Sediment and Phosphorus TMDLs for Castle Rock (Fennimore) Creek and Gunderson Valley Creek

January 27, 2004
June 28, 2004

Introduction

Castle Rock Creek (also known as Fennimore Creek) (WBIC 1211300) from mile 15.5 to mile 26 and the entire 4 mile length of Gunderson Valley Creek (WBIC 1212600), a tributary to Castle Rock Creek are included on Wisconsin's 2002 section 303(d) list of impaired waters.[1] The streams are located in northeastern Grant County, Wisconsin and are part of the Blue River Watershed. The Blue River flows to the Lower Wisconsin River. Castle Rock Creek downstream from the impaired segment is designated as a state Outstanding Resource Water. Both streams were listed as a high priority for TMDL development on the October 2002 303(d) list.

Castle Rock Creek was listed as impaired due to degraded habitat due to sedimentation that limited the stream's coldwater fishery to the extent that the stream's designated use was not met. In addition, Castle Rock Creek has a substantial amount of filamentous algae that is not found in nearby trout streams. Gunderson Valley Creek has similar sedimentation problems, substantial diurnal fluctuations in dissolved oxygen and common exceedances of the dissolved oxygen criterion in Wisconsin's water quality standards. Based on these impairments, Total Maximum Daily Load (TMDL) allocations are prepared for sediment and phosphorus for both streams. These TMDLs are intended to determine the maximum amount of pollutants that can enter the stream and still allow water quality standards to be met.

Physical Description of Watersheds

The watershed draining to the impaired segment of Castle Rock Creek is 39.1 square miles. The land cover for the watershed is as follows:

corn and soybeans	15%
pasture and grassland, including portions in contour strips	57%
forested	27%
urban	<1%
other	<1%

Source: WISCLAND 1998

[1] Both the confluence of Gunderson Valley Creek with Castle Rock Creek and the downstream end of the impaired segment of Castle Rock Creek are located in T7N, R2W, S36.

The watershed tends to be steeply sloped from Military Ridge on the south towards the Wisconsin River to the north. Dubuque is the predominant soil type. Dubuque soils were formed in silt over residual clay and are classified as a silt loam. Sandstone and limestone outcroppings are common in the watershed. Within the watershed, the Dubuque series includes deep, moderately eroded and severely eroded phases. The slopes range from 2% to 45%.

The only urban area is a portion of the city of Fennimore. There are no point sources located within the watershed.

Gunderson Valley Creek has a watershed of 5.7 square miles. The land cover is as follows:

corn and soybeans	12%
pasture and grassland, including portions in contour strips	57%
forested	30%
urban	0%
other	<1%

Source: WISCLAND 1998

The soils and geology of the Gunderson Valley watershed are the same as those for Castle Rock.

Description of Water Quality Impairments

Castle Rock Creek

The impaired segment of Castle Rock Creek has a designed use of coldwater fishery. Currently, it supports a class III trout fishery with the potential to support a class II trout fishery. The trout stream classes are defined in s. NR 1.02(7), Wis. Adm. Code for fish management purposes as follows:

> **Class** 1. These are high quality trout waters, have sufficient natural reproduction to sustain populations of wild trout at or near carry capacity. Consequently, streams in this category require no stocking of hatchery trout.
>
> **Class** 2. Streams in this classification may have some natural reproduction, but not enough to utilize available food and space. Therefore, stocking is required to maintain a desirable sport fishery. These streams have good survival and carryover of adult trout, often producing some fish larger than average size.

> **Class** 3. These waters are marginal trout habitat with no natural reproduction occurring. They require annual stocking of trout to provide trout fishing. Generally, there is no carryover of trout from one year to the next.

For purposes of listing waters on the 303(d) list, class III trout waters with the potential to be class II or class I waters are listed as impaired.

The water quality of Castle Rock Creek is described in a report entitled "Castle Rock Creek TMDL Project Final [Monitoring] Report". In this report, for example, the Index of Biological Integrity for three sites on Castle Rock Creek have a score of 10 (poor). As stated in the report:

> "The low IBI scores, high abundance of eurythermal species, and the low abundance of Mottled Sculpin indicated degraded conditions with the stream at all the sites surveyed …."

From the monitoring surveys of Castle Rock Creek there are two factors that are the most significant relative to the degraded conditions. One is the abundance of sediment covering the bed of the stream. Sediment covering the bed of a stream often hinders spawning, limits habitat for certain aquatic insects that may be food sources for trout and can reduce the volume for trout when pools are filled, especially cool water areas in low water periods or very hot weather. Near the confluence with Gunderson Valley Creek, there is a significant sediment deposit filling a pool of up to four feet in depth. The other is presence of filamentous algae in the stream indicating high levels of nutrients according to EPA's " Nutrient Criteria Technical Guidance Manual: Rivers and Streams" (see, for example Chapter 6). Filamentous algae may cause a reduction in dissolved oxygen at predawn periods in the summer and reduces the volume where trout may be.

Nutrient levels during base flow periods vary by segment of the stream. At an upstream location (Baumgartner Road), the mean of the total phosphorus concentrations during the 2001 growing season was 0.17 mg/l. At a location downstream of the confluence with Gunderson Valley Creek, the mean values for the same period of time are 0.30 mg/l; nearly double the upstream concentrations. The nutrient levels are particularly high during runoff events where total phosphorus concentrations at both upstream and downstream location were about 6 mg/l on June 3, 2002 and about 2.5 mg/l on June 11, 2002. Temperature levels are at the maximum level for trout waters.

The monitoring surveys did not find any substantial exceedance of the 6 mg/l dissolved oxygen water quality standards criterion. Castle Rock Creek does exhibit a diurnal swing of dissolved oxygen levels due to primary productivity in the stream. For example, in June through August 2001 at one site and July through August in 2002 at a second site the maximum dissolved oxygen concentration was between 10 and 11 mg/l. The minimum concentration at the same sites was between 6 and 7 mg/l. BOD5

values, an indication of organic pollutant load was low during base flow periods, but high during runoff events.

Based on this information, the TMDLs for Castle Rock Creek are developed for sediment to address the degraded habitat situation and for phosphorus to address the concerns with filamentous algae. There is no "critical" period for the sedimentation concern. The sediment is present throughout the year, although sediment loads from the watershed do come from runoff events. The "critical" period for phosphorus is summer base flow conditions. However, the phosphorus loads from runoff events – especially those in the growing season – are the source of the base flow phosphorus loads. There are no continuous discharge sources of phosphorus in the watershed.

Gunderson Valley Creek

Gunderson Valley Creek has not been assigned a designated use. Therefore, it falls into a default situation where the use may be any of the five fish and aquatic use classifications.[2] It may or may not be able to support a trout fishery since the temperatures in this stream are at the maximum to support a coldwater fishery. At a minimum, it should be able to support a warmwater sport or forage fishery not dominated by tolerant eurythermal species. For purposes of this set of TMDLs, Gunderson Valley Creek is assumed to be able to support a coldwater fishery.

The coldwater IBI score for this stream, an overall indicator of fish community health, was zero and there are a number of other measures that indicate a severely degraded stream. Nutrient concentrations in this stream are very high. The mean of the total phosphorus concentrations during the 2001 growing season was 0.52 mg/l. The nutrient levels are particularly high during runoff events where total phosphorus concentrations were 4.3 mg/l on June 3, 2002 and 2.4 mg/l on June 11, 2002. A habitat survey was not conducted on Gunderson Valley Creek, but the sedimentation problem is readily apparent in the downstream portion of the stream near the confluence with Castle Rock Creek.

Dissolved oxygen levels do not meet the water quality criterion of 6 mg/l for a coldwater stream (nor 5 mg/l for a warmwater sport or forage fishery stream). For example between June and August 2001, the minimum values occurring as part of a diel swing went down to 2.6 mg/l. Dissolved oxygen levels went below 6 mg/l on five (monthly) sampling dates in 2001 and 2002. Predawn levels were likely lower than these daytime samples. Such diel dissolved oxygen swings are indicative of nutrients supporting aquatic plant growth with in turn results in night time dissolved oxygen use.

[2] The five fish and aquatic life classifications contained in Ch. NR 102, Wisconsin Administrative Code are coldwater fish community, warmwater sport fish community, warmwater forage fish community, limited forage fish community and limited aquatic life. The dissolved oxygen criteria for these five classifications are 6 mg/l, 5mg/l, 5 mg/l, 3mg/l and 1 mg/l respectively.

Another concern is dissolved oxygen sue during summer storm events. The bacteria in the organic load carried in the runoff event use much of the dissolved oxygen and cause the levels to drop further. One such occurrence took place on August 5, 2002 and is described in the "Castle Rock Creek TMDL Project Final [Monitoring] Report". This August event demonstrates the combination of dissolved oxygen being lowered by both nutrients (diel swings) and BOD ("slug load"). Manure runoff is the most likely cause of the further lowering of the dissolved oxygen. Gunderson Valley Creek also has high levels of ammonia and, based on very limited sampling, high levels of bacteria. The ammonia levels, however, do not exceed water quality criteria for either a coldwater of warmwater stream.

Based on this information, the TMDLs for Gunderson Valley Creek are developed for sediment to address the degraded habitat situation and for phosphorus to address the concerns with diurnal dissolved oxygen swings. There is no "critical" period for the sedimentation concern. The sediment is present throughout the year, although sediment loads from the watershed do come from runoff events. The "critical" period for phosphorus is summer base flow conditions. However, the phosphorus loads from runoff events – especially those in the growing season – are the source of the base flow phosphorus loads. There are no continuous discharge sources of phosphorus in the watershed.

Applicable Water Quality Standards

As stated above, both Castle Rock Creek and Gunderson Valley Creek are not meeting their designated uses. Both appear to have the potential to support coldwater fisheries. Section NR 102.04(3), Wisconsin Administrative Code, which contains the designated uses for streams describes cold water communities as follows:

> "(a) *Cold water communities*. This subcategory includes surface waters capable of supporting a community of cold water fish and other aquatic life, or serving as a spawning area for cold water fish species. This subcategory includes, but is not restricted to, surface waters identified as trout water by the department of natural resources (Wisconsin Trout Streams, publication 6-3600 (80))."

This segment of Castle Rock Creek is listed in the 1980 Wisconsin Trout Stream publication as a Class II trout stream and, therefore, has a designated use of a cold water fishery.[3] Gunderson Valley Creek has not been officially assigned a designated use. However, it has properties that indicate it should be considered as have an attainable use of a coldwater fishery. Based on recent fisheries surveys, the existing default classification is not attained and the fisheries are more indicative a current use of a Limited Forage fish community (LFF).

[3] The 2002 Wisconsin Trout Streams publication, this segment of Castle Rock Creek is classified as a class III trout fishery. The 2002 publication is not presently referenced in the water quality standards portion of the administrative code and, therefore, only cited for informational purposes.

Cold water communities must meet specific water quality criteria including those for dissolved oxygen. S. NR 102.04(4)(e) states the following:

> "*Temperature and dissolved oxygen for cold waters*. Stream classified as trout waters by the department of natural resources (Wisconsin Trout Streams, publication 6-3600 (80)) or great lakes or cold water communities may be altered from natural background temperature and dissolved oxygen levels to the extent that trout populations are adversely affected.
>
> 1. There shall be no significant artificial increases in temperature where natural trout population is to be protected.
>
> 2. The dissolved oxygen in classified trout streams shall not be artificially lowered to less than 6.0 mg/L at any time, nor shall the dissolved oxygen be lowered to less [than] 7.0 mg/L during he spawning season."

As stated above in the summary of water quality problems, Gunderson Valley Creek has dissolved oxygen levels that do not meet the water quality standard.

In addition, all waters regardless of their designated use must meet the water quality standards in s. NR 102.04(1), Wis. Adm. Code, which is as follows:

> "*General*. To preserve and enhance the quality of waters, standards are established to govern water management decisions. Practices attributable to municipal, industrial, commercial, domestic, agricultural, land development or other activities shall be controlled so that all waters including the mixing zone and the effluent channel meet the following conditions at all times and under all conditions:
>
> (a) Substances that will cause objectionable deposits on the shore or in the bed of a body of water, shall not be present in such amounts as to interfere with public rights in waters of the state.
>
> (b) Floating or submerged debris, oil, scum or other material shall not be present in such amounts as to interfere with public rights in the waters of the state.
>
> (c) Materials producing color, odor, taste or unsightliness shall not be present in such amounts as to interfere with public rights in waters of the state.
>
> (d) Substances in concentrations of combinations which are toxic or harmful to humans shall not be present in amounts found to be of public health significance, nor shall substances be present in amounts which are acutely harmful to animal, plant or aquatic life."

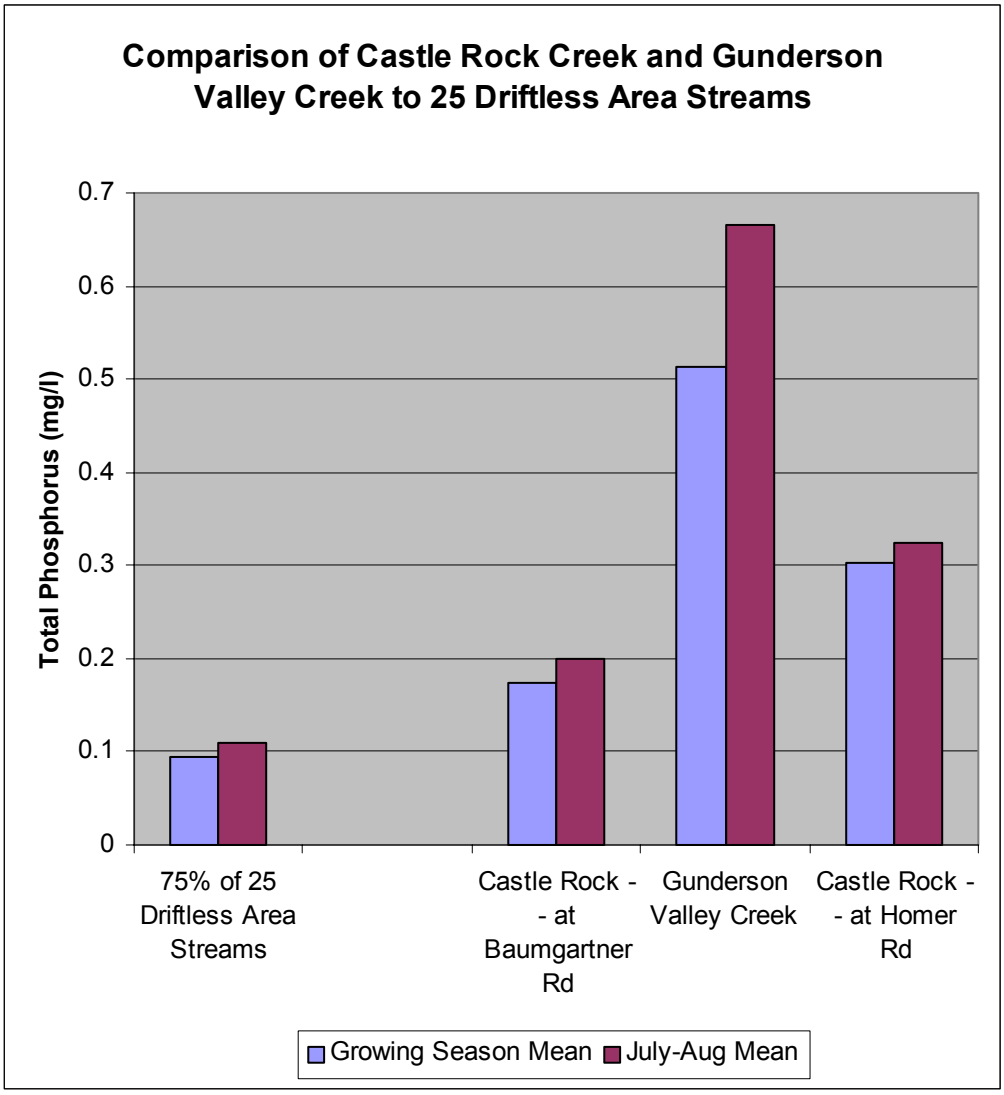
As stated previously, both Castle Rock Creek and Gunderson Valley Creek have substantial sediment deposits on the bed of the stream. The filamentous algae in Castle Rock Creek are, at a minimum unsightly, but appear to be creating conditions that may be harmful to aquatic life. There are no numeric criteria for sediment, suspended solids or phosphorus.

Load Capacity

The load capacity is the amount of a pollutant that enter a stream or lake during a critical period and still allow water quality standards to be met. The objective for both of these streams is to restore a naturally sustainable cold water fishery that is at a minimum a class II trout fishery. Load capacities are presented for both streams and for both sediment and phosphorus.

For purposes of determining a phosphorus load capacity for Castle Rock Creek and Gunderson Valley Creek, water quality information from 25 "driftless" area's streams in south west and west central Wisconsin were analyzed. The watersheds of these 25 streams have similar soils, similar terrain and similar land use. Data from 2001 were used in the analysis. All, if not nearly all, of the 25 streams support at least a class II trout fishery. Some should be considered as high quality trout fishery, while others have the potential to support a class I tout fishery but due to some level of degradation presently support a class II trout fishery. Two of the 25 streams are listed as impaired on the 303(d) list, but neither exhibits the effects of high nutrient concentrations. These two streams have phosphorus concentrations that are average for this group.

Since the 25 streams as a group represent good to high quality, the 75th percentile of the data was selected. The 75th percentile approach is described by EPA as a "reference" approach in chapter 7 or its "Nutrient Criteria Technical Guidance Manual: Rivers and Streams". In that approach streams meeting their designated use and generally considered in good condition form a reference set. The 75th percentile of the reference set then serves as a goal for all waters within the geographic region. The chart below shows the differences between the total phosphorus concentrations for the 25 driftless area streams and Castle Rock Creek and Gunderson Valley Creek.



For purposes of these TMDLs the growing season mean is used to determine the load capacity. This is done with the recognition that there are not significant difference between the growing season mean and the July-August mean. Using the 75th percentile of the growing season mean values, a value of 0.095 mg/l was selected.

Based on the 75th-percentile growing season value of 0.095 mg/l the percent reduction in concentration is as follows:

Castle Rock Creek at Baumgartner Road (included as an intermediate site due to a substantial amount of data at this site)	45%
Castle Rock Creek at Homer Road	70%
Gunderson Valley Creek	80%

To translate the 75th percentile concentration into loads, the average flow was calculated for the same period of time. The average 2001 growing season flow for Castle Rock Creek at Homer Road was 5.9 cfs; and for Gunderson Valley Creek 0.8 cfs. The corresponding total phosphorus loads are as follows:

Castle Rock Creek at Baumgartner Road (included as an intermediate site due to a substantial amount of data at this site)	2.5 lbs/day
Castle Rock Creek at Homer Road	3.0 lbs/day
Gunderson Valley Creek	0.42 lbs/day

These average growing season loads are for baseflow conditions. They represent the residual effect of runoff event loads. Based on the runoff event concentrations, it is readily apparent that the vast majority of the event load is carried through Gunderson Valley Creek and Castle Rock Creek and only a portion remains in the stream. The portion that remains, however, is causing the filamentous algae growth and the diel oxygen swings in the streams.

The load capacity for sediment is defined in terms of annual load and is shown below for each of the impaired streams. The objective in setting these values is to reduce the load to what is found in similar streams that are supporting a coldwater fishery. For a discussion on the derivation of the values, please see the section below on monitoring. Such values correspond to loads in driftless area streams that support trout fisheries.

Castle Rock Creek at Homer Road	24,000 tons/year
Gunderson Valley Creek	3,400 tons/year

Waste Load Allocation

The Wasteload Allocation is the portion of the load capacity allocated to pollutant loads from point sources. Since there are no point sources in the watershed, including confined animal facilities needing Wisconsin Discharge Elimination System permits, the wasteload allocation is zero.

Load Allocation

The Load Allocation is the portion of the load capacity allocated to pollutant loads from nonpoint sources. Since this set of TMDLs use an implicit Margin of Safety (see discussion below), the load allocation equals the load capacity.

Summary of TMDL Allocations

Castle Rock Creek –

Phosphorus at Homer Road

Load Capacity = Wasteload Allocation + Load Allocation

3.0 lbs/day = 0 lbs/day + 3.0 lbs/day

Sediment at Homer Road

Load Capacity = Wasteload Allocation + Load Allocation

24,000 tons/year = 0 tons/year + 24,000 tons/year

Gunderson Valley Creek

Phosphorus at mouth

Load Capacity = Wasteload Allocation + Load Allocation

0.42 lbs/day = 0 lbs/day + 0.42 lbs/day

Sediment at mouth

Load Capacity = Wasteload Allocation + Load Allocation

3,400 tons/year = 0 tons/year + 3,400 tons/year

Discussion of Pollutant Sources and Load Reductions

Given the very large runoff event pollutant loads and the severity of the impairments, to achieve the in-stream concentration of phosphorus identified above and the corresponding load capacity, a substantial amount of control of nonpoint sources will be necessary throughout the Castle Rock Creek watershed, including the Gunderson Valley Creek subwatershed. There are no watershed/stream models that reasonably allow a load reduction to be calculated directly. Generally, a best estimate of pollutant control needed must be made, improvements tracked and adjustments made if the stream does

not adequately respond. In the case of these TMDLs, the best estimate is made by comparison to streams supporting a coldwater fishery.

In development of these TMDLs are number of alternatives were considered. For example, one alternative was to evaluate equating a percent (mass) load reduction to the percent reduction in concentration. For example, if Gunderson Valley Creek must have an 80 percent reduction in the phosphorus concentration, then an 80 percent reduction in phosphorus load should be called for. Such an association of load reduction and concentration reduction may be appropriate where there is a point source discharging on a continuous basis to a stream and the point source is the major source of the pollutant. However, that is an overly simplistic assumption for watersheds with no point sources and nearly all of the pollutants coming in runoff from snowmelt and rain events. Such an assumption could not pass a reality check. As discussed below, an 80 percent reduction in phosphorus load for Gunderson Valley Creek could only be achieved through the elimination of agriculture in the watershed. And there are many examples of nearby good quality streams that support class I trout fisheries in agricultural watersheds. In addition, as described below, the severity of the water quality problems are not directly related to the pollutant load. Gunderson Valley Creek has the most severe water quality problems, but does not have the greatest pollutant load per unit area. This fact is based on both modeling and field checks.

The very high phosphorus concentrations are found in deposition areas and do not directly measure pollutant loads that are carried in these streams during snowmelt and rainfall runoff events. The differences in concentrations between Baumgartner Road and Homer Road largely represent the difference between a major deposition area and a non-deposition area. They do not represent a significant difference between the pollutant loads moving past those sites. A small portion of the pollutant loads carried by these streams during runoff events is deposited on the bed of the stream. Over time, the pollutants attached to the sediment release into the water column and are taken up by aquatic plants. Aquatic plants may also obtain nutrients directly from the bottom sediments.

Although these TMDLs are developed for phosphorus and sediment, there is a concern in Gunderson Valley Creek that biochemical oxygen demand (BOD) is compounding the dissolved oxygen problem. In addition, there may be a human health concern with bacteria, based on a very limited number of fecal coliform samples. As part of the modeling, attention was given to make sure control of the phosphorus and sediment sources would also control the BOD and fecal coliform sources.

There is no single source of pollutants that is causing the water quality problems in these streams. The pollutants are coming from tens or hundreds of sites. Common sources of pollutants in the watershed include:

- Livestock areas, barnyards and steeply sloped areas along intermittent and perennial stream channels where livestock are fenced into the channel. Often these areas have no vegetation and with their close proximity to the channels and steep slopes result in very high pollutant loads of phosphorus, sediment, bacteria, ammonia and biochemical oxygen demand (BOD).

- Pastures on steep slopes – especially those that are overgrazed. These pastures are significant sources of sediment and phosphorus attached to the sediment. They may also contribute BOD and fecal coliform.

- Manure spread within close proximity (e.g. 20 feet) of stream channels. Manure spread areas may contribute phosphorus, BOD and bacteria. However, they tend to be more late-winter and early spring sources where the loads tend to be flushed through the streams.

- Cropping within close proximity (e.g. 20 feet) of stream channels.

On the other hand, best management practices, such as contour strip cropping, are common within the watershed.

The Soil and Water Assessment Tool (SWAT), developed by the Agricultural Research Service of the U. S. Department of Agriculture, was used to estimate sediment and phosphorus loads for 11 subwatersheds in the watershed of the impaired segment of Castle Rock Creek, including an upper subwatershed and lower subwatershed for Gunderson Valley Creek. The ArcView interface version of the SWAT model is Geographic Information System (GIS) based and routes runoff water throughout the watershed. The primary spatial data layers are topography (USGS digital elevation model data), soil types (USDA-NRCS STATSGO database) and land cover (WISCLAND). Long-term weather data specific to southwestern Wisconsin (Lancaster Weather Station #474546) and general land management (from Grant County Land Conservation Department) were input into the model. Based on information provided by the Grant County Land Conservation Department and field checks, all fields in a corn – oats - hay rotation were modeled as contour strip cropped and the soil test phosphorus level was assumed to be 50 ppm. The following is the specific information used for cropped fields:

Year	Crop	Tillage	Nutrients
Corn – Alfalfa (Dairy Rotation)			
1	Corn grain	Spring disk (2 passes), fall chisel	Spring 365 kg/ha 46-00-00 Spring 56 kg/ha 6-24-24 Daily haul manure 28,000 kg/ha/yr
2	Corn silage	Spring disk and harrow	Spring 365 kg/ha 46-00-00 Spring 56 kg/ha 6-24-24 Daily haul manure 28,000 kg/ha/yr
3	Oats	Spring disk	None
4	Alfalfa	None	Daily haul manure 28,000 kg/ha/yr incl.

			Spring manure 16,800 kg/ha
5	Alfalfa	None	Daily haul manure 28,000 kg/ha/yr
6	Alfalfa	none	Daily haul manure 28,000 kg/ha/yr
Corn – Soybeans (Cash Crop Rotation)			
1	Soybeans	Spring disk, fall chisel	Spring 84 kg/ha 10-20-20
2	Corn grain	Spring disk, fall chisel	Spring 448 kg/ha 46-00-00 Spring 56 kg/ha 10-20-20

The model was calibrated based for hydrology by balancing surface water, groundwater and evapotranspiration on an annual basis. The Penman-Montieth evapotranspiration routine, one of three options in the SWAT model, was selected. The period of 1951 to 1980 was used for calibration and the period of 1995 through 2003 was used for verification. The average annual water yield was 10.7 inches and 10.6 inches for the calibration period and the verification period, respectively. Both compare well to the historic yield of about 9 inches. Given the presence of springs, especially in the lower portion of the watershed, and the relatively small size of the watershed, suggest that the calibration and validation results are adequate for the purposes of TMDL development.

Two situations were modeled. The first is the present condition with the cropping conditions identified above and overgrazing of various areas close to streams. The second situation is with the same cropping conditions, but with the overgrazing eliminated. Barnyard runoff situations are not simulated directly in SWAT. Also, stream bank erosion contributions could not be modeled. The results of the two situations are as follows:

Castle Rock Creek (including Gunderson Valley Creek) --

Situation	Phosphorus (lbs/year)	Sediment (tons/year)
1 – Current	55,800 (25,300 kg/yr)	35,000 (32,100 mT/yr)
2 – elimination of overgrazing	37,000 (16,800 kg/yr)	24,000 (21,500 mT/yr)
% reduction	33%	33%

Gunderson Valley Creek --

Situation	Phosphorus (lbs/year)	Sediment (tons/year)
1 – Current	6,900 (3,140 kg/yr)	4,200 (3,770 mT/yr)
2 – elimination of overgrazing	5,700 (2,600 kg/yr)	3,400 (3,080 mT/yr)
% reduction	18%	18%

The modeling showed substantial sediment deposition in the lower portion of Gunderson Valley Creek and in Castle Rock Creek near the confluence with Gunderson Valley Creek. This is consistent with the observed conditions and the very high nutrient concentrations.

To determine whether Situation 2 is a sufficient reduction (at least for an initial estimate), unit area loads for the creeks' watersheds were compared to streams in the driftless area with annual load information (see "Unit-Area Loads of Suspended Sediment, Suspended Solids and Total Phosphorus From Small Watersheds in Wisconsin, USGS Survey Fact Sheet FS-195-97). A unit area load is the annual calculated load (mass of pollutants) divided by the drainage area. A comparison to driftless area streams has merit in that the majority of the driftless area streams do support trout fisheries.

	Phosphorus (lbs/sq. mi)	Sediment (tons/sq. mi.)
Castle Rock Creek	1000	570
Gunderson Valley Creek	990	520
Driftless Area 50th and 75th percentiles	950 / 1250	350 / 750

It appears Situation 2 falls between the 50th and 75th percentile of driftless area streams for both phosphorus and sediment.

The modeling results did not show any subwatersheds that contribute substantially greater amounts of sediment or phosphorus on a per unit area basis (tons of sediment per acre or pounds of phosphorus per acre). Keeping that in mind, the somewhat higher contributing subwatersheds on a per unit area basis are the Doc Smith Creek subwatershed, the subwatershed of the tributary to Doc Smith Creek and the subwatershed to the unnamed stream along Baumgartner Road. Although Gunderson Valley Creek has very high in-stream concentrations of nutrients and corresponding dissolved oxygen problems, it's subwatershed pollutant loadings are the lowest for the watershed. Again, it should be noted that all of the loadings are relatively high when compared to loadings of other driftless area streams.

The significance of the pollutant loadings in regards of the impaired segment of Castle Rock Creek may vary by location. In particular, Doc Smith Creek comes into the impaired segment at it downstream end. Therefore, it has less impact than other subwatersheds. Doc Smith Creek, on the other hand, is likely a significant contributor of pollutants to the downstream outstanding resource segment of Castle Rock Creek.

Margin of Safety

This set of TMDLs uses an implicit margin of safety. That is, conservative assumptions are used. It can be anticipated that a greater percent reduction in both sediment and phosphorus can be achieved than what is modeled under Situation 2. Situation 2 assumes no reduction in pollutants from cropped fields. In reality, soil erosion reductions and corresponding pollutant reductions from some fields is possible and reasonable. In addition, installation of vegetated buffers along the streams will reduce the conveyance of pollutants from fields by at least 10 to 15% in this terrain. As of January 2004, Grant County had nearly 3,000 acres enrolled in the Conservation

Reserve Enhancement Program for establishment of riparian filter strips and riparian buffers.

Seasonal Variation

There is no seasonal variation in the sedimentation of these two streams. Sedimentation occurs primarily due to runoff during rainfall and snowmelt events, which occur throughout the year. The amount of sediment entering the streams increases during spring runoff and intense summer rainstorms. Over time, it appears that the net result has been a build-up of sediment in the pools. Much of the sediment tends to stay in the pools until major flood events occur and scour the pools. This is more of an episodic occurrence rather than a seasonal occurrence.

Reasonable Assurance

Although there are no point sources in the watershed, EPA Region 5 requires that states demonstrate "reasonable assurance" of nonpoint source load reductions needed to achieve the load allocation will be implemented. The following is a summary of current and future implementation:

- The nonpoint source best management practices needed to implement this TMDL are the same as or consistent with practices necessary to meet the agricultural performance standards and prohibitions listed and described in Ch. NR 151, Wis. Adm. Code. The agricultural performance standards and prohibitions are enforceable provisions provided cost share assistance is offered to the landowner of the pollutant source. The intent of the Department of Natural Resources is to implement the performance standards and prohibitions first in watersheds with impaired or outstanding/exceptional resource waters.

- Grant County has applied for and received two Targeted Runoff Management (TRM) Project grants for implementation of best management practices in this watershed. Grant County is eligible to apply for additional TRM project grants to help implement this set of TMDLs. Funds from EPA were used to supplement cost sharing under the first TRM grant.

- This watershed is eligible under the Conservation Reserve Enhancement Program (CREP) for the establishing riparian buffers. Landowners may enroll strips of land along the streams in this program either under a 14 to 15-year contract or through a permanent easement. As of January 2004, Grant County has enrolled nearly 3,000 acres in this program.

- Funds from the federal (USDA – NRCS) Environmental Quality Incentives Program (EQIP) may also be used to assist landowners in this watershed. Funds are allocated to every county.

Public Participation

A public notice calling for public comment on this set of TMDLs was issued on January 27, 2004 and extended through March 1, 2004. A news release was published as part of the weekly DNR News calling attention to the public notice and draft TMDLs available on the DNR website. Hard copies or e-mail copies of the news release were sent to all daily and weekly newspapers, all television and radio stations, interest groups and individuals. The total distribution list exceeds 900 entries. In addition, hard copies of the public notice and draft TMDLs were sent to Grant County Land Conservation Department, to all members of the Castle Rock Creek Watershed Association and others that expressed interest. Two public comments were received. A copy of those comments and the Wisconsin Department of Natural Resources' response are appended to this set of TMDLs. In addition, comments were received from EPA Region 5. The public comment draft was revised in response to pertinent comments.

Monitoring Plan

The Department of Natural Resources intends to monitor Castle Rock Creek and Gunderson Valley Creek every three to five years, depending on available resources and the level of nonpoint source best management practice installation. The monitoring will likely consist of collection of grab samples during summer base flow periods to obtain total phosphorus information. Habitat assessments may be conducted in deposition areas. Data to calculate biological indicators, such as the Index of Biological Indicators (a fish based metric) will also be collected periodically.

Attachments:

1. Map of Estimated Current Annual Sediment Loads

2. List of 25 streams where data was used to determine suitable conditions

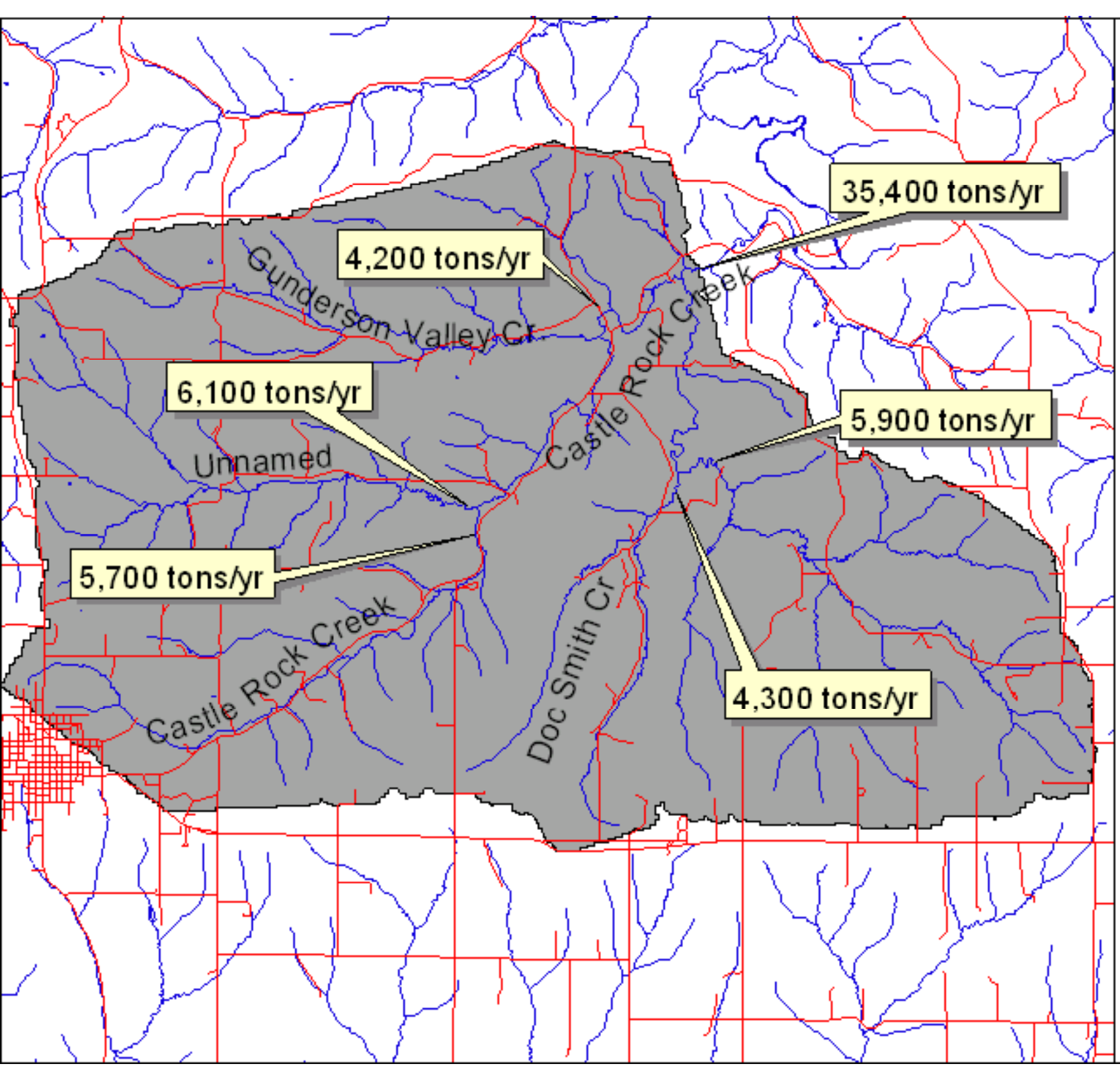
3. USGS flow report

References:

1. Nutrient Criteria Technical Guidance Manual: Rivers and Streams, US EPA Office of Water, July 2000 (not submitted with TMDLs)

2. Castle Rock Creek TMDL Project Final [Monitoring] Report

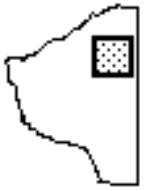
3. Unit-Area Loads of Suspended Sediment, Suspended Solids and Total Phosphorus From Small Watersheds in Wisconsin, USGS Survey Fact Sheet FS-195-97.



Castle Rock Creek Watershed

Estimated Current Annual Sediment Loads

Grant County



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Map Creator:
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