JOB COMPLETION REPORT

As required by

FEDERAL AID IN FISHERIES RESTORATION ACT

TEXAS

Federal Aid Project No. F-7-R-12

FISHERIES INVESTIGATIONS AND SURVEYS OF THE WATERS OF REGION 1-A

Job No. C-1 Pollution Studies

Project Co-leaders: Lonnie J. Peters, Region 1-A1
George G. Henderson, Jr., Region 1-A2

J. Weldon Watson
Executive Director
Parks and Wildlife Department
Austin, Texas

Marion Toole
D-J Coordinator

Eugene A. Walker
Assistant Director, Wildlife

March 9, 1965

ABSTRACT

Region 1-A1 (Canyon)

Pollution from the Canyon sewage treatment plant killed fish in approximately 3 miles of Tierra Blanca Creek. Future pollution from this source could be prevented if the plant effluent was used for irrigation of nearby fields instead of being released into the creek.

A serious threat to the fish population of Buffalo Lake exists in the accumulation of organic materials in feed lots located in the Hereford area. Run-off from these feed lots carries a tremendous organic load and results in a "slugging" of oxygen-depleted water which destroys aquatic life downstream in Tierra Blanca Creek and the upper end of Buffalo Lake. Other continuing sources of pollution are the Hereford sewage treatment plant and the slaughterhouse. Seasonally, vegetable processing houses contribute to the organic load.

Region 1-A2 (Slaton)

Fish mortalities were investigated at four lakes this year. At Buffalo Springs Lake there was a fish die-off of almost 3 months duration. The mortalities progressed at varying rates and separate species died at different times of the year. The suspected cause is poor basic water quality and a thermally developed toxic layer of chemicals which existed in the lake most of the summer.

Reese Air Force Base Lake had a continuing or recurring die-off which was attributed to poor water quality in combination with insecticide buildup in fish and wide fluctuations of dissolved oxygen and carbon dioxide gases.

The fish died at McKenzie State Park Lake because of unusually high water temperatures associated with extremely high dissolved oxygen and low carbon dioxide levels.

Fish mortalities at South Lake are unexplained. Circumstantial evidence indicated that an angler had attempted to stock the lake with large fish which did not survive.

The site of a proposed flood control playa lake drainage project at Plainview was examined. Polluting wastes were being discharged into one of the playa lakes. It was recommended that business establishments be required to treat these wastes prior to their admission to the watershed.

JOB COMPLETION REPORT

State of Texas

Project No. F-7-R-12 Name: Fisheries Investigations and Surveys of the Waters of Region I-A

Job No. C-1 Title: Pollution Studies (Fisheries Region 1-A-1)

Period Covered January 1, 1964 - December 31, 1964

Objectives:

To determine the source and nature of natural or man-made pollutants which affect fish populations.

Procedure:

Field observations and limited water analyses were by project personnel. Laboratory analysis for pH, conductivity, dissolved solids, chlorides, sulfates, chlorine demand, dissolved oxygen, B.O.D., ammonia nitrogen, nitrite nitrogen, nitrate nitrogen, alkalinity, and suspended solids were made by the State Health Department laboratory. Additional laboratory analyses for dissolved oxygen, A.B.S., and B.O.D. were made by the Potter-Randall County Health Unit.

All fish kills discovered by, or reported to, project personnel were investigated to determine if they were caused by pollution. If pollution was apparent, attempts were made to locate the source(s) and to determine the nature.

Findings:

During this segment, pollution-caused fish kills were detected along two areas of Tierra Blanca Creek in Randall and Deaf Smith counties. An area of the creek, beginning at the Canyon city sewage treatment plant and extending downstream for about 3 miles, did not receive normal run-off during an extended period of drought and became stagnant in late February 1964. Fish began dying at this time (primarily gizzard shad, Dorosoma cepedianum), but observations and D.O. checks did not indicate pollution. The creek was very low, and extremely cold water suggested the possibility of normal winter mortality. Water samples collected along this portion of Tierra Blanca Creek on March 3, 1964, were analyzed for D.O., A.B.S., and B.O.D. at the Potter-Randall County Health Unit laboratory. Results, shown in Table 1 and Figure 1, revealed a high B.O.D. in all samples. Fish continued to die throughout March, and on April 13 a second investigation was made. Analyses of water samples taken during this check also revealed excessive B.O.D. and critically low D.O.

By mid-June, still no run-off had entered the creek, and a major fish kill occurred due to oxygen depletion. Recommendations were made to the Canyon city manager to provide for disposal of the sewage plant's effluent other than release into Tierra Blanca Creek.

Table 1. Analysis Results of Water Samples from Tierra Blanca Creek, March 3, 1964.

Point of Collection	D.O.	A.B.S.	B.O.D.
1. 1 mile above sewage plant (Canyon)	7.3	Trace	28
2. Final effluent at plant	2.9	6	55
3. Oxidation pond	3.7	8	53
4. Creek at oxidation pond effluent	4.1	6	48
5. Creek at Highway 217	3.8	6	47
6. Palo Duro Club Lake #1	4.6	5	25
7. Palo Duro Club Lake #2	4.8	5	12
8. Palo Duro Club spillway	5.2	3	17

A second fish-kill, of greater magnitude, occurred in Tierra Blanca Creek downstream from Hereford and extended into the upper end of Buffalo Lake. Heavy rains in the Hereford area washed organic material from feed lots into the creek where it was carried downstream, reaching the lake about 25 hours after the initial inflow of run-off into the lake. Fish ascending the creek were met by the polluted, oxygen-depleted water and were killed.

Project personnel were at Buffalo Lake on both Saturday, June 13, and Sunday, June 14, gathering data concerning fish spawning activities. A moderate flow of fresh, unpolluted water was entering the lake at this time. On Monday, June 15, at 8:30 a.m. project personnel approaching the extreme upper end of the lake observed sick fish and noted a strong "feed-lot" odor. Continuing upstream into Tierra Blanca Creek, increasing numbers of sick and dying fish were noted. It appeared that the polluted water had first reached the lake only a short time earlier, probably around 6 a.m. By noon on Monday, June 15, thousands of dead fish (mostly small carp and bullheads) were washed ashore along the creek banks and in the upper area of the lake which had received the pollution. Damage to game species appeared minimal, probably because the inflow was considerably colder than the lake water, and channel catfish and white bass were not sexually mature at this time.

Water samples were taken the following day, on June 16, the analyses results of which are given in Table 2.

On July 14, a cooperative investigation with the State Health Department was made on Tierra Blanca Creek from Buffalo Lake westward to a point about 3 miles west (upstream) from Hereford. The objective of this investigation was to locate sources of organic pollution. The locations of water sampling stations are shown in Figure 2 and the results of water analyses are given in Table 3.

The major source of organic pollution is from cattle feed lots located on the creek or on tributaries of the creek. Other sources contributing to the organic loading of the creek were three vegetable-processing houses and one slaughterhouse.

Summary:

Pollution from the Canyon sewage treatment plant killed fish in approximately 3 miles of Tierra Blanca Creek. Future pollution from this source could be

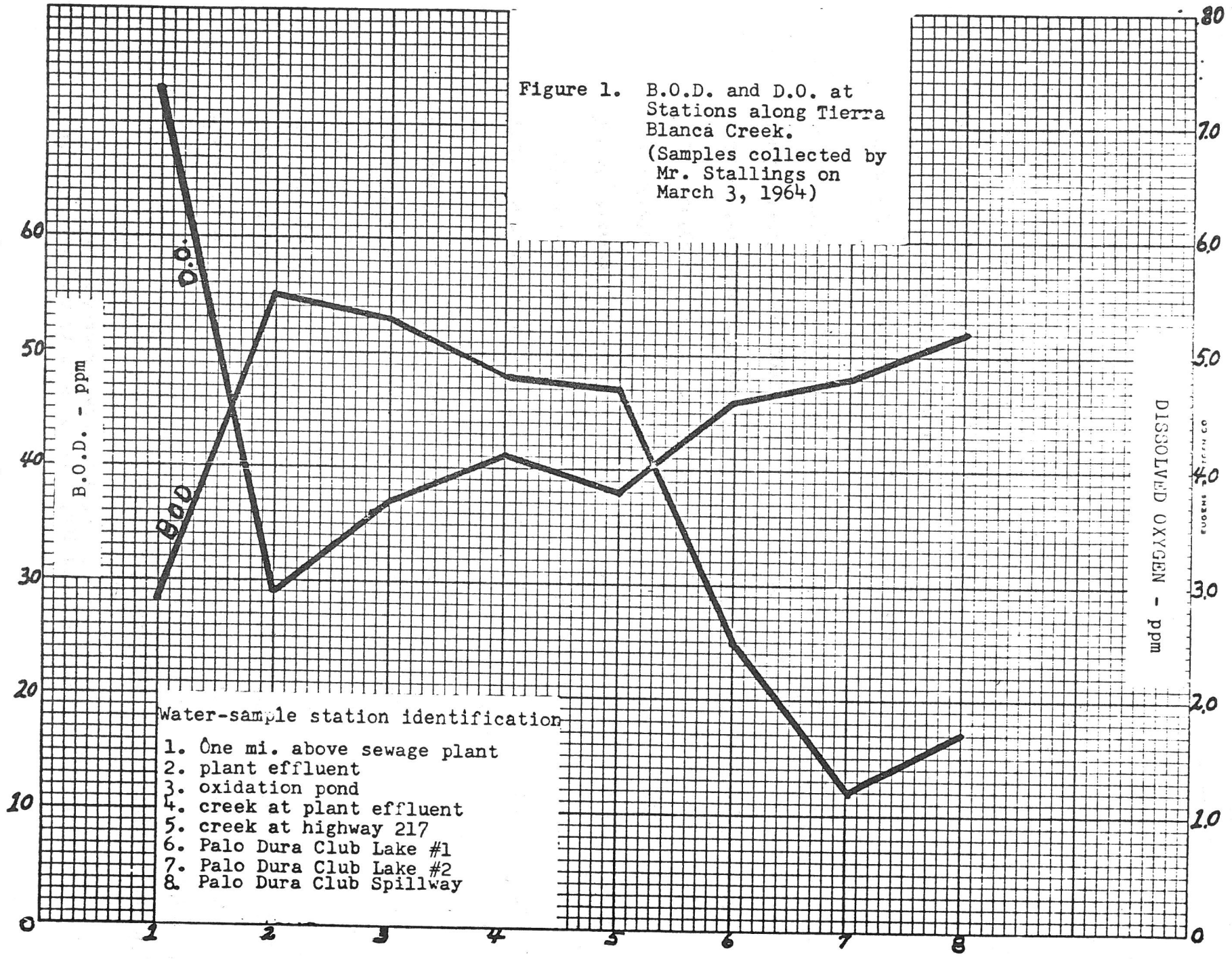

Figure 1. B.O.D. and D.O. at Stations along Tierra Blanca Creek. (Samples collected by Mr. Stallings on March 3, 1964)

Table 2. Analysis Results of Water Samples Taken from Buffalo Lake and Tierra Blanca Creek, June 16, 1964.

	Station 1	Station 2	Station 3	Station 4
pH	7.6	7.8	8.7	8.7
Conductivity, Micromhos	420	292	1065	1060
Total Dissolved Solids ppm	252	175	639	636
Chloride ppm	21	8	55	56
Sulfates ppm	25	15	76	71
Chlorine Demand ppm	3.5	9.0	4.5	4.5
Dissolved Oxygen (field) ppm	4.0	5.6	12.8	5.5
B.O.D. ppm	17	12	6	5
Ammonia Nitrogen ppm	4.2	2.2	0.2-	0.2-
Nitrite Nitrogen ppm	0.1-	0.1-	0.1-	0.1-
Nitrate Nitrogen ppm	0.4-	0.4-	0.4-	0.4-
P. Alkalinity ppm	0	0	12	16
Total Alkalinity ppm	144	120	354	352
Total Suspended Solids ppm	447	635	86	33
Total Volatile Solids ppm	68	77	19	10
Total Fixed Solids ppm	409	558	67	23

Station 1 - Upper End Buffalo Lake in Polluted Area

Station 2 - Tierra Blanca Creek above Buffalo Lake

Station 3 - North Side Buffalo Lake

Station 4 - Buffalo Lake Dam

Figure 2. Water Sample Stations on Tierra Blanca Creek - July 14, 1964.

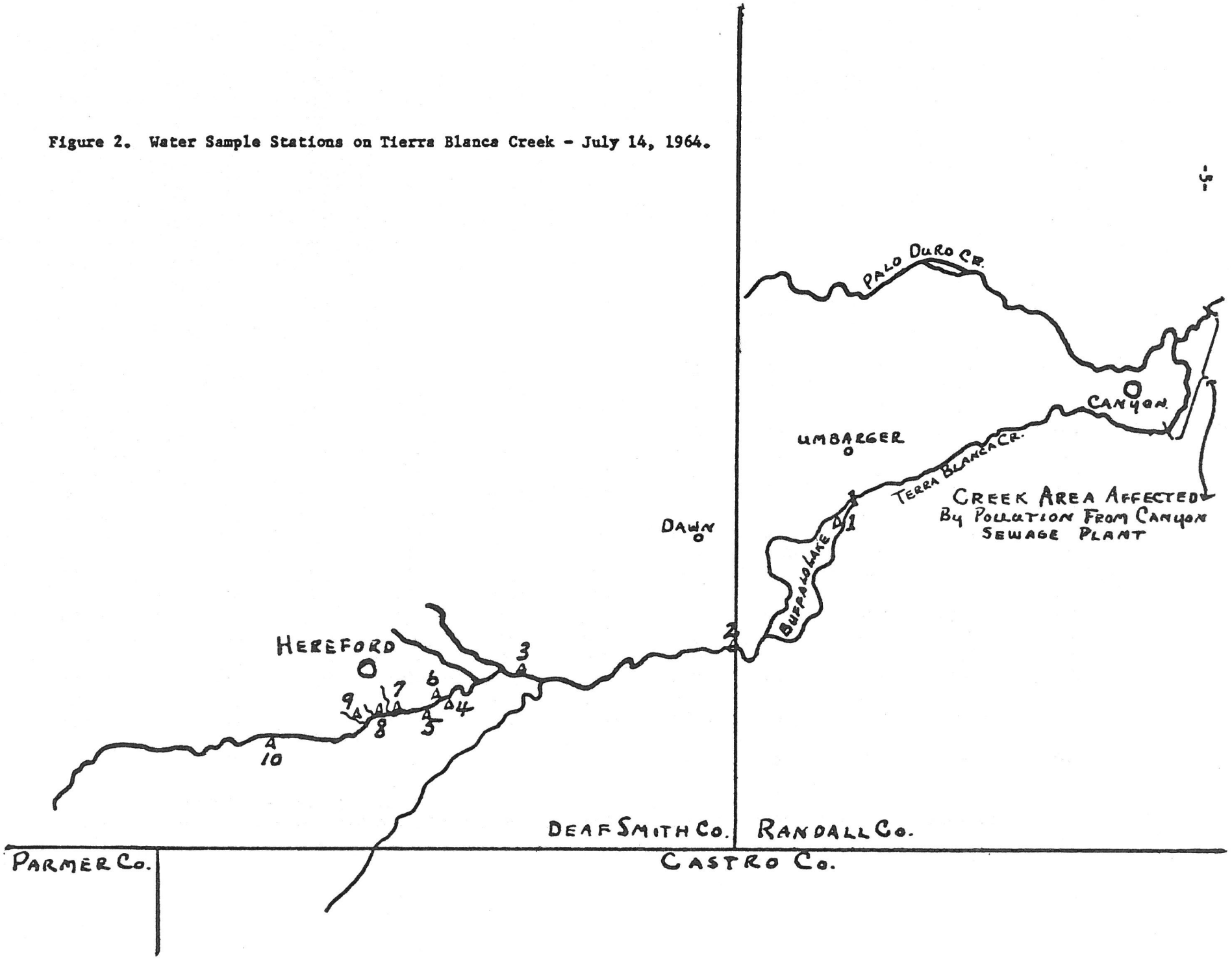

Table 3. Results of Water Analysis From Samples Taken From Tierra Blanca Creek and Industrial Effluents - July 14, 1964.

	1	2	3	4	5	6	7	8	9	10
Flow	Lake	0	0.01	2.50	2.07	189*	80*	70*	45*	--
pH	8.3	8.4	7.9	7.9	7.8	8.0	7.5	7.4	7.2	7.3
T.D.S.	675	468	893	817	756	1003	639	615	557	621
Cl	62	28	80	60	42	90	29	19	38	40
SO4	80	55	203	170	167	202	158	174	92	10
Cl. Demand	4.5	13.0	13.5	4.5	9.0	5.0	4.0	6.0	16.5	16.5
D.O.	0.9	0.0	0.9	0.3	0.0	0.6	0.0	0.0	0.0	0.0
Fld. D.O.	7.2	4.0	3.6	7.0	7.0	--	--	--	--	--
B.O.D.	4	12	13	17	12	30	18	17	66	203
NH3-N	0.2-	0.2-	0.8	6.0	7.0	8.0	0.2-	0.2-	0.2-	33.0
NO2-N	0.1-	0.1-	0.2-	0.1-	0.1-	0.1-	0.1-	0.1-	0.1-	0.1-
NO3-N	0.4-	0.4-	0.4-	0.4-	0.4-	0.4-	0.9	0.4-	0.4-	0.4-
P. Alk.	0	9	0	0	0	0	0	0	0	0
Tot. Alk.	364	310	386	358	348	416	272	264	294	396
T.S.S.	12	272	56	52	45	61	1208	1643	1852	285
V.S.S.	7	51	10	32	22	59	100	138	187	174
Fix S.S.	5	221	46	20	23	2	1108	1505	1665	111
Conductivity	1125	780	1488	1362	1260	1672	1065	1025	928	1035

* GPM (Other Flow in cfs)

1. Buffalo Lake Near Boat Ramp
2. Creek at Weir Flow Measuring Station
3. Sulphur-Bar Ranch Road Crossing at Creek
4. One Hundred Yards Below Hereford Sewage Plant
5. Twenty Five Yards Above Hereford Sewage Plant Discharge
6. Final Effluent From Oxidation Ponds - Sewage Plant
7. Effluent Ditch from Vegetable Processing Plant (Dick Barrett's Produce) Processing Potatoes
8. Effluent Ditch from Vegetable Processing Plant (Jack Renfroe) Processing Potatoes
9. Effluent Ditch from Vegetable Processing Plant (Reinauer) Processing Potatoes
10. Creek at Discharge from Meat Packing House.

prevented if the plant effluent was used for irrigation of nearby fields instead of being released into the creek. Some of this effluent is now disposed of in this manner, but sufficient amounts enter the creek to cause oxygen depletion during periods of low water.

A serious threat to the fish population of Buffalo Lake exists in the accumulation of organic materials in feed lots located in the Hereford area. Run-off from these feed lots carries a tremendous organic load and results in a "slugging" of oxygen-depleted water which destroys aquatic life downstream in Tierra Blanca Creek and the upper end of Buffalo Lake. Other continuing sources of pollution are the Hereford sewage treatment plant and the slaughterhouse. Seasonally, vegetable processing houses contribute to the organic load.

Recommendations:

This job should be continued. Special emphasis should be given to study of feed lot pollution from the Hereford area, and to determining whether insecticides are significant in any future fish kills that may occur from the same source.

Prepared by Lonnie Peters
Project co-leader
Date March 9, 1965

Approved by Marion Toole
Coordinator
Leo D. Lewis
Regional Supervisor

JOB COMPLETION REPORT

State of Texas

Project No. F-7-R-12 Name: Fisheries Investigations and Surveys of the Waters of Region 1-A

Job No. C-1 Title: Pollution Studies (Fisheries Region 1-A2)

Period Covered January 1, 1964 - December 31, 1964

Objectives:

To determine the source and nature of natural or man-made pollutants which affect fish populations.

Procedure:

Fish kills or die-offs were investigated by field observations, counts of fish killed, examinations of the fish, and chemical analysis of the affected waters. Water analysis in the field included dissolved oxygen, carbon dioxide, and pH determinations. Occasionally, water samples were sent to the State Health Department laboratory in Austin for more detailed analysis. Searches above and below affected areas were conducted in order to determine origin, type and extent of pollution.

Findings:

Investigations were carried out at four lakes this year. One lake, Buffalo Springs Lake in Lubbock County, is currently the subject of a study to determine its limnological and game fish problems. Consequently, much information is available on this lake, and information pertinent to pollutions problems is included in this report.

The other three lakes were South Lake at Post, Reese Air Force Base Lake, and McKenzie State Park Lake.

Buffalo Springs Lake

Buffalo Springs Lake is an end depository for almost all settleable solids and many chemicals which originate in storm drains, dump grounds, feed lots, and several industrial plants in Lubbock. Most probably, the majority of fish mortalities at Buffalo Springs Lake are directly and/or indirectly the result of the basic water quality which is produced on the watershed.

Leuter's cattle feed lot constituted a source of pollutants that caused fish kills in 1963. The feed lot effluent now drains into a retention pool. From the pool it is pumped into shallow, broad oxidation ponds and disposed of safely.

One of Lubbock's water reclamation plants is situated on the watershed. Its effluent does not flow directly into Yellowhouse Canyon but is pumped into large holding ponds and utilized for irrigation. The irrigated areas are drained into catchment tanks, but heavy rains and ground percolation provide eventual transport of some of the materials from these waters into Buffalo Springs Lake.

These conditions produce a very rich water supply. The lake develops a thermal and chemical stratification, and during the summer of 1964 a layer of toxic substances, including high levels of ammonia nitrogen (up to 6.5 ppm) and hydrogen sulfide (over 5 ppm), existed from an average depth of 18 feet to the lake bottom. This stratification existed from mid-April until September when cool weather caused the thermal layer to disintegrate.

The date of the first reported fish mortalities at Buffalo Springs Lake was March 8, 1964. Investigations revealed a few small, winter-weakened fish in the shallow upper end of the lake. Twenty-eight black bullheads (Ictalurus melas) and twelve sunfish (Lepomis sp.) were counted along 300 yards of shoreline which accounted for about one-fourth of the shoreline of the affected area. Health Department water analysis in the field showed dissolved oxygen to be 9.5 ppm at the surface and 8.3 ppm at 10 feet. Water samples analyzed at the Austin laboratory disclosed a pH of 8.6, nitrite nitrogen 0.2 ppm, nitrate nitrogen 0.4 ppm, and ammonia nitrogen 1.2 ppm. All of these readings are satisfactory under most conditions, but this area of the lake had just thawed from a brief freeze-over during cloudy weather. The die-off was attributed to oxygen depletion during the inclement weather thereby affecting the winter-weakened fish.

On April 9, 1964, another die-off of largemouth bass (Micropterus salmoides) and sunfish of several species was reported and investigated. This die-off was almost restricted to Centrarchids, although a few dead catfish and minnows were observed. Mortalities progressed at varying rates until June 3, when the number of affected catfish increased markedly. Centrarchid mortalities tapered off until June 30, after which date a selective die-off of catfish, including black bullheads and channel catfish (Ictalurus punctatus), began and continued sporadically until the latter part of July.

This continued loss of fish necessitated a program of water analyses, dead fish counts, autopsies, and bio-assays with live caged fish in the waters of the lake. Specimens were sent to the Federal Fish Pesticides Research Laboratories in Denver, and although test results indicated that pesticides were not the major cause of mortalities, they could conceivably have caused a few deaths. DDT, and its metabolites, was the only pesticide isolated. The one largemouth bass tested contained DDD 3.56 ppm, DDT 0.92 ppm, and DDE 1.61 ppm, for a total of 6.09 ppm DDT and its metabolites. Twenty-four sunfish contained an average total DDT and metabolites of 1.49 ppm.

The average surface water quality at the upper end of Buffalo Springs Lake is given in Table 1. This information was compiled from the Texas State Health Department records for 1963.

Table 1. Average surface water quality entering Buffalo Springs Lake in 1963. Compiled from 18 samples taken between December 3, 1962, and May 25, 1964. Units are expressed as parts per million.

pH	Sulfate	B.O.D.	Ammonia Nitrogen	Nitrite Nitrogen	Nitrate Nitrogen	Total Alkalinity
8.43	417.64	6.44	1.80	0.22	0.98	322.88

The California Water Quality Criteria publication No. 3-A for 1963 states that the pH of ninety-five per cent of the waters in the United States which support a good fish fauna is less than 8.3, and sulfates in the same per cent of waters are less than 90 ppm. B. O. D. (biochemical oxygen demand) affects fish only indirectly by causing a rapid decrease in the available dissolved oxygen when photosynthesis is obstructed by darkness or cloudy weather. The average concentration of ammonia nitrogen shown in Table 1 is detrimental to both plant and fish life. High alkalinities are not detrimental to fish unless the strong alkalis are sufficiently abundant to raise the pH over 9.0. The nitrite and nitrate nitrogen content is acceptable.

The pH of 8.43 and ammonia nitrogen of 1.80 in Table 1 are described as detrimental to fish life on the basis of the following: the toxicity of ammonia to fish is directly related to the amount of non-ionized ammonium hydroxide present in solution. The amount of ammonium hydroxide in solution is directly related to pH so that as the pH rises, the concentration of ammonium hydroxide rises. The test for ammonia nitrogen indicates total ammonia present in ionized or unionized form. Quantitative analysis of the amounts of ammonia present in its different forms has not been made. However, the pH is relatively high, the total alkalinity is high and carbon dioxide is usually not present in the lake. Low carbon dioxide levels increase the toxicity of ammonia, and a moderately low dissolved oxygen level (which would otherwise be acceptable) becomes lethal with increased ammonia content because ammonia inhibits the ability of hemoglobin to combine with oxygen.

Water quality changes drastically after rains, and Table 2 contains data that were obtained after a rain in 1963. The sample was taken while Leuter's feed lot effluent still influenced water quality.

Table 2. Conditions during high water on June 24, 1963, when Leuter's feed lot effluent affected water quality. Units are expressed in parts per million.

	pH	B.O.D.	Ammonia Nitrogen	Nitrite Nitrogen	Nitrate Nitrogen	Total Alkalinity
Surface	7.5	17.5	14.0	0.45	0.1	432

Conditions in the lake during high water in 1964 after remedial measures had eliminated Leuter's as a polluting source are shown in Table 3. Fish were distressed and dying when the samples were extracted to be analyzed to produce the data in Table 3.

Table 3. Conditions during high water and a fish die-off in the upper lake on May 25, 1964. Units are expressed in parts per million.

	pH	Sulfate	B.O.D.	Ammonia Nitrogen	Nitrite Nitrogen	Nitrate Nitrogen	Total Alkalinity
Surface	8.6	352	9.5	3.0	0.1	0.4	198
Bottom (6')	9.0	363	10.0	3.0	0.1	0.4	210

The large difference a few feet in depth can make in water quality readings is also shown in Table 3. A toxic combination of pH, total alkalinity, and ammonia nitrogen is demonstrated in Table 3 at the six-foot depth.

Buffalo Springs Lake has a dense marginal growth of sago pondweed and a profuse algae growth. Photosynthetic activities by these plants produces high dissolved oxygen and low dissolved carbon dioxide levels during the daytime in the shallow upper lake. At night and during cloudy weather, the metabolic activities of the plants, associated with the average B.O.D. of 6.44 ppm, produces low levels of dissolved oxygen in the lake. An all night check of dissolved oxygen levels revealed a 4.7 ppm fluctuation between extreme readings of 10.7 ppm at 8:33 p.m. and 6.0 ppm at 6:30 a.m. A day of sunshine followed by a clear windy night produced optimum readings. When a calm night is followed by a calm cloudy day the variation is even greater, and lower dissolved oxygen levels are reached. After rains, when higher than average B.O.D. levels are present and calm nights decrease aeration of the water, dissolved oxygen levels become dangerously low, even without the complicating factors of a high pH and ammonia nitrogen content.

The large dissolved gas fluctuations produce metabolic stresses in fish which decrease their resistance to disease. The stresses are coupled with DDT buildup in the fish and detrimental average water quality in the lake. These factors all combine to reduce fish resistance to a level where any unusual lowering of dissolved oxygen or other gaseous shifts causes an immediate die-off of weakened individuals. The worsened environmental conditions cause further weakening of fish that were combating latent infections or parasitic infestations at the time that the toxic conditions arose. These weakened fish ultimately succumb to the effects of whatever disease they may have had. This is proposed because many fish were examined which exhibited symptoms of various infectious diseases, but insufficient numbers of repeated symptoms occurred to cause die-offs to be classified as an epizooty.

In the deeper portion of the upper lake and throughout the lower lake the toxic layer of water mentioned earlier exists. This toxic layer includes hydrogen sulfide in addition to ammonia nitrogen. Fish introduced into this layer, retained for short periods of time and removed, showed definite signs of distress.

Table 4. Results of live caged fish bio-assays of the toxic layer of water in Buffalo Springs Lake on August 6, 1964. All fish were submerged to 22-foot depth. Each basket contained 4 bullheads and 3 sunfish.

Basket No.	Time	Condition when removed from layer	Condition next day
1	5 min.	3 sunfish alive, distressed 4 bullheads alive, distressed and swimming upward	3 sunfish alive, color faded 1 bullhead alive, red flecked 3 bullheads dead
2	10 min.	3 sunfish looked dead, 1 recovered 4 bullheads alive, distressed	3 sunfish dead 2 bullheads dead 2 bullheads alive, red flecked
3	15 min.	3 sunfish looked dead, 1 recovered 4 bullheads alive, distressed	2 sunfish, dead 1 alive, fine condition 4 bullheads alive
4	Control on surface - all fish in fine condition.		

Gill netting results indicated that fish enter this toxic layer voluntarily to feed or for other reasons. These fish are repeatedly found dead in the nets, apparently killed by the conditions existing in the toxic layer.

It is strongly suggested that the quality of water entering Buffalo Springs Lake must be altered before a good game fish population will exist in the lake. It is recommended that special attention be given to determining the continuing water quality of Buffalo Springs Lake at several depths accompanied by qualitative bio-assays of the effect of these waters on game fishes. These investigations should be accompanied by biological examinations of the fish to be certain that mortalities are not caused directly by biological disease.

Reese Air Force Base Lake

Reese Air Force Base Lake is an end recipient of treated sewage from a Hays contact aeration sewage treatment plant and 2 small 1/4-acre shock load oxidation ponds. The first shock load pond is aerated by compressed air from 1,500 feet of perforated plastic hose weighted in a grid on the bottom of the pond. The lake itself is broad and shallow and densely populated with algae. Reese Air Base personnel and Parks and Wildlife Department personnel have been cooperating in an attempt to establish a game fish population in the lake. In the spring of 1963, fingerling largemouth bass and channel catfish were stocked in the lake and the fish exhibited excellent growth and survival throughout the summer and fall. On January 4, 1964, however, dead fish were seen following a freeze-over of the lake. After the first freeze, 500 feet of weighted, perforated plastic hose was installed in an attempt to keep an area of the lake ice-free by aeration. The lake froze a second time, however, and another die-off occurred on January 12. Two largemouth bass were preserved by freezing and later sent to Denver and analyzed for insecticide content.

On January 24, 1964, following a third die-off, 3 drags with a 100-foot 1/2-inch mesh seine produced 6 channel catfish, 4 of which were dead. Ninety-six channel catfish and 3 largemouth bass were counted dead along about one-eighth of the lake shoreline.

A survey on April 18, 1964, revealed that the fish remaining in the lake were restricted to goldfish and black bullheads. Four sick goldfish were preserved by freezing and sent, along with the two previously preserved largemouth bass, to the Federal Laboratories in Denver to be analyzed for insecticide content. The goldfish contained DDD 8.90 ppm, DDT 0.66 ppm, DDE 0.97 ppm, a total of 10.53 ppm DDT and derivities. The largemouth bass contained DDD 3.56 ppm, DDT 0.78 ppm, and DDE 1.22 ppm for a total of 5.56 ppm. These amounts of DDT could possibly have caused some mortalities, but there is no proof that they did.

On June 12, 1964, the Public Health Department was contacted to determine possible sources of the DDT found in the fish. The Health Department had been treating rain puddles and bar-ditches adjacent to Reese Air Force Base for mosquito control. Rain run-off from these puddles could carry residual DDT into Reese Lake. Other sources were the sewage effluent from the treatment plant and run-off from residues left after fogging for insects on the air base.

Reese Lake water is similar to Buffalo Springs Lake water with large amounts of ammonia nitrogen and a relatively high pH as illustrated in Table 5.

Table 5. Water quality in Reese Air Force Base Lake as shown by two samples taken on June 17, 1964. No. 1 was at the east pump pit surface and No. 2 at the same location on bottom at 7 feet. Units are expressed in parts per million.

No.	pH	Sulfates	B.O.D.	Ammonia Nitrogen	Nitrite Nitrogen	Nitrate Nitrogen	Total Alkalinity
1	9.1	168	32	3	0.1	0.4	644
2	9.1	164	30	2.8	0.1	0.4	647

This water quality was accompanied by large fluctuations in dissolved oxygen from as high as 20 ppm to unmeasured lows at night and during cloudy weather. Malfunctions of the Hays plant load the two shock ponds with semi-raw sewage and worsen the water quality of the lake. Accumulating DDT in fish flesh produces additional unfavorable conditions. Lower than usual dissolved oxygen levels, sudden excessive temperature fluctuations, concentration of toxic substances in the lake by evaporation or lowering of the water level then become overbalancing factors which produce fish mortality.

Recommendations were made to drain the lake and allow the bottom to dry out and be exposed to sunlight to lessen the toxic effect of undesirable substances. However, fall rains occurred which filled the lake and prevented this action.

Two areas of the lake were deepened during a low-water period and aeration equipment was installed in one deepened area. Doubling the aeration in the first oxidation pond is in progress and continual proper operation of the Hays plant will add to the desirable water quality of the lake. It is again recommended that the lake be drained before restocking. A recent impending encephalitis epidemic caused Reese officials to have the base sprayed with DDT. Two tests, using live caged fish, sunfish and minnows respectively, were run on the lake water. These tests resulted in over 50 per cent mortality in 12 hours. All the surviving fish were badly distressed.

On June 15, 1964, a die-off of 19 largemouth bass, 10 goldfish and numerous minnows and small black bullheads occurred in a small 1/4-acre pond on Reese Air Force Base. A high algae bloom, recent fertilization of the area surrounding the pond and addition of water from the main lake to the pond caused water quality as shown in Table 6.

Table 6. Water quality in 1/4-acre pond at Reese Air Force Base - June 15, 1964. Units are expressed in parts per million.

pH	Sulfates	B.O.D.	Ammonia Nitrogen	Nitrite Nitrogen	Nitrate Nitrogen	Total Alkalinity
9.4	200	48	5.4	0.1	0.4	792

The fish died during cloudy weather. Their death is attributed to the conditions noted above compounded by low dissolved oxygen conditions.

South Lake

On July 1, 1964, Game Warden Bud Howell of Garza County called to request investigation of a reported fish die-off in South Lake at Post. South Lake had been treated for fish eradication on April 16, 1964. Investigation revealed 7 dead largemouth bass averaging an estimated 2 pounds and 1 crappie of about 1 pound. Examination of the dead fish revealed empty digestive tracts, hook marks in the mouths and no indications of illness or other reasons for death. Other fish were observed alive and in good condition in the lake. It is suspected that an angler had been fortunate enough to catch the game fish mentioned and decided to stock South Lake, but did not succeed in transporting his catch without causing their demise. A subsequent survey netted another largemouth bass with definite hook damage in the mandible, further strengthening the suspected stocking theory.

McKenzie State Park Lake

On August 24, 1964, notification was received by telephone that fish were dying at McKenzie State Park Lake in Lubbock. Investigation revealed about 200 dead sunfish and black bullheads. Limited water analysis revealed a temperature of 90° F. in the shallow area of the lake, intense algae growth, and 17.5 ppm dissolved oxygen. No carbon dioxide was present. Deaths were attributed to the extreme temperatures and dissolved gas levels. No further mortalities have occurred.

Plainview

On September 15, 1964, a trip was made to Plainview to examine several playa lakes in connection with a planned flood control drainage program. One of several playa lakes was receiving polluting effluent of significance to fisheries.

Playa lake II-2, as designated by the U. S. Army Corps of Engineer's map of the Brazos River Drainage, Running Water Draw Watershed, File - Braz. 503-248, is partially occupied by and receives drainage from the Hill and Roderick cattle feed lot. Visual observations indicated a sizable amount of wastes present. There is also a small packing house (West Texas Meat Company) located on the periphery of this lake. It empties its effluent containing blood wastes into the same playa lake as the feed lot. Also worthy of consideration in this same vicinity of Plainview is the effluent from a vegetable packing plant and the outdoor toilet facilities of human habitations.

Plainview is approximately 65 river-miles above the newly constructed White River Reservoir which now contains a thriving population of rapidly growing largemouth bass and channel catfish. This reservoir is now the end receptacle for any water flowing down the Running Water Draw into White River. With the installation of the proposed drainage system at Plainview, a heavy rainfall will flush wastes downriver and conceivably into the White River. Possibly, dilution and natural treatment accomplished by distance would render organic wastes sufficiently non-toxic at White River Reservoir. However, the eventual residual effect of discharging this type waste into the drainage is detrimental and a probable cause of future fisheries problems. It is detrimental to allow such wastes to be discharged into the drainage as a precedent of future action.

Using recent fish kills at Buffalo Lake near Umbarger as an example, we should object to the drainage of untreated wastes from all feed lots into watercourses above public lakes. Buffalo Lake is approximately 20 miles down a practically dry draw from the city of Hereford. Near Hereford is a feed lot operation similar to that at Plainview. It discharges similar wastes, which are still toxic enough to kill fish at Buffalo Lake following rainfall. This has also occurred at Buffalo Springs Lake near Lubbock, Rita Blanca Lake near Dalhart, and other waters in Region I. Therefore, it is recommended that the business establishments in Plainview discharging organic wastes such as those produced by feed lots, vegetable packing plants, and meat packing plants be required to retain their effluents in oxidation ponds similar to the one being used by Leuter's feed lots near Lubbock.

A cotton delinting plant with an acid effluent is also located at Plainview. It is located far enough upstream that its acid effluent would be rendered harmless by dilution with run-off water and neutralization by the alkaline soils.

The remaining playa lakes encompassed by the planned drainage program have no present fisheries significance.

Recommendations:

Special attention should be given to determining the continuing water quality of Buffalo Springs Lake at several depths. This work should be accompanied by qualitative bio-assays of the effect of these waters on game fishes.

Reese Air Force Base Lake should be drained prior to restocking and the Hays plant should be operated efficiently so that no raw sewage enters the small oxidation ponds. Efficient operation of the aeration system in the first shock load oxidizing pond must be maintained. The lake must have an ice-free area at all times during the winter.

Those business establishments discharging effluent containing a high amount of organic wastes or other material judged to be detrimental should be required to retain those effluents in oxidation ponds when they are above public bodies of water.

Prepared by George G. Henderson, Jr.
Project co-leader
Date March 9, 1965

Approved by Marion Toole
Coordinator
Leo D. Lewis
Regional Supervisor