WATERSHED BASED PLAN FOR THE DECKERS CREEK WATERSHED

Preston and Monongalia Counties, West Virginia

Updated August 2006

Submitted to:

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Division of Water and Waste Management
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Executive Summary

The Deckers Creek watershed comprises 64 square miles in Preston and Monongalia Counties, West Virginia. The West Virginia Integrated Water Quality Monitoring and Assessment Report, which includes the state's 303(d) list, identifies eight streams, including the mainstem, that are impaired by nonpoint source pollutants. Seven streams are impaired by acid mine drainage pollutants and one by lead. There is also evidence of impairment by nonpoint sources of fecal coliform bacteria and sediment. Enough information is available to enumerate sources, estimate costs and plan remediation for the nonpoint acid mine drainage sources. This plan has also been updated to provide more detailed information including suspected sources and loads of, and estimate treatment costs for fecal coliform bacteria from wastewater. Addressing the other pollutants will require additional data collection. A clean-up plan, the Total Maximum Daily Load document, calls for reductions of metal loads for 13 subwatersheds. This watershed based plan identifies 17 high-priority acid mine drainage sources that must be treated in order to meet the required metal reductions in ten of these subwatersheds. Recent monitoring data on the remaining three subwatersheds do not confirm the need for metal reductions. Pollutant loads from the 17 high-priority sources must be reduced in order to meet the requirements of the clean-up plan. Passive treatment methods can reduce loads from 16 of the 17 high-priority sources by 90% at a cost of $5.9 million. The remaining source, the Richard mine, will require ongoing, active treatment. The Deckers Creek Restoration Team, a coalition of state and federal agencies, local individuals, groups, and businesses, and the watershed organization, Friends of Deckers Creek, will carry out this watershed based plan with funding from the Office of Surface Mining, the Abandoned Mine Land Trust Fund, nonpoint source pollution funds from the United States Environmental Protection Agency, and other sources. Parallel efforts are underway to raise funds for ongoing, active treatment of the drainage from the Richard mine.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ACKNOWLEDGEMENTS

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SUGGESTED REFERENCE

Christ, M., and M. Pavlick. 2006. Watershed based plan for the Deckers Creek watershed, Preston and Monongalia Counties, West Virginia. Morgantown, WV: Friends of Deckers Creek. August.

LIST OF ABBREVIATIONS

µg/L	Micrograms per liter
Al	Aluminum
AMD	Acid mine drainage
AML	Abandoned mine land
BFS	Bond forfeiture site
cfu	Colony-forming unit
DCRT	Deckers Creek Restoration Team
DWWM	Division of Water and Waste Management (within WVDEP)
EQB	Environmental Quality Board
Fe	Iron
FODC	Friends of Deckers Creek
GIS	Geographic Information System
Gpm	Gallons per minute
HAU	Home aeration unit
mg/L	Milligrams per liter
Mn	Manganese
MRB	Manganese removal bed
MRCD	Monongahela Resource Conservation District
NPDES	National Pollutant Discharge Elimination System
NPS	Nonpoint source
NRCS	Natural Resources Conservation Service
NTU	Nephelometric turbidity unit
OAMLR	Office of Abandoned Mine Lands and Reclamation (within WVDEP)
OLC	Oxic (or open) limestone channel
OSM	Office of Surface Mining, Reclamation, and Enforcement
PA	Problem area
PAD	Problem area description
Pb	Lead
pH	Intensity of acid or base reaction in a solution (negative log of hydrogen ion activity)
PSD	Public service district
RAPS	Reducing and alkalinity producing system
RM	River mile, the distance from the mouth of a stream upstream to a particular point
SAPS	Successive alkalinity producing system
SMCRA	Surface Mining Control and Reclamation Act
SRG	Stream Restoration Group (within OAMLR)
SWS	Subwatershed
TMDL	Total Maximum Daily Load
UDCI	Upper Deckers Creek impoundment
UNT	Unnamed tributary
USEPA	United States Environmental Protection Agency
USGS	United States Geologic Survey
VFP	Vertical flow pond
WBP	Watershed based plan
WCAP	Watershed cooperative agreement program
WVCA	West Virginia Conservation Agency
WVDEP	West Virginia Department of Environmental Protection

1. WATERSHED DESCRIPTION

The Deckers Creek watershed covers roughly 64 square miles in Monongalia and Preston Counties, West Virginia. In Monongalia County, part of the city of Morgantown drains to Deckers Creek. In Preston County, part of Masontown and all of Reedsville drain to Deckers Creek (Figure 1). The unincorporated towns of Brookhaven, Richard, Dellslow, Rock Forge, Sturgisson, Greer and Mountain Heights in Monongalia County, and Bretz and Arthurdale in Preston County also lie within the watershed.

Deckers Creek rises on Chestnut Ridge, which approximately follows the line between Preston and Monongalia Counties, flows east and then north through a valley that parallels the ridge. This area is the Valley District of Preston County. It then cuts a gorge through that ridge as it flows northwest. Deckers Creek flows into the Monongahela River in Morgantown. The Monongahela flows north to Pittsburgh, where it joins the Allegheny River to form the Ohio River.

Forested land makes up the majority of the watershed (Table 1): The watershed is most heavily settled in and near Morgantown. There are smaller population centers and some agricultural land in the Preston County portion of the watershed. Unsettled and forested land dominates the portion of the watershed taken up by Chestnut Ridge. In the 1970s, the West Virginia Soil Conservation Agency and the United States Soil Conservation Service implemented measures to protect land in the Preston County portion of the watershed from flooding. The measures included seven impoundments, five for flood control and two for waterfowl habitat, and channelization of approximately six miles of streams.

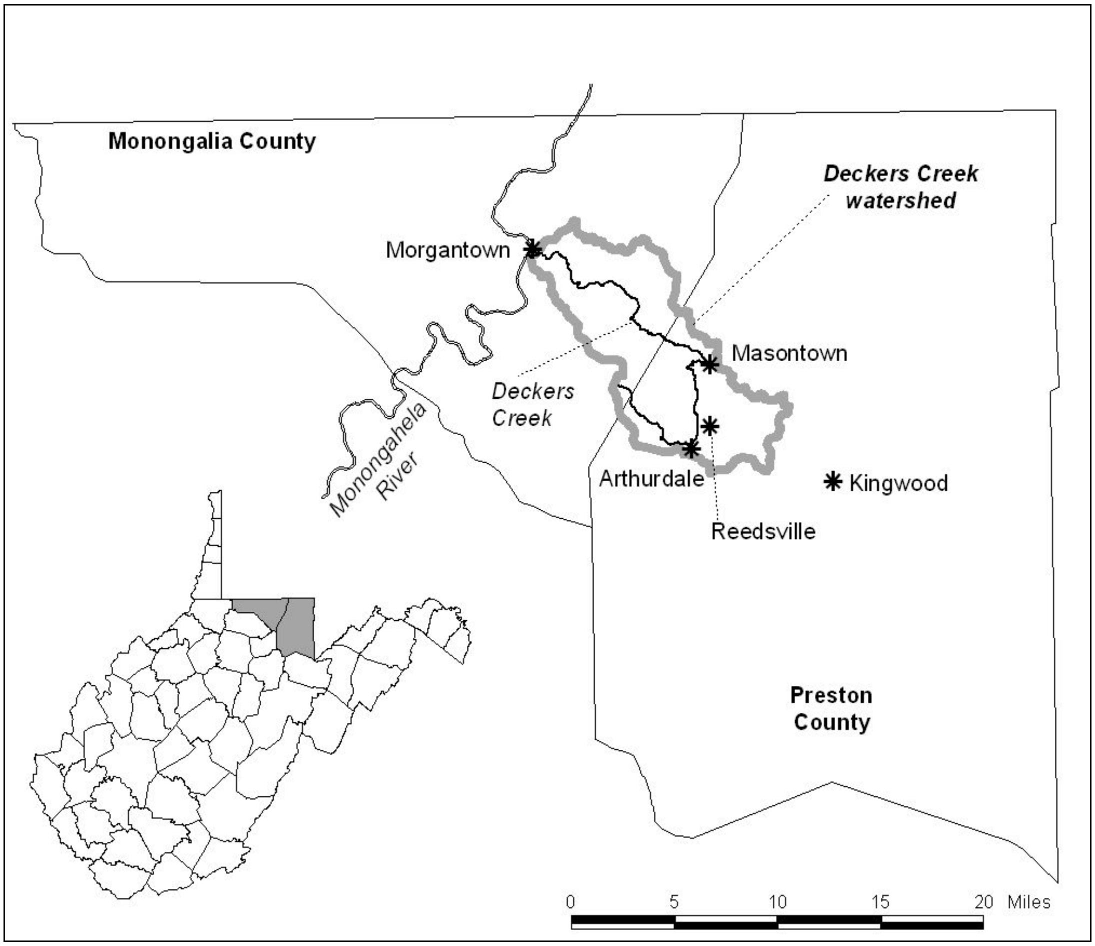
In this document, streams and subwatersheds (SWSs) within the Deckers Creek watershed are identified in three ways: by name, where one exists; by stream codes (WVDEP, 2005a); and by the SWS numbers used by the Total Maximum Daily Load (TMDL) document for the Monongahela River watershed (USEPA, 2002). For example, the stream that flows into Deckers Creek from the north in Sabraton, two miles from its mouth, is Hartman Run or M-8-0.5A, or the stream of SWS149. Impoundments built for flood protection are referred to as Upper Deckers Creek Impoundments (UDCIs) #1 through #7. The most important of these is UDCI #1 (See Section 5.1.1), which serves as a public water supply, distributed by Preston County Public Service District #1.

Table 1: Land use classes in the Deckers Creek watershed

Land use	Acres	Percent
Forest	28,681	71.3
Farmland	6,270	15.6
Urban land	2,937	7.4
Mined land	1,621	4.0
Other (water, barren, roads)	706	1.7
Total	40,251	100.0

Source: NRCS, 2000.

Figure 1: Location of the Deckers Creek watershed



2. WATER QUALITY STANDARDS

All stream segments in the Deckers Creek watershed should, at a minimum, be fishable and swimmable, and should be clean enough to contain healthy communities of indigenous aquatic species. The federal Clean Water Act, state Water Pollution Control Act, and federal and state regulations have set standards to protect designated uses of the streams. Designated uses for streams in the Deckers Creek watershed include public water supply (Category A), maintenance and propagation of aquatic life (warm water fishery streams, Category B1), and water contact recreation (Category C). The numeric and narrative water quality standards related to pollutants address by this Watershed Based Plan are shown in Table 2.

Table 2: Selected West Virginia water quality standards

	Section	Aquatic life	Human health	
		Category B1 *Warm water fishery*	*Category A* *Public water supply*	*Category C* *Recreation*
Aluminum[a] (dissolved)	8.1	Not to exceed 87 µg/L (chronic) or 750 µg/L (acute)	NS[b]	NS
Biological impairment	3.2.i	[N]o significant adverse impact to the…biological [component] of aquatic ecosystems shall be allowed.		
Fecal coliform	8.13	NS	Maximum allowable level of fecal coliform content for Primary Contact Recreation (either MPN or MF) shall not exceed 200/100 ml as a monthly geometric mean based on not less than 5 samples per month; nor to exceed 400/100 ml in more than ten percent of all samples taken during the month.	
Iron (total)	8.15	Not to exceed 1.5 mg/L (chronic)	Not to exceed 1.5 mg/L	NS
Lead	8.16	Not to exceed chronic and acute concentrations that vary with hardness[d]	Not to exceed 50 µg/L	NS
Manganese[c] (total)	8.17	NS	Not to exceed 1.0 mg/L	NS
pH	8.23	No values below 6.0 nor above 9.0. Higher values due to photosynthetic activity may be tolerated.		
Turbidity	8.32	No point or non-point source to West Virginia's waters shall contribute a net load of suspended matter such that the turbidity exceeds 10 NTU's over background turbidity when the background is 50 NTU or less, or have more than a 10% increase in turbidity (plus 10 NTU minimum) when the background turbidity is more than 50 NTUs.[e]		

Source: 46 CSR 1. Sections refer to this rule.

[a] When the TMDL was developed for the Monongahela River watershed, an acute total aluminum criterion of 750 µg/L was in effect. Since then, the aluminum criterion was changed to dissolved aluminum, and a chronic criterion was added. At the time that this plan is being written, the West Virginia Environmental Quality Board has suspended the chronic dissolved aluminum criterion of 87 µg/L in all but trout waters until July 2007.

[b] NS indicates no standard for a particular designated use.

[c] When the TMDL was being developed, USEPA was considering whether or not to approve a modification to the state manganese criterion that would make it apply only upstream from known drinking water sources. This change to the water quality standards has been approved, and the manganese criteria only applies in waters five (5) miles upstream of a drinking water source intake.

[d] The chronic dissolved lead equation is: $Pb = e^{(1.273[\ln(hardness)]-4.705)} \times CF$. The acute dissolved lead equation is: $Pb = e^{(1.273[\ln(hardness)]-1.46)} \times CF$. The correction factor CF is also dependent upon hardness, and has the value: $CF= 1.46203-[(\ln hardness)(0.145712)]$.

[f] See 46 CSR 1 Sections 8.32 and 8.32.1 for special circumstances for the turbidity standard.

3. NONPOINT SOURCE POLLUTION IN DECKERS CREEK

This watershed based plan (WBP) addresses four types of pollution that must be controlled if all stream segments in the Deckers Creek watershed are to meet water quality standards. WVDEP's 303(d) list (WVDEP, 2004) indicates that two types, AMD and lead, impair stream segments in the Deckers Creek watershed (Table 3). A TMDL plan (USEPA, 2002) calls for reductions in the metal loads from watersheds contributing to these segments. The sources of AMD and of lead enumerated in Table 3 will be described in Chapter 5.

Table 3: Deckers Creek watershed stream segments on West Virginia's 303(d) list

Streams	Code	Miles	Sources
AMD			
Deckers Creek	M-8	24.7	12
Kanes Creek	M-8-I	4.3	9
UNT/Kanes Creek RM 2.6	M-8-I-1	0.8	2
Laurel Run	M-8-H	3.5	2
Dillan Creek	M-8-G	5.4	6
Slabcamp Run	M-8-F	1.5	1
Glady Run	M-8-D	1.2	1
Deep Hollow	M-8-A.7	2.3	7
Hartman Run	M-8-0.5A	1.6	2
Total		**45.3**	**42**
Lead[a]			*Acres of fill*
UNT/Deckers Creek RM 18.6	M-8-J	2.5	45

Source: WVDEP, 2004.

[a] Approximately 10 additional acres of possible lead fill have been identified inside the Deckers Creek watershed but outside of the watershed UNT/Deckers Creek RM 18.6.

Friends of Deckers Creek (FODC) has gathered data suggesting that two other types of pollution, fecal coliform bacteria and sediment, impair certain segments. The fecal coliform pollution is caused by point sources as well as nonpoint sources, and in many cases permittees are taking steps to control their point sources. Numbers of sources for each type of pollution are listed in Table 4. Because data will currently support only an AMD and fecal coliform bacteria plan, this WBP proposes additional monitoring for nonpoint pollutants other than AMD and bacteria.

Table 4: Streams with evidence of nonpoint source pollution, but without 303(d) listings

Streams	Code	Miles	Sources
Fecal coliform bacteria (sites with readings >400 cfu (100 mL)$^{-1}$)[a]			
Deckers Creek	M-8	RM 0 to 19.1	Combined sewer overflows, livestock in creek, possible failed septic systems, straight pipes,
Aarons Creek	M-8-A	RM 0 to 4.8	Livestock in creek, possible failed septic systems and straight pipes
Knocking Run	M-8-A.5	2.6	Possible failed septic systems and straight pipes
UNT/Deckers Creek RM 3.6	Not assigned	2.5	Possible failed septic systems and straight pipes
Tibbs Run	M-8-B	RM 0 to 2.0	Possible failed septic systems and straight pipes
UNT/Tibbs Run RM 2.0	Not assigned	0.2	Possible failed septic systems and straight pipes
Deep Hollow	M-8-A.7	4.0	Possible failed septic systems and straight pipes
Kanes Creek	M-8-I	RM 2.2 to 3.8	Livestock in creek, possible failed septic systems and straight pipes
Total	**8 segments**		
Sediment (embedded streambed, moving sands in streambed)[b]			
Deckers Creek	M-8	RM 15.9 to 20.5	Channelization
Aarons Creek	M-8-A	RM 0 to 2.6	Possibly from construction practices
Dillan Creek	M-8-G	RM 0 to 1.3	Channelization
Laurel Run	M-8-H	RM 0 to 0.3	Channelization
Kanes Creek	M-8-I	RM 0 to 0.4	Channelization
Total	**5 segments**	**9.2**	

[a]Fecal coliform data were collected by FODC(2006a, 2006b). [b]FODC observations.

3.1. Acid mine drainage

Coal from the Upper Kitanning, Lower and Upper Freeport, Bakerstown and Pittsburgh seams have been mined in the Deckers Creek watershed. All of these seams contain pyrite and other minerals with sulfur. When these minerals encounter air and water, they oxidize to form sulfuric acid and dissolved metals. The resulting solution also dissolves aluminum from other minerals which it contacts. The resulting solution is known as acid mine drainage (AMD).

AMD may form whenever disturbance to the rocks exposes the coal and pyrite to air and water. In the Deckers Creek watershed, AMD has been generated at coal mines that fall into three categories. First, there are two coal mines in the watershed that currently hold permits for treating water (Table 5). Although AMD is generated at these sites, the mines treat the water before it is discharged off the site, under regulation by National Pollutant Discharge Elimination System (NPDES) permits. Second, bond forfeiture sites (BFSs) have had mining permits revoked. The WVDEP has taken over responsibility for treating AMD at these sites (Table 6). Finally, abandoned mine lands (AMLs) were mined before passage of the Surface Mining Control and Reclamation Act (SMCRA) in 1977. There are 69 AML sites in the Deckers Creek watershed (Table 7). SMCRA provided for the collection of funds by states for the sake of solving problems created by these mines. AMD sources on AMLs and BFSs are considered nonpoint sources in the TMDL (USEPA 2002). However, WVDEP is committed to treating effluent from BFS to meet the NPDES permits held by the original mining company. Therefore, the inventory of AMD sources comprises AML sites that produce AMD and additional sources identified by citizens, including FODC.

Table 5: Active mining permits in the Deckers Creek watershed

Name of owner	Name of mine	Mining permit	NPDES permit	Receiving stream	Status
Decondor Coal Company, inc.	Mountain Run Mine No. 5	U014782	WV0063258	UNT/Kanes Creek RM 2.6	Active, treating water
Patriot Mining Company (Anker Energy)	Mine #1	E004100	WV1007050	Kanes Creek	Active, treating water
Preston Coal and Coke Corp.	Refuse Disposal	O013283	WV0065218	Falls Run	Inactive
ED-E Development Co.		S103286	None	Kanes Creek	Permit Revoked, Converted from forfeited bonds
AC Mining		S100489	None	Dillan Creek	Completely Released
Coaltrain Corporation	Sypolt Job	S100496	WV1011693	Swamp Run of Dillan Creek	Incremental Phase 3 Release
Coaltrain Corporation	Street Surface Mine	S106191	None	Swamp run of Dillan Creek	Completely Released
Sharon Coal Company	Daugherty Coal Tipple	O014583	WV1010298	Deckers Creek	Inactive, seeking bond release
Volkstone Co.		S102489	None	Dillan Creek	Completely Released

Source: WVDEP, 2006a.

Table 6: Bond forfeiture sites in the Deckers Creek watershed

Company Name	Permit Number	Receiving stream	Notes
Valley Mining Co.	S-17-82	Deep Hollow	Treatment measures were installed in 2004
Hillcrest Construction Co., Inc.	S-33-83	Deep Hollow	Little AMD
Pinnacle Mining Co.	S-62-85	Deep Hollow	No AMD
Pinnacle Mining Co.	S-1028-86	Deep Hollow	No AMD
ED-E Development Co.	S-1032-86	Kanes Creek	Portion of this permit within the Deckers Creek watershed not known to produce AMD
Daugherty Coal Co.	S-40-73	Dillan Creek	AMD sources may be on bond forfeiture site or may be AMD
Daugherty Coal Co.	S-188-75	Dillan Creek	AMD sources may be on bond forfeiture site or may be AMD
WOCAP Energy Resources	O-77-82	Kanes Creek	No AMD

Source: WVDEP, 2002, 2006a

Table 7: Abandoned Mine Lands in the Deckers Creek watershed

Problem area name (PA number)	Status	Subwatershed	County	USGS Quad
Aaron Creek Portal (92)	No AMD	Aarons Creek	Monongalia	Morgantown South
Atkins & Ryan Subsidence (459)	No AMD	Hartman Run	Monongalia	Morgantown North
Back Run Highwall (1324)	Low	Direct Drain	Preston	Masontown
Beulah Chapel Portal (1141)	High	Deep Hollow	Monongalia	Morgantown South
Beulah Hollow Portal (91)	Low	Deep Hollow	Monongalia	Morgantown South
Borgman Refuse And Portals (5409)	Low	Kanes Creek	Preston	Newburg
Bretz (Anderson) Subsidence (5833)	No AMD	Direct Drain	Preston	Masontown
Bretz (Methany) Mine Drainage (5810)	High	Direct Drain	Preston	Masontown
Burk Mine Drain (6009)	High	Laurel Run	Preston	Masontown
Clinton Braham (2192)—included in PA 6088	High	Kanes Creek	Preston	Morgantown South
Comer Highwall & Portals (3792)	Low	Knocking Run	Monongalia	Morgantown North
Dalton (1975)	High	Direct Drain	Monongalia	Masontown
Dawson (2058)	Low	Deep Hollow	Monongalia	Morgantown South
Deckers Creek #1 (1105)	Low	Direct Drain	Monongalia	Morgantown North
Deckers Creek Watershed (4010)	Watershed	NA		Masontown
Deep Hollow Portals (90)	No AMD	Deep Hollow	Monongalia	Morgantown North
Depot Street Subsidence II (4441)	No AMD	Direct Drain	Preston	Masontown
Dewey Hastings (4565)	No AMD	Aarons Creek	Monongalia	Morgantown South
Dillan Creek (5333)	Watershed	Dillan Creek	Preston	Masontown
Dillan Creek #1 (2820)	High	Dillan Creek	Preston	Masontown
Dillan Creek #2 (1035)	Low	Dillan Creek	Preston	Masontown
Dillan Creek Pa #3 (1036)	No AMD	Dillan Creek	Preston	Masontown
Dogtown Road (Hovatter) Portals (6129)	Low	Kanes Creek	Preston	Newburg
Dogtown Road Waterline (4460)	No AMD	Kanes Creek	Preston	Newburg
Dump Highwall (3870)	No AMD	Hartman Run	Monongalia	Morgantown North
Earl Reiner (1135)	No AMD	Hartman Run	Monongalia	Morgantown North
Elkins Coal & Coke Mining Facility (5120)	Constructed	Direct Drain	Preston	Masontown
Gladys Run Strips (1734)	High	Glady Run	Preston	Masontown

Table 8: Abandoned Mine Lands in the Deckers Creek watershed, *continued*

Problem area name (PA number)	Status	Subwatershed	County	USGS Quad
Harold Rehe (2225)	No AMD	Direct Drain	Preston	Masontown
Hartman Run Drainage (1099)	High	Hartman Run	Monongalia	Morgantown North
Hartman Run Drainage II (6008)	High	Hartman Run	Monongalia	Morgantown North
Hawkins Mine Discharge (3455)	High	Kanes Creek	Preston	Newburg
Kanes Creek Area Waterline (5064)	No AMD	Kanes Creek	Preston	Masontown
Kanes Creek North (1732)	Low	Dillan Creek	Preston	Masontown
Kanes Creek South (2003)	High	Kanes Creek	Preston	Masontown
Kanes Creek South Reclamation Project (5900)	High	Kanes Creek	Preston	Newburg
Kanes Creek Tipple (2002)	High	Kanes Creek	Preston	Masontown
Laurel Run #1 (2005)	Low	Laurel Run	Preston	Masontown
Masontown (Fullenberger) Subsidence II (5011)	No AMD	Direct Drain	Preston	Masontown
Masontown (Polce) Subsidence (5203)	No AMD	Direct Drain	Preston	Masontown
Masontown Subsidence (4373)	No AMD	Direct Drain	Preston	Masontown
McKinney Cave Road (Taylor) Subsidence (6108)	No AMD	Slabcamp Run	Preston	Masontown
Mellons Chapel Portal (89)	No AMD	Deep Hollow	Monongalia	Morgantown South
Morgan Mine Road AMD (5990)	High	Kanes Creek	Preston	Newburg
Morgan Mine Road Mine Fire (6045)	No AMD	Kanes Creek	Preston	Newburg
Morgantown (Dorinzi) Subsidence (4639)	No AMD	Hartman Run	Monongalia	Morgantown North
Morgantown (Hartman Run Rd) Subsidence (6134)	No AMD	Hartman run	Monongalia	Morgantown North
Morgantown Airport Subsidence (4145)	No AMD	Hartman Run	Monongalia	Morgantown North
Mount Vernon Strip (1323)	Low	Laurel Run	Preston	Masontown
Neil Braham (2191)—included in PA 6088	Low	Kanes Creek	Preston	Morgantown South
Ponderosa Pines Opening (1143)	Low	Aarons Creek	Monongalia	Morgantown South
Reedsville (Baniak) Subsidence (6137)	No AMD	Dillan Creek	Preston	Masontown
Reedsville (Conner) Subsidence (5539)	No AMD	UNT/Deckers RM 17.3	Preston	Masontown
Richard Refuse (1142)	No AMD	Direct Drain	Monongalia	Morganton South
Sabraton (Hriblan) AMD (5815)	Low	Direct Drain	Monongalia	Morgantown North
Sabraton (Huggins) Portal (4919)	No AMD	Knocking Run	Monongalia	Morgantown North
Sandy Run Highwall, Portals (6088)	High	Kanes Creek	Preston	Newburg
Slab Camp - Friends Of Deckers Ck. (5902)	Constructed	Slabcamp Run	Preston	Masontown
Slabcamp Run #2 (1999)	Constructed	Slabcamp Run	Preston	Masontown
Superior Hydraulics (3738)	High	Direct Drain	Monongalia	Morgantown South
Superior Hydraulics (4024)	No AMD	Direct Drain	Monongalia	Morgantown South
Tibbs Run #2 Portal (2452)	Low	Tibbs Run	Monongalia	Morgantown South
Tibbs Run Portals And Tipple (2011)	Low	Tibbs Run	Monongalia	Morgantown South
Union PSD Subsidence (460)	No AMD	Tibbs Run	Monongalia	Morgantown South
Upper Deckers Creek - Impoundment 5 (4863)	Constructed	Kanes Creek	Preston	Newburg
Valley Highwall #3 (3068)	High	Kanes Creek	Preston	Kingwood
Valley Point #12 (1456)	High	Kanes Creek	Preston	Valley Point
Woodland U.M. Church Subs. (5533)	No AMD	Hartman Run	Monongalia	Morgantown North
WV - Monongalia - FEA (954061)	No AMD	Hartman Run	Monongalia	Morgantown

Sources: OSM, 2006; WVDEP, Various dates. PA numbers are tracking numbers for AML problem areas assigned by WVDEP.

AMD sources differ in severity. This WBP identifies two priority levels for AMD sources. High-priority sources are those that must be addressed in order to reduce pollutant loads enough to delist all the segments in the watershed according to current information (Table 8**Error! Reference source not found.**). Low-priority sites also contribute AMD, but are not clearly responsible for impairing any entire segment (Table 9). This plan calls for remediation at all high-priority sources, and continued monitoring to determine whether low-priority sources must also be addressed. Many of the AMLs are not known to discharge any AMD, and are omitted from the list of sources in Table 8 and Table 9.

Table 9: High-priority AMD sources in the Deckers Creek watershed

Subwatershed	Site
Deckers upstream from UDCI #1	Dalton (1975)
Kanes Creek	Valley Point #12 (1456) Valley Highwall #3 (3068) Kanes Creek South Site #1 (=Kanes Creek Tipple, 2002) Kanes Creek South Site #3 (2003) Sandy Run Highwall, Portals (6088) Morgan Mine Road AMD (5990) Hawkins mine drainage (3455)
Laurel Run	Burk mine drain (6009)
Dillan Creek	Dillan Creek #1 (2820)
Deckers from Slabcamp to Back Run (SWS 99)	Bretz (Methany) mine drainage (5810)
Deckers from Back Run to Glady Run (SWS 24)	This area was designated Goat Mine #1 in the NRCS PL-566 plan. It corresponds to Back Run Highwall (1324)
Glady Run	Gladys Run strips (1734)
Deep Hollow	Beulah Chapel portal (1141)
Deckers from Deep Hollow to Aarons Creek (SWS 20)	Richard mine (=Superior Hydraulics, 3738)
Hartman Run	Hartman Run drainage (1099) Hartman Run drainage II (6008)

Table 10: Low-priority AMD sources in the Deckers Creek watershed

Subwatershed	Site
Kanes Creek	Borgman Refuse And Portals (5409)
UNT/Deckers Creek RM 17.3	Zinn Chapel sites
Laurel Run	Laurel Run #1 (2005) Mount Vernon Strip (1323)
Dillan Creek	Dillan Creek #2 (1035)
Deckers from Back Run to Glady Run	Back Run Highwall (1324)
Tibbs Run	Tibbs Run #2 Portal (2452) Tibbs Run Portals And Tipple (2011)
Deep Hollow	Beulah Hollow Portal (91)
Knocking Run	Comer Highwall & Portals (3792) Deckers Creek #1 (1105)
Deckers from Aarons Creek to Hartman Run	Sabraton (Hriblan) AMD (5815)
Aarons Creek	Ponderosa Pines Opening (1143)

The list of AMD sources is not complete. Additional sites may be found that discharge AMD, or AMLs thought to have no AMD may prove to be sources. Any additional sites will be assessed and added to any future revisions of this plan (Section 10).

Streams receiving AMD are commonly impaired according to aluminum (Al), iron (Fe) and manganese (Mn) concentrations. Examination of the data, however, indicates that violations by Mn are less common than violations by the other metals. Eight segments of Deckers Creek are impaired with regard to Mn (WVDEP, 2004). However, for many of the segments, Mn loads are close to target loads (USEPA, 2002), and reductions may not be necessary.[1]

3.2. Lead

One tributary (UNT/Deckers Creek RM 18.6; M-8-J; SWS 210) is impaired by lead. A foundry for plumbing fixtures in the upper part of the watershed used sand in their processes. The sand became infused with lead and other metals, and was landfilled in three areas of the watershed (Figure 2). Concentrations of lead violating the aquatic life designated use have been found in the stream water. According to area residents, there are approximately 45 acres where the fill material may have been used in the watershed of this tributary, and an additional 10 acres of fill material that may contribute lead to other segments of the Deckers Creek stream system.

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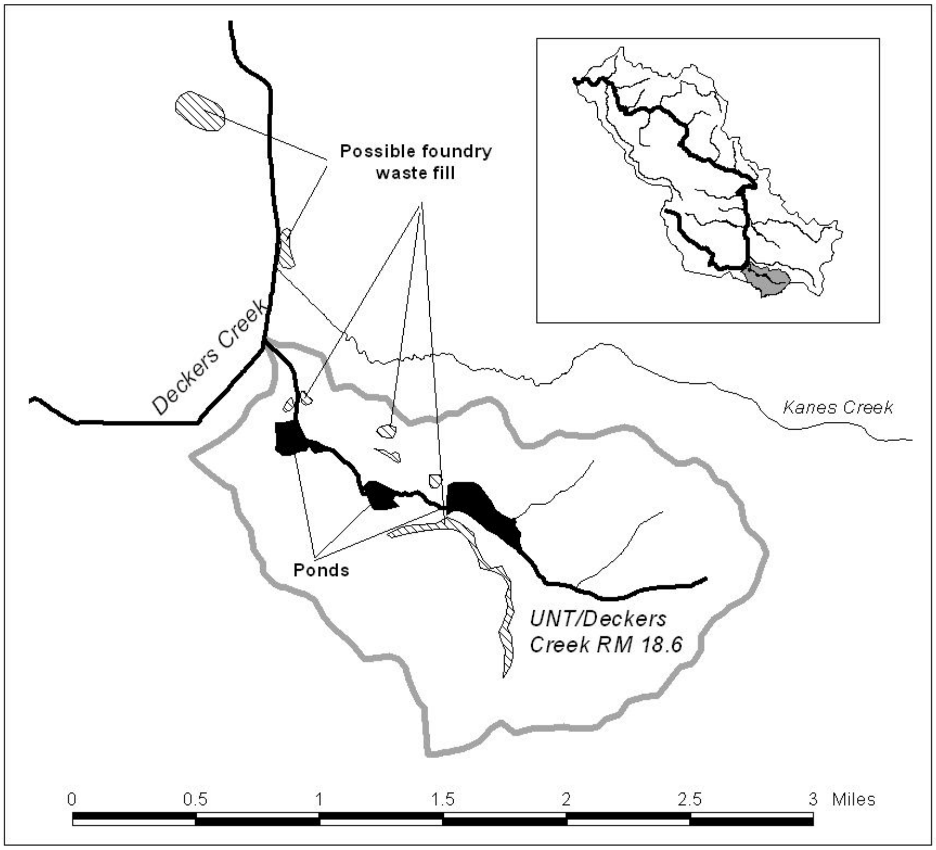
[1] At the time the TMDL was written, the manganese standard applied to all waters of the state. The standard has since been changed to only apply to waters five miles upstream of a drinking water source intake. Until all drinking water source intakes are identified for Deckers Creek, it is unknown if and where the manganese TMDL will still apply in Deckers Creek, and if any tributaries are still violating the standard. Furthermore, when the TMDL was written, the aluminum standard was for total aluminum. It has since been changed to dissolved aluminum and a chronic criterion was added. (See Chapter 2). This Watershed Based Plan will continue to focus on total aluminum reductions until more data is collected to determine dissolved aluminum levels in the Deckers Creek watershed. MC- what do you think about what I said about Al here?

Figure 2: Lead sources to UNT/Deckers Creek RM 18.6



3.3. Fecal coliform bacteria

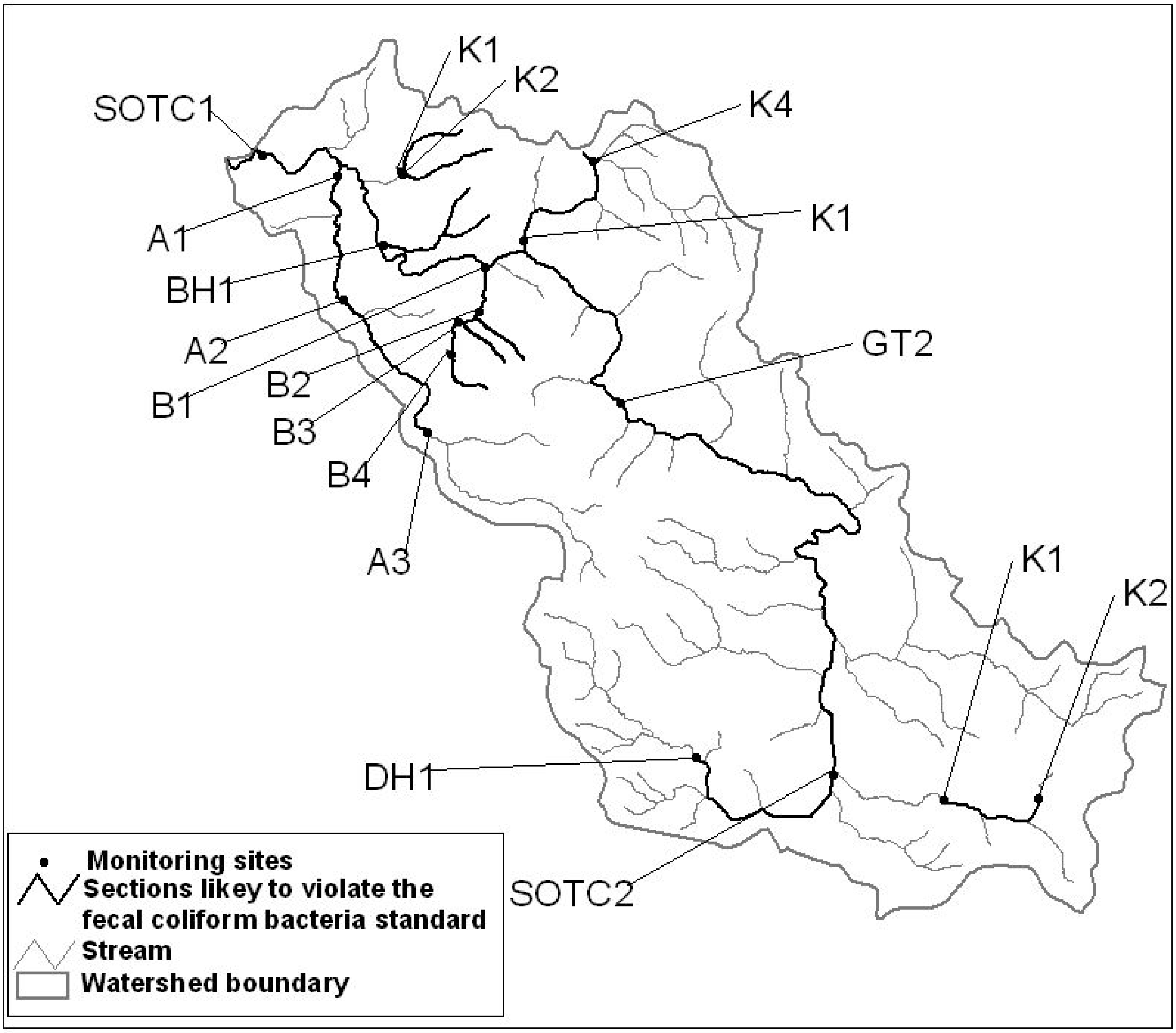
Deckers Creek is not currently on the 303(d)list for fecal coliform impairment, but data collected by FODC (Table 10) indicate 6 tributaries and 19.1 miles of the mainstem where fecal coliform counts have exceeded 400 cfu (100 mL)$^{-1}$, a component of the fecal coliform water quality criterion shown above in Table 2. While a one-time sample does not officially violate the fecal coliform bacteria standard, observations above 400 cfu (100 mL)$^{-1}$ are a health risk and impairment of this tributary is likely. Data have also shown that an additional tributary, Dillan Creek has exceeded 200 cfu (100 mL)$^{-1}$. Bacterial levels exceeding 200 cfu (100 mL)$^{-1}$ on only one occasion do not violate the fecal coliform standard but they are high enough to create suspicion that either point or nonpoint sources of bacteria are entering the stream.

Table 11: Recent fecal coliform bacteria levels that exceed 400 cfu (100 mL)$^{-1}$

Stream	Stream code	Sampling site code	Average (cfu/100ml)	Maximum (cfu/100ml)
Deckers Creek RM 0.7	M-8	SOTC 1	121	500
Deckers Creek RM 7.4	M-8	GT2	845	1640
Deckers Creek RM 16.8	M-8	SOTC 2	132	790
Deckers Creek RM 19.1	M-8	DH1	91	900
Aarons Creek	M-8-A	A1	144	570
Aarons Creek	M-8-A	A2	352	740
Wolf Run/Knocking Run	M-8-A.5	K1	580	590
Knocking Run	M-8-A.5	K2	6350	8400
UNT/Deckers Creek RM 2.8	Not assigned	BH1	--	2100
Deep Hollow	M-8-A.7	B1	353	790
Deep Hollow	M-8-A.7	B2	239	700
Deep Hollow	M-8-A.7	B3	289	810
Deep Hollow	M-8-A.7	B4	--	960
Tibbs Run	M-8-B	T1	227	980
UNT/Tibbs Run RM 2.0	Not assigned	T4	450	490
Kanes Creek	M-8-I	KA2	257	560

Note: Source, FODC 2006a, 2006b. Sites without an average value only had one sample collected; value is recorded in the maximum column. Raw data can be found in Appendix A.

Figure 3: Stream segments likely to violate the fecal coliform bacteria standard



Note: Segments listed as likely impaired if at least one measurement indicated bacteria levels above 400 cfu (100 mL)-1. If these streams segments are to be included on the 303(d) list at least 3 samples will have to be collected with all three exceeding fecal coliform bacteria levels of 400 cfu (100 mL)-1, or at least 10% of samples exceeding this value with sample sets greater than 10 (WVDEP, 2006b). Other considerations will be made for sample sets falling between 3 and 10 samples (WVDEP, 2006b).

3.3.1. Point Sources

Point sources may account for some of the fecal coliform pollution, and those problems are being addressed by the permittees. The Morgantown Utility Board has approximately 20 combined sewer overflows (CSOs) that discharge to the lower 3.2 miles of Deckers Creek. The Masontown sewage treatment plant has released untreated water when stormwater entering the system has exceeded capacity. Both entities are taking steps to eliminate these discharges. A number of package plants in the watershed have also discharged water into Deckers Creek with high fecal coliform bacteria levels as evident in the notices of violations issued for improper maintenance of systems under their NPDES permit. There are thirty home aeration units discharging into Deckers Creek. Proper operation and maintenance of these systems will determine whether or not they will have an impact on bacteria levels.

Permitted point sources are not covered under this plan, but their locations will be used for planning related to addressing nonpoint sources of fecal coliform bacteria pollution.

3.3.2. Nonpoint Sources

Nonpoint sources of fecal coliform bacteria to streams that may be impaired include residences, businesses or whole communities with failed septic systems or straight pipes, livestock with direct access to streams, and possibly wildlife areas. Because of suspicions that failing septics and straight pipes are the major nonpoint sources of fecal coliform in Deckers Creek and its tributaries, a comprehensive assessment of the watershed was completed. This assessment was designed to determine which SWSs are highly impacted by wastewater, the extent of impairment, and the location of wastewater pollution sources.

The wastewater assessment involved merging a number of data sets to determine the types of wastewater treatment for each home and business and to identify possible problem areas. Maps of centralized systems (Morgantown, Masontown, Reedsville), package plants, home aeration units (HAUs) and individual septic system locations were used with fecal coliform bacteria data collected for the Friends of Deckers Creek Clean Creek Program and during the spring and summer 2006 to accompany this assessment. All of this information was mapped using a geographic information system (GIS) to identify the watersheds most likely impacted by wastewater pollution. Conversations with the Monongalia and Preston County sanitarians and other knowledgeable local people about suspected problem areas and field surveys of specific stream segments provided additional information to support the GIS-based analysis.

Some data quality issues existed, specifically with the location of HAUs and septic systems. When permits are issued for HAUs, the location of these sites is recorded and sent to the WVDEP. In some instances the coordinates provided are inaccurate. HAUs are also entered into WVDEP’s database by landowner name, not location. Trying to match landowners with HAU permits was often difficult due to changes in property owners and data issues with GIS analysis. As wastewater issues are addressed in each subwatershed, further research into the location of each home aeration unit will have to be completed.

The septic system permit records kept by the county health departments do not highlight the exact locations of each system. Many permit applications only list the closest town and a rural route number for the system location. Only recently has the WVDEP required county health departments to document locations of new permitted septic systems. Given the resources available for this assessment, it was not possible to fully research and identify the exact location of each individual septic system in the watershed. Instead it is assumed that homes not connected to package plants, mainline systems, or home aeration units are either connected to an individual septic system or a straight pipe. Stream walks were used to rule out the presence of straight pipes in certain watersheds, but not every mile of stream was walked in the targeted SWSs.

To narrow the focus of the assessment, only highly developed watersheds and those with known problem areas were extensively surveyed through stream walks, fecal coliform bacteria sampling, and additional GIS analysis. Also watersheds where 100% of the wastewater is being managed by the Morgantown Utility Board were not extensively assessed (See Table 11). CSOs are the major source of fecal bacteria in these segments of Deckers Creek and MUB is working to alleviate all associated impacts.

Table 11 provides an overview of the major land uses and wastewater treatment systems in each subwatershed. A brief reasoning for choosing to focus on specific segments during the wastewater assessment is also provided. Upon completion of the assessment, five subwatersheds were deemed target watersheds for addressing wastewater pollution sources through this Watershed Based Plan. These subwatersheds are in bold in Table 11. Chapter 5 outlines the expected load reductions and costs associated with fecal coliform bacteria in the targeted watersheds.

In watersheds with agriculture and forest as the dominant land uses, fecal coliform bacteria pollution may be associated with wildlife and livestock. When resources become available, it is recommended that these subwatersheds be explored more thoroughly to determine the extent of fecal coliform bacteria impairment through additional data collection and source tracking.

Table 12: Overview of wastewater assessment

Stream code (SWS)	Stream names	Major land uses	Wastewater treatment	Focus for assessment
M-8 (150, 196, 197, 198)	Deckers Creek RM 0 to 2	Urban, suburban	Centralized (Morgantown Utility Board), few septic systems and straight pipes possible	No. Morgantown Utility Board is addressing CSO discharges. Virtually all homes connected to mainline system.
M-8-0.5A (149)	Hartman Run	Urban, suburban	Centralized (Morgantown Utility Board), home aeration units, a few septic systems and straight pipes possible	No. Morgantown Utility Board is addressing CSO discharges. All home connected to mainline system.
M-8-A (18)	**Aarons Creek**	**Urban, suburban**	**Centralized (Morgantown Utility Board), home aeration units, septic systems, straight pipes**	**Yes. Majority of homes and businesses in watershed are hooked up to septic systems/straight pipes/HAUs. High bacteria levels documented.**
M-8 (20)	Decker Creek RM 2 to 5.5, UNT/Deckers Creek	Urban, suburban	Centralized, septic systems, straight pipes	No. Majority of homes and businesses along mainstem and are hooked up to mainline systems.
M-8-A.5 (20)	**Knocking Run**	**Urban, suburban**	**Centralized (Morgantown Utility Board), home aeration units, septic systems, straight pipes, package plants**	**Yes. Majority of homes and businesses in watershed are hooked up to septic systems/straight pipes/HAUs. High bacteria levels documented.**
M-8 (146)	Deckers Creek RM 5.5 to 6.1	Urban, suburban, agriculture	Centralized (Morgantown Utility Board), septic systems, straight pipes	No. All but a few homes and businesses in SWS are connected to centralized systems.
M-8-A.7 (19)	**Deep Hollow**	**Suburban, forest**	**Centralized (Deckers Creek PSD), home aeration units, septic systems, straight pipes**	**Yes. Majority of homes and businesses in watershed are hooked up to septic systems/straight pipes. High bacteria levels documented.**

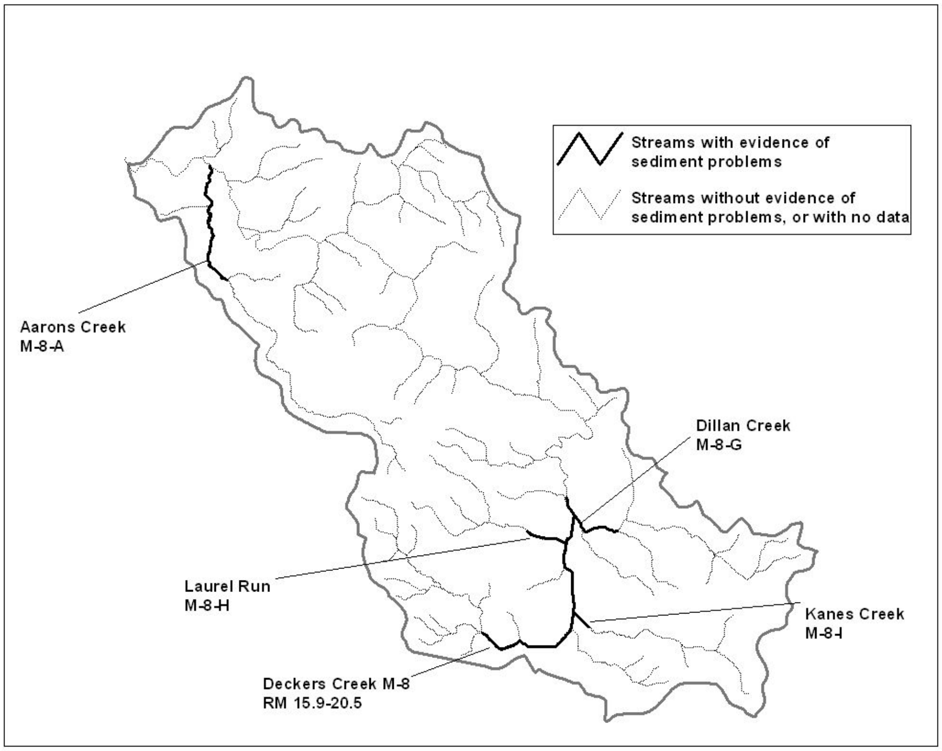
Table 13: Overview of wastewater assessment, *continued*

Stream code (SWS)	Stream names	Major land uses	Wastewater treatment	Focus for assessment
M-8-B (21)	**Tibbs Run**	**Suburban, forest**	**Centralized (Deckers Creek PSD), septic systems, straight pipes, HAUs, package plants**	**Yes. Many homes in watershed are hooked up to septic systems/straight pipes/HAUs. Package plant in headwaters with known violations. High bacteria levels documented.**
M-8 (147, 148)	**Deckers Creek RM 6.1 to 13.1**	**Forest, suburban, industrial/mined land**	**Home aeration units, septic systems, straight pipes**	**Yes. Majority of homes are connected to septic systems or straight pipes.**
M-8-D (17)	Glady Run	Forest, agriculture	Septic systems, straight pipes	No. Agriculture and low development. Difficult to separate impacts from agriculture vs. wastewater.
M-8 (22, 23, 24, 96, 97, 98, 99, 100, 101, 102)	Deckers Creek RM 13.1 to 18.2, Laurel Run, UNTs/Deckers Creek	Forest, agriculture, suburban	Centralized (Reedville/Masontown sewer system) , septic systems, straight pipes	No. Low development, majority of houses are connected to mainline systems, and high levels of agriculture would make it difficult to determine exact sources of fecal bacteria.
M-8-G (15, 16, 207, 208)	Dillan Creek	Forest, agriculture, suburban	Centralized (Reedsville/Masontown sewer system, septic systems, straight pipes	No. Low development, majority of houses are connected to mainline systems, and high levels of agriculture would make it difficult to determine exact sources of fecal bacteria.
M-8-I (205, 206)	**Kanes Creek**	**Forest, agriculture, suburban**	**Centralized (Reedville/Masontown sewer system), septic systems, straight pipes, package plants**	**Yes. Known failing septic systems in the headwaters region.**
M-8 (103, 209, 210)	**Deckers Creek RM 18.2 to 23.7**	**Forest, agriculture suburban**	**Centralized (Reedsville/Masontown sewer system), home aeration units, septic systems, straight pipes, package plant**	**Yes. Limited data in the headwaters region. Known problem areas.**

3.4. Sediment

No segments are listed as impaired by sediment. However, Aarons Creek has embedded rocks, suggesting possible sediment input, possibly from inadequately controlled construction practices and unstable stream banks. In addition, six miles of stream channels were dredged and straightened as part of the flood protection project in the upper part of the watershed. These channels are prone to streambank erosion. FODC has observed relatively high turbidity, grassy chunks of streambank in the stream and moving sand in the streambed even at average flows along much of the channelized stretch (Figure 4).

Figure 4: Location of stream segments that may be impaired by sediment


Streams with evidence of sediment problems
Streams without evidence of sediment problems, or with no data
Aarons Creek
M-8-A
Dillan Creek
M-8-G
Laurel Run
M-8-H
Kanes Creek
M-8-I
Deckers Creek M-8
RM 15.9-20.5

4. MEASURES FOR ELIMINATING NONPOINT SOURCE POLLUTION

Eliminating nonpoint source (NPS) pollution in the Deckers Creek watershed will require a large team of cooperating entities to implement a wide range of pollution control measures. The Deckers Creek Restoration Team (DCRT) or a similar entity will lead the efforts to address the pollution sources addressed by this plan.

4.1. Acid mine drainage

4.1.1. Remediation

AMD can be eliminated by active or passive methods. The most common active water treatment is one of a number of devices that add an alkaline material to the AMD, such as hydrated lime or pebble quicklime, followed by a settling pond where metals precipitate out of solution and form sludge. Passive treatment methods include land reclamation, in which a surface mine, a refuse pile, or spoil are landscaped to prevent contact between pyrite and water. Passive treatment also includes a number of water treatment measures (Table 14) in which AMD is neutralized by contact with limestone or other alkaline materials.

Watzlaf et al. (2004) match different passive treatment methods with different kinds of AMD according to chemistry. Net alkaline drainage should be treated with aeration ponds. Net acidic water with concentrations of Al, iron in the ferric state and dissolved oxygen concentrations no greater than 1 mg/L may be treated with anoxic limestone drains (ALDs). Net acidic water with Al, ferric iron or dissolved oxygen concentrations greater than 1 mg/L require a reducing and alkalinity producing system (RAPS). In such systems, also known as successive alkalinity producing systems (SAPS) or vertical flow ponds (VFPs), water is allowed to seep through a compost layer which strips it of oxygen, and reduces ferric iron to the ferrous state. In a second reactor, the anoxic water reacts with limestone to neutralize any acidity present, and to add alkalinity to offset the acidity generated as iron oxidizes and precipitates from solution. In the last reactor, water is allowed to take on oxygen, allowing iron to oxidize and precipitate out of solution. Deep mine sources in the Deckers Creek watershed usually contain too much Al, ferric iron and oxygen and are generally unfit for ALDs. They will require RAPSs for treatment.

In addition to several RAPSs, treating AMD in the Deckers Creek watershed will rely on land reclamation, wet seals, OLCs, and in at least one case, active treatment.

4.1.2. Prevention

In recent years, OSM and WVDEP have observed a policy of refusing permits to mines that are likely to create perpetual AMD problems. New permit applications are stretching the boundaries of this policy. It is the most important safeguard preventing additional AMD pollution.

4.1.3. Agents

Passive mine drainage remediation entails a number of tasks and roles, including planning, site evaluation, funding, conceptual design, engineering design, project management, maintenance and monitoring. A number of organizations and state and federal agencies are committed to filling these roles (Table 15).

There is little funding available for operating and maintaining active treatment facilities, which will be needed at the Richard Mine (PA 3738). Active treatment expenses include the cost of chemicals, energy to mix them into the AMD, disposal of the sludge, maintenance, and labor. FODC and DCRT are seeking ways to generate operations and maintenance funds for active treatment.

Table 14: Passive AMD treatment methods

Method	Function	Notes	Size guideline
Aerobic Wetland	Allows water to aerate, causing metals to precipitate from solution	Used for net alkaline discharges	Removes 5 g iron m^{-2} day^{-1}
Anoxic Limestone Drain (ALD)	Water that has little oxygen is allowed to flow through limestone	Suitable water is rare in the Deckers Creek watershed	According to retention time or total amount of acidity to neutralize
Compost Wetland	Contains anaerobic zone that generates alkalinity through sulfate reduction	Alkaline material is required in compost to maintain environment suitable for sulfate reduction	RAPS or SRS are usually preferred
Grouting	Material is pumped into a mine and allowed to harden, creating a barrier to water flow	Most examples show high costs and low to moderate success	According to mine geometry
Manganese Removal Bed (MRB)	Removes Mn from water	Used when Al and Fe have already been removed	Size for 24-hour hydraulic retention time
Open Limestone Channel (OLC)	Controls water path, prevents seepage back into spoil, neutralizes some acidity	Cheap to construct, acidity neutralization not completely understood. Wide construction rights of way distasteful to some landowners	Length set by distance water must be conveyed. Width set according to volume of water to transport.
Reducing and Alkalinity Producing System (RAPS)	In sequential reactors, water is stripped of oxygen, ferric ion is reduced to ferrous, acidity is neutralized with limestone, and reoxidation allows precipitation of iron	Also known as sequential alkalinity producing system (SAPS) or vertical flow pond (VFP)	Size to neutralize 25 g acidity m^{-2} day.
Sulfate Reducing Bioreactor	Compost and alkaline material are combined in a single bed. pH is kept neutral in anaerobic zone, promoting alkalinity generation by sulfate reduction	Relatively new, a limited number have been built for water typical of AMD in Deckers Creek watershed	Sized to remove 0.3 moles of metals or of sulfate per cubic meter of substrate per day
Wet seal	Path from underground to above ground is constrained, usually to a pair of PVC pipes	Controls where water flows, also prevents access to mine	According to flow

Table 15: Agents and their roles in AMD remediation in the Deckers Creek watershed

Agent[a]	Site ID	Plan[b]	Funds	O&M	Design[c]	Project Management[d]	Notes
DCRT	X	X	-	-	C	-	Includes all cooperating entities
Local governments	TBD	TBD	TBD	TBD	-	-	Town and city councils and county commissions will participate as they see fit
MRCD	X	X	-	TBD	C	-	Small O&M role, most likely related to vegetation maintenance, is possible
NRCS	X	X	X	-	C,E	X	Can fund design and construction through PL566 funds; has design and project management expertise
WVCA	X	X	-	TBD	C	-	Contributes expertise in water resource management and coordination with NRCS and conservation districts
OAMLR	X	X	X	X	C,E	X	Can plan, design and execute projects using AML Trust Fund disbursements; can participate in O&M through set-aside fund
OSM	-	X	X	-	C,E	-	Makes WCAP funds available
WVU	X	X	-	-	C	-	Has extensive expertise in AMD remediation
DWWM	X	X	X	-	C,E	X	Manages 319 funds disbursed to state
Landowners	X	X	-	TBD	C	-	Permit all activities on their land, may play role in monitoring condition of treatment measures
FODC	X	X	-	TBD	C	TBD	Convenes DCRT to ensure all remediation activities go forward. May raise funds and play large O&M role

[a]See List of Abbrevations. [b]Planning includes developing conceptual designs, writing proposals for funding, and distributing responsibility for other remediation tasks. [c]C indicates conceptual design, E indicates engineering design. [d]Includes running a bid to select a contractor, inspecting work and completing all financial transactions and reporting. Key: X: will play a role; TBD: role to be determined.

4.2. Lead

Although the source of lead pollution in the Deckers Creek watershed, and particularly in the watershed of the UNT/Deckers Creek RM 18.6, is probably foundry waste used as fill, there is not enough information available to determine the best measures for eliminating inputs to the streams. The largest source could be the waste materials themselves, organic matter or sediments stored in the impoundments of the subwatershed which have absorbed the lead over the years, or other materials. The most important immediate measure will be additional research to determine sources of lead. Once that effort is complete, measures may include removal of the foundry waste, eliminating water flow through the material, or other measures.

Further problems with heavy metals are unlikely because foundries no longer operate in the watershed, because foundries generally use processes that generate less waste, and because of much stricter regulation than in the time when the foundry operated.

Research to narrow down the source of the lead pollution will be required before any remediation can take place. WVDEP has slated completion of a TMDL for lead pollution in UNT/Deckers Creek RM 18.6

for 2017 (WVDEP, 2004). Hopefully, WVDEP and DCRT can accomplish much of the research well before the 2017 target date.

4.3. Fecal coliform bacteria

Given the available data this section focuses on reducing fecal coliform bacteria by addressing wastewater. Before other sources of fecal coliform bacteria can be addressed, more data will have to be collected to determine the location of other pollution sources contributing to fecal coliform bacteria impairment. However, some suggestions for addressing fecal coliform bacteria from non-wastewater sources are presented at the end of this section.

The Deckers Creek wastewater assessment has determined that at least 6 tributaries and 19.1 miles of the mainstem are likely violating water quality criteria for fecal coliform bacteria due to wastewater. While some of this pollution can be attributed to point sources such as CSOs and poorly maintained package plants, nonpoint sources of pollution also contribute to the wastewater pollution in Deckers Creek. Nonpoint source wastewater pollution can be attributed to inadequate wastewater treatment caused by a number of different factors including poor soils, insufficient drain field size, leaking or broken septic tanks or drain fields, and proximity of drain fields to waterways. In turn, these physical problems may be traced to various predisposing factors in the watershed, such as, low income levels, low population densities, and distance of housing clusters from centralized systems.

4.3.1. Remediation

Many different decentralized and onsite wastewater treatment systems can be utilized to address the wastewater needs of the targeted watersheds, as well as any other wastewater pollution sources identified in the future. The Upper Guyandotte River Watershed Based Plan (UGWA, 2006) describes the following systems.

> “Note: … [This section] draw heavily from *Helping Solve Local Wastewater Problems: A Guide for WV Watershed Organizations*, pg 16-32. WV Rivers Coalition 2005” (UGWA, 2006, p.30).

4.3.1.1. Individual Onsite

> “Where space and soil conditions allow, traditional onsite treatment systems serving a single home or business are the simplest and most cost-effective option. Space constraints often preclude the use of individual onsite systems in communities located in narrow valleys. Nevertheless, onsite systems are the preferred wastewater treatment method for many communities, particularly those in more isolated areas and those located along ridge tops” (UGWA, 2006, p.30).
>
> “Onsite systems commonly consist of a septic tank and a subsurface wastewater infiltration system (or treatment field). The septic tank allows solids to settle out and grease and “scum” to float to the top. The effluent from the tank is then transported, typically by gravity, to the treatment field. The treatment field disperses the effluent and allows it to be absorbed and purified by the soil. Conventional treatment fields consist of perforated pipes lain in gravel-filled trenches. Additional treatment technologies (as detailed below) may be necessary on some lots in order to ensure effective treatment” (UGWA, 2006, p.30).

4.3.1.2. Cluster Systems

> “Cluster systems utilize the same treatment technologies as do individual onsite systems…. [But, u]nlike individual onsite, cluster systems are shared by two or more homes and may use small (4

inch) diameter pipes to transport, typically by gravity, septic tank effluent to a common treatment field. (Shallow-burial collection systems may use even smaller-diameter, light-weight pipe in longer lengths in order to minimize joints.) Additional treatment technologies (as detailed below) are necessary in some communities in order to ensure effective treatment. When space and soil conditions allow, multiple cluster systems can be installed in order to serve as many homes as possible in the community" (UGWA, p.30, 2006).

Low Pressure Pipe (LPP)

"Low pressure pipe systems use a pump or siphon to pressure dose effluent to a treatment field. Pressure dosing forces the effluent completely through the pipe system and creates a more equal distribution of effluent through the field. (A pump typically achieves a more uniform distribution than does a siphon). Also, dosing the field a few times a day allows for resting, more time for the effluent to percolate through the soil, and more chance for oxygen in the soil to rejuvenate the treatment field" (UGWA, 2006 p.30).

"LPP systems are typically slightly more expensive than conventional fields because of the pump or siphon and the extra tank each device uses. However, these systems have many advantages. They can be installed on upslope sites, on sites with high groundwater tables or bedrock, and in soils with slow percolation rates. When used on sites with high groundwater, some additional treatment of the effluent may be required" (UGWA, 2006, pp.30-31).

Drip Dispersal

"Drip dispersal systems, or drip irrigation, also use pumps to pressure dose effluent to a subsurface absorption field. However, in this case, small flexible tubes with emitters are used to force the effluent into the soil. Because the tubes and emitters are so small, a filter is typically installed after the pump to remove most of the solids" (UGWA, 2006, p.31).

"Installing drip tubes is relatively easy; they can be placed at a depth of 12-18 inches below the soil using a small plow. This ease of installation allows for the utilization of unconventional treatment fields such as forested or rocky sites, sites with high bedrock or groundwater tables, or sloping sites. They do require a sophisticated pumping and control system, which adds to the cost. Most designers also recommend additional treatment beyond a septic tank before using drip dispersal. However, for cluster systems, the cost per house drops rapidly because of the low cost of installation" (UGWA, 2006, p.31).

Pretreatment

"At some sites, septic tank effluent requires additional treatment before entering the treatment field. One of the most reliable and effective pretreatment systems is the recirculating media filter. In a recirculating media filter, microorganisms are attached to a fixed media and the effluent passes over the media. A variety of materials can be utilized for the media including sand, peat, or textiles. Effluent percolates through the media, is collected by an underdrain, and recirculates for additional treatment. A once-through variation of this approach is the intermittent sand filter. In an intermittent sand filter, the septic tank effluent is similarly spread evenly over the surface of the sand, ground glass, or peat at a lower loading rate, is collected by an underdrain and discharged to the treatment field" (UGWA, 2006, p.31).

4.3.1.3. Decentralized - Collection Systems

Septic Tank Effluent

"When decentralized community systems are employed, a septic tank effluent system is the preferred collection system for many communities. These systems are economical solutions for small, dense communities, where lot size, soil conditions, depth to bedrock, groundwater, or other constraints prevent a straightforward onsite approach" (UGWA, 2006, p.31).

"In this type of collection system, properly sized septic systems are installed at each home and/or business. The septic tank collects the solids and the effluent from the tank then enters the collection system. The collection system consists of shallowly buried, small diameter pipe. The effluent is transported through the system by gravity or, when necessary, small pumps. When gravity flow and 4-inch pipes are utilized the system is referred to as Septic Tank Effluent Gravity or STEG; when pumps and 2- or 3-inch pipes are used the system is called Septic Tank Effluent Pumped or STEP" (UGWA, 2006, p.31).

"These small diameter sewers are advantageous and cost-effective because the need for constant slope, manholes, lift stations and their inherent capital and operation and maintenance costs are minimized. In addition, because the collection and on-lot piping system is sealed, inflow and infiltration is rare. Drawbacks include a more expensive on-lot component and the periodic need to access private property in order to pump and haul solids from the tank" (UGWA, 2006, p.32).

Vacuum

"Vacuum sewers also use small diameter pipes (typically 4-inch), but, unlike STEP or STEG, they use centrally-located pumps to generate a vacuum to pull sewage along rather than using pressure to force it through the mains. The onsite component for the system is a vacuum valve pit, which can serve 1 to 4 homes. The valve is actuated when enough sewage collects in the pit to allow the vacuum in the line to "suck" the collected sewage to the vacuum collection station. The collection station houses the vacuum pumps and storage tanks and pumps the sewage to the treatment plant" (UGWA, 2006, p.32).

"Vacuum sewers are capable of lifting sewage over high points and are advantageous for densely populated areas of 75 or more homes, in rolling terrain, and for areas with high bedrock or water tables. They are also capable of transporting solids, so there are no residuals left on site for periodic pump and haul operations. The valve pit is cheaper than a STEP connection, especially where multiple houses share a pit, but the vacuum collection station can be quite expensive" (UGWA, 2006, p.32).

Gravity

"Traditional gravity collection systems transport all the wastewater from a home or business to a treatment plant using a large diameter (8 inch and greater) pipe. In order for these systems to transport solids in addition to fluids, pipes must be installed at a certain slope to ensure scouring and movement of solids. Maintaining this slope moves the pipe deeper, which requires either deep excavations or lift stations to pump the waste back up toward the ground surface. Manholes are also required at set intervals and pipe junctions for maintenance purposes" (UGWA, 2006, p.32).

"Gravity collection systems are well understood, reliable and frequently chosen because engineers and designers have little experience with alternative sewers. However, a high capital cost often makes them cost prohibitive in rural areas of low population density and they have been selected as the preferred treatment type in only a limited number of communities. Because of their depth, high number of pipe joints, leaking manholes, poor on-lot lateral construction and insufficient inspection (which often results in illegal "clear water" entry), they are also subject to extensive infiltration and inflow…" (UGWA, 2006, p.32).

4.3.1.4. Decentralized - Treatment Systems

Community Treatment Field

"When space and soil conditions allow, a single treatment field can be used to serve an entire community. If state codified site criteria can be met, treatment fields offer very high treatment efficiency in removing total suspended solids (TSS), biological oxygen demand (BOD), phosphorus, and microbiological contaminants. These subsurface wastewater infiltration systems typically demonstrate 99% efficiency in removing pollutants from wastewater (USEPA, 2002) and the design is based on the same principles as in onsite systems…. Additional treatment technologies… may be necessary in some communities in order to meet code requirements and ensure effective treatment. In order to protect water quality, treatment technologies utilizing subsurface dispersal are preferred" (UGWA, 2006, pp.32-33).

Package Plant

"Package plants utilize the same treatment technology as do large, centralized wastewater treatment facilities…, but on a smaller scale. Unfortunately, the same level of skilled operation is required for both" (UGWA, 2006, p.33).

"Package plants can treat wastewater to secondary levels (30 mg/L of BOD and TSS) and typically demonstrate 90% efficiency in removing pollutants from wastewater. They must be followed by disinfection to meet surface discharge requirements for pathogens, and must be augmented in order to perform significant nutrient (nitrogen and phosphorus) removal" (UGWA, 2006, p.33).

"They are the preferred treatment system only for communities where a subsurface discharge is not feasible. Because package plants result in a surface discharge which requires a NPDES permit, Section 319 funding will not be sought to implement these projects" (UGWA, 2006, p.33).

4.3.1.5. Centralized Systems

"Traditional, centralized wastewater collection and treatment systems pipe wastewater from a large number of homes and businesses to a central place for treatment. …Treatment plants are sized according to the volume of wastewater they handle. During primary treatment, solids and fluids are separated and aerobic bacteria treat the waste. Most facilities also use chlorine, UV light, or ozone to further disinfect treated effluent. Disinfected effluent is then discharged to a surface water body. Ultimately, the solids generated by the treatment facility must be removed from the system, treated if necessary, and disposed of by hauling to a sewage treatment facility or landfill or, more typically, via land application" (UGWA, 2006, p.33).

4.3.1.6. Prevention

As this watershed based plan is implemented, it is strongly suggested that proper operation and maintenance measures be put in place for new systems. "Adequate and capable management of wastewater treatment systems is critical to ensuring system performance and the protection of water quality and public health. If the options presented in this WBP are to be long-term, sustainable solutions, then proper maintenance of treatment systems is essential" (UGWA, 2006, p.33). Existing entities that could assist in the proper operation and maintenance of systems include:

- Deckers Creek Public Service District
- Morgantown Utility Board
- Home Owner Associations
- County Health Departments

- Local Utility Companies

4.3.2. Agents

To implement this Watershed Based Plan, strong partnerships with local agencies and adequate funding will be needed. DCRT will seek advice and technical and financial assistance from several quarters to address wastewater sources. DCRT will approach home and business owners, West Virginia Department of Health and Human Resources, WVDEP, extension agents, county sanitarians, local public service districts, Morgantown Utility Board, and the National Small Flows Clearinghouse to form partnerships and to find funding for failed septic systems and straight pipes.

DCRT will approach landowners, the Natural Resources Conservation Service (NRCS), the West Virginia Conservation Agency (WVCA), the Monongahela Resource Conservation District (MRCD), and extension agents for solutions to fecal coliform pollution by livestock. Point source dischargers are also expected to decrease unpermitted discharges. Prevention of additional fecal coliform pollution will depend on the vigilance of citizens, citizens' groups, and WVDEP.

4.3.3. Remediation of Other Bacteria Sources

Other likely nonpoint sources of fecal coliform bacteria pollution include livestock and wildlife. While wildlife sources of fecal coliform bacteria are difficult to control, livestock sources of fecal coliform bacteria pollution can be addressed though a number of methods including, but not limited to,:

- fencing livestock out of streams,
- creating permanent riparian zones, making them inaccessible to livestock,
- construction of ponds to collect pasture runoff, and
- construction of sheds to hold animal waste.

4.4. Sediment

Further monitoring to identify sediment sources as well as research on sediment control methods are required to determine appropriate control measures for this NPS pollutant. Streambank stabilization, in-stream structures, natural stream design and streamside buffer strips are likely to be a part of the solution. Citizens' groups and WVDEP are expected to prevent additional sources of sediment to the creek. WVDEP, FODC, NRCS and possibly the Canaan Valley Institute will begin the process of solving the current sediment input problems.

5. LOAD REDUCTIONS AND COSTS FOR ACID MINE DRAINAGE NONPOINT SOURCE POLLUTION

5.1. Load reductions

This section compares loads of pollutants detected in streams to loads of pollutants known to come from specific AMD sources. Because loads vary with different hydrological conditions, matches between source loads and stream loads are only approximate. Field observations of changes in water quality above and below pollutant sources provide evidence that remediation of those sources will benefit the streams. The TMDL (USEPA, 2002) and the 303(d) list (WVDEP, 2004) suggest where projects are needed, but they do not match perfectly. The TMDL calls for reductions in some subwatersheds with unimpaired stream segments, and does not call for reductions in some subwatersheds with impaired segments. Table 16 provides an overview of how such discrepancies are resolved in this WBP.

Measurements needed to compare source loads with in-stream loads are available in only a few cases. Furthermore, when multiple in-stream load estimates are available, they frequently differ by orders of magnitude. Nevertheless, in all the subwatersheds for which source and in-stream load measurements are available, the planned reductions achieve the loads in the TMDL for at least one set of measurements (Table 17). This success is taken as evidence that the inventory of sites is close to complete, and that the high-priority sources in less data rich subwatersheds have also been identified. Note that several subwatersheds have already met TMDLs according to some of the measurements. Nevertheless, observations continue to confirm that they are impaired and require remediation.

Eight segments are impaired with regard to Mn (WVDEP, 2004). However, many of the subwatersheds achieve or almost achieve the Mn target loads, or may achieve them after the benefits of current treatments are measured. In particular, Kanes Creek and three direct drain subwatersheds to Deckers Creek meet their Mn targets (Table 17). According to FODC data, however, UNT/Kanes Creek RM 2.6 violates the Mn standard. This stream was not listed at the time the TMDL was written. Although Deep Hollow, the tributary to Deckers in Dellslow, exceeds its load allocation, the improvements from water treatment at a BFS have not yet been measured. Effects on Al and Fe loads, as well as Mn loads, of passive treatment installations on Slabcamp Run and Dillan Creek have also not been measured. Treatment measures for Mn are proposed only for UNT/Kanes Creek RM 2.6.

The following sections describe each subwatershed containing high or low-priority AMD sources.

Table 16: Actions planned in each subwatershed described by the TMDL

Subwatershed[a]	Stream segment	TMDLs[b]	Number of major sources or alternative plan
Reductions required and streams impaired			
17	Glady Run	Al Fe Mn	1 major source
19	Deep Hollow	Al Fe Mn	1 major source
20	Deckers, Deep Hollow to Aarons Creek	Al Fe	1 major source
23	Slabcamp Run	Fe Mn	Monitor effects of recently installed project
24	Deckers Creek, Back Run to Glady Run	Fe	No major sources
99	Deckers Creek, Slabcamp Run to Back Run	Fe	1 major source
102	Laurel Run, mainstem	Al Fe Mn	1 major source
149	Hartman Run	Al Fe Mn	2 major sources
206	Upper Kanes Creek	Al Fe	8 major sources
208	Upper Dillan Creek	Al Fe Mn	1 major source
Reductions not required, but stream impaired			
103	Deckers Creek, above UDCI #1		1 major source
Streams impaired, but no TMDLs allocated			
15	Lower Dillan Creek and UNT RM 0.3		No major source
96	Deckers, Kanes Creek to Laurel Run		“
97	Deckers, Laurel Run to Dillan Creek		“
98	Deckers, Dillan Creek to Slabcamp Run		“
146	Deckers, Tibbs Run to Deep Hollow		“
147	Deckers, UNT RM to Tibbs Run		“
148	Deckers, Glady to UNT RM		“
150	Deckers, Aarons Creek to Hartman Run		“
196	Lower Deckers Creek		“
197	Lower Deckers Creek		“
198	Lower Deckers Creek		“
205	Lower Kanes Creek		“
207	Dillan Creek RM 1.0 to 1.7		“
209	Deckers, RM 18.6 to UDCI #1		“
Reductions required, streams not impaired, no action currently planned			
18	Aarons Creek	Fe	Iron may not be from AMD
21	Tibbs Run	Fe	Occasional Al violations
210	UNT/Deckers Creek RM 18.6	Fe	No impairment from AMD
No reductions required, stream not impaired			
16	UNT/Dillan Creek RM 1.0		
22	Back Run		
101	UNT Laurel Run RM 1.6		

Notes: [a]See USEPA, 2002, Appendix 6 for location of subwatersheds. [b]Metals for which load allocations are established in USEPA, 2002.

Table 17: Load measurements (lbs/yr) from the TMDL and other sources, target loads, source loads, and possible reductions

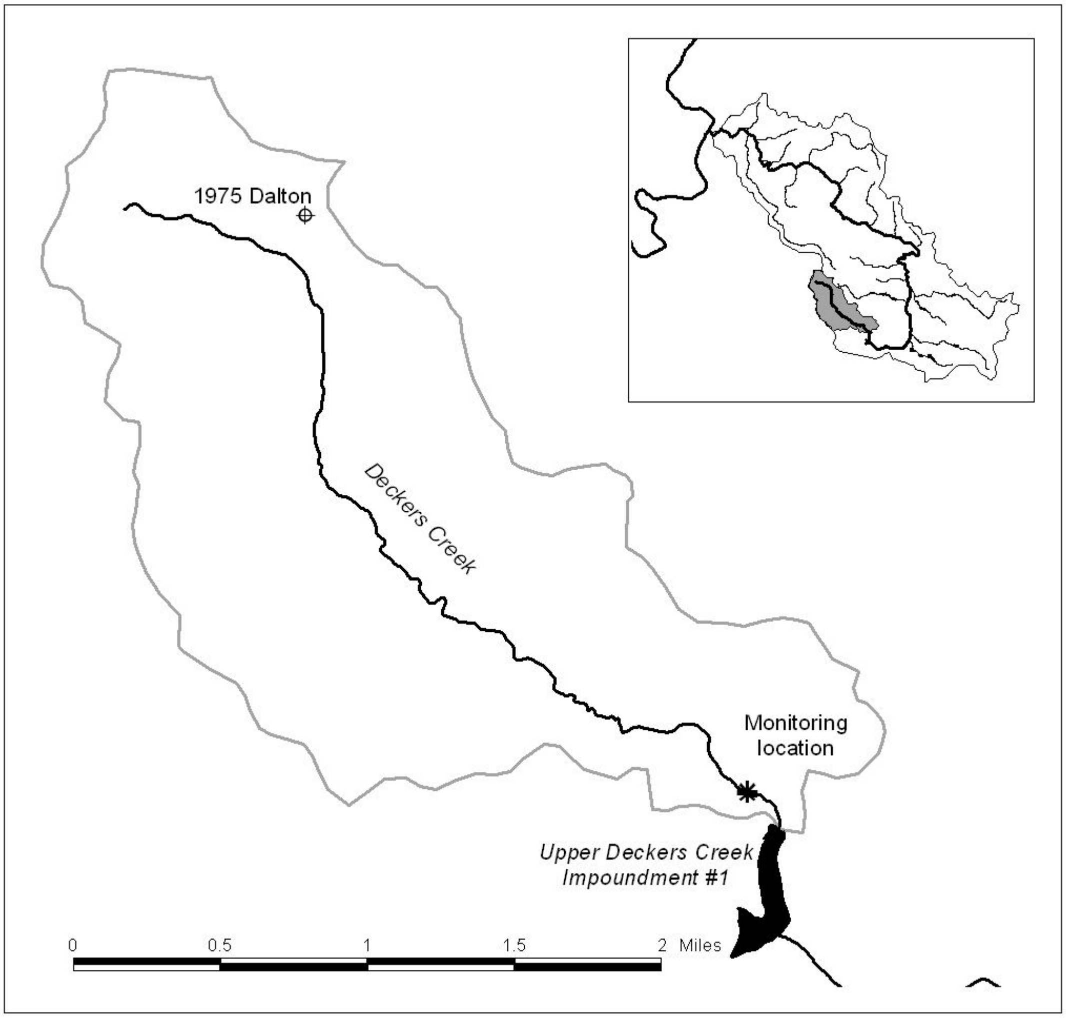
Watershed	Metal	Loads		Target[a]	Source Loads[c]	Range following remediation[d]
		TMDL[a]	*Range*[b]			
Deckers Creek	Al	1,410	1,410-4,625	1,410	130	1,280-6,480
M-8, above UDCI #1	Fe	9,787	1,490-9,787	9,787	4	1,200-9,800
	Mn	694	423-1,000	694	70	417-1340
Kanes Creek	Al	11,791	9,226-33,102	2,437	15,677	0-17,425
M-8-I, SWS 206	Fe	52,987	14,975-52,987	7,516	15,222	0-37,765
	Mn	2,633	2,633-9,072	2,633	178	0-6,381
Laurel Run	Al	41,530	2,541-41,530	3,214	NA	NA
M-8-H, SWS 102	Fe	197,754	4,128-197,754	10,943	NA	NA
	Mn	6,862	614-6,862	4,200	NA	NA
Dillan Creek	Al	8,014	7,398-20,115	1,648	13,800	0-11,580
M-8-G, SWS 208	Fe	40,838	4,366-40,838	8,629	5,100	0-36,410
	Mn	2,153	2,019-12,611	1,610	2,200	1,300-2,300[e]
Deckers Creek,	Al	424	NA	424	NA	NA
Slabcamp to Back Run	Fe	1,601	NA	1,528	NA	NA
M-8 RM 15.9-16.3, SWS 99	Mn	495	NA	495	NA	NA
Glady Run	Al	3,436	484-3,436	631	NA	NA
M-8-D, SWS 17	Fe	14,546	675-14,546	2,661	NA	NA
	Mn	1,019	174-1,019	706	NA	NA
Deep Hollow	Al	9,213	456-9,213	1,618	NA	NA
M-8-A.7, SWS 19	Fe	65,652	157-65,652	6,386	NA	NA
	Mn	2,682	150-4,282	2,293	NA	NA
Deckers Creek, Deep Hollow	Al	19,161	19,161-173,321	2,991	59,000	0-168,000
to Aarons (including Richard	Fe	70,269	70,269-545,092	7,485	143,000	0-143,000
Mine) M-8 RM 2.7-6.3,	Mn	3,271	3,271-25,520	3,271	3,200	420-15,000
SWS 20						
Hartman Run	Al	9,945	3,663-9,945	1,765	NA	NA
M-8-0.5A, SWS 149	Fe	46,109	1,200-46,109	5,811	NA	NA
	Mn	3,699	818-3,699	1,933	NA	NA

[a] From USEPA (2002). [b] From SRG (2004), Stewart and Skousen (2002b) or FODC (unpublished data). [c] From SRG (2004) or FODC (unpublished data). [d] Approximate range post remediation calculated as range before remediation minus 90% of source loads. [e] No Mn measures planned, TMDL current loads used for final loads

5.1.1. Deckers Creek above Reedsville Farm Pond (M-8 RM 21.2 to 24.7; SWS 103)

The uppermost 3.5 miles of Deckers Creek are mildly impaired by acid: the pH averages 5.8 (Christ, 2006). The one known source of AMD in this watershed, PA 1975, discharges 5 gpm with a pH of 4.5 (OAMLR files). Pollutant loads for that site have not been measured, but this watershed is close to meeting targets and any reduction in acid load should remove it from the 303(d) list. This watershed and this AMD source are given a high priority in order to ensure that the uppermost part of Deckers Creek achieves standards.

Figure 5: AMD sources to Deckers Creek upstream of the Reedsville Farm Pond (UDCI #1)



5.1.2. Unnamed Tributary to Deckers Creek at RM 18.6 (M-8-J; SWS 210)

The watershed of this 2.5-mile stream contains no AMLs and is not on the 303(d) list as impaired by acid mine drainage. pH values and Fe and Mn concentrations are all within standards, and Al concentrations average 0.14 mg/L (Stewart, 2000). There are several reclaimed mines in the Bakerstown coal seam. Such mines often discharge acceptable water after they are reclaimed, due to the layer of alkaline shale found above this coal seam. The TMDL calls for a reduction in Fe from a BFS of 11 lbs/yr, but the WVDEP has not shown any BFS on their inventory in this watershed (WVDEP, 2002). Because this tributary is so mildly impacted and has no clear AMD sources, no AMD remediation is planned here.

More information on this watershed and lead pollution in it appears in section 3.2.

5.1.3. Kanes Creek (M-8-I; SWS 205 and 206)

The Kanes Creek stream system consists of a 4.3-mile main stem with an impoundment from RM 2.3 to 2.5 and tributaries entering at RM 2.4, 2.6 and 3.2 (Figure 6). All of Kanes Creek and the UNT at RM 2.6 appear on the 303(d) list. FODC has documented that UNT RM 2.4 and UNT RM 3.2 are also impaired.

The Kanes Creek subwatershed contains seven high-priority and two low-priority AMD sources. Loads from five of the high-priority sources have been measured by FODC or by NRCS at the actual mine discharges. The sixth major sources is the watershed of Sandy Run (UNT/Kanes Creek RM 2.6). This watershed contains at least two substantial AMD sources, both of which are listed in the "Sandy Run Highwall, Portals" PAD. The importance of the last site, Hawkins mine drainage (PA 3455), is based on visual evidence (see photo below, from 2004).

According to the estimates of the sources and of the subwatershed loads in the TMDL, reducing the high-priority sources by 90% will bring loads of aluminum and manganese below the TMDL targets (Table 18). It is likely that sufficient iron will be eliminated as well because the TMDL appears to have overestimated loads compared to other measurements. Furthermore, the unquantified major source, Hawkins mine drainage, is the farthest downstream of all the sources, and may have strongly influenced the estimate of the watershed load.

Monitoring on the subwatershed, including the minor sources, will continue. In the event that load reductions for major sources do not bring the creek up to water quality standards, additional remediation work will be done at the minor sources (Table 19).

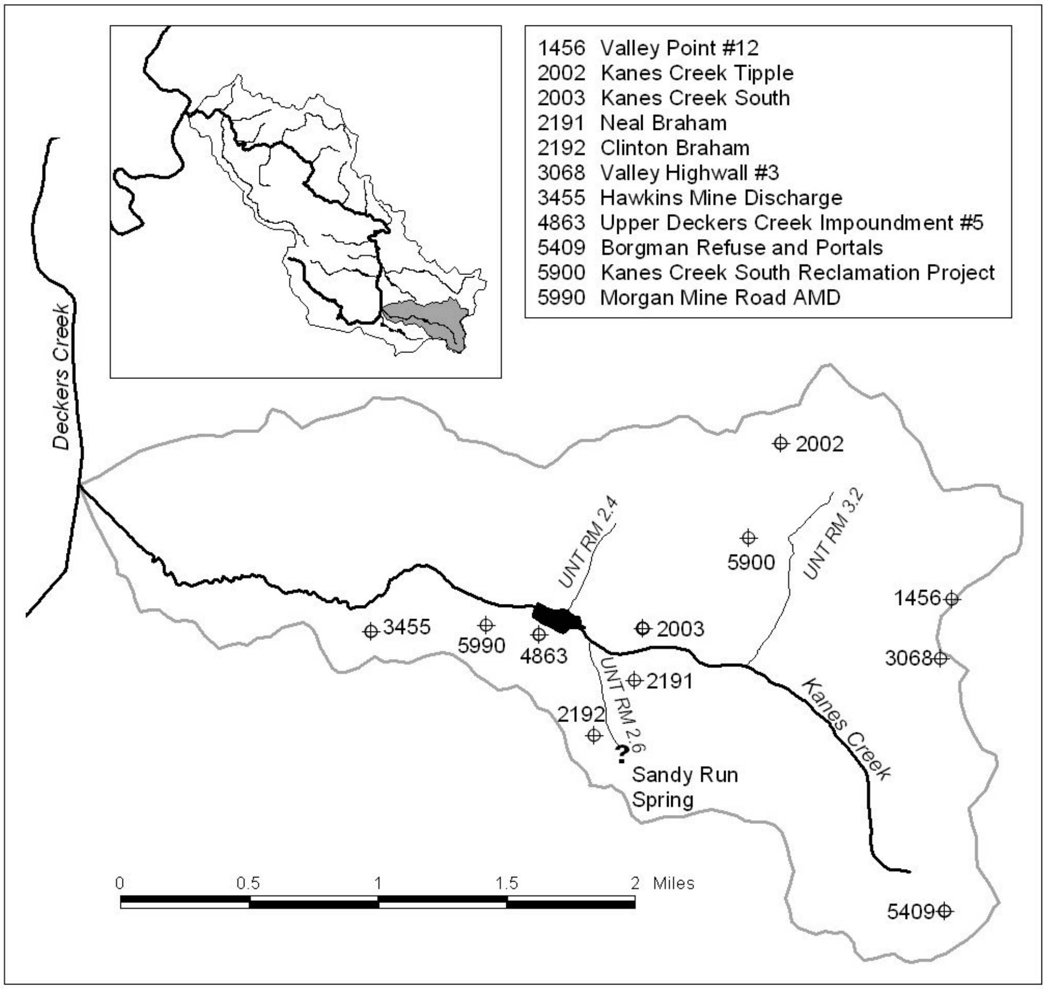
Table 18: Loads (lbs/yr) of AMD to Kanes Creek measured at the sources, and expected metal loads following remediation

	Al	Fe	Mn	Data source and notes
Major sources, measured loads				
Valley Point #12 (1456)	1,390	4,364	36	NRCS, FODC
Kanes Creek South, site 3 (2003)	2,635	3,486	161	FODC
Sandy Run Highwall, Portals (6088)	8,891	1,237	2,406	FODC
Kanes Creek Tipple (2002) = Kanes Creek South Site #1	816	2,920	44	FODC
Valley Highwall #3 (3068)	1,083	1,646	12	NRCS
Morgan Mine Road AMD (5990)	862	1,569	32	FODC
Major sources, unmeasured loads				
Hawkins Mine Discharge (3455)	-	-	-	No data
Total of major sources	**15,677**	**15,222**	**2,691**	
Effects of remediation				
TMDL current load	12,000	53,000	2,600	
Expected reduction (90% of major sources)	14,109	13,699	2,422	
Remainder	**0**	**39,301**	**178**	
Target from TMDL	**2,400**	***7,500***	**2,600**	

Table 19: Minor AMD sources in the Kanes Creek watershed

Source	Data source and notes
Borgman Refuse and Portals (5409)	This AML project has three sites, only one of which is in the Deckers Creek watershed. No load estimates for that site are available. OAMLR has begun to develop a remediation project for the site.
Upper Deckers Creek Impoundment #5 (4863)	OAMLR reclaimed this site and built a SAPS in 1996. Large flows from this site have not been observed in the last few years. Measurements from 1998-2001 suggest large loads that are inconsistent with recent observations. This site will be monitored and addressed if remediation at major sources fails to improve Kanes Creek

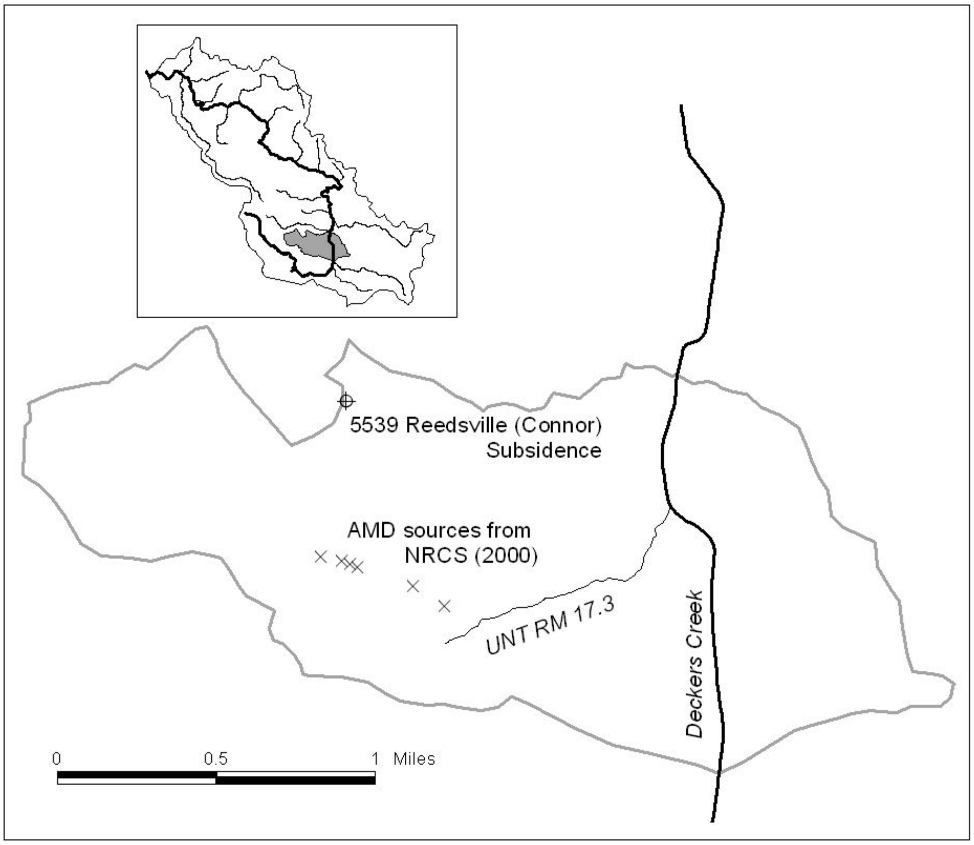
Figure 6: AMD sources to Kanes Creek



5.1.4. Deckers Creek from Kanes Creek to Laurel Run (M-8 RM 18.2 to 16.9, SWS 96)

According to the TMDL, sources in this subwatershed do not exceed any load allocations for AMD pollutants. NRCS (2000) identified Al, Fe and Mn sources of 730, 350 and 70 lbs/yr, respectively, to UNT/Deckers Creek RM 17.3, which is in this subwatershed, but measurements of that tributary near its mouth indicate that it does not contribute significant pollution to the mainstem of Deckers Creek. The pH averages 6.6, and Al, Fe and Mn concentrations average 0.2, 0.4 and 0.4 mg/L, respectively. The one AML in this subwatershed is a subsidence complaint with no description of AMD. The sources identified by NRCS may impair segments of the UNT, but the site receives a low priority for the remediation of the Deckers Creek watershed.

Figure 7: AMD sources in subwatershed 96, including UNT/Deckers Creek RM 17.3

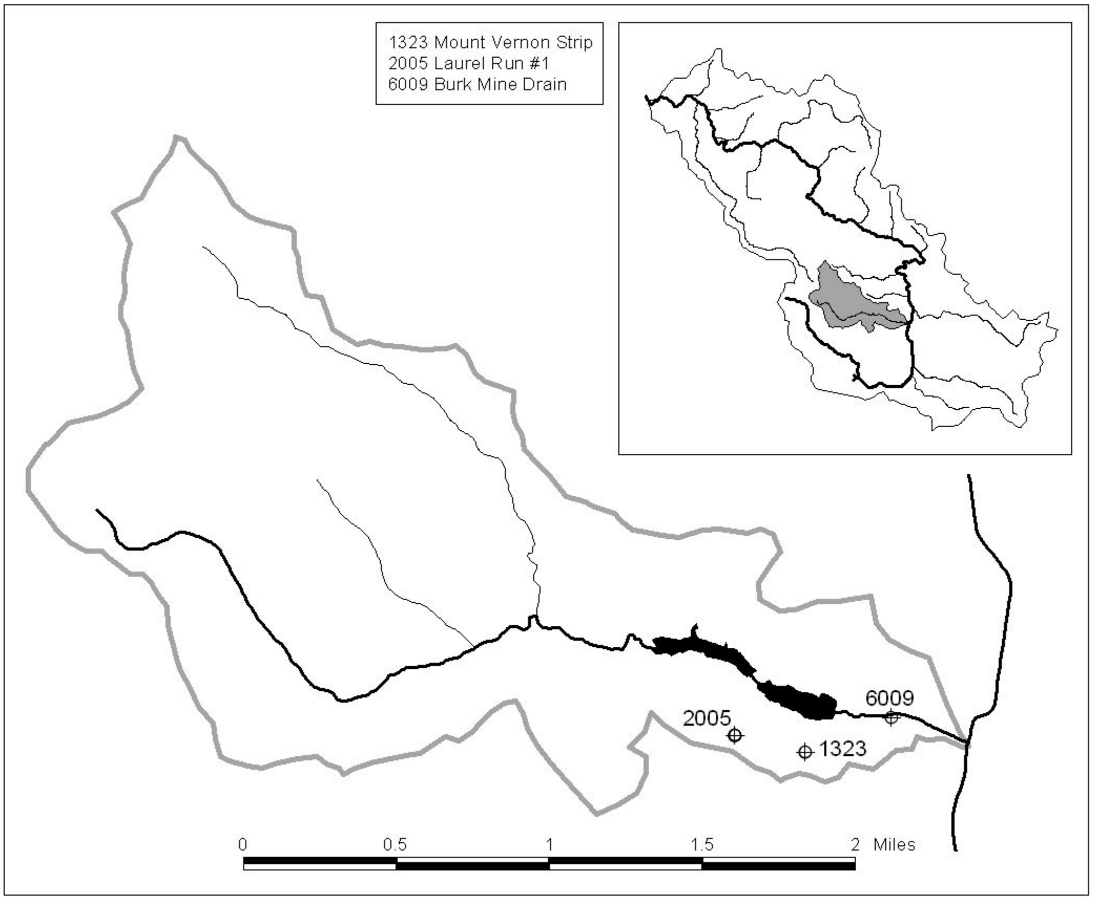


5.1.5. Laurel Run (M-8-H; SWS 100, 101 and 102)

The Laurel Run stream system consists of a 3.5 mile main stem with tributaries entering at RM 1.6 and 1.9 (Figure 8). There are also two impoundments on the mainstem. All tributaries enter above the known sources of AMD. The TMDL calls for a small reduction in Al and Mn loads to the segment above RM 1.6 (SWS 100), but cites no data sources for the conclusion (USEPA, 2002). The main stem passes three AMD sources, including Mount Vernon Strip (1343), Laurel Run #1 (2005) and the Burk Mine Drain (6009).

NRCS (2000) measured AMD loads from several sources associated with PAs 1343 and 2005. Those loads (595, 50 and 91 lbs/yr Al, Fe and Mn, respectively) account for a small fraction of the loads that have been measured at the mouth (Table 17). Those sources are therefore assigned a low priority. The difference is likely due to Burk mine drain (PA 6009), which is assigned a high priority.

Figure 8: AMD sources to Laurel Run

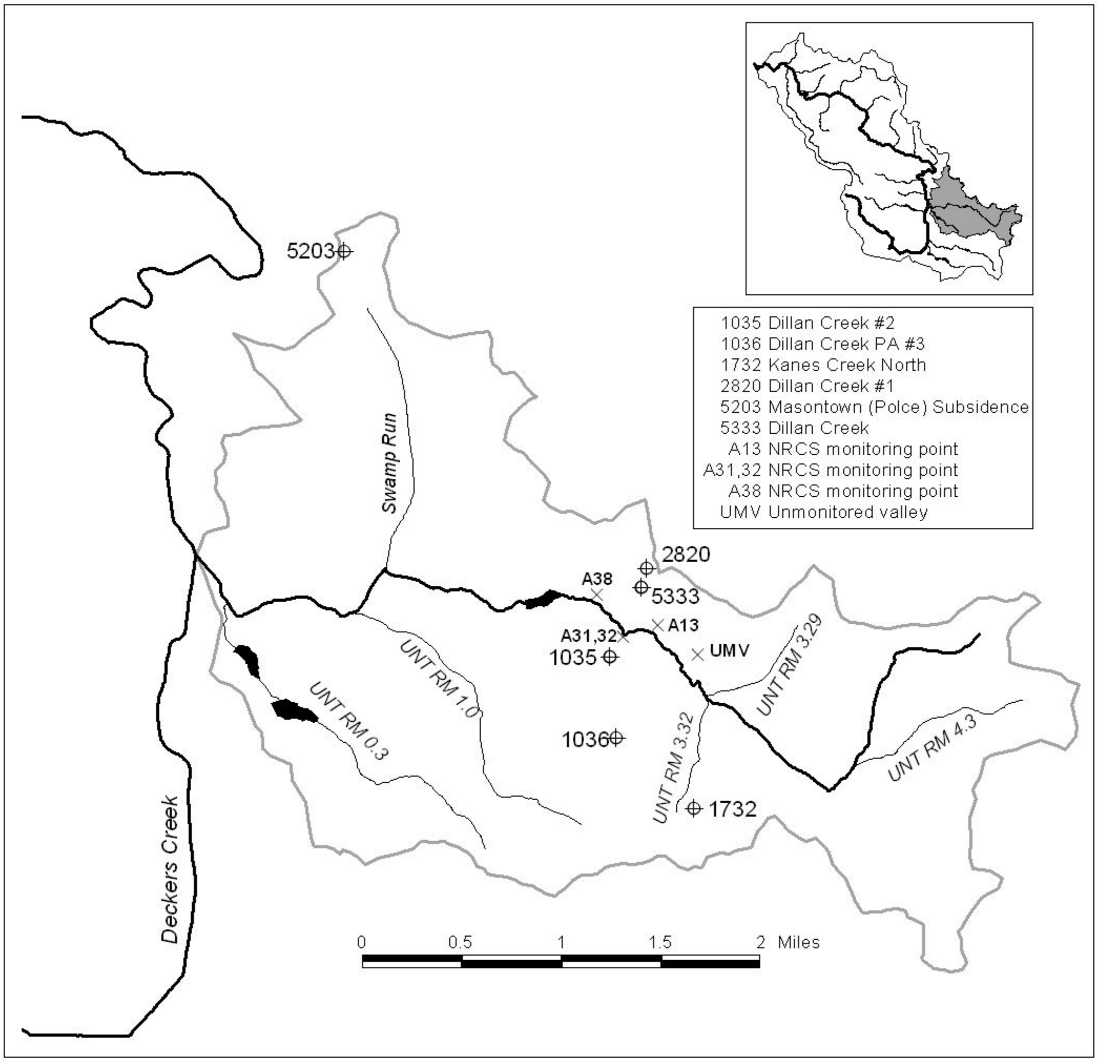


5.1.6. Dillan Creek (M-8-G; SWS 15, 16, 207, 208)

The 5.4 mile long mainstem of Dillan Creek encounters tributaries at RM 0.3, 1.0, 1.3 (Swamp Run), 3.29, 3.32 and 4.3 (Figure 9). There is a flood-control impoundment (Upper Deckers Creek Impoundment #4) from RM 2.1 to 2.3. Most of the AMD load is added to Dillan Creek between RM 2.1 and 3.1. At most times the AMD is neutralized as Dillan Creek joins with Swamp Run, a highly buffered stream draining a carefully reclaimed Bakerstown coal mine.

The AMD between RM 2.1 and 3.1 enters Dillan Creek from three small valleys on the north side and one on the south. OAMLR has reclaimed strip-mined land in the western most valley on the north side (A38 in Figure 9), and has eliminated a pond and placed some OLCs in two more. However, even after that work had been completed, AMD from these sources drives the pH of Dillan Creek from above 6 to below 4. One of these partially-reclaimed sources contributes Al, Fe and Mn loads of 11,000, 4,000 and 1,700 lbs/yr, respectively (see A13 on Figure 9, NRCS, 2000). The partially-reclaimed sources are assigned a high priority. A smaller source on the south side of Dillan Creek (see A31,32 on Figure 9) contributes only 110, 80 and 60 lbs/yr of Al, Fe and Mn, respectively (NRCS, 2000). NRCS has designed a plan to prevent surface water from entering acid forming materials at this site, and hopes to construct the project in 2006.

Figure 9: AMD sources to Dillan Creek

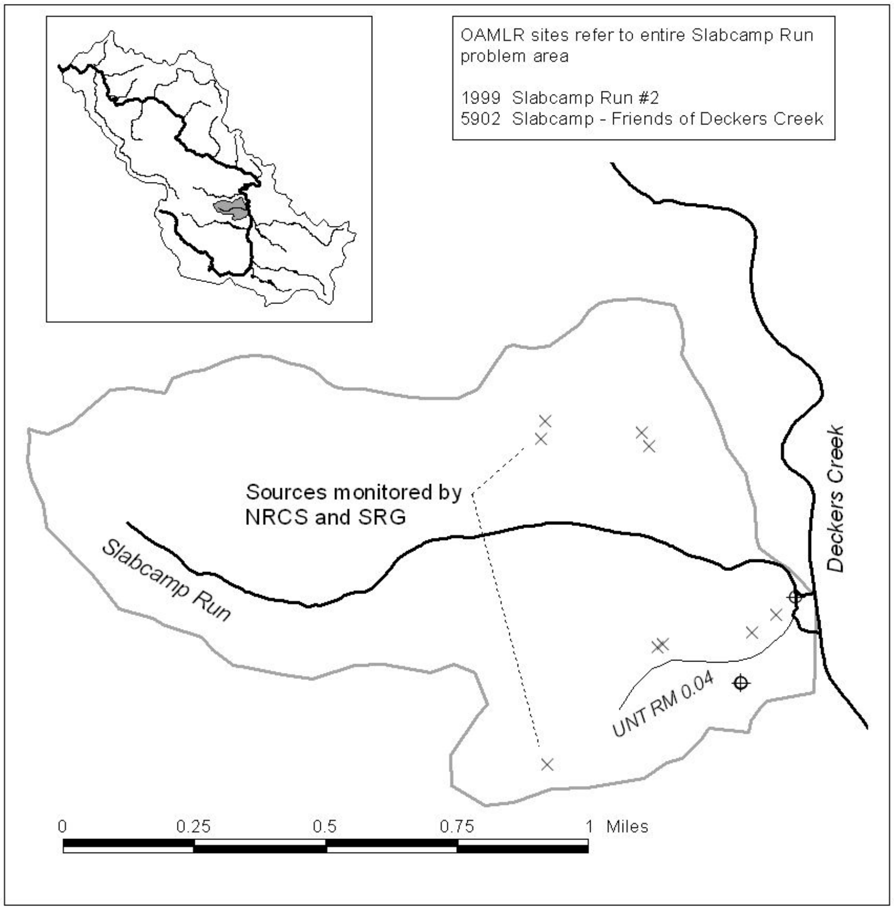


5.1.7. Slabcamp Run (M-8-F; SWS 23)

This 1.5-mile stream (

Figure 10) is small but extremely impaired. A tributary at RM 0.04 is also polluted. Slabcamp Run delivers some of the most concentrated AMD to Deckers Creek of all the tributaries. Most of the AMD flows from six portals and a few acres of spoil. OAMLR, with support from FODC and the Nonpoint Source Program in WVDEP, constructed measures to address this site in 2004 (Slabcamp Run #2, PA 1999). No further work on this site will take place until the remaining loads after the project are clearly documented. Ongoing monitoring is evaluating the effectiveness of the project.

Figure 10: AMD sources to Slabcamp Run



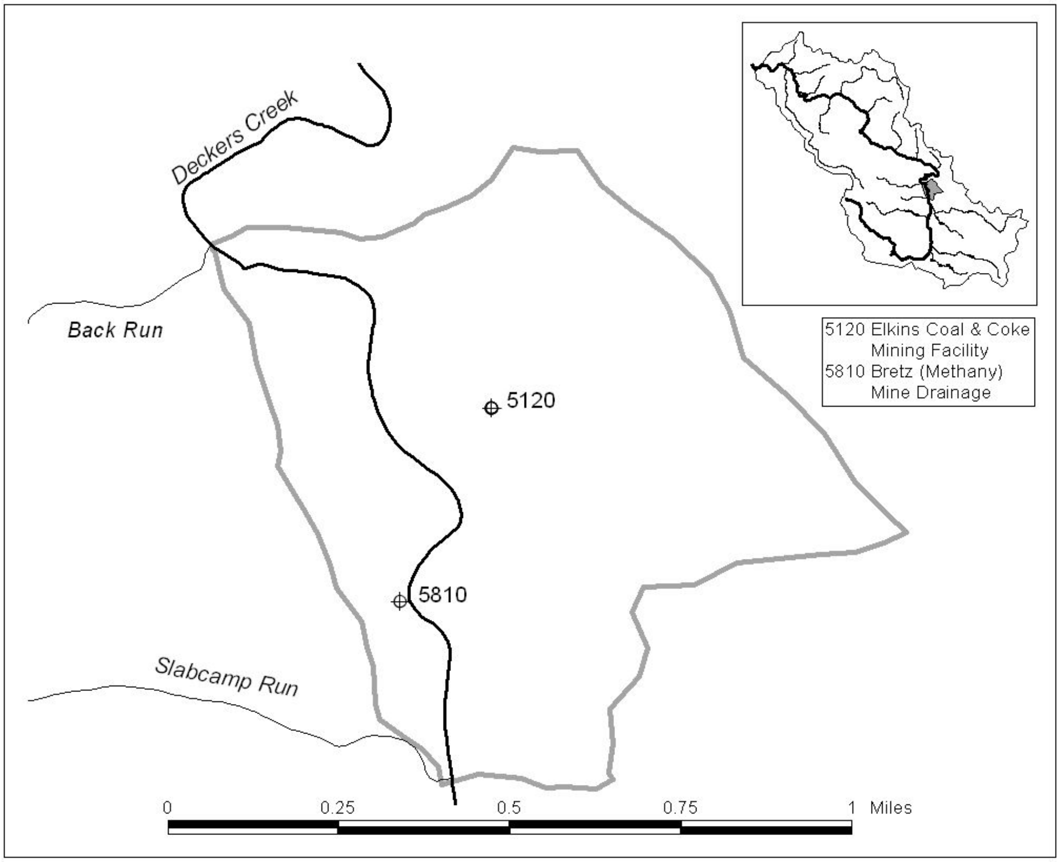
5.1.8. Deckers Creek from Slabcamp Run to Back Run (M-8 RM 14.9 to 15.9; SWS 99)

The TMDL calls for a small reduction in Fe loads from this subwatershed, and a much larger reduction in Fe loads from the next subwatershed downstream (Deckers Creek from Back Run to Glady Run, see section 5.9). However, the TMDL document sites no measurement records for subwatershed 99. It is therefore likely that loads requiring remediation calculated to lie in subwatershed 24 actually lie in subwatershed 99.

One major source has been identified in subwatershed 99. The Bretz (Methany) mine drainage (PA 5810) delivers concentrated AMD (pH ~2.8) from an underground mine. The volume of this flow has not been measured. Based on visual assessment, however, it is given a high priority. PA 5120 (Elkins Coal and

Coke) consists of a few mine entries and a large number of coke ovens. The site was reclaimed in 2002 by OAMLR. However, acid water still drains into the creek from a number of sites along the bank. Additional treatment at PA 5120 will await better determination of its AMD loads.

Figure 11: AMD sources to Deckers Creek between Slabcamp Run and Back Run



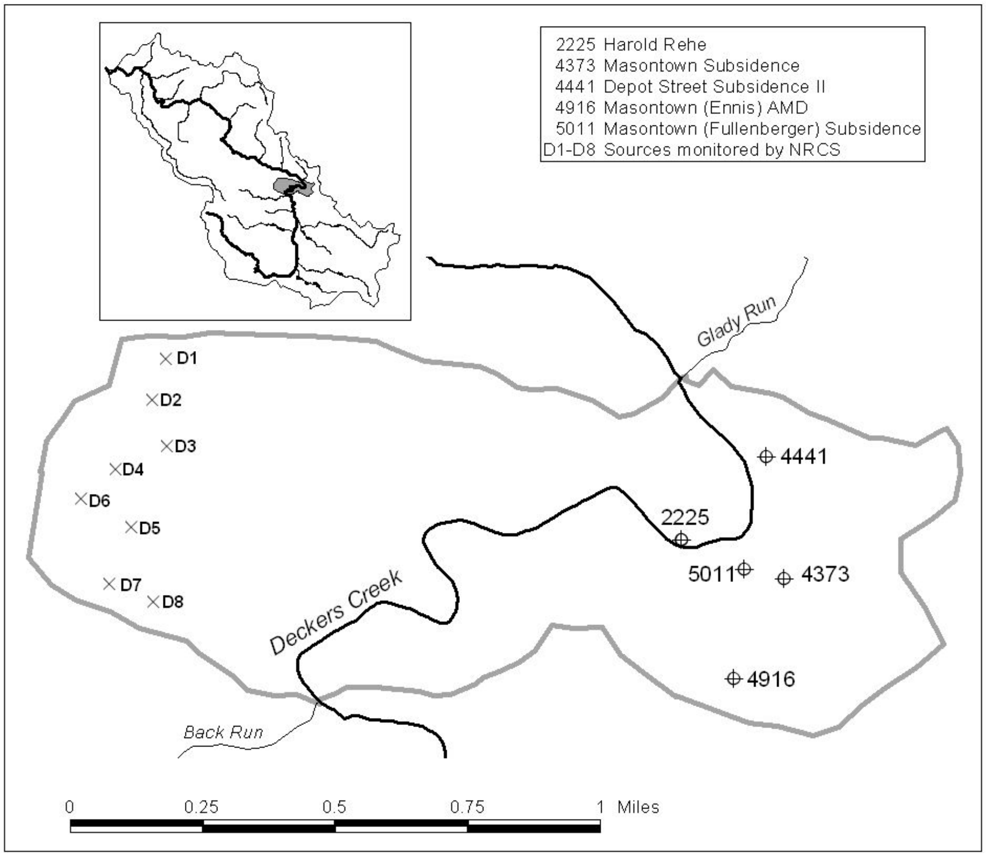
5.1.9. Deckers Creek from Back Run to Glady Run (M-8 RM 13.2 to 14.9; SWS 24)

This 1.6-mile stretch of Deckers Creek (

Figure 12) passes by a large reclaimed area (PA 2225) and several subsidence complaints (PAs 4373, 4441 and 5011) that have been addressed. One AMD source (4916) has a high pH and probably does not contribute significantly to the load of this subwatershed. NRCS documented some AMD flowing from the abandoned “Goat” mines (sites D1-D8 on

Figure 12). According to NRCS data, those seeps contribute average loads of 4200, 520 and 610 lbs/yr of Al, Fe and Mn, respectively, to Deckers Creek (NRCS, 2000). This is small compared to the 187,008 lbs/yr source of Fe described in the TMDL. The load of Fe from this subwatershed is not consistent with the much more moderate loads of Al and Mn, and may be erroneous. The only known sources, those associated with the Goat mines, have a low priority.

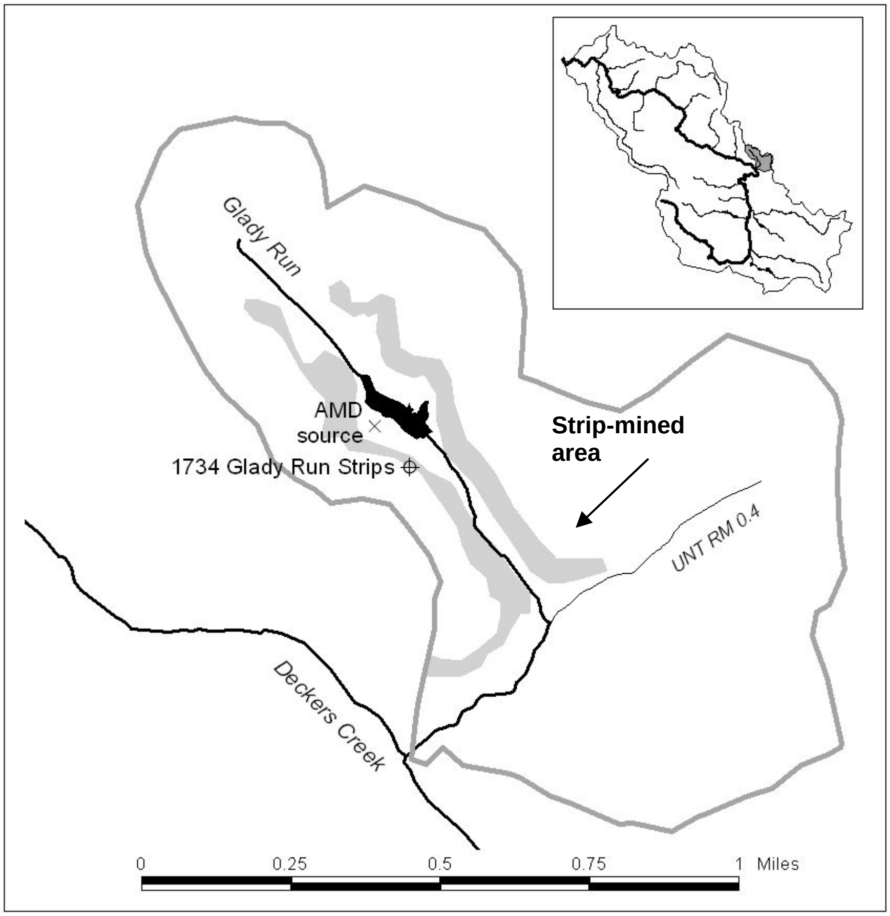
Figure 12: AMD sources to Deckers Creek between Back Run and Glady Run



5.1.10. Glady Run (M-8-D; SWS 17)

Glady Run is a 1.2-mile stream with an impoundment and one substantial tributary at RM 0.4 (Figure 13). Both of these streams are impaired by AMD. OAMLR describes a PA (1734) without listing specifics of the AMD sources. This site was investigated by FODC's OSM Summer Intern in 2004 (Bird, 2004). The Masontown quadrangle indicates roughly 37 acres of strip mining (USGS, 1983). For cost estimates, 10 acres are assumed to contribute AMD. In addition, there is one moderate seep from a deep mine. The large pond in this generally wooded site would provide excellent recreation. Remediation here is given a high priority because the stream will not attain standards without remediation.

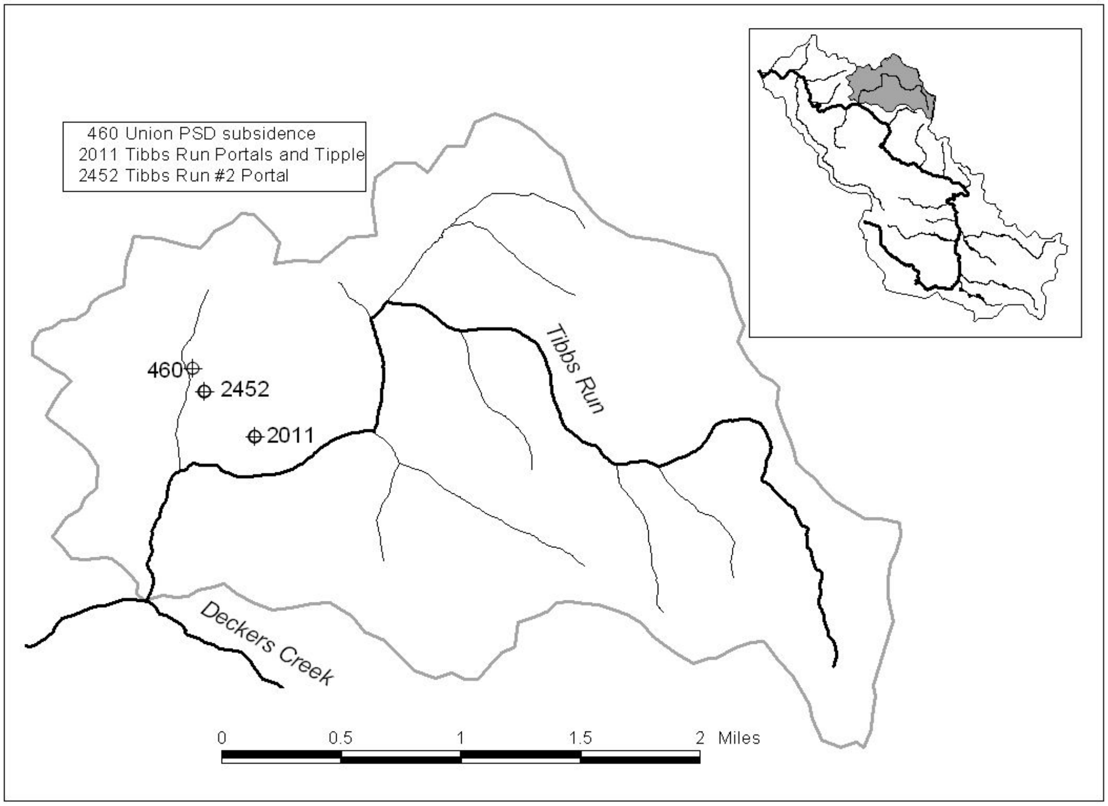
Figure 13: AMD sources to Glady Run



5.1.11. Tibbs Run (M-8-B; SWS 21)

Tibbs Run is one of the largest tributaries to Deckers Creek (Figure 14). The TMDL called for small reductions in Al, although it is not listed as an impaired stream (WVDEP, 2004). Measurements between 1998 and 2001 suggested that Tibbs does not exceed target loads. Recent measurements taken during high water, however, indicate that Al targets are exceeded. Although there are a number of mine openings, most are to a coal seam that dips away from the Tibbs Run watershed. The two known sources are reclaimed portals. Several residents have contacted FODC concerning AMD draining from PA 2452. Water quality in Tibbs indicates that the sources are not large, and are given a low priority.

Figure 14: AMD sources to Tibbs Run

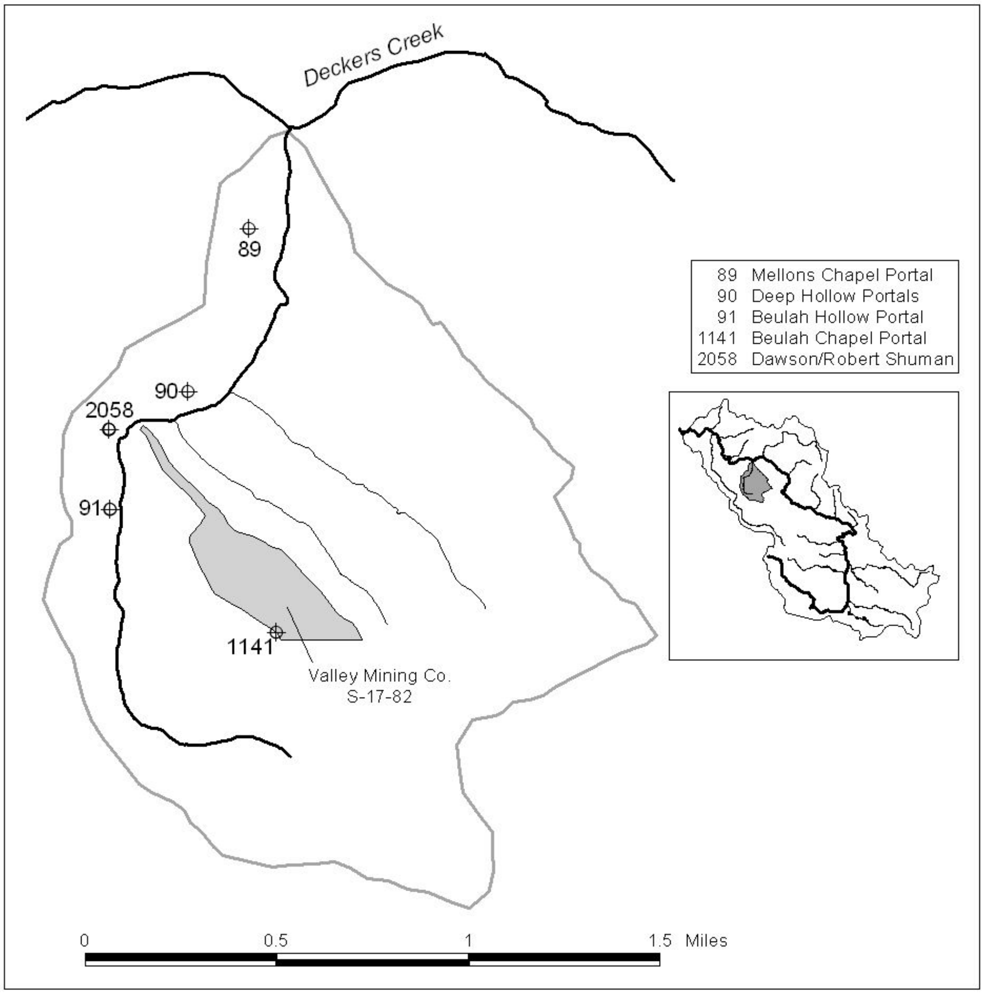


5.1.12. Deep Hollow (M-8-A.7; SWS 19)

The watershed of this 2.3 mile tributary contains not only five AMLs but also four BFSs. The largest AMD source among the BFSs, Valley Mining Co. (Permit S-17-82), has recently been addressed by the WVDEP Office of Special Reclamation.

There are no measurements on AMD loads from any of the AML sources. PAs on two of the sites (89 and 90) mention no AMD. The BFS discharges into water that already carries AMD. Its source, Beulah Chapel Portal (PA 1141) is given a high priority. Beulah Hollow Portal (PA 91) discharges one gpm (chemistry not measured) and is considered a low-priority source.

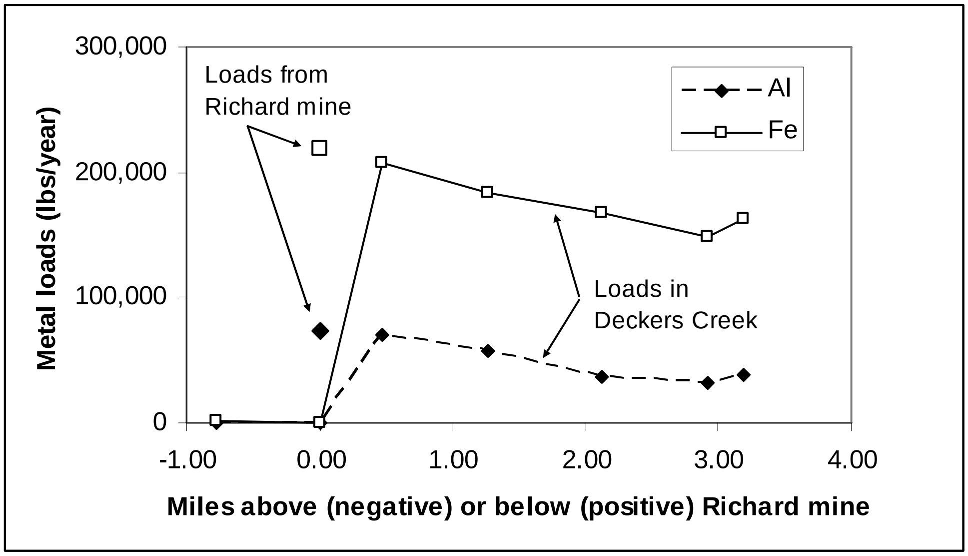
Figure 15: AMD sources to Deep Hollow



5.1.13. Deckers Creek from Deep Hollow to Aarons Creek (M-8 RM 2.2 to 5.7)

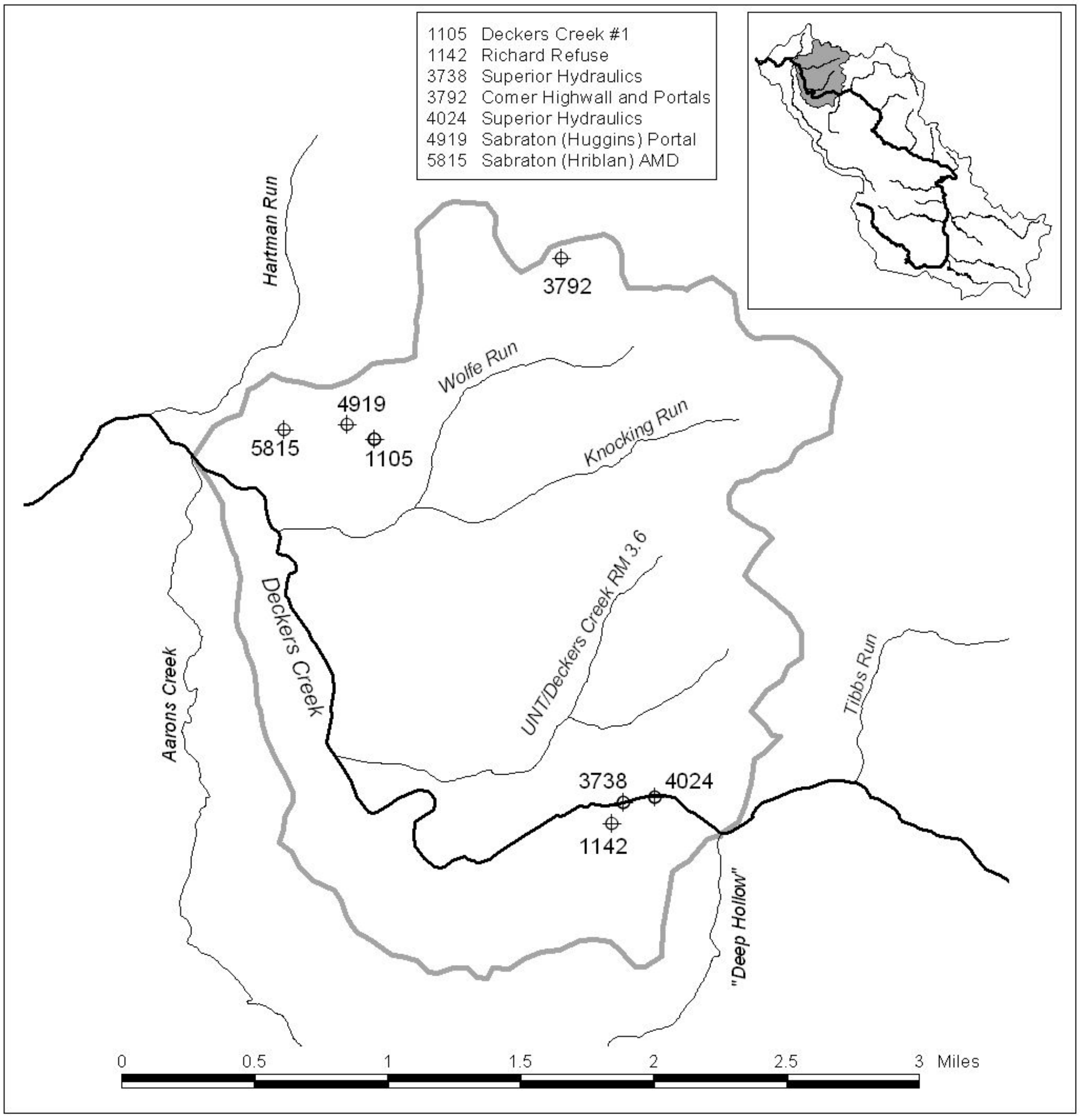
The Richard mine (discharging at Superior Hydraulics, PA 3738) delivers the single greatest AMD contribution to Deckers Creek in its entire length. It loads Deckers Creek with Al, Fe and Mn at rates of 59,000, 143,000 and 3,200 lbs/yr (Stewart and Skousen, 2002b). Pollutants from the mine can be tracked downstream in Deckers Creek, and account for most of the load it carries through the City of Morgantown (Figure 16).

Figure 16: Al and Fe loads from the Richard mine compared with loads in Deckers Creek upstream and downstream, measured October 29, 2001 (adapted from Christ, 2002).



Other AMD sources are reported in PADs for this segment (Figure 17), but are low-priority sites. The Richard mine is in the Upper Freeport seam, but sources on the northwest side of this subwatershed are from abandoned mines in the Pittsburgh seam. Three of these sources (1105, 3792 and 4919) are low-priority sites because Knocking Run, to which they contribute, is not impaired by AMD. The fourth site (5815) is small, runs directly to Deckers Creek, and has a circumneutral pH on some monitoring visits. It is also a low priority.

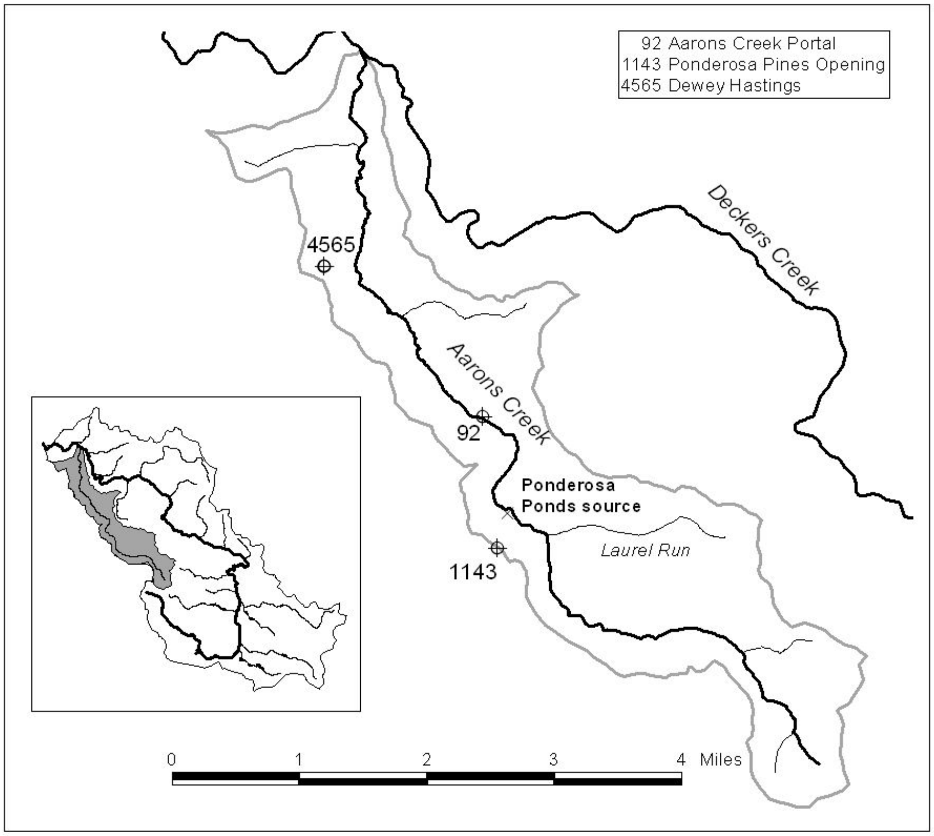
Figure 17: AMD sources to Deckers Creek between Deep Hollow and Aarons Creek



5.1.14. Aarons Creek (M-8-A; SWS 18)

Aarons Creek, the longest tributary to Deckers Creek (Figure 18) is relatively unimpacted by AMD. The TMDL calls for small reductions in its iron load, but the stream is not listed as impaired. Recent measurements consistently show high pH values, substantial alkalinity and low metal concentrations. Higher metal concentrations are generally associated with rain events and suspended sediment. One source in the watershed is given a low priority for remediation. NRCS (2000) measured loads of 360, 100 and 11 lbs/yr of Al, Fe and Mn, respectively, at Ponderosa Ponds (near site 1143, "Ponderosa Pines Opening," for which water discharges are not recorded). At site 92, the PAD indicates that water flows into, rather than out of, Aarons Creek Portal (OAMLR files). No information is available for site 4565 (Dewey Hastings) but fish have been seen in Aarons Creek nearby downstream.

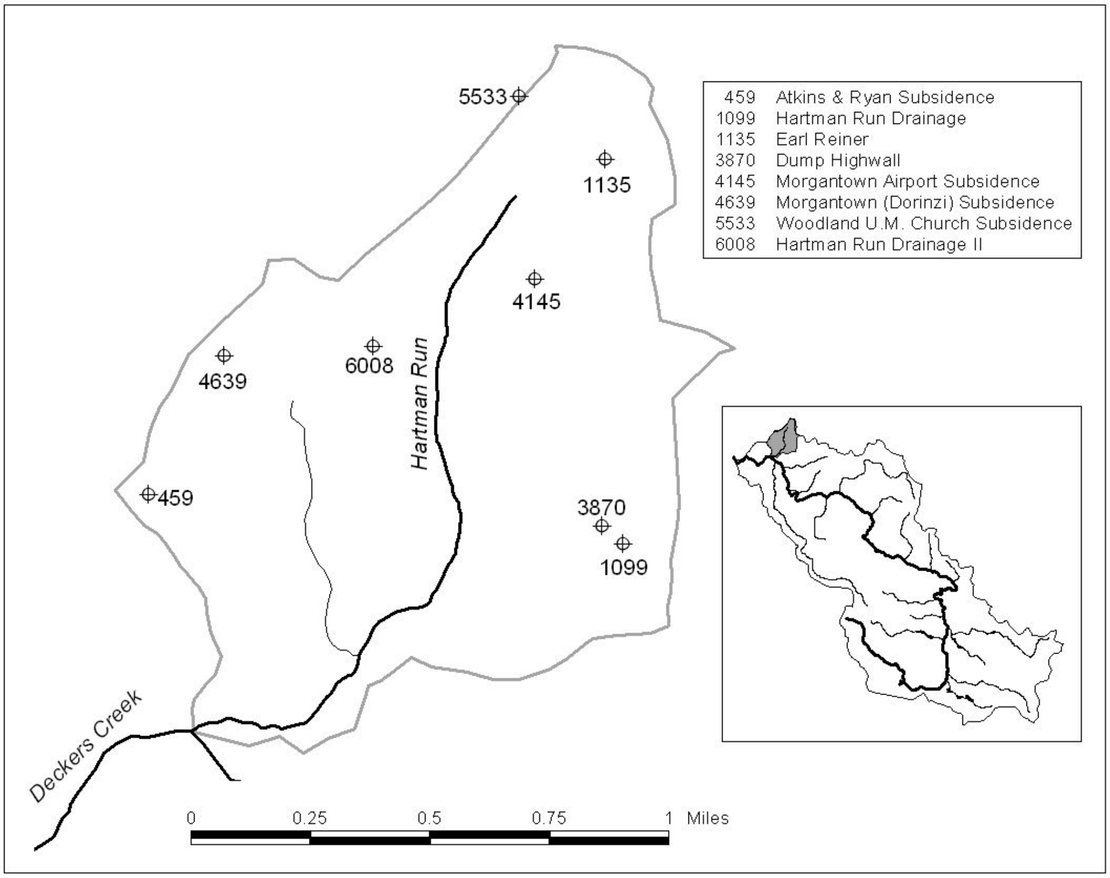
Figure 18: AMD sources to Aarons Creek



5.1.15. Hartman Run (M-8-0.5A; SWS 149)

Hartman Run is the last tributary to Deckers Creek before it flows into the Monongahela River (Figure 19). Its northern half is ringed by a ridge upon which Morgantown's airport and the "Mileground," an important commercial street, are located. The Pittsburgh coal seam lies just below this ridge, and has been heavily mined, causing a number of mine drainage (PAs 1099 and 6008) and subsidence problems (459, 1135, 4145, 4639 and 5533). Hartman Run varies in chemical characteristics. It often carries enough AMD to violate standards, but also hosts fish at times. Recent grouting to solve some of the subsidence problems may have diverted flow of water within the mine pool toward Hartman Run. The major sources of AMD are both high-priority sites.

Figure 19: AMD sources to Hartman Run



5.2. Costs of remediation measures

There is not enough information available to estimate the costs of reducing all the AMD sources, let alone all the nonpoint source pollutants, to acceptable levels. This plan therefore estimates costs for eight of the high-priority AMD sources and extrapolates from those the costs for remediation at other high-priority sites. The estimated cost of this WBP is $5.9 million.

Eight of the high-priority sites have been sampled enough to estimate remediation costs (Table 20). Those costs include construction, engineering and project management. Construction costs include four treatment measures: land reclamation, wet seals, open limestone channels (OLCs) and reducing and alkalinity producing systems (RAPS). Land reclamation, valued at $10,000/acre, is included in costs whenever PADs or observation suggests that an area of acid-producing material is contributing to the AMD loads. Wet seals ($5,000 each) are required where water springs from underground, usually through an abandoned portal. OLCs are required to control the path of any AMD on site. The amount of OLC is estimated at 100 feet for each wet seal, 100 feet for every acre of reclamation, and 100 feet for every RAPS. OLC construction costs $35/foot. The AMDTreat program (OSM, 2005) was used to determine a cost for a RAPS, using the hot acidity values of AMD sampled on site and a design flow. Design flow was either the maximum flow value observed, or twice the observed flow if only one estimate exists. Engineering and project management costs are each estimated as 10% of the construction costs. For sources to UNT/Kanes Creek RM 2.6, the one stream where data consistently indicates Mn impairment, the cost of MRBs with one-day retention times was also added.

One site, Hawkins Mine Drainage (3455), may be connected to the mine pool of an operation with an NPDES permit. Its cost is not included in this iteration of the plan.

Table 20: Cost (in thousands of dollars) calculations for high-priority, data-rich AMD sources

Site	Reclamation		Wet seals		RAPS			MRB[a]	OLC		EPM[b]	**Project totals**
	Area	Cost	Count	Cost	Flow	Acidity	Cost	Cost	Length	Cost	Cost	**Cost**
	Ac.	*$1000*		*$1000*	*gpm*	*mg/L*	*$1000*	*$1000*	*Feet*	*$1000*	*$1000*	***$1000***
Kanes Creek South (2003)[c]	0	0	0	0	147	290	448	0	100	4	90	**542**
Kanes Creek Tipple (2002)[c]	0	0	0	0	12	1,250	163	0	100	4	33	**200**
Morgan Mine Road AMD (5990)[c]	0	0	1	5	35	520	195	0	200	7	41	**248**
Sandy Run Highwall, Portals (6088), site 1[c]	2	20	1	5	22	257	65	10	400	14	21	**135**
Sandy Run Highwall, Portals (6088), site 2[c]	2	20	1	5	10	695	78	4	400	14	23	**144**
Superior Hydraulics (3738)[e]	0	0	0	0	600	1,000	6,000	0	100	4	1,200	**7,204**
Valley Highwall #3 (3068)[f]	2	20	4	20	52	354	198	0	700	25	53	**316**
Valley Point #12 (1456)[f]	0	0	2	10	77	460	374	0	300	11	79	**474**
Grand total												**9,263**
Superior Hydraulics limited to $1,000,000												***3,059***

[a] Manganese Removal Bed. [b] Engineering and project management costs. [c] Data from FODC. [d] Data based on load and flow from Sandy Run (=UNT/Kanes Creek RM 2.6) less the contributions of Sandy Run Highwall, Portals, site 2 source. [e] Data from Stewart and Skousen, 2002b. [f] Data from NRCS.

According to these calculations, the most expensive site will be the Richard mine (draining at Superior Hydraulics, PA 3738). It is unlikely, however, that a RAPS will be used to decrease pollution from that site. Calculations by AMDTreat (OSM, 2005) indicate that such an installation would require more than 50 acres. The DCRT is currently gathering data to estimate the cost of installing a chemical treatment plant for this mine. $1,000,000 is a reasonable estimate for the capital expenses for such a plant. Operations and maintenance costs for the site are not included in the plan.

The total cost for the data rich sites, excluding the Richard mine, is $2,239,000, or an average of $320,000 per site. This cost is used as an estimate for the average of the remaining nine high-priority sites. The total cost for high-priority remediation sites in the Deckers Creek watershed is therefore $5.9 million:

$$\$3,059,000 + 9 \times \$320,000 = \$5,939,000$$

6. LOAD REDUCTIONS AND COSTS FOR FECAL COLIFORM BACTERIA NONPOINT SOURCE POLLUTION

6.1. Load reductions

Streams in the Deckers Creek watershed are not on the 303(d) list for fecal coliform bacteria, so TMDL load reductions are not required for specific subwatersheds. However, data collected by FODC demonstrate that current fecal coliform bacteria concentrations in some tributaries violate the water quality standard (Table 10). The fecal coliform bacteria loads associated with these tributaries are outlined below in Table 19.

Table 20 highlights the current known forms of wastewater treatment in the targeted subwatersheds. The number of homes hooked up to each system was determined by placing parcel maps over aerial photos in GIS. Any parcel containing a structure was assumed to discharge wastewater from one average family. In some instances this may not reflect reality, but it provides a common ground for developing load reductions and associated costs early in the planning process.

Since loads from each nonpoint source of fecal coliform bacteria from wastewater are still unknown, and a TMDL does not exist for fecal coliform bacteria in Deckers Creek, accurate load reductions cannot be determined at this time. However, a range of loads and possible load reductions are provided to show the reductions that can be achieved if all nonpoint sources of wastewater are properly addressed (Table 21). For this Watershed Based Plan, it is assumed that all unknown systems (septic systems/straight pipes/HAUs) are failing and contributing fecal coliform bacteria to the targeted subwatersheds. It is also assumed that all fecal coliform bacteria loads in the targeted subwatersheds are from nonpoint wastewater sources. These assumptions, once again, create a common ground for developing load reduction goals and cost assumptions.

The upper end of the instream load range is the fecal coliform bacteria load expected from 100% untreated wastewater from unknown systems. This is the extreme, worst-case scenario based on the assumption made that all unknown systems are failing. The lower end of the range is based on the current instream loads for the targeted subwatersheds (see Table 19). The calculations used to determine the worst-case scenario loads and the current instream loads can be found in Appendix B. A load range was determined for each targeted subwatershed. For example, the range of instream loads for Knocking Run is 2.80E+14 cfu/year (worst-case scenario) to 1.06E+13 cfu/year (current instream load). By comparing the expected loads for the worst-case scenario to the current instream loads, it is evident that many of the systems in the targeted subwatersheds are, in fact, adequately treating wastewater.

Load reductions are determined by subtracting from the worst-case scenario and current instream loads the expected loads following the replacement of all failing systems with new functioning septic systems (See Section 6.2). According to UGWA (2006) and Horsley and Whitten (1996), on average, properly maintained septic systems are 99% efficient. Load reductions are based on this 99% efficiency, where it is assumed 99% of the fecal coliform bacteria entering a system will be treated and 1% of the fecal coliform bacteria will be discharged into the stream. Load reductions were determined for each subwatershed. For example, the expected instream loads for Knocking Run following system replacement are 2.80E+12 cfu $(100ml)^{-1}$ to 1.06E+11 cfu $(100ml)^{-1}$. All load reductions and their associated instream concentrations are provided in Table 21. The load reduction range is considered a reasonable goal because it is unlikely that 100% of the systems are failing, it is not known whether all nonpoint sources of wastewater can be identified and addressed in each subwatershed, and in some locations onsite systems are likely achieving 100% efficiency. Calculations for load reductions can be found in Appendix B and with Table 21.

Table 21: Current fecal coliform bacteria loads

Stream	Stream code	Site code	Average fecal coliform (cfu/100ml)	Average flow (cfs)	Fecal coliform loads (cfu/year)
Deckers Creek RM 0.7	M-8	SOTC1	122	70.98	7.73E+13
Deckers Creek RM 7.4	M-8	SOTC2	119	11.55	1.23E+13
Deckers Creek RM 16.8	M-8	DH1	92	2.42	1.99E+12
Deckers Creek RM 19.1	M-8	GT2	845	30.10	2.27E+14
Aarons Creek	M-8-A	A1	145	7.68	9.92E+12
Aarons Creek	M-8-A	A2	352	4.81	1.51E+13
Wolf Run/Knocking Run	M-8-A.5	K1	580	0.11	5.44E+11
Knocking Run	M-8-A.5	K2	6,350	0.18	1.00E+13
UNT/Deckers Creek RM 3.6	Not assigned	BH1	2,100	0.80	1.49E+13
Deep Hollow	M-8-A.7	B1	353	1.82	5.72E+12
Deep Hollow	M-8-A.7	B2	239	1.79	3.83E+12
Deep Hollow	M-8-A.7	B3	289	1.90	4.90E+12
Deep Hollow	M-8-A.7	B4	960	0.89	7.65E+12
Tibbs Run	M-8-B	T1	227	4.17	8.44E+12
UNT/Tibbs Run	M-8-B	T4	450	0.15	6.03E+11
Kanes Creek	M-8-I	KA2	257	1.21	2.79E+12

Source: FODC (2006a, 2006b).

Table 22: Wastewater treatment systems and the approximate number of home connected to each in the targeted subwatersheds

Stream name	Stream code	Unknown (septic systems/ straight pipes/HAUs)	Centralized system	Package plant (no. of systems)
Knocking Run	M-8-0.5A	120	32	14(1)
Kanes Creek	M-8-I	192	285	73(3)
Tibbs Run	M-8-B	114	350	42(1)
Deep Hollow	M-8-A.7	244	52	0
Aarons Creek	M-8-A	~800	189	0

Table 23: Current and expected fecal coliform bacteria loads from wastewater in targeted watersheds

Stream name	Stream code	Number of unknown systems	Worst-case scenario: all unknown systems discharge 100% wastewater			Best-case scenario: treatment can reduce all current loads by 99%		
			Worst-case load	Load after treatment	Concentration after treatment	Current load	Load after treatment	Concentration after treatment
			cfu/year	cfu/year	cfu/100 mL	cfu/year	cfu/year	cfu/100 mL
Knocking Run	M-8-0.5A	120	2.80E+14	2.80E+12	1,112	1.06E+13	1.06E+11	42
Kanes Creek	M-8-I	192	4.47E+14	4.47E+12	412	2.79E+12	2.79E+10	3
Tibbs Run	M-8-B	114	2.66E+14	2.66E+12	71	8.44E+12	8.44E+10	2
Deep Hollow	M-8-A.7	244	5.69E+14	5.69E+12	351	6.E+12	5.72E+10	4
Aarons Creek	M-8-A	~800	1.86E+15	1.86E+13	271	1.E+13	9.92E+10	1

Note: See Appendix B for calculations of worst case loads. Worst case instream concentrations calculated by dividing previous column by average flows and by the conversion factor of 8.93 x 10^9. Instream loads from Table 19. Final column of instream concentrations calculated by dividing previous column by average flows and by the conversion factor of 8.93 x 10^9. Average flows are from Table 19, sites K1 + K2, KA2, T1, B1, and A1. Unknown systems refer to septic systems/straight pipes/HAUs.

6.2. Costs

Until more data are collected to determine the current efficiency of installed systems, the exact number of homes without adequate wastewater treatment, and the necessary changes in wastewater treatment for certain homes, exact costs cannot be calculated. The current cost estimate for addressing wastewater pollution in the targeted tributaries is $9.5 million, as explained below.

This section provides rough estimates of costs, based on several assumptions, to address fecal coliform bacteria pollution from wastewater. First, it is assumed that all structures connected to unknown systems (septic systems/straight pipes/HAUs) are not functioning properly and will have to be replaced. In reality this is not the case (See section 6.1), but it creates a common ground for cost assumptions across all subwatersheds and provides a worst-case scenario. Second, to determine the number of houses connected to each type of wastewater treatment system, parcel maps were placed over aerial photos in GIS. Any parcel containing a structure was assumed to discharge wastewater from one average family. In some instances this may not reflect reality, but once again it provides a common ground for developing cost assumptions early in the planning process. Parcels treated by systems considered a point source are not addressed by this plan. Table 20 outlines the current understanding of how wastewater is being treated in the targeted subwatersheds.

For this Watershed Based Plan one treatment option is used to develop cost assumptions; septic systems. The cost for septic system installation is based the treatment system cost assumptions outlined in the Upper Guyandotte Watershed Based Plan (UGWA, 2006) (Table 22). To develop the cost assumptions for Deckers Creek, the values provided for all variations of septic systems were averaged to generate one value to use in the calculations. Until all factors affecting wastewater pollution within each subwatershed are completely understood, it is difficult to develop more precise treatment system needs and costs. Data needed for developing the best treatment system options include:

- soil types,
- topography,
- parcel size,
- exact location of failing systems,
- exact locations of homes/businesses without treatment systems, and
- economic status of communities.

If it is found that other systems are better suited to address wastewater treatment needs or that costs have changed based on current technology and available funding, this Watershed Based Plan will be updated to reflect those changes.

Table 24: Wastewater treatment technology cost assumptions

Item	Cost	Included in cost (all include installation)
Individual on-site system w/ traditional drainfield	$5,000 per home	New tank & drainfield
Individual on-site system w/ drip dispersal drainfield	$9,000 per home	New tank & drainfield
Individual on-site system w/ low pressure pipe drainfield	$6,500 per home	New tank & drainfield
Average costs used in Deckers Creek cost assumptions	**$6,830**	

Source: UGWA, 2006.

Table 25: Cost summary for addressing fecal bacteria pollution in the targeted subwatersheds

Subwatershed	Stream code	Estimated cost ($ million)
Knocking Run	M-8-0.5A	0.8
Kanes Creek	M-8-I	1.3
Tibbs Run	M-8-B	0.2
Deep Hollow	M-8-A.7	1.7
Aarons Creek	M-8-A	5.5
Total cost to address all targeted watersheds		**9.5**

Note: Costs estimated by multiplying the number of unknown systems in Table 20 by $6,830, and then rounding.

A breakdown and summary of costs for each subwatershed is outlined below.

6.2.1. Knocking Run (M-8-A.5; SWS 20)

Knocking Run starts outside of Morgantown's city limits, but crosses the city line on its way through Sabraton (a part of Morgantown) to Deckers Creek. Houses in the lower, densely populated section of the watershed are connected to a centralized system. All structures in the headwater tributaries are connected to septic systems, straight pipes, HAUs, or a package plant. Knocking Run was chosen as a targeted watershed due to the high levels of fecal coliform bacteria levels measured by FODC in 2006.

Many of the homes located at the mouth of the two headwater tributaries and all along the northwestern tributary (Wolf Run) are scattered and are located adjacent to the stream. Straight pipes are also suspected in this region based on visual assessments through stream surveys during the spring and summer of 2006. The eastern end of the watershed contains a package plant (Valley View Acres, WVG550198) and more densely clustered homes compared to the northwestern and western section of the watershed. The package plant has received notices of violation in the past for improper operation and maintenance of the system. Proper maintenance should reduce any impacts from this package plant.

Table 26: Parcel based inventory of wastewater treatment systems in the Knocking Run watershed

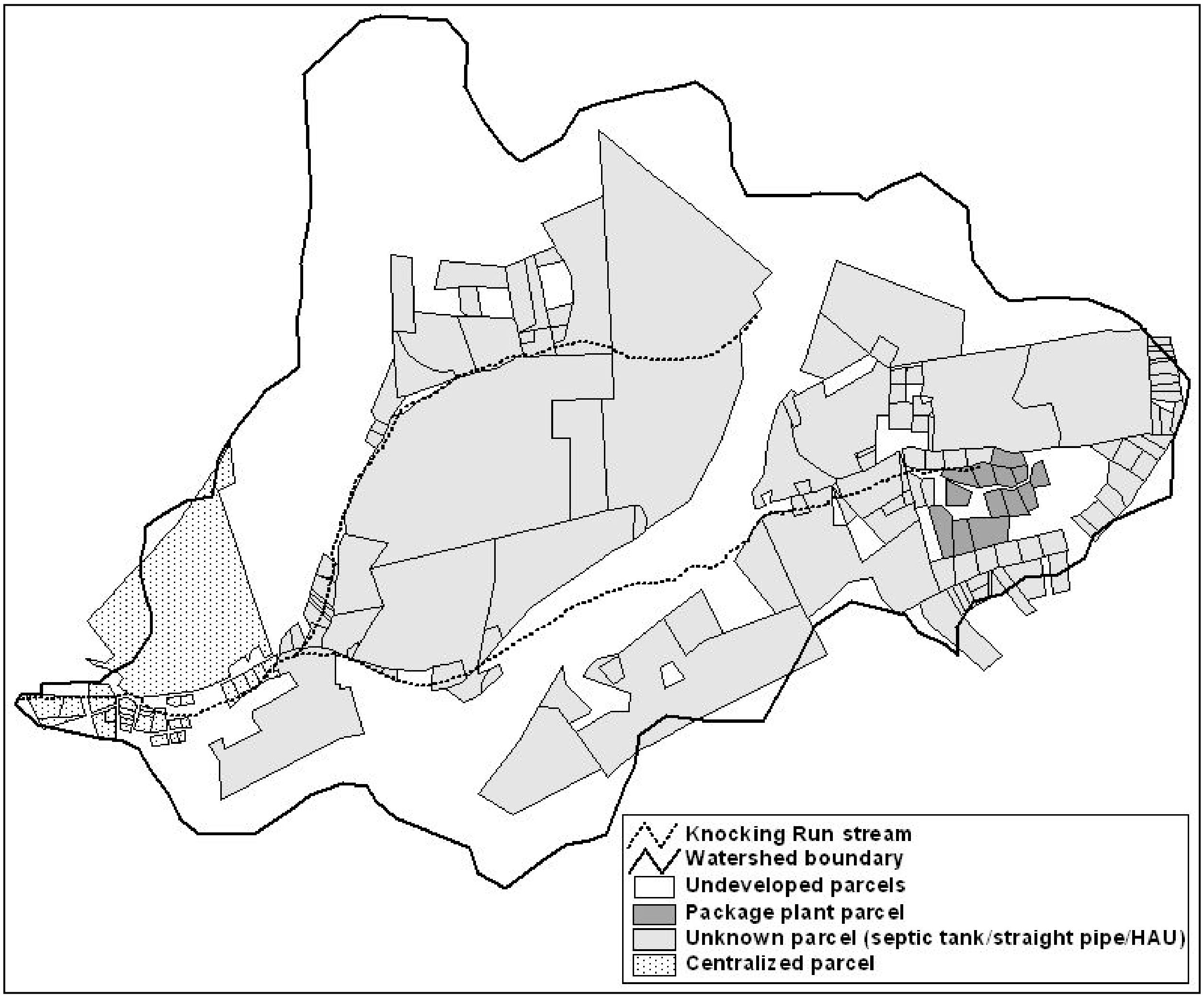


Table 27: Wastewater improvement cost assumptions for the Knocking Run watershed

Proposed treatment system	No. of homes	Cost per system	Total cost
Septic systems	120	$6,830	$819,600
Total			**$819,600**

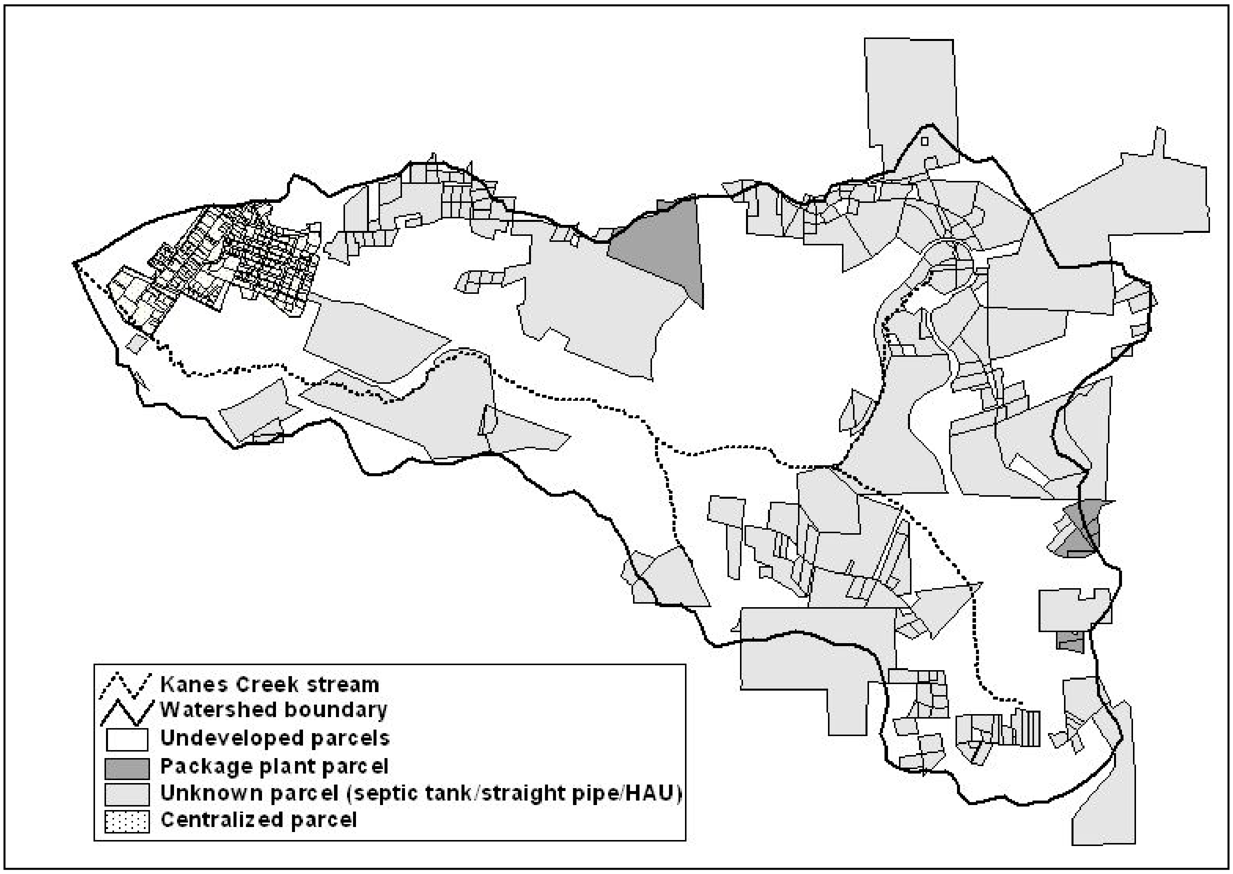
6.2.2. Kanes Creek (M-8-I; SWS 205, 206)

Kanes Creek was selected as targeted watershed for a number of reasons. Kanes Creek is the first target watershed for AMD remediation. Using 319 funds and OSM WCAP funds, FODC is now in the final design stage for a treatment system at Valley Point #12, with construction scheduled to begin in 2006. Two additional projects are scheduled for construction in 2007, and one more for 2008. As the AMD is cleaned up in Kanes Creek, it is suspected that wastewater issues will become more noticeable due to the natural treatment effects AMD has on wastewater pollution. A second reason for focusing on Kanes Creek is that high fecal coliform bacteria levels have been documented by FODC during the spring and summer 2006 monitoring. Finally, failing septic systems are believed to exist in the headwaters region of Kanes Creek.

The homes located at the mouth of Kanes Creek near Deckers Creek are served by the Town of Reedsville's centralized sewer system. An expansion to this system are currently planned and, if approved, may include homes located along the north central watershed boundary of Kanes Creek. If these homes are not addressed through the expansion, alternative approaches should be explored if additional data indicate that wastewater from these homes impairs Kanes Creek.

Three package plants also treat wastewater in the Kanes Creek watershed (Indian Rock Estates, WVG550425; Light Mobile Home Park, WVG550657; Windy Hill Manor, WVG550993). Two of the three package plants have been cited for improper system maintenance. Proper maintenance of these plants is recommended to eliminate any future wastewater impacts on Kanes Creek.

Figure 20: Parcel based inventory of wastewater treatment systems in the Kanes Creek watershed



Note: Parcels highlighted for package plants do not highlighting the exact number of homes treated by the package systems.

Table 28: Wastewater improvement cost assumptions for the Kanes Creek watershed

Proposed treatment system	No. of homes	Cost per system	Total cost
Septic systems	192	$6,830	$1,311,360
Total			**$1,311,360**

6.2.3. Tibbs Run (M-8-B; SWS 21)

Tibbs Run has been selected as a target watershed because of the high levels of fecal coliform bacteria documented by FODC at the mouth and in an unnamed tributary at RM 2.0 (FODC, 2006a and 2006b).

Homes located at the mouth of Tibbs Run are connected to a centralized wastewater treatment system. Wastewater from approximately 114 parcels is treated by an unknown method (septic systems/straight pipes/HAUs). One major change in wastewater treatment will be occurring in the near future. Sunshine Estates, the one package plant system (WVG551081) in Tibbs Run, will be removed and all homes in this development will be connected to the Deckers Creek Public Service District wastewater collection lines. Homes located along this line extension will have the option to connect into the centralized system if homeowners are willing to pay the connection fee.

Water quality data indicate that the headwaters region is not experiencing impairment from fecal coliform bacteria. Therefore, it is suggested that only unknown systems in the lower reaches of the watershed be addressed. If data in the future indicate that systems in the headwaters of Tibbs Run are in fact impairing water quality, this plan should be update to address those sources.

Figure 21: Parcel based inventory of wastewater treatment systems in the Tibbs Run watershed

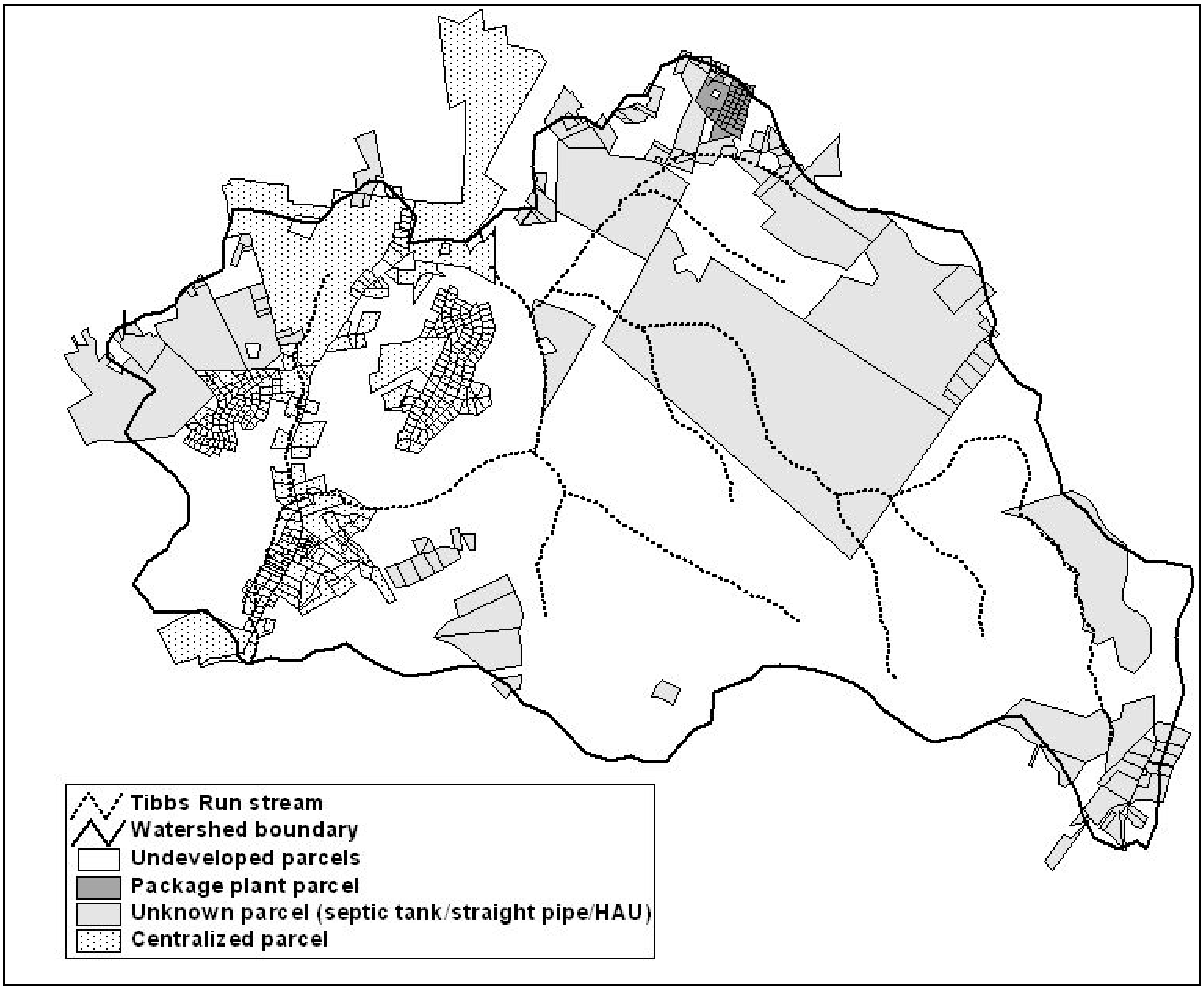


Table 29: Wastewater improvement cost assumptions for the Tibbs Run watershed

Proposed treatment system	No. of homes	Cost per system	Total cost
Septic systems	35	$6,830	$239,050
Total			**$239,050**

6.2.4. Deep Hollow (M-8-A.7; SWS 19)

Deep Hollow has been selected as a target tributary because of the high fecal coliform bacteria levels documented by FODC (2006b), the proximity of homes in Deep Hollow to the Deckers Creek Public Service District centralized sewer lines, and the high density of homes in the watershed.

Only a small portion of the homes, located at the mouth of Deep Hollow, are connected to centralized sewer lines. The wastewater from approximately 244 parcels is treated by unknown systems (septic systems/straight pipes/HAUs). During stream surveys it was noted that many homes are located adjacent to the stream, with little room for a properly sized septic tank drain field. No straight pipes were observed in the watershed during the stream walk, but the possibility cannot be ruled out because the upper regions of the headwaters were not surveyed.

In the last decade, the Deckers Creek Public Service District has considered connecting a large portion of the homes in the Deep Hollow watershed to centralized sewer lines. At eth time the option was ruled out because of cost. This option will be re-explored by FODC and the Deckers Creek PSD, along with alternative treatment options, for addressing the fecal coliform bacteria problems in this watershed.

Figure 22: Parcel based inventory of wastewater treatment systems in the Deep Hollow watershed

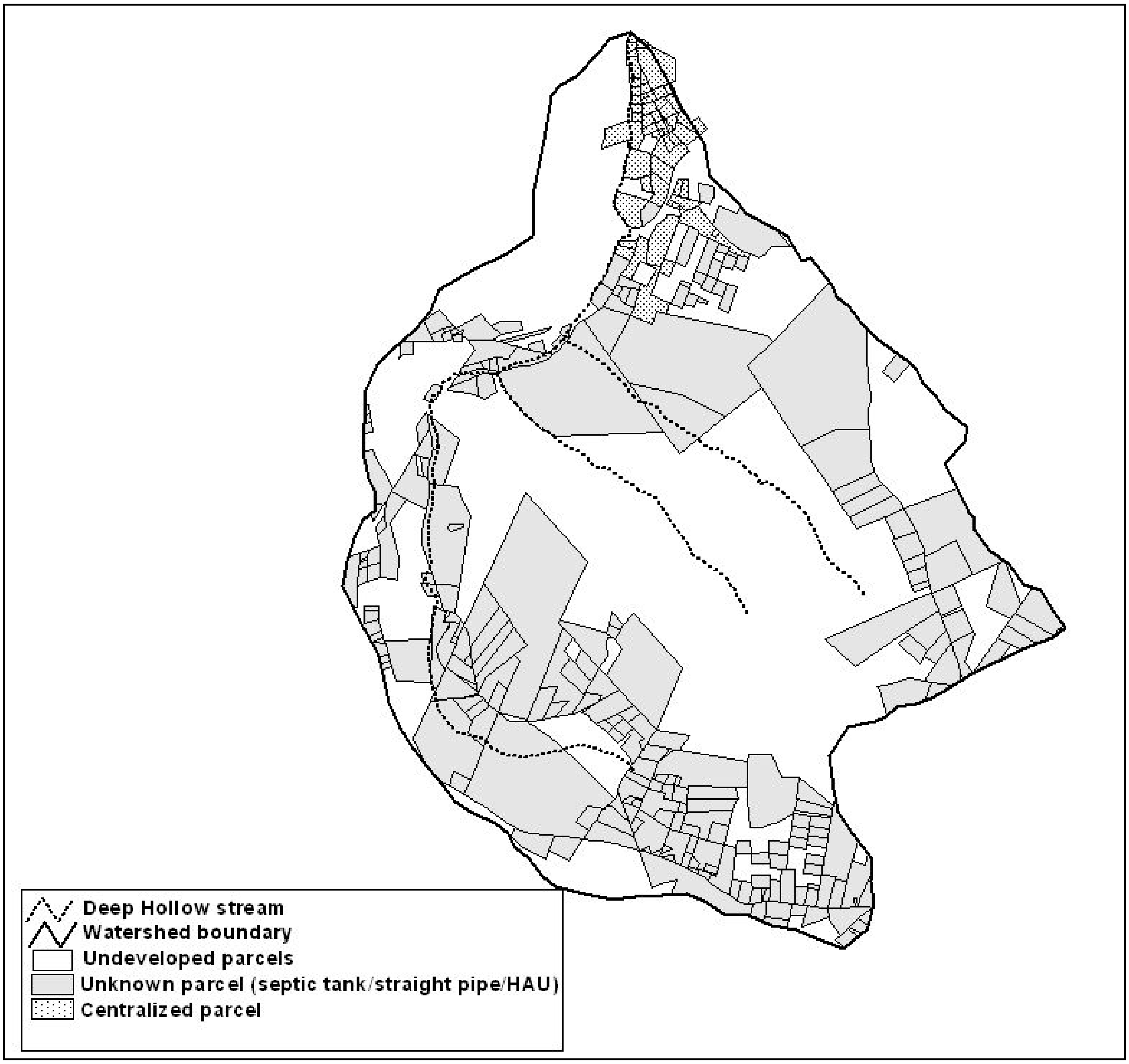


Table 30: Wastewater improvement cost assumptions for the Deep Hollow watershed

Proposed treatment system	No. of homes	Cost per system	Total cost
Septic systems	244	$6,830	$1,666,520
Total			**$1,666,520**

6.2.5. Aarons Creek (M-8-A; SWS 18)

Aarons Creek is a rapidly developing watershed because of its proximity to the City of Morgantown. The development threats, along with the high levels of bacteria documented in the lower 4.8 miles, have made Aarons Creek a targeted watershed.

Only a small portion of the watershed, near the mouth is currently connected to centralized sewer lines. The remaining portion of the watershed is treated by unknown systems (septic system/straight pipes/HAUs). Stream surveys have documented straight pipes and failing septic systems in the lower reaches of Aarons Creek. The upper reaches have not been visually surveyed, so other insufficient treatment methods may exist.

Some livestock are found in the central region of the Aarons Creek subwatershed. More targeted monitoring will have to be completed to determine if livestock are contributing to the fecal coliform bacteria problems in the watershed.

Figure 23: Parcel based inventory of wastewater treatment systems in the Aarons Creek watershed

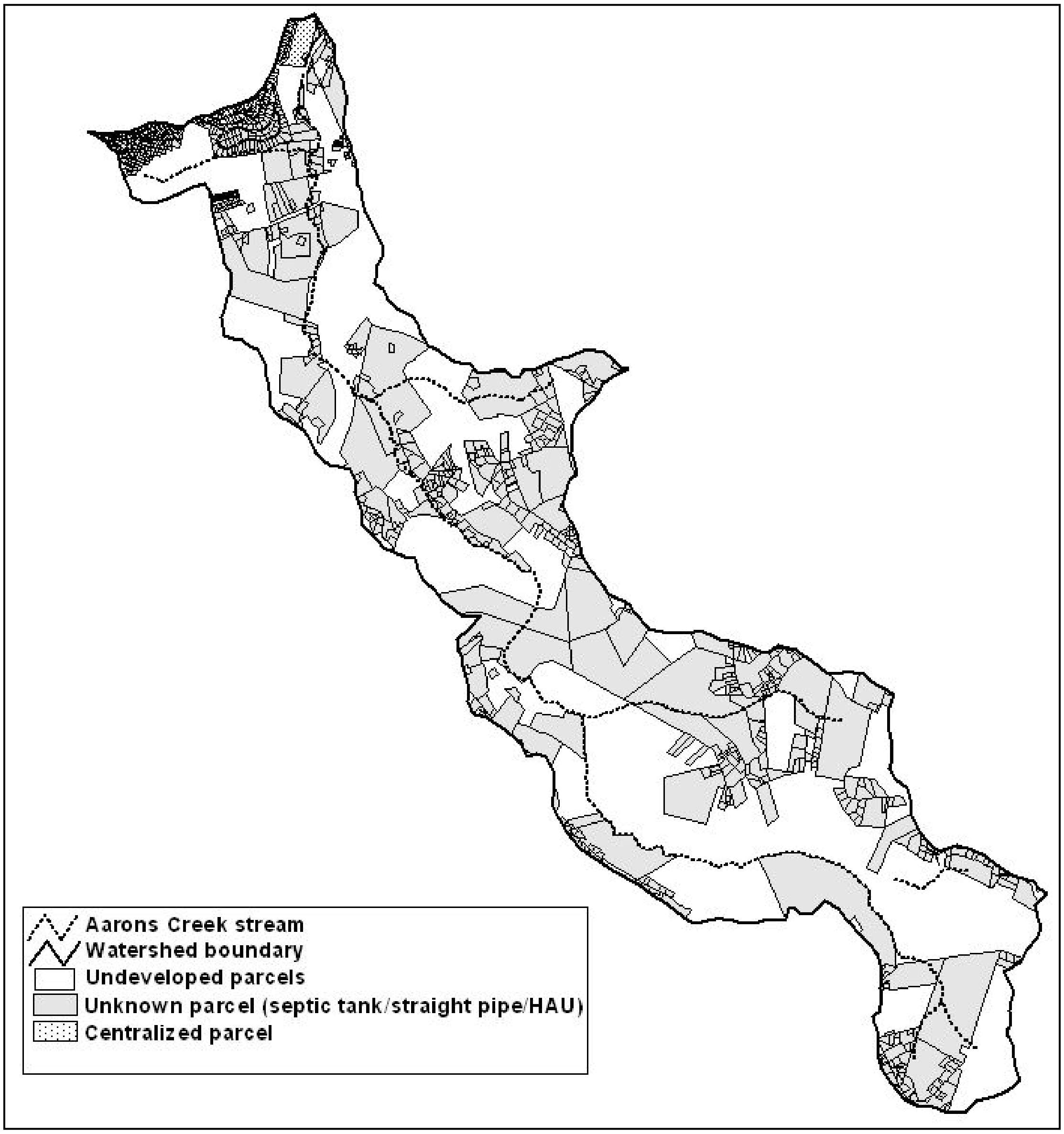


Table 31: Wastewater improvement cost assumptions for the Aarons Creek watershed

Proposed treatment system	No. of homes	Cost per system	Total cost
Septic systems	~800	$6,830	$5,464,000
Total			**$5,464,000**

6.2.6. Other watersheds of concern

Monitoring by FODC through the Clean Creek Program and in the spring and summer of 2006 have revealed that other watersheds do experience high levels of fecal coliform bacteria, most likely from wastewater.

Gamble Run (also known as UNT/Deckers Creek RM 3.6) drains the community of Brookhaven. Early in the wastewater assessment, it was ruled out for additional review because most of the homes in the watershed are connected to the Deckers Creek Pubic Service District centralized sewer lines. Late in the assessment, one bacteria sample was collected at the mouth of Gamble Run, indicating high bacteria levels. It is recommended that this tributary be explored further, in partnership with the Deckers Creek Public Service District, to determine the exact sources of fecal bacteria pollution.

Samples collected in Dillan Creek, as mentioned above, have shown elevated levels of fecal coliform bacteria on occasion. Most of the land in Dillan Creek is forest and sparsely populated agricultural land with occasional livestock. If higher levels of fecal coliform bacteria are documented in the future, it is suggested that additional monitoring take place to determine the exact sources. Fecal coliform levels may increase as DCRT addresses AMD in the uppermost 45% of the watershed. Decreases in metal loads, which can either kill bacteria or remove them from the water column, are likely to cause increases in fecal coliform loads.

7. EDUCATION COMPONENT

In order for the nonpoint source management measures to be successful, indeed, to be built in the first place, many constituencies will have to participate. The program below is designed to communicate with those constituencies.

Friends of Deckers Creek has conducted a number of activities to educate watershed residents and users about the problems and potentials of the watershed. These avenues will also be used to communicate the goals and progress of the WBP:

- Clean Creek Program

  FODC monitors 13 sites in the watershed four times each year and assesses water quality using chemical means. In addition, FODC assesses communities of fish and of benthic macroinvertebrates once each during the year. Data are compiled in an annual *State of the Creek* report which is distributed to local libraries, schools, government personnel and citizens. This tool also helps target areas where remediation is needed and supports the evaluation of completed projects.

- The CarpFest

  FODC hosts an annual festival for watershed residents and visitors. This festival is called the CarpFest and takes place in the fall. The festival has an education component and informational booths as well as live music, food vendors and children's activities.

- DeckersCreek.org

  FODC maintains a website with information about Deckers Creek, links to other watershed groups, and information about watershed remediation.

- Deckers Creek Currents

  FODC publishes a newsletter three times each year to inform subscribers about the progress of remediation projects in the watershed, and about other information of interest. Subscriptions are free.

- Natural history brochures

  FODC has published two natural history brochures, *Ferns of the Deckers Creek Rail Trail* and *Wildflowers of the Deckers Creek Rail Trail*. FODC has also prepared a birding checklist for the Deckers Creek watershed and is preparing it for publication as a brochure.

- Educational kiosks

  FODC is partnering with the Morgantown Utility Board to install 3 permanent kiosks along the Deckers Creek Trail. The kiosks will discuss pollution sources, natural resources, and historical events in the watershed.

- Public Meetings

  FODC holds monthly meetings open to the public. These meeting provide the organization opportunities to discuss current issues and activities happening in the watershed to address pollution sources.

- Other publications

  FODC, in collaboration with other groups, has published other reports, including *Deckers Creek stream quality inventory*, *Acid mine drainage in Deckers Creek: what we know so far*, *Remediation of Deckers Creek: a status report*, and *Friends of Deckers Creek volunteer stream monitoring manual.*

The Deckers Creek Restoration Team holds quarterly meetings that are open to the public. Information about nonpoint source remediation projects and priorities will be freely available to those who attend these meetings.

West Virginia Department of Environmental Protection will hold a public meeting in the watershed to gather suggestions for monitoring locations prior to its five-year monitoring effort beginning in 2009. WVDEP will include information at this meeting on the status of plans for eliminating nonpoint source pollution in the watershed.

8. IMPLEMENTATION SCHEDULE

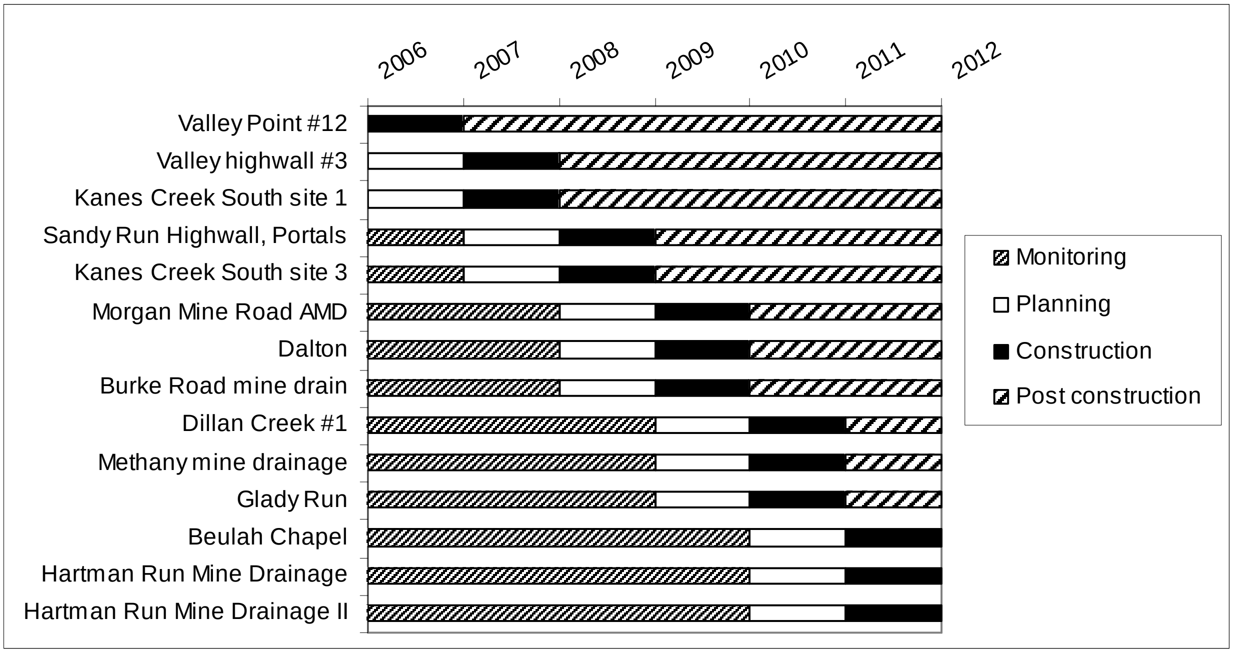
8.1. Acid mine drainage

Remediation of Deckers Creek sources will follow two tracks simultaneously. In one track, the DCRT will pursue remediation of the high-priority AMD sources, from upstream sites to downstream sites. In the other track, DCRT or a similar group will pursue the long-term, difficult project of treating the discharge from the Richard mine. These projects are expected to be finished by 2011.

In the first track, sites will be addressed from upstream to downstream. The DCRT will executes projects from the top of Kanes Creek going downstream, then address the one site upstream from Kanes Creek, and then address sites according to the order in which they contribute to Deckers Creek (Figure 24).

Because the second track, the Richard mine, will depend on funds to support operations and maintenance, expenditures on that track are not related to USEPA 319 funds. A coalition of Morgantown area residents, including FODC, Trout Unlimited, the Morgantown Area Chamber of Commerce and others are establishing a trust fund and seeking contributions to address the Richard mine.

Figure 24: Implementation schedule for high-priority AMD sources



8.2. Fecal coliform bacteria

Addressing fecal coliform bacteria issues in the watershed will require some additional assessment and strategic planning. Positive outcomes will depend on multiple factors including community support for projects, funding availability, and the willingness of project partners to assist with long term operation and maintenance of new wastewater treatment systems. DCRT will focus on addressing wastewater pollution in the five target tributaries outlined in Chapter 3.3.

Phase 1: 2006-2010: Additional Assessment and Planning: Knocking Run and Kanes Creek

Phase 1 will address pollution in two of the five targeted watersheds, Knocking Run and Kanes Creek. Knocking Run will be looked at first due to the high levels of bacteria and, Kanes Creek because of the work already happening to address AMD in the watershed.

The major tasks during Phase 1 include:

- Developing a project team to drive wastewater activities in Knocking Run and Kanes Creek,
- collecting more data to pinpoint the largest contributors to wastewater pollution in both tributaries,
- working with entities expanding the Reedsville centralized system to assure maximum benefit from the project in Kanes Creek,
- locating funding sources to fund decentralized and onsite system pilot projects, and
- develop preliminary plans for wastewater decentralized system pilot projects to be installed in both tributaries.

Success of all tasks will ultimately be determined by the land owner support and available funding. Success of Phase 1 will be assessed in 2010 by the project team. Phase 2 priorities will be adjusted, if necessary, to reflect changes in needs to meet goals of Phase1.

Phase 2: 2010 to 2015: Assessment and Planning: Tibbs Run, Beulah Hollow, Aarons Creek and Preliminary Construction: Kanes Creek and Knocking Run

Phase 2 will involve construction of pilot projects in both Knocking Run and Kanes Creek. The remaining three subwatersheds will be assessed to determine location of major pollution sources. Preliminary plans to address sources and locating funding will take place during this phase. At the end of Phase 2 needs to meet goals of this watershed based will be evaluated for all five of the targeted subwatersheds.

During Phase 2 the DCRT will also begin to look at other sources of fecal coliform bacteria pollution, including livestock and wildlife. DCRT will work with local agents to identify additional fecal coliform bacteria sources and begin work on developing long term solutions to address the pollution.

8.3. Other nonpoint pollution problems

Specific plans for the elimination of other nonpoint pollution problems, specifically lead and sediment, cannot be developed without additional data. This WBP includes a plan to gather the data necessary to address these pollution sources. A later revision of this plan will set out an implementation schedule. The plan proceeds in three phases.

Phase 1: Preliminary monitoring (2006-2007): As described in Section 3, above, several areas with occasional or constant lead and sediment problems have been identified. During the first two years, this WBP calls for confirming the impairment in those areas and identifying the most important sources.

Measurable goals: identify major areas of impairment and methods for determining how they can be addressed.

Phase 2: Source monitoring and planning (2008-2009): During the second phase, monitoring will focus on gathering information needed to eliminate the problems. Procuring funds to implement remediation measures will also occur during this phase.

Measurable goals: Revise WBP to include implementation of remediation measures for other pollutants. Secure funding for implementation.

Phase 3: Implementation (2010-2014): During this phase, measures to reduce the loads of lead and sediments that impair the creek will be executed.

Measurable goals: Eliminate impairment by lead and sediment from the Deckers Creek stream system.

9. REMEDIATION MILESTONES

9.1. Acid Mine Drainage

Setting the most upstream AMD sources first in the schedule will produce fast results in headwater stream segments. In the year following remediation at a particular site, chemical water quality monitoring will indicate no violations of standards downstream (at least as far as the next major source). In the second year following remediation, a large increase in benthic macroinvertebrate numbers and community scores (e.g., the West Virginia Stream Condition Index, or WVSCI), will be noted. The third year following treatment will bring improvements in the fish community. In streams that are isolated from the mainstem by effects of other major AMD sources, DCRT will, in consultation with the West Virginia Division of Natural Resources, consider stocking fish.

Segments where these changes are predicted are listed in **Error! Reference source not found.**.

Table 32: Expected improvements in stream segments due to remediation activities

Subwatershed	Segments	Projects causing improvement	Expected year for improvement		
			Meets standards	*Improved WVSCI*	*Improved fish communities*
Kanes Creek	Mainstem above RM 3.2	Valley Highwall #3	2007	2008	2009
	UNT RM 3.2	Valley Point #12, Kanes Creek South site 1	2007	2008	2009
	Entire subwatershed down to UDCI 5	Sandy Run Highwall, Portals and Kanes Creek South site 3	2008	2009	2010
Laurel Run	Entire subwatershed	Burk Mine Drain	2008	2009	2010
Deckers Creek	Mainstem above Dillan Creek	Dalton site, and Kanes and Laurel subwatersheds	2008	2009	2010
Dillan Creek	From headwaters to Swamp Run	Dillan Creek #1	2009	2010	2011
Deckers Creek	Mainstem above Deep Hollow	Bretz (Methany) mine drainage, Glady Run Strips	2009	2010	2011
Deep Hollow	Entire subwatershed	Beulah Chapel portals	2010	2011	2012
Hartman Run	Entire subwatershed	Hartman Run Mine Drainage I and II	2010	2011	2012
Deckers Creek	Entire watershed	Cumulative projects, additional adaptive projects	2011	2012	2013

9.2. Fecal Coliform Bacteria

Five tributaries have been targeted for addressing fecal coliform bacteria from nonpoint source wastewater. During Phase 1, no system installation is scheduled. At the onset of Phase 2, remediation goals will be determined for based on expected system installation and other tasks to be completed.

10. ADAPTIVE MANAGEMENT OF WATERSHED GOALS

The DCRT will have opportunities to modify the plan at the first DCRT meeting of each calendar year. Changes in the plan should be considered as new data on sources, loads or impairment come to light, new treatment techniques are recognized, and as success of previous projects is recognized. The plan should continually be modified to reduce pollutant loads and to remove stream segments and stream miles from the impaired list.

11. MONITORING

Planning remediation measures, evaluating efficacy, and assessing the progress of the WBP will all require extensive monitoring. Several agencies and organizations currently monitor the Deckers Creek watershed, and will continue to do so.

<u>WVDEP Watershed Assessment Program:</u> According to WVDEP's five-year watershed management framework cycle, the agency performs in-depth monitoring of the state's watersheds every five years. The next monitoring year for the Monongahela River, which includes the Deckers Creek watershed, is scheduled to begin in summer 2009. These monitoring data will be helpful to show whether streams are improving or declining in quality. In addition to AMD water chemistry, technicians collect benthic macroinvertebrates to determine biological impairments and fecal coliform data to determine bacteria impairments. Technicians also perform sediment-related assessments. WVDEP will then use these data, plus data collected by other agencies and organizations, to make impairment decisions for the next 303(d) list.

<u>WVDEP Stream Restoration Group:</u> The Stream Restoration Group (SRG), which works within OAMLR, collects source data when WVDEP is designing a remediation project. SRG also monitors past OAMLR projects to assess their efficacy, and performs occasional sweeps across the whole watershed to help target projects.

<u>FODC monitoring programs</u>: FODC has a number of ongoing monitoring programs, and regularly initiates additional programs for specific purposes. The organization's central monitoring activity is the Clean Creek Program, which assesses water quality and pollution loads through chemical, physical, and bacteria measurements at 13 sites four times every year. It also assesses water quality through the fish and macroinvertebrate communities at those sites once a year. In FODC's Volunteer Monitoring Program, volunteers measure pH and conductivity at a variety of sites chosen to reveal important information. For example, one set of sites that a volunteer would monitor would reveal the effect of pollution from the Richard mine by monitoring sites above and below it on Deckers Creek. FODC is currently cooperating with OAMLR to monitor the effects of the recent project on Slabcamp Run. FODC plans to work with local agents to continue assessment of fecal coliform bacteria levels.

<u>Additional monitoring</u>: As this Watershed Based Plan is implemented, additional fecal coliform bacteria monitoring will be necessary to address nonpoint wastewater sources. FODC will monitor as needed and expects other agents, such as the County Health Department and Public Service Districts, to provide additional monitoring support.

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Appendix A

Table 33: Fecal coliform bacteria data for the Deckers Creek watershed

Sample date	Stream	Site code	Fecal coliform (cfu/100ml)	Flow (cfs)	Data source
11/6/2002	Aarons Creek	A1	50		FODC (2006a)
2/12/2003	Aarons Creek	A1	110	9.08	FODC (2006a)
5/21/2003	Aarons Creek	A1	280	13.24	FODC (2006a)
7/21/2003	Aarons Creek	A1	300	2.79	FODC (2006a)
10/24/2003	Aarons Creek	A1		3.21	FODC (2006a)
12/30/2003	Aarons Creek	A1	3	20.09	FODC (2006a)
5/28/2004	Aarons Creek	A1	130	18.26	FODC (2006a)
8/18/2004	Aarons Creek	A1	300	0.07	FODC (2006a)
11/22/2004	Aarons Creek	A1	34	16.99	FODC (2006a)
2/25/2005	Aarons Creek	A1	3	11.55	FODC (2006a)
6/9/2005	Aarons Creek	A1	4	7.24	FODC (2006a)
8/1/2005	Aarons Creek	A1	11	0.64	FODC (2006a)
11/18/2005	Aarons Creek	A1	4		FODC (2006a)
3/2/2006	Aarons Creek	A1	38		FODC (2006a)
5/17/2006	Aarons Creek	A1	25		FODC (2006a)
5/31/2006	Aarons Creek	A1	450	2.06	FODC (2006b)
5/31/2006	Aarons Creek	A1		2.06	FODC (2006a)
6/28/2006	Aarons Creek	A1	570	7.98	FODC (2006b)
5/17/2006	Aarons Creek	A2	57		FODC (2006b)
5/31/2006	Aarons Creek	A2	740	2.17	FODC (2006b)
6/28/2006	Aarons Creek	A2	260	7.45	FODC (2006b)
5/31/2006	Aarons Creek	A3	1	1.46	FODC (2006b)
6/28/2006	Aarons Creek	A3	115	4.68	FODC (2006b)
5/17/2006	Deep Hollow	B1	230		FODC (2006b)
5/31/2006	Deep Hollow	B1	38	0.25	FODC (2006b)
6/28/2006	Deep Hollow	B1	790	3.38	FODC (2006b)
5/17/2006	Deep Hollow	B2	5		FODC (2006b)
5/31/2006	Deep Hollow	B2	13	0.21	FODC (2006b)
6/28/2006	Deep Hollow	B2	700	3.38	FODC (2006b)
5/17/2006	Deep Hollow	B3	42		FODC (2006b)
5/31/2006	Deep Hollow	B3	16	2.9	FODC (2006b)
6/28/2006	Deep Hollow	B3	810	0.89	FODC (2006b)
6/28/2006	Deep Hollow	B4	960	0.89	FODC (2006b)
6/28/2006	Gamble Run	BH1	2100	0.8	FODC (2006b)
10/25/2002	Deckers mainstem	DH1	30		FODC (2006a)
2/14/2003	Deckers mainstem	DH1	3	2.26	FODC (2006a)
5/20/2003	Deckers mainstem	DH1	21	3.57	FODC (2006a)
7/22/2003	Deckers mainstem	DH1	2	1.24	FODC (2006a)
10/27/2003	Deckers mainstem	DH1		5.19	FODC (2006a)
2/18/2004	Deckers mainstem	DH1			FODC (2006a)
5/14/2004	Deckers mainstem	DH1	4		FODC (2006a)
8/12/2004	Deckers mainstem	DH1	900	0.39	FODC (2006a)
11/10/2004	Deckers mainstem	DH1	3	4.52	FODC (2006a)
3/16/2005	Deckers mainstem	DH1	3		FODC (2006a)
6/10/2005	Deckers mainstem	DH1	3	3.6	FODC (2006a)
8/4/2005	Deckers mainstem	DH1	8	0.46	FODC (2006a)
11/17/2005	Deckers mainstem	DH1	4		FODC (2006a)
3/3/2006	Deckers mainstem	DH1	28		FODC (2006a)
5/17/2006	Deckers mainstem	DH1	2		FODC (2006b)
5/31/2006	Deckers mainstem	DH1	25	1.34	FODC (2006b)
5/31/2006	Deckers mainstem	DH1		1.34	FODC (2006a)
6/28/2006	Deckers mainstem	DH1	340	7.61	FODC (2006b)
5/17/2006	Glady to Tibbs	GT2	50		FODC (2006b)
5/31/2006	Glady to Tibbs	GT2	1640	30.1	FODC (2006b)
5/17/2006	Wolf Run/Knocking Run	K1	590		FODC (2006b)
5/31/2006	Wolf Run/Knocking Run	K1	570	0.11	FODC (2006b)

Table 34: Fecal coliform bacteria data for the Deckers Creek watershed, *continued*

Sample date	Stream	Site code	Fecal coliform (cfu/100ml)	Flow (cfs)	Data source
5/17/2006	Knocking Run	K2	8400		FODC (2006b)
5/31/2006	Knocking Run	K2	4300	0.18	FODC (2006b)
5/17/2006	Kanes Creek	KA2	1		FODC (2006b)
5/31/2006	Kanes Creek	KA2	210	0.62	FODC (2006b)
6/28/2006	Kanes Creek	KA2	560	1.81	FODC (2006b)
11/6/2002	Deckers mainstem	SOTC1	23		FODC (2006a)
2/12/2003	Deckers mainstem	SOTC1	8	59.26	FODC (2006a)
5/21/2003	Deckers mainstem	SOTC1	350	93.02	FODC (2006a)
7/21/2003	Deckers mainstem	SOTC1	500	34.04	FODC (2006a)
10/14/2003	Deckers mainstem	SOTC1	4	24.12	FODC (2006a)
12/29/2003	Deckers mainstem	SOTC1	3	141.93	FODC (2006a)
5/28/2004	Deckers mainstem	SOTC1	240	107.43	FODC (2006a)
8/18/2004	Deckers mainstem	SOTC1	500	6.57	FODC (2006a)
11/22/2004	Deckers mainstem	SOTC1	22	247.06	FODC (2006a)
2/25/2005	Deckers mainstem	SOTC1	3	105.63	FODC (2006a)
6/9/2005	Deckers mainstem	SOTC1	3	60.14	FODC (2006a)
8/1/2005	Deckers mainstem	SOTC1	8	5.93	FODC (2006a)
11/18/2005	Deckers mainstem	SOTC1	4		FODC (2006a)
3/2/2006	Deckers mainstem	SOTC1	39		FODC (2006a)
5/31/2006	Deckers mainstem	SOTC1		37.61	FODC (2006a)
10/15/2003	Deckers mainstem	SOTC2	12	12.54	FODC (2006a)
1/2/2004	Deckers mainstem	SOTC2	7	35.2	FODC (2006a)
6/2/2004	Deckers mainstem	SOTC2	27	11.65	FODC (2006a)
8/11/2004	Deckers mainstem	SOTC2	300	0.85	FODC (2006a)
11/10/2004	Deckers mainstem	SOTC2	34	11.51	FODC (2006a)
3/15/2005	Deckers mainstem	SOTC2	3	19.6	FODC (2006a)
6/10/2005	Deckers mainstem	SOTC2	4	7.98	FODC (2006a)
8/4/2005	Deckers mainstem	SOTC2	4	0.35	FODC (2006a)
11/17/2005	Deckers mainstem	SOTC2	8		FODC (2006a)
3/3/2006	Deckers mainstem	SOTC2	790		FODC (2006a)
5/31/2006	Deckers mainstem	SOTC2		4.3	FODC (2006a)
11/6/2002	Tibbs Run	T1	30		FODC (2006a)
2/12/2003	Tibbs Run	T1	23	4.2	FODC (2006a)
5/21/2003	Tibbs Run	T1	80	8.19	FODC (2006a)
7/21/2003	Tibbs Run	T1	70	2.83	FODC (2006a)
10/15/2003	Tibbs Run	T1	8	4.34	FODC (2006a)
12/30/2003	Tibbs Run	T1	4	11.27	FODC (2006a)
6/2/2004	Tibbs Run	T1	240	3.5	FODC (2006a)
8/18/2004	Tibbs Run	T1	1600	0.28	FODC (2006a)
11/22/2004	Tibbs Run	T1	6	10.24	FODC (2006a)
2/25/2005	Tibbs Run	T1	3		FODC (2006a)
6/9/2005	Tibbs Run	T1	13	2.86	FODC (2006a)
8/1/2005	Tibbs Run	T1	110	0.71	FODC (2006a)
11/18/2005	Tibbs Run	T1	13		FODC (2006a)
3/2/2006	Tibbs Run	T1	37		FODC (2006a)
5/17/2006	Tibbs Run	T1	980		FODC (2006b)
5/31/2006	Tibbs Run	T1	410	2.9	FODC (2006b)
5/31/2006	Tibbs Run	T1		2.9	FODC (2006a)
5/31/2006	Tibbs Run	T4	490	0.1	FODC (2006b)
6/28/2006	Tibbs Run	T4	410	0.2	FODC (2006b)
10/14/2003	Dillan Creek		3	1.55	FODC (2006a)
1/2/2004	Dillan Creek		4	23.77	FODC (2006a)
6/2/2004	Dillan Creek		23	4.52	FODC (2006a)
8/11/2004	Dillan Creek		300	0.85	FODC (2006a)
11/12/2004	Dillan Creek		240	13.31	FODC (2006a)
3/16/2005	Dillan Creek		3		FODC (2006a)
6/10/2005	Dillan Creek		13		FODC (2006a)
8/5/2005	Dillan Creek		30	0.14	FODC (2006a)

Table 35: Fecal coliform bacteria data for the Deckers Creek watershed, *continued*

Sample date	Stream	Site code	Fecal coliform (cfu/100ml)	Flow (cfs)	Data source
11/17/2005	Dillan Creek		6		FODC (2006a)
3/3/2006	Dillan Creek		2		FODC (2006a)
5/31/2006	Dillan Creek			5.19	FODC (2006a)

APPENDIX B

The following calculations for fecal coliform bacteria loads are based on load calculations from the Upper Guyandotte Watershed Based Plan (UGWA, 2006, Appendix C). Modifications made to reflect needs of Deckers Creek watershed. See Table 21 for targeted watershed loads.

EXPECTED FECAL COIFORM BATERIA LOADS FROM 100% UNTREATED WASTEWATER FROM UNKNOWN SYSTEMS

Average daily discharge of household wastewater = 70 *gallons/person/day* (Horsley and Witten, 1996)

Concentration of fecal coliform bacteria in untreated wastewater = $1.0\text{x}10^{6}$ *cfu/100mL* (Horsley and Witten, 1996)

Average number of persons per household in the Deckers Creek Watershed (average for Monongalia County (2.3) and Preston County (2.5)) = 2.4 (US Census Bureau, 2000)

$$\left(70\, gallons\ /\ person\ /\ day \right) \times \left(\frac{1mL}{2.64 \times 10^{-4}\, gallons} \right) \times 2.4\, persons\ /\ household = 6.37 \times 10^{5}\, mL\ /\ household\ /\ day$$

$$6.37 \times 10^{5}\, mL\ /\ household\ /\ day \times \left(\frac{1 \times 10^{6}\ \text{colony forming units}}{100\, mL} \right) \times 365\, days\ /\ year = 2.33 \times 10^{12}\, cfu\ /\ household\ /\ year$$

($2.33\text{x}10^{12}$ *cfu/household/year*) x (no. of homes with failing septic or straight pipe) = **Fecal coliform bacteria from 100% untreated wastewater from parcels with unknown systems**

CURRENT INSTREAM LOADS (CFU/YEAR)

Current instream loads were calculated using average fecal coliform bacteria concentrations and flows from Table 19.

$$\frac{\text{Fecal coliform bacteria concentration } (cfu)}{100\ ml} \times \frac{28{,}316\ ml}{1\ ft^{3}} \times \text{average flow } (cfs) \times \frac{31{,}536{,}000\ seconds}{1\ year} = \textbf{Fecal coliform load (cfu/year)}$$

EXPECTED LOADS AFTER INSTALLATION OF NEW SEPTIC SYSTEMS

Typical inefficiency of a properly maintained septic system = 1% (USEPA, 2002b).

(*Load*) x 0.01 = Total annual load from permitted septic systems