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Governor

STATE OF WASHINGTON
DEPARTMENT OF ECOLOGY
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MEMORANDUM
April 29, 1981

To: John Glynn

From: Lynn Singleton and Joseph Joy

Subject: Lynden STP Receiving Water Study

INTRODUCTION

A receiving water survey on the Nooksack River was conducted in conjunction with a Class II inspection of the Lynden STP on January 13-14, 1981. The purpose of the survey was to evaluate the impact of the Lynden plant effluent on water quality in the Nooksack River. The Class II inspection was conducted by Sharon Chase and the concurrent receiving water study by Lynn Singleton and Joseph Joy, all Department of Ecology (DOE), Water and Wastewater Monitoring Section staff.

Besides handling municipal wastes of Lynden (approximate population 2,800), the newly constructed plant treats effluents from Consolidated Dairy Products (Darigold) year-round, and various fruit and vegetable processors seasonally. These industrial contributors are suspected of occasionally causing plant upsets which may effect effluent and receiving water quality. The discussion of such upsets and the complete Class II inspection results are covered in a separate memorandum (Chase, 1981).

METHODS

The Lynden STP discharges to the Nooksack River (waterway segment 01-01-04) from the right bank at river mile (R.M.) 17.4 via a submerged diffuser pipe. Three water quality sampling stations were established in the vicinity of the outfall: Station 1 - upstream at R.M. 18.0, the Hennegan Road bridge; Station 2 - downstream at R.M. 16.7, on the right bank; and Station 3 - downstream at R.M. 15.3, U.S. Highway 99A bridge (Figure 1). Surface grab samples were taken both days at each station. Samples at Stations 1 and 3 were obtained at points of 1/3 and 2/3 the width of the channel by rope and bucket from the bridges, and are designated as right bank, left bank. Duplicate surface grab samples at

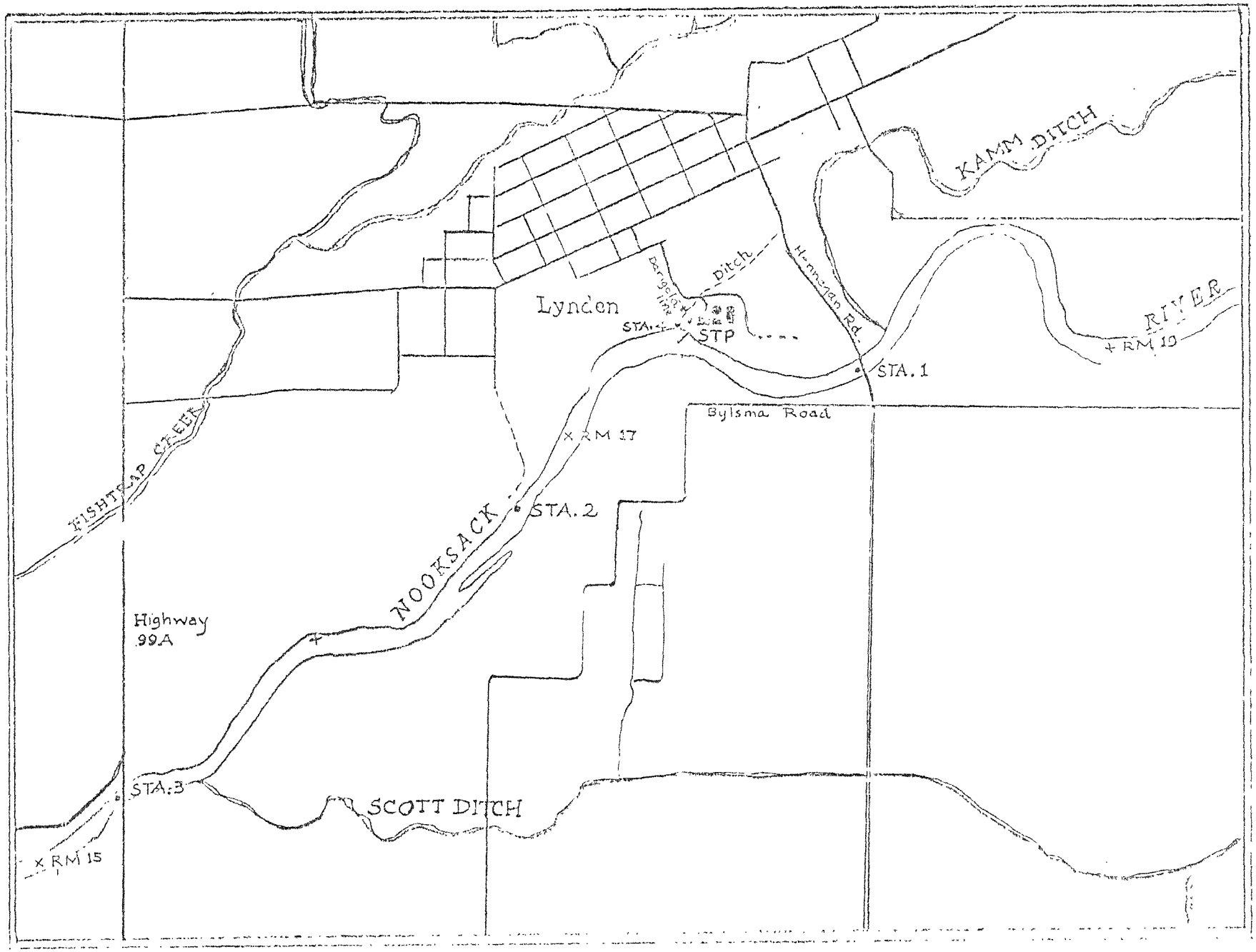

FIGURE 1. RECEIVING WATER MONITORING STATIONS ON THE NOOKSACK RIVER AT LYNDEN, WA., JANUARY 13-14, 1981.

Station 2 were taken 25 feet from the right bank while wading in three feet of water. Samples to be analyzed for COD, BOD, turbidity, and solids were composited from the two collections at each station.

Grab samples also were taken from Station 4, a small drainage ditch bordering the STP site, and from the Darigold cooling water bypass culvert before it mixed with STP effluent.

The following analyses were performed in the field on each sample: temperature (°C); conductivity (umhos/cm) and pH (standard units) by field meter; dissolved oxygen (D.O. mg/L) by Winkler's method; and total residual chlorine (TRC mg/L) by DPD ferrous titrametric method.

Additional samples were collected, packed in ice, and analyzed by the DOE Tumwater laboratory within 24 hours. The following constituents were sought using standard procedures (EPA, 1979):

Turbidity (NTU)	Total PO_4-P (mg/L)
COD (mg/L)	Ortho PO_4-P (mg/L)
BOD (mg/L)	Total Solids (mg/L)
NO_3-N (mg/L)	Total Non-Volatile Solids (mg/L)
NO_2^--N (mg/L)	Total Suspended Solids (mg/L)
NH_3-N (mg/L)	Total Non-Volatile Suspended Solids (mg/L)
	Fecal Coliform (org/100 ml)

As part of the Class II inspection, a 24-hour composite sample was taken of the chlorinated STP effluent before the addition of Darigold's cooling effluent. A Manning^R field compositor set to sample 250 mls at 30-minute intervals was used for this purpose. Fecal coliform samples were taken twice daily from the chlorinated effluent (Chase, 1981).

River discharge data were interpolated from data obtained from the USGS Water Resources Office in Tacoma, Washington. The STP discharge was taken from in-plant measuring devices.

RESULTS

Results of water quality sampling for both days are presented in Table 1.

Mean Nooksack River discharges at Deming (R.M. 36.58) and at Ferndale (R.M. 5.8) were 2480 cfs and 2680 cfs, respectively, on January 13, 1981 (USGS, 1981). Using the drainage areas and river mileage of the sampling stations around Lynden and those of Deming and Ferndale, the discharge was estimated to be 2540 cfs at Station 1 and 2550 cfs at Station 3. Mean discharge from the STP was approximately 1.7 cfs and Darigold's cooling effluent estimated to be 0.3 cfs (Stoffer, 1981). The dilution ratio of river to combined effluent waters was an estimated 1270:1 during the study.

Table 1. Water Quality Data; Nooksack River, Lynden STP Effluent, and Drainages, January 13-14, 1981.

Date	Temp. (°C)[1]	pH (S.U.)[1]	Conductivity[1] (umhos/cm)	Dissolved Oxygen[1] (mg/L)	Total Residual[1] Chlorine (mg/L)	Turbidity (NTU)	COD (mg/L)	BOD_5 (mg/L)	Nitrate-N (mg/L)	Nitrite-N (mg/L)	Ammonia-N (mg/L)	Total Phos.-P (mg/L)	Orthophos.-P (mg/L)	Total Solids (mg/L)	Total Non-Volatile Solids (mg/L)	T. Sus. Solids (mg/L)	T. Non-Vol. Sus. Solids (mg/L)	Fecal Coliforms (org/100 ml)
Station 1 - Hennagan Bridge, R.M. 18 (2540 cfs)																		
Right Bank 1/13	6.2	7.4	115	12.7		10	6	<4	0.39	<0.01	0.02	0.02	<0.01	96	56	8	6	4[2]
Left Bank 1/13	6.9	7.4	115	12.9					0.33	<0.01	0.01	0.02	<0.01					2[2]
Right Bank 1/14	4.0	7.3	115	12.9	--	7	8	<4	0.38	<0.01	0.02	0.03	<0.01	94	60	8	6	20[2]
Left Bank 1/14	3.9	7.3	115	12.9					0.34	<0.01	0.02	0.03	<0.01					90[2]
Station 2 - Right Bank, R.M. 16.7																		
1/13	4.9	7.2	115	12.8	N.D.[4]	8	4	<4	0.37	<0.01	0.02	0.03	0.02	100	68	8	7	4[2]
1/13	4.9	7.4	115	12.9	N.D.				0.37	<0.01	0.03	0.03	0.02					4[2]
1/14	3.9	7.4	110	13.0	N.D.	8	4	<4	0.38	<0.01	0.02	0.03	0.02	89	70	12	6	16
1/14	3.9			13.0	N.D.				0.39	<0.01	0.02	0.02	0.02					12[2]
Station 3 - Highway 539 Bridge, R.M. 15.4 (2550 cfs)																		
Right Bank 1/13	5.2	7.2	117	12.8	N.D.	10	8	<4	0.37	<0.01	0.03	0.03	0.02	100	64	8	7	2[2]
Left Bank 1/13	5.2	7.1	125	12.8	N.D.				0.42	<0.01	0.04	0.02	0.02					2[2]
Right Bank 1/14	4.0	7.4	117	12.9	N.D.	5	4	<4	0.40	<0.01	0.04	0.03	0.02	110	67	12	8	21
Left Bank 1/14	3.9	7.4	120	12.9	N.D.				0.44	<0.01	0.03	0.03	0.02					20[2]
Station 4, Drainage Ditch Bordering STP																		
1/13	6.5	6.5	270	9.9		19	30	4	0.42	<0.01	0.28	0.18	0.11	210	140	16	8	5[2]
Darigold Cooling Water (about 0.3 cfs)																		
1/14	18.5	6.5	50	6.9					0.22	<0.01	0.39	0.21	0.04					2[2]
STP Effluent (24-hr. composite)(about 1.7 cfs)																		
1/13-1/14		9.0	787		1.1	5	63	11	3.2	2.4	15	21	13	480	370	8	1	72, 10[2]
																		3[2][3]

[1] Field analysis.

[2] Estimated population based on non-ideal plate counts.

[3] Independent samples taken at various times throughout the Class II inspection.

[4] None detected.

Memo to John Glynn
Lynden STP Receiving Water Study
April 29, 1981

Field Parameters

Nooksack River temperature, pH, and dissolved oxygen values did not change appreciably after the addition of STP effluent. All values at Stations 1 through 3 were in accordance with Class A water quality standards. Stations 2 and 3 values for these parameters are not significantly different from Station 1 values.

Conductivity values at Station 3 were slightly higher than those found at Station 1 and 2 ($0.025 < P < 0.05$). These higher values may be from Scott Ditch water entering from the left bank 0.2 mile upstream of Station 3. High conductivity values emanating from this tributary were reported in an earlier study (Johnson and Prescott, 1979).

Estimated total mixing values of STP effluent and river water indicate no increase in downstream conductivity would be expected.

No TRC was detected at Stations 2 or 3. The estimated mixing value for 1.1 mg/L in the effluent would be 0.7 ug/L. This value is far below the 10 ug/L minimum detectable value for the technique. It also is below the 2 ug/L criterion set for salmonids (U.S. EPA, 1976), and the 5 ug/L concentration considered harmful to aquatic biota (Thurston, et al., 1979).

Nutrients

Nutrient levels in the river changed only slightly in the vicinity of Lynden. No significant contributions to river nutrient loads from STP effluent were found. Effluent concentrations of ammonia, orthophosphate, and total phosphate are estimated to have raised river nutrient levels by 0.01 mg/L under the flow conditions found during the study.

Nutrients from Kamm Ditch entering from the right bank 0.1 mile upstream from Station 1, and Scott Ditch upstream from Station 3 may have been affecting river nutrient levels more than the STP during the study. A statistically significant increase in ammonia was observed between Stations 2 and 3 ($0.025 < P < 0.05$). Also, Station 1, right bank and Station 3, left bank, levels of nitrate tended to be higher than their corresponding opposite bank sample.

Nutrient levels found in the Nooksack River at Station 3 during this study are similar to those recorded during flows of 1500 to 3600 cfs in December through February of water years 1974 and 1977 when DOE water monitoring station 01A090, Nooksack River near Lynden, was in operation at that location. The mean values for these seven observations are presented in Table 2.

Table 2. Mean values and standard deviations of seven observations at station 01A090 during flows of 1500 to 3600 cfs in December to February.

	$NO_3 + NO_2$-N	NH_3-N	Total P	Ortho P
mg/L	0.47 ± 0.09	0.10 ± 0.04	0.04 ± 0.04	0.006 ± 0.005
lbs/day	7000 ± 3000	1500 ± 800	700 ± 800	100 ± 90

The primary difference between the historical values and those of this study are the higher ammonia and lower orthophosphate values of the historical data. The higher historical values may be artifically high from lab errors made during the period of sampling and recently discovered by DOE staff (Heffner, 1981). No comment can be made at this time whether instream ammonia levels are truly dropping. One-third of the orthophosphate load can be attributed to the STP; the other two-thirds may be from non-point sources and drainages such as Station 4 and Scott Ditch. Why this value is higher than those previously found under similar conditions is unknown.

Ammonia levels in the river were not high enough to cause toxic conditions for aquatic life. The season and water temperature were not conducive to algal growth, so that nitrate, orthophosphate, and total phosphate levels did not pose an immediate bloom potential.

Nutrients in the Darigold bypass system are higher than expected for cooling water. Although Darigold uses water from Fishtrap Creek for cooling, on the day of sampling 90 percent of the water was from the evaporated milk process and 10 percent was city water (Stoffer, 1981). Neither of the two sources used that day would normally produce the ammonia and phosphate values found in the sample. A possible explanation is that the bypass also is used as a stormwater collector for the Darigold and Western Farmer facilities. The Western Farmer facility includes feed and fertilizer loading and storage operation. Previous storm events may have driven fertilizers into the culvert and caused the aberrant values.

Solids

The additions of solids made by the STP were insignificant to the load already carried by the river. The total solid loading from the STP was calculated to be 0.3 percent of the solid load carried by the river at Station 1.

Solids loading may be of significance during STP upset events. During such events in the past, large amounts of poorly treated effluent and biomass associated with the treatment plant processes were probably passed into the river. These wastes could possibly be of great enough quantity and BOD to exert a substantial oxygen demand downstream.

Bacteriological

Fecal coliform counts were low, or were estimated to be low at all stations sampled. Coliform counts in STP effluent were low due to substantial chlorination.

Low ambient water temperatures, a lack of direct agricultural runoff, and low effluent coliform populations probably were responsible for the low instream counts. Fecal counts in the Nooksack River below Lynden and from Scott and Kamm ditches often exceeded Class A water quality standards during past summer and fall low flow conditions (Johnson and Prescott, 1979; DOE, 1975). Eight fecal count observations made during December through February over a seven-year period and under similar flow conditions as was found in this study yielded a median value of 50 col/100 mls, with a range of 20 to 240. The low fecal counts found during this study concur with historical data and indicate that fecal contamination is not a chronic problem in the Nooksack River under winter low flow conditions.

Sludge Disposal

The STP may be affecting the water quality of the Nooksack through other routes other than its main effluent outfall. Sludge cleanup practices and sludge deposition at and around the plant could have an impact on the Nooksack.

A sample was taken at Station 4 after noting that fresh dewatered sludge was being washed into the small drainage ditch adjacent to the plant site. Approximately one cubic foot of sludge is washed from plant grounds after each sludge truck loading has been completed.

The sample taken at Station 4 had elevated nutrient concentrations, a high solids content, and a high conductivity, all of which could have been due to the sludge. The Station 4 sample was not tested for metals, but appreciable quantities of metals are present in the sludge (Table 3).

Table 3. Lynden STP sludge constituent concentrations.

METALS mg/kg dry weight (Total)[1/]							
Cadmium	Chromium	Copper	Iron	Manganese	Nickel	Lead	Zinc
4.1	83	150	3500	170	33	140	650

NUTRIENTS mg/L wet weight				
Total Phos.-P	Orthophos.-P	Nitrate-N	Nitrite-N	Ammonia-N
210	53	7.5	<0.50	7.5

[1/] No soluble fraction of metals was found because sample was lost.

Although only one cubic foot or so of sludge is deposited after each washdown, the practice contributes to nutrient enrichment and toxic materials addition to the Nooksack.

Surface disposal of sludge occurs on pasture land adjacent to the STP. This land usually experiences yearly flooding (Klimpel, 1981) which could bring the sludge with its toxic and deleterious components into the river channel. The sludge would have a negative effect upon water quality downstream.

Both sludge handling practices constitute a National Pollutant Discharge Elimination System (NPDES) permit violation. The violation is discussed in greater depth in the Class II inspection report (Chase, 1981).

SUMMARY AND DISCUSSION

The Lynden STP was having a minimal impact on water quality in the Nooksack during this study. The plant was operating normally and winter low flow conditions in the river adequately diluted STP effluent. Under different circumstances, the plant may have a greater impact upon water quality.

Under normal operating conditions and winter low flows instream, the effluent contributes some nutrients, solids, and potentially toxic materials into the Nooksack. However, effective treatment of effluent and an instream dilution ratio of 1270:1 ensures that Class A water

quality standards are met. The effluent's contribution of nutrients to this segment of the river may be less significant than additions made by ditches draining adjacent agricultural lands.

Improper sludge handling practices at the plant may be contributing to water quality degradation in the river. Toxic materials and nutrients present in sludge may be entering the river from sludge deposited on the flood plain and sludge washed daily from the plant grounds into an adjacent drainage ditch. Efforts must be made to stop the entry of sludge into the Nooksack and its tributaries.

The STP may have a greater impact upon the water quality of the Nooksack at other times. The plant experiences periodic upsets characterized by overloading and pH imbalances resulting in substantial increases in solids loading to the river (Kimple, 1981). Also, operators state that late summer and fall food processing activities stress the plant's operation. Further studies need to be made on receiving water quality while the plant is stressed, especially during late summer and fall low flow conditions in the Nooksack.

JJ:LRS:cp

Attachments

REFERENCES

Chase, S., 1981. *Lynden STP Class II Inspection*, unpub. memo to John Glynn, DOE.

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U.S. Environmental Protection Agency, 1976. *Quality Criteria for Water*, EPA-440/9-76-023, Washington, D.C., 501 pp.

U.S. Geological Survey, 1981. Water Res. Div., Tacoma, personal communication with field staff, March 1981.

August 5, 1971

Memo to: John Arnquist
Redmond Office

From: Ron Lee

Subject: Darigold at Lynden

The analytical results for the samples collected at the above named industry are presented in Table 1. All values are expressed in ppm.

Station #	COD	BOD	TS	TNVS	TSS	TSNVS	TVSS
1	433	290	352	56	84	2	82
2	296	115	469	202	62	5	57
3	1080	710	976	115	34	3	31
4	380	260	360	76	87	2	85
5	43	20	148	72	16	3	13
6	28	4	133	68	9	4	5

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The following are the analytical results from survey conducted at.

Marigold @ Lynden — 04-C06

Collected 7/?/71

LAB. NO	STATION NO.	ppm COD	ppm BOD	ppm T.S.	ppm T.N.V.S.	ppm T.S.S.	ppm T.S.N.V.S.	ppm T.V.S.S.
71-2213		433.	290.	352.	56.	84.	2	82.
2214		296.	115.	469.	202.	62.	5.	57.
2215	}	1080.	710.	976.	115.	34.	3.	31.
2216	1	380.	260.	360.	76.	87.	2	85
2217		43.	20.	148.	72.	16.	[illegible]	13.
2218	,	28.	4.	133.	68.	9.	4	5

Notes:

Summarized by Pat Lee

Date 7/19/71