88-e31

10-22-04

WA-22-0030

Urban Storm Drain Inventory
Inner Grays Harbor

by
G. J. Pelletier
T.A. Determan

Washington State Department of Ecology
Water Quality Investigations Section
Olympia, Washington 98504-6811

July 1988

ABSTRACT

Approximately 90 urban drains which discharge into Grays Harbor were inspected during a dry weather survey in July 1987. Twenty-nine drains were flowing at the time and sampled for a variety of indicator pollutants. Six of the drains sampled exhibited anomalous pollutant levels and suspicious visual characteristics. At least one drain was later found to receive a domestic sewage connection. The results of the present study provide a list of drains which may receive improper domestic or industrial discharges.

INTRODUCTION

Historically, Grays Harbor has experienced severe water quality problems, and by implication, an impaired fishery. It is suspected that these problems have been related to industrial and municipal wastewater discharges and other sources. Extensive studies have been conducted, beginning in the 1930s and continuing to the present, to investigate fish kills in the inner harbor. The current investigations focus primarily on survival of coho salmon. However, a variety of water quality problems are of concern, including low dissolved oxygen, bacterial contamination in shellfish, resuspension of dredged sediments, and potentially toxic industrial discharges (Beyer *et al.*, 1979). Unpublished Department of Fisheries data indicate the problem of coho salmon survival is confined to the lower Chehalis River and inner Grays Harbor during spring out-migration. The Washington State Departments of Fisheries and Ecology, and U.S. EPA in cooperation with industrial and municipal dischargers, are starting an effort to identify and correct the causes of the poor water quality and explain unexpectedly low coho returns to the Chehalis system.

A survey of unregulated discharges to the lower Chehalis River system and inner Grays Harbor was undertaken by Ecology during dry weather to meet the following objectives:

- Locate and map discharges to the lower Chehalis, Wishkah, and Hoquiam Rivers, and inner Grays Harbor.
- Observe discharges, take field measurements, and collect selected samples to prioritize the discharges for further study.
- Recommend candidate discharges for possible additional investigations.

METHODS

The lower reaches of the Chehalis, Wishkah, and Hoquiam Rivers were visited on July 7, 14, and 29, 1987. An effort was made to locate all pipe discharges within the urban area of Aberdeen, Hoquiam, Cosmopolis, and vicinity. Discharges regulated by National Pollutant Discharge Elimination System (NPDES) permits were not included in the survey.

Each of the discharges was visually inspected. A discharge measurement was conducted if possible when flow was present. Approximately 90 drains were observed, of which 29 were flowing, and sampled for a variety of conventional water quality analyses, including fecal coliform, ammonia, nitrate and nitrite, total phosphorus, total solids, total non-volatile solids, total suspended solids, non-volatile suspended solids, and turbidity. In addition, field measurements of temperature, pH, and specific conductance were made. Laboratory testing methods conformed to EPA-approved techniques (APHA, 1985; EPA, 1979).

RESULTS AND DISCUSSION

The most significant result of this investigation is the identification and mapping of approximately 90 discrete discharges in the inner Grays Harbor urban area. The locations of these discharges are presented in Figure 1, and visual observations are summarized in Appendix A. The results of physical and chemical analyses are presented in Table 1.

Sampling was done during dry weather (1.4 inches of rain in Aberdeen during July; less than 0.05 inch during surveys and 24-hour antecedent periods) and seasonal low flow in the Chehalis River. The discharge rates observed in the sampled drains ranged to 0.3 cfs.

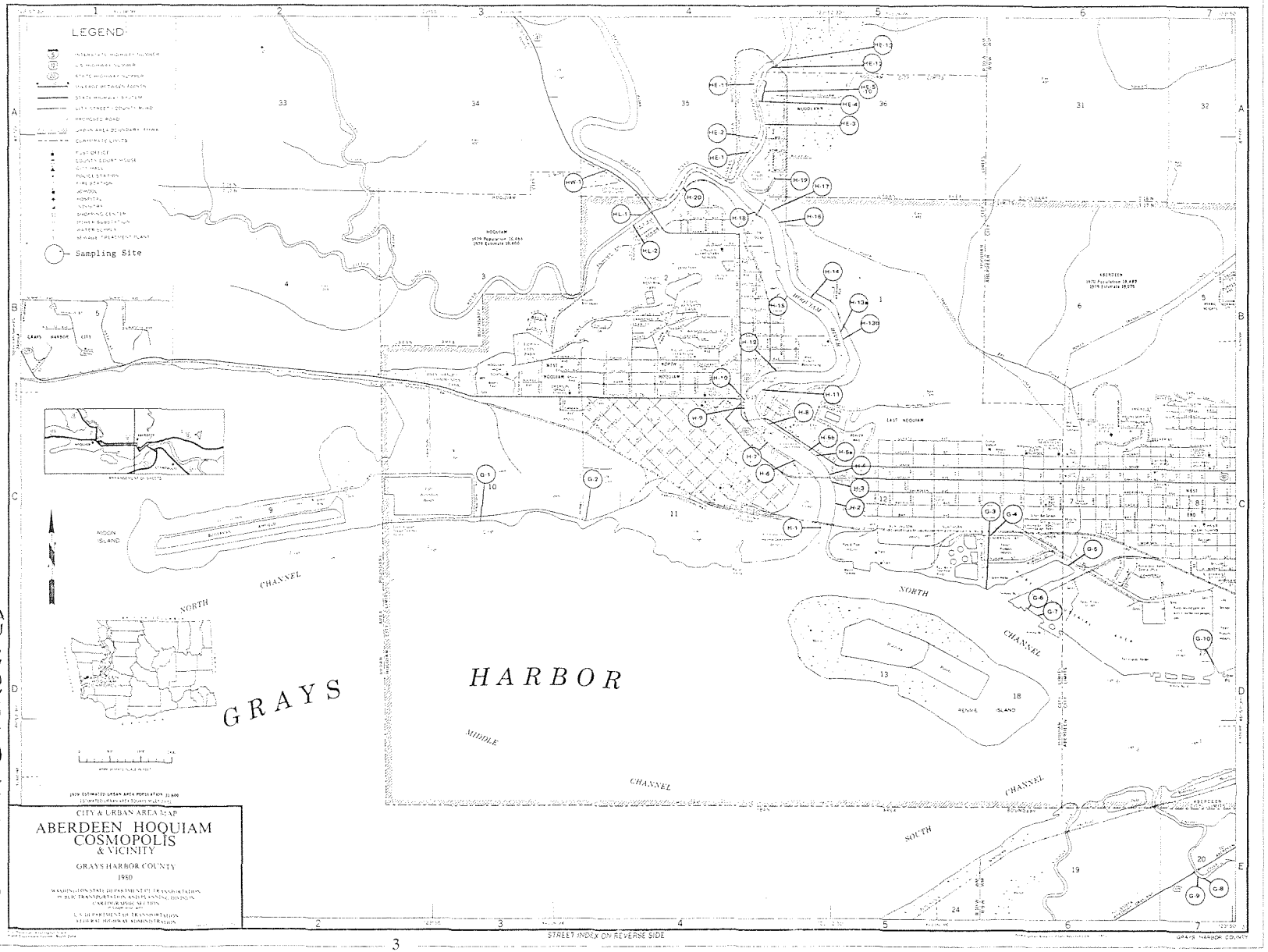
Nineteen of the 29 sampled drains had pollutant levels in the worst 10 percentile for at least one parameter (Table 1). Of these, six drains (H-1, HW-1, W-12, W-18, W-20, and G-2) had values outside the normal 95 percent confidence interval, and three drains (HW-1, W-20, and G-2) had pollutant levels substantially higher than typical urban runoff (Table 1).

Concentrations of indicator water quality parameters are typically high in urban area storm drains due to a variety of sources (EPA, 1983; METRO, 1979), including road runoff, permitted discharges, and illegal connection to domestic and industrial wastewater streams (Schmidt and Spencer, 1986). Although some of the extreme values from the present study are within the expected range for typical urban storm drains, they nevertheless may indicate potentially improper wastewater connections.

The storm sewers for the study area were originally combined sewers, with numerous direct connections to sanitary residential wastewater. During the late 1970s, efforts were undertaken to completely separate domestic wastewater from the storm sewer system. However, it is generally acknowledged that some individual residences may discharge sanitary sewage to the stormwater system (personal communication, Jim Barkman, City of Aberdeen).

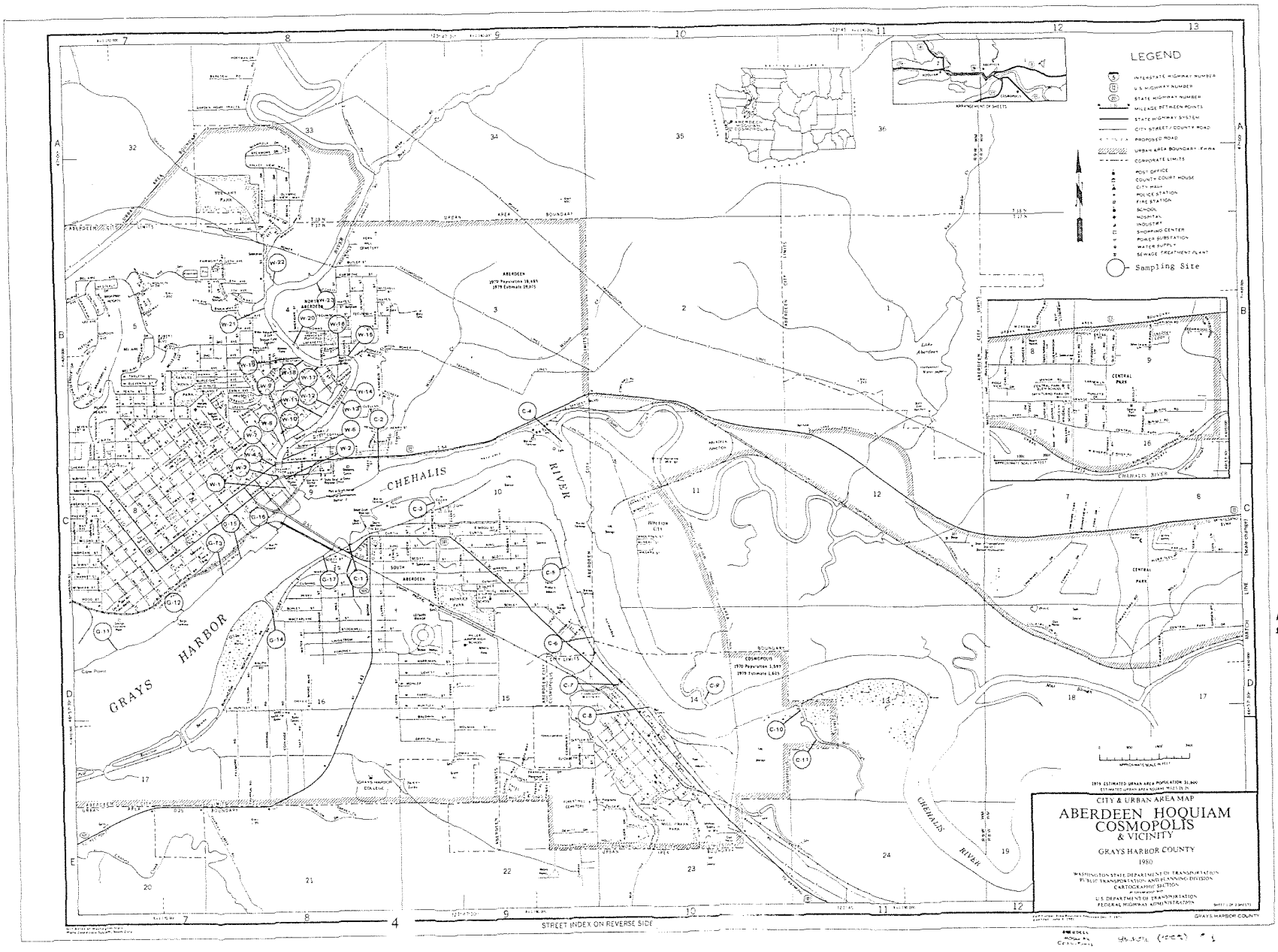
The concentration of fecal coliform bacteria is a useful indicator of possible sanitary connections to the stormwater system. Drains in the Aberdeen urban area with the highest fecal coliform counts (W-18 and W-20) were field checked by the city personnel to identify possible sanitary connections. In one case (drain W-18 at Arthur

Figure 1. Location of Sampling Sites



URBAN AREA SUPERSEDED

Figure 1 (cont). Location of Sampling Sites



URBAN AREA SUPERSEDED

Table 1. Summary of Grays Harbor urban area storm drain sampling results.

Map Ref.	Date	Flow (cfs)	Temp. (°C)	pH (S.U.)	Fecal Coliform (#/100 mL)	NH_3-N + NH_4-N (mg/L)	NO_2-N + NO_3-N (mg/L)	Total P (mg/L)	TS (mg/L)	TNVS (mg/L)	TSS (mg/L)	NVSS (mg/L)	Turb. (NTU)	Lab Result Qualifier Code (#)
H 1	7/07	--	16.2	7.5	44,000 <**	0.36	0.4	0.29 <*	840	620	9	4	10	J(FC)
H-4	7/14	0.002	16.8	7.5	220	0.11	0.2	0.08	18,000 <*	15,000 <*	46	38	12	
H-5a	7/07	--	15.6	7.3	8,700 <*	0.11	0.2	0.08	3,900	3,200	10	8	6	J(FC)
H 5b	7/07	--	13.8	7.6	46	0.01	0.2	0.02	100	60	13	9	4	
H-6	7/07	0.004	16.4	6.8	420	0.09	0.0	0.22	7,300	5,900	19	9	22	
H-7	7/14	0.0044	17.3	6.8	8	0.37	0.4	0.10	19,000 <*	15,000 <*	10	8	13	
H-8	7/14	0.004	15.2	6.9	3	0.45	0.3	0.25	4,300	3,700	13	13	25	
H-14	7/07	<0.5	13.2	7.8	380	0.01	1.2	0.06	160	80	43	39	14	K(NH3)
H-16	7/07	0.06	14.4	7.5	3	0.01	0.0	0.04	170	86	4	2	3	
HW-1	7/29	0.053	15.5	7.2	38	12.00 <***	0.1	0.02	600	480	31	25	62 <*	
W-2	7/14	0.003	18.5	6.9	270	0.50	0.4	0.07	12,000	18	25	10,000 <*	13	
W-3	7/14	0.004	18.0	6.3	6	0.97	0.1	0.09	3,800	8	11	3,300	12	
W-8	7/14	0.001	17.7	7.3	31	0.17	0.0	0.08	1,400	34	41	1,200	8	
W-12	7/14	0.007	17.0	10.1 <**	6	0.01	0.3	0.04	17,000 <*	25	31	14,000 <*	4	
W-13	7/14	0.003	17.7	6.3	9	1.70 <*	0.0	0.06	4,700	38	53	3,900	15	
W-16	7/14	0.07	13.7	6.9	51	0.13	0.4	0.03	360	11	18	260	11	
W-18	7/14	0.02	17.4	4.6 <**	1,100	0.39	0.4	0.23	2,300	90	110 <*	1,900	26	
W-20	7/14	0.06	15.9	6.2 <*	3,100	0.21	0.1	0.29 <*	9,900	210	250 <***	8,500 <*	35 <*	
W-21	7/14	0.17	14.0	6.9	3	0.01	0.0	0.01	63	1	2	33	1	K(FC,NH3,TP)
W-22	7/14	0.1	14.3	7.1	210	0.01	0.0	0.01	99	1	2	24	1	K(NH3,NVSS);U(FC)
C-10	7/14	0.3	25.4 <*	6.8	430	0.04	0.0	0.14	7,900	20	40	6,800	12	J(FC)
G-2	7/29	0.003	22.0 <*	8.0 <*	7,000 <*	0.18	0.4	0.81 <***	890	750	6	5	9	
G-5	7/29	--	22.0 <*	7.6	140	0.10	0.3	0.07	1,100	930	14	13	11	
G-6	7/29	0.006	17.0	7.2	33	0.76	0.0	0.57 <*	5,400	4,400	10	5	9	
G-7	7/29	0.002	--	6.8	8	1.80 <*	0.0	0.25	11,000	8,300	41	32	40 <*	
G-8	7/29	--	20.7	6.9	180	0.10	0.1	0.09	6,800	5,600	23	21	8	
G-9	7/29	0.07	19.5	6.4	240	0.50	0.0	0.07	5,900	4,600	86 <*	61	25	
G-10	7/29	0.042	15.6	7.3	230	0.13	0.1	0.08	15,000	12,000 <*	14	12	9	
G-13	7/14	0.05	16.8	7.6	230	0.33	0.1	0.16	14,000	12,000 <*	11	6	9	
G-15	7/14	--	16.8	7.3	210	0.60	0.2	0.14	4,200	17	24	3,700	18	
Typical Urban Runoff (Mean +/- SE: EPA, 1983; Metro 1979)					21,000 ± 17,000	0.20 ± 0.40	0.56 ± 0.37	0.26 ± 0.20	--	--	67 ± 76	--	--	

Laboratory-result qualifier
J: Estimated value; value not accurate
K or U: Compound was analysed for but not detected. The number reported is detection limit.

* Data flag "<*" indicates sample is among worst 10 percent of samples for that parameter.
** Data flag "<**" indicates sample is outside approximate 95 % distribution interval for parameter.
*** Data flag "<***" indicates sample is outside approximate 95 % distribution interval and >2 standard deviations above typical urban runoff mean for parameter.

Street, discharging to the Wishkah River), a direct residential connection was observed and has since been removed from the system. Three other drains (H-1, H-5a, and G-2) had relatively high fecal coliform levels (Table 1) and may deserve further investigation for potentially improper wastewater disposal.

A summary of urban drains with observed "hits" or elevated levels of at least one water quality parameter is presented in Table 2. Table 3 presents a summary of suspect drains based on visual observations. Of the drains that were found to have anomalous water quality data, six (HW-1, W-13, G-2, G-6, G-7, and G-10) also appeared to exhibit suspicious visual characteristics, as summarized in Table 3. These six drains may be most deserving of further investigation.

CONCLUSIONS AND RECOMMENDATIONS

Most of the drains sampled exhibited pollutant levels within the normal range for typical urban runoff. However, the anomalous levels observed in some of the drains sampled indicate candidate sites for further field checks. The drains which were both visually suspicious and exhibited data outliers should be given highest priority for further investigation. Specifically, the possibility of direct sanitary connections should be checked. Other potential sources, such as illegal industrial or commercial discharges, are also suspected based on the present study, although specific sources cannot be identified. A wet weather survey of storm drains may be of value for detecting potential problems in drains which were not flowing at the time of the present survey.

Table 2. Hit list summary of Grays Harbor urban storm drain sampling results.

Map Ref.	Temp.	pH	Fecal Coliform	Ammonia	Nitrate + Nitrite	Total-P	Total Solids	Total Non-vol. Solids	Total Susp. Solids	Total Non-vol. Susp. Solids	Turb.
H-1			**		*	*					
H-4							*	*			
H-5a			*								
H-7					*		*	*			
H-14					*						
HW-1				***							*
W-2					*					*	
W-12		**					*			*	
W-13				*							
W-18		**							*		
W-20		*				*			***	*	*
C-10	*										
G-2	*	*	*		*	***					
G-5	*										
G-6						*					
G-7				*							*
G-9									*		
G-10								*			
G-13								*			

Footnotes:

*indicates sample is among worst 10 percent of samples for that parameter.
**indicates sample is outside approximate 95 percent distribution interval for parameter.
***indicates sample is outside approximate 95 percent distribution interval and >2 standard deviations above typical urban runoff mean for parameter.

Table 3. Summary of suspect urban storm drains in Grays Harbor based on visual observations.

Map Ref.	Visual Observation	Water Quality Data Outliers
H-3	Suspected residential greywater discharge	
HW-1	Iron-colored filamentous growth	ammonia, turbidity
W-13	Suspected residential greywater discharge	ammonia
G-2	Suspected improper machine-shop wastewater discharge	temperature, pH, fecal coliform, nitrate + nitrite, total-P
G-3	May receive accidental sulfite waste liquor discharges from pipelines that run through the ditch.	
G-6	"Sudsy" dark brown discharge, cooling water from Evans Prod., effluent from Port oil-water separator	total-P
G-7	Oily sheen, iron-colored filamentous growth	ammonia, turbidity
G-10	Oily sheen	total nonvolatile solids

REFERENCES

APHA, 1985. Standard Methods for the Examination of Water and Wastewater. 16th Edition. Amer. Pub. Health Assn,, Wash, D.C., 1134p.

Beyer, D.L., P.A. Kingsbury, and J.E. Butts, 1979. History and current status of water quality and aquatic ecology studies in the lower Chehalis River and Grays Harbor, Washington. Prepared for Washington Public Power Supply System.

EPA, 1979. Methods for chemical analysis of water and wastes. EPA 600/4-79-020.

EPA, 1983. Results of Nationwide Urban Runoff Program. Volume 1: Final Report. EPA WH-554.

METRO, 1979. Urban Drainage Stormwater Monitoring Program. Municipality of Metropolitan Seattle.

Schmidt, S.D. and D.R. Spencer, 1986. The magnitude of improper waste discharges in an urban stormwater system. JWPCF, Vol. 58, No. 7. pp. 744-748.

APPENDIX A. Summary of Visual Observations

Map Ref.	Location	Description	Height (feet above MLLW)	Comments
HOQUIAM RIVER SYSTEM (Main stem Hoquiam River)				
H-1	Right bank, K St. drain (just downstream of RR bridge).	Open channel spills into deep water from bank top.		Flowing; flow not measured
H-2	Right bank, halfway between RR and Hwy 101 bridges).	Open channel 2-3 feet wide.		Not flowing
H-3	Brown house south side of Simpson Street bridge.	Suspected greywater discharge.		Not flowing
H-4	Riverside Drive at 20th Street.	30-inch drain with tide gate.	+3	Flow measured
H-5a	Riverside Drive at 19th Street (300 yards upstream from Hwy 101 bridge).	Stormdrain with tidegate.	+5	Flowing; flow not measured
H-5b	30 feet downstream of H-5a.	Stormdrain with tidegate.	+4	Flowing; flow not measured
H-6	Right bank, foot of 10th St. (200 yards upstream of HWY 101 bridge).	Pipe with tide gate		Flow measured
H-7	Right bank, foot of 8th St. (800 yds. upstream of Simpson Ave. bridge).	Pipe , no concrete head-works, tide gate broken.	+3	Flow measured
H-8	Riverside Dr. at 15th Street.	Drain with tide gate.	+3	Sewer bypass during heavy rain. Most Western Laundry past toxic source. Flow measured
H-9	Right bank, Lincoln Ave near 5th St. (100 Yards north of Riverside Ave. bridge.	48-inch dia. with grate	+4	Not flowing
H-10	Emerson Ave. (200 yards above Riverside Ave. Br.)	Drain with tidegate	+4	Not flowing
H-11	Left bank south of inactive boatworks (70 yards upstream of Riverside Ave. bridge).	V-shaped eroded channel perhaps draining streets.		Not flowing
H-12	Left bank near Chenault Ave.	24-inch dia. corrugated pipe (N of fish plant).	above tide	Not flowing
H-13a,b	Left bank 1500 yards upstream of Riverside Ave. bridge.	Two narrow channels on either side of a point.		Not flowing
H-14	Left bank 1700 yards upstream from Riverside Ave. bridge.	18-inch dia. corrugated pipe with tide gate.	+5	Flow measured
H-15	Right bank near Ramer Ave.	Drain not observed. Reported location shown on map.		

APPENDIX A. (continued)

Map Ref.	Location	Description	Height (feet above MLLW)	Comments
HOQUIAM RIVER SYSTEM - Continued (Main stem Hoquiam River) - Continued				
H-16	Left bank 150-200 yards downstream from 2nd. RR bridge.	Small creek draining marsh.		Flow measured
H-17	Left bank 100-150 yards downstream from 2nd. RR bridge.	Small creek draining marsh.		Flowing; flow not measured
H-18	Right bank Lincoln St. and Queen Ave. (near marina).	Drain; no tide gate; has grill.	+4	Seepage; not measured
H-19	Left bank Panama and Alameda Streets.	Drain not observed. Reported location shown on map.		
H-20	Right bank between east and west-fork confluences.	8-inch dia. pipe.		Seepage; not measured
(East Fork Hoquiam River)				
HE-1	Right bank 300 yards above confl. with Hoquiam R.	Small creek draining alder/hemlock swamp.		Flowing; flow not measured
HE-2	Right bank 400 yards above confl. with Hoquiam R.	As above; deep-V eroded channel.		Flowing; flow not measured
HE-3	Left bank 200 yards south of Hoquiam Plywood mill.	8-inch dia. pipe draining residential area.		Flowing; flow not measured
HE-4	Left bank 100 yards south of Hoquiam Plywood mill.	8-inch dia. with tide-gate draining storeyard.	+3	Flowing; flow not measured
HE-5-10	Left bank, vicinity of Hoquiam Plywood mill.	Small ditch-drains adjacent to plant/storeyards.		Flowing; flow not measured
HE-11	Small farm opposite Hoquiam Plywood mill.	Several ditch-drains		Seepage; not measured
HE-12 & 13	Left bank on either side of Broadway Ave. bridge.	Drain not observed. Reported location shown on map.		
(West Fork Hoquiam River)				
HW-1	Right bank, drainage includes Hoquiam Landfill.	Samples taken west side of HWY 101.		Streambed covered with iron-colored filamentous growth.
(Little Hoquiam River)				
HL-1	Left bank west of US 101 bridge.	Eroded channel draining heavy equipment yard.		Not flowing
HL-2	Cottage Lane	Tide-gate equipped.	+2	Tide encroached on drain, flow status not known

APPENDIX A. (continued)

Map Ref.	Location	Description	Height (feet above MLLW)	Comments
WISHKA RIVER SYSTEM				
W-1	Right bank F St. at State (north of Breakwater Seafood)			Not flowing
W-2	Left bank south of Heron St. bridge.	8-inch pipe with tide gate 8 feet below street level.		Flow measured
W-3	Right bank 100 feet north of Heron Street bridge.	12-inch pipe		Past source of oils and greases. Flow measured
W-4	Right bank south of Wishkah Street bridge.	12-inch corrugated pipe with tide gate.	+8	Not flowing
W-5	Within 10 feet of W-5.	8-inch pipe, no tide gate.	+9	Not flowing
W-6	Left bank north of Wishkah St. Street bridge.	18-inch drain with tide gate.	+1	Tide encroached on drain; flow status not known
W-7	Right bank at South E Street.	30-inch drain with tide gate.	+2	Tide encroached on drain, flow status not known
W-8	Right bank 100 yards north of Wishkah St. br. (S. D St. ?).	30-inch drain with tide gate.		Flow measured
W-9	Right bank between South D and South C Streets.	6-inch drainpipe, no tide gate.	above tide	Probable parking lot drain. Seepage
W-10	Right bank at South B Street (near defunct boatyard).	8-inch pipe	Not noted	Not flowing
W-11	Right bank near Grant Street.	6-inch drain, several 3-inch drains.	above tide	Suspected abandoned house waste drain. Seepage
W-12	Right bank 300-400 yards NE of Wishkah Street bridge.	No pipe; water seeps from under log bulkhead.	above tide	Flow measured
W-13	Left bank about 500 yards north of Wishkah St. bridge.	12-inch PVC line above intertidal zone.	+9	Probable residential grey-water drain. Flow measured
W-14	Left bank 50 to 75 yards NE of W-13.	3-inch drain behind yellow house.	above tide	Not flowing
W-15	Left bank 50 yards before reaching Market Street br.	V-shaped eroded channel perhaps draining streets.	above tide	Not flowing
W-16	Left bank on east side of North Aberdeen bridge.bridge.	24-inch drain.	+1	Flow measured
W-17	Right bank near Randall St.	Two small drains (one wood).	+12/+7	Seepage
W-18	Right bank at Arthur Street.	18-inch drain with tido gate.	+5	Flow measured
W-19	Same as W-18 above.	Two 36-inch jet-like outfalls serving a storm-water pump station.	+1	Not flowing
W-20	Left bank near Sheridan and Lafayette Streets.	Small creek	above tide	Flow measured
W-21	Right bank on North B St. between 5th and 6th Avenues.	16-inch reservoir overflow pipe.		Flow measured
W-22	Right bank 200 yards upstream of W-21 above.	Stewart Cr. spills onto mudflat from bank top.		Many seeps drain marshy areas in this section of river. Flow measured
W-23	Left bank 300 yards upstream of Stewart Creek.	Surface drainage from marsh area.		Typical of several more on both banks nearby. None sampled. Flow measured

APPENDIX A. (continued)

Map Ref.	Location	Description	Height (feet above MLLW)	Comments
CHEHALIS RIVER				
C-1	Left bank NE of Aberdeen-Cosmopolis bridge at Scott Street.	Drain not observed. Reported location shown on map.		
C-2	Right bank; Wilson Creek outlet.	Drain not observed. Reported location shown on map.		
C-3	Left bank; urban creek draining South Aberdeen.	Drain not observed. Likely location shown on map.		Weyerhaeuser sort yard located in drainage.
C-4	Right bank ; Elliot Slough.	Deep channel, tidally influenced.		No sources as far as the abandoned RR bridge (1300 yards from slough mouth). Landfill 2.3 miles from mouth.
C-5	Left bank 300 yards north of Weyerhaeuser marine terminal.	Drain not observed. Reported location shown on map.		Drains Weyerhaeuser sortyard.
C-6	Left bank near Taylor St. in South Aberdeen.	Drain not observed. Reported location shown on map.		
C-7	Left bank 500 yards north of Cosmopolis boat launch.	Cosmopolis Waterway/Mill Creek. Specific sources not observed.		Waterway is tide-influenced; receives urban runoff.
C-8	Left bank 100 yards north of Cosmopolis boat launch	Drain not observed. Reported location shown on map.		Cosmopolis sewer pump station bypass during heavy rainfall.
C-9	Right bank; "Ann's Slough".	Slough not explored or sampled.		Used by U.S. Fish and Wildlife Service for study.
C-10	Left bank, Mill Slough draining leachate from Weyerhaeuser Kraft mill.	24-inch pipe with tide gate.	+6	Flow measured
C-11	Mill Slough 50 yards SW of C-9.	Several large submerged pipes draining wetland area.		Drains submerged, flow observed but not measured.

APPENDIX A. (continued)

Map Ref.	Location	Description	Height (feet above MLLW)	Comments
GRAYS HARBOR				
G-1	North shore near Paulson Road.	Drain not observed. Reported location shown on map.		
G-2	North shore; Ditch parallel to Adams Street.	Open ditch on west side of street.		Samples taken adjacent to Lamb Grays Harbor, Inc. Suspected improper wastewater discharge from machine shop.
G-3	Corner of 28th and Henderson 1 block south of pump sta.	36-inch drain with tide gate discharges into tidal ditch.	+4	Sulfite waste liquor pipelines run through the ditch. Ditch may receive accidental spent sulfite liquor from ITT Rayonier. Tide encroached on drain; flow status not known.
G-4	Immediately adjacent to G-3.	18-inch drain with tide gate.	+4	Tide encroached on drain; flow status not known.
G-5	Fry Creek mouth on Port Industrial Road.	Three 5-foot drains with tide gates.	+2	Sample collected from pond behind closed tide gates. Tide encroached on drain; flow not measured.
G-6	North shore between Terminal Nos. 1 and 2.	36-inch drain with tide gate in rip rap wall.	+4	Effluent was "sudsy" and dark brown (cooling water from Evans Prod.; effl. from Port oil-water separator. Flow measured.
G-7	About 50 yards east of G-6.	16-inch drain with tide gate.	+7	Slight oily sheen; streambed covered with iron-colored filamentous growth
G-8	South shore; Charley Creek at State HWY 105 bridge.	Tidally influenced creek. Tide coming in at sampling.		Wetland used as disposal site for wood waste. No flow measurement made.
G-9	Left bank of Charley Creek at HWY 105 bridge.	36-inch drain with tide gate.	+6	Flow measured
G-10	North shore between Terminal No. 4 and Cow Point.	Drain in ravine set back from beach.		Oily sheen visible in pools. Flow measured
G-11	North shore seaward of Aberdeen WTP.	Large drain with tide gate.	+2	Land access through Lakeside Industries (S. Monroe St.). Tide encroached on drain; flow status not known
G-12	North shore 400 yards east of Aberdeen WTP.	Drain not observed. Reported location shown on map.		
G-13	North shore 1300 yards SW of RR bridge (across channel from Cedarwood Forest Products mill).	Large drain with tide gate set back (out of sight) from beach.		Flow measured
G-14	South shore NE of Cedarwood Forest Products mill.	Drain not observed. Reported location shown on map.		Mill treats cedar shakes with phosphoric acid/formaldehyde fire retardants.
G-15	North shore 800 yards SW of RR bridge (derelict ship across navigation channel).	Approx. 24-inch corrugated pipe, no tide gate.	+3	Tide encroached on drain, no time for flow measurement.
G-16	North shore 100 yards SW of RR bridge.	Approx 4-foot drain with tide gate.	+3	Tide encroached on drain, flow status not known, samples not taken.
G-17	South shore SW of Aberdeen-Cosmopolis bridge at Scott Street.	Drain not observed. Reported location shown on map.		