

EXTRA
CONFIDENTIAL

AERATION PROPOSAL

TO

THE PELICAN RIVER BOARD OF MANAGERS

BY

INSTRUMENTAL RESEARCH, INC.

DECEMBER 1984

By:

Delman R. Hogen

Delman R. Hogen, President

LITTLE FLOYD LAKE

Purpose:

Maintain complete mixing of the lake to prevent the formation of an anoxic hypolimnion. Prevent the build up of high concentrations of carbon dioxide and ammonia in the hypolimnion.

Method One:

Drive the aeration heads from two 2-horsepower electric motors which would be mounted at a shore station. Four lines would run to the twelve sites where each will deliver approximately 1.0 cfm of air at the bottom. The total water entrainment from these ^{the shore} ~~four~~ heads will be 7780 cfm. This should turn the lake over in about 14 days. If the flow stream is not sufficient to break through the thermocline this will deliver 0.7 mg of oxygen per liter per five days and may be sufficient to replace the oxygen depleted by the decaying algae populations.

Advantages:

The electrical unit will run continuously and can be operated through the winter months. There would be no reason to disconnect or remove the unit for the winter even if the unit was not operated during this time.

Disadvantage:

The operation requires a constant electrical source to drive the two 2-horsepower motors.

Method Two:

The aeration heads are powered by a wave driven pumping system. The delivery rate is more than twice that of the proposed electrical unit and will be sufficient to turn the lake over in 7.5 days. The oxygen delivered to the hypolimnion will be 1.6 mg oxygen per liter of hypolimnetic water per five days. The result should be an increase at the bottom from the measured 1.4 mg/L in July of 1983 to 5.3 mg/L. The oxygen level of .1 mg/L in August of 1983 will increase to 3.6 mg/L.

Advantages:

The installation requires considerably less balancing than the electrical system since each compressor drives only two heads. There is no electric power required to drive this system so the savings over the years will be considerable. Since the units will be mounted over 15 feet of water, there will be less distribution line to install thereby reducing the labor costs.

Disadvantages:

The units will operate only when there is sufficient wind to drive the pumps. The units cannot be operated in the winter months and must be removed before the lake freezes and reinstalled in the spring.

AERATION ESTIMATE
ELECTRIC
LITTLE FLOYD LAKE

12/19/1984

ITEM	PRICE EA	NO. REQ	INST TIME	COST
COMPRESSOR	\$972.12	2	6	\$2244.24
PAD	\$80.00	1	1	\$130.00
HOUSING	\$350.00	1	0.5	\$375.00
3/4 PVC	\$23.25	276	138	\$13317.00
COUPLINGS	\$0.85	276	69	\$3684.60
TEE FTGS	\$1.36	12	3	\$166.32
THD COUPLING	\$1.54	12	3	\$168.48
WEIGHTS	\$0.45	276	4.6	\$354.20
PROGRAMMING	\$70.00	6		\$420.00
MILEAGE	\$0.44	250		\$110.00
MILEAGE	\$0.35	1000		\$350.00
PER DIEM	\$114.00	23		\$2622.00
TRAVEL WAGE	\$50.00	9		\$450.00
TRAVEL WAGE	\$40.00	18		\$720.00
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TOTAL				\$25111.84

AERATION ESTIMATE

WAVE DRIVEN

LITTLE FLOYD LAKE 12/19/1984

ITEM	PRICE EA	NO. REQ	INST TIME	COST
COMPRESSOR	\$665.00	12	3	\$8100.00
MOUNTING	\$53.50	12	14	\$1202.00
3/4 PVC	\$23.25	54.3	43.2	\$2990.48
1 in PVC	\$37.25	35.4	27.4	\$2414.65
COUPLINGS 3/4	\$0.85	55	9.1	\$410.75
COUPLINGS 1	\$0.95	36	6	\$274.20
THD COUPLINGS	\$1.59	12	3	\$139.08
WEIGHTS	\$0.45	261	4.6	\$301.45
PROGRAMMING	\$70.00	3		\$210.00
MILEAGE	\$0.44	250		\$110.00
MILEAGE	\$0.35	1000		\$350.00
PER DIEM	\$114.00	11		\$1254.00
TRAVEL WAGE	\$25.00	9		\$225.00
TRAVEL WAGE	\$40.00	18		\$720.00

TOTAL \$18701.61

LAKE ST. CLAIR

Purpose:

Treat Lake St. Clair like an aeration pond to condense the sediments by shifting the microbial activity to an oxygen base system from the current anoxic environment. The aerobic microbes are capable of degrading more than 95% of their available substrate (organic hydrocarbons). The removal of the nitrogen and carbon compounds as N_2 and CO_2 gas will eventually deplete these nutrients to the point where the algae in the lake will become nutrient limited.

The anarobic bacteria are only 40% to 60% efficient at utilizing their substrate and because they lower the pH of the environment considerably the nitrogen end product, ammonia, is retained in solution. The carbon end products, CO_2 and methane CH_4 , are trapped both in solution and as gas bubbles in the sediments where they become the substrate for other microbes. Thus many of the sediment materials are constantly recycled over the years.

The phosphorus released by the aerobic bacteria have a number of available substrates to bind with for removal. Two of these are Fe^{+3} (ferric iron) and calcium silicate base clays. The anarobic bacteria shift the iron to the

ferrous (Fe^{+2}) state where it is an unacceptable binding site for phosphates. The lowered pH solubilizes the phosphates as free ions where they can diffuse to the upper waters and become available to the algae as a nutrient source. Thus the high total phosphorus concentrations at the outlet from Lake St. Clair.

The assessment on Lake St. Clair is to map the lake bottom and determine where the condensed material exists and the depth of the detritus. The laboratory work-up is to determine the amount of aeration required and whether there are sufficient quantities of micronutrients and binders for the system to function properly.

Method One:

The electric aeration of Lake St. Clair can be accomplished by using one 2 hp high pressure compressor and three 2.5 hp ring blowers. The total electric horsepower will be 9.5. The blowers should be run through the open water season and then rely on the high pressure compressor to keep the lake oxygenated through the winter months. This is possible because the biological activity is greatly reduced in the winter and because the dissolved oxygen saturation level is three times the midsummer saturation.

The compressor units will all be located on one pad so the distribution of flow to the lake will come from one origin. The usual method of setting up a system like this is to run separate air lines for each aeration head. It is possible to design the system by computer and to set the individual heads with a calibrator. This will allow us to aerate the lake with one head per acre of water, 145 heads. The next best estimate obtained from another company was higher than this one, used more electric power, and only eleven aeration heads.

Advantages:

The all electric system will operate continuously and the high pressure unit will be capable of running throughout the year. The computer design will assure equal distribution of air flow.

Disadvantages:

The unit will require electric power continuously throughout the year. Later, when the sediments have been condensed, it may be possible to install an oxygen electrode to operate the aerators only when the oxygen concentration drops below 4 mg per liter. This system requires a large amount of distribution piping which is expensive and cumbersome to install.

Method Two:

Partial electric aeration and the majority driven by wave actuated pumps. The wave actuated pumps can deliver more than twice as much air to the heads because of greater efficiency and low line losses. More heads can be installed for considerably less money. When the laboratory testing has been completed, we will know the number of heads required to accomplish the job.

Advantages:

The wave driven pumps utilize available energy and draw no electric power. The single 2 hp compressor will still be required for winter operation, but the electric costs for the year will be 1/3 of the costs for an all electric system. The installation of this system is faster and requires much less balancing of air flows. Removal and reinstallation of the systems will not demand the hiring of technical personnel for anything but direction.

Disadvantages:

The wave driven units will not operate when the lake is dead calm. This is generally at sunrise and sunset each day for about 1/2 hour. The systems probably need to be pulled in the fall to prevent ice damage. There is the possibility that the heads run in the winter may make removal unnecessary.

The installation of these units in Little Floyd Lake and Lake St. Clair are intended to remedy existing problems in these lakes. These proposed aeration systems will function only under existing conditions and do not preclude actions to remove the input of nutrients to these lake systems from their watersheds.

Because the wave driven aeration system is currently in the process of being patented by Instrumental Research, Inc. the information contained in this document is to be considered confidential and proprietary.

ASSESSMENT ESTIMATE

AERATION

LAKE ST. CLAIR

12/19/1984

ITEM	PRICE EA	NO. REQ	INST TIME	COST
LAKE SURVEY				
CENTER LN	\$65.00	3.15		\$204.75
SIDE RUNS	\$65.00	13.8		\$897.00
TESTING	\$65.00	10.2		\$663.00
MAPPING	\$25.00	11.2		\$280.00
MILEAGE	\$0.35	525		\$183.75
TRAVEL	\$65.00	8.2		\$533.00
PER DIEM	\$114.00	2		\$228.00

TOTAL				\$2989.50
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COLLECT SAMP	\$65.00	3		\$195.00
CONTAINERS	\$55.00	2		\$110.00
COMPRESSOR	\$396.41	1		\$396.41
SET UP	\$25.00	7.5		\$187.50
ELECTRICITY	\$173.88	1		\$173.88
REGULATOR	\$21.64	2		\$43.28
AER HEAD	\$7.50	2		\$15.00
TUBING & FTG	\$5.00	2		\$10.00
CHEMISTRY				
COD	\$24.75	18		\$445.50
PHOSPHORUS	\$11.55	18		\$207.90
NITRATE	\$8.92	18		\$160.56
NITRITE	\$8.75	18		\$157.50
AMMONIA	\$8.51	18		\$153.18
CHL-A	\$15.05	18		\$270.90

TOTAL				\$2526.61
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SUB TOTAL				\$5516.11
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ESTIMATE
ELECTRIC AERATION
LAKE ST. CLAIR 12/19/1984

ITEM	PRICE EA	NO. REQ	INST TIME	COST
PROGRAMING	\$70.00	88		\$6160.00
COMPRESSOR	\$972.12	1	3	\$1122.12
BLOWER	\$726.00	3	4.5	\$2403.00
HIGH P 3/4	\$23.25	49	97.2	\$5999.25
LOW P 4in	\$87.73	51	236	\$16274.23
LOW P 3in	\$53.67	64	256	\$16234.88
LOW P 2in	\$45.46	80	74	\$7336.80
LOW P lin	\$37.25	100	238.6	\$15655.00
3in REDUCER	\$9.40	6	1	\$106.40
2in REDUCER	\$8.63	6	1	\$101.78
lin REDUCER	\$5.42	53	8.8	\$727.26
TEE	\$1.89	145	24.1	\$1479.05
COUPLING 4in	\$3.65	255	42.5	\$3055.75
COUPLING 3in	\$3.15	320	53.3	\$3673.00
COUPLING 2in	\$1.86	400	66.7	\$4079.00
COUPLING lin	\$0.96	100	16.7	\$931.00
COUPLING 3/4	\$0.85	49	8.2	\$451.65
HEADS AER	\$7.10	145	24.2	\$2239.50
SHIPPING	\$0.02	24000		\$360.00
CALIBRATOR	\$525.00	2		\$1050.00
PER DIEM	\$57.00	61		\$3477.00
SUB TOTAL				\$92916.67
ASSESSMENT				\$5516.11
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TOTAL				\$98432.78

AERATION ESTIMATE
WAVE DRIVEN AERATION
LAKE ST. CLAIR 12/19/1984

ITEM	PRICE EA	NO. REQ	INST TIME	COST
PROGRAMING	\$70.00	14	0	\$980.00
COMPRESSOR	\$665.00	44	23.5	\$30435.00
COMP ELECT 2	\$972.12	1	3	\$1122.12
PAD	\$80.00	1	1	\$130.00
HOUSING	\$350.00	1	0.5	\$375.00
MOUNTING	\$28.00	44	38	\$3132.00
HI P 3/4in	\$23.25	49	97.2	\$5999.25
DIST 1/2in	\$10.00	172	47	\$4070.00
TEE	\$1.89	172	14.4	\$1045.08
HEADS AER	\$7.10	188	6.3	\$1649.80
SHIPPING	\$0.02	7758	0	\$116.37
WEIGHTS	\$0.45	376	6.6	\$499.20
PER DIEM	\$114.00	19	0	\$2166.00
SUB TOTAL				\$51719.82
ASSESSMENT				\$5516.11
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TOTAL				\$57235.93