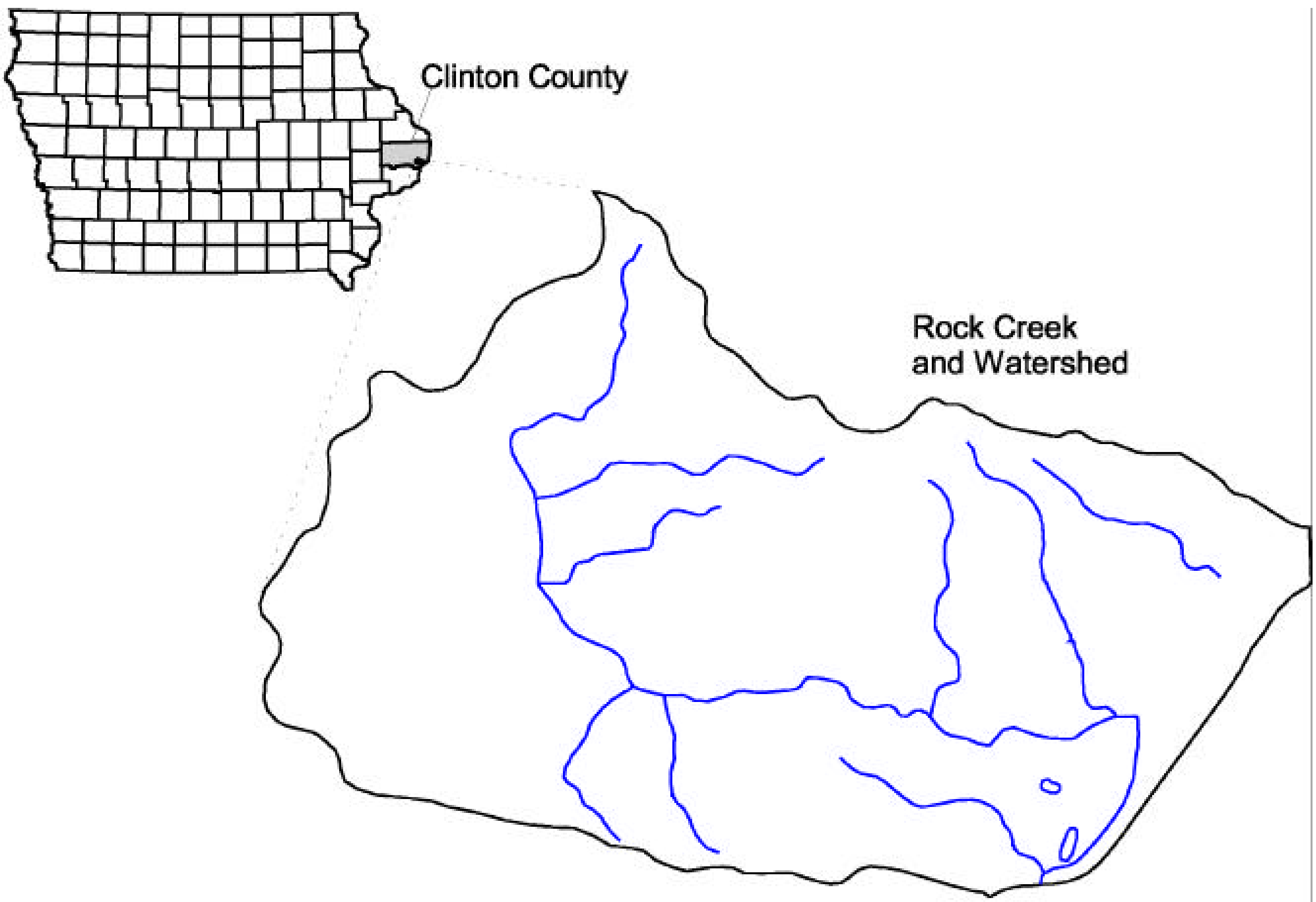
Total Maximum Daily Load
For Ammonia and NOx
Rock Creek
Clinton County, Iowa

December 2000

Iowa Department of Natural Resources
Water Resources Section

TMDL for Ammonia and NOx
Rock Creek
Clinton County, Iowa

Waterbody Name:	Rock Creek
IDNR Waterbody ID:	IA 01-MAQ-0010-0
Hydrologic Unit Code:	HUC11 07080101030
Location:	Sec. 23, T81N, R5E
Latitude:	41 Deg. 47 Min. N
Longitude:	90 Deg. 16 Min W
Use Designation Class:	B (LR) (aquatic life)
Watershed Area:	10,688 acres
Segment Length	9 miles
Major River Basin:	Copperas-Duck
Receiving Water Body:	Mississippi River via Schricker Slough
Pollutant:	Ammonia and NOx
Pollutant Sources:	Contaminated Site Agricultural Non Point Sources
1998 303d Priority:	High



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1. Description of Waterbody and Watershed

Rock Creek is located in eastern Clinton County, in east central Iowa. Rock Creek is located in the Copperas-Duck watershed (HUC 8: 07080101) and drains approximately 16.7 mi^2 (10,688 acres) (Larimer, 1974) of Clinton County at the Highway 67 bridge. Rock Creek flows east-southeast before draining into the Mississippi River. Figure 1 shows the location of the watershed.

The landuse of the Rock Creek watershed is predominately agriculture. Based on IDNR 1992 landuse data, the Rock Creek watershed is composed primarily of agricultural lands (90%), with 4% urban and 6% forest and wetlands.

2. Applicable Water Quality Standards

The Iowa Water Quality Standards (Iowa, 1996) list the designated uses for this basin as Aquatic Life (Class B(LR) - Limited Resource) and general uses of secondary contact recreation, crop irrigation, agricultural uses, domestic uses, and livestock watering.

According to the 1998 303(d) list, the waters in this basin are impaired by toxic levels of ammonia nitrogen (NH_3-N) and elevated levels of nitrate/nitrite nitrogen (NO_x-N). Rock Creek has exceeded the criteria for Ammonia Nitrogen – Limited Resource Streams (Table 3c, Iowa, 1996). This criteria is variable and dependent on temperature and pH. There are no numeric criteria for nitrate or nitrite nitrogen in the Iowa Water Quality Standards for Class B waters.

3. Current Water Quality Conditions and Desired Endpoint

The Nitrate/Nitrite (NOx) TMDL is bundled with the ammonia TMDL because the pollutants are so closely related. In the nitrification process, ammonia is oxidized, broken down to nitrite and then to nitrate. Further, there is a statistical relationship between the increase in NOx and the increase in ammonia around the PCS Nitrogen facility. By limiting the amount of ammonia that can complete the nitrification cycle, the amount of nitrites and nitrates will also be limited.

Data for this basin are limited, with no USGS or STORET data sources available from the Rock Creek subbasin. The monitoring data used in this report are from monitoring reports for Schricker Slough, located below the mouth of Rock Creek in the Mississippi River. The monitoring data is part of a Long Term Resource Management Program (LTRMP) effort. Stream flow data were derived from a nearby watershed.

3.1 Water Quality Data

Long-term monitoring data for Schricker Slough are available from 1993-present (Gritters, 1997, 2000). The monitoring data were collected upstream of PCS Nitrogen, downstream of PCS Nitrogen, and in Schricker Slough. Reported nitrogen species are ammonia and nitrate/nitrite. Sampling on May 21, 1997, was performed at four additional stations, including a sample upstream of PCS Nitrogen on the tributary where it is located (Figure 2). On May 3, 2000, staff from IDNR and US Fish and Wildlife inspected the watershed. Photographs were taken at six sites, along with field measurements for temperature, pH, and nitrate at four sites, and channel geometry and velocity at three sites. Water quality data from several monitoring stations and monitoring wells, and the field data from May 3, 2000, were used to establish the background concentrations.

3.2 Water Quality Analysis

Water quality samples from May 21, 1997, for the upstream and downstream sites were similar to the LTRMP data. No other sample data were available for the small unnamed north/south creek referred to as Ammonia Creek. Table 1 presents the data for May 21, 1997, from upstream to downstream LTRMP data. The portion of the watershed in which monitoring data were collected is shown in Figure 2. The impact of PCS Nitrogen on in-stream ammonia and nitrate/nitrite is well demonstrated by these sample data. LTRMP data confirm this impact. Monitoring data for ammonia and nitrate/nitrite are shown in Figures 3 and 4 respectively.

Water quality standards are violated downstream of PCS Nitrogen for ammonia. Under the Long Term Resource Monitoring Program, biweekly samples are collected in Schricker Slough and at two sites in Rock Creek, one above PCS Nitrogen and one below PCS Nitrogen. During the sampling, field data were collected, including temperature and pH. The ammonia criteria for Rock Creek was calculated from the equation used to derive Table 3c of the Iowa Water Quality Standards (Iowa, 1996). This was done for each temperature and pH of the monitoring data and the criteria compared to the ammonia concentration in the stream. Tables 2 and 3 summarize the monitoring data for the two LTRMP Rock Creek sites. The data from upstream of PCS Nitrogen show no ammonia concentrations near toxicity values, whereas 6 of 82 samples at the downstream station exceeded the calculated chronic criteria.

3.3 USGS Flow Gauge Data

The Rock Creek basin does not have a stream flow monitoring gauge. Crow Creek, which is located approximately 20 miles downstream on the Mississippi River, has flow records and is similar to Rock Creek in shape, drainage area, and landuse characterization. The landuses in Rock Creek were compared to landuses in Crow Creek using the 1992 IDNR landuse data. The comparison shows Rock Creek is 90% agricultural while Crow Creek is 77% agricultural. It is recognized that landuse in both of these watersheds may have changed since the data was collected in 1992. The proximity of Crow Creek to Rock Creek and the similarity of land uses support the use of Crow Creek as a surrogate gauge to calculate flows in Rock Creek. Daily flows for the Crow Creek gauge (USGS station 05422470 Crow Creek at Bettendorf, Iowa) were used to estimate the flow of Rock Creek on days with monitoring data and summary statistical data were used to estimate the median flows for Rock Creek. The median flow is the stream flow that 50 percent of measured flows exceed. The critical flow for Iowa streams is the 7Q10 flow, a 7-day average low flow expected to occur once in 10 years. For Rock Creek, a protected low flow of 0.5 cfs has been established in lieu of the 7Q10. Therefore, the critical low flow is 0.5 cfs.

3.4 Ammonia Endpoint

Elevated ammonia levels can cause aquatic toxicity and lower in-stream dissolved oxygen due to conversion of ammonia to nitrate. Iowa's numeric criteria for ammonia nitrogen are for acute and chronic toxicity and are based on pH, temperature, and water quality classifications (Iowa, 1996). As part of the Iowa DNR wasteload allocation procedures, a summer water temperature of 23.8 °C and a pH of 8.2 are used to determine the critical conditions. The summer critical period has been chosen since in-stream reaction rates are greatest and the DO saturation value is smallest at that time. The chronic criterion will be used as the basis for the selected endpoint. Table 3c of the Iowa Water Quality Standards does not list criteria for 23.8 °C and pH of 8.2. However, the DNR has calculated a corresponding criteria of 1.84 mg/L as N using the criterion's equation. Therefore, the selected endpoint is 1.84 mg/L. For Phase I of this TMDL , this will be achieved at the outlet of the constructed wetland. To achieve and maintain this ammonia concentration, the ammonia load capacity for Rock Creek is 5.0 pounds per day at the protected flow of 0.5 cfs. For Phase II, the same ammonia endpoint will be achieved in Rock Creek following complete mixing with Ammonia Creek at a location approximately 200 feet downstream.

For use in assessment of future monitoring data, seasonal ammonia endpoints are also provided based on other critical stream flow and instream pH and temperature conditions. These example endpoints are discussed in the Stream Loading section.

3.5 Nitrate Endpoint

The water quality standard for nitrate/nitrite for Class B(LR) use is a narrative standard that states: waters shall be free from substances attributable to wastewater discharges or agricultural practices in concentrations or combinations, which are acutely toxic to humans, animals or plant life. Rock Creek was listed on the 1998 303(d) for NOx (nitrate/nitrite) based on best professional judgement (BPJ). It was believed the fish community would be negatively impacted by very high levels of nitrate/nitrite found in the water column. After further investigation through fish collection it was determined, based on BPJ, that no significant adverse impacts were affecting the fish community. However, reductions in NOx should benefit the overall aquatic system.

4. Source Assessment

4.1 Point Sources

Data retrieved from the EPA Permit Compliance System (USEPA, 2000) show four permitted facilities located in the Rock Creek watershed. The four facilities are the City of Low Moor (IA0040100), Equistar Chemicals, L.P. (IA0000191), DuPont (IA0001066), and PCS Nitrogen Fertilizer, L.P. (IA0003522). The locations of the four facilities are shown in Figure 5. Review of the facility information indicates that only the City of Low Moor discharges to Rock Creek. The remaining facilities discharge to the Mississippi River. Table 4 summarizes the Permit Compliance System monitoring data and permit limits for the City of Low Moor. Although the City of Low Moor has no monitoring data or permit limits for nitrogen compounds, wastewater treatment plants (WWTPs) do discharge nitrogen compounds. The Low Moor WWTP is a controlled discharge lagoon that is to discharge twice per year, usually in the spring and fall. This discharge may or may not be occurring at the 7Q10 or protected flow. Considering the size of the Low Moor discharge, the in-stream effects for this point source will be minor.

4.2 Nonpoint Sources

<u>4.2.1 Groundwater Contamination Sites</u>

Although Equistar, DuPont, and PCS Nitrogen NPDES outfalls do not discharge to Rock Creek, these three sites are considered contaminated sites. The Equistar and Dupont sites are considered Superfund sites. As contaminated sites, all three have the potential to contribute pollutants to Rock Creek through groundwater contamination. Documents for Equistar and DuPont were obtained from the US EPA, Iowa DNR was responsible for supplying data for PCS Nitrogen.

The data for the DuPont facility are contained in the Record of Decision (USEPA, 1988) and the 5-year review (USEPA, 1995). The DuPont facility is located on the Todtz farm property near Murphy's Lake. The site history includes sand and gravel mining from 1959 to 1969 and then a municipal landfill from 1969 to 1975. In 1971, DuPont began disposing of cellophane wastes, which continued until 1975. The landfill has been capped and the groundwater is still being monitored. No nitrogen parameters are included in the monitoring requirements and no nitrogen monitoring results were included in the 1995 five-year review document. Based on the topography and proximity to several lakes and ponds, groundwater and pollutants leaving the Todtz farm property would be intercepted prior to reaching Rock Creek.

The data for the Equistar facility is contained in the latest 5-year review document (USEPA, 1999). The Equistar facility is located on a tributary stream of Rock Creek in an industrial park. The facility has had several owners since polyethylene manufacturing began in 1967, and it is still operating. The areas of concern at this site include storage and loading areas, a former landfill, and surface impoundments on the property. Organic chemicals, including non-aqueous phase liquids, are being recovered from the groundwaters of this site. No nitrogen parameters are included in the monitoring requirements, nor were any nitrogen monitoring results included in the 1999 five-year review document. Because the contaminants for this site are organic chemicals, there is an insignificant chance of additional nitrogen reaching the tributary and Rock Creek from this facility.

The PCS Nitrogen facility is located within 0.5 miles of the Equistar complex. This facility has been owned by a variety of companies that manufactured nitrogen fertilizer. PCS Nitrogen purchased the site in March 1997, but closed the plant in August 1999 due to economic problems. PCS Nitrogen is now closed and much of the manufacturing system has been removed. Historic spills of chemicals, including urea, have led to a groundwater contamination problem around this site. LAW Engineering estimates 96 lbs/day of ammonia enters Rock Creek from an unnamed creek commonly referred to as Ammonia Creek (LAW Engineering memo to PCS, cited in Gritters, 2000). No NOx loading estimates are available. Using LTRMP data from site 3 on May 21, 1997 (Tables 2 and 3), an estimate for the typical nitrate concentration of 38 mg/L yields a nitrate loading of 12.3 lbs/day at the estimated flow in Ammonia Creek of 0.06 cfs. This load reflects both, background nitrate/nitrite and that portion contributed by the

PCS Nitrogen site. Listed in Table 5 are the descriptions for four surface water monitoring stations on the PCS Nitrogen property and an in-stream station 1,000 feet downstream of the southern boundary. Figure 6 shows these stations and the LTRMP monitoring stations. Sampling data collected by LAW Engineering at these five stations are available for the six dates shown in Table 6. The data from site 3 compare well with the data from the LTRMP upstream station, with nitrate values within the LTRMP data range. The ammonia values are frequently higher than the LTRMP data range. The data from site 5 were compared to the LTRMP downstream station and show trends similar to site 3. Without a site map showing groundwater flow directions, the influence of past spills cannot be determined. Elevated groundwater levels during the spring and surface runoff from precipitation could have spread the plume in the past 30 years to influence sites 1 and 3.

4.2.2 Agriculture and Background

Although agriculture dominates the landscape of the Rock Creek watershed, it does not appear to be a primary contributor to the ammonia in Rock Creek. LTRMP monitoring upstream of PCS Nitrogen shows a mean ammonia concentration of 0.09 mg/L (Table 2). However, agricultural lands and drainage tiles are known to convey elevated levels of nitrate to receiving waters. Ammonia nitrogen, nitrite and nitrate nitrogen will be monitored upstream of PCS Nitrogen during phase 1 of this TMDL. This will allow a more accurate identification of ammonia, nitrite, and nitrate levels from agriculture and background sources.

5. Pollutant Loading Scenario

The TMDL process is designed to establish the total loading a stream can assimilate without causing violation of the water quality standards. The allocation of that loading may be assigned equally to all sources, or the allocation may be adjusted to account for the economic and technologic ability of the discharger. The allocation for Rock Creek must account for the impacts of historical spills to the lands adjacent to PCS Nitrogen and the influence of agricultural tile drains and other diverse sources.

5.1 Seasonal Considerations

Analysis of the long-term monitoring data shows that the highest in-stream ammonia and nitrate concentrations occur during the summer when low-flow conditions typically occur. However, to facilitate the potential of other critical conditions, seasonal ammonia nitrogen endpoints using seasonal pH and temperature values and alternative stream flow regimes will be calculated. The critical condition will be determined based on Phase 1 monitoring data. The initial stream allocations will be made using the protected flow.

Based on the LTRMP and PCS Nitrogen data, current ammonia and NOx loading to Rock Creek for the critical conditions were determined. The current loadings are presented in Table 7. The current loading for the various seasonal example conditions (noted in Table 8) will not be calculated. Very limited monitoring data were available to calculate the current loading levels for these example conditions. Monitoring data will be collected during Phase I to assist in projecting the current loading at these example conditions.

5.2 Estimated Nonpoint Load

The estimated Nonpoint Load for ammonia and nitrate/nitrite was developed from LTRMP monitoring data. As noted in Table 2, various statistical summaries of the monitoring data are provided. For purposes of the critical load allocation, the August to October Mean monitoring concentrations were considered to represent the stream conditions during the low stream flow (Protected Flow) conditions. At the Protected Flow regime, the background nitrate/nitrite concentration was 5.73 mg/l (15.4 lbs/d) (Table 2). An ammonia concentration of 0.09 mg/L was used for the background agriculture concentration (Table 2). Therefore, the estimated background or nonpoint load for ammonia and NOx at the protected flow is :

- Ammonia: 0.2 pound/day (0.09 mg/l x 8.34 x 0.5 cfs/1.547 = 0.24 lbs/d)
- NOx: 15.4pounds/day (5.73 mg/l x 8.34 x 0.5 cfs/1.547 = 15.4 lbs/d)

5.3 Estimated Point Source Load

For the purposes of this TMDL discussion, the loadings from Ammonia Creek (and the PCS Nitrogen site) will be considered as a generalized point source. In actuality, the sources of ammonia and nitrate from the site may be from localized surface and ground water contributions. However, the impact to Rock Creek is similar to that of a point source loading.

As noted above, the LAW Engineering memo to PCS Nitrogen estimated the ammonia loading to Ammonia Creek at 96 pounds/day. This estimation is made from monitoring data collected very near the mouth of Ammonia Creek and is assumed to represent the loading to Rock Creek. No degradation or uptake is assumed to occur in the lower several feet of Ammonia Creek prior to mixing with Rock Creek.

The nitrate loading discussed above was with an estimated loading of 102 pounds/day projected for Ammonia Creek. The estimated loadings are presented in Table 7.

6. TMDL or Stream Allocation

6.1 Description of TMDL Allocation

Total Maximum Daily Loads (TMDLs) are composed of the sum of individual waste load allocations (WLAs) for point sources, load allocations (LAs) for nonpoint sources, and natural background levels. In addition, the TMDL must include a margin of safety (MOS), either implicitly or explicitly, that accounts for the uncertainty in the relationship between pollutant loads and the quality of the receiving water body. Conceptually, this definition is denoted by the equation:

$$TMDL = \Sigma\, WLAs + \Sigma\, LAs + MOS$$

The TMDL is the total amount of a pollutant that can be assimilated by the receiving water while still achieving water quality standards.

For some pollutants, TMDLs are expressed on a mass loading basis (e.g., pounds or kilograms per day). In some cases a TMDL is expressed as another appropriate measure that is the relevant expression for the reduction of loadings of the specific pollutant to meet water quality standards or goals. This TMDL is expressed on a mass loading basis.

6.2 Phased TMDL

The Rock Creek TMDL is being established in two separate Phases that reflect the assessment of ongoing site remediation of the PCS Nitrogen releases to the creek. Phase 1 will include the initial period of time to allow for assessment and evaluation of the effectiveness of the recently developed and constructed site remediation efforts. During Phase 1, the ammonia endpoint in Rock Creek will be met in the stream below the constructed wetland complex. As discussed in the Implementation Section, water quality monitoring and stream flow measurements will be conducted at various locations, including the discharge from the wetland complex. The monitoring data will be assessed to determine if compliance with the endpoint is achieved. It is anticipated that Phase 1 will encompass a 2-4 year stream assessment and monitoring period discussed in the Implementation Section.

Phase II will reflect the potential conditions where the endpoint has been met at the discharge of the wetland complex, but the instream conditions in Rock Creek below Ammonia Creek are still exceeding the ammonia endpoint. This phase would indicate that additional control methods are needed to assure total protection of the designated reach of Rock Creek. Additional assessment and evaluation of needed controls would be conducted during Phase II. This phase will continue until the endpoint has been achieved in Rock Creek after complete mixing with Ammonia Creek.

6.3 Selecting a Margin of Safety

The MOS is part of the TMDL development process. There are two basic methods for incorporating the MOS (USEPA, 1991):

- Implicitly incorporate the MOS using conservative model assumptions to develop allocations.
- Explicitly specify a portion of the total TMDL as the MOS, allocating the remainder to sources.

For the Rock Creek watershed, an implicit MOS has been included. One of the implicit factors for this TMDL is the selection of the critical instream conditions for calculating the ammonia TMDL. The statewide value used in the conventional wasteload Allocation process and described in the rule-referenced document to the Water Quality Standards (Iowa, 1996) lists the August instream pH of 8.2 and an in-stream temperature of 23.8 °C. The mean temperature for both monitoring stations is less than 20 °C, so using a higher temperature for the criteria results in a more stringent TMDL. In the calculations of loads, a protected flow of 0.5 cfs was used instead of the 7Q10 flow of 0.9 cfs occurring at the mouth of Rock Creek. This protected flow of 0.5 cfs is calculated for the headwaters of Rock Creek. It is assumed that the corresponding low flow in Rock Creek at the confluence with Ammonia Creek, approximately four miles downstream, is substantially greater than the 0.5 cfs protected flow at the head waters, resulting in the implicit margin of safety.

6.4 Stream Loading Capacity

The TMDL process is designed to establish the total loading a stream can assimilate without causing violation of the water quality standards. The allocation of that loading may be assigned equally to all sources, or the allocation may be adjusted to account for the economic and technologic ability of the discharger. The allocation for Rock Creek must account for the impacts of historical spills to the lands adjacent to PCS Nitrogen and the influence of agricultural drains.

For a stream dominated by point sources, the critical condition is usually the summer low-flow period. The 7Q10 flow in many streams is established as the critical low flow regime. However for some designated streams experiencing very low stream flows a minimum flow, or “protected flow” has been established. For Rock Creek the Protected flow of 0.50 cfs is established. The critical pH of 8.2 and critical temperature of 23.8 °C will be applied at the Protected Flow regime.

In the consideration of seasonality, several different instream conditions and flow regimes were also included in this TMDL discussion. It is possible that other seasons and/or stream flow regimes may be more critical than the assumed summer low flow condition. The example stream capacities are presented in the following table (Table 8).

<u>6.4.1 Load Allocation (nonpoint sources)</u>

Due to the elevated current loading from Ammonia Creek for both ammonia and nitrate/nitrite during the critical summer period, the load allocation is considered to be equal to the current loading. Truly for the conditions associated with Rock Creek this is justified from an economic and technical standpoint. Thus, the load allocation for ammonia and NOx at the protected flow is:

- Ammonia: 0.2 pound/day
- NOx: 15.4 pounds/day

6.4.2 Waste Load Allocations (point source)

The waste load allocations for ammonia and NOx were calculated using the critical stream flow and instream conditions. For ammonia, the Water Quality Standards chronic criteria noted in Table 3c (IDNR, 1996) was used as the targeted in-stream concentration. Since this TMDL is being completed in two phases, for Phase I the chronic numerical criterion will be achieved at the overflow from the downstream wetland complex. Under Phase II, the chronic numerical criterion will be achieved after mixing of Ammonia Creek and Rock Creek. Complete mixing of Ammonia Creek with Rock Creek is expected to occur 200 feet downstream of the confluence of Ammonia Creek. This analysis is based on the best professional judgement of IDNR staff and knowledge of the natural hydro-geological conditions in Rock Creek.

As noted above, the ammonia wasteload allocation used the chronic ammonia criterion in Iowa's Water Quality Standards (Iowa, 1996). Since the chronic criterion is a function of stream pH and temperature conditions, applicable pH and temperature values were selected. Due to the limited monitoring values in Rock Creek, statewide pH and temperature values were selected (Table 8). At a pH of 8.2 and a summer temperature of 23.8 °C, the chronic criterion is 1.84 mg/l or 5.0 pounds/day (Table 8). For ammonia, the distribution of the ammonia TMDL will be to allocate the Load Allocation to the nonpoint loading and reduce the Wasteload Allocation to the remaining capacity as noted in Table 8.

For nitrate/nitrite, the Wasteload Allocation is based on the expected reduction for the instream ammonia concentrations. Under the critical low flow condition of 0.5 cfs (Aug-Oct Mean values in Tables 2 and 3), the difference in ammonia concentration between Rock Creek downstream and upstream of PCS Nitrogen currently averages 2.34 mg/l (2.43 – 0.09 = 2.34). Under the critical summer low flow conditions, the ammonia WLA concentration in Rock Creek would be limited to 1.75 mg/l (1.84 - 0.09 = 1.75) (Table 8). The difference between the observed concentration and the WLA would require a 25% reduction in ammonia concentrations. If the NOx is assumed to respond in a similar manner, the TMDL at summer low flow would be calculated as follows:

12.95 mg/l, existing downstream nitrate concentration (Table 3)
- 5.73 mg/l, upstream nitrate concentration (or nonpoint concentration) (Table 2)
= 7.22 mg/l, current nitrate waste load estimate

Assuming a corresponding 25 percent reduction in the nitrate concentration, the wasteload allocation is calculated as:

7.22 (75%) = 5.41 mg/l, WLA nitrate concentration
+ 5.73 mg/l, LA nitrate concentration
= 11.14 mg/l, TMDL concentration

Therefore, at the protected flow of 0.5 cfs, the NOx TMDL would be:

14.6 pounds per day, as the Nox Wasteload Allocation
(5.41 mg/l x 8.34 x 0.5 cfs x .646 mgd/cfs = 14.6 #/d)
+15.4 pounds per day, as the NOx Load Allocation
(5.73 mg/l x 8.34 x 0.5 cfs x .646 mgd/cfs = 15.4 #/d)
= 30.0 pounds per day, as the NOx TMDL

The Wasteload Allocations, Load Allocations, and TMDLs for ammonia and nitrate/nitrite at the protected flow are shown in Table 9. It is important to note that the expected 25% reduction in the NOx to Rock Creek may be significantly greater when the ammonia wasteload allocation is achieved. The above nitrate/nitrite calculations will be refined when the phased monitoring efforts are implemented.

7. Implementation

The Iowa Department of Natural Resources recognizes that an implementation plan is not a required component of a Total Maximum Daily Load. However, the IDNR offers the following implementation strategy as a guide to improve water quality in Rock Creek.

The PCS Nitrogen site is the major source of ammonia and nitrogen to Rock Creek. PCS Nitrogen has been very cooperative in the remediation of the contaminated site. There are already a number of remediation practices in place at the site. Upon discovery of the groundwater contamination, a subsurface drainage system from a sump in the loading area was eliminated. This sump is believed to have been the primary source of groundwater contamination. An approximately 300 foot long groundwater recovery trench connected to three sumps that operate continuously has been installed along Ammonia Creek. Contaminated water from this drain is pumped to the plant's wastewater system and through the NPDES discharge directly to the Mississippi River. In addition, PCS Nitrogen has also planted hybrid poplar trees along Ammonia Creek to uptake nitrogen, and conducted tests by adding molasses to the subsurface to create anaerobic conditions favorable for denitrification. Over 100 acres of farmland that is part of the site, has been taken out of crop production and native grasses and woodlands are being established. The native plants will absorb nitrogen, nitrogen input for crops will be ceased, and the area will provide an attractive wildlife habitat. PCS Nitrogen closed this plant in 1999, and is in the process of dismantling it.

Perhaps the main feature of this remediation project is the establishment of a wetland on Rock Creek, downstream of the PCS Nitrogen site. This wetland was the cooperative result of PCS Nitrogen, a private landowner, the DNR Fisheries and Wildlife staff, and others. The wetland provides an environmentally favorable method for naturally removing nitrogen compounds. It is hoped that the wetland will permanently remove nitrogen compounds from the water, as opposed to intercepting contaminants and discharging them to the Mississippi River.

Other possible alternatives for cleanup of the PCS Nitrogen site include planting of additional hybrid poplar trees, soil testing and removal of highly contaminated soils, and continued attempts at inducing in-situ denitrification. The construction of riffles in Rock Creek would help to aerate the water and promote the oxidation of ammonia. Extraction of contaminated groundwater with pumping wells before it enters Rock Creek is technically feasible. However, there is concern of influencing other contamination plumes nearby if this is done. Handling of extracted groundwater may also pose a problem, since removal of nitrogen compounds from it is probably not practical, and discharge to the Mississippi River is a less than perfect option. Land application of this extracted water does not seem feasible.

In addition to the cleanup efforts at PCS Nitrogen, there is currently a water quality project in the watershed administered by the Clinton County Soil and Water Conservation District. This project is funded with Watershed Protection Funds and tentatively approved to be sponsored by Clean Water Act Section 319 and the Division of Soil Conservation Water Protection Fund. The Rock Creek Water Quality Project is addressing non-point source issues including nutrient management and soil erosion in the watershed. This will be done by promoting and cost sharing a variety of best management agricultural practices, including, but not limited to, conservation tillage, vegetative filter strips, riparian buffers, nutrient and pest management, wetland construction, grade stabilization structures, streambank stabilization, livestock exclusion, and construction of animal waste systems.

Under Phase I, an assessment of the Rock Creek water quality will begin in 2001. This assessment will determine the current nitrogen loading (ammonia, nitrite, and nitrate) to Rock Creek from the entire watershed. The assessment will also help determine the impact of the PCS Nitrogen site on the water quality of Rock Creek, and also to determine the effectiveness of the wetland at assimilating nitrogen compounds (ammonia, nitrite, and nitrate). This monitoring will continue for two to four years. After the monitoring is complete, the level of impairment will be reassessed. Following the Phase I assessment, it will be determined if the ammonia endpoint has been achieved at the discharge of the wetland complex. If the endpoint has not been achieved at the discharge of the wetland complex, then additional control measures will be implemented to achieve the endpoint. Following achievement of the endpoint at the wetland complex discharge, Phase II will be initiated. It is expected that Phase II will begin in 3-5 years following adoption of this TMDL.

Additional monitoring and evaluation of data will continue into Phase II as the ammonia endpoint will be met in Rock Creek below the mixing zone with Ammonia Creek. It is anticipated that a significant reduction of ammonia (and NOx) loading from the PCS Nitrogen site will occur during the implementation of Phase I efforts. Thus it is possible that no Phase II efforts will be needed if Phase I monitoring data demonstrates that the endpoint was achieved at both the Wetland complex discharge and in Rock Creek below the confluence with Ammonia Creek.

8. Public Participation

A public meeting was held in Camanche on March 7, 2000 regarding the Rock Creek TMDL. A second public meeting was held regarding the Rock Creek watershed prior to the final TMDLs being submitted to EPA. Comments were received until December 15, 2000 and, where appropriate, incorporated into the final document.

9. References

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10. Appendix I Figures and Tables

Figure 1. Location of Rock Creek Watershed.

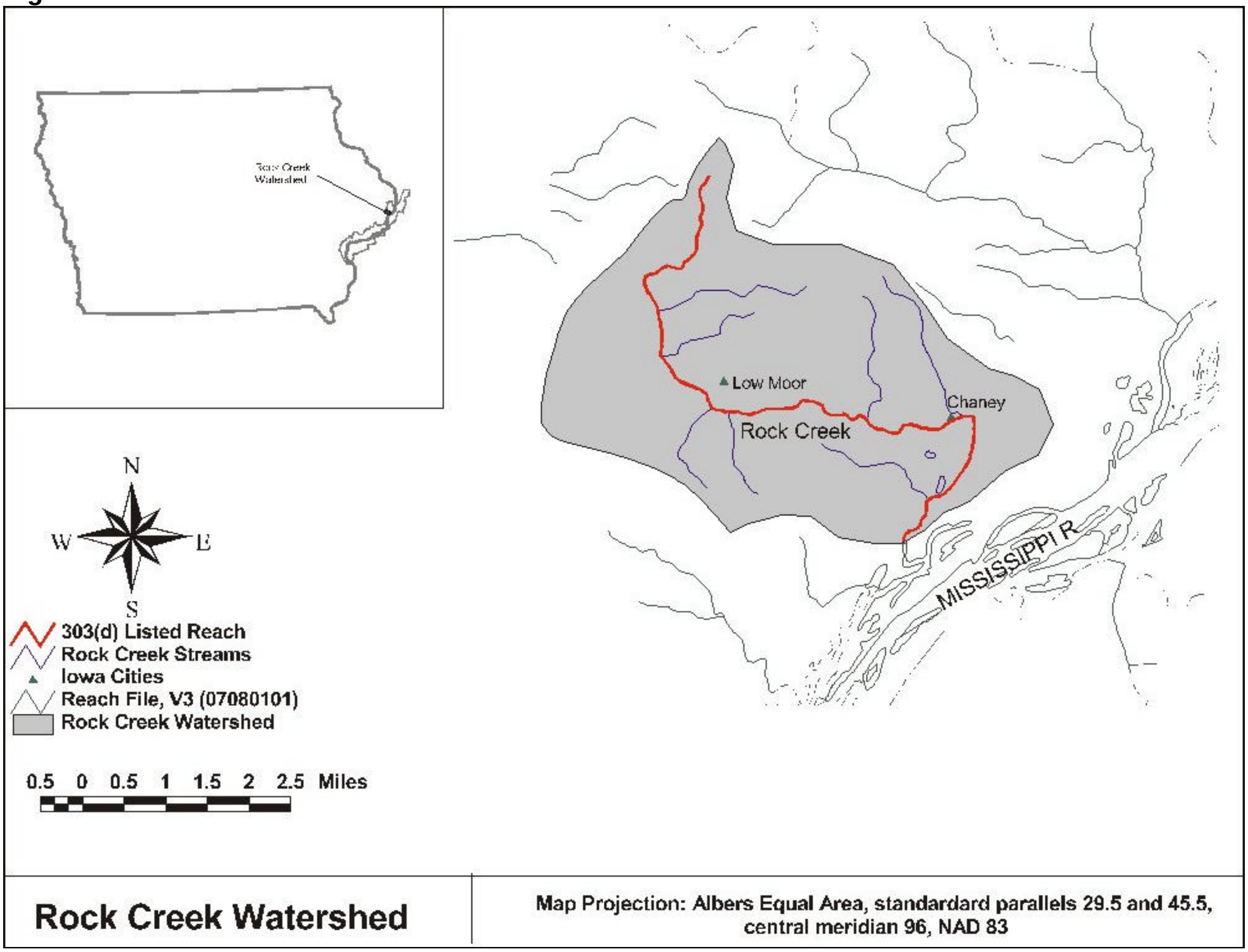

Figure 2. Monitoring Stations for May 21, 1997

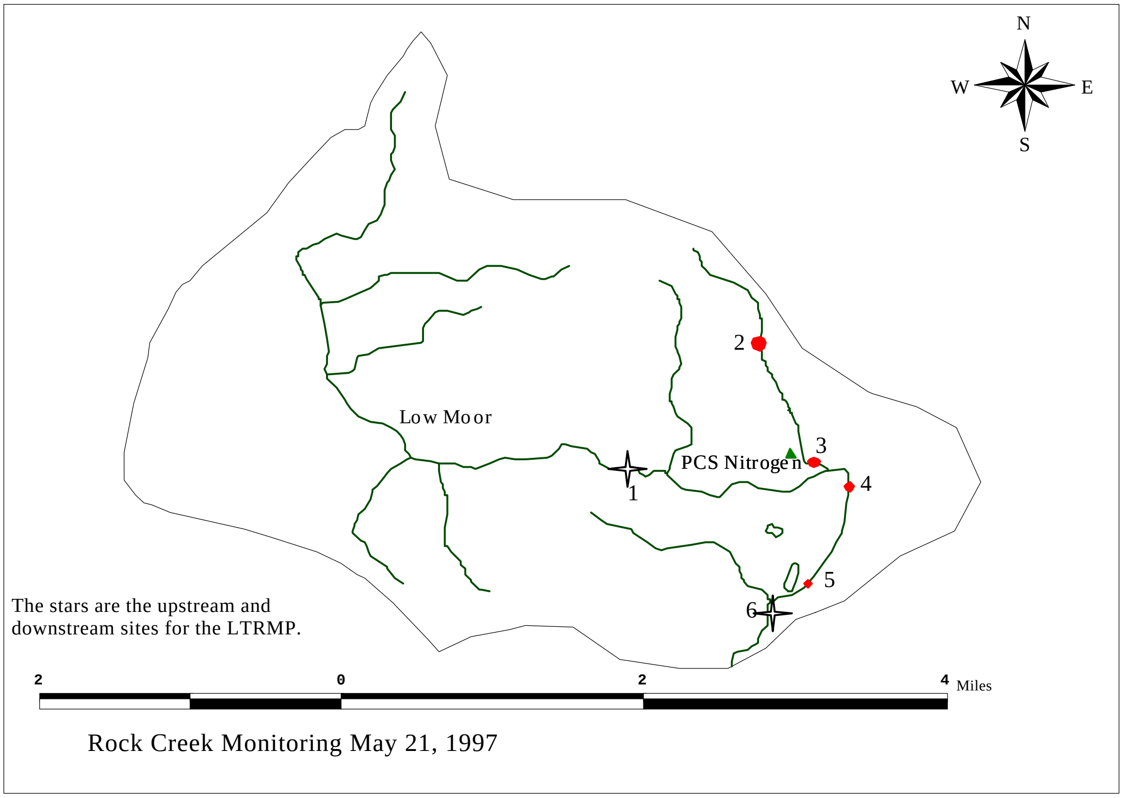

Figure 3. LTRMP Ammonia Monitoring

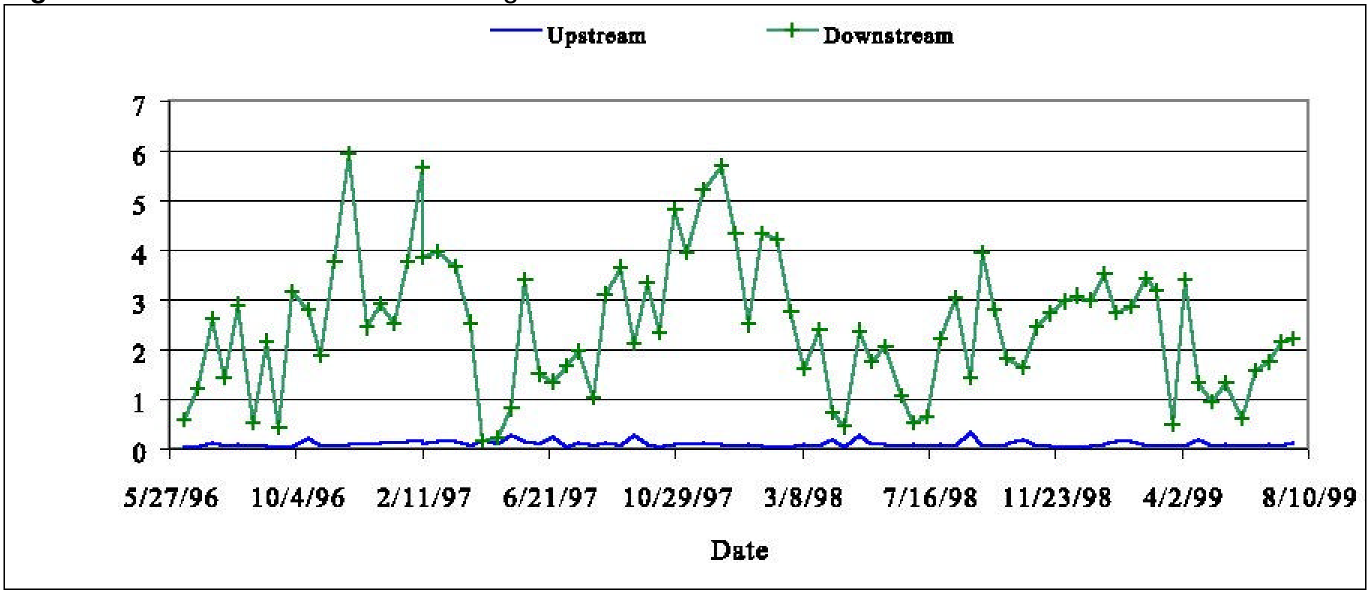

Figure 4. LTRMP Nitrate Monitoring

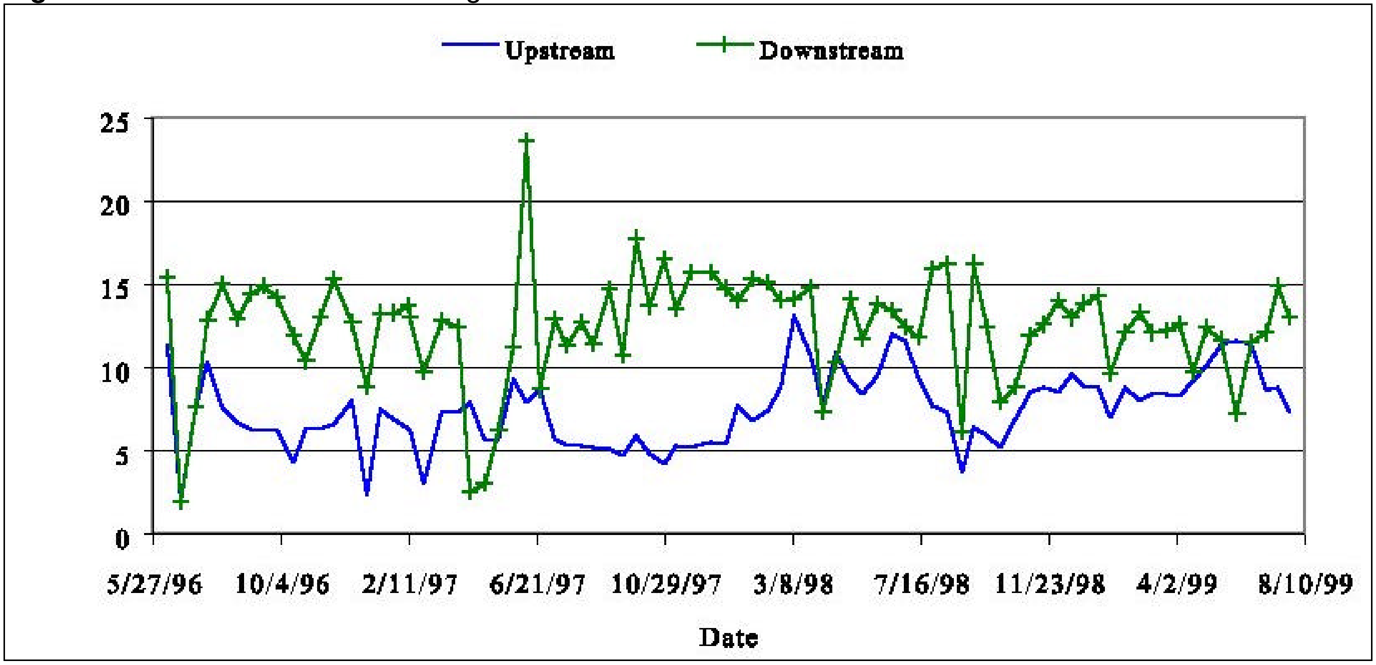

Figure 5. Point Source Dischargers in Rock Creek Watershed

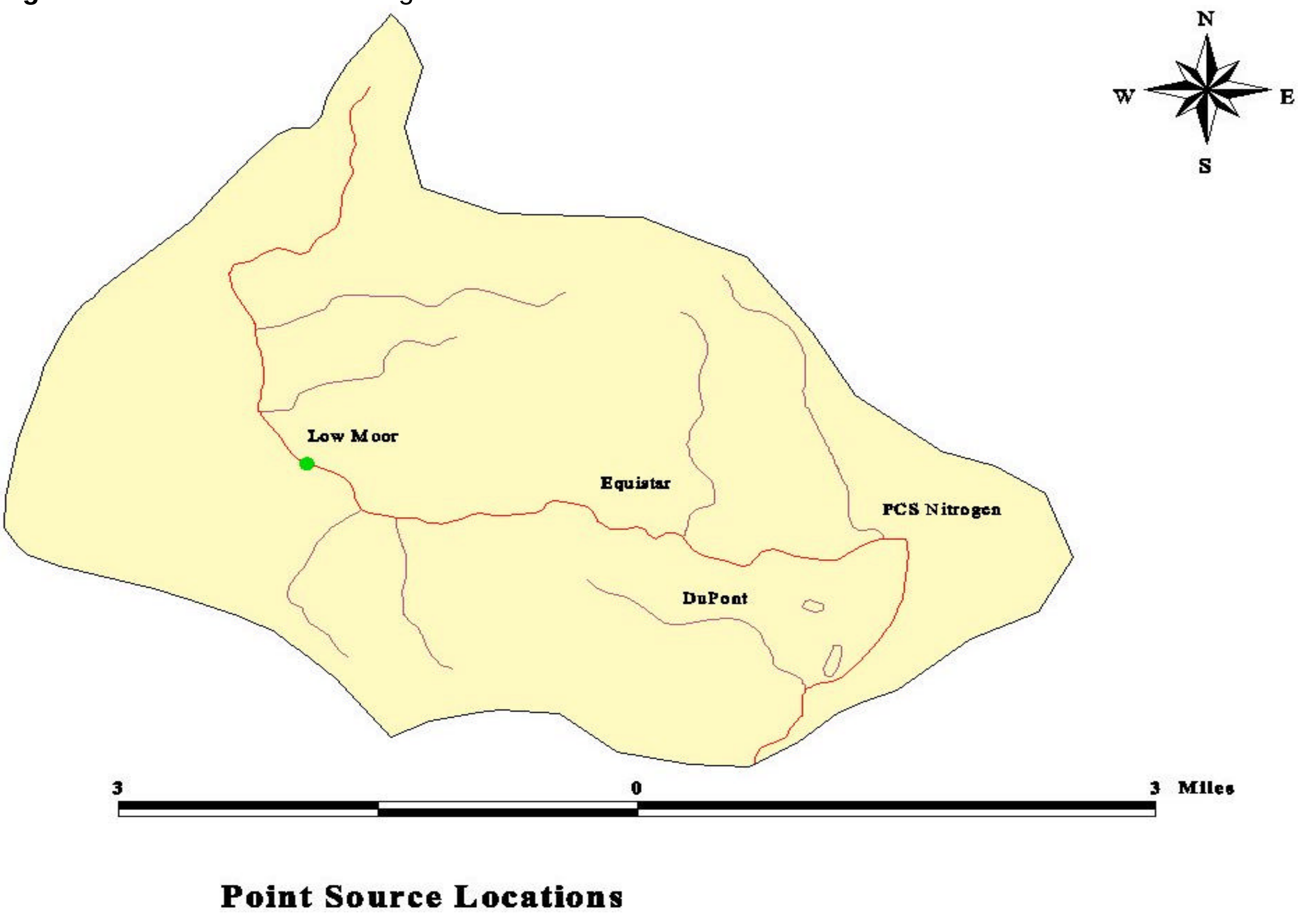

Figure 6. Monitoring Sites for PCS Nitrogen Surface water

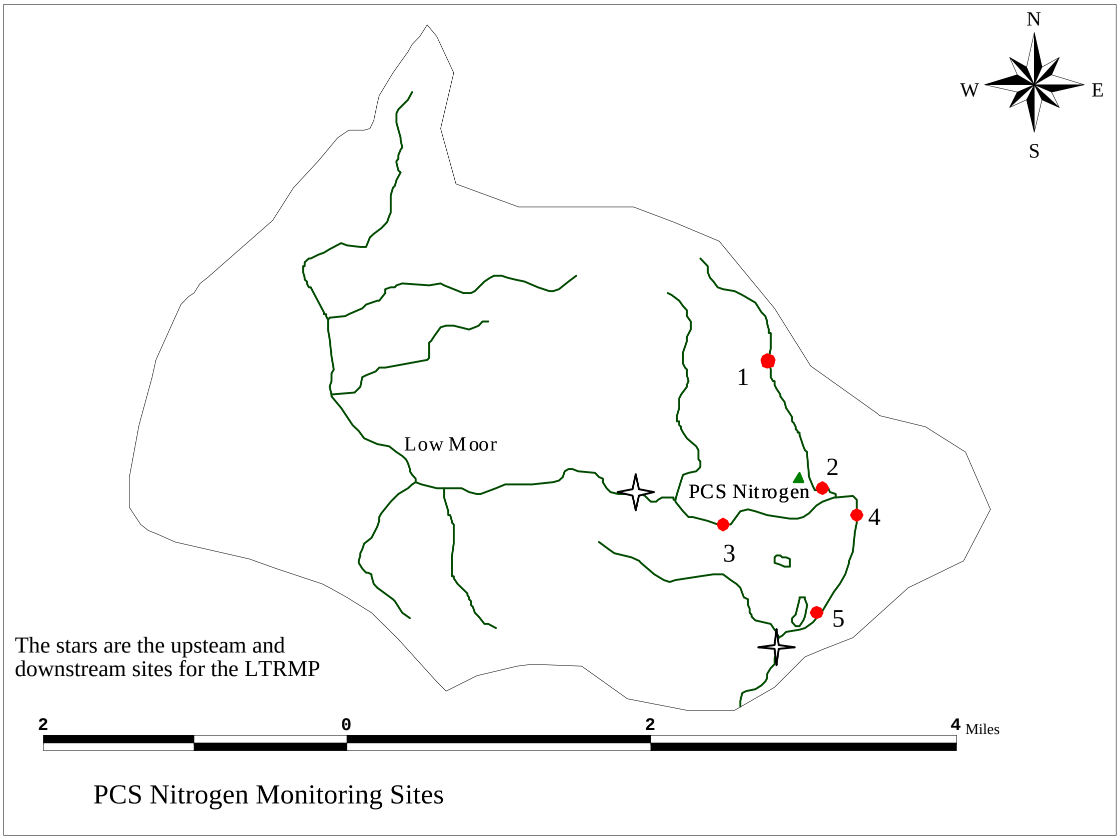

Table 1. Rock Creek Monitoring for May 21, 1997

Site	Site Name	Ammonia (mg/L)	Nitrate (mg/L)
1	Rock Creek Upstream	0.2	7.4
2	Ammonia Creek	0.2	17
3	Ammonia Creek below PCS Nitrogen	15	38
4	Rock Creek below Ammonia Creek	3.5	13
5	Rock Creek 1 mile below Ammonia Creek	2.9	12
6	Rock Creek at Hwy 67	2.2	10

Table 2. Rock Creek Monitoring Upstream of PCS Nitrogen

Parameter	Minimum	Mean	Aug-Oct Mean	Maximum
Temperature (°C)	0.40	11.47	15.87	20.80
pH	7.10	7.80	7.77	8.50
Nitrate (mg/L)	1.99	7.48	5.73	13.15
Ammonia (mg/L)	0.01	0.09	0.09	0.32

Table 3. Rock Creek Monitoring Downstream of PCS Nitrogen

Parameter	Minimum	Mean	Aug-Oct Mean	Maximum
Temperature (°C)	0.10	11.96	16.75	27.30
pH	6.00	7.34	7.37	8.30
Nitrate (mg/L)	0.01	12.31	12.95	23.62
Ammonia (mg/L)	0.14	2.44	2.43	5.93

Table 4. Permit Compliance System Monitoring Data Statistics for the City of Low Moor

Permit	Parameter	Max	Mean	Min	Limit	Count
IA0040100	Flow (MGD)	0.048	0.014	0.008	0.064	45
	BOD_5 (mg/L)	24.1	19.10	14.0	30.0	7
	Ammonia	None	None	None	None	None
	Nitrate	None	None	None	None	None

Table 5. PCS Nitrogen Monitoring Stations

Station	Location
Site 1	Northern property boundary on Ammonia Creek 2/3 miles above Rock Creek
Site 2	Ammonia Creek 1/4 miles above Rock Creek
Site 3	Western property boundary on Rock Creek 3/4 miles above Ammonia Creek
Site 4	Rock Creek 1/10 miles below Ammonia Creek
Site 5	Rock Creek 1,000 south of PCS property boundary

Table 6. Monitoring Data for PCS Nitrogen Facility

Parameter	Site 1	Site 2	Site 3	Site 4	Site 5
October 7, 1996					
NO_3 mg/L	19.50	40.30	6.07	14.80	15.10
NO_2 mg/L	ND	0.70	ND	ND	4.91
NH_3 mg/L	1.80	44.00	0.43	5.01	4.70
December 3, 1997					
NO_3 mg/L	10.90	58.10	7.80	19.80	10.20
NO_2 mg/L	ND	0.21	ND	0.10	ND
NH_3 mg/L	2.50	28.00	2.65	8.90	6.10
December 5, 1997					
NO_3 mg/L	18.80	68.40	5.70	18.20	13.80
NO_2 mg/L	ND	0.20	ND	0.10	ND
NH_3 mg/L	ND	26.50	ND	5.55	3.90
December 7, 1997					
NO_3 mg/L	19.10	63.40	6.00		14.50
NO_2 mg/L	ND	0.20	ND	ND	ND
NH_3 mg/L	0.22	27.00	0.14	5.70	4.70
June 24, 1999					
NO_3 mg/L	25.00	32.40	11.60	14.10	13.10
NO_2 mg/L	0.10	0.10	ND	ND	ND
NH_3 mg/L	0.11	9.80	1.64	7.20	2.90

Table 7. Estimated Current Concentrations and Loadings for Rock Creek

Nonpoint Sources (Upstream Conditions)					Ammonia Creek				
Flow	Ammonia		Nitrate		Flow	Ammonia		Nitrate	
(cfs)	(mg/L)	(lbs/day)	(mg/L)	(lbs/day)	(cfs)	(mg/L)	(lbs/day)	(mg/L)	(lbs/day)
0.5	0.1	0.3	6.4	17.3	0.06	-	96	38	12.3

Table 8. Ammonia Wasteload Allocations and Load Allocations at Various Conditions

	Stream Condition		Water Quality Criterion		Allocations	
Season & Stream Flow	pH	Temp. (°C)	NH3-N (mg/l)	NH3-N (#/day)	WLA NH3-N (#/day)	LA NH3-N (#/day)
Summer @ Prot. Flow (0.5 cfs)	8.2	23.8	1.84	5.0	4.8	0.2
Winter @ Prot. Flow (0.5 cfs)	7.8	0.6	4.63	12.5	12.3	0.2
Fall @ Prot. Flow (0.5 cfs)	8.1	6.0	2.45	6.6	6.4	0.2
Summer @ Mean Flow (4.4 cfs)	8.2	23.8	1.84	43.6	41.5	2.1
Summer @ Annual Average. Flow (9.6 cfs)	8.2	23.8	1.84	95.2	91.3	3.9

Table 9. Wasteload Allocations (WLA), Load Allocations (LA) and TMDLs at protected flow for Rock Creek

Parameter	TMDL (#/d)	WLA (#/d)	LA (#/d)
Ammonia	5.0	4.8	0.2
Nitrate/Nitrate	30.0	14.6	15.4