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STATE OF WASHINGTON

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M E M O R A N D U M

October 17, 1977

To: Howard Steeley, Gerry Calkins, Rich Greiling

From: Dale Tucker

Re: Modification of Paradise Point State Park Effluent Pipe

Previous investigation of the Paradise Point State Park sewage treatment system was undertaken on June 15, 1977.[1] On this date there was no effluent from the park's sewage treatment lagoon. Therefore, a flow of approximately twenty thousand gallons per day was induced, most of which ran directly into the East Fork Lewis River in about thirty minutes. As this seemed an unacceptable situation to regional personnel, a proposal was entertained to extend and bury the lagoon outfall, causing it to drain into an adjacent marsh. Water samples, for later analysis, were then taken (when neither waste nor induced effluent were flowing) as an aid to both evaluating the feasibility of the recommended changes, and determining the existing water quality of the system for future comparison in the event that any alterations of the outfall were made. The survey findings suggested that improved sewage treatment might result from the intended modifications with little risk to the marsh.

On September 18, 1977, approximately one week after changes on the effluent pipe were completed, a comparative investigation was

[1] See prior memo dated July 7, 1977.

conducted by Fred Parker and I in an attempt to determine any effects of the alterations on the marsh and/or river. Sampling sites and descriptions are given in Figure 1 and Table 1. Samples were taken at around 0700, 1000 and 1800, corresponding closely to lower low, lower high and higher low tidal influences. According to head park ranger, John Miller, by the morning of the 18th the valve between the lagoon and chlorine contact chamber had been closed for one or two days. Consequently, the first two sets of samples were gathered when there was no discharge in the effluent pipe. At about 1030, that valve was opened, permitting wastewater discharge. A flow of approximately fifteen gallons per minute was introduced into the chlorine contact chamber through a garden hose to supplement the limited effluent. This resulted in a combined flow (roughly 50% lagoon discharge and 50% induced discharge) of approximately 0.43 MGD. Water samples were then taken after about 7.5 hours of continuous flow. Enclosed is a summary of both field measurements and analysis by the Southwest Regional Department of Ecology Laboratory of the samples collected.

An overall comparison of mean analysis and measurements from this survey with those on June 15 reveals, for the East Fork Lewis River, 1) lower nitrate nitrogen values, 2) somewhat higher coliform bacteria counts, and 3) higher ratios of total coliform densities to fecal coliform densities (2.7:1 on June 15 and 4.2:1 on September 18). Marsh drainage also exhibits 1) a higher total coliform to fecal coliform ratio (3.8:1 on June 15 and 6.2:1 on September 18) as well as 2) a higher dissolved oxygen level, 3) increased nitrate nitrogen and, 4) a lower temperature. Rising nitrate nitrogen and dissolved oxygen levels, overall bacteria counts and total:fecal coliform bacteria ratios as well as lower temperatures would seem to be expected seasonal changes attributable to lower ambient air temperatures and increased rainfall runoff. The low nitrate-nitrogen values in the river are unexplained by this observer. However, examination of nitrate nitrogen levels monitored in the past[2] reveals this phenomenon to be not unusual for the East Fork Lewis River, at least over the past two years.

The three sample sets gathered on September 18 exhibit no significant variation of parameters in the Lewis River save temperature which would naturally vary with ambient air temperature. Marsh temperatures also seem to follow this natural fluctuation. However, several other marsh drainage constituents demonstrate some interesting fluctuations which appear to reflect the effects of possibly three processes, i.e. - aerobic reduction, increased rainfall runoff, and lagoon waste discharge.

The September survey date was characterized by moderate, steady rainfall beginning in early morning and lasting all day. As the marsh lies at the foot of a wooded, 45° slope, the general rise throughout the day in nutrients and the change in coliform counts and ratios was probably a result of collected runoff during that rainfall event. Rising nitrate nitrogen concentrations coupled with warming temperatures during the day may have stimulated reduction processes apparent in the marsh and, hence, may have contributed to the comparatively large ammonia nitrogen value observed at 1800. This comparatively high mean ratio of

[2] DOE routine monitoring station 27D090 on the East Fork Lewis River near Dollar Corner has only been sampled since 1976.

ammonia nitrogen to nitrate nitrogen and the substantial mean orthophosphate and dissolved oxygen levels suggest a process of aerobic reduction occurring in the marsh. A similar situation was observed on the June 15 study, but was then thought to be anaerobic due to the lower mean dissolved oxygen concentrations observed at that time.[3] Effluent from the sewage treatment lagoon during September may well have had some of the character of rainfall runoff due to increased rainfall and low use.[4] Consequently, it may be partly responsible for the comparatively large jump in total coliform density (14,000 org./100 ml observed at 1800)[5] and ammonia nitrogen levels.

The mixed effect of these three phenomenon - reduction, runoff, and effluent - seems to be the most probable explanation of the analytical results. Much, however, is based on judgement and confirmation could prove somewhat difficult. Irregardless, two definite conclusions can be drawn from the analytical results, i.e. - 1) if the data reflects any effect in the marsh from the combined effluent it is practically undiscernable, certainly minimal, and appears quite compatible with the natural system, 2) no significantly observable effects have been exhibited in the East Fork Lewis River due to the marsh drainage, with or without any sewage lagoon waste discharge.

[3] Decomposition of the nitrogenous products of protein breakdown leads to the production of ammonia, whether mediated by aerobic or by anaerobic bacteria. But, under the aerobic conditions that seem to prevail in the marsh in September, if sufficient phosphates are present, oxidation of ammonia should proceed more rapidly shifting the equilibrium and resulting in a lower ammonia nitrogen to nitrate nitrogen ratio. That this ratio remains comparitively high suggests that limited levels of available organic material may be an inhibiting factor at this time.

[4] Head park ranger John Miller counted 19 overnight campers on the evening of the 17th to 18th and alleges that to be typical use for the previous two weeks.

[5] It should be remembered, of course, that coliform bacterial counts are naturally highly variable and frequently unpredictable.

DT:ee

Attachments

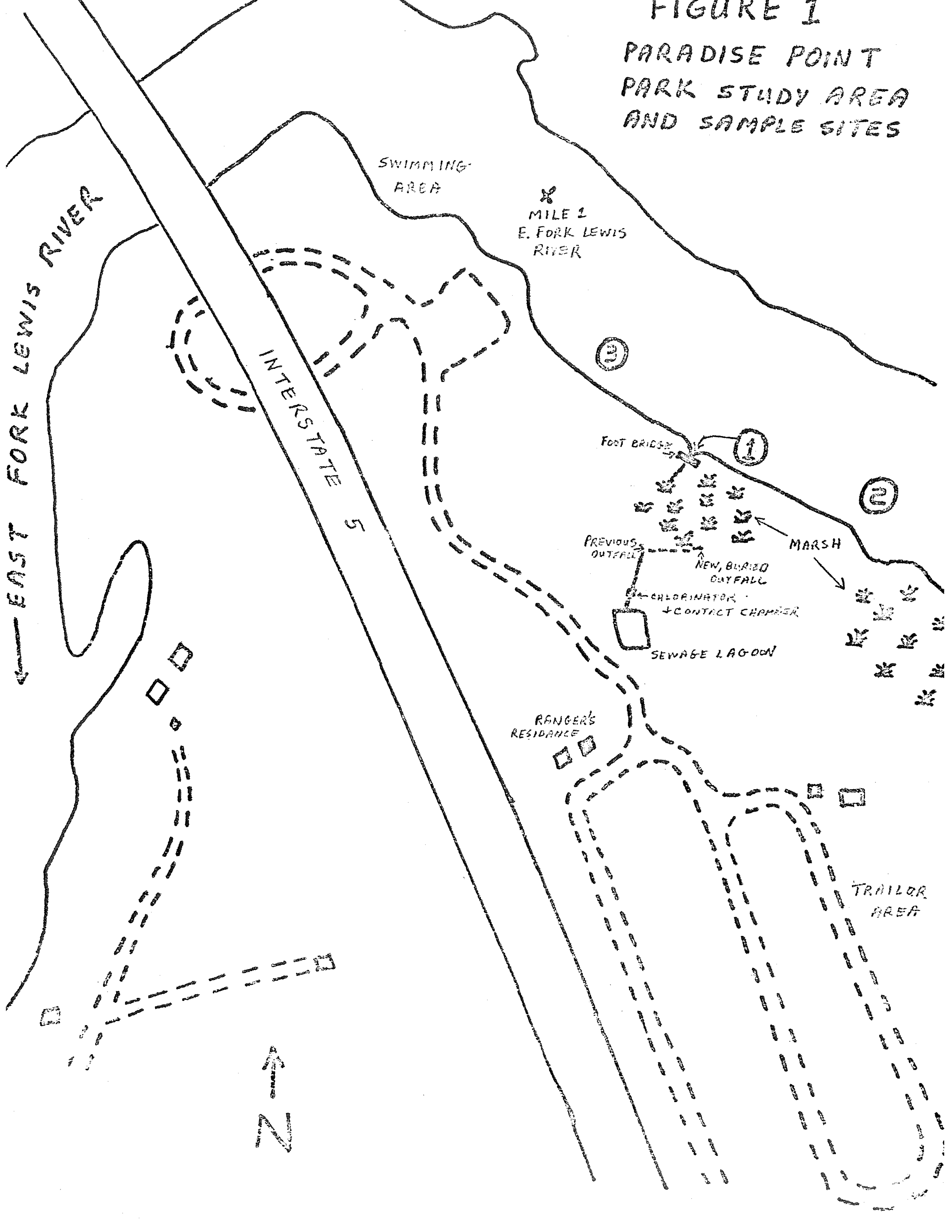
FIGURE 1
PARADISE POINT
PARK STUDY AREA
AND SAMPLE SITES
SWIMMING AREA
MILE 1
E. FORK LEWIS
RIVER
EAST FORK LEWIS RIVER
INTERSTATE 5
3
FOOT BRIDGE
1
2
MARSH
PREVIOUS OUTFALL
NEW, BURIED OUTFALL
CHLORINATOR + CONTACT CHAMBER
SEWAGE LAGOON
RANGER'S RESIDANCE
TRAILOR AREA
N

Table 1

Paradise Point Sample Sites

1) Marsh drainage to East Fork Lewis River, approximately four yards in from river bank; upstream side of wooden footbridge.

2) Approximately five feet from south bank of East Fork Lewis River, twenty-five yards upstream from confluence of marsh drainage and the river.

3) Approximately 5 feet from south bank of East Fork Lewis River, twenty-five yards downstream from confluence of marsh drainage and the river.

Table 2

Laboratory and Field Analysis, Lewis River and Marsh near Paradise Point, 9/18/77

Station/ time	1/ 0700	1/ 1000	1/ 1800	2/ 0700	2/ 1000	2/ 1800	3/ 0700	3/ 1000	3/ 1800
Temp (°C)	14.5	14.0	15.5	15.0	15.0	17.0	15.0	15.0	17.0
pH*	6.4	6.1	6.5	6.5	6.2	7.4	7.1	6.1	7.1
Cond. (umhos cm^{-1})	145	146	158	67	68	55	67	68	60
Diss. O_2 (mg/l)	9.8	9.8	7.7	9.6	10.0	10.3	9.8	9.7	10.3
Turbidity (NTU)	20	10	3	2	3	3	3	3	19
Total Solids (mg/l)	175	164	145	62	44	42	43	44	72
Total Suspended Solids (mg/l)	74	62	10	8	3	10	6	5	44
Total Coliform (org/100 ml)	Est. 6000	Est. 2700	14,000	Est. 800	Est. 340	Est. 300	Est. 340	Est. 400	Est. 700
Fecal Coliform (org/100 ml)	2000	560	840	100	84	80	100	110	190
NO_3-N (filtered, mg/l)	0.15	0.21	0.24	0.05	0.04	0.03	0.04	0.04	0.05
NO_2-N (filtered, mg/l)	< 0.02	<0.02	<0.02	<0.02	<0.02	<0.02	< 0.02	<0.02	<0.02
NH_3-N (unfiltered, mg/l)	< 0.19	0.46	1.10	0.03	0.02	0.02	0.02	0.02	0.04
OPO_4-P (filtered, mg/l)	0.05	0.13	0.22	<0.02	<0.02	<0.02	< 0.02	<0.02	<0.02
Total Phos.-P (unfiltered, mg/l)	0.06	--	--	0.02	0.02	0.03	< 0.02	<0.02	<0.02

* Some difficulty was experienced with field pH measurements rendering these values of dubious reliability.

Table 3

Mean Sample Values, Lewis River and Marsh Drainage near

Paradise Point, 6/15/77

Station	Total Coliform (org/100 ml)	Fecal Coliform (org/100 ml)	NO_3-N (mg/l)	NO_2-N (mg/l)	NH_3-N (mg/l)	OPO_4-P (mg/l)	Total Phos-P. (mg/ml)	Cond. umhos. cm^{-1}	pH
1	7700	2100	< 0.02	< 0.02	0.67	0.15	0.29	157	6.6
2	78	25	0.13	< 0.02	0.02	< 0.02	< 0.02	40	6.9
3	94	39	0.13	< 0.02	< 0.02	< 0.02	< 0.02	45	6.8

Station	Total Solids (mg/l)	Total Suspended Solids (mg/l)	Turbidity (NTU)	Dissolved O_2 (mg/l)
1	151	37	26	5.9
2	51	8	5	10.0
3	49	7	3	10.1

Table 4

Mean Sample Values, Lewis River and Marsh Drainage near

Paradise Point, 9/18/77

Station	Total Coliform (org/100 ml)	Fecal Coliform (org/100 ml)	NO_3-N (mg/l)	NO_2-N (mg/l)	NH_3-N (mg/l)	OPO_4-P (mg/l)	Total Phos-P. (mg/ml)	Cond. umhos. cm^{-1})
1	Est. 6100	980	0.20	<0.02	0.46	0.11	0.06	150
2	430	90	0.04	<0.02	0.02	<0.02	0.02	63
3	460	130	0.04	<0.02	0.03	<0.02	<0.02	65

Station	pH	Total Solids mg/l	Total Suspended Solids (mg/l)	Turbidity (NTU)	Dissolved O_2 (mg/l)
1		161	36	8	9.0
2		49	6	3	10.0
3		51	11	6	9.9

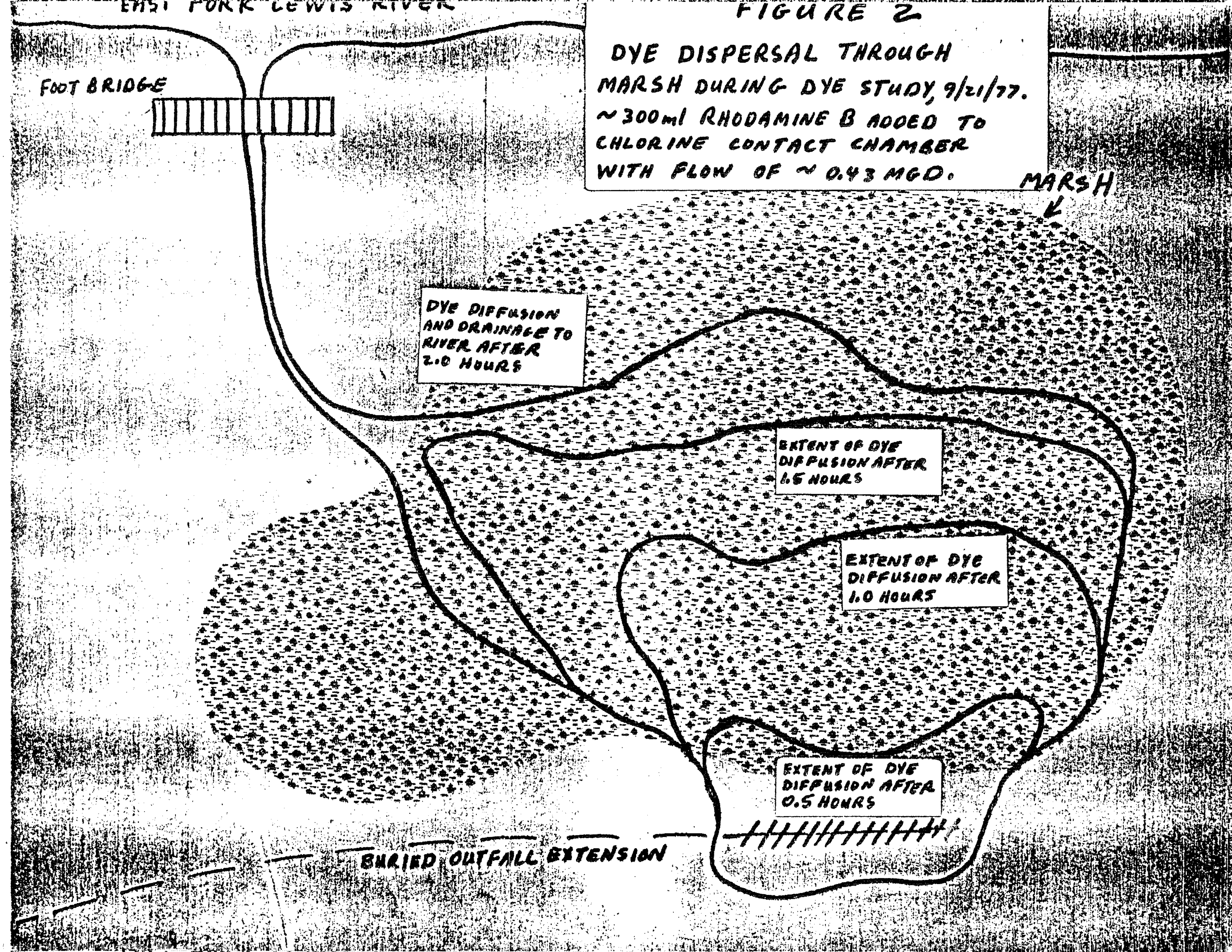

FIGURE 2

DYE DISPERSAL THROUGH MARSH DURING DYE STUDY, 9/21/77. ~300ml RHODAMINE B ADDED TO CHLORINE CONTACT CHAMBER WITH FLOW OF ~0.43 MGD.