APPENDIX 3

DETENTION/RETENTION FACILITIES

LISTING OF DETENTION FACILITIES IN PERCIVAL BASIN

Name	Subbasin	Type	Volume	Potential
AM/PM Mini Market	P-13	P	2380	0%
Automall Mini Storage	P-12	P	11500	0%
Blk Hills Hospital	P-7	P		0%
Blk Lake Blvd Street	P-11	P		0-5%
Blk Lake Place Parking #1	P-9	U		0%
Blk Lake Place Parking #2	P-9	U	3719	0%
Blk Lake Place Parking #3	P-9	U	1684	0%
Blk Lake Place Annex	P-9	U		0%
Boone Ford West	P-12	P	5010	5-10%
Boone Pond	P-12	P		10-20%
Bracy/Thomas Office Bldg	P-11	U	388	0%
Brewery City Pizza	P-8	U	1520	0%
Burger Master	P-8	U	1526	0%
Calista Seafoods	P-13	P	14142	5-10%
Cambridge Ct PH 1	P-5	P		0%
Cambridge Ct PH 2	P-5	P	64135	0%
Capitol Coachman	P-12	U	22863	0%
Capitol City Honda/Chevrolet	P-12	U	9198	0%
Capital High School	P-8	P		5-10%
Capital Mall	P-9	U		0%
Capitol Place	P-9	P	13000	0%
Capital View Addition	P-13	P		0%
Centennial Bank (Hood)	P-8	U	660	0%
Columbia Beverage	P-4	P	35000	5-10%
Cooper Point Village	P-11	P		0%
Costco	P-3	P		5-15%
DOT/Kaiser Road	P-5	P	196000	20%
DOT/Evergreen Prk	P-13	P		50%
DOT/Mottman Rd	P-11	P		15-20%
Drebick Office Bldg	P-13	U	9253	0%
Ellehammer Packing	P-4	P		5-10%
ESD #113	P-5	P		0-5%
Evergreen Christian Ctr	P-11	P		200%
Evergreen Chrystler Plymouth	P-12	U		0%
Evergreen Vet Clinic	P-7	P	26671	0-5%
Fabricland	P-11	P	2600	0%
Firestone Auto Service	P-8	U	4263	0%
Group Health (Oly West)	P-7	U		0%
Hanson Motors	P-12	U	54300	0%

Name	Subbasin	Type	Volume	Potential
Harrison Park Apts	P-8	P		0-5%
Highland Green	P-13	P	3000	0-5%
Honda Shop (Westmoor Ct)	P-11	U	6640	0%
Jones Quarry	P-4	P	348480	50%
L and E Bottling	P-6	P	2600	5-10%
Lewis Kemp Seafood	P-4	P	96000	5-10%
Lincoln-Mercury of Olympia	P-12	P		0%
Lumbermans	P-11	P		0-5%
McDonalds (Westside)	P-8	U		0%
McKinney-Cahan	P-9	U		0%
Mega Foods	P-11	P		0%
Meir Plaza (Cap. Floor)	P-11	P		0%
Mini-Storage (Westside)	P-11	P		0-5%
Mottman Industry Prk Lot	P-4	U		0%
Office Tavern	P-3	P		0-5%
Percival Bridge, LID 755	P-13	P		5-10%
Percival Creek Outfall	P-3	P		5-10%
Percival Manor	P-13	P		0%
Pizza Hut	P-8	P		0%
Puget Sound Health Care	P-5	P		10-15%
Racquet Club Apartments	P-12	P		0%
Rainier Dodge	P-12	P	7500	10-15%
Rotter Oldsmobile-Buick-GMC-Toyota	P-12	P		0-5%
Security Pacific Bank	P-9	U		0%
Sherwood Glen	P-13	P		0%
Sommerset Hill	P-3	P		40%
SPSCC	P-3	P		20-30%
Strathmoor Business Park	P-4	U		0%
Tabitha Park	P-7	P	7271	0-5%
Target Place	P-8	P		5-10%
TCI Building	P-7	U	5252	0%
Top Foods	P-11	U		0%
Toys R Us	P-11	P	15000	0-5%
Van Quaethem Clinic	P-7	P		10%
Walnut Estates	P-7	P		0-5%
Walnut Park	P-8	P	56000	10-15%
Wendy's Restaurant	P-8	U		0-5%
Westhill Office Park	P-11	U	25461	0%
West Park PUD Drainage	P-7	U		0%
Westside Dental Pond	P-7	P		10%
Westview Estates	P-7	P	4500	0%
Whispering Pines	P-11	P	5687	0-5%
Yauger Medical Park	P-7	U	14000	0-5%
Yauger Park	P-10	P	3136320	10-15%

APPENDIX 4

COMPUTER MODELING TECHNICAL INFORMATION

Hydrologic Modeling for the Percival Creek System

Hydrologic modeling for the Percival Creek basin plan was performed using the EPA's Hydrologic Simulation Program—FORTRAN (HSPF) model (USEPA, 1988). HSPF is a sophisticated computer modeling program which simulates land surface and in-stream hydrologic processes on a continuous basis. The model is commonly used to transform long-time series of observed rainfall and evaporation data into a concurrent time series of stream flow data using continuous accounting of soil moisture levels. This approach offers some distinct advantage over the more traditional modeling approach using event-based models. Event-based models simulate stream flow for individual storm events. Their accuracy depends on the ability to accurately portray watershed conditions (primarily soil moisture levels) antecedent to the storm event being modeled. Event-based models cannot be used to simulate low flows and hence are of little value in characterizing the overall hydrologic regime of a basin.

The HSPF model requires the division of the surface of each drainage basin into land segments, each with distinctive but reasonably uniform meteorologic, physical (soil, slope, and land cover), and hydrologic traits. It is not necessary for all parcels of each land segment to be contiguous. Therefore, relatively few land segments are needed to represent the complex mosaic of soils, slope, and land cover in each basin.

Three slope classes: 0 to 3 percent (mild), 2 to 15 percent (moderate), and greater than 15 percent (steep) are recognized by the program. Land segments for each of the 3 slope classes were identified on United State Department of Agriculture (USDA) Soil Conservation Service (SCS) soil survey maps, and topographic maps were used for verification. A method was derived by which 6 land use (impervious surface) categories were obtained from the three jurisdictions sets of zoning classifications.

The HSPF model has the capability of routing stream flow from subbasins along connected reaches of a drainage network to the outlet of a drainage basin. Routing allows the simulated runoff from different parts of a drainage basin to be correctly sequenced in time. In order to utilize the routing capability, the linked network of stream channels, drainage pipes, and perennial lakes, ponds, and wetlands that form the drainage of each of the basins are divided into reaches.

Model Development

Three basic steps were involved in the computer modeling work. First, the model was calibrated against existing hydrometeorologic data for existing land use conditions. Second, the model parameters were adjusted to represent future land use conditions, and the model was then used with historic rainfall data to create a synthetic sequence representing future stream flows. Third, various proposed control measures (such as regional detention facilities and alternative zoning) were modeled to determine their effects on future flood flows at various points in the basins.

Model Calibration

Rainfall data recorded from March 1988 through March 1989 was used along with recorded stream flows to calibrate the HSPF computer model. Percival Creek basin contains two continuous recording rain gauges and one manual gauge. A correlation between the precipitation data and the National Weather Service (NWS) Olympia Airport station data for the one year period was developed for the purpose of extending the records for the period of meteorologic record, January 1955 through June 1990. Pan evaporation data was obtained from the National Weather Service Class A evaporation pan near Puyallup, Washington, for the period of March through October 1988.

Stream flow data needed for the calibration was collected at 15-minute intervals from continuous recording gages in the basins. Instantaneous peak flows were estimated a few times each year and stage data were collected by observers periodically. Major storm events and the predicted flow rates were selected from the period March 1, 1988, through March 29, 1989, to calibrate the model and evaluate recommended solutions.

Reaches were selected as network components that represent relatively uniform hydraulic characteristics and either drain or connect subbasins. Measurements from field surveys were used to determine general hydraulic characteristics for each reach (personal communication, Steven Berris, 1990, USGS Progress Reports). Field measurements and maps were used in conjunction with general hydraulic characteristics to determine the storage volumes for the reaches. Reaches may lose water from channel or lake seepage or from multiple outlets, one or more of which discharges out of the basin.

Runoff generated from upland till segments not directly connected to stream reaches was assumed to drain to outwash segments at the first down gradient location where an outwash soil is present. Based on stream flow information, this guideline was applied with subbasins where outwash segments exist immediately down gradient from till segments. The assumption behind this is that the surface runoff and interflow generated on a till segment would become recharge once the flow reached an outwash contact.

Land cover was interpreted and mapped from aerial photographs for the model calibration. The 6 land use classes consisting of forest and non-forest pervious segments (grass, pasture, and gravel pits), and effective impervious-area segments were determined. Effective impervious-area segments represent areas with direct runoff from impervious surfaces hydraulically linked to the channel system. The percent effectiveness for each of the 6 classes of impervious land cover was adjusted to 86 percent, 48 percent, 48 percent, 23 percent, and 4 percent respectively for heavy commercial, low density industrial, high density residential, suburban residential, moderate residential, and sparse residential.

Non-effective impervious areas in residential and commercial areas were assumed to have the same hydrologic characteristics as the non-forested underlying soils and non-effective areas in sparse residential areas were divided between forest and non-forest segments. All impervious areas in closed subbasins of the Percival Creek drainage basin were considered to be non-effective. All non-effective impervious areas are assumed to drain to their underlying pervious land segments, which are considered to be non-forested.

Observed and simulated values of total runoff for the period, and the absolute and percentage difference for the simulated values are shown in Table 4. Runoff is depicted as the total volume of stream flow at the gauging stations during the period of record divided by the upstream basin area, converted to units of inches. The differences in simulated total runoff from observed total runoff ranged from 1 to 10 percent at individual gaging stations. The relatively small differences are generally within the limitations of the accuracy of the observed data.

Departures of simulated stream flow from observed stream flow can occur for two reasons: 1) inadequate or inaccurate basic data to drive or calibrate the model, and 2) inadequate representation of runoff processes by the models. Departures related to inadequate or inaccurate basin data include the rainfall and evaporation data that drive the models, and the stream flow data used for model calibration.

Although it is often assumed that the frontal storms that commonly generate runoff in the Puget Sound region are relatively homogeneous throughout the area, the data collected for this study show that rainfall can at times vary significantly between rain gauges a few miles apart. Additionally snowfall is not adequately measured by the rain gauges. Although snow is not a common form of precipitation in the study area, about 7 inches of snow was recorded at the Olympia Airport in January 1989, 14 inches was recorded in February 1989, and 8 inches was recorded in March 1989 during the time period of model calibration and may account for some variability.

Daily rates of evaporation for the study region were derived from pan-evaporation records from Puyallup, Washington, and temperature data from Olympia Airport. Actual evaporation rates within the drainage basins probably vary from the evaporation records used for the model runs. This is another potential source of inaccuracy.

Stream flow data, while not as subject to spacial or temporal difference as precipitation or evaporation, are subject to differences from other sources. The locations of stream-gaging stations were chosen specifically for model-calibration purposes. However, some of those locations had variable stage-discharge relations due to unstable channels. Frequent discharge measurements were made to maintain the accuracy of these relations, but some stream flow records can only be rated "fair," or only within 15 percent of their correct values. Stream-gage station malfunction, caused by freezing conditions, resulted in a small loss of stream flow records. Stream flow records for these periods were estimated by hydrographic comparisons to nearby gages.

Table 4.-- Observed and simulated runoff data for March 1, 1988, through March 29, 1989.

Observed = observed value, in inches;
Simulated = simulated value, in inches;
Difference = simulated - observed, in inches;
Percent difference = 100 x (simulated-observed/observed).

Station Name Station Number	Runoff from March 1, 1988, through March 29, 1989 Observed	Simulated	Difference	Percent Difference
Black Lake Ditch near Olympia, WA 12078720	93.2	97.1	3.90	4.2
Percival Creek near Olympia, WA 12078730	46.3	47.3	1.00	2.2

Table 5.-- Measures of difference for model-simulated daily mean discharges for each steam-gaging station used for model calibration from March 1, 1988, through March 29, 1989.

Station Number[1]	Flow Regime[2]	Mean absolute difference[3]		Root mean square difference[4]		Bias[5]	
		Average	Percent	Average	Percent	Average	Percent
12078720	Low	0.805	11.9	1.056	18.1	-0.173	0.7
	Medium	3.839	15.4	4.834	19.3	3.633	14.6
	High	3.484	6.0	4.352	7.6	0.770	1.8
	Total	2.722	11.0	3.814	15.7	1.391	5.6
12078730	Low	0.434	17.7	0.531	21.4	-0.272	-12.2
	Medium	0.865	16.0	1.026	19.2	0.514	9.3
	High	1.182	9.0	1.535	11.4	0.240	3.8
	Total	0.828	14.2	1.110	17.8	0.163	0.4

[1] Station names for the displayed station numbers are shown in table 4.

[2] Low, medium, and high flow regimes are the lower, middle, and upper thirds of the daily mean discharge values from each station. Total refers to the complete daily mean flow record at the station.

[3] AVERAGE = sum (|S-M|/n)
PERCENT = 100.0 * (sum(|S-M|/M))/n for all M > 0.1

[4] AVERAGE = square root(sum((S-M)**2)/n)
PERCENT = 100.0 * square root(sum(((S-M)/M)**2)/n) for all M > 0.1

[5] AVERAGE = sum (S-M)/n
PERCENT = 100.0 * (sum ((S-M)/M)/n) for all M > 0.1

S = Simulated value
M = Measured value
sum = Summation
n = Number of pairs of daily values
| | = Absolute value

NOTE: Because of the method of computing percentages, measured daily mean discharges below 0.1 cubic feet per second are considered as "dry" and are not considered in this analysis.

Table 6.-- Observed and simulated storm runoff and peak-discharge data.

Obs.	- observed value, in inches for runoff and in cubic feet per second for discharges;
Sim.	- simulated value, in inches for runoff and in cubic feet per second for discharges;
Diff.	- Difference: Simulated-Observed in inches for runoff and in cubic feet per second for discharges;
Percent diff.	- Percent difference: 100 x [(Simulated-Observed)/Observed]

Station Number[1]	Date of Storm	Date of Peak	Storm Runoff[2]				Peak Discharge[3]			
			Obs.	Sim.	Diff.	Percent Diff.	Obs.	Sim.	Diff.	Percent Diff.
12078720	03/24-28/88	03/26/88	2.67	2.95	0.28	10.5	97.3	106	8.70	8.9
	04/04-07/88	04/06/88	2.68	2.63	-.05	-1.9	123	118	-5.00	-4.1
	12/28-31/88	12/30/88	1.78	1.97	.19	10.7	99.0	114	15.0	15.2
	01/14-19/89	01/18/89	3.76	3.76	0	0	108	108	0.0	0
12078730	03/24-28/88	03/26/88	1.58	1.52	-.06	-3.8	44.0	32.8	-11.2	-25.4
	04/04-07/88	04/06/88	1.46	1.54	.08	5.5	55.9	45.6	-10.3	-18.4
	12/28-31/88	12/30/88	1.49	1.49	0	0	64.8	62.9	-1.9	-2.9
	01/14-19/88	01/16/89	2.23	2.00	-.23	-10.3	41.0	31.7	-9.3	-22.7

[1]Station names for the displayed station numbers are in table 4.

[2]Storm runoff data are the total streamflow volumes for the time period of each storm.

[3]Peak discharge data are the maximum instantaneous discharges for each storm.

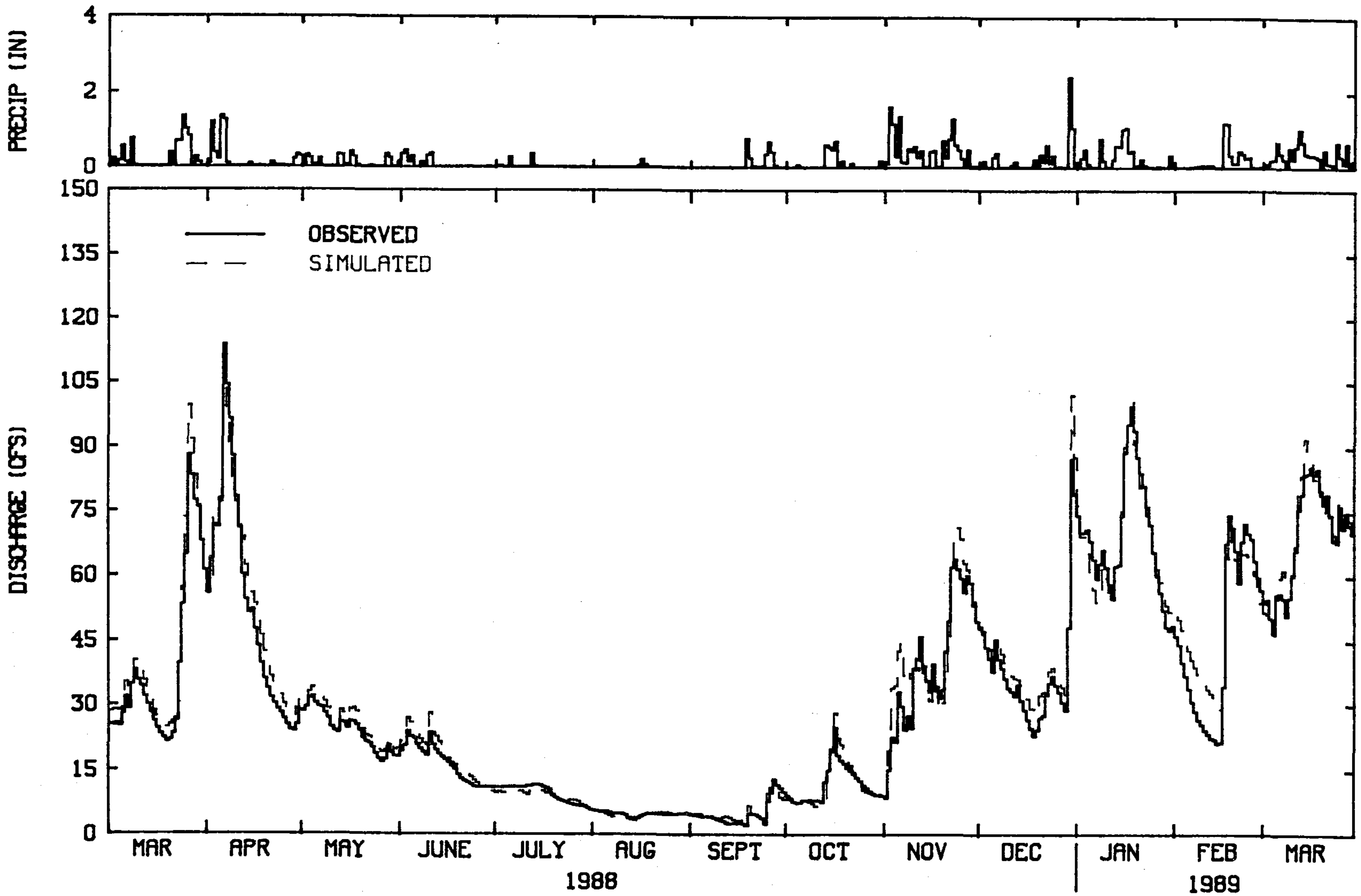


Figure 3. -- OBSERVED AND SIMULATED MEAN DAILY DISCHARGES FOR BLACK LAKE DITCH AT MOTTMAN ROAD (12078720)

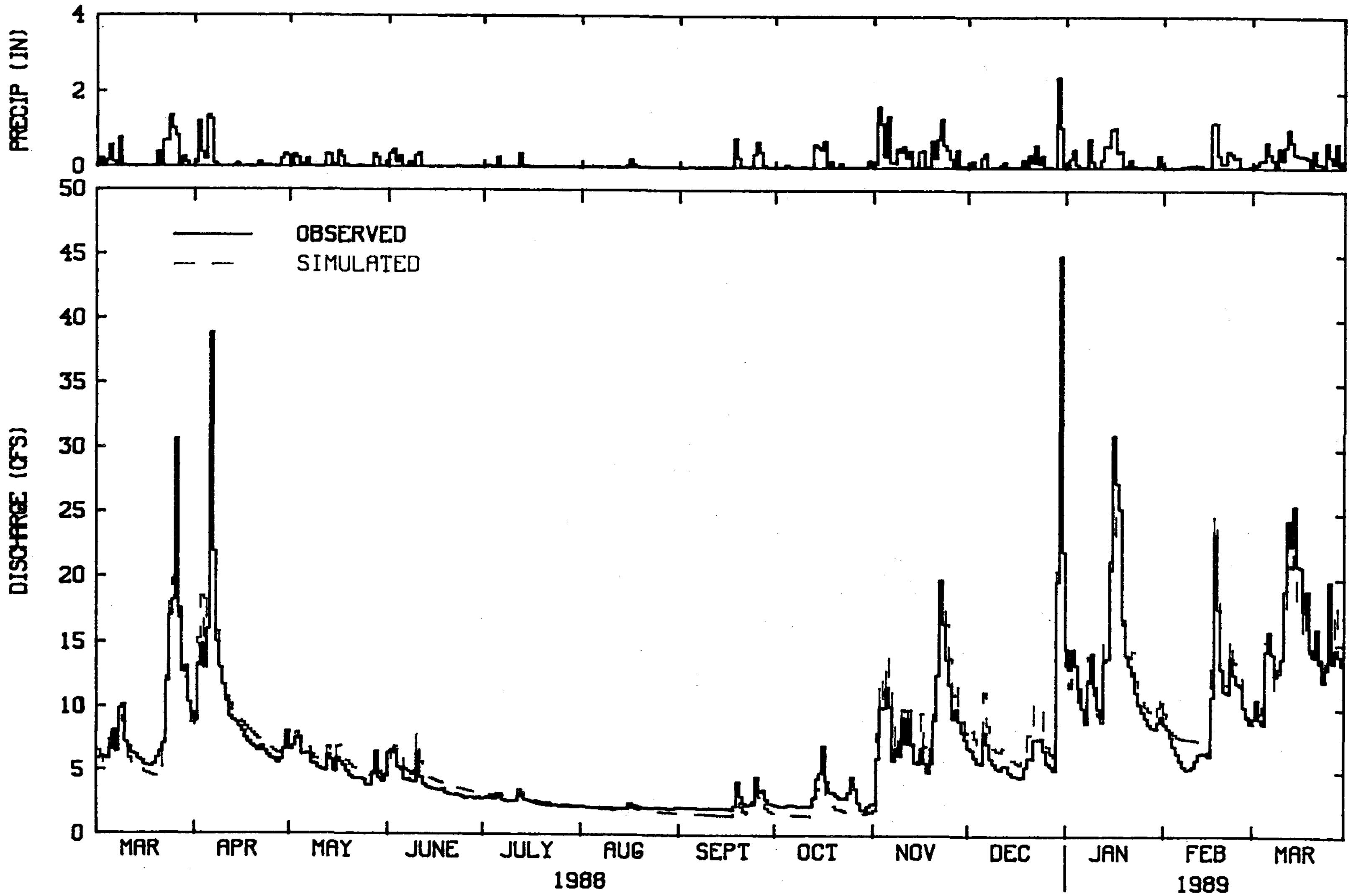


Figure 4. -- OBSERVED AND SIMULATED MEAN DAILY DISCHARGES FOR PERCIVAL CREEK AT MOTTMAN ROAD (12078730)

APPENDIX 5

WATER QUALITY MONITORING RESULTS

AMBIENT MONITORING PERCIVAL CREEK October 30 - November 1, 1989										
Station	Fecal Coliform	Flows (CFS)	Temp (C)	D.O. (mg/l)	S.C. (uHMOS)	Turb. (NTU)	pH	N+N (mg/l)	TKN (mg/l)	TP mg/l
P-1	10	18.661	10.8	11.2	99	4.5	6.68	0.16	0.7	0.29
P-2	5	N/A[4]	N/A	N/A	N/A	N/A	N/A	0.07	0.83	0.062
P-3	55	N/A	10.5	N/A	N/A	N/A	6.27	0.35	<0.5	0.029
P-4	50	N/A	N/A	N/A	N/A	N/A	N/A	0.22	<0.5	0.63
P-5	45	N/A	N/A	N/A	N/A	N/A	N/A	<0.05	<0.5	0.056
P-6	5	11.15	12.0	13.5	92	5.2	6.44	<0.05	0.8	0.08
P-7	0	N/A	12.6	N/A	N/A	N/A	6.47	<0.05	1.2	0.057
P-8	0	12.15	12.3	5.0	88	5.8	6.37	0.07	1.0	0.07
P-9	15	N/A	N/A	N/A	N/A	N/A	N/A	Dry	0.048	Dry
P-10	N/A	N/A	11.2	N/A	N/A	N/A	6.64	N/A	N/A	N/A
P-11	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

AMBIENT MONITORING PERCIVAL CREEK January 29 - February 2, 1990							
Station	Fecal Coliform	Flows (CFS)	Temp (C)	D.O. (mg/l)	S.C. (uHMOS)	pH	Turb. (NTU)
P-1	40	157.61	4.9	12.8	74	6.65	5.6
P-2	135	190.58	5.5	12.4	67	6.57	7.1
P-3	0	24.70	5.6	12.6	74	7.66	7.2
P-4	30	20.16	6.4	12.8	126	7.39	4.6
P-5	10 25	2.00	3.8	13.1	130	7.87	2.2
P-6	120	134.32	5.8	12.2	67	6.8	9.9
P-7	60	N/A	5.2	12.5	68	7.58	4.7
P-8	10	87.03	5.3	12.7	86	6.20	2.7
P-9	450	5.05	4.9	12.8	134	6.81	25
P-10	200	3.54	3.7	13.3	N/A	6.77	13
P-11	40	8.19	5.9	12.4	84	N/A	3.4

[4] N/A: Data not available

AMBIENT MONITORING
PERCIVAL CREEK
April 2-3, 1990

Station	Fecal	Flows (CFS)	Temp (C)	D.O. (mg/l)	S.C. (uHMOS)	pH	Turb. (NTU)
P-1	5	58.31	10.9	12.0	79	7.4	3.5
P-2	5	46.12	10.1	10.8	78	7.91	2.7
P-3	55	8.27	11.7	10.9	101	7.24	3.6
P-4	20 20	6.09	13.1	10.7	101	7.24	3.6
P-5	10	N/A	14.0	10.5	95	7.34	3.6
P-6	0	38.552	10.8	10.9	71	7.91	2.6
P-7	5	N/A	13.0	11.6	67	7.38	2.6
P-8	20	36.25	11.9	11.5	65	7.61	2.2
P-9	DRY[5]						
P-10	DRY						
P-11	00	.22	11.9	11.5	70	6.55	2.8

AMBIENT MONITORING
PERCIVAL CREEK
October 24, 1990

Station	Fecal Coliform	Flows (CFS)	Temp (C)	D.O. (mg/l)	S.C. (uHMOS)	pH	Turb. (NTU)	N+N (mg/l)	TKN (mg/l)	TP (mg/l)
P-1	85	33.13	12.0	11.4	65	7.0	6.8	0.051	0.676	0.084
P-2	20	35.56	11.9	10.8	69	N/A	7.89	0.102	0.714	0.083
P-3	15	4.47	9.75	11.25	75	6.93	3.15	0.335	0.290	0.025
P-4	10	3.24	9.0	8.5	75	6.85	.9	0.207	0.411	0.030
P-5	20 25	1.5	9.0	7.2	79.8	6.68	.8	0.032	0.271	0.054
P-6	20	34.92	12	10.2	60	6.69	8.5	0.043	0.755	0.091
P-7	10	N/A	12.1	14.0	60	6.68	110	0.012	0.833	0.099
P-8	15	26.22	12.2	10.6	62	7.25	7.7	<0.010	0.685	0.092
P-9	DRY									
P-10	DRY									
P-11	DRY									

[5] [illegible] measurable flow

AMBIENT MONITORING PERCIVAL CREEK March 3, 1991										
Station	Fecal Coliform	Flows (CFS)	Temp (C)	D.O. (mg/l)	S.C. (uHMOS)	pH	Turb. (NTU)	N+N (mg/l)	TKN (mg/l)	TP (mg/l)
P-1	225	104.15	8.00	14.2	49.0	7.75	4.8	0.356	0.511	0.042
P-2	165	123.20	8.0	13.4	52.	8.12	3.8	0.348	0.486	0.037
P-3	105 23	27.45	8.0	13.5	60.0	8.81	4.9 4.2	0.435	0.373	0.034
P-4	190	190	8.0	11.0	60.0	8.49	2.6	0.368	0.367	0.026
P-5	40	N/A[6]	8.0	10.0	69.0	8.02	2.10	0.397	0.715	0.096
P-6	100	N/A	8.0	11.2	59.0	8.52	4.8	0.300	0.576	0.041
P-7	50	N/A	8.0	12.8	50	8.77	5.6	0.262	0.493	0.041
P-8	60.0	N/A	8.0	12.4	51	12.4	2.7	0.282	0.508	0.043
P-9	110	6.83	7.0	12.2	29	8.62	49.0	0.069	0.405	0.122
P-10	370	1.54	8.0	12.0	30.	N/A	3.7	0.063	0.218	0.033
P-11	20	3.66	9.0	9.8	90.0	8.72	2.1	0.252	0.276	0.020

[6] Data not available: too deep for flow measurement.

Results of Percival Creek Sediment Analysis					
Station	Contaminant	Concentration	Metals[7] Criteria (ppm)	LAET[8] (ppb)	HAET[9] (ppb)
P-1	Bis(2-ethylhexyl)phthalate	280		1900	1900
P-3	Arsenic	12	10	N/A[10]	N/A
	Butylbenzylphthalate	70		63	450
	Bis(2-ethylhexyl)phthalate	300		1900	1900
P-6	Bis(2-ethylhexyl)phthalate	74		1900	1900
P-7	Mercury	0.3	.10	N/A	N/A
	Cyanide	7.1	N/A	N/A	N/A
	Bis(2-ethylhexyl)phthalate	1600		1900	1900
	Benzo fluoranthenes	1600		1700	9800
P-8	Mercury	0.2	.10	N/A	N/A
	Cyanide	5.0	N/A	N/A	N/A
	Bis(2-ethylhexyl)phthalate	4400		1900	1900
P-10	Lead	190	50	N/A	N/A
	Mercury	0.2	.10	N/A	N/A
	Nickel	37	100	N/A	N/A
	Zinc	320	100	N/A	N/A
	Phenanthrene	1400		1500	5400
	Fluoranthene	2200		1700	9800
	Pyrene	1500		2600	11000
	Butylbenzylphthalate	200		63	450
	Benzo(a)anthracene	910		63	450
	Chrysene	1000		1300	4500
	Bis(2-ethylhexyl)phthalate	2200		1900	1900
	Benzo fluoranthenes	3100		1700	9800
	Benzo(a)pyrene	950		1600	9800
	Indeno(1,2,3-c,d)pyrene	870		600	800
	Benzo(g,h,i,)perylene	830		670	5400

Shaded compounds exceed comparison criteria

[7]Criteria developed by Wisconsin DNR

[8]LAET: Lowest Apparent Effects Threshold

[9]HAET: Highest Apparent Effects Threshold

[10]Data not available

YAUGER PARK SEDIMENT SAMPLING
OCTOBER 2, 1991

Station #1 - Outlet Pond
Time - 1:15 PM

Samples were collected in the sedimentation pond in the Yauger Park system at the corner of Cooper Point Road and Capital Mall Drive. Using a pre-cleaned stainless steel spoon, sediment was scraped off the surface at 5 locations within the pond area and composited in a clean glass container. Two of the sample locations were near the outlet structure where the sediments were moist. Two samples were collected where run-off from Capital Mall enters the pond. One sample was collected in an upper, dry area of the pond.

Station #2 - Capital Mall Pond
Time - 1:30 PM

Samples were collected at 5 locations within the pond area and composited in a cleaned glass jar. Three samples were located near the pipe which discharges to the pond where the soils were visibly wet. Two were collected in dry upper areas of the pond area.

Station #3 and 4 - Baseball Field
Time 1:50 PM

Samples #3 and 4 are replicate samples of the same area. They were collected from the southern most baseball field in Yauger Park, the one closest to the outlet. Samples were collected from 5 areas and composited. Two sampling sites were located inside the baseball diamond, one was just behind the fence near home plate, and two sites were located in the grass area in the outfield. The soil in the baseball diamond area was very compact and difficult to sample. The samples collected from those areas represent only the very surface material.

Samples were refrigerated and shipped by Greyhound bus to AmTest Inc. in Redmond for analysis.

The samples were analyzed for Total Percent Solids, Total Metals for cadmium, nickel, lead, and zinc (Method 6010), mercury (Method 7470), and semi-volatile organics (EPA Method 8270).

YAUGER PARK SEDIMENT SAMPLING RESULTS
SAMPLING DATE - OCTOBER 2, 1991

STATION # and NAME	1 Outlet Pond	2 Capital Mall Pond	3 Ball Field 1	4 Ball Field 2	CRITERIA (ppm)	
PARAMETERS					Prov. Sed. Qual. Guidelines[1]	Wisconsin DNR[2]
Total Solids (%)	69	81	99	99		
Cadmium (ppm dry wt.)	< 0.26	<0.23	<0.17	<0.29	0.6	1
Mercury (ppm dry wt.)	0.136	0.207	0.031	0.019	0.2	0.1
Nickel (ppm dry wt.)	42.	28.	28.	29	16	100
Lead (ppm dry wt.)	64.	84.	3.5	4.4	31	50
Zinc (ppm dry wt.)	230	300	54.	47	120	100
POLYAROMATIC HYDROCARBONS (PAH)					Puget Sound Apparent Effects Threshold (AET) Values[3]	
Low Molecular Weight PAH (ppm dry weight)					Lowest AET	Highest AET
Phenanthrene	.680	1.20	<.062	<.067	1.5	5.4
High Molecular Weight PAH (ppm dry weight)						
Fluoranthene	1.90	2.40	<.062	<.067	1.7	9.8
Pyrene	1.90	3.30	<.062	<.067	2.6	11.0
Benzo(a)anthracene	.840	.790	<.062	<.067	1.3	4.5
Chrysene	1.50	1.70	<.062	<.067	1.4	6.7
Benzo(b)fluoranthene	1.60	.920	<.062	<.067	3.2[4]	8.0[4]
Benzo(k)fluoranthene	.690	1.30	<.062	<.067		
Benzo(a)pyrene	.780	.950	<.062	<.067	1.6	6.8
Indeno(1,2,3-cd)pyrene	<.850	.940	<.120	<.130	.60	.88
Benzo(g,h,i)perylene	<.850	.950	<.120	<.130	.67	5.4

STATION # and NAME	1 Outlet Pond	2 Capital Mall Pond	3 Ball Field 1	4 Ball Field 2	CRITERIA (ppm)	
PHTHALATES (ppb dry weight)						
Butylbenzylphthalate	<.430	.570	<.062	<.067	.063	.47
bis(2-Ethylhexyl)phthalate	20.0	9.60	.410	.290	1.9	1.9
Di-n-octylphthalate	.640	.380	<.062	<.067	*N/A	N/A

[1] Provincial Sediment Quality Guidelines developed by Ontario Ministry of the Environment, May 1991.
[2] Criteria developed by Wisconsin Department of Natural Resources, 1985.
[3] Puget Sound Apparent Effects Threshold, Tetra Tech 1987.
[4] Benzofluoranthenes criteria includes benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(j)fluoranthene.
* N/A - Not Available.

Detection Limits for Undetected Semi-Volatile Organic Compounds in Sediment Samples
Yauger Park Sampling Project; October 2, 1991
EPA Analytical Method 8270; (ug/Kg dry wt.; ppb)
EPA Acid Digestion for Soils Method 3050

Compound	Lower Detection	Upper Detection
N-Nitrosodimethylamine	150	1100
Aniline	62	430
2-Chlorophenol	62	430
Bis(2-chloroethyl)ether	62	430
Phenol	62	430
1,3-Dichlorobenzene	62	430
1,4-Dichlorobenzene	62	430
1,2-Dichlorobenzene	62	430
Benzyl Alcohol	62	430
Bis(2-chloroisopropyl)ether	62	430
2-Methylphenol	62	430
4-Methylphenol	62	430
N-Nitroso-di-n-dipropylamine	62	430
Hexachloroethane	62	430
Nitrobenzene	62	430
Isophorone	62	430
2-Nitrophenol	150	1100
2,4-Dimethylphenol	62	430
Bis(2-chloroethoxy)methane	62	430
2,4-Dichlorophenol	62	430
1,2,4-Trichlorobenzene	62	430
Napthalene	62	430
Benzoic Acid	150	1100
4-Chloroaniline	62	430
Hexachlorobutadiene	62	430
2-Methylnapthalene	62	430
4-Chloro-3-Methylphenol	62	430
Hexachlorocyclopentadiene	150	1100
2,4,6-Trichlorophenol	62	430
2,4,5-Trichlorophenol	62	430
2-Chloronaphthalene	62	430
2-Nitroaniline	150	1100
Acenaphthylene	62	430
Dimethyl phthalate	62	430

Detection Limits for Undetected Semi-Volatile Compounds in Sediment Samples (cont.)
Yauger Park Sampling Project; October 2, 1991
EPA Method 8270; (ug/Kg dry wt.; ppb)
EPA Acid Digestion for Soils Method 3050

Compound	Lower Detection	Upper Detection
2,6-Dinitrotoluene	150	1100
3-Nitroaniline	150	1100
Acenaphthene	62	430
2,4-Dinitrophenol	310	2100
2,4-Dinitrotoluene	150	1100
4-Nitrophenol	150	1100
Dibenzofuran (diphenylene oxide)	62	430
4-Chlorophenyl-phenyl ether	62	430
Fluorene	62	430
Diethyl phthalate	62	430
4-Nitroaniline	150	1100
2-Methyl-4,6-dinitrophenol	150	1100
N-Nitrosodiphenylamine	62	430
Azobenzene	62	430
4-Bromophenyl-phenyl ether	62	430
Hexachlorobenzene	62	430
Pentachlorophenol	150	1100
Phenanthrene	62	67
Anthracene	62	430
Di-n-butyl phthalate	62	240
Fluoranthene	62	67
Benzidine	1500	11000
Pyrene	62	67
Butylbenzylphthalate	62	430
3,3-Dichlorobenzidine	93	640
Benzo(a)anthracene	62	67
Chrysene	62	67
bis(2-Ethylhexyl)phthalate	--	--
Di-n-octyl phthalate	62	67
Benzo(b)fluoranthene	62	67
Benzo(k)fluoranthene	62	67
Benzo(a)pyrene	62	67
Indeno(1,2,3-cd)pyrene	120	850
Dibenzo(a,h)anthracene	120	850
Benzo(g,h,i)perylene	120	850

TROSPER LAKE WATER QUALITY SAMPLING
OCTOBER 8, 1991

Sampling Location - Approximately the Center of the lake.
Sampling Time - 12:15 PM
Weather Conditions - High Fog with sun breaking through; air temperature in the 50's; calm.
Field Equipment Used - Hydrolab Surveyor II, Kemmerer water sampler, secchi disk, water column sampler.
Field Samplers - Sue Davis and Sammy Blocher, Thurston County Environmental Health Division.

NUTRIENT AND CHLOROPHYLL *A* DATA

Depth meters	Total P mg/l	Ortho P mg/l	NO3-NO2 mg/l	Ammonia mg/l	Chl *a* ug/l	Phaeo *a* ug/l
0	0.021	0.003	0.011	0.063	--	--
5	0.192	0.009	0.029	0.052	--	--
5 - 3 meter water column samples	--	--	--	--	14.5	5.4

Secchi Disk Visibility (water clarity) - 3.25 meters

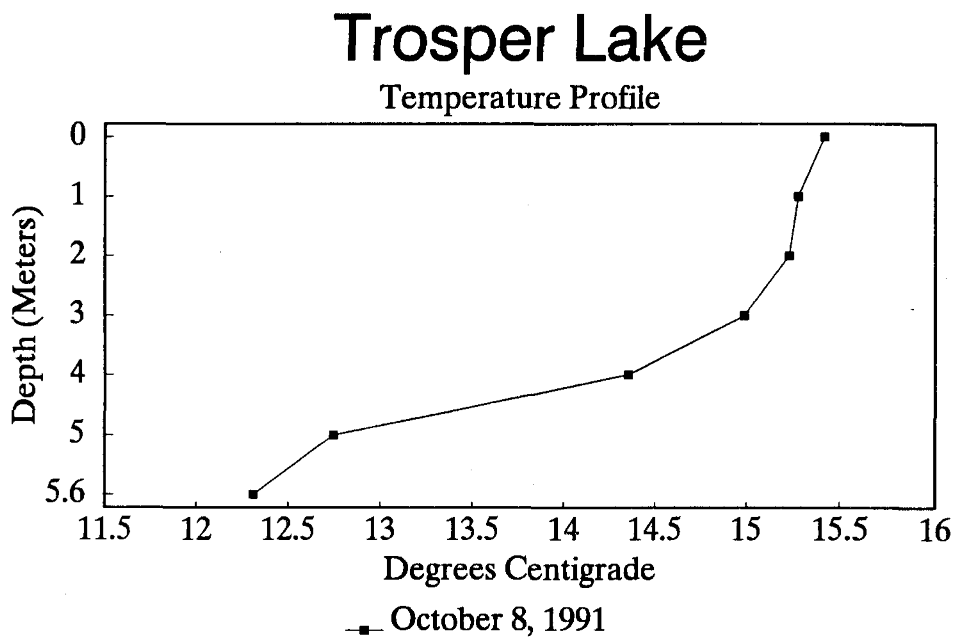
Carlson's Trophic State Index (TSI):

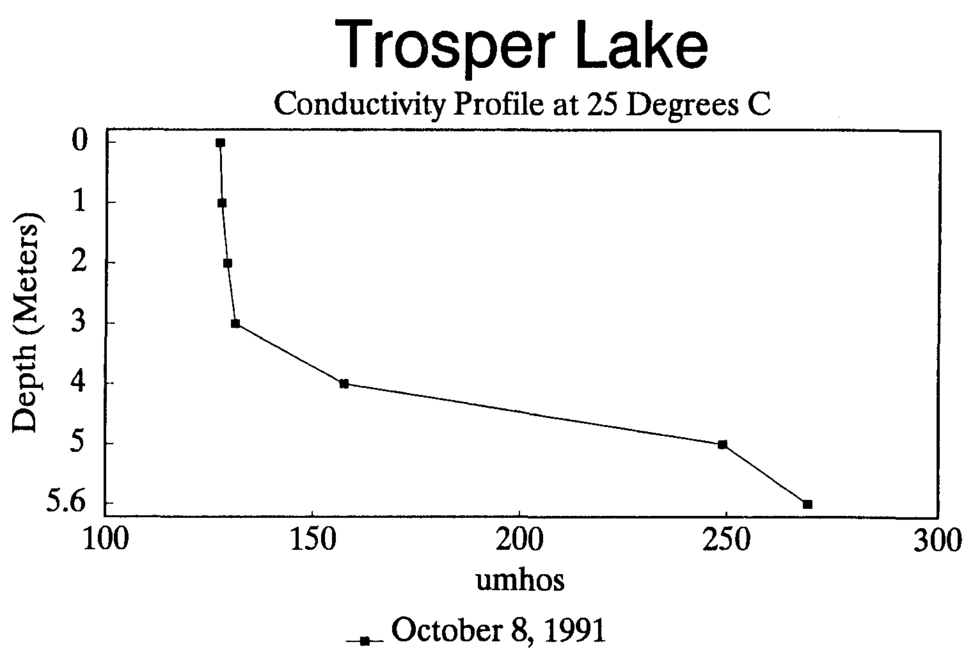
	Oct '91	June '81
$TSI_{Secchi\ Disk}$	43	47
$TSI_{Total\ Phosphorus}$	48	57
$TSI_{Chlorophyll}$	57	48

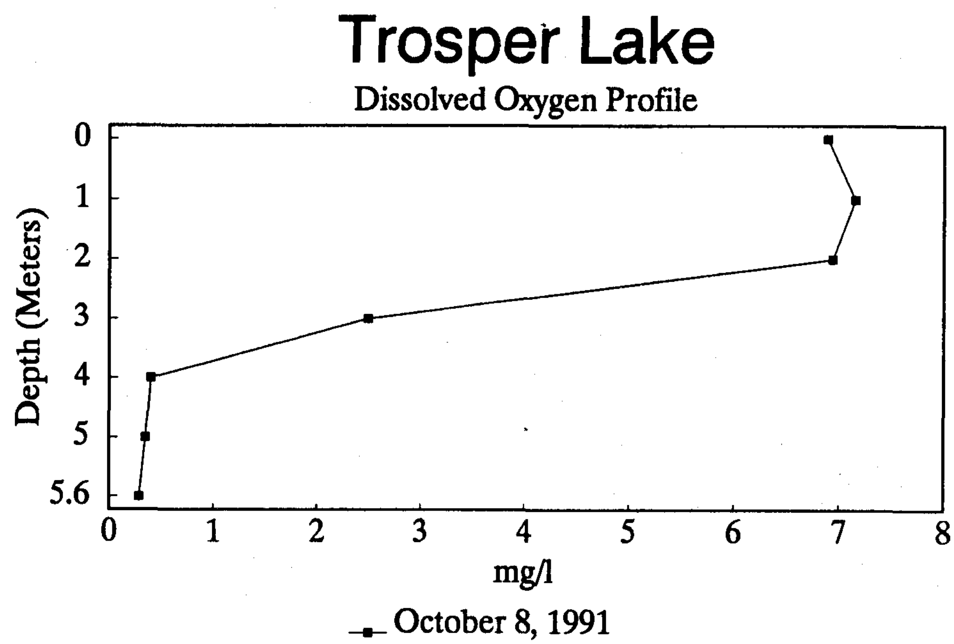
The TSI values are from 0 to 100 with 0 being extremely oligotrophic and 100 being extremely eutrophic. A TSI of 41 is the upper limit of oligotrophy and a TSI value of 51 as the lower limit of eutrophy. The TSI values calculated from the October 1991 data indicates that the lake is in a mesotrophic state, which is very similar to the TSI values calculated for June 1981 by Sumioka and Dion, 1985 (Water Supply Bulletin 57).

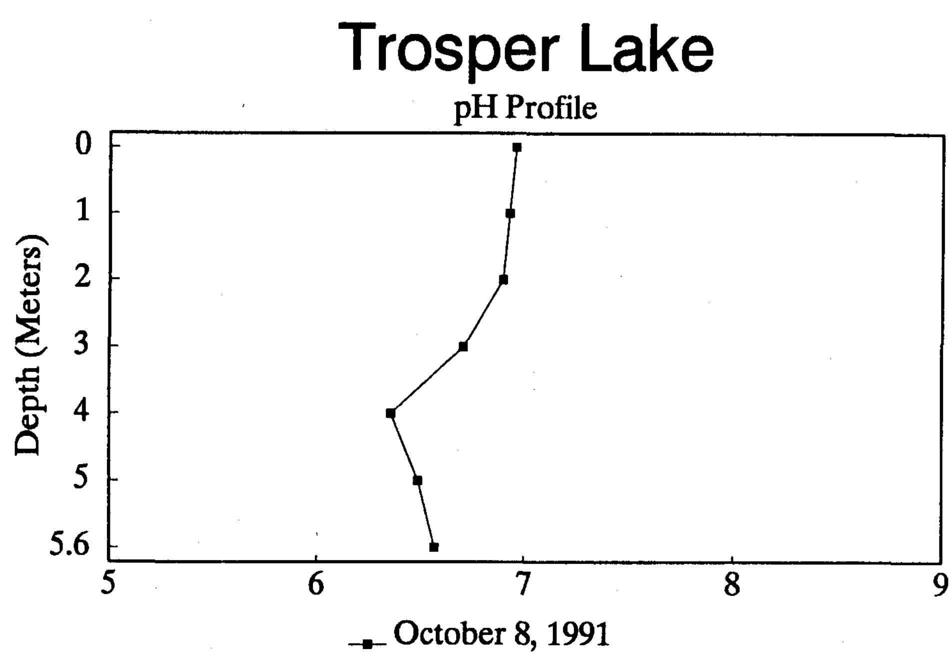
OBSERVATIONS

Water is very clear but dark colored.
Shoreline very natural; no bulkheads.
A lot of wetland vegetation along the shoreline.
Some patches of water lilies near the shorelines.
Approximately 11 houses near the lake.


Trosper Lake
Temperature Profile
Depth (Meters)
0
1
2
3
4
5
5.6
11.5
12
12.5
13
13.5
14
14.5
15
15.5
16
Degrees Centigrade
October 8, 1991


Trosper Lake
Conductivity Profile at 25 Degrees C
Depth (Meters)
0
1
2
3
4
5
5.6
100
150
200
250
300
umhos
October 8, 1991


Trosper Lake
Dissolved Oxygen Profile
Depth (Meters)
0
1
2
3
4
5
5.6
0 1 2 3 4 5 6 7 8
mg/l
October 8, 1991


Trosper Lake
pH Profile
Depth (Meters)
0
1
2
3
4
5
5.6
5 6 7 8 9
October 8, 1991

APPENDIX 6

OPEN SPACE/CLUSTER DEVELOPMENT

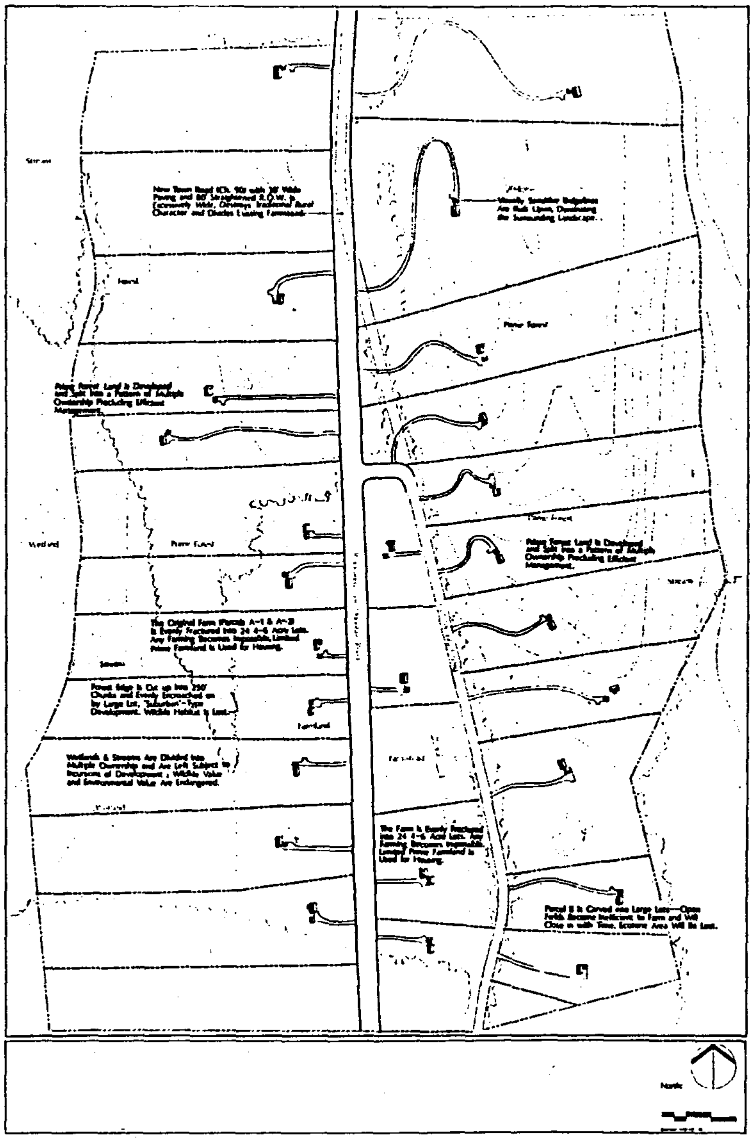
CLUSTER DEVELOPMENT

Creative development techniques are rapidly becoming a standard tool used to more effectively manage natural resources and the patterns of growth. Cluster is a development design technique which arranges buildings on a specific area of a site so as to preserve a portion of the entire site for common open space, recreation, or preservation of environmentally sensitive areas in perpetuity. Techniques such as cluster development are widely used on the east coast as a means of preserving the historic character of towns and rural areas, while at the same time allowing for continued growth.

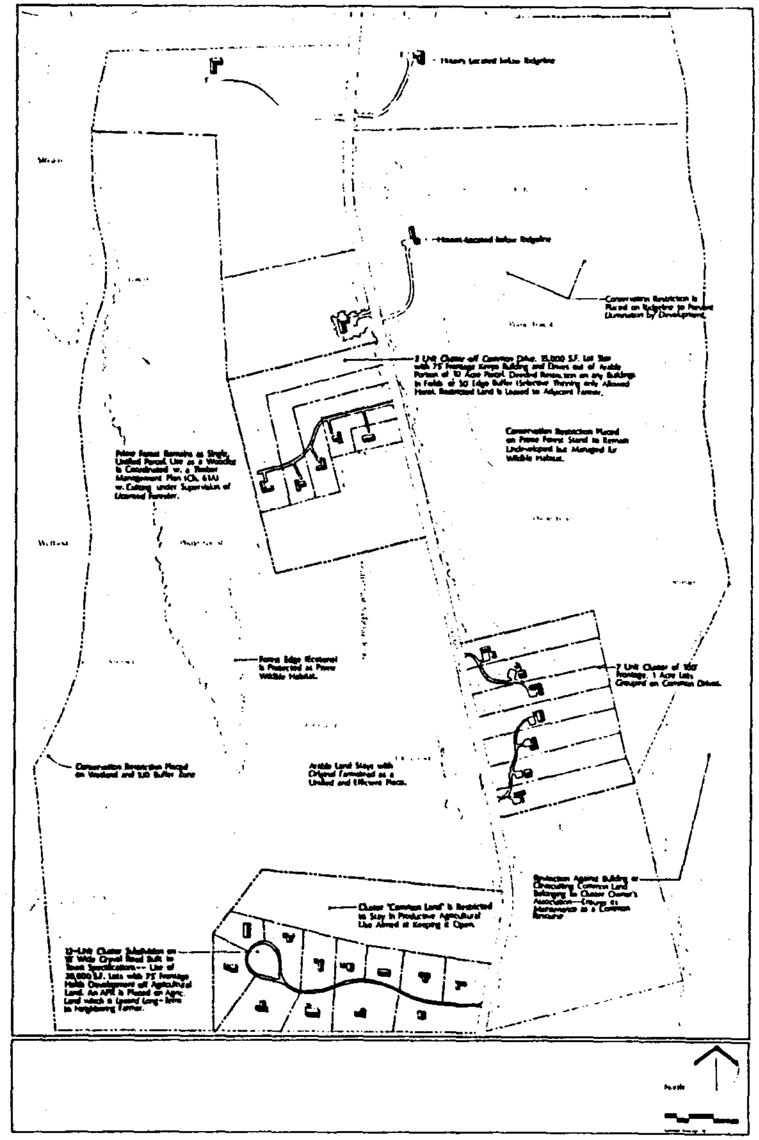
The use of innovative development design such as cluster development is equally advantageous on the west coast. Cluster development is an efficient means of reducing runoff, preserving natural functions, and maintaining aesthetic characteristics of a development site. Natural vegetation not only offers wildlife habitat areas and visual breaks between dissimilar land uses, but also absorbs and intercepts rainfall. Research in western Washington has shown that in undeveloped areas, little or no overland runoff is generated during rainstorms of even the highest intensity and duration. By maintaining a large undeveloped area within a development, cluster techniques substantially reduce the amount of runoff generated by an area.

New development is currently required to meet strict stormwater treatment and storage regulations. These regulations are anticipated to increase substantially in the future. By maximizing the amount of natural vegetation on a site, stormwater volumes can be greatly reduced. By constructing all the buildings on one portion of the site, the amount of disturbed vegetation and impervious road surfaces is minimized. In addition, cluster development is usually more aesthetically pleasing and studies have shown property values in cluster developments to appreciate more rapidly than those in conventional developments.

The following are a series of site plans intended to demonstrate the concept of cluster design. Two residential and one commercial cluster design have been included for comparison. These site plans have been borrowed from Dealing with Change in the Connecticut River Valley: A Design Manual for Conservation and Development. This document has been developed by the Massachusetts Department of Environmental Management and the Center for Rural Massachusetts.

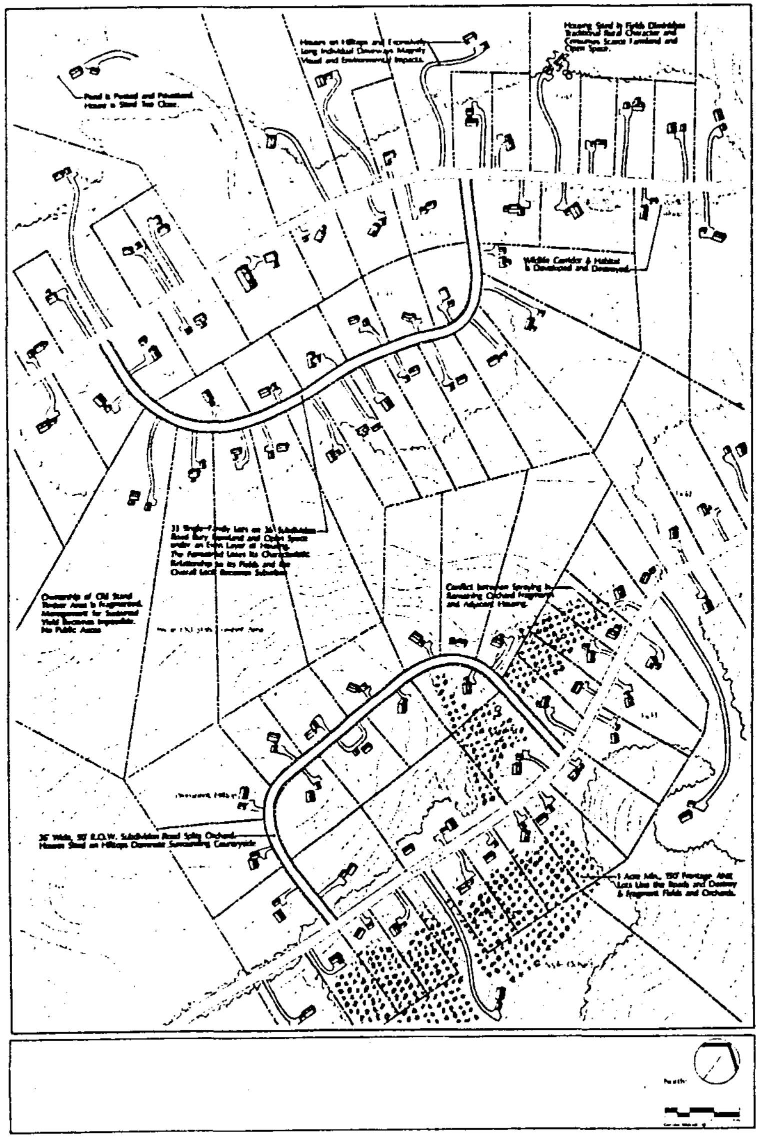


Plan of Site C After Conventional Development

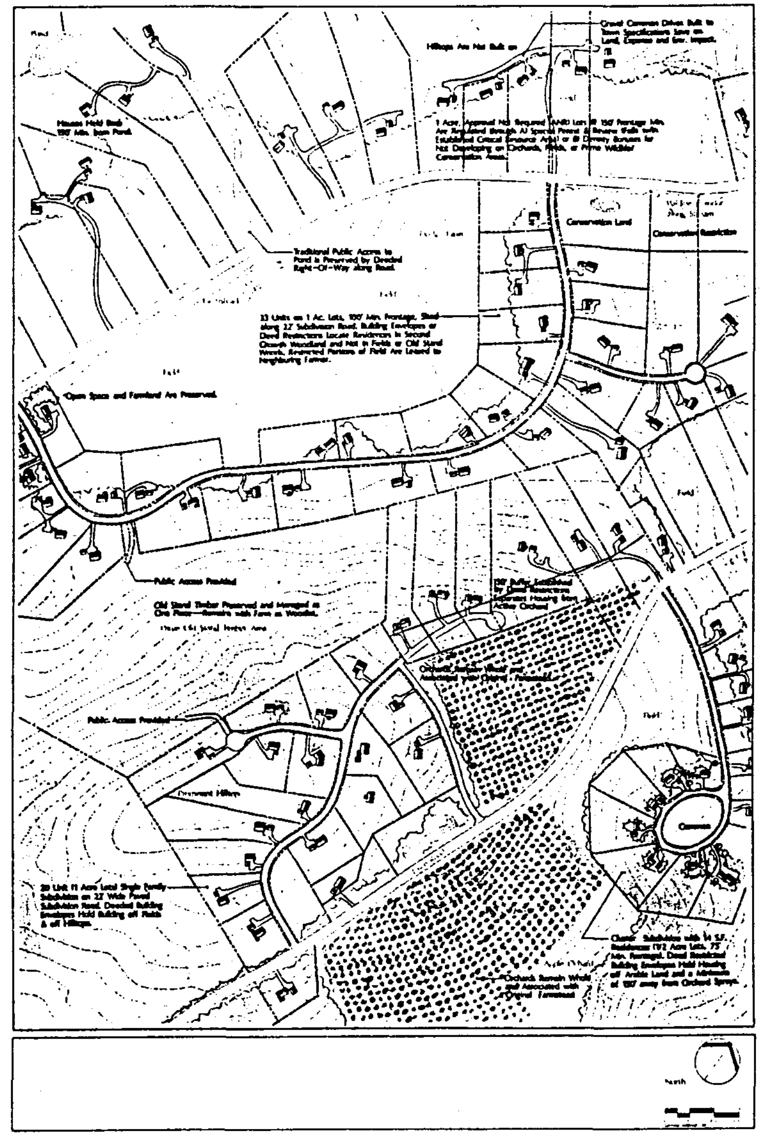


Plan of Site C After Creative Development

Borrowed from: Yaro, Robert, et al. <u>Dealing with Change in the Connecticut River Valley: A Design Manual for Conservation and Development.</u> Cambridge: Lincoln Institute of Land Policy, 1989.

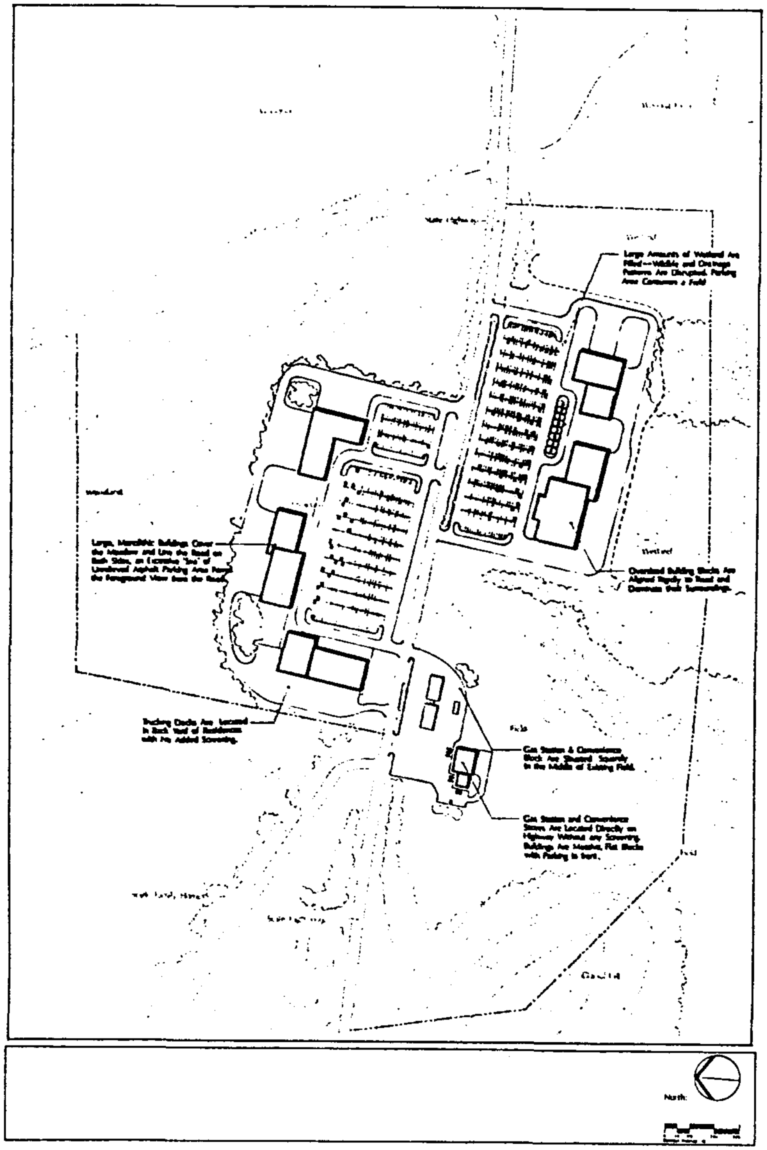


Plan of Site F After Conventional Development

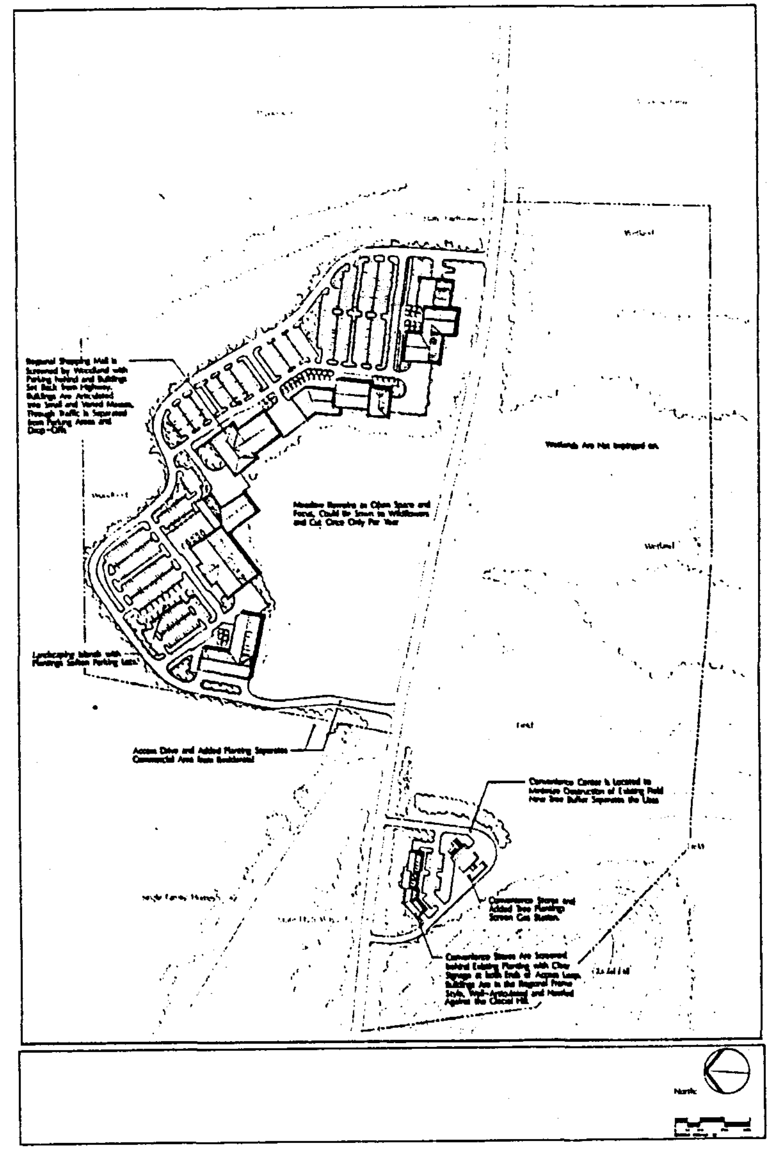


Plan of Site F After Creative Development

Borrowed from: Yaro, Robert, et al. Dealing with Change in the Connecticut River Valley: A Design Manual for Conservation and Development. Cambridge: Lincoln Institute of Land Policy, 1989.



Plan of Site E After Conventional Development



Plan of Site E After Creative Development

Borrowed from: Yaro, Robert, et al. Dealing with Change in the Connecticut River Valey: A Design Manual for Conservation and Development Cambridge: Lincoln Institute of L[illegible] [illegible]icy, 19[illegible]

APPENDIX 7

PUBLIC INVOLVEMENT AND EDUCATION DOCUMENTS

Over the past several years, education has become an integral part of environmental management. As stated in the Washington Department of Ecology's 2010 action agenda, "This has never been more true than it is today, with the dominant sources of pollution so dispersed, and so much a function of deeply ingrained habits, values, and lifestyles. Education can help people regulate themselves by developing widespread understanding of, and appreciation for, what is at stake and how those stakes can be protected." In their analysis of PIE programs throughout the Puget Sound region, the Puget Sound Water Quality Authority found the following deficiencies in PIE programs: *"Most were sporadic or without any sustained funding base; very few agencies allocated staff or budget to education, little coordination occurred resulting in conflicting or poorly targeted messages and inefficient use of educational resources, and there was a need for more teacher training on water related issues."*

A primary justification for the educational approach taken in the Percival basin and the Thurston region comes from the initial level of community interest in water resource related issues, and in particular Stream Team related activities. Nearly 900 individuals have participated in training workshops, action projects (stencilling, clean-ups), and field training since it was initiated in October of 1990. Nearly 2,000 hours of volunteer time have been contributed by Stream Team volunteers to the future health of the Percival, Indian/Moxlie, and Woodard/Woodland Creek basins.

The two final Stream Team workshops, Bugs and Water Quality (July 1991), and Fish Watching (September 1991), were funded through the Percival Creek planning effort. In addition, Olympia Water Resources Program staff will enter into an aggressive phase of outreach during the sixth month review period for the draft, allowing additional opportunities for comment and public input.

The information below illustrates the broad range of PIE approaches taken during plan development. The intent is to analyze the effectiveness of certain approaches and recommend retaining or changing strategies. PIE guidelines and models from other agencies and environmental education groups included in these appendices are:

- Stream Team Statistics
- Regional PIE Approach (ETAC proposal, July, 1991)
- 2010 Guidelines for PIE
- Policies and Guidelines from PSWQA
- Environmental Education Legislation
- PIE Plan for Percival Basin Planning Effort
- Summary of Percival Public Workshop (5/29/91)
- Environmental Education Priorities for EPA Region 10

Stream Team Statistics

The following information on Stream Team activities has been presented in a variety of ways for evaluation purposes. The statistics below reflect a variety of issues and trends relating to public involvement and education.

Participants in workshops and related activities are all asked to voluntarily fill out a Stream Team survey form, which puts them on our official register of available volunteers. One hundred individuals and families are currently on this list. Of the total, 17 surveys (15 percent) listed an interest in Percival basin projects. Twenty-seven (24 percent) of the total number of surveys returned wanted to get involved but had no preference as to where. This reflects a common situation in many communities, people who want to do something to help the environment—but don't know how to get started.

Over 300 individuals have been involved in Stream Team action projects since September 1990. These action projects include revegetation, storm drain stenciling, clean-ups, and wetland walks. They do not include the Stream Team training workshops. Volunteers receive credits toward a T-shirt for these activities. Fifty-two of these individuals (15 percent) have been involved in activities within the Percival basin.

A. Total Stream Team volunteer hours, October 1990 to present - 2,194 hours
B. Total number of Stream Team participants - 699
C. Total number of volunteers interested Percival basin - 17 (15 percent)
D. Total number of registered volunteers interested in "any" basin - 27 (24 percent)
E. Total number of registered Stream Team volunteers - 115 volunteers

1. Stream Team Workshop and Project Overview

The following list includes a summary of all Stream Team workshops and action projects. Projects occurring in Woodland or Woodard Creeks were coordinated by Thurston County, Office of Water Quality staff. (Percival-specific activities appear in bold italics)

Indian Creek Clean-up - September, 1990	30 vol.	x 2 hrs.	=	90 hrs.
Orientation Workshop - October 24, 1990	50 partic.	x 2 hrs.	=	100 hrs.
Orientation Workshop - November 7, 1990	85 partic.	x 2 hrs.	=	170 hrs.
Floods and Flows Workshop - Jan. 24, 1991	85 partic.	x 2 hrs.	=	170 hrs.
Floods and Flows Training - Feb. 22, 1991	20 vol.	x 3 hrs.	=	60 hrs.
Grass Lake Clean-up - March 2, 1991	*6 vol.*	*x 3 hrs.*	=	*18 hrs.*
Landscaping for Healthy Streams Workshop - March 22, 1991	70 partic.	x 2 hrs.	=	140 hrs.
Percival Creek Clean-up - April, 1991	*11 vol.*	*x 1.5 hrs.*	=	*16.5 hrs.*
Woodland Creek Clean-up - April 20, 1991	9 vol.	x 1.5 hrs.	=	13.5 hrs.
Woodard Creek Clean-up - April 20, 1991	16 vol.	x 2 hrs.	=	32 hrs.
Moxlie Creek Revegetation - April 27, 1991	30 vol.	x 3 hrs.	=	90 hrs.
Wetland, Wildlife and You Workshop - May 1, 1991	80 partic.	x 2 hrs.	=	160 hrs.
Woodard Creek Revegetation - May 18, 1991	53 vol.	x 2 hrs.	=	106 hrs.
Woodland Creek Revegetation - June 1, 1991	24 vol.	x 2 hrs.	=	48 hrs.
Streamwalk Workshop - June 5, 1991	35 partic.	x 2 hrs.	=	70 hrs.
Wetland Walks - June 11,13,19,23, 1991	*50 vol.*	*x 3 hrs.*	=	*150 hrs.*
Streamwalk Training - July 16,18, 1991	*20 vol.*	*x 3 hrs.*	=	*60 hrs.*
Totals for region	699 vol/partic.			2,194 hrs.

2. Stream Team Follow-up Training

The following information was collected from the six educational workshops offered in 1991. Volunteers were invited to participate in follow-up training to teach them the skills necessary to implement the field activities.

Floods and Flows (January)	2 hours	- 85 participants
Follow-up training (February)	3 hours	- 20 participants
Landscaping for Healthy Streams (March)	2 hours	- 80 participants
Follow-up training (April)	3 hours	- 30 participants
Wetlands, Wildlife, and You (May)	2 hours	- 80 participants
Follow-up training (June/July)	3 hours	- 50 participants
Streamwalk (June)	2 hours	- 40 participants
Follow-up training (July)	3 hours	- 20 participants
Bugs and Water Quality (July)	2 hours	- 50 participants
Follow-up training (August)	3 hours	- 12 participants
Fish Watching (September)	2 hours	
Follow-up training	3 hours	
	29 hours	- 390 participants
	(as of July 17, 1991)	

3. Stream Team Participation in Events

Participation in the following community events is part of the Stream Team's educational approach and is an avenue for recruiting new volunteers and participation.

Earth Day - Olympia, April 1990 and 1991
Low Tide '91 Urban Shoreline Walk - Olympia, May 1991
Lacey Fun Fair - Lacey, May 1991
Environmental Education Assoc. of Washington Conference - Cispus, May 1991
Sportfishing Expo - Lacey, June 1990 and 1991
Community Awareness Days - Olympia, June 1990 and 1991
Adopt-A-Stream Workshop - Tacoma, July 1991
Northwest Assoc. of Marine Educators Conference - Port Townsend, July 1991

4. Stream Team Captain Statistics

Captains are recruited at Stream Team workshops. Primary duties include working closely with Stream Team staff, training "team" members, and organizing "team" meetings. Whether location or project captains, these volunteers are crucial to the success of the program.

Floods and Flows		
Wetland Walks		
Moxlie Creek Revegetation		
Streamwalk	11 vol.	130 hours

5. Miscellaneous Stream Team Jobs

Implementation of the Stream Team project is often aided by volunteers in the office and in the field. Volunteer skills help diversify the program and provide opportunities for everyone.

Office help Mailings Photography Event Set-up/take down Library	11 vol.	70 hours
	22 captains and other volunteers	200 hours

6. Media Rankings from Stream Team Surveys

This information was collected on workshop evaluation forms. The following media approaches are ranked according to participant preference and effectiveness. One hundred volunteers filled out surveys as of July 17, 1991: 39 ranked media, 61 did not. The ranked media options are as follows:

Community TV	-	4.4
Radio	-	4.2
Schools	-	4.2
CityScape	-	4.0
Newspaper Advertisements	-	3.9
Newsletter	-	2.9
Newspaper Articles	-	2.5
Mail	-	1.9