# The Effects of Pollution Reduction on a Wild Trout Stream

## Baseline Studies Report: 2005

Spring Run

Dumpling Run

**November 2005**

# The Effects of Pollution Reduction on a Wild Trout Stream
## Baseline Studies Report: 2005

## Introduction

Spring Run is a unique aquatic resource in the Potomac Highlands region of West Virginia. Unlike many small headwater streams that tend to go dry, it is fed by the largest spring in the region, with discharge typically ranging from 3000-3500 gallons per minute. With a temperature of ~53 °F at the spring and a pH of ~8, aquatic conditions are ideal for trout and the aquatic insects they eat. Spring Run flows about two miles from the spring source to its confluence with South Mill Creek, which is about four miles from the South Branch of the Potomac River. Spring Run has no tributaries. Much of the stream is shallow, and does not provide the complex habitat that trout need - but that is not the case in a three-fourths mile section in the middle of the Run.

Since the early 1960's, landowner's have issued permits for fly fishing, catch-and-release on three-fourths mile of Spring Run. Landowners and other interested parties have installed and maintained various structures to form pools and overhead cover that provide hiding and feeding habitat for trout. Spring Run is recognized as one of the best "wild" rainbow trout fisheries in West Virginia. Friends of Springs Run's Wild Trout, was formed in 1996 to restore structure to Spring Run following flooding in 1996.

In the last few years, however, fishermen have noted a decline in the fishery. Emergence of the mayfly, Ephemerellidae (sulfurs) disappeared in the late 1990s. The number of large trout (14" and above) has decreased and trout in the 11-13" range are also fewer. The population of trout is considerably lower in the lower reach of the three-fourths mile section. Algae formation is heavy in the upper reach of the three-forth mile section, much heavier than in the past, and algae reforms soon after washout by high water.

There have long been plenty of nutrients in Spring Run, contributed largely in effluent from the Spring Run Trout Hatchery located about one-half mile upstream near the spring. (SRH is a rearing facility; trout are not spawned there). In recent years, however, SRH has been producing more rainbow and "golden trout" for stocking West Virginia streams, and it seems that the effluent stream now may be a problem for the health of Spring Run. WVDEP issued a citation for violation of the Spring Run Trout Hatchery NPDES permit in January 2004, specifically for discharging excess biochemical oxygen demand (BOD) and total suspended solids (TSS). WVDNR, which operates SRH, is now preparing to install an effluent treatment process at the facility to meet their permit requirements.

Installation of effluent treatment at SRH provides a unique opportunity to address a number of issues of both regional and national significance:

1. Will the hatchery effluent treatment process significantly reduce nutrient discharge? Fish hatcheries throughout the country produce nutrient-rich effluents of concern to receiving waters. This study will evaluate the downstream result of effluent reduction of BOD and TSS, as well as nutrients, from a small but high throughput point source. The results of renovation at SRH and this study will provide important information to the WV Potomac Tributary Strategy point source innovation process.
2. What are the biological impacts of Spring Run's high nutrient levels, and how is the biota affected by reductions in nutrients, TSS and BOD following hatchery upgrades? This issue is of importance to the nutrient criteria development process that WV and the other 49

states are currently struggling through, as one of the key questions is: "what does nutrient impairment look like?"

3. Is the wild trout population in Spring Run being harmed by hatchery effluent, and does improvement in that effluent improve the trout fishery?
4. Is the benthic invertebrate population in Spring Run being harmed by hatchery effluent, and does improvement in that effluent improve diversity? Spring Run fishermen have noted the loss in recent years of a certain family of mayflies, the Ephemerellidae (Spiny crawler mayfly) that used to emerge regularly in the springtime. Also, WV DEP's Tim Craddock did a benthic assessment of Spring Run in 2002, and found the lower part of the fly fishing section to be dominated by Chironomidae (midge) larvae, a group often indicative of pollution by organic waste.
5. Why do trout, especially larger fish, favor the upper part of the fly-fishing section? Why has the density-center of the trout population moved upstream in recent years? Is there a relationship between distribution of benthic invertebrates in the stream and trout distribution? If the Ephemerellidae mayfly rebound after the hatchery effluent is treated, will the trout population improve also? In particular, are trout avoiding areas they used to frequent that are now dominated by midge larvae? If upgrades to the hatchery reduce organics in the stream and also the midge populations, will trout return to those areas? If that turns out to be true, and we could demonstrate that it is true, that would buttress public acceptance of benthic invertebrate stream assessments.

Overall, this project will have the potential to be used to address many questions beyond the five questions identified above.

## Partners

Friends of Spring Run's Wild Trout, Cacapon Institute (CI), the WV Conservation Agency (WVCA), WV Department of Agriculture (WVDA), WV Division of Natural Resources (WVDNR), WV Department of Environmental Protection (WVDEP), and the Freshwater Institute are partnering in this study. This project is funded primarily by West Virginia Conservation Agency's participation through the Chesapeake Bay Program. An associated sediment reduction project is funded through a Friends of Spring Run's Wild Trout 2005 Stream Partners Grant.

WVDA, WVDEP and WVDNR are all contributing in-kind services to the project. WVDA is collecting water samples, taking flow measurements, and performing field and laboratory water quality analyses. WVDEP is participating in collections of benthic invertebrate and periphyton and helping to cover the costs of analysis. WVDNR is performing fish surveys and Friends of Spring Run's Wild Trout is providing information on size and location of trout caught and released by permitted fly fisherman.

The Freshwater Institute provided guidance to WVDNR on treatment methods for their effluent and is providing technical guidance for the project. WVCA is acting as project coordinator. Cacapon Institute has overall technical oversight for the project, will participate in field work, and will, in cooperation with partnering organizations, be responsible for data analysis and production of annual reports.

# Methods

The project has two experimental components, an upstream/downstream design in Spring Run, and a control/experimental design that includes Dumpling Run, another spring fed stream nearby. Both streams have their origins in the same geology: limestone (Helderberg and Tonoloway/Wills Creek) and sandstone (Oriskany, McKenzie) formations. Spring Run flows off the ridge to the northwest into South Mill Creek, a tributary of the South Branch of the Potomac River. Dumpling Run flows east into the South Fork of the South Branch of the Potomac River.

The upstream/downstream part includes three sites in Spring Run: the first site is near the spring upstream of the hatchery; the second site is in the upper part of the fly fishing stream section; and the third is in the lower part of the fly fishing section. There are two sites on Dumpling Run, one just below the spring, the other some distance downstream. Overall, this design allows within stream and between stream comparisons. Under most conditions of flow the springs constitute the main source of water in both streams, but both streams also have periodic surface flow entering the main channel upstream of the spring.

Water chemistries are collected monthly from April through September, typically on Wednesday. We chose to avoid collections on Mondays at the time of the hatchery cleanout because the "biosolids from the aquaculture effluent are notoriously patchy and difficult to characterize in sampling. . . . my thoughts on the nutrients is to focus on the residual chronic impacts, not the pulse of the cleaning plume" (Joe Hankins, Freshwater Institute, personal communication).

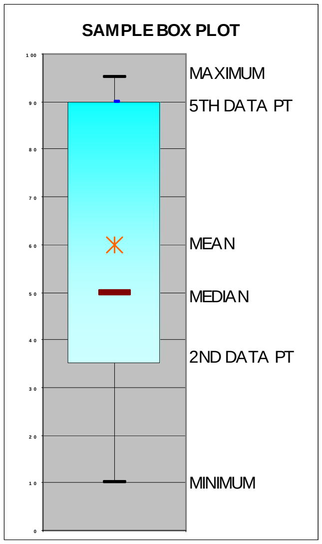
Water quality parameters include nitrogen in the forms of ammonia-nitrogen, nitrate/nitrite, total Kjeldahl nitrogen, total nitrogen (the sum of nitrate/nitrite and TKN), soluble reactive phosphorus, total phosphorus, total suspended solids (TSS), biochemical oxygen demand ($BOD_5$), and basic field parameters (pH, temperature, conductivity) (see Appendix 2 for laboratory methods). Flow measurements are collected at the same time as water samples at one site in each stream. This work is done primarily by the WVDA.

Benthic invertebrate and periphyton samples are collected twice each year at all sites, in May and August, according to the standard protocols in use by the WVDEP. WVDEP format Rapid Bioassessment Protocol habitat analyses will be conducted once each year. Primarily WVDEP and Cacapon Institute will do the fieldwork for this component.

WVDNR will conduct electro shocking fishery assessments, and the permitted fly fishermen of Spring Run have been enlisted to record information on size and location of trout caught and released.

Since changes to the system may not occur rapidly, an assessment will be made at the end of the third year to determine if “out year” monitoring might be needed?

The methods used to analyze water quality data were graphical and statistical. Data distributions were displayed using box plots (figure at right), which are useful for side-by-side visual comparisons of data distributions. Because the data set is small (six data points at each site), traditional box plots with 25th and 75th quartiles were deceptive. Rather than use quartiles, the box boundaries are the 2nd and 5th data point in each series. One way analysis of variance (ANOVA) was run on rank transformed data for comparison of median concentration distributions. An alpha value of 0.05 was used as the threshold for statistical



significance. If a significant difference among group medians was detected, Tukey's multiple comparison test was used on the rank transformed data to determine where differences were located (Helsel and Hirsh, 1992). Statistics were calculated using JMP Statistical Discovery Software (version 4.0.2). Summary statistics and raw data are provided in Appendix XX.

## Baseline Water Chemistry & Flow Data Results

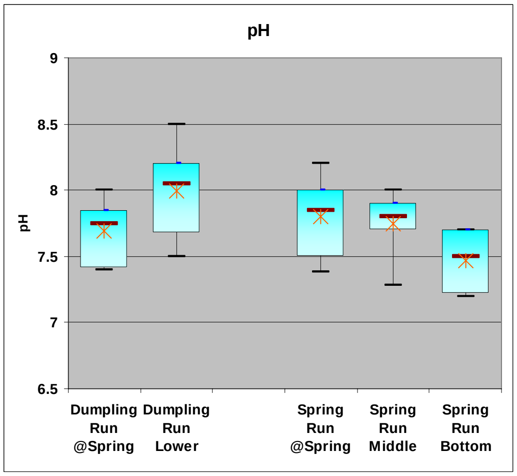
Pre-treatment results and analysis the water quality data will focus on five questions:

1. How does the spring source water of the two streams compare? It is assumed that the springs constitute the main source of water in both streams, certainly true at most conditions of flow. Note: both streams have surface flow entering the main channel upstream of the spring.
2. How does the water in the control stream change as it flows downstream?
3. How does the water in the experimental stream change as it flows downstream?
4. Are there significant differences in water chemistry at any of the sites?
5. How did water quality vary over time?

While viewing the baseline results, it is important to recognize that the data set is small (six monthly samples each site), which reduces the power of statistical tests to detect differences.

### Results

**Field Parameters:** pH, Dissolved Oxygen and Conductivity (see Appendix 1 for summary statistics).

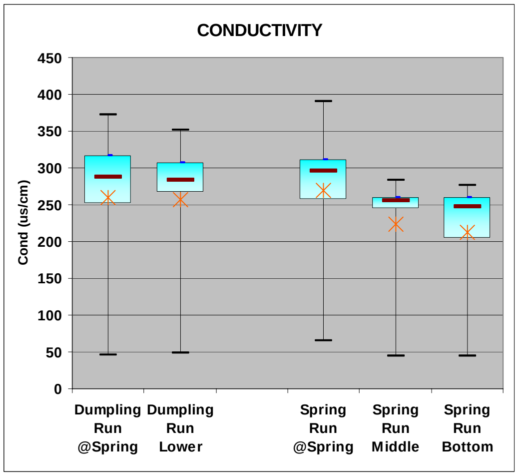


**Source Water:** pH in the main source water for the two streams was similar, with data ranging narrowly from 7.4 to 8.0 and 7.4 to 8.2 in Dumpling Run and Spring Run, respectively.

**Control Stream Trends:** median pH tended to increase in a downstream direction.

**Experimental Stream Trends:** median pH tended to decrease in a downstream direction in Spring Run, with Spring Run at the bottom station distinctly, although not significantly, lower than the other two sites.

**Significant differences:** pH in SR Bottom was significantly lower than DR Lower.



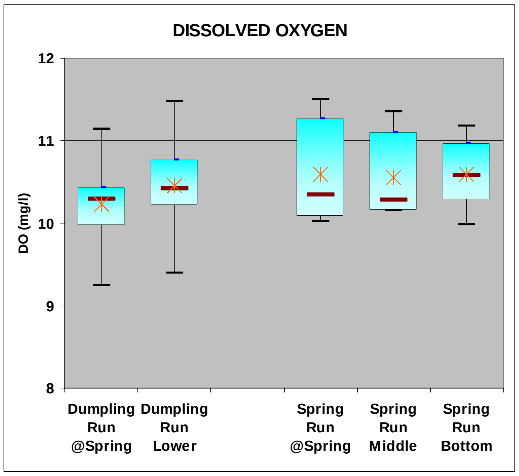
**Source Water:** Median conductivity in the two streams was very similar, with data ranging broadly from 45.8 to 372 and 64.6 to 390.0 (µs/cm) in Dumpling Run and Spring Run, respectively.

**Control Stream Trends:** median conductivity did not change in a downstream direction.

**Experimental Stream Trends:** Median conductivity was lower (not significantly) at the two downstream sites than the source water in Spring Run.

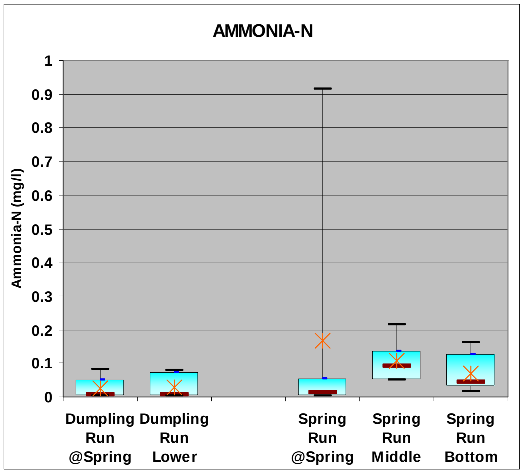
**Significant differences:** No sites were significantly different.

**Field Parameters:** pH, Dissolved Oxygen and Conductivity (see Appendix 1 for summary statistics).



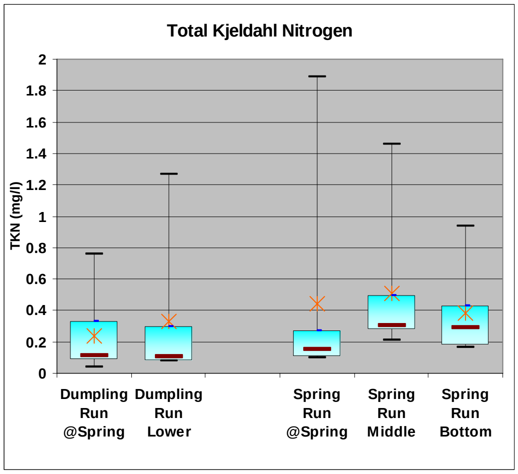
**Source Water:** Median dissolved oxygen in the two streams was similar and high, with data ranging from 9.2 to 11.1 and 10.0 to 11.5 (mg/l) in Dumpling Run and Spring Run, respectively.
**Control Stream Trends:** DO trended slightly higher in a downstream direction.
**Experimental Stream Trends:** DO was slightly higher at SR Bottom.
**Significant differences:** there were no significant differences.

**Laboratory Parameters:** Ammonia, TKN, Nitrate, Nitrite, Total Nitrogen, Total Phosphorus, Total Suspended Solids, Biochemical Oxygen demand. (See Appendix 1 for summary statistics).

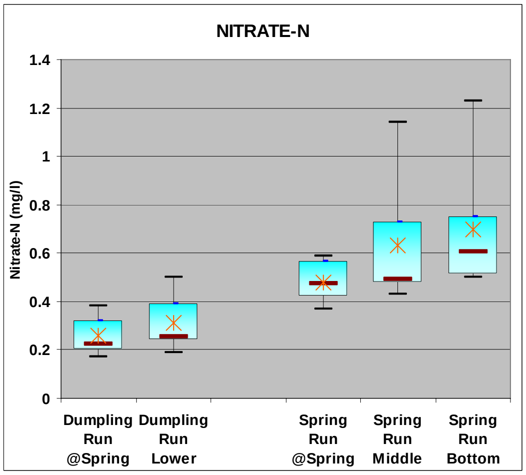


**Source Water:** Median ammonia in the main source water for the two streams was similar and low. However, while the data range in Dumpling Run was relatively small (0.003 to 0.082 mg/l), the range in Spring Run was large (0.003 to 0.915 mg/l). It is possible that the one high value was a one-time anomaly, but we have no way to know.
**Control Stream Trends:** no trends are apparent.
**Experimental Stream Trends:** Ammonia was higher at the middle site, then decreased in the downstream direction. The reduction in ammonia between SPR Middle and SPR Bottom is likely due to normal in-stream processes that convert ammonia to nitrate.
**Significant differences:** SR Middle is significantly higher than DR Spring.

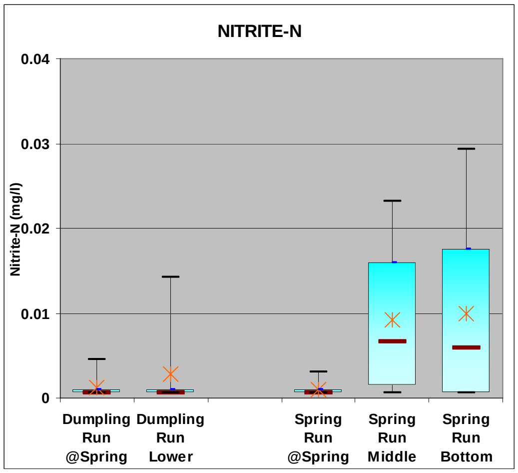
**Laboratory Parameters:** Ammonia, TKN, Nitrate, Nitrite, Total Nitrogen, Total Phosphorus, Total Suspended Solids, Biochemical Oxygen demand. (See Appendix 1 for summary statistics).



**Source Water:** Median TKN in the two streams was very similar, with data ranging broadly from 0.041 to 0.758 and 0.099 to 0.271 (mg/l) in Dumpling Run and Spring Run, respectively.
**Control Stream Trends:** median TKN did not change in a downstream direction.
**Experimental Stream Trends:** Median TKN was higher (not significantly) at the two downstream sites than the source water in Spring Run.
**Significant differences:** No sites were significantly different.

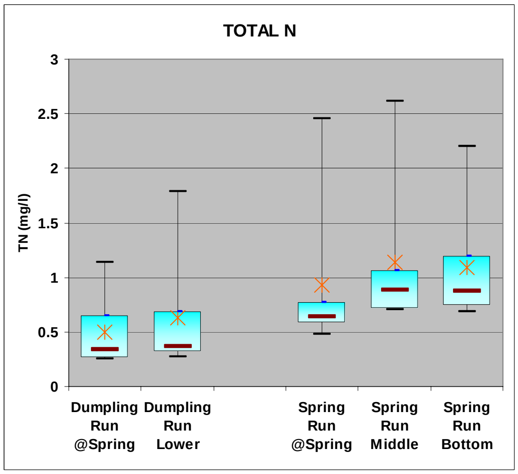


**Source Water:** Median nitrate ($NO_3$-N) in the two streams was significantly higher in SR than DR. Data in both streams ranged narrowly from 0.17 to 0.38 and 0.37 to 0.59 (mg/l) in DR and SR, respectively.
**Control Stream Trends:** median nitrate did not change in a downstream direction.
**Experimental Stream Trends:** Median nitrate and the range of values increased in the downstream direction (not significantly).
**Significant differences:** All SR sites had significantly higher nitrate than DR at its source; SR Middle and Lower had higher nitrate than DR Lower.

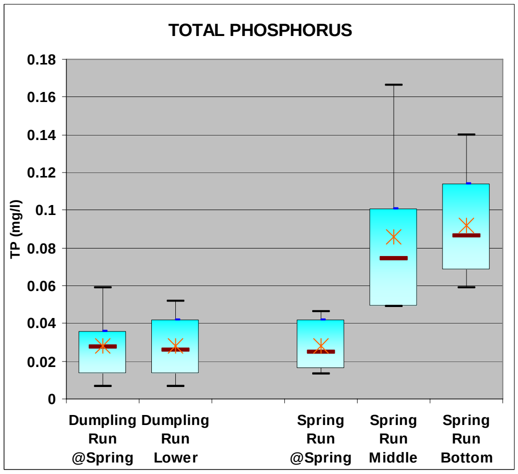


**Source Water:** Median nitrite ($NO_2$-N) concentrations in the two streams were below detection limits. Each site had a single measurable concentration during a high water event in August.
**Control Stream Trends:** median nitrite did not change in a downstream direction.
**Experimental Stream Trends:** Nitrite was typically detectable at low concentrations at the two downstream sites.
**Significant differences:** All SR sites had significantly higher nitrite than DR at its source; SR Middle and Lower had higher nitrite than DR Lower.

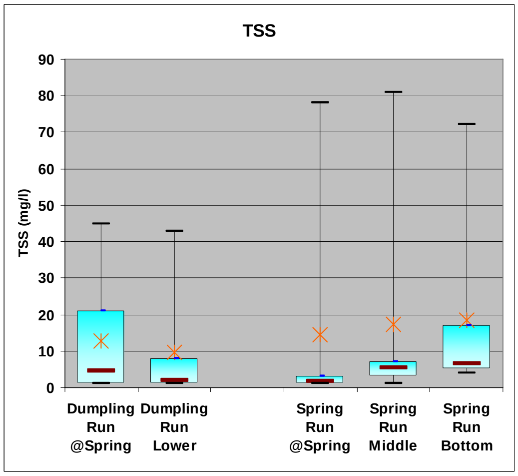
**Laboratory Parameters:** Ammonia, TKN, Nitrate, Nitrite, Total Nitrogen, Total Phosphorus, Total Suspended Solids, Biochemical Oxygen demand. (See Appendix 1 for summary statistics).



**Source Water:** Median Total N was distinctly (not significantly) higher in SR than DR. Data in both streams ranged broadly from 0.25 to 1.14 and 0.48 to 2.45 (mg/l) in DR and SR, respectively.
**Control Stream Trends:** median TN did not change in a downstream direction.
**Experimental Stream Trends:** Median TN was higher (not significantly) at the two downstream sites than in the source water in SR.
**Significant differences:** TN in SR Middle was higher than DR at the source.

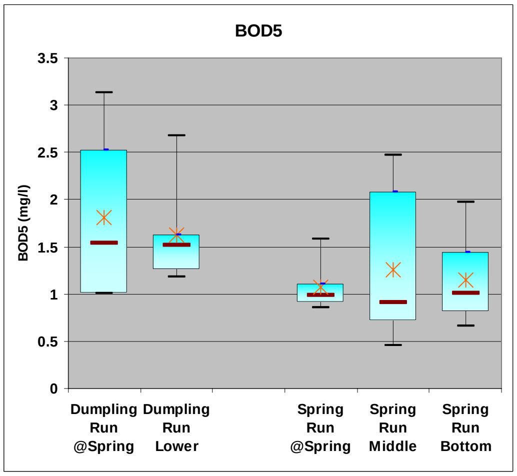


**Source Water:** Median Total Phosphorus in the two streams was very similar, with data ranging from 0.007 to 0.059 and 0.013 to 0.046 (mg/l) in DR and SR, respectively.
**Control Stream Trends:** median TP did not change in a downstream direction.
**Experimental Stream Trends:** TP was distinctly (and significantly) higher at the two downstream sites than in the source water in Spring Run.
**Significant differences:** TP in SR Middle and SR Bottom was significantly higher than all other locations.



**Source Water:** Median Total Suspended Solids was similar, ranging broadly from 45.8 to 372 and 64.6 to 390.0 in Dumpling Run and Spring Run, respectively.
**Control Stream Trends:** median TSS decreased slightly in a downstream direction.
**Experimental Stream Trends:** Median TSS increased in a downstream direction (not significantly.
**Significant differences:** No sites were significantly different.

**Laboratory Parameters:** Ammonia, TKN, Nitrate, Nitrite, Total Nitrogen, Total Phosphorus, Total Suspended Solids, Biochemical Oxygen demand. (See Appendix 1 for summary statistics).

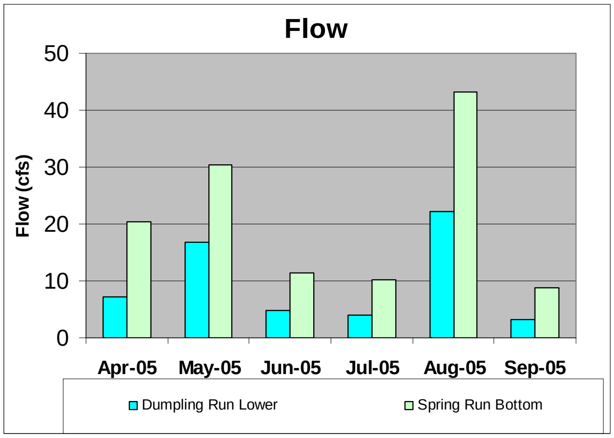


**Source Water:** Median Biochemical Oxygen Demand was distinctly (but not significantly) higher in DR than SR. Data ranged broadly in DR from 1.01 to 3.13 and narrowly in SR from 0.86 to 1.58 (mg/l).

**Control Stream Trends:** median BOD did not change in a downstream direction, although the range of values was lower downstream.

**Experimental Stream Trends:** Median BOD did not change in a downstream direction, but the range of values was greater downstream than at the source.

**Significant differences:** No sites were significantly different.

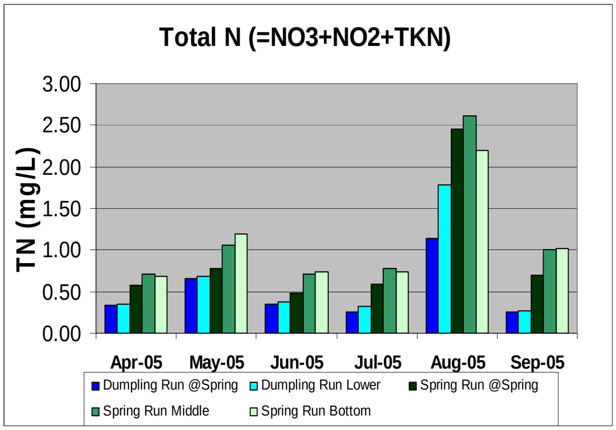
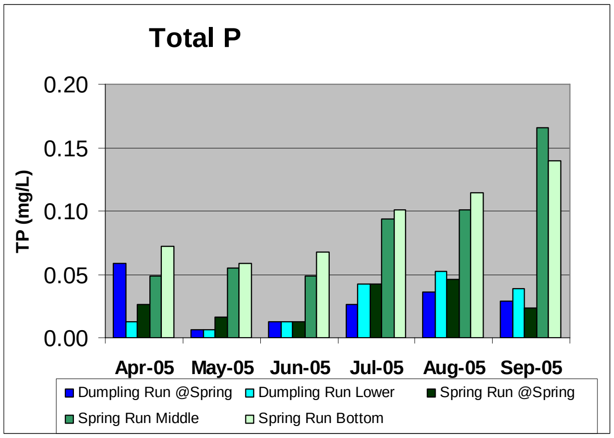
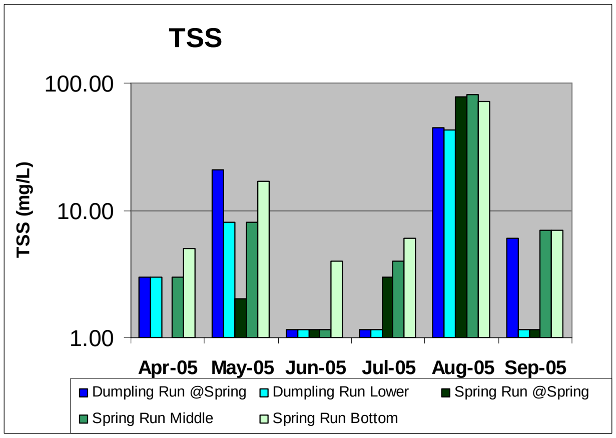
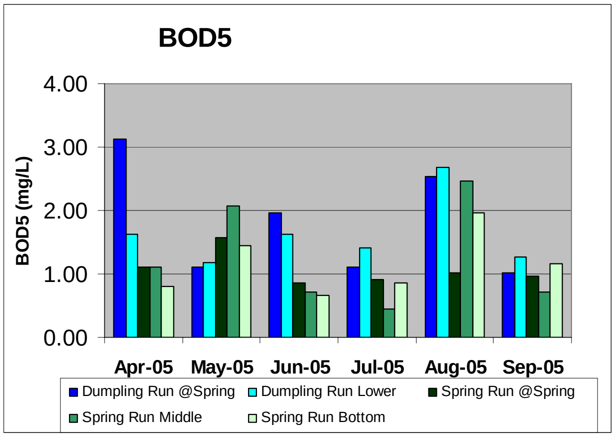


Flow measurements were taken at the Dumpling Run Lower and Spring Run Bottom sites. Flow in Dumpling Run ranged from about one third to one half of the flow in Spring Run (figure at left). Water samples were collected on three days with fairly low water (June, July, and September), two moderate flow (April and May), and one high water (August).

Since we are most concerned with local effects in this study, concentration is the most relevant way to look at the data. However, flow is necessary for interpretation of the time series data presented below.

The flow stations are not suitable surrogates for flows at all of the stations. This is particularly an issue in Spring Run, where a significant portion of the total stream flow is diverted at the springhouse to the trout hatchery and does not flow through the upper channel where samples are collected. This means that we cannot reasonably estimate parameter loadings at any sites but those with flow measurements.

**How did water quality vary over time?** The following four time-series bar graphs and associated text show how total N, total P, TSS and BOD5 varied during the baseline sampling period.

| Time series bar graphs of total nitrogen, total phosphorus, total suspended solids, and biochemical oxygen demand | |
|---|---|
|  |  |
| Total nitrogen varied widely and generally tracked with flows at all sites (see correlation tables below). The highest levels were observed in August during a high water event. | Total phosphorus varied widely over time at all sites and did not vary with flow levels (see correlation tables below). The phosphorus from the hatchery was evident at all flows, and the three highest readings at SR Middle and Bottom occurred at lowest, highest and second lowest flows. |
|  |  |
| TSS varied widely and very roughly tracked with flows at all sites (see correlation tables below). The highest levels were observed in August during a high water event. | BOD5 varied substantially between sites. BOD in Spring Run sites varied with flows, while concentrations in Dumpling Run had no discernable pattern (see correlation tables below). |

## Correlation Analysis

The following four tables present simple correlation analysis on the un-transformed sample data for key parameters: total N, total P, TSS, BOD5, and flow. The purpose of the four tables is to partition effects that might be due to different factors, such as point and non point sources of pollution. The first table offers correlations on all sites, the second Spring Run only, the third Dumpling Run only, and the fourth excludes point source impacted sites in Spring Run. More sophisticated approaches will be used in future reports when the size of the data set makes them more appropriate.

**Table 1. Correlations for key parameters and flow at all stations.**

| | Total N (mg/L) | TP (mg/L) | TSS (mg/L) | BOD5 (mg/L) | FLOW (cfs) |
|---|---|---|---|---|---|
| **Total N (mg/L)** | 1.0000 | ** | *** | * | *** |
| **TP (mg/L)** | 0.4216 | 1.0000 | n.s. | n.s. | n.s. |
| **TSS (mg/L)** | 0.9191 | 0.2813 | 1.0000 | ** | *** |
| **BOD5 (mg/L)** | 0.3759 | -0.0505 | 0.4365 | 1.0000 | n.s. |
| **FLOW (cfs)** | 0.8365 | 0.2197 | 0.7987 | 0.2874 | 1.0000 |

**Table 2. Correlations for key parameters and flow for Spring Run stations only.**

| | Total N (mg/L) | TP (mg/L) | TSS (mg/L) | BOD5 (mg/L) | FLOW (cfs) |
|---|---|---|---|---|---|
| **Total N (mg/L)** | 1.0000 | n.s. | *** | ** | *** |
| **TP (mg/L)** | 0.3173 | 1.0000 | n.s. | n.s. | n.s. |
| **TSS (mg/L)** | 0.9832 | 0.2411 | 1.0000 | ** | *** |
| **BOD5 (mg/L)** | 0.6300 | 0.0432 | 0.5862 | 1.0000 | *** |
| **FLOW (cfs)** | 0.8293 | -0.0597 | 0.8269 | 0.7771 | 1.0000 |

**Table 3. Correlations for key parameters and flow for Dumpling Run stations only.**

| | Total N (mg/L) | TP (mg/L) | TSS (mg/L) | BOD5 (mg/L) | FLOW (cfs) |
|---|---|---|---|---|---|
| **Total N (mg/L)** | 1.0000 | n.s. | *** | n.s. | *** |
| **TP (mg/L)** | 0.2753 | 1.0000 | n.s. | * | n.s. |
| **TSS (mg/L)** | 0.9217 | 0.2572 | 1.0000 | n.s. | *** |
| **BOD5 (mg/L)** | 0.4981 | 0.6347 | 0.4650 | 1.0000 | n.s. |
| **FLOW (cfs)** | 0.8873 | 0.0368 | 0.9013 | 0.3905 | 1.0000 |

**Table 4. Correlations for key parameters and flow for all stations except SR Middle and SR Bottom (i.e. NPS stations).**

| | Total N (mg/L) | TP (mg/L) | TSS (mg/L) | BOD5 (mg/L) | FLOW (cfs) |
|---|---|---|---|---|---|
| **Total N (mg/L)** | 1.0000 | n.s. | *** | n.s. | *** |
| **TP (mg/L)** | 0.3636 | 1.0000 | n.s. | n.s. | n.s. |
| **TSS (mg/L)** | 0.9338 | 0.3814 | 1.0000 | n.s. | *** |
| **BOD5 (mg/L)** | 0.1290 | 0.4550 | 0.1904 | 1.0000 | n.s. |
| **FLOW (cfs)** | 0.8625 | 0.1273 | 0.7669 | 0.0224 | 1.0000 |

**Correlation Tables Note**: n.s. means not significant; * = significant at p=0.05; ** = significant at 0.01; *** = significant at 0.001

Certain results were consistent across all four tables. Total nitrogen and TSS were strongly and positively correlated with flow, and with each other. These were also the only significant correlations for the non-point impacted sites (Table 4). TSS was also positively correlated with BOD5 in Spring Run (Table 2) and overall (Table 1). BOD5 was positively correlated with flow in Spring Run (Table 2).

## Discussion of water quality results

The two study streams are impacted by a variety of potential sources of pollution, some readily apparent and some not. The Spring Run watershed contains the trout rearing facility point source, which is a known source of BOD, TSS and nutrients, as well as a number of non point sources including poultry houses, residences, and roads. The Dumpling Run watershed has no point sources, and apparently no poultry houses, but includes residences and small farms with livestock. In addition, the source springs in both watersheds both originate in limestone and sandstone strata and show rapid changes (turbidity, increase in flow) following heavy precipitation; this is indicative of solution channel connections through limestone at the surface of the ground.

Despite the wealth of confounding variables, some patterns are reasonably clear from the baseline data. The spring source water for the two streams has similar pH, conductivity, dissolved oxygen, and phosphorus. Source water in Dumpling Run tends to have less nitrate, nitrite, and total N than

Spring Run, and higher BOD5 and TSS. Conductivity and pH tend to increase or not change in a downstream direction in Dumpling Run, and tend to decrease in a downstream direction in Spring Run. Nutrients and TSS are generally similar in the two Dumpling Run sites, and tend to increase in a downstream direction in Spring Run, often dramatically.

The decision to collect water samples two days after the scheduled Monday cleanouts at the hatchery contributed to the apparently anomalous result of Dumpling Run having somewhat more BOD5 and TSS than Spring Run. It is quite clear that we are not observing a significant residual impact in the water column from those cleanouts two days after the fact.

The purpose of this report was simply to establish baseline conditions in Spring Run and Dumpling Run. Future reports will include more comprehensive analyses of these data in the context of changing conditions in Spring Run.

## Benthic & Periphyton Analysis

Data for 2005 not yet available. However, an assessment of Spring Run in 2003 by WVDEP (Tim Craddock, 2003) collected benthic invertebrate samples at sites near those chosen for the current study. The study found low diversity at the lower station, where the most abundant family was the Chironomidae, an indicator of organic pollution. It also found abundant Gammaridae amphipods at all sites. (See Appendix 3 for results.)

Observations during benthic field collections also indicated abundance, often overwhelming abundance, of amphipods at all sites in both streams (Craddock and Gillies, personal observations). Amphipods are often abundant in limestone spring fed streams, and their abundance renders many standard benthic invertebrate indices unsuitable for assessing this type of stream. Assessment of benthic communities in this setting will depend on comparisons between control and experimental sites, not standard metrics.

## Fisherman Survey

Data currently being analyzed.

## Evaluation of Fisheries Resources in Spring Run, Grant County, West Virginia

The West Virginia Division of Natural Resources in cooperation with the West Virginia Conservation Agency conducted a fisheries survey in the fly fishing managed section of Spring Run on May 23, 2005. Sampling began at the downstream end of stream section #4 and extended 110 meters upstream. A brief summary of the WVDNR report follows.

The Spring Run fish survey was conducted by triple pass backpack electro fishing. Collected specimens were measured, weighed and released downstream from the survey area. A total of 122 fishes were captured. Rainbow trout was the most common species and 112 individuals comprised 91.8% of the relative abundance. Three additional species were also captured: brook trout, brown trout *Salmo trutta* and mottled sculpin *Cottus bairdi*. The total biomass observed from the 110-meter stream reach was 8.582 kg; rainbow trout contributed 7.212 kg to the total. Length frequencies indicated strong year classes of rainbow trout in the 110 mm and 200 mm size range and few fish in the larger size groups. Only one non-game / prey species was observed, which reflects the domination of predatory fish in Spring Run.

WVDNR found a high rainbow trout density, with a biomass of rainbow trout under 6 inches greater than 12 kg/ha. A "Class A" wild rainbow trout stream in Pennsylvania has a total biomass greater than 2.0 kg/ha of rainbow trout under 6 inches (Graff 1997). Despite the high biomass of up to 6-

inch rainbow trout, the report noted a dramatic difference in overall fish biomass per acre when compared to a 1978 Spring Run survey (311 lbs./acre in 1978 vs. 133 lbs./acre in 2005, based on an average stream width of 19 feet). (Note: the 1978 survey (Gerald Lewis, unpublished data, 1978) was performed just above the confluence with South Mill Creek, which is a distinctly different stream. WVDNR conducted a second survey in Spring Run in 2005 in the same area; once these results are available, they will be compared to the 1978 survey.)

## Update On Upgrade Of Rearing Facility

As of this writing, the engineering study for the plant upgrade is nearing completion. Working drawings are expected in early 2006, and the WVDNR anticipates putting the project out for bid in the spring of 2006. If all of the above dates are achieved, construction may begin as early as June or July of 2006. (Rick Backus, WVDNR, personal communication)

## Benthic Workshop Press Release

"An educational day couldn't get any better than this," was the statement made by Arthur Halterman, middle and high school teacher at East Hardy Early Middle School. Mr. Halterman was referring to the recent benthic-monitoring workshop held on Spring Run on May 6, 2004. Friends of Spring Run's Wild Trout hosted the one-day workshop in Grant County as a component of the new three-year environmental study that recently commenced on Spring Run. Over forty individuals took part in the hands-on program.

Spring Run is the focus of an intensive water quality research project involving numerous agencies and non-governmental organizations. West Virginia Department of Natural Resources owns and operates the Spring Run Trout Hatchery located immediately above the 2.5-mile stretch of stream being monitored. The hatchery is preparing to install an effluent treatment process at the facility to meet their permit requirements and improve the quality of water leaving the facility. The research project will gather water chemistry, benthics, periphyton (attached algae and other organisms that live on surface of rocks) and fish samples to assess the present water quality prior to the upgrade of the effluent treatment process. Two consecutive years of monitoring will follow implementation to determine the long-term benefits of the upgrade. This research project is being financed by the West Virginia Conservation Agency through the Chesapeake Bay Program.

Friends of Spring Run's Wild Trout, West Virginia Conservation Agency, Cacapon Institute, WV Department of Agriculture, WV Division of Natural Resources and WV Department of Environmental Protection are all partnering on this project and are striving to raise awareness and educate the community on the importance of maintaining/improving water quality. The benthic workshop brought together a diverse group of individuals ranging from students; fly-fisherman, environmental professional and community leaders to better understand freshwater ecology. Friends of Spring Run's Wild Trout through a Potomac Valley Conservation District Mini-grant sponsored the field day. For more information on this project contact Carla Hardy at 304.538.7581.

## Volunteer Involvement

The Potomac Christian Educators, a home school group with members located in the North Mill Creek watershed, Petersburg, Cabins and the surrounding area will also be contributing to the project. This group has been trained and certified by WV Save Our Streams and will use the level one methods to monitor Spring Run at the lower portions of the catch and release area. The results of their first monitoring from August of 2005 can be viewed on the Internet through WV Save Our Streams Volunteer Access Database (VAD) http://www.wvdep.org/dwwm/wvsos/vad/index.htm.

At the sign-in screen, select "**View stream assessment reports**"; you do not have to register to view reports. You will see a complete list of streams currently in the database. To locate the Spring Run report, select the South Branch Potomac basin and click-on [**GO**]. The stream names and report codes are listed in alphabetical order.

### Outreach- Watershed Celebration Day and Volunteer Monitoring in the Mid-Atlantic- Displays & awards

Education and outreach are a key component to this study. A table top display has been designed and displayed at several conferences including 2005 Watershed Celebration Day and the recent Volunteer Monitoring in the Mid-Atlantic Conference held in Canaan Valley. The display gives a comprehensive overview of the study and encourages public interest and participation.

### Plan to use NSR techniques on eroding channel

Friends of Spring Run's Wild Trout are recipients of a 2005 Stream Partners Grant. Through this funding, FSRWT will join with and support the multi-agency, multi-year Spring Run Rehabilitation and Monitoring Project. The objective is to use natural stream restoration techniques to slow down the excessive amount of sediment entering Spring Run with each rain event from a drainage channel above the spring. The original bed of this channel was relocated by road construction and is now constrained on one side by the road and on the other side by a steep hillside. The worst erosion is occurring in a section approximately 300' in length and 6'deep. While it would be possible to treat the problem with stone rip-rap, FSRWT has decided to seek a more natural solution using a series of step pools to slow down the velocity of water (reducing its erosive force), center the flow in the channel and away from the banks, and create benthic habitat in this intermittent stream The West Virginia Conservation Agency is in the process of project design and will oversee the installation of the in-stream structures. The end product will be a demonstration project that WVCA, FSRWT and WVDNR will be able to use to endorse natural stream restoration techniques to the public. It is expected that construction will commence February 2006.

### Year Two expectations

With the actual date for upgrading effluent treatment at the trout rearing facility uncertain, we are considering the possibility of extending baseline data collections until that occurs. A final decision will be made based on availability of funds to support additional sampling. Otherwise, the next phase of this project will be put on hold until the upgrade is complete.

## Literature

Craddock, T. 2003. WV Save Our Streams Ecological Assessment of Spring Run. Unpublished report.

Graff, D. R. 1997. Management of trout fisheries in Pennsylvania waters. Division of Fisheries Management, Pennsylvania Fish and Boat Commission. Federal Aid in Fish Restoration. Project F-57-R. Available at: http://sites.state.pa.us/fish/trman98.htm

Hedrick, Jim. 2005. Evaluation of Fisheries Resources in Spring Run, Grant County, West Virginia. Unpublished report conducted on July 08, 2005 by Jim Hedrick, District Fisheries Biologist, WVDNR and Carla Hardy, Watershed Specialist, WCVA.

Helsel, D. R., & R. M. Hirsh, 1992. Studies in Environmental Science 49: Statistical Methods in Water Resources. Elsevier Science Publishers B.V. 522 pp.

## Appendix 1.  Water quality summary data.

| Site | Minimum | Median | Maximum | Mean | Std.Dev. |
|---|---|---|---|---|---|
| **Ammonia-N (mg/L)** | | | | | |
| Dumpling Run @Spring | 0.003 | 0.007 | 0.082 | 0.025 | 0.033 |
| Dumpling Run Bottom | 0.003 | 0.007 | 0.079 | 0.028 | 0.037 |
| Spring Run 1 | 0.017 | 0.043 | 0.161 | 0.070 | 0.059 |
| Spring Run Middle | 0.051 | 0.093 | 0.214 | 0.107 | 0.063 |
| Spring Run @spring | 0.003 | 0.012 | 0.915 | 0.167 | 0.367 |
| **Nitrate-N (mg/L)** | | | | | |
| Dumpling Run @spring | 0.170 | 0.225 | 0.380 | 0.260 | 0.079 |
| Dumpling Run Bottom | 0.190 | 0.255 | 0.500 | 0.310 | 0.117 |
| Spring Run Bottom | 0.500 | 0.605 | 1.230 | 0.700 | 0.275 |
| Spring Run Middle | 0.430 | 0.490 | 1.140 | 0.630 | 0.273 |
| Spring Run @spring | 0.370 | 0.475 | 0.590 | 0.480 | 0.083 |
| **Nitrite-N (mg/L)** | | | | | |
| Dumpling Run @spring | 0.001 | 0.001 | 0.005 | 0.001 | 0.002 |
| Dumpling Run Bottom | 0.001 | 0.001 | 0.014 | 0.003 | 0.006 |
| Spring Run Bottom | 0.001 | 0.006 | 0.029 | 0.010 | 0.011 |
| Spring Run Middle | 0.001 | 0.007 | 0.023 | 0.009 | 0.009 |
| Spring Run @spring | 0.001 | 0.001 | 0.003 | 0.001 | 0.001 |
| **TKN (mg/L)** | | | | | |
| Dumpling Run @spring | 0.041 | 0.115 | 0.758 | 0.240 | 0.273 |
| Dumpling Run Bottom | 0.081 | 0.108 | 1.270 | 0.330 | 0.471 |
| Spring Run Bottom | 0.167 | 0.291 | 0.938 | 0.380 | 0.291 |
| Spring Run Middle | 0.214 | 0.305 | 1.460 | 0.510 | 0.475 |
| Spring Run @spring | 0.099 | 0.150 | 1.890 | 0.440 | 0.711 |
| **Total N (mg/L)** | | | | | |
| Dumpling Run @spring | 0.252 | 0.341 | 1.143 | 0.500 | 0.348 |
| Dumpling Run Bottom | 0.274 | 0.364 | 1.784 | 0.630 | 0.583 |
| Spring Run Bottom | 0.688 | 0.877 | 2.197 | 1.090 | 0.574 |
| Spring Run Middle | 0.710 | 0.887 | 2.616 | 1.140 | 0.736 |
| Spring Run @spring | 0.476 | 0.641 | 2.453 | 0.930 | 0.755 |
| **TP (mg/L)** | | | | | |
| Dumpling Run @spring | 0.007 | 0.028 | 0.059 | 0.028 | 0.019 |
| Dumpling Run Bottom | 0.007 | 0.026 | 0.052 | 0.028 | 0.019 |
| Spring Run Bottom | 0.059 | 0.087 | 0.140 | 0.092 | 0.031 |
| Spring Run Middle | 0.049 | 0.075 | 0.166 | 0.086 | 0.046 |
| Spring Run @spring | 0.013 | 0.025 | 0.046 | 0.028 | 0.014 |
| **TSS (mg/L)** | | | | | |
| Dumpling Run @spring | 1.150 | 4.500 | 45.000 | 12.880 | 17.423 |
| Dumpling Run Bottom | 1.150 | 2.075 | 43.000 | 9.580 | 16.588 |
| Spring Run Bottom | 4.000 | 6.500 | 72.000 | 18.500 | 26.629 |
| Spring Run Middle | 1.150 | 5.500 | 81.000 | 17.360 | 31.281 |
| Spring Run @spring | 1.000 | 1.575 | 78.000 | 14.380 | 31.175 |
| **Turbidity (NTU)** | | | | | |

## Appendix 1. Water quality summary data.

| Site | Minimum | Median | Maximum | Mean | Std.Dev. |
|---|---|---|---|---|---|
| Dumpling Run @spring | 0.451 | 0.903 | 22.950 | 7.520 | 10.603 |
| Dumpling Run Bottom | 1.240 | 2.115 | 43.800 | 10.290 | 16.826 |
| Spring Run Bottom | 1.960 | 3.145 | 51.300 | 13.400 | 19.656 |
| Spring Run Middle | 1.310 | 3.400 | 36.000 | 9.580 | 13.519 |
| Spring Run @spring | 1.030 | 1.945 | 18.420 | 5.220 | 6.842 |
| **BOD5 (mg/L)** | | | | | |
| Dumpling Run @spring | 1.010 | 1.540 | 3.130 | 1.810 | 0.884 |
| Dumpling Run Bottom | 1.180 | 1.515 | 2.680 | 1.630 | 0.546 |
| Spring Run Bottom | 0.660 | 1.010 | 1.970 | 1.150 | 0.489 |
| Spring Run Middle | 0.450 | 0.910 | 2.470 | 1.255 | 0.827 |
| Spring Run @spring | 0.860 | 0.985 | 1.580 | 1.070 | 0.263 |
| **DO (mg/L)** | | | | | |
| Dumpling Run @spring | 9.240 | 10.290 | 11.140 | 10.230 | 0.624 |
| Dumpling Run Bottom | 9.400 | 10.420 | 11.480 | 10.450 | 0.688 |
| Spring Run Bottom | 9.980 | 10.575 | 11.180 | 10.590 | 0.476 |
| Spring Run Middle | 10.150 | 10.275 | 11.350 | 10.550 | 0.530 |
| Spring Run @spring | 10.020 | 10.340 | 11.500 | 10.590 | 0.632 |
| **pH** | | | | | |
| Dumpling Run @spring | 7.400 | 7.750 | 8.000 | 7.690 | 0.236 |
| Dumpling Run Bottom | 7.500 | 8.050 | 8.500 | 7.990 | 0.361 |
| Spring Run Bottom | 7.200 | 7.500 | 7.700 | 7.470 | 0.229 |
| Spring Run Middle | 7.280 | 7.800 | 8.000 | 7.750 | 0.250 |
| Spring Run @spring | 7.380 | 7.850 | 8.200 | 7.800 | 0.309 |
| **Conductivity (us/cm)** | | | | | |
| Dumpling Run @spring | 45.800 | 286.900 | 372.000 | 260.000 | 112.414 |
| Dumpling Run Bottom | 48.100 | 283.500 | 352.000 | 257.000 | 106.735 |
| Spring Run Bottom | 45.100 | 247.500 | 276.000 | 213.000 | 85.869 |
| Spring Run Middle | 44.900 | 255.000 | 284.000 | 223.000 | 88.651 |
| Spring Run @spring | 64.600 | 296.100 | 390.000 | 269.000 | 109.377 |

Appendix 2. Laboratory Methods for Water Quality Parameters.

| **Parameter** | **Method** |
|---|---|
| Ammonia Nitrogen | EPA 350.2 |
| Nitrate | EPA 353.2 |
| Nitrite | EPA 353.2 |
| * Ortho Phosphate | HACH 8048 |
| Total Phosphate | EPA 365.2 |
| Total Kjeldahl Nitrogen | EPA 351.2 |
| Total Suspended Solids | SM 2540D |
| * Turbidity | HACH 2100N |
| Biochemical Oxygen Demand 5 | SM5210B |

Appendix 3. WV Save Our Streams Macroinvertebrate Assessment July 2003

**Station 1** (catch-and-release)

| | |
|---|---|
| Ephemeroptera (mayflies) | |
| ***Baetidae*** | 73 |
| ***Heptageniidae*** | 2 |
| Trichoptera (caddisflies) | |
| ***Rhyacophilidae*** | 2 |
| ***Hydropsychidae*** | 13 |
| Diptera (true flies) | |
| ***Simuliidae*** | 8 |
| ***Chironomidae*** | 67 |
| Amphipoda (scuds) | |
| ***Gammaridae*** | 31 |
| Total | 196 |

**Station 2** (catch-and-release)

| | |
|---|---|
| Ephemeroptera (mayflies) | |
| ***Ephemerellidae*** | 1 |
| ***Heptageniidae*** | 4 |
| ***Baetidae*** | 45 |
| Plecoptera (stoneflies) | |
| ***Capniidae*** | 1 |
| ***Chloroperlidae*** | 1 |
| ***Perlodidae*** | 4 |
| Trichoptera (caddisflies) | |
| ***Glossosomatidae*** | 2 |
| ***Rhyacophilidae*** | 1 |
| ***Hydropsychidae*** | 18 |
| Coleoptera (beetles) | |
| ***Elmidae*** | 4 |
| Diptera (true flies) | |
| ***Simuliidae*** | 16 |
| ***Chironomidae*** | 37 |
| Amphipoda (scuds) | |
| ***Gammaridae*** | 125 |
| Total | 259 |

**Station 3** (above hatchery)

| | |
|---|---|
| Ephemeroptera (mayflies) | |
| ***Isonychiidae*** | 2 |
| ***Ephemerellidae*** | 3 |
| ***Baetidae*** | 30 |
| Plecoptera (stoneflies) | |
| ***Capniidae*** | 17 |
| ***Perlodidae*** | 6 |
| Trichoptera (caddisflies) | |
| ***Rhyacophilidae*** | 3 |
| ***Hydropsychidae*** | 17 |
| Coleoptera (beetles) | |
| ***Elmidae*** | 12 |
| ***Psephenidae*** | 1 |
| Diptera (true flies) | |
| ***Dixidae*** | 1 |
| ***Simuliidae*** | 12 |
| ***Chironomidae*** | 6 |
| Amphipoda (scuds) | |
| ***Gammaridae*** | 60 |
| Total | 170 |