Stream Flow and Analysis Study

by

D. G. Jackson

Westinghouse Savannah River Company

Savannah River Site

Aiken, South Carolina 29808

Lockwood Greene

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E.I. du Pont de Nemours & Company, Inc.
Savannah River Plant

Tim's Branch Drainage Area

Stream Flow & Analysis Study

LOCKWOOD GREENE

Planners/Engineers/Architects/Managers
Atlanta • Dallas • New York • Oak Ridge • Springfield

E. I. DUPONT DE NEMOURS & CO., INC.

SAVANNAH RIVER PLANT

AIKEN, SOUTH CAROLINA

STREAM FLOW AND ANALYSIS STUDY

FINAL REPORT

NOVEMBER 4, 1983

LOCKWOOD GREENE ENGINEERS, INC.

ATLANTA, GEORGIA

PROJECT NO. 83251.04

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ADC &
Reviewing
Official

Deborah L. Hudson
(Name and Title)

Date: 9/17/97

LOCKWOOD GREENE

ARCHITECTS • ENGINEERS

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83251.04

November 3, 1983

Mr. H. Drannon
E. I. du Pont Company
Savannah River Plant
Aiken, South Carolina 29808

Dear Mr. Drannon:

Please find enclosed the final report entitled "Tim's Branch Drainage Area - Stream Flow & Analysis Study". The report is complete with the exception of TTO (total toxic organics) analyses, which are in progress at this time. The results of TTO analyses will be forwarded under separate cover as soon as they become available.

We appreciate the cooperation you and your associates have extended to us during the course of this study.

Very truly yours,

LOCKWOOD GREENE ENGINEERS, INC.

Charles P. Nichols

Charles P. Nichols, P.E.
Project Manager

CPN/pc

Enclosure

150 YEARS
OF DESIGN

NEW YORK • SPARTANBURG • ATLANTA • DALLAS

STREAM FLOW AND ANALYSIS STUDY

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SECTION 1 - INTRODUCTION

Lockwood Greene Engineers, Inc. (LGE) was retained by E. I. duPont de Nemours and Co., Inc., Savannah River Plant, Aiken, South Carolina, to conduct on-site flow measurements and sampling of tributaries and outfalls flowing into a portion of Tim's Branch Creek. Water samples were analyzed for chemical characteristics.

This report presents the results of the flow and analytical data collected during the 24 hour monitoring period, October 5 and 6, 1983.

SECTION 2 - SCOPE OF SERVICES

Objectives

The objectives of the stream flow and analysis study were as follows:

1. Measure the amount of non-process water flow discharging into Tim's Branch for the purpose of calculating the dilution ratio of future process wastewater effluent with non-process water in Tim's Branch.
2. Calculate the 7 Q 10 flow* of Tim's Branch based on available data from the U.S. Geological Survey and on-site flow measurements.
3. Characterize the dry weather composition of stream and non-process water discharge points by means of a 24-hour composite and grab sampling program at five different points sampled simultaneously.

*7 Q 10 is the lowest 7 day average flow expected on an average of once in 10 years.

Scope of Services

Specifically, the following items were included to accomplish the above objectives:

1. Two days of field observations to determine optimal locations of flow measuring points for the purpose of designing dams and flow measuring devices.
2. Design of four flow measurement structures; fabrication and installation was by others (T&T Construction Group at S.R.P.)
3. Specifications and installation sketches of flow indicators/recorders as required for five flow monitoring stations, described as follows:

Site 1: Tim's Branch tributary.

Site 2: Garage/storm sewer outfall to Tim's Branch tributary.

Site 3: Cooling water/^{private} storm sewer outfall to Tim's Branch tributary.

Site 4: Tim's Branch downstream of Steed's Pond.

Site 5: Tim's Branch upstream of Site 1 above.

4. Four days of on-site consultation and inspection of flow monitoring stations during installation.
5. One set of dry weather 24-hour flow measurements made at five monitoring stations.
6. Review and compilation of meteorological data, USGS data, and calculation of Tim's Branch 7 Q 10 flow.

7. One set of flow proportional 24-hour composite samples and 4-hour spaced grab samples for the five sampling locations during dry weather conditions.
8. Chemical analyses of composite and grab water samples.

SECTION 3 - SUMMARY AND CONCLUSIONS

A. FLOW DATA SUMMARY

1. Flow data was gathered at all five sites over a 24-hour period (approximately 2 p.m., October 5th through 2 p.m., October 6th, 1983). Only 0.01" rainfall had been experienced in the area for 14 days previous to the testing and 0.02" was recorded at 9:30 p.m. October 5, 1983. Instantaneous and continuous flow readings were obtained at each site using direct depth measurements and ISCO Model 1870 flow meters. Due to technical problems with some of the flow meters, the data recorded continuously on charts was not considered accurate for sites 1, 2, 3, and 5. Therefore, only the manually obtained depths and corresponding flow estimates were considered reliable throughout the 24-hour period.
2. The 7 Q 10 (the lowest 7 day average flow expected on an average of once in 10 years) for the USGS gaging station located about 2 miles downstream of Site 4 was calculated to be 1.1 CFS. Based on the ratio of contributing drainage areas, the calculated 7 Q 10 at Steed's Pond (Site 4) was estimated to be 0.88 CFS (395 gpm).
3. Actual flow measurements at Site 4 yielded only 0.43 CFS (193 gpm) and therefore the estimate of the 7 Q 10 based on the USGS gaging

station information is not credible. Soil samples taken by Mr. Virgil Rogers of the Soil Conservation Service on October 19, 1983 indicated a high degree of permeability (25"/hr) in the area downstream of Steed's Pond earthen dam. Rough estimates show that a flow rate of several hundred gallons per minute could be passing through the earthen dam and ground immediately beneath Steed's Pond. Under dry weather conditions, only the flow escaping through the cracks in the wooden section of the dam was observed to contribute surface water to the downstream Tim's Branch creek bed.

B. ANALYTICAL DATA SUMMARY

1. Section 6 provides the results of the analytical tests performed on the samples with the exception of TTO (total toxic organics), which are still in progress.
2. The analytical information available to date indicates no contamination of Tim's Branch from sources identified as Site 2 and Site 3. A relatively high iron content (7.0 mg/l) was noted in the sample from Site 5 (referred to subsequently as "No Name Pond"). Further investigations are recommended to establish the reason for high iron from this source.

C. CONCLUSION

No reliable estimate of the 7 Q 10 at Site 4 can be obtained by conventional means since the measured flow at Site 4 was significantly less than the flow estimated by proportioning the downstream USGS 7 Q 10 flow based on respective drainage areas. A flow rate slightly lower than that measured (0.40 CFS) is recommended at this time for the 7 Q 10. Should this prove not to be acceptable, a more detailed hydrological study will be required to determine the 7 Q 10 at Site 4.

SECTION 4 - DESCRIPTION OF STUDY AREA

A. DRAINAGE AREA DESCRIPTION

According to page 230 of the 1981 Water Resources Data, South Carolina, Water Year 1981, the Tim's Branch drainage basin consists of 17.5 square miles of surface area (from "on-plant" and "off-plant" areas draining into the existing U.S.G.S. gaging station at Tim's Branch downstream of Steed's Pond (refer to Appendix K). The land is largely wooded (softwood) and rolling with some marshy areas and includes developed portions of the "300" and "700" Areas. The soil is generally clayey sand with varying amounts of clay and sand. The Tim's Branch is a tributary of the Upper Three Runs Creek which in turn is a tributary of the Savannah River. A map outlining the drainage area within the SRP is shown in Appendix A.

Five sites were selected for making flow and analytical measurements. The locations of these sites are shown in Appendix B.

A description of these sites is as follows:

<u>Site Number</u>	<u>Description</u>
1	Tributary to Tim's Branch between Sites 4 and 5
2	Concrete pipe under Road D (garage/storm sewer); flows into Site 1 Tributary

- 3 Existing weir at cooling water outfall; flows into Site 1 Tributary
- 4 Approximately 150' downstream from Steed's Pond
- 5 "No Name" pond, downstream from twin culverts; headwaters of Tim's Branch

The highest point in the drainage area that remains perennially wet is estimated to be approximately 1/2 mile upstream from Site 5 where an east-west high voltage power line crosses the stream bed.

The known man-made flow contributors to Tim's Branch include the flows as measured at Sites 2 and 3.

B. STREAM CLASSIFICATION

One criteria for determining the allowable waste load for a stream is its classification. Stream classifications are issued by the South Carolina Department of Health and Environmental Control for those surface bodies of water in South Carolina. A stream classification is based upon hydrological study of a drainage basin to determine the existing biota which rely on the water resources within the basin, to determine the water resources, to quantify these sources, and to determine their downstream uses. The purpose of a stream classification is to ensure that a stream's natural conditions are preserved as well as to protect the users of the water resources.

Tim's Branch does not have a listed classification. The Savannah River, however, is classified as Class B for the reach between Clark Hill Reservoir and Fort Pulaski. Tim's Branch is tributary to this reach via Upper Three Runs Creek. Thus, it is assumed by the South Carolina Department of Health and Environmental Control that Tim's Branch would also be a Class B stream. As enacted by the State of South Carolina, a Class B stream is defined as follows:

"Class B - freshwater suitable for secondary contact recreation and as a source of drinking water supply after conventional treatment in accordance with requirements of the Department. Suitable for fishing, survival and propagation of fish, and other fauna and flora. Suitable also for industrial and agricultural uses."

The specific standards for a Class B stream and general stream classification criteria are presented in Appendix C.

SECTION 5 - STREAM FLOW AND ANALYTICAL RESULTS

A. FLOW DATA

During the week preceding the 24 hour flow measurements, 90 degree V-notch weirs were constructed at Sites 1, 2, 4 and 5. It was concluded from preliminary site investigations that the V-notch weirs would be adequate to measure the flows which were all estimated to be less than 2 CFS. The existing rectangular weir at Site 3 was capable of measuring a wide range of flows and was also acceptable. The design sketches used to fabricate dams and weirs are included in Appendix D.

Upon completion of the dam and weir construction, LGE set up an ISCO Model 1870 flow meter, which continuously records depth, and an ISCO Model 1580 automatic sampler at each site. In order to verify the instrument readings, direct reading measurements were made at 4 hour intervals using rulers. During the course of the 24-hour monitoring period, technical problems with the equipment (erroneous chart readings and weak batteries) made it necessary to rely on the manual measurements. A detailed record of depth measurements and corresponding calculated flows is included in Appendix E. A narrative description of the 24-hour flow testing is included in Appendix F.

The flow test was preceded by 14 days of no significant rain according to rainfall records (refer to Appendix G). The results of the 24-hour dry weather flow measurements are summarized below:

<u>Site No.</u>	<u>Average Flow</u>		<u>Range of Flow Over 24 Hours</u>	
	(CFS)	(GPM)	(CFS)	(GPM)
1	0.525	236	0.490-0.592	220-266
2	0.138	62	0.125-0.160	56- 72
3	0.637	286	0.615-0.692	276-311
4*	0.403	181	0.397-0.420	178-189
5	0.420	189	0.420	189

*Does not include an estimated 15 GPM flow observed from a small tributary downstream of weir.

The flow measurement results lead to several observations as follows:

1. The flow at Site 1 was significantly less than the sum of flow at Sites 2 and 3. No known surface or piped flow is known to enter or leave the tributary between these two locations. The known flows from Sites 2 and 3 into the tributary total 0.775 CFS; however, the flow through the weir at Site 1 was 0.525 CFS. The difference of 0.25 CFS could be due to exfiltrate from the stream into the ground through porous native soils underlying the tributary bed.

The dam at Site 1 created a water level with a 20' to 30' long perimeter, such that complete water tightness along the length of the dam was not achieved. Some water losses bypassing the weir were noticed, but not considered significant since the flow losses observed were trickles of water estimated to be on the order of 2 to 3 GPM (0.004 to 0.007 CFS).

2. The flow measured at Site 4 was significantly less than the sum of flows from Sites 1 and 5. The known average flows into Steed's Pond (Sites 1 and 5) total 0.945 CFS, compared to the Site 4 flow measurement of 0.403 CFS. A minor stream was noted entering Tim's Branch about 100' downstream from Site 4. The stream could possibly be the result of seepage through or under the Steed's Pond earthen embankment dam. The surface flow of the minor stream was estimated to be on the order of 15 gpm (0.033 CFS) bringing the total estimated outflow from Steed's Pond to 0.436 CFS.

Since the sum of the inflows were significantly greater than the outflow, a brief investigation was made as to the soil type in the area of the pond to confirm or deny the hypothesis that the difference in flows was primarily due to flow into the ground water.

On October 19, 1983, Mr. Virgil Rogers, a soil scientist with the Soil Conservation Service, was contacted to obtain some permeability data for native soil in the area of Site 4. The results

of this testing indicate that a permeability value on the order of 25" per hour can be expected in the sand/gravel mixture. It was Mr. Rogers' opinion that a very large percentage of the pond's water was escaping through this permeable soil. Some rough calculations made using some simplistic assumptions verify that losses through the earthen dam could add up to hundreds of gallons per minute.

Evaporative losses from Steed's Pond were also calculated based on an annual evaporation of 44 inches. This is equivalent to an average of 0.07 CFS or about 30 gpm, not enough to account for the 0.509 CFS difference.

3. The flow measured at Site 4 is less than the drainage area proportioned flow based on low flow data at the USGS gaging station downstream from Site 4. The USGS daily flow records for Tim's Branch at Road C, are included in Appendix H.

The lowest daily flow on record (3/74-9/82) at the Tim's Branch USGS station was 1.0 CFS. There are 3.53 additional square miles of land draining into Tim's Branch between Site 4 and the USGS Station. The drainage area ratio can then be used to estimate the flow at Site 4. This ratio is $(17.5-3.53)/(17.5)$, or 80%. The resulting lowest daily flow at Site 4 is calculated to be $0.8 \times 1.0 \text{ CFS} = 0.80 \text{ CFS}$. This calculated flow is greater than the measured flow of 0.436 CFS. The reasons for this difference

are possibly due to exfiltration from Steed's Pond as previously noted. A hydrologic investigation would be required to confirm the reason for these flow differences.

B. CHEMICAL ANALYSES

The chemical constituents selected for analysis were recommended by LGE to provide general background data on heavy metals, organics, and typical water related chemical indicators. The recommended list was approved by DuPont without modification.

Composite and grab samples were collected at each of the five sites. The samples were refrigerated and shipped off-site for analysis by independent laboratories (SCL and Mead CompuChem). A list of the constituents analyzed and their respective results are provided in detail in Appendix I and summarized in Section 6. Also included in Appendix I is the complete report prepared by Scientific Control Laboratories, Inc. Only the TTO (total toxic organics) results are not completed at this time.

The collection of samples was accomplished by two methods: composite and grab. The composite samples were collected by the ISCO samplers which were activated by the ISCO flow meters. The samplers were set such that a sample would be collected every time a predetermined volume of water (as measured by the flow meter) flowed over the weir. The samplers and flow meters were calibrated so that a sufficient

volume of sample for laboratory analysis would be collected over the 24-hour period of the study. Unfortunately, equipment malfunction resulting from battery failure prevented proper sample collection at Sites 1, 3 and 5. At the end of the 24-hour sampling period, grab samples were added to the water collected at these sites to ensure sufficient sample quantity for analysis. For this reason, only Sites 2 and 4 represent flow proportional composite samples.

Grab samples were collected every four hours at each site for analysis of volatile total toxic organics (TTO). These samples were collected in a manner so as to not allow any air into the sample bottle. The seven grab samples for each site were then combined into one time averaged composite by SCL, Inc.

SECTION 6 - EVALUATION OF RESULTS

A. DETERMINATION OF 7 Q 10 FOR TIM'S BRANCH AT SITE 4

"7 Q 10" is a short hand abbreviation for the lowest expected 7 day average daily flow in an average 10 year period. It is presumed that this statistic would be used in determining a practical low flow for permissible wastewater loading.

This flow was to be determined at Site 4 since this is the point considered representative of dilution water flow upstream of a future waste treatment plant outfall.

The procedure used to determine the Tim's Branch USGS 7 Q 10 was obtained by the method by H. C. Riggs in Chapter B-1, "Low Flow Investigations", of Techniques of Water Resources Investigations of the United States Geological Survey. The data and graph that was used to calculate the 7 Q 10 is included in Appendix J. Although some deviation does occur and the period of study is relatively short (9 years), a fairly definitive straight line is able to be drawn to establish a pattern. On the basis of this data, a stream flow of 1.1 CFS is estimated to be the 7 Q 10 at the Tim's Branch USGS gaging station.

Since USGS flow data at Site 4 does not exist, the only readily available method of estimating the 7 Q 10 at Site 4 is to proportion the flow based on the ratio of drainage areas; or another method is to use the ratio of simultaneous low flow measurements at Site 4 and the USGS Station.

The drainage area at the USGS station is listed in the USGS Water Data Report SC-81-1 as 17.5 square miles (refer to Appendix K). The area drained by Tim's Branch between Site 4 and the USGS gaging station is shown in Appendix A and measures 3.53 square miles. Site 4 therefore drains $(17.5 - 3.53) \div 17.5 = 80\%$ of the area draining to the USGS station. Therefore, 80% of 1.1 CFS = 0.88 CFS, which is the 7 Q 10, calculated by proportioning drainage areas.

Simultaneous low flow measurements (at the USGS station and Site 4) were not available since the USGS station is no longer operating, according to DuPont personnel who investigated the possibility of obtaining this information. Therefore, the method of calculating 7 Q 10 by the ratio of simultaneous low flow measurements could not be used.

Since the measured flow totaled 0.436 CFS (including the 0.033 CFS tributary downstream from Site 4), the proportional drainage area method results in a 7 Q 10 flow approximately twice as high as the measured daily flow. It should be noted that the measured daily flow is based on one 24-hour flow measurement, while the 7 Q 10 is

projected on a 7 day average flow basis. However, historical data (Appendix H) indicate that the 7 Q 10 at the USGS station (1.1 CFS) is only 10% higher than the lowest daily flow (1.0 CFS) recorded at the USGS station.

According to conversations with the South Carolina Department of Health and Environmental Control, a parameter sometimes associated with 7 Q 10 flows in that area of the state is 0.18 CFS per square mile of drainage area. Since 13.97 square miles drains into the Site 4 area, a "rule of thumb" 7 Q 10 of 2.5 CFS is obtained, obviously too high for use at Site 4 in view of the much lower observed flow.

Due to the limited data available, a flow somewhat less than the measured flow is recommended for estimating the low flow dilution available from Site 4. A low flow of 0.40 CFS (180 GPM) at Site 4 is recommended for low flow dilution estimates and should be acceptable for regulatory permitting purposes since flow measurements were taken during dry weather conditions, prior to which no significant rainfall had occurred over a period of 14 days.

B. ANALYTICAL RESULTS

Table 6-1 summarizes the analytical results. The asterisks indicate those tests which could not be performed on the samples due to an insufficient volume. The cause of the sample loss is unknown.

However, it is suspected that the losses were a result of spillage during shipping of the samples to the laboratory.

As illustrated by Table 6-1, constituent levels in general appear to be relatively low and of the same magnitude expected from natural surface water sources. It is curious, however, that iron is evident in substantially higher quantities at Sites 4 and 5 in comparison with the other sites. The source of the elevated iron concentration may be located upstream of Site 5, or may be naturally occurring in the supply of water to Site 5. However, further site study would be required to make any speculations regarding its source.

TABLE 6-1
ANALYTICAL RESULTS

<u>PARAMETER</u>	<u>CONCENTRATIONS (MG/L)</u>				
	<u>SITE 1</u>	<u>SITE 2</u>	<u>SITE 3</u>	<u>SITE 4</u>	<u>SITE 5</u>
Sodium	0.4	0.3	1.0	0.9	0.6
Copper	0.01	0.02	0.04	< 0.01	< 0.01
Lead	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Nickel	< 0.01	< 0.01	< 0.01	0.01	< 0.01
Iron	1.0	0.11	0.4	5.2	7.0
Total Phosphorus	0.4	0.3	0.2	0.3	0.4
Oil & Grease	0.6	0.2	*	0.5	*
pH	7.45	7.40	7.40	7.20	6.04
Uranium	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
Total Dissolved Solids	61.0	69.0	*	60.0	*
Total Organic Carbon	10.0	9.0	7.0	20.0	10.0
Aluminum	0.6	0.1	< 0.01	< 0.01	< 0.1
Nitrate	0.32	0.29	4.0	3.3	3.2
Total Suspended Solids	2.0	4.0	*	2.0	*
Arsenic	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Nitrite	< 0.1	< 0.1	*	< 0.1	< 0.1
Boron	0.1	0.1	0.4	1.3	< 0.1
Cadmium	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Chromium	0.01	0.01	0.01	0.01	0.01
Lithium	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Phenol	< 0.1	< 0.1	*	*	*
Sulfate	3.0	2.0	*	7.0	3.5
Chloride	3.5	3.2	*	3.3	1.1
Barium	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Mercury	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001
Selenium	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Silver	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
TT0**	--	--	--	--	--

*Insufficient Volume of Sample

**Analytical testing in progress

APPENDIX A - TIM'S BRANCH DRAINAGE AREA MAP

APPENDIX A
TIM'S BRANCH DRAINAGE
AREA

DRAINAGE AREA
INTO SITE 4

ROUTE 125 THROUGH PLANT
CLOSED TO THROUGH TRAFFIC ONLY.
OBTAIN PASS AT GATE.

Jackson

DRAINAGE AREA
BETWEEN SITE 4
AND USGS STATION

USGS SITE

APPENDIX B - SAMPLING SITE LOCATIONS

APPENDIX B SAMPLING SITE

C. ROUTE 125 THROUGH PLANT
ITED TO THROUGH TRAFFIC ONLY.
OBTAIN PASS AT GATE.

TO AUGUSTA 11 MILES
Jackson

TO AUGUSTA 9 MILES

TO AIKEN

APPENDIX C - SOUTH CAROLINA WATER CLASSIFICATION STANDARDS

reprint

removed

APPENDIX D - DAM AND WEIR DESIGN SKETCHES

PLAN VIEW

NOTE SEE TYPICAL DETAILS
ON SHEET SK-6

APPENDIX D

WEIR AT SITE 2
(EFFLUENT FROM R.C.P.)

100 name
DUPONT STREAM STUDY

[illegible]

APPENDIX D

sheet title		WEIR AT SITE 4 (STEED'S POND)	
job name		DUPONT STREAM STUDY	
drawn by	P. SMITH	job no.	R3251.04
dept. ck.		date	9/20/83
dept. appr.		rev no.	
coord ck.		scale	NONE
p.m. appr.		dwg. no.	SK-4
client appr.			

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ARCHITECTS - ENGINEERS
1830 WEST PEACHTREE STREET N.W.
ATLANTA, GEORGIA 30387-8801

no	date	REVISION	by	ck	appr

sheet title WEIR AT SITE 5 (NO NAME POND)		job no. 83251.04		date 9/20/83	
job name DUPONT STREAM STUDY		scale NONE		rev. no. SK-5	
drawn by P. SMITH		dept. ch. LOCKWOOD GREENE		dept. app. ARCHITECTS - ENGINEERS	
coord. ch. 1300 WEST PEACOCK STREET N.W.		p.m. app. ATLANTA, GEORGIA 30307-8401		client app. 	
no. 		date 		revision

SECTION THRU WEIR

SECTION THRU WEIR @ 2' DEPTH

FRONT VIEW OF WEIR (LOOKING UPSTREAM)

NOTE #4 OR LARGER REBAR RDO MAY BE USED INSTEAD OF WOODEN STAKE.

SECTION THRU 2"x2" STAKE

SECTION THRU NOTCH IF PLATE THICKNESS > 1/8"

TYPICAL DETAILS

DUPONT STREAM STUDY

job no	83251.04	date	9/21/83
scale	NONE	rev. no.	
drawn by	P. SMITH	dept. no.	
dept. ch.		dept. app.	
coord. ch.		p. m. app.	
client app.		draw no.	SK-6

LOCKWOOD GREENE
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APPENDIX E - FLOW MEASUREMENT DATA

LOCKWOOD GREENE

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ATLANTA

APPENDIX E

JOB NO. 83251.04

SHEET NO. 1 of 2

DATE 10/6/83

JOB NAME DUPONT

COMPUTED BY BC

SUBJECT SITE #1, #2, #3, #4, #5

CHECKED BY PJS

READING No.	TIME	① MEASURED DEPTH	② METERED DEPTH	(cfs) FLOW ⁺		METERED TOTAL VOL.	(TOT. VOL. TOT. SEC.) Avg FLOW
				①	②		
#1 1	1355	0.541 ft	0.548 ft	0.538	0.556	-	-
2	1755	0.521 ft	0.527 ft	0.490	0.504	7660 cf	0.532 cfs
3	2210	0.541 ft	0.540 ft	0.538	0.536	15370 cf	0.518 cfs
4	0205	0.521 ft	0.526 ft	0.490	0.502	25330 cf	0.553 cfs
5	0550	0.521 ft	0.534 ft	0.490	0.521	34430 cf	0.601 cfs
6	0940	0.541 ft	0.550 ft	0.538	0.561	51150 cf	0.719 cfs DNU
7	1345	0.562 ft	0.573 ft	0.592	0.621	69220 cf	0.907 cfs DNU
#2 1	1420	0.312 ft	0.310 ft	0.136	0.134	-	-
2	1820	0.312 ft	0.310 ft	0.136	0.134	1420 cf	0.099 cfs
3	2225	0.302 ft	0.315 ft	0.125	0.139	3460 cf	0.119 cfs
4	0235	0.323 ft	0.333 ft	0.148	0.160	5730 cf	0.130 cfs
5	0610	0.333 ft	0.337 ft	0.160	0.165	7910 cf	0.139 cfs
6	1000	0.312 ft	0.337 ft	0.136	0.165	10170 cf	0.144 cfs
7	1420	0.302 ft	0.301 ft	0.125	0.124	12360 cf	0.143 cfs
#3 ⁺⁺ 1	1425	0.240 ft	0.238 ft	0.615	0.608	-	-
2	1825	0.240 ft	0.238 ft	0.615	0.608	9130 cf	0.634 cfs
3	2225	0.250 ft	0.250 ft	0.654	0.654	16570 cf	0.575 cfs
* 4	0230	0.240 ft	-	0.615	-	25510 cf	0.586 cfs
5	0607	0.240 ft	-	0.615	-	27450 cf	0.486 cfs
6	0955	0.250 ft	-	0.654	-	-	-
7	1415	0.260 ft	-	0.692	-	-	-
#4 ^{**} 1	1445	0.479 ft	0.480 ft	0.397	0.399	-	-
2	1905	0.479 ft	0.480 ft	0.397	0.399	7630 cf	0.489 cfs
3	2245	0.479 ft	0.480 ft	0.397	0.399	12950 cf	0.450 cfs
4	0255	0.490 ft	0.485 ft	0.420	0.410	18910 cf	0.432 cfs
5	0625	0.490 ft	0.485 ft	0.420	0.410	24210 cf	0.429 cfs
6	1010	0.479 ft	0.484 ft	0.397	0.407	29720 cf	0.425 cfs
7	1440	0.479 ft	0.483 ft	0.397	0.407	36450 cf	0.423 cfs
#5 1	1455	0.490 ft	0.490 ft	0.420	0.420	-	-
2	1920	0.490 ft	0.483 ft	0.420	0.405	6580 cf	0.414 cfs
3	2255	0.490 ft	0.483 ft	0.420	0.405	11890 cf	0.413 cfs
4	0310	0.490 ft	-	0.420	-	17590 cf	0.399 cfs
5	0640	0.490 ft	-	0.420	-	17830 cf	0.314 cfs
* 6	1025	0.490 ft	-	0.420	-	-	-
7	1500	0.490 ft	-	0.420	-	-	-

++ FLOWS FROM FRANCIS FORMULA, CAMERON HYDRAULIC DATA, P. 69

* EQUIPMENT FAILURE

+ FLOWS FROM EQ. 5-45, HANDBOOK OF HYDRAULICS, BRATER & KING

LG FORM 47B (3/80)

** 0.034 ± cfs NOT MEASURED BY WEIR, FLOW ENTERS DOWNSTREAM OF WEIR

LOCKWOOD GREENE

ARCHITECTS • ENGINEERS
ATLANTA

APPENDIX E

JOB NO. 83251.04

SHEET NO. 2 of 2

DATE 10/6/83

JOB NAME Dupont

COMPUTED BY BCL

SUBJECT SITES # 1, 2, 3, 4, 5

CHECKED BY PJS

Avg. Flows (cfs)

SITE	MANUAL MEAS.	METERED MEAS.	TOTALIZER
1	0.525	0.543	0.807 (NOT RELIABLE)
2	0.138	0.146	0.143
3	0.637	*	*
4	0.403	0.404	0.423
5	0.420	*	*

SCHEMATIC OF SITES

Flow Equations:

90° V-NOTCH WEIR $Q = 2.5 H^{2.5}$

RECT. WEIR W/ END CONTR. $Q = 3.33 (1.620 - 0.2H) H^{1.5}$

APPENDIX F - 24 HOUR FLOW MONITORING NARRATIVE

LOCKWOOD GREENE
ARCHITECTS • ENGINEERS
 1330 WEST PEACHTREE STREET N.W.
 ATLANTA, GEORGIA 30367-8501

MEETING MINUTES

MEETING NO. _____

PAGE 1 of 2PROJECT DuPont Flow StudyPROJECT NO. 83251.04HELD AT Savannah River PlantDATE 10/4/83PREPARED BY Pete SmithDATE 10/7/83AttendeesNo.
CopiesAttendeesNo.
Copies

Hank Drannon, DuPont
 Pete Smith, LGE
 Bill Cook, LGE
 Steve Morton, LGE
 Gary Gelderman, LGE

Other distribution: _____

Attendees: Please inform the writer of required corrections or additions to these minutes.

SUBJECTACTION BYDUE DATE

We met at the site on 10/4 at 1:20 p.m. to go over details of our flow measurement and sample taking, etc. Gary obtained temp. badge.

Hank gave us a beeper, 3 pairs of leggings and made arrangements for rubber gloves and boots to be picked up at Steed'd Pond on 10/5 a.m.

LGE dropped off equipment at each site (10/4) in preparation for start up on 10/5. On 10/5 a.m. LGE started calibration, etc. of each machine. At 2:00 p.m. all flow measuring and sample devices were ready. A problem at site 1 with the dam required some lowering of weir plate and shifting of sand bags. At 2:00 p.m. all 4 LGE people were involved in initializing of the devices. Morton and Cook left after the initial run and then returned to hotel. Smith and Gelderman took first 12 hour shift which began at 2:00 p.m. on 10/5. During the first shift the yardstick depth was adjusted at Sites 2 and 4. At 9:30 p.m. a slight shower occurred

MINUTES OF MEETING NO. _____

PAGE 2 of 2

PROJECT NAME: DuPont Flow Study	ACTION BY	DUE DATE
<p>totaling only a trace of rain on the order of .01" to .1" of water. No evidence of runoff was apparent and therefore no effect on the streams or ground water is expected.</p> <p>At 1:30 a.m. (10/6) Morton and Cook returned to take the second 12 hour shift. During this joint inspection, it became obvious that several malfunctions were occurring.</p> <p>Site 1 - Pumped only air due to apparent loss of priming and no water had accumulated in the sample jar. Flow recorder pen was apparently stuck also.</p> <p>Site 2 - Flow recorder gear was stuck and chart not moving.</p> <p>Site 3 - Battery had run down.</p> <p>Site 4 - No problems noted.</p> <p>Site 5 - No water had accumulated in the sample jar (as on site 1) and battery was showing signs of weakness.</p> <p>At this point it was decided that we would probably have to amend the way composite sampling was done and rely on the depth readings for the flows.</p> <p>Smith and Gelderman returned at 1:00 p.m. to assist in pick-up and packing of samples and equipment. During pickup at Steed's Pond Smith walked downstream of the site and noted a previously unnoticed tributary from Steed's Pond. The flow was estimated to be 15 gpm by a field estimate of a 5"x1/2" cross section at 2 ft/sec = .034 cfs or 15 gpm. Since this flow is about 100' downstream and represents other flow around or thru Steed's Pond it should be considered constant and added to the weir flows at site 4.</p> <p>DuPont had asked LGE to determine if any surface water existed in the creek bed located about 2000' south of the treatment plant area and draining toward the east. At 3:30 p.m. (10/6) Smith and Gelderman traveled in the creek bed approximately 2000' but found no surface water.</p> <p>All 4 LGE people met at the hotel to obtain chilled gel packs and to go to UPS for packing and shipping. Shipping was complete at 6:15 p.m.</p>		

APPENDIX G - RAINFALL DATA

LOCKWOOD GREENE
ARCHITECTS • ENGINEERS
ATLANTA

APPENDIX G
**RECORD OF TELEPHONE
CONVERSATION**

PROJECT DUPONT STUDY DATE 10-28-83
JOB NO. 83251.04 TIME 3:15 pm
TEL. BILLING _____ PARTIES H. Drannon, M. Kennedy - Dupont
P. Smith - LGE

TOPIC

Mr. Drannon connected me with Mark Kennedy of the Meterologic Group
in charge of maintaining rainfall data. The data showed the
following rainfall on the dates indicated:

13 Sept. 83 - 2.07" Rainfall

20 Sept. 83 - 0.88" Rainfall

21 Sept. 83 - 0.01" Rainfall

5 Oct. 83 - 0.02" Rainfall

This indicates a 14 day dry period between 20 Sept. 83 and 5 Oct. 83
if the .01" rainfall is ignored.

SKETCH

P.J. Smith

APPENDIX H - USGS STATION FLOW DATA

UNITED STATES DEPARTMENT OF INTERIOR - GEOLOGICAL SURVEY

PROCESS DATE IS 10-03-83

STATION NUMBER 02197309
LATITUDE 331712TIMS BRANCH AT ROAD C (SRP)
LONGITUDE 0814145 DRAINAGE AREA

DATUM

STREAM

SOURCE AGENCY USGS
STATE 45 COUNTY 003DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1973 TO SEPTEMBER 1974
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1						---	5.9	4.6	4.3	3.5	3.8	4.9
2						---	6.4	4.6	4.6	3.5	4.5	5.5
3						---	6.2	4.5	4.5	4.3	4.7	6.3
4						---	6.2	4.8	4.3	8.9	5.1	5.0
5						---	17	6.8	4.3	8.5	8.1	5.0
6						---	8.5	5.5	4.5	6.2	13	15
7						---	6.6	5.1	5.3	7.7	7.8	13
8						---	9.0	4.8	9.8	5.0	7.0	7.0
9						---	9.7	4.7	5.1	4.4	5.8	5.5
10						---	7.0	4.6	4.5	4.3	5.5	5.0
11						---	6.4	4.5	4.7	4.1	9.7	4.8
12						---	6.1	6.3	4.3	4.0	6.2	4.5
13						---	6.0	5.5	4.1	3.9	6.9	4.4
14						---	6.2	5.0	4.1	3.7	7.8	4.7
15						---	6.7	4.7	5.1	3.6	5.9	4.7
16						---	5.9	4.8	4.6	3.6	5.1	4.3
17						---	5.6	4.7	4.3	6.2	4.7	5.1
18						---	5.5	4.4	4.1	5.2	4.5	6.4
19						---	5.5	6.8	4.0	4.0	4.2	5.1
20						7.8	5.3	11	4.1	3.9	4.2	4.6
21						12	5.1	6.5	4.1	4.0	4.5	4.4
22						8.2	5.1	5.7	3.9	3.9	4.3	4.7
23						6.7	5.6	5.7	3.9	3.8	4.2	4.9
24						6.4	5.2	5.3	3.9	4.7	4.2	4.2
25						9.0	5.0	4.8	3.8	4.6	4.2	4.2
26						7.7	4.9	5.1	3.9	4.3	4.2	4.3
27						6.8	4.8	7.0	4.0	4.2	4.1	4.4
28						6.6	4.7	5.2	3.9	5.8	4.5	4.4
29						8.5	4.7	4.9	3.8	4.3	7.5	4.2
30						7.2	4.6	4.7	3.6	3.9	6.1	3.9
31						6.1	---	4.4	---	3.8	5.0	---
TOTAL						---	191.4	167.0	133.4	145.8	177.3	164.4
MEAN						---	6.38	5.39	4.45	4.70	5.72	5.48
MAX						---	17	11	9.8	8.9	13	15
MIN						---	4.6	4.4	3.6	3.5	3.8	3.9

UNITED STATES DEPARTMENT OF INTERIOR - GEOLOGICAL SURVEY

PROCESS DATE IS 10-03-83

STATION NUMBER 02197309
LATITUDE 331712TIMS BRANCH AT ROAD C (SRP)
LONGITUDE 0814145 DRAINAGE AREASTREAM SOURCE AGENCY USGS
DATUM STATE 45 COUNTY 003DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1974 TO SEPTEMBER 1975
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	3.8	4.6	7.4	5.6	5.7	6.1	5.7	9.5	5.9	5.0	5.6	4.4
2	4.0	4.7	5.4	5.3	5.7	5.9	9.7	9.1	6.0	4.5	5.3	4.5
3	4.1	4.6	4.8	5.0	7.9	5.5	46	13	6.0	4.3	5.1	4.9
4	4.2	4.6	4.7	5.8	15	5.6	11	14	5.3	4.2	4.9	4.8
5	4.2	5.0	5.1	5.5	9.2	5.5	6.8	6.6	4.9	4.5	4.8	4.8
6	4.1	5.4	5.0	5.1	7.4	5.4	5.8	5.7	4.9	4.3	5.0	7.7
7	4.1	4.8	5.6	5.2	6.2	5.8	5.4	6.2	4.9	5.5	6.0	33
8	4.2	4.6	6.6	6.1	5.8	6.4	5.5	6.5	4.6	5.1	5.7	9.0
9	4.2	4.6	5.7	5.8	5.7	5.5	5.7	11	4.8	4.7	5.5	6.3
10	4.2	4.4	5.4	4.9	5.7	5.6	6.4	8.1	5.3	6.0	6.1	5.9
11	4.1	4.2	5.4	7.9	5.7	6.7	6.2	7.8	6.4	25	23	5.7
12	4.1	4.3	5.4	12	16	7.7	5.7	6.5	42	12	11	6.7
13	4.0	4.1	5.4	17	10	6.5	5.2	6.0	9.4	6.8	6.4	16
14	4.1	4.1	5.3	7.4	6.9	9.9	12	5.5	6.2	7.4	5.4	7.7
15	4.3	4.4	8.9	6.0	6.0	7.0	11	5.8	6.2	30	5.0	5.8
16	4.4	4.3	16	5.5	6.1	9.8	6.5	6.4	8.1	16	5.2	5.7
17	4.6	4.2	7.5	5.2	13	11	5.8	11	6.1	14	5.2	11
18	4.4	4.6	6.3	5.3	10	12	5.4	14	5.7	9.8	4.6	36
19	4.2	4.5	6.9	5.3	55	24	5.3	6.6	5.4	7.3	5.4	14
20	4.1	5.2	14	6.1	24	9.3	5.1	5.7	5.5	6.4	5.4	8.1
21	4.1	5.0	12	5.7	9.1	7.9	4.8	5.4	6.0	5.8	4.7	7.9
22	4.2	4.3	6.9	5.3	10	6.4	4.8	5.1	5.1	5.6	4.5	7.5
23	4.1	4.1	6.1	6.8	12	5.9	4.9	4.9	4.7	5.4	4.4	7.5
24	4.2	4.2	6.1	14	11	11	4.9	4.8	4.6	5.6	4.3	7.0
25	4.2	4.2	6.6	18	7.9	23	5.0	4.6	10	8.2	4.2	6.5
26	4.2	4.2	6.1	11	6.4	9.0	4.8	6.5	14	6.8	4.1	6.2
27	4.1	4.2	5.5	7.5	5.9	6.5	4.9	15	7.8	6.0	4.3	5.9
28	4.1	4.1	5.5	5.7	6.0	6.0	5.0	6.4	5.7	5.5	4.6	5.5
29	4.2	4.0	6.7	5.6	---	5.9	6.0	5.8	4.8	5.6	4.4	5.5
30	4.2	4.7	6.7	5.7	---	6.3	7.2	5.6	5.0	7.1	4.2	5.7
31	4.5	---	6.0	5.7	---	5.6	---	6.3	---	6.6	4.2	---
TOTAL	129.5	134.2	211.0	223.0	295.3	254.7	228.5	235.4	221.3	251.0	178.5	267.2
MEAN	4.18	4.47	6.81	7.19	10.5	8.22	7.62	7.59	7.38	8.10	5.76	8.91
MAX	4.6	5.4	16	18	55	24	46	15	42	30	23	36
MIN	3.8	4.0	4.7	4.9	5.7	5.4	4.8	4.6	4.6	4.2	4.1	4.4

WTR YR 1975 TOTAL 2629.6 MEAN 7.20 MAX 55 MIN 3.8

UNITED STATES DEPARTMENT OF INTERIOR - GEOLOGICAL SURVEY

PROCESS DATE IS 10-03-83

STATION NUMBER 02197309
LATITUDE 331712TIMS BRANCH AT ROAD C (SRP)
LONGITUDE 0814145 DRAINAGE AREASTREAM
DATUMSOURCE AGENCY USGS
STATE 45 COUNTY 003DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1975 TO SEPTEMBER 1976
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	6.3	4.6	7.1	12	8.6	5.2	5.5	13	9.1	5.1	3.8	3.7
2	6.1	4.6	6.9	7.8	9.2	5.5	5.1	6.3	7.2	4.6	3.7	3.9
3	5.1	4.6	6.4	7.1	8.8	5.3	4.9	4.8	9.3	4.4	3.6	4.0
4	5.0	4.8	6.3	6.8	7.5	5.2	4.7	4.4	12	5.5	3.7	4.1
5	4.9	5.0	6.2	6.1	7.3	5.3	4.7	4.3	8.1	7.5	3.7	4.1
6	4.9	5.0	6.0	6.3	7.0	5.3	4.9	4.2	6.1	7.4	3.7	4.2
7	4.9	6.3	5.8	12	6.6	5.1	4.9	4.2	5.4	6.3	3.7	4.1
8	5.5	6.6	6.1	28	6.1	5.4	4.8	4.8	5.3	5.2	3.6	4.0
9	9.2	5.5	11	11	5.9	8.3	4.7	4.9	7.6	4.7	3.8	4.0
10	6.5	5.7	9.4	8.6	6.3	6.2	4.5	4.2	7.8	4.5	4.2	4.0
11	5.6	13	7.3	7.5	6.6	5.5	4.5	4.3	5.9	4.3	5.0	3.8
12	5.1	24	6.5	7.1	6.3	5.5	4.4	4.4	6.9	4.1	4.4	3.8
13	5.0	32	6.3	7.0	6.1	9.4	4.5	4.1	5.6	4.0	4.1	3.9
14	5.0	10	6.0	6.9	6.2	6.2	4.7	4.1	5.2	3.9	4.0	23
15	5.0	7.1	5.8	6.5	5.8	10	4.8	7.9	5.2	3.9	4.0	30
16	4.9	6.1	7.2	6.4	5.7	39	4.6	6.5	6.4	3.8	3.9	11
17	6.0	5.8	12	7.3	5.9	17	4.3	6.3	7.2	3.8	4.0	5.9
18	6.6	6.0	12	6.7	6.7	13	4.1	5.0	6.7	4.1	3.9	4.9
19	5.2	6.2	7.9	6.1	8.6	8.3	4.0	4.4	5.9	4.0	3.7	4.8
20	5.1	6.2	6.9	6.3	6.8	6.8	4.2	4.2	6.4	3.9	4.1	4.7
21	4.9	6.1	6.3	6.5	6.3	6.1	4.3	4.0	6.5	3.8	4.8	4.8
22	4.9	5.9	6.2	6.3	6.5	5.5	5.5	3.9	5.6	3.8	4.5	4.5
23	4.9	5.6	6.1	6.2	5.9	5.4	4.6	5.9	5.4	4.0	4.3	4.3
24	4.9	5.7	5.9	6.2	5.6	5.3	4.3	12	5.6	3.9	4.1	4.3
25	4.9	6.1	6.0	5.9	5.6	5.3	4.2	11	5.4	3.8	4.2	4.2
26	4.9	6.1	13	7.5	5.6	5.5	4.1	6.3	4.9	3.9	4.3	4.6
27	4.8	6.2	8.1	39	5.5	5.7	4.1	8.7	4.6	3.8	4.2	4.8
28	4.8	5.9	6.9	17	5.4	5.3	4.0	36	5.1	4.1	4.1	4.8
29	5.0	5.8	6.4	11	5.3	5.2	4.0	86	5.0	4.2	4.0	5.0
30	4.9	5.8	8.4	8.1	---	5.4	17	26	5.8	3.9	3.9	5.4
31	4.6	---	15	7.2	---	5.5	---	16	---	3.9	3.7	---
TOTAL	165.4	228.3	237.4	294.4	189.7	237.7	148.9	322.1	193.2	138.1	124.7	182.6
MEAN	5.34	7.61	7.66	9.50	6.54	7.67	4.96	10.4	6.44	4.45	4.02	6.09
MAX	9.2	32	15	39	9.2	39	17	86	12	7.5	5.0	30
MIN	4.6	4.6	5.8	5.9	5.3	5.1	4.0	3.9	4.6	3.8	3.6	3.7

CAL YR 1975 TOTAL 2786.0 MEAN 7.63 MAX 55 MIN 4.1
WTR YR 1976 TOTAL 2462.5 MEAN 6.73 MAX 86 MIN 3.6

UNITED STATES DEPARTMENT OF INTERIOR - GEOLOGICAL SURVEY

PROCESS DATE IS 10-03-83

STATION NUMBER 02197309

TIMS BRANCH AT ROAD C (SRP)

STREAM

SOURCE AGENCY USGS

LATITUDE 331712

LONGITUDE 0814145

DRAINAGE AREA

DATUM

STATF 45 COUNTY 003

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1976 TO SEPTEMBER 1977
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	4.9	7.2	7.4	3.7	3.8	6.2	6.6	4.9	4.3	3.5	5.3	3.9
2	4.5	6.9	6.9	3.4	3.5	5.5	6.3	4.9	4.1	3.5	4.8	3.7
3	4.3	5.9	6.2	4.4	3.6	5.4	6.1	4.8	4.1	3.5	16	3.8
4	4.2	5.8	4.7	5.2	3.9	15	5.6	4.8	4.1	3.5	13	4.9
5	4.1	5.4	4.6	4.4	3.8	11	7.2	4.8	4.1	3.3	6.6	4.9
6	4.1	5.0	4.9	4.1	3.7	17	5.8	4.6	4.0	3.4	5.9	4.2
7	4.3	4.9	9.9	4.6	4.0	22	5.3	4.8	3.9	3.1	5.1	7.4
8	6.5	4.8	6.0	3.5	4.2	11	5.4	4.9	3.8	3.0	4.4	12
9	13	5.1	6.2	3.2	4.4	9.3	5.4	4.7	3.7	2.9	4.0	6.4
10	5.8	5.2	5.9	5.8	4.4	8.7	5.4	4.5	3.6	2.8	3.8	4.9
11	4.8	5.2	7.9	3.9	6.6	8.3	5.4	4.6	3.6	2.8	3.6	4.4
12	4.5	5.0	24	3.7	5.4	7.6	5.3	4.5	4.4	2.8	3.4	4.1
13	4.4	4.8	16	3.9	5.3	15	5.1	4.5	3.8	3.1	3.4	4.0
14	4.3	5.1	9.7	5.9	5.1	7.2	11	4.4	4.0	3.2	3.7	4.1
15	4.2	10	8.9	4.8	5.1	6.5	7.2	4.4	3.1	3.0	4.0	4.1
16	4.3	7.6	7.9	4.2	5.0	6.3	5.3	4.3	3.4	2.8	8.7	4.1
17	8.1	7.6	6.9	4.5	5.9	11	5.1	4.9	3.5	2.8	5.4	4.7
18	6.6	7.3	6.5	4.4	6.4	10	5.1	4.2	3.5	3.3	5.1	4.2
19	5.0	6.8	5.8	4.3	5.8	6.5	5.1	3.8	3.3	3.1	5.7	4.1
20	24	6.3	6.0	4.4	5.2	7.3	5.1	4.2	3.4	3.0	5.4	4.1
21	11	5.9	5.8	4.4	5.0	9.3	5.0	4.1	3.3	3.0	5.2	4.0
22	9.0	5.2	5.7	4.8	5.0	36	5.4	4.3	3.1	3.4	4.8	3.9
23	7.6	4.9	5.8	3.9	5.1	11	7.1	4.3	3.1	3.7	4.7	3.8
24	7.5	4.9	5.0	4.5	12	10	6.7	5.3	3.1	3.3	7.1	3.9
25	8.3	5.0	5.1	4.7	7.0	9.2	5.6	5.1	3.0	3.2	21	3.9
26	9.7	5.8	7.8	4.0	5.3	8.1	5.2	4.9	3.7	3.5	39	8.1
27	7.9	7.2	5.9	3.7	9.5	7.5	5.2	4.8	4.1	3.5	9.9	7.4
28	7.5	12	4.8	3.8	8.8	6.9	5.1	4.6	3.3	3.4	6.0	11
29	7.4	9.2	4.5	4.3	---	6.2	4.9	4.5	3.6	4.0	5.3	6.2
30	7.5	7.2	4.2	4.9	---	7.7	5.0	4.4	3.7	4.5	4.9	5.6
31	7.4	---	4.0	3.7	---	8.8	---	4.4	---	4.5	4.2	---
TOTAL	216.7	189.2	220.9	133.0	152.8	317.5	174.0	142.2	109.7	102.4	229.4	155.8
MEAN	6.99	6.31	7.13	4.29	5.46	10.2	5.80	4.59	3.66	3.30	7.40	5.19
MAX	24	12	24	5.9	12	36	11	5.3	4.4	4.5	39	12
MIN	4.1	4.8	4.0	3.2	3.5	5.4	4.9	3.8	3.0	2.8	3.4	3.7

CAL YR 1976 TOTAL 2458.2 MEAN 6.72 MAX 86 MIN 3.6

WTR YR 1977 TOTAL 2143.6 MEAN 5.87 MAX 39 MIN 2.8

UNITED STATES DEPARTMENT OF INTERIOR - GEOLOGICAL SURVEY

PROCESS DATE IS 10-03-83

STATION NUMBER 02197309
LATITUDE 331712TIMS BRANCH AT ROAD C (SRP)
LONGITUDE 0814145 DRAINAGE AREASTREAM SOURCE AGENCY USGS
DATUM STATE 45 COUNTY 003DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1977 TO SEPTEMBER 1978
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	5.0	4.8	25	6.2	8.4	6.7	5.3	10	4.1	3.5	2.4	4.5
2	10	5.0	12	5.1	20	6.2	5.2	8.6	4.1	3.4	2.4	4.7
3	11	5.2	8.0	4.5	21	8.3	5.1	9.7	4.5	3.5	2.6	8.5
4	6.2	5.6	6.5	5.1	13	7.2	5.1	12	16	3.3	2.6	5.5
5	6.2	5.8	22	6.4	8.2	6.3	5.1	8.1	9.0	3.4	2.5	4.4
6	7.1	6.5	12	6.2	7.5	6.0	5.0	6.4	8.2	3.4	2.6	4.2
7	6.7	5.7	6.5	5.3	7.5	5.9	5.0	5.5	6.2	3.3	2.6	4.3
8	12	5.1	5.7	13	7.4	6.5	4.8	5.6	6.9	3.2	2.4	4.4
9	13	5.1	5.4	28	8.0	12	4.8	25	8.8	3.0	2.4	9.5
10	7.5	5.1	5.0	7.2	7.8	18	4.8	11	6.0	3.0	3.4	7.9
11	5.1	4.9	4.4	6.3	7.2	9.4	4.9	6.5	5.0	2.9	5.0	4.7
12	6.6	4.6	4.3	6.7	6.4	7.1	5.1	5.9	4.6	2.9	5.2	3.9
13	6.9	4.5	4.3	34	7.3	5.8	16	5.7	4.4	2.9	4.7	3.4
14	6.1	4.5	7.8	17	7.4	5.7	8.6	5.1	4.2	2.8	4.9	3.2
15	5.5	4.6	7.4	11	6.2	5.6	6.4	4.8	4.0	4.2	3.6	3.2
16	4.8	4.7	5.1	9.3	6.0	5.2	5.3	4.7	3.9	11	4.3	3.7
17	4.6	4.8	4.8	10	9.6	5.2	4.7	4.7	3.8	15	3.4	4.3
18	4.4	5.3	5.6	8.4	8.6	5.8	5.3	6.7	3.8	6.5	4.9	3.4
19	4.6	5.3	4.9	24	7.4	5.2	8.6	14	3.7	4.2	4.1	3.1
20	4.6	4.7	5.6	20	6.7	5.0	6.0	11	3.7	3.5	4.7	3.1
21	4.5	4.6	6.3	8.4	6.3	4.9	5.5	7.5	3.9	3.2	5.2	3.0
22	4.5	4.8	4.7	7.0	6.3	4.9	5.4	5.6	3.8	3.0	4.7	3.0
23	4.4	5.7	4.4	6.7	6.2	4.9	5.1	5.0	3.8	3.0	4.2	3.0
24	4.3	11	4.3	6.8	6.3	11	4.8	4.7	3.7	2.8	4.0	3.0
25	5.1	6.5	5.7	30	6.2	9.1	6.9	4.6	3.7	2.8	3.8	3.0
26	10	5.5	4.9	27	5.9	12	9.1	4.3	3.8	3.0	3.9	3.0
27	9.8	5.2	4.3	14	5.7	6.8	6.8	6.5	3.6	2.9	4.0	3.0
28	8.7	8.1	5.1	10	6.3	5.8	5.5	5.1	3.5	2.8	4.1	3.0
29	6.7	12	6.6	9.4	---	5.7	5.1	4.6	3.4	2.7	4.2	3.0
30	5.9	8.0	9.5	8.7	---	5.5	5.0	4.4	3.5	2.6	4.3	4.2
31	5.2	---	9.5	8.7	---	5.4	---	4.2	---	2.4	4.3	---
TOTAL	207.0	173.2	227.6	370.4	230.8	219.1	180.3	227.5	151.6	120.1	117.4	125.1
MFAN	6.68	5.77	7.34	11.9	8.24	7.07	6.01	7.34	5.05	3.87	3.79	4.17
MAX	13	12	25	34	21	18	16	25	16	15	5.2	9.5
MIN	4.3	4.5	4.3	4.5	5.7	4.9	4.7	4.2	3.4	2.4	2.4	3.0

CAL YR 1977 TOTAL 2124.6 MEAN 5.82 MAX 39 MIN 2.8
WTR YR 1978 TOTAL 2350.1 MEAN 6.44 MAX 34 MIN 2.4

UNITED STATES DEPARTMENT OF INTERIOR - GEOLOGICAL SURVEY

PROCESS DATE IS 10-03-83

STATION NUMBER 02197309

TIMS BRANCH AT ROAD C (SRP)

STREAM

SOURCE AGENCY USGS

LATITUDE 331712

LONGITUDE 0814145

DRAINAGE AREA

DATUM

STATE 45 COUNTY 003

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1978 TO SEPTEMBER 1979
MEAN VALUES

PROVISIONAL DATA

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	5.2	2.8	7.2	5.5	5.1	7.9	---	6.7	25	5.4	3.3	---
2	4.1	2.8	5.8	8.2	4.7	7.0	4.0	6.9	12	3.2	3.2	---
3	3.5	2.8	5.2	6.9	4.7	5.8	---	5.6	7.6	2.9	2.8	---
4	3.4	2.8	5.0	5.9	5.4	5.5	9.6	4.7	6.0	3.2	3.2	---
5	3.1	2.8	4.8	5.6	4.8	5.2	7.4	5.1	5.3	3.1	3.6	20
6	3.0	2.8	4.3	5.3	8.3	4.4	5.2	5.3	5.0	3.0	3.1	13
7	2.8	3.0	4.1	5.4	22	3.8	4.5	4.5	4.9	3.5	2.9	7.6
8	2.8	3.8	4.1	5.5	9.5	---	4.5	5.8	4.6	4.5	3.0	4.9
9	2.8	3.6	4.3	4.5	7.1	3.8	10	7.6	4.9	4.0	2.9	3.8
10	2.8	3.4	4.3	4.3	5.7	3.9	5.9	6.7	4.6	3.3	2.7	3.4
11	2.7	3.3	4.3	4.3	5.3	5.4	5.5	7.1	4.0	3.0	3.2	3.3
12	2.8	3.4	4.9	4.9	5.0	4.2	8.1	8.4	3.7	2.9	5.4	3.3
13	2.8	3.3	5.1	5.5	4.8	4.0	12	14	3.6	2.7	3.5	3.4
14	3.1	3.2	4.8	4.9	4.7	4.7	15	18	3.4	2.5	3.2	3.6
15	3.0	3.4	4.4	4.3	4.7	5.0	6.8	11	3.3	2.4	2.9	3.7
16	2.9	3.5	4.4	4.2	4.6	4.3	5.8	7.8	5.1	2.3	2.8	3.1
17	2.8	3.5	4.5	4.3	4.3	4.5	6.7	6.2	---	2.6	2.9	3.2
18	2.8	3.8	4.3	5.0	6.7	4.3	5.8	5.1	3.8	3.4	2.6	3.3
19	2.8	3.8	4.3	4.5	6.0	4.3	4.9	4.5	3.4	3.4	2.6	3.2
20	2.8	3.5	4.3	4.7	6.5	4.4	4.5	4.6	3.2	3.1	---	3.1
21	2.8	3.5	4.5	6.2	19	4.4	4.4	5.4	3.1	6.1	---	3.5
22	2.8	3.5	4.9	4.9	17	5.0	4.3	6.9	5.0	---	---	3.4
23	2.8	3.5	4.5	4.6	---	15	4.2	8.7	3.4	14	---	3.2
24	2.8	3.5	8.9	7.9	---	17	4.2	6.6	3.0	8.7	---	3.2
25	2.8	3.5	7.6	5.7	---	6.5	15	6.1	3.0	8.3	---	4.5
26	2.8	3.5	5.0	5.1	19	7.9	24	6.7	5.2	7.6	---	4.2
27	2.9	4.1	4.7	13	12	5.7	10	4.5	4.5	4.5	---	3.9
28	2.9	4.6	4.6	6.2	9.2	5.5	7.0	4.2	3.1	3.8	---	6.3
29	3.0	12	4.6	4.7	---	5.2	5.7	4.2	2.7	3.5	---	7.6
30	2.8	21	5.2	4.5	---	---	4.9	8.0	4.4	3.2	---	8.9
31	2.8	---	6.0	5.3	---	---	---	11	---	3.1	---	---
TOTAL	93.2	128.0	154.9	171.8	---	---	---	217.9	---	---	---	---
MEAN	3.01	4.27	5.00	5.54	---	---	---	7.03	---	---	---	---
MAX	5.2	21	8.9	13	---	---	---	18	---	---	---	---
MIN	2.7	2.8	4.1	4.2	---	---	---	4.2	---	---	---	---

CAL YR 1978 TOTAL 2118.4 MEAN 5.80 MAX 34 MIN 2.4

UNITED STATES DEPARTMENT OF INTERIOR - GEOLOGICAL SURVEY

PROCESS DATE IS 10-03-83

STATION NUMBER 02197309

TIMS BRANCH AT ROAD C (SRP)

STREAM

SOURCE AGENCY USGS

LATITUDE 331712

LONGITUDE 0814145

DRAINAGE AREA

DATUM

STATE 45 COUNTY 003

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1979 TO SEPTEMBER 1980

PROVISIONAL DATA

MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	5.5	3.1	3.9	4.6	7.3	6.7	12	6.4	3.1	2.5	2.1	1.7
2	4.2	7.2	4.4	7.1	5.0	7.2	9.2	6.4	2.8	2.6	2.3	2.5
3	3.4	10	3.6	5.8	4.2	7.6	8.8	6.3	2.7	2.4	3.4	2.3
4	3.8	5.3	3.2	3.9	3.8	7.4	11	6.2	2.6	5.7	3.1	1.6
5	6.8	4.5	4.0	4.4	3.5	7.9	12	6.2	2.5	3.1	2.2	1.4
6	4.6	4.0	4.4	3.5	4.3	8.6	8.9	6.2	2.6	2.6	3.4	1.4
7	3.7	8.2	3.8	3.4	4.7	6.9	8.0	6.0	2.6	3.1	2.9	1.4
8	3.4	6.3	3.5	3.6	4.5	14	8.7	6.4	2.5	2.7	1.8	1.4
9	8.4	4.1	3.9	3.6	6.8	14	13	7.1	2.4	2.5	2.4	1.4
10	5.9	3.9	4.9	3.1	13	10	15	5.9	2.4	2.4	2.0	1.8
11	3.8	19	4.3	3.6	7.6	15	11	5.4	2.4	2.1	1.7	2.5
12	3.2	14	3.5	3.6	6.5	20	7.8	5.2	2.4	2.0	3.9	2.6
13	3.2	8.3	3.4	3.5	5.9	37	8.0	4.8	2.4	2.0	2.6	3.4
14	3.1	6.3	3.4	6.8	7.9	19	8.8	5.0	2.3	1.9	2.6	4.6
15	2.8	5.3	3.7	6.2	6.3	17	10	5.0	2.2	2.0	2.0	5.0
16	3.4	5.0	3.8	4.9	8.7	10	8.6	4.7	2.0	1.9	1.7	5.3
17	4.1	7.1	3.8	4.6	7.2	9.9	7.8	5.0	2.2	1.9	1.5	6.5
18	3.7	5.8	3.8	6.6	6.0	18	7.4	5.1	6.4	1.8	1.7	3.6
19	3.8	4.5	3.7	5.7	5.8	9.6	7.3	4.5	7.9	1.9	1.9	1.6
20	4.0	3.9	3.5	4.4	6.1	12	7.4	6.3	4.5	1.8	4.9	1.7
21	3.6	3.9	4.0	4.2	10	13	7.1	6.1	3.6	1.8	3.1	1.8
22	3.8	3.7	3.6	4.4	9.1	13	7.0	8.2	3.3	1.8	2.5	2.6
23	4.2	3.6	4.9	8.6	8.4	8.9	6.8	10	3.1	1.8	2.2	2.2
24	3.8	3.7	4.5	5.7	7.0	11	6.7	16	3.3	2.3	2.2	2.9
25	3.7	3.5	3.7	5.0	6.3	21	6.6	7.8	5.3	2.3	1.9	8.1
26	3.8	3.6	3.4	6.1	8.3	26	6.5	5.5	6.8	2.2	1.6	8.2
27	3.9	3.5	3.5	10	7.7	8.7	6.5	4.3	4.4	2.1	1.6	5.8
28	3.7	4.2	3.9	6.2	6.7	21	6.4	3.7	3.5	2.5	1.8	7.6
29	3.7	6.0	7.9	5.0	6.4	26	6.4	4.6	3.1	2.7	1.6	20
30	3.8	5.4	6.9	4.2	---	26	6.4	4.1	2.6	2.3	1.5	17
31	3.8	---	5.5	11	---	17	---	3.5	---	2.1	1.7	---
TOTAL	126.6	176.9	128.3	163.3	195.0	449.4	257.1	187.9	99.9	72.8	71.8	129.9
MEAN	4.08	5.90	4.14	5.27	6.72	14.5	8.57	6.06	3.33	2.35	2.32	4.33
MAX	8.4	19	7.9	11	13	37	15	16	7.9	5.7	4.9	20
MIN	2.8	3.1	3.2	3.1	3.5	6.7	6.4	3.5	2.0	1.8	1.5	1.4

WTR YR 1980 TOTAL 2058.9 MEAN 5.63 MAX 37 MIN 1.4

UNITED STATES DEPARTMENT OF INTERIOR - GEOLOGICAL SURVEY

PROCESS DATE IS 10-03-83

STATION NUMBER 02197309
LATITUDE 331712TIMS BRANCH AT ROAD C (SRP)
LONGITUDE 0814145 DRAINAGE AREA

DATUM

STREAM

SOURCE AGENCY USGS
STATE 45 COUNTY 003DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1980 TO SEPTEMBER 1981
MEAN VALUES

PROVISIONAL DATA

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	14	4.9	6.3	3.9	4.4	4.0	6.4	2.8	34	2.3	19	8.6
2	8.4	4.1	6.3	3.6	3.9	5.0	5.8	2.7	13	3.0	10	2.8
3	5.3	3.6	5.6	3.5	3.6	5.8	4.9	3.1	6.5	3.0	4.5	3.9
4	4.3	4.6	4.2	3.3	3.4	6.6	3.9	2.8	13	2.6	3.7	4.2
5	3.7	6.3	3.9	3.1	3.3	5.4	4.0	2.6	8.5	2.4	4.4	3.9
6	3.4	4.5	3.6	3.2	3.6	4.9	3.9	2.6	5.1	2.3	4.5	3.4
7	3.5	4.5	3.7	5.2	3.4	4.3	3.7	3.1	7.9	2.2	5.0	3.5
8	3.6	4.3	3.7	11	3.2	4.1	3.6	3.1	17	5.4	6.7	3.9
9	3.7	4.1	3.7	5.4	4.9	3.9	3.5	2.8	7.7	4.8	8.5	4.2
10	3.1	4.1	4.1	3.8	21	3.8	3.4	2.8	4.9	3.1	2.7	4.7
11	7.5	3.6	4.0	3.5	15	3.7	3.3	2.7	3.9	2.6	2.1	4.3
12	4.1	4.2	3.7	3.4	8.1	3.6	3.3	2.6	4.3	2.3	2.7	4.1
13	2.7	4.2	3.6	3.4	6.1	3.5	3.3	2.6	3.6	2.2	3.6	3.8
14	3.5	3.9	3.3	3.6	5.0	3.5	3.2	2.5	2.9	2.1	11	3.4
15	3.7	4.5	3.4	4.6	4.7	3.5	3.2	2.5	2.6	2.5	2.5	3.4
16	3.1	5.9	3.7	12	9.6	3.5	3.2	2.4	2.5	3.2	3.4	5.1
17	3.1	5.3	4.1	5.7	7.7	4.0	3.2	2.4	2.4	3.9	4.0	2.2
18	3.0	5.7	4.0	8.8	5.2	4.8	3.2	2.5	2.3	3.2	3.0	1.6
19	3.1	5.8	4.0	5.3	4.8	6.2	3.3	2.7	2.3	2.4	5.7	2.0
20	2.7	6.0	3.9	6.7	4.3	5.5	3.5	2.7	2.2	2.2	4.7	2.0
21	2.5	6.1	3.7	5.0	5.7	4.3	3.8	2.6	2.2	2.1	5.7	1.8
22	2.5	5.9	3.6	4.3	4.0	4.3	3.6	2.4	2.1	2.3	7.4	1.6
23	2.8	5.7	7.6	4.1	5.2	4.8	3.5	2.1	2.0	3.9	8.3	1.3
24	3.7	5.9	6.3	3.9	7.0	4.3	3.3	2.1	2.1	5.2	15	1.3
25	4.4	7.5	5.0	4.0	4.5	3.9	3.1	2.0	2.1	4.5	9.7	1.2
26	3.7	7.0	4.2	3.3	3.9	3.6	3.1	2.1	2.0	3.7	2.0	1.1
27	3.3	8.9	4.3	3.5	3.8	3.4	3.3	2.5	1.9	3.8	1.9	1.0
28	5.5	8.0	5.1	3.5	3.8	3.4	3.2	2.8	1.9	3.6	2.1	1.2
29	4.4	6.7	4.9	3.7	---	3.8	3.0	2.3	1.8	3.3	2.4	1.1
30	5.6	6.3	4.7	6.2	---	4.5	2.9	2.1	1.9	3.1	4.3	1.2
31	5.3	---	4.3	5.4	---	5.0	---	3.5	---	5.0	12	---
TOTAL	133.2	162.1	136.5	149.9	163.1	134.9	108.6	80.5	166.6	98.2	182.5	87.8
MEAN	4.30	5.40	4.40	4.84	5.83	4.35	3.62	2.60	5.55	3.17	5.89	2.93
MAX	14	8.9	7.6	12	21	6.6	6.4	3.5	34	5.4	19	8.6
MIN	2.5	3.6	3.3	3.1	3.2	3.4	2.9	2.0	1.8	2.1	1.9	1.0

CAL YR 1980 TOTAL 2058.9 MEAN 5.63 MAX 37 MIN 1.4
WTR YR 1981 TOTAL 1603.9 MEAN 4.39 MAX 34 MIN 1.0

UNITED STATES DEPARTMENT OF INTERIOR - GEOLOGICAL SURVEY

PROCESS DATE IS 10-03-83

STATION NUMBER 02197309
LATITUDE 331712TIMS BRANCH AT ROAD C (SRP)
LONGITUDE 0814145 DRAINAGE AREASTREAM SOURCE AGENCY USGS
DATUM STATF 45 COUNTY 003DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1981 TO SEPTEMBER 1982
MEAN VALUES~~PROVISIONAL DATA~~

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	1.4	2.3	6.3	30	4.3	3.5	3.1	4.9	2.6	2.2	5.9	1.9
2	1.4	2.1	9.3	16	3.5	3.1	3.0	4.6	2.3	2.1	5.1	1.9
3	1.3	2.3	7.9	18	6.8	3.9	3.0	4.4	2.7	1.9	4.8	1.8
4	1.3	2.3	8.3	18	9.2	3.8	2.9	6.3	4.5	1.8	3.5	1.7
5	1.7	1.9	8.3	14	6.0	3.7	3.9	5.7	3.9	1.9	5.6	1.6
6	1.7	4.4	7.5	10	4.8	3.5	4.0	5.1	3.1	1.9	10	1.4
7	1.5	5.2	7.4	9.2	4.0	7.8	3.3	4.5	2.6	1.9	6.0	1.4
8	1.6	3.2	7.3	8.8	3.7	6.5	3.9	4.0	2.3	1.9	4.3	1.3
9	1.6	2.5	7.7	8.3	4.0	4.0	4.9	3.7	2.2	2.0	4.3	1.3
10	3.3	2.4	8.1	7.8	5.0	4.4	3.9	3.4	2.1	2.7	3.5	1.5
11	3.1	2.6	8.6	5.0	5.2	4.2	3.4	3.2	2.1	2.4	2.7	1.8
12	2.5	2.7	8.6	3.4	5.5	4.1	3.2	3.2	2.0	2.7	2.7	1.9
13	2.2	2.5	8.7	4.1	8.6	3.6	2.9	3.0	2.9	4.8	5.6	1.9
14	2.0	2.3	12	7.9	5.2	3.1	2.8	3.0	2.8	3.3	3.0	2.0
15	2.0	2.3	21	7.6	3.7	3.0	3.4	2.9	2.4	2.6	2.3	1.9
16	1.9	2.3	18	5.2	3.7	3.5	3.5	2.7	2.3	2.5	2.0	1.7
17	1.9	2.4	9.4	4.4	7.6	6.7	4.2	2.6	3.1	2.6	2.0	1.5
18	1.9	2.3	5.6	3.8	5.9	7.3	4.5	5.8	2.9	2.5	3.4	3.3
19	2.0	2.4	5.1	4.1	5.6	5.1	3.3	4.4	2.5	2.1	7.0	12
20	1.8	2.5	4.1	4.3	4.7	4.4	7.2	3.5	2.2	2.2	3.7	7.1
21	1.9	2.5	3.8	6.0	3.9	4.0	7.7	3.0	2.3	3.5	2.9	6.4
22	1.9	2.6	3.9	4.0	3.2	3.4	7.2	2.8	4.2	2.4	2.5	5.6
23	1.9	2.6	3.9	4.4	3.2	3.3	6.0	2.8	3.5	2.3	2.4	4.0
24	2.1	2.8	3.7	6.5	3.9	3.6	4.7	2.6	4.4	2.7	2.0	3.3
25	2.1	2.8	9.1	4.6	4.2	4.3	5.6	2.7	4.6	2.8	1.6	3.0
26	4.6	2.9	7.5	3.8	4.3	4.1	11	2.6	4.8	3.7	1.4	3.0
27	3.4	3.2	5.5	3.5	4.8	3.5	14	2.5	7.0	3.2	1.8	3.0
28	2.9	3.7	5.5	3.5	4.1	3.2	9.9	2.4	7.2	2.6	1.7	2.8
29	2.5	4.4	8.0	3.5	---	3.4	7.0	2.3	4.2	5.9	1.4	2.7
30	2.3	4.7	5.5	4.8	---	3.2	6.0	2.6	3.0	12	1.6	2.6
31	2.3	---	21	4.3	---	3.2	---	3.1	---	7.6	1.7	---
TOTAL	66.0	85.1	256.6	238.8	138.6	128.4	153.4	110.3	98.7	96.7	108.4	87.3
MEAN	2.13	2.84	8.28	7.70	4.95	4.14	5.11	3.56	3.29	3.12	3.50	2.91
MAX	4.6	5.2	21	30	9.2	7.8	14	6.3	7.2	12	10	12
MIN	1.3	1.9	3.7	3.4	3.2	3.0	2.8	2.3	2.0	1.8	1.4	1.3

WTR YR 1982 TOTAL 1568.3 MEAN 4.30 MAX 30 MIN 1.3

APPENDIX I - ANALYTICAL RESULTS

LOCKWOOD GREENE ENGINEERS

LAB NO: 5-274

PO #25667

October 20, 1983

TABLE OF CONTENTS:

I. LABORATORY CHRONICLE

II. ANALYTICAL METHODS: DEFINITIONS & EXPLANATIONS

III. RECORDED RESULTS

IV. QUALITY CONTROL DATA

I. LABORATORY CHRONICLE

4:30 PM
10-10-83

Samples received and refrigerated. (Note: 6 (six) 2 1/2 gallon size jars were received. Of the six sample jars received, Sample 1 consisted of a full container; Sample 2 consisted of two jars, one jar completely full, the second approximately half full. Sample 3 contained approximately 200 to 250 mls. Sample 4 contained approximately 500 mls. Sample 5 contained approximately 300 mls.

10-11-83

Customer notified of possible analytical problems arising from insufficient sample. Work to proceed on Samples 1, 2 & 4. All samples are to remain refrigerated.

10-11-83

Portions of samples 1, 2 & 4 sent to Mead Compu-Chem for Non Volatile Total Toxic organics testing.

10-11-83

Samples identified as 1 thru 5 inclusive sent to Mead Compu-Chem for Volatile Toxic Organics testing.

10-13-83

Instructions from Mr. Nichols regarding order of priority to be followed in testing parameters for Samples 3 & 5.

10-20-83

Formal report completed.

II. ANALYTICAL METHODS

PARAMETER

TEST PROCEDURES:

Sodium	Flame Emission/AA*, Standard Methods; 15th Edition, pg. 231 Sec. 325A
Copper	Digestion/AA*, Standard Methods; 15th Edition, pg. 152 Sec. 303A
Lead	Digestion/AA*, Standard Methods; 15th Edition, pg. 152 Sec. 303A
Nickel	Digestion/AA*, Standard Methods; 15th Edition, pg. 152 Sec. 303A
Iron	Digestion/AA*, Standard Methods; 15th Edition, pg. 152 Sec. 303A
Total Phosphorus	Digestion/Colorimetric Method, Standard Methods; 15th Edition, pg. 415 Sec. 424D
Oil & Grease	Partition-Gravimetric Method, Standard Methods; 15th Edition, pg. 461 Sec. 503A
pH	Instrumentation - A Fisher Accumet Model 620 pH Meter
Uranium	Thiocyanate Method - Scotts' Standard Methods of Chemical Analysis; 6th Edition, Volume 1
Total Dissolved Solids	Filtrable Residue, Standard Methods; 15th Edition, pg. 94 Sec. 209C
Total Organic Carbon	Combustion-Infrared Method, Standard Methods; 15th Edition, pg. 471 Sec. 505
Aluminum	Digestion/AA*, Standard Methods; 15th Edition, pg. 157 Sec. 303C
Nitrate	Cadmium Reduction, Standard Methods; 15th Edition, pg. 370 Sec. 418C
Total Suspended Solids	Suspended Matter, Standard Methods; 15th Edition, pg. 94 Sec. 209D
Arsenic	Hydride System, Standard Methods; 15th Edition, pg. 160 Sec. 303E
Nitrite	NED dehydrochloride Method, Standard Methods; 15th Edition, pg. 380 Sec. 419
Boron	Curcumin Method, Standard Methods; 15th Edition, pg. 257 Sec. 404A

(cont.)

PARAMETER

TEST PROCEDURES:

Cadmium	Digestion/AA*, Standard Methods; 15th Edition, pg. 152 Sec. 303A
Chromium	Digestion/AA*, Standard Methods; 15th Edition, pg. 152 Sec. 303A
Lithium	Digestion/AA*, Standard Methods; 15th Edition, pg. 152 Sec. 303A
Phenol	Chloroform Extraction, Standard Methods; 15th Edition, pg. 510 Sec.510B
Sulfate	Turbidimetric Method, Standard Methods; 15th Edition, pg. 439 Sec.426C
Chloride	Argentometric Method, Standard Methods; 15th Edition, pg. 270 Sec.407A
Barium	Digestion/AA*, Standard Methods; 15th Edition, pg. 157 Sec 303C
Mercury	Cold Vapor Emission, Standard Methods; 15th Edition, pg. 164 Sec.303F
Selenium	Hydride System, Standard Methods; 15th Edition, pg. 160 Sec. 303E
Silver	Digestion/AA*, Standard Methods; 15th Edition, pg. 152 Sec. 303A

* AA refers to analysis by Atomic Absorption Spectroscopy using a Perkin-Elmer Model 5000.

III. RECORDED RESULTS

SAMPLE ID: COMPOSITE #1

<u>PARAMETER</u>	<u>ANALYSIS (mg/l)</u>
Sodium	0.4
Copper	0.01
Lead	*0.01
Nickel	*0.01
Iron	1.0
Total Phosphorus	0.4
Oil and Grease	0.6
pH	7.45
Uranium	*2.0
Total Dissolved Solids	61.0
Total Organic Carbon	10.0
Aluminum	0.6
Nitrate	0.32
Total Suspended Solids	2.0
Arsenic	*0.001
Nitrite	*0.1
Boron	*0.1
Cadmium	*0.01
Chromium	*0.01
Lithium	*0.01
Phenol	*0.1
Sulfate	3.0
Chloride	3.5
Barium	*0.01
Mercury	*0.0001
Selenium	*0.001
Silver	*0.01

* Denotes less than

SAMPLE ID: COMPOSITE #2

<u>PARAMETER</u>	<u>ANALYSIS (mg/l)</u>
Sodium	0.3
Copper	0.02
Lead	*0.01
Nickel	*0.01
Iron	0.11
Total Phosphorus	0.3
Oil and Grease	0.2
pH	7.40
Uranium	*2.0
Total Dissolved Solids	69.0
Total Organic Carbon	9.0
Aluminum	0.1
Nitrate	0.29
Total Suspended Solids	4.0
Arsenic	*0.001
Nitrite	*0.1
Boron	*0.1
Cadmium	*0.01
Chromium	*0.01
Lithium	*0.01
Phenol	*0.1
Sulfate	2.0
Chloride	3.2
Barium	*0.01
Mercury	*0.0001
Selenium	*0.001
Silver	*0.01

* Denotes less than

SAMPLE ID: COMPOSITE #3

<u>PARAMETER</u>	<u>ANALYSIS (mg/l)</u>
Sodium	1.0
Copper	0.04
Lead	*0.01
Nickel	*0.01
Iron	0.4
Total Phosphorus	0.2
Oil and Grease	Insufficient Sample
pH	7.40
Uranium	*2.0
Total Dissolved Solids	Insufficient Sample
Total Organic Carbon	7.0
Aluminum	*0.01
Nitrate	4.0
Total Suspended Solids	Insufficient Sample
Arsenic	*0.001
Nitrite	Insufficient Sample
Boron	0.4
Cadmium	*0.01
Chromium	0.02
Lithium	*0.01
Phenol	Insufficient Sample
Sulfate	Insufficient Sample
Chloride	Insufficient Sample
Barium	*0.01
Mercury	*0.0001
Selenium	*0.001
Silver	*0.01

* Denotes less than

SAMPLE ID: COMPOSITE #4

<u>PARAMETER</u>	<u>ANALYSIS (mg/l)</u>
Sodium	0.9
Copper	*0.01
Lead	*0.01
Nickel	0.01
Iron	5.2
Total Phosphorus	0.3
Oil and Grease	0.5
pH	7.20
Uranium	*2.0
Total Dissolved Solids	60.0
Total Organic Carbon	20.0
Aluminum	*0.01
Nitrate	3.3
Total Suspended Solids	2.0
Arsenic	*0.001
Nitrite	*0.1
Boron	1.3
Cadmium	*0.01
Chromium	*0.01
Lithium	*0.01
Phenol	Insufficient Sample
Sulfate	7.0
Chloride	3.3
Barium	*0.01
Mercury	*0.0001
Selenium	*0.001
Silver	*0.01

* Denotes less than

SAMPLE ID: COMPOSITE #5

<u>PARAMETER</u>	<u>ANALYSIS (mg/l)</u>
Sodium	0.6
Copper	*0.01
Lead	*0.01
Nickel	*0.01
Iron	7.0
Total Phosphorus	0.4
Oil and Grease	Insufficient Sample
pH	6.04
Uranium	*2.0
Total Dissolved Solids	Insufficient Sample
Total Organic Carbon	10.0
Aluminum	*0.1
Nitrate	3.2
Total Suspended Solids	Insufficient Sample
Arsenic	*0.001
Nitrite	*0.1
Boron	*0.1
Cadmium	*0.01
Chromium	*0.01
Lithium	*0.01
Phenol	Insufficient Sample
Sulfate	3.5
Chloride	1.1
Barium	*0.01
Mercury	*0.0001
Selenium	*0.001
Silver	*0.01

* Denotes less than

IV. QUALITY CONTROL DATA

Standard samples supplied by Environmental Research Associates were analyzed along with the submitted samples. Correct answers to these standards were not known by the analyst.

RESULTS:

Concentration in (mg/l)

<u>PARAMETER</u>	<u>ACTUAL VALUE</u>	<u>ACCEPTABLE RANGE</u>	<u>OUR ANALYSIS</u>
<u>Sodium</u>			
ERA #1995	67.0	60.0 to 74.0	68.0
ERA #1543 (1/1000)	0.60	0.51 to 0.69	0.59
<u>Copper</u>			
ERA #9501	0.207	0.190 to 0.224	0.201
<u>Lead</u>			
ERA #9501	0.163	0.145 to 0.181	0.165
<u>Nickel</u>			
ERA #9501	0.213	0.193 to 0.233	0.211
<u>Iron</u>			
ERA #9501	0.129	0.100 to 0.158	0.133
<u>Total Phosphorus</u>			
ERA #8801	5.4	4.8 to 6.0	5.3
<u>Oil & Grease</u>			
ERA # 8801	10.0	6.0 to 14.0	9.6
<u>pH</u>			
ERA #8801	9.0 units	8.8 to 9.2 units	9.00
ERA #1497	9.2 units	9.0 to 9.4 units	9.14
<u>Total Dissolved Solids</u>			
ERA #8801	1140.	1040 to 1240	1160.
<u>Total Organic Carbon</u>			
ERA #8701	37.0	32.0 to 42.0	39.0
<u>Aluminum</u>			
ERA #9501	0.315	0.300 to 0.330	0.320
<u>Nitrate (as Nitrogen)</u>			
ERA #1995	4.2	3.8 to 4.6	4.10
<u>Total Suspended Solids</u>			
ERA #8801	*1.0	0 to 1.0	*1.0
<u>Arsenic</u>			
ERA #1995	0.035	0.025 to 0.045	0.031
<u>Boron</u>			
ERA #8701	0.214	0.194 to 0.234	0.202
<u>Cadmium</u>			
ERA #1995	0.057	0.047 to 0.067	0.050

* Denotes less than

Scientific
CONTROL LABORATORIES, INC.

(cont.)

<u>PARAMETER</u>	<u>ACTUAL VALUE</u>	<u>ACCEPTABLE RANGE</u>	<u>OUR ANALYSIS</u>
<u>Total Chromium</u>			
ERA #1995	0.068	0.056 to 0.080	0.061
<u>Phenol</u>			
ERA #8801	0.130	0.110 to 0.150	0.123
<u>Sulfate</u>			
ERA #1995	89.0	83.0 to 95.0	91.0
ERA #1547 (1/10)	6.8	5.9 to 7.7	6.7
<u>Chloride</u>			
ERA #8801	260.	235. to 285	254.
ERA #8701 (1/100)	2.81	2.65 to 2.97	2.75
<u>Barium</u>			
ERA #1995	0.376	0.340 to 0.412	0.372
<u>Mercury</u>			
ERA #1995	0.0017	0.0009 to 0.0025	0.0015
<u>Selenium</u>			
ERA #1995	0.021	0.010 to 0.032	0.020
<u>Silver</u>			
ERA #1995	0.015	0.000 to 0.030	0.013

* Denotes less than

Scientific
CONTROL LABORATORIES, INC.

Respectfully submitted,

SCIENTIFIC CONTROL LABORATORIES, INC.

FA:lls
2c

By

Frank Altmayer
Frank Altmayer

CERTIFICATION

The above statements and report were subscribed and sworn to before
me this TWENTIETH day of OCTOBER, 1983.

Carol L. Herman
Notary Public

APPENDIX J - 7 Q-10 CALCULATION

LOCKWOOD GREENE

Planners/Engineers/Architects/Managers
Atlanta, Georgia

JOB NO. 83251.04

SHEET NO. _____

DATE 10/12/83

JOB NAME DUPONT STREAM STUDY

COMPUTED BY PJS

SUBJECT 7 Q 10 DATA FOR NEARBY USGS GAGING STREAM CHECKED BY RA

<u>YEAR</u> ⁺	<u>7 DAY AVE LOW FLOW</u> [*]	<u>ORDER OF MAGNITUDE</u>	<u>RECURRENCE INTERVAL</u> ^{**}
73-74	3.75	8	1.25
74-75	4.07	9	1.11
75-76	3.67	7	1.43
76-77	2.93	6	1.67
77-78	2.50	4	2.50
78-79	2.63	5	2.0
79-80	1.48	3	3.33
80-81	1.16	1	10.0
81-82	1.46	2	5.0

NOTES + YEAR IS FROM OCTOBER THRU SEPTEMBER EXCEPT 73-74 WHICH BEGAN ON MARCH 20TH.

* AVERAGE OF USGS 7 DAY LOW FLOW FOR RESPECTIVE YEAR

** RECURRENCE INTERVAL (RI) = $n+1/m$; WHERE n = # OF YEARS & m = ORDER OF MAGNITUDE

9-179b
Extreme log data plot
April 1955

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
WATER RESOURCES DIVISION

APPENDIX J
File

Magnitude and frequency of USGS GAGING STATION on TIM'S BRANCH
Drainage area 17.5 sq. mi. Period 1973-1982

APPENDIX K - USGS TIM'S BRANCH DRAINAGE BASIN AREA