/L	0.10	1	AK63630	11/17/16 09:00	11/17/16 13:38	SM4500-PE	

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Page 2 of 6

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Redwood City, City of - Redwood Shores 1400 Broadway Street Redwood City, CA 94063	Project Manager: Brandon Gilmore Project: Redwood Shores Lagoon Project Number: Monthly Monitoring	Reported: 12/01/16 10:56
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	Result	Reporting Limit	Dilution	Batch	Prepared	Analyzed	Method	Note
R-3 (16K1607-03)								
Anions: by EPA Method 300.0								
Nitrate as N	ND mg/L	5.0	25	AK63692	11/18/16 02:24	11/18/16 02:24	EPA 300.0	R-01
R-4 (16K1607-04)								
Conventional Chemistry Parameters: by APHA/EPA Method:								
Orthophosphate as P	0.29 mg/L	0.10	1	AK63630	11/17/16 09:00	11/17/16 13:38	SM4500-P E	
Anions: by EPA Method 300.0								
Nitrate as N	ND mg/L	5.0	25	AK63692	11/18/16 02:40	11/18/16 02:40	EPA 300.0	R-01
R-5 (16K1607-05)								
Conventional Chemistry Parameters: by APHA/EPA Method:								
Orthophosphate as P	0.26 mg/L	0.10	1	AK63630	11/17/16 09:00	11/17/16 13:38	SM4500-P E	
Anions: by EPA Method 300.0								
Nitrate as N	ND mg/L	5.0	25	AK63692	11/18/16 02:56	11/18/16 02:56	EPA 300.0	R-01

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END OF REPORT