Operation, Maintenance, and Replacement Plan for AMD Remediation Projects in Huntingdon County, PA

Old Neversweat Passive Treatment System
Benedict Passive Treatment System
Miller Run #1 and #2 Passive Treatment Systems
Minersville Passive Treatment System
and
Hartman Run, Miller Run, and Kennedy Run Limestone Sand Dosing Projects

Prepared for the Huntingdon County Conservation District
By Skelly and Loy, Inc.
Through the Trout Unlimited
AMD Technical Assistance Program

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OPERATION, MAINTENANCE, AND REPLACEMENT PLAN FOR AMD REMEDIATION PROJECTS IN HUNTINGDON COUNTY, PA

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Background

The Shoup Run watershed is located in numerous townships in the southeastern corner of Huntingdon County, Pennsylvania. From its headwaters to its confluence with the Raystown Branch of the Juniata River, the watershed is primarily forested and is classified as a warm water fishery (WWF). Shoup Run enters the Raystown Branch of the Juniata River at Saxton (HUC = 02050303). Three main tributaries to Shoup Run, including Miller Run, Kennedy Run, and Hartman Run, are the focus streams for the abandoned mine drainage (AMD) remediation systems of this operation, maintenance, and replacement (OM&R) plan.

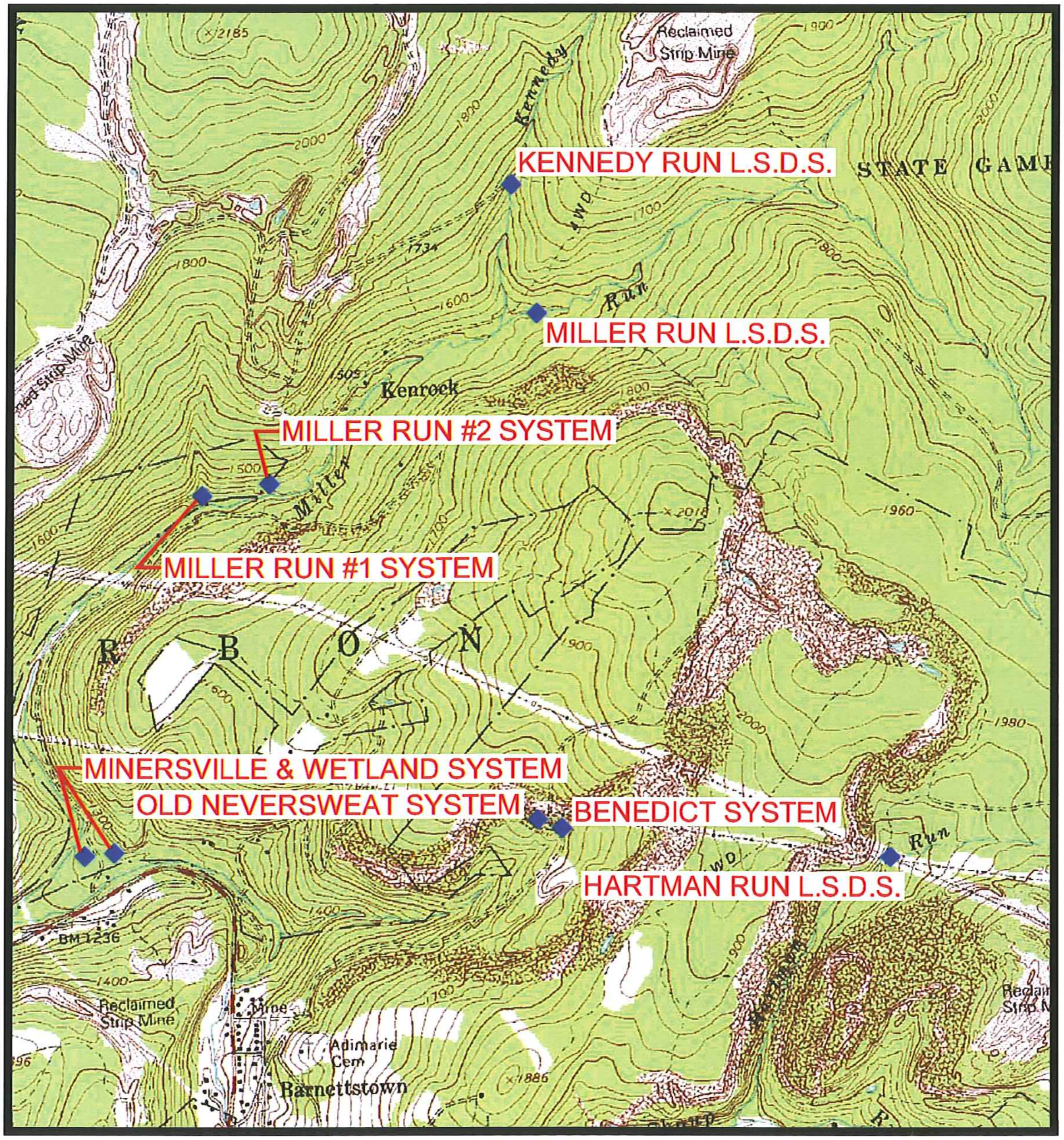
The impacts of abandoned underground and surface coal mines have severely impaired the aquatic life in Shoup Run. Old mining operations have resulted in at least 11 AMD sites in the Shoup Run watershed. The AMD discharges further lower the naturally low pH and produce elevated dissolved metals concentrations in Shoup Run. The entire 7.7-mile mainstem of Shoup Run, 2.4-mile mainstem of Miller Run, and 1.1-mile mainstem of Hartman Run are listed as impaired on the Pennsylvania Department of Environmental Protection's (PA DEP) 303(d) list for both pH and metals as a result of the AMD discharges. There are five priority AMD discharges along the mainstem of Miller Run and an unnamed tributary to Shoup Run in addition to the limestone sand dosing sites along Miller Run, Kennedy Run, and Hartman Run. The five AMD discharges that include Old Neversweat Mine, Benedict Mine, Miller Run #1, Miller Run #2, and Minersville are currently remediated by passive treatment to increase pH, provide excess alkalinity, and reduce metals loading, specifically iron and aluminum to help restore the water quality in Shoup Run. The AMD discharges are characterized as low to moderately net acidic with moderate to high dissolved aluminum and low to moderate iron concentrations. Overall, these discharges contribute approximately 3.5 tons of aluminum, 0.4 ton of iron, and 31.5 tons of acidity annually to Shoup Run.

Huntingdon County Conservation District (HCCD) and Shoup's Run Watershed Association (SRWA) received Growing Greener Grant funding for the design and construction of five passive treatment systems and limestone sand dosing areas at these five high priority AMD discharges and three Shoup Run tributary sites (see Figure 1 for a location map of all sites). HCCD and SRWA selected Skelly and Loy, Inc. and Natural Resources Conservation Service (NRCS) to design the passive treatment systems and limestone sand dosing sites. The five passive treatment systems were designed for an estimated 20- to 25-year life based on the volume of limestone within each system. Each of the three limestone sand dosing sites on Miller, Kennedy, and Hartman Runs has several stockpiles of sand anticipated to last for several years. Both HCCD and SRWA volunteers are committed to providing long-term OM&R activities for all of the constructed passive AMD treatment systems and limestone sand dosing sites in the Shoup Run and tributary watersheds.

In the limestone ponds, the AMD discharges pass through the high calcium carbonate limestone (typically greater than 80% $CaCO_3$) and dissolves the limestone to impart alkalinity and neutralize acidity. The net alkaline water from the limestone ponds is typically routed through settling or retention ponds for precipitation of the metals, primarily iron and aluminum. Both passive flushing systems and automatic dosing siphons were designed to aid in the removal of aluminum and iron precipitates from the void spaces in the limestone ponds. Before their treatment, the individual AMD discharges were characterized as follows:

Shoup Run Watershed Raw AMD Discharges Characterization

SITE	FLOW (gpm)	pH (SU)	ALKALINITY (mg/L)	ACIDITY (mg/L)	TOTAL IRON (mg/L)	TOTAL ALUMINUM (mg/L)	TOTAL MANGANESE (mg/L)
Old Never-sweat	30.0	3.4	0.0	120.0	0.5	10.0	2.0
Benedict	25.0	4.5	0.0	25.0	0.7	1.0	0.7
Miller Run #1	35.0	4.0	0.0	20.0	<0.5	2.0	0.8
Miller Run #2	10.0	4.0	0.0	40.0	0.5	2.5	1.4
Minersville #1	90.0	2.7	0.0	100.0	1.4	12.8	2.2
Minersville #2	6.0	2.9	0.0	85.0	2.0	9.5	2.5



L.S.D.S. = LIMESTONE SAND DOSING SITE

SOURCE: U.S.G.S. 7.5' QUADRANGLE – SAXTON, PENNSYLVANIA

SKELLY and LOY Inc. ENGINEERS–CONSULTANTS	07/07/11	FIGURE 1

SHOUP RUN AMD REMEDIATION PROJECTS–OM&R PLAN

LOCATION MAP

CARBON TOWNSHIP
HUNTINGDON COUNTY, PA

JOB #.: R10-0471.001	SCALE: 1"=2,000'

Old Neversweat Treatment System

Site Description

GPS Coordinates for the Site = 40° 13' 6.7" N and -78° 9' 49.7" W
The Old Neversweat system is located along a private access road off of T.R. 339 in the town of Dudley, which is accessed near the Ave Maria Cemetery. There is a removable guard rail to enter the private access road off of T.R. 339.

The source of this discharge is an old surface mine on the site, which created a ponded area for the AMD within a small pit surrounded by spoil piles. This AMD discharge is characterized as fairly consistent with respect to flow rate and has historically averaged 30 gallons per minute (gpm). The passive treatment system (see Figure 2) was designed to treat the Old Neversweat AMD discharge with an open limestone pond for alkalinity generation followed by two small settling ponds for detention of the treated water to capture the aluminum precipitates. Despite the undefined location of the AMD seepage, all of the raw AMD directly enters the limestone pond, containing approximately 600 tons of limestone in a 3.5-foot-deep layer with two perforated pipes within the bottom of the limestone bed. Based on an average flow of 30 gpm directed into the system and historic water chemistry data, it was calculated that the amount of limestone used in the limestone pond and calculated retention time based on the automatic dosing siphon cycle would produce enough alkalinity to raise the pH and precipitate the dissolved aluminum in the AMD. The perforated pipes were specified for placement near the bottom of the limestone layer and attached to an automatic dosing siphon contained within a concrete manhole installed within the constructed berm between the limestone pond and first settling pond on the north side of the access road. The automatic dosing siphon provides for both normal outflow and flushing each time that it operates based on the flow rate entering the limestone pond. A manual valve was also installed to bypass the automatic dosing siphon to allow periodic manual flushing of the limestone pond as needed. The water is then directed out of the limestone pond and into a small settling pond (Settling Pond #1A) where the aluminum precipitates are settled and retained. Connected by a culvert, a second settling pond (Settling Pond #1B) located on the south side of the access road serves as the final polishing component of the passive treatment system, which provides the retention and capacity to settle and retain the remaining aluminum precipitates. A perforated riser pipe with a surface bar guard was specified as the final outlet structure in Settling Pond #1B to allow the water to gradually discharge from the settling ponds between flush cycles from the automatic dosing siphon.

An automatic dosing siphon within a concrete manhole was designed and installed to outlet and flush the water and aluminum precipitates from the limestone bed. The automatic dosing siphon operates based on flow rate into the limestone bed and water within the bed reaching a specific elevation referred to as the high water line. Upon reaching the high water line, the automatic dosing siphon begins siphoning water from two perforated pipes near the bottom of the limestone bed until the water level reaches the low water line. The limestone bed, which contains high calcium carbonate limestone (typically greater than 80% $CaCO_3$), dissolves when in contact with the AMD to impart alkalinity and neutralize acidity. During each flush cycle from the automatic dosing siphon, the limestone contacted AMD water is routed into the first of two small settling ponds, one on either side of the access road with a 48" HDPE pipe under the road connecting the ponds. The culvert pipe provides additional storage capacity and hydraulically connects the two settling ponds, which allow for the settling and retaining of the metal precipitates, primarily aluminum. Skelly and Loy designed the automatic flushing system for the limestone bed to aid in the removal of aluminum precipitates from the void spaces in the limestone pond and maintain its porosity.

The outfall from the Settling Pond #1B perforated riser pipe serves as the final discharge that enters a rock-lined ditch immediately downstream of the settling pond that originally served as the AMD channel that eventually enters the unnamed tributary to Shoup Run. The limestone pond was lined only with geotextile to create a barrier between the excavated pit and placed limestone. The limestone pond and Settling Pond #1B have emergency spillways in case flows in the system exceed the capacity of the individual outlet structures or if they become clogged and have limited or no capacity.

When properly functioning, the passive treatment system is expected to reduce aluminum concentrations by 85% and remove all of the acidity in the final system outfall.

Operational Check-Up

In order to ensure the proper operation of the passive treatment system for the AMD discharge, water quality sampling and flow measurements at various locations within the system must be collected and monitored. The water quality sampling and flow measurement events must be conducted prior to any manual or automatic flushing events from the different treatment system components, due to their potential impact on the results. Water quality sampling and flow measurements should be collected at the final system outfall location (see Figure 2) at least once every six months to provide periodic snapshots of the operations and effectiveness of the system. Other identified sampling locations at the site should be monitored for flow and water chemistry as needed based on results of the regularly monitored location to troubleshoot problems, including the raw AMD where possible and outfall from each system component.

Flow rates must be measured at all locations, wherever possible especially where water (AMD) enters and leaves the passive treatment system. However, the raw AMD discharge into the Limestone Pond will be difficult to measure flow and even water quality because of the methods of introduction into the respective treatment pond. In addition, understanding flow rates of the limestone-containing pond may help to identify problems associated with hydraulic conductivity or permeability of the limestone bed. All locations identified as flow measurement locations for the passive treatment system should be measured using the bucket and stopwatch approach or installation of weirs or through visual estimation if necessary. As indicated above, the flow measurements and water quality sampling should be conducted every six months at a minimum at the final system outfall.

Flow and Water Chemistry Sampling Points:

1 – AMD Discharge Area in Limestone Pond (Water Chemistry only)
*2 – Outfall From Outlet Structure/Riser Pipe (Settling Pond #1B/Final System Outfall)

*This sampling location should be monitored every six months to monitor system performance and using the results of the water chemistry analyses to determine when sampling is needed at the additional locations.

Water quality sampling should include both field measurements and water samples collected and sent for analysis to an off-site independent laboratory. Water samples collected and sent to an off-site independent laboratory for analysis should be performed at least once every six months at the final system outfall and should include the following parameters for analysis.

- Total Iron
- Total Aluminum
- Total Manganese
- Total Alkalinity
- Hot Acidity
- pH

Normally, the primary sampling location (final system outfall) should be tested for the above parameters, but additional parameters are recommended should results from a sampling event indicate problems with the treatment system. In order to investigate the problem, dissolved metals analysis for both iron and aluminum may be necessary at certain sampling locations. For the dissolved iron and aluminum analyses, the water sample can be either filtered in the field and placed directly into a nitric acid preserved bottle (after filtering) or sent to the laboratory unpreserved (no nitric acid) for filtering. If the limestone pond is not working properly, it will allow dissolved metals to persist through the system and can be checked at different outfalls to determine the source of the problem, which may not be concluded from a total metals analysis.

In addition to the standard laboratory analyses performed at least twice a year, other field analyses should be performed more frequently at the system outfall if possible to closely track the system operation to serve as indicators for maintenance. Field kits and meters can be used to easily measure parameters at the site for such things as acidity, alkalinity, total iron, and pH. Since certain components of the treatment system may require somewhat frequent maintenance, as often as once per quarter for flushing the limestone pond, it would be advantageous to simultaneously measure some of the parameters easily measured in the field such as acidity, alkalinity, and pH at the final outfall location. However, it is important to note that water quality measurements should not be collected for the final outfall during a flushing event from the upstream limestone pond. Locations recommended for field testing of water quality (at a minimum pH, acidity, and alkalinity) during more frequent maintenance activities at the treatment system should include the following.

Water Quality and Flow Sampling Point:
2 – Outfall From Outlet Structure/Riser Pipe (Settling Pond #1B/Final System Outfall)

Maintenance Activities

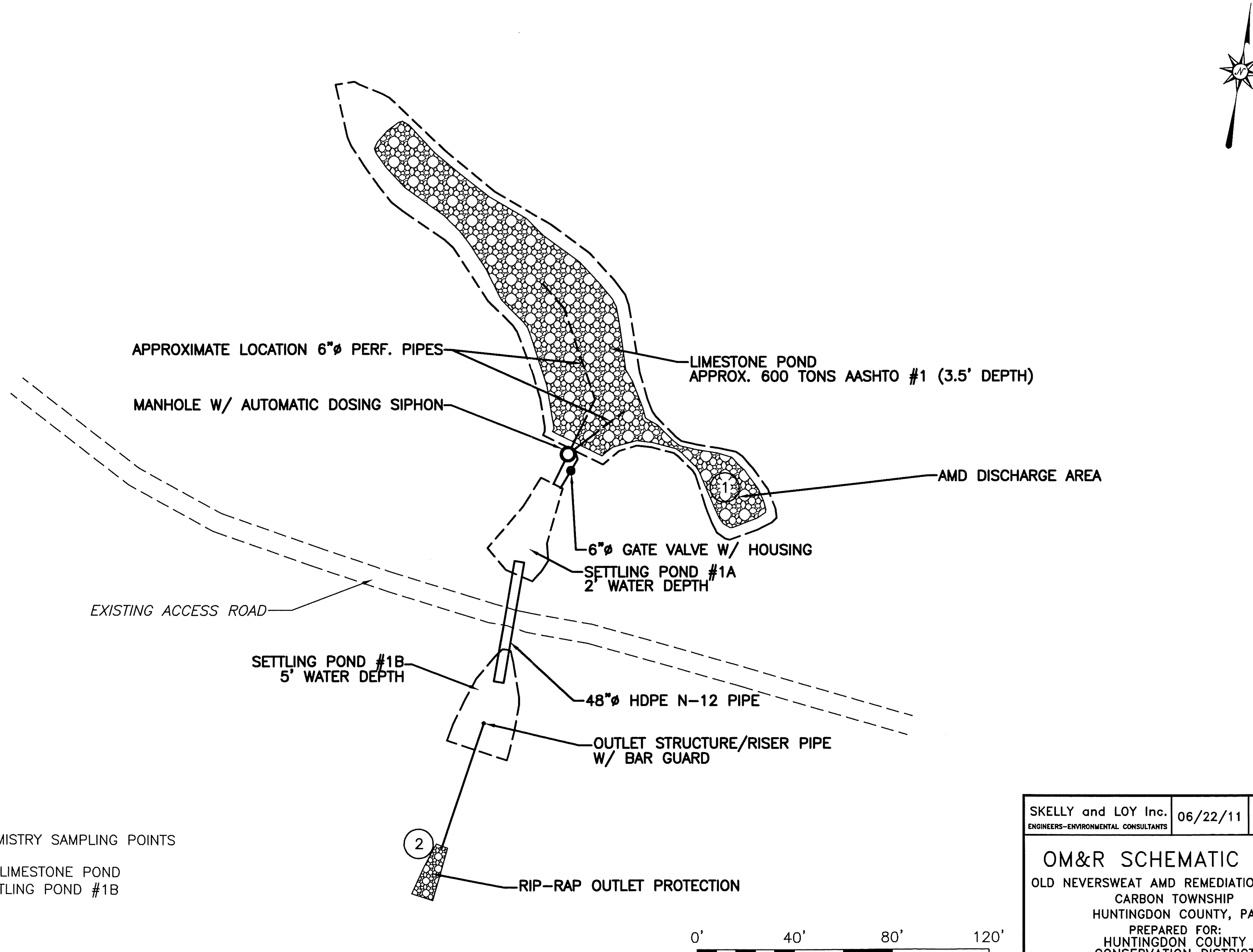
<u>Limestone Pond</u>
This limestone pond is operated by an automatic dosing siphon which performs automatic flushes of the limestone bed regularly based on flow rates of the AMD discharge. However,

checking the operation of the automatic dosing siphon and stirring or replacing the limestone material will all need to be performed at differing frequencies to keep this component functioning properly. Depending on the duration of maintenance site visits, it may be difficult to discern the cycle of the automatic dosing siphon, since the unit may operate up to an hour, then shut off for several hours before activating again. The primary goal is to check to make sure that the dosing siphon is performing this on/off cycle and to make sure that it is not constantly discharging water or never discharging water at all. If the limestone pond outfall indicates that the AMD is not being treated adequately (adequate treatment defined as having pH of 5.0 or greater and 50% or more dissolved Al removal), arrangements should be made to stir up the top few feet of limestone in the limestone pond with a piece of equipment such as a backhoe, making sure to not damage the perforated piping at the bottom of the pond. During the stirring operation, the water level in the limestone bed may be lowered using the manual flush valve as needed. The limestone bed may also show signs of reduced volume in certain areas due to the limited space available, level of acidity, and source location of the raw AMD. If these reduced volume areas are observed and treatment efficiency is compromised, then limestone (AASHTO #1) should be added to the limestone pond as needed to maintain the top of stone above the maximum water surface elevation. Any accumulation of leaves or other debris on the surface of the limestone pond should be removed as well, which can readily be accomplished by hand or with rakes and shovels. Manual operation of the flush valve installed adjacent to the automatic dosing siphon manhole should be performed at least every six months to assist with the continued removal of aluminum precipitates from the limestone bed.

Settling Ponds #1A and #1B

Settling Ponds #1A and #1B receives the limestone pond outfall from the automatic dosing siphon and manual flush valve. The settling ponds are hydraulically connected by a 48" HDPE culvert pipe that should be checked for debris accumulation during each site visit. The primary outlet from the settling ponds is an outlet structure/perforated riser pipe with an emergency spillway in the downstream berm to handle excess flows in the pond or problems with the primary outlet. Each time that a site visit is conducted for maintenance and monitoring, which should be every six months for the limestone pond or more often as needed based on system operation, the perforated riser should be inspected for debris accumulation around the surface bar guard and perforations and removed as needed. It is imperative to ensure that the perforations remain open to allow the settling ponds to adequately dewater between flush events from the automatic dosing siphon.

Sludge accumulation within Settling Ponds #1A and #1B is dependent on the treatment efficiency of the limestone pond and flow rates entering the settling ponds. However, every three years, the sludge levels in the bottom of Settling Ponds #1A and #1B should be measured. Once the sludge levels accumulate to more than one foot at any location within the settling ponds, steps should be taken to perform a sludge clean-out event. Depending on the method used for sludge cleanout, dewatering most or all of the water from the pond will be necessary by pumping from Settling Pond #1B and opening the manual flush valve to drain the limestone pond. The sludge material should be removed immediately after pumping and draining all the ponds, preferably during low flow conditions, before the water level accumulates high enough in the limestone pond to operate the automatic dosing siphon. If problems are encountered, however, the potential exists to route the inflow from the automatic dosing siphons temporarily around the settling ponds by installing some temporary pipe. Methods of sludge removal include the use of a vacuum truck, pumping and dewatering the sludge material in a geomembrane textile bag, or completely dewatering the pond and using heavy equipment with a bucket to remove the material and place it in a pile on the site for drying before hauling off-site. Upon removal of the sludge material from Settling Ponds #1A and #1B, the inflow from the limestone pond may be directed back into the ponds.



(#) – FLOW AND WATER CHEMISTRY SAMPLING POINTS

1 – RAW AMD AT SOURCE IN LIMESTONE POND
2 – FINAL OUTFALL FROM SETTLING POND #1B

SKELLY and LOY Inc. ENGINEERS–ENVIRONMENTAL CONSULTANTS	06/22/11	FIGURE 2
OM&R SCHEMATIC PLAN OLD NEVERSWEAT AMD REMEDIATION SYSTEM CARBON TOWNSHIP HUNTINGDON COUNTY, PA PREPARED FOR: HUNTINGDON COUNTY CONSERVATION DISTRICT		
R10-0471.001	SCALE: 1" = 40'	

Benedict Treatment System

Site Description

GPS Coordinates for the Site = 40° 13' 6.3" N and -78° 9' 46.7" W
The Benedict system is located along a private access road off of T.R. 339 in the town of Dudley, which is accessed near the Ave Maria Cemetery. There is a removable guard rail to enter the private access road off of T.R. 339.

The source of this discharge is an old surface mine on the site that historically flowed down a channel, formed a small ponded area upstream of a culvert, then through the culvert and ultimately to an unnamed tributary to Shoup Run. This AMD discharge, which includes two seeps as shown on Figure 3, is characterized as inconsistent with respect to flow rate and has historically ranged from a few gpm to 50 gpm with an average of approximately 20 gpm. The passive treatment system (see Figure 3) was designed to treat the Benedict AMD discharge with an open limestone pond for alkalinity generation followed by segments of limestone channel lining and a limestone sand dosing area to remove the limited acidity and aluminum concentrations. The raw AMD discharges directly enter the limestone pond, containing approximately 120 tons of limestone in a 3-foot-deep layer with a perforated pipe within the bottom of the downstream end of the limestone bed. Based on an average flow of 20 gpm directed into the system and historic water chemistry data, it was calculated that the amount of limestone used in the limestone pond would produce enough alkalinity to raise the pH and precipitate the small amount of dissolved aluminum in the AMD. The perforated pipe was specified for placement near the bottom and downstream end of the limestone layer and attached to a 3-foot-tall riser pipe with Fernco fitting to maintain the water level within the limestone bed and serve as the outfall structure into the limestone lined area at the upstream end of the replaced culvert under the access road. After flowing through the culvert, the treated water enters another segment of limestone-lined channel where limestone sand that is stockpiled at the site may be placed to add alkalinity into the water prior to entering the unnamed tributary to Shoup Run.

The Fernco fitting on the riser pipe outlet structure from the limestone pond allows for draining and flushing of the limestone bed, which is attached to a perforated pipe near the bottom of the downstream end of the limestone bed. The limestone bed, which contains high calcium carbonate limestone (typically greater than 80% $CaCO_3$), dissolves when in contact with the AMD to impart alkalinity and neutralize acidity. The limestone area that receives the outfall from the limestone pond allows for accumulation of the limited aluminum precipitates and also imparts additional alkalinity to the water prior to entering the 18" HDPE culvert. The culvert pipe routes the water underneath the access road and outlets onto a 40-foot segment of limestone-lined channel that the AMD historically flowed through enroute to the unnamed tributary. This final segment of limestone-lined channel allows for additional alkalinity to be added to the AMD by both the limestone lining and limestone sand that may be placed within the segment that is stockpiled at the site.

When properly functioning, the passive treatment system is expected to reduce dissolved aluminum concentrations by 75% and remove all of the acidity in the final system outfall.

Operational Check-Up

In order to ensure the proper operation of the passive treatment system for the AMD discharge, water quality sampling and flow measurements at various locations within the system must be collected and monitored. The water quality sampling and flow measurement events must be conducted prior to any manual flushing event from the limestone pond due to their potential impact on the results. Water quality sampling and flow measurements should be collected at the final system outfall location (see Figure 3) at least once every six months to provide periodic snapshots of the operations and effectiveness of the system. Other identified sampling locations at the site should be monitored for flow and water chemistry as needed based on results of the regularly monitored location to troubleshoot problems, including the raw AMD where possible and outfall from each system component.

Flow rates must be measured at all locations, wherever possible especially where water (AMD) enters and leaves the passive treatment system. In addition, understanding flow rates of the limestone-containing pond may help to identify problems associated with hydraulic conductivity or permeability of the limestone bed. All locations identified as flow measurement locations for the passive treatment systems should be measured using the bucket and stopwatch approach or installation of weirs or through visual estimation if necessary. As indicated above, the flow measurements and water quality sampling should be conducted every six months at a minimum at the final system outfall.

Flow and Water Chemistry Sampling Points:

1 – Smaller (Northern) AMD Discharge (Raw Upstream of Limestone Pond))
2 – Larger (Southern) AMD Discharge (Raw Upstream of Limestone Pond)
3 – Outlet/Downstream End of 18" Culvert (Limestone Pond Outfall)
*4 – Downstream End of Rock-Lined Channel and Limestone Sand Dosing Area (Final System Outfall)

*This sampling location should be monitored every six months to monitor system performance and using the results of the water chemistry analyses to determine when sampling is needed at the additional locations.

Note: Some locations may require modification of the rock-lined channel by either installing a weir or pipe to provide a discrete location in each for measuring flow and collecting water samples. Otherwise, these locations might only be sampled for water chemistry.

Water quality sampling should include both field measurements and water samples collected and sent for analysis to an off-site independent laboratory. Water samples collected and sent to an off-site independent laboratory for analysis should be performed at least once every six months at the final system outfall and should include the following parameters for analysis.

- Total Iron
- Total Aluminum
- Total Manganese

- Total Alkalinity
- Hot Acidity
- pH

Normally, the primary sampling location (final system outfall) should be tested for the above parameters, but additional parameters are recommended should results from a sampling event indicate problems with the treatment system. In order to investigate the problem, dissolved metals analysis for both iron and aluminum may be necessary at certain sampling locations. For the dissolved iron and aluminum analyses, the water sample can be either filtered in the field and placed directly into a nitric acid preserved bottle (after filtering) or sent to the laboratory unpreserved (no nitric acid) for filtering. If the limestone pond is not working properly, it will allow dissolved metals to persist through the system and can be checked at the limestone pond outfall, which may not be concluded from a total metals analysis.

In addition to the standard laboratory analyses performed at least twice a year, other field analyses should be performed more frequently at the system outfall if possible to closely track the system operation to serve as indicators for maintenance. Field kits and meters can be used to easily measure parameters at the sites for such things as acidity, alkalinity, total iron, and pH. Since certain components of the treatment system may require somewhat frequent maintenance, as often as twice per year for flushing the limestone pond, it would be advantageous to simultaneously measure some of the parameters easily measured in the field such as acidity, alkalinity, and pH at the final outfall location. However, it is important to note that water quality measurements should not be collected for the final outfall during a flushing event from the upstream limestone pond. Locations recommended for field testing of water quality (at a minimum pH, acidity, and alkalinity) during more frequent maintenance activities at the treatment system should include the following.

Water Quality and Flow Sampling Point:
4 – Downstream End of Rock-Lined Channel and Limestone Sand Dosing Area (Final System Outfall)

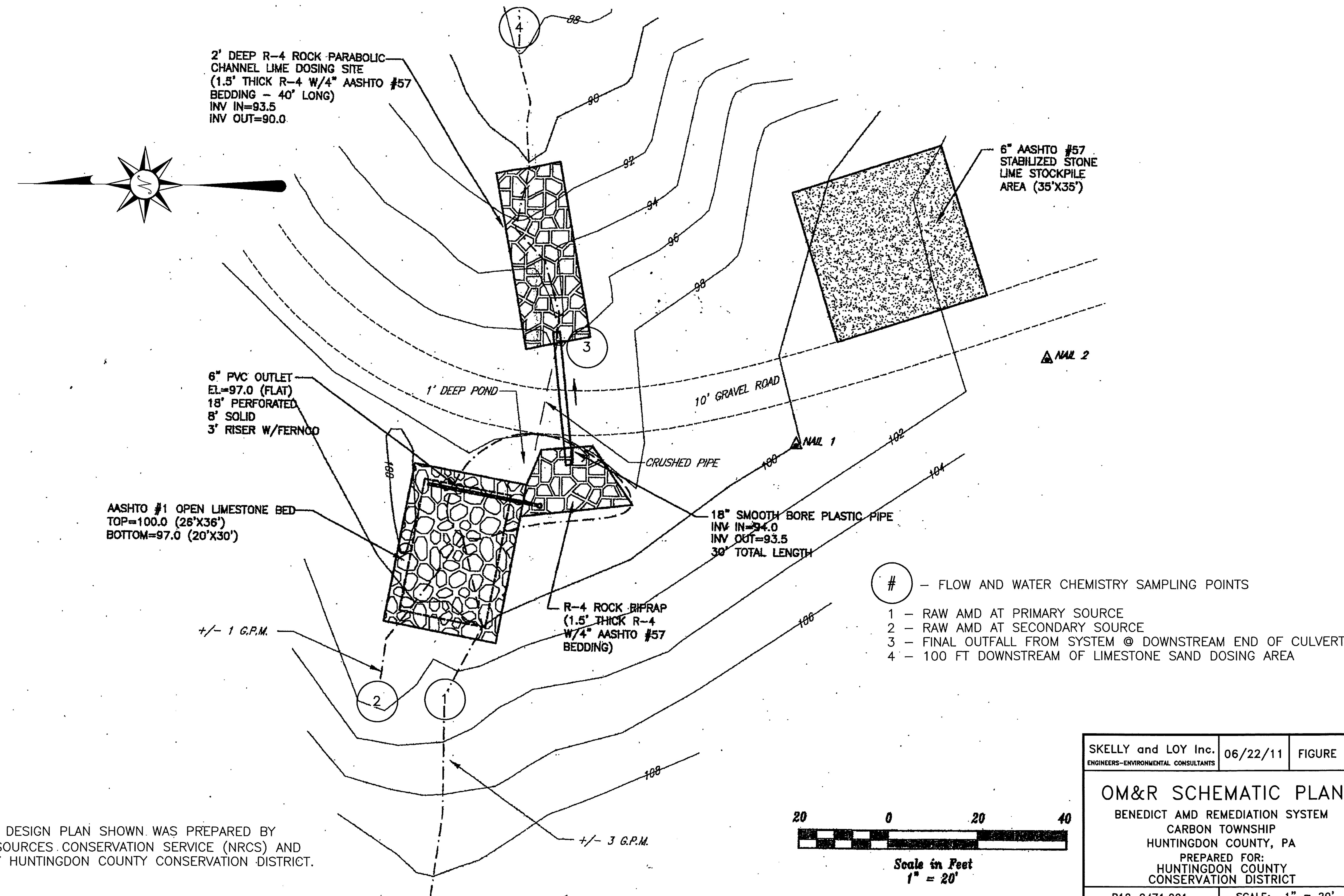
Maintenance Activities

<u>*Limestone Pond*</u>

This limestone pond is operated by a piping network within the limestone bed connected to a riser pipe and Fernco fitting downstream of the limestone pond. This piping system allows the height of the riser pipe to control the water level within the limestone bed and also allows removal of the riser at the Fernco fitting to drain or flush the limestone pond. Checking the operation of the riser to ensure that it continues to discharge water and stirring or replacing the limestone material will all need to be performed at differing frequencies to keep the limestone pond functioning properly. If the limestone pond outfall indicates that the AMD is not being treated adequately (adequate treatment defined as having pH of 5.0 or greater and 50% or more dissolved Al removal), arrangements should be made to first remove the riser pipe at the Fernco fitting and drain the limestone pond. If, after performing this flush/drain operation, the outfall from the limestone pond is still not removing most of the dissolved aluminum and increasing pH greater than 5.0, then stir up the top few feet of limestone in the limestone pond with a piece of equipment such as a backhoe, making sure to not damage the perforated piping network at the bottom of the downstream end of the pond. The limestone bed may also show signs of reduced volume in certain areas due to the limited space available, level of acidity, and source location of the raw AMD. If these reduced volume areas are observed and treatment efficiency is compromised, then limestone (AASHTO #1) should be added to the limestone pond as needed to maintain the top of stone above the normal operating water surface elevation. Any accumulation of leaves or other debris on the surface of the limestone pond should be removed as well, which can readily be accomplished by hand or with rakes and shovels.

Limestone Sand Dosing Channel

The rock-lined channel immediately upstream and downstream of the culvert that outlets the AMD discharging from the limestone pond should be inspected and the lining replaced as needed to maintain the lining thickness and provide the conditions needed for placement of limestone sand within the downstream channel segment as needed. Limestone sand from the adjacent stockpile shall be placed in the rock-lined channel segment downstream of the culvert to add alkalinity to the Benedict AMD as deemed necessary by SRWA and HCCD personnel based on water quality/chemistry data. The limestone sand shall be loosely placed (not compacted) across the entire width of stream channel, within the extent of the rip-rap lining, and not exceed the top of bank within the stream channel. Additional limestone sand shall be replaced at the stockpile location as needed or based on available funding.



NOTE:

ENGINEERING DESIGN PLAN SHOWN WAS PREPARED BY NATURAL RESOURCES CONSERVATION SERVICE (NRCS) AND PROVIDED BY HUNTINGDON COUNTY CONSERVATION DISTRICT.

SKELLY and LOY Inc. ENGINEERS–ENVIRONMENTAL CONSULTANTS	06/22/11	FIGURE 3

OM&R SCHEMATIC PLAN

BENEDICT AMD REMEDIATION SYSTEM
CARBON TOWNSHIP
HUNTINGDON COUNTY, PA
PREPARED FOR:
HUNTINGDON COUNTY
CONSERVATION DISTRICT

R10-0471.001	SCALE: 1" = 20'

Miller Run #1 Treatment System

Site Description

GPS Coordinates for the Site = 40° 13' 45.8" N and -78° 10' 40.0" W
The Miller Run #1 treatment system is accessed off of S.R. 0913 at the outskirts of Barnettstown by turning onto T.R. 354 and then onto the State Game Lands No. 67 access road that runs along nearly the entire stretch of Miller Run. There are lockable gates at certain locations on the State Game Lands No. 67 access road.

The source of this discharge is an old surface mine on the State Game Lands No. 67 site that historically flowed down a channel from a mining area, then through a culvert under the Game Lands access road and ultimately into Miller Run. This AMD discharge, which includes multiple seeps, is characterized as inconsistent with respect to flow rate and has historically ranged from a few gpm to over 100 gpm with an average of approximately 25 gpm. The passive treatment system (see Figure 4) was designed to treat the Miller Run #1 AMD discharge with an open limestone pond for alkalinity generation to remove the acidity and aluminum concentrations. The raw AMD discharge directly enters the limestone pond on the southwestern end, which contains approximately 400 tons of limestone in a 5-foot-deep layer with a perforated pipe within the bottom of the eastern end of the limestone bed. Based on an average flow of 25 gpm directed into the system and historic water chemistry data, it was calculated that the amount of limestone used in the limestone pond would produce enough alkalinity to raise the pH and precipitate nearly all of the dissolved aluminum in the AMD. The perforated pipe was specified for placement near the bottom and eastern end of the limestone layer and attached to an inline water level control structure to maintain the water level within the limestone bed, serve as the normal outfall structure, and manually flush the limestone bed. The outlet from the inline structure enters a French drain underneath the Game Lands access road, which outlets into the mainstem of Miller Run.

The limestone pond contains a perforated pipe within the limestone bed that connects to the inline structure that serves as both the normal outlet structure for AMD following contact with the limestone and a manual flushing device that helps to remove accumulated metal precipitates from the limestone void spaces. The outlet pipe from the inline structure is discharged into a French drain situated underneath of the State Game Lands access road. The limestone bed, which contains approximately 400 tons in an approximately 5.0-foot-deep layer of high calcium carbonate limestone (typically greater than 80% $CaCO_3$), dissolves when in contact with the AMD to impart alkalinity and neutralize acidity. The French drain that receives the outfall of the limestone pond from the inline structure contains a pipe that routes the water underneath the access road and outlets the treated AMD into Miller Run.

When properly functioning, the passive treatment system is expected to reduce dissolved aluminum concentrations by 80% and remove all of the acidity in the final system outfall.

Operational Check-Up

In order to ensure the proper operation of the passive treatment system for the AMD discharge, water quality sampling and flow measurements at various locations within the system must be collected and monitored. The water quality sampling and flow measurement events must be conducted prior to any manual flushing event from the limestone pond due to their potential impact on the results. Water quality sampling and flow measurements should be collected at the final system outfall location (see Figure 4) at least once every six months to provide periodic snapshots of the operations and effectiveness of the system. Other identified sampling locations at the site should be monitored for flow and water chemistry as needed based on results of the regularly monitored location to troubleshoot problems, including the raw AMD where possible and outfall from each system component.

Flow rates must be measured at all locations, wherever possible especially where water (AMD) enters and leaves the passive treatment system. In addition, understanding flow rates of the limestone-containing pond may help to identify problems associated with hydraulic conductivity or permeability of the limestone bed. All locations identified as flow measurement locations for the passive treatment systems should be measured using the bucket and stopwatch approach or installation of weirs or through visual estimation if necessary. As indicated above, the flow measurements and water quality sampling should be conducted every six months at a minimum at the final system outfall.

Flow and Water Chemistry Sampling Points:

1 – Rock-Lined Collection Channel for AMD Sources (Inflow to Limestone Pond)
*2 – Outlet of French Drain Pipe near Miller Run (Final System Outfall)

*This sampling location should be monitored every six months to monitor system performance and using the results of the water chemistry analyses to determine when sampling is needed at the additional locations.

Note: Some locations may require modification of the rock-lined channel by either installing a weir or pipe to provide a discrete location in each for measuring flow and collecting water samples. Otherwise, these locations might only be sampled for water chemistry.

Water quality sampling should include both field measurements and water samples collected and sent for analysis to an off-site independent laboratory. Water samples collected and sent to an off-site independent laboratory for analysis should be performed at least once every six months at the final system outfall and should include the following parameters for analysis.

- Total Iron
- Total Aluminum
- Total Manganese
- Total Alkalinity
- Hot Acidity
- pH

Normally, the primary sampling location (final system outfall) should be tested for the above parameters, but additional parameters are recommended should results from a sampling event indicate problems with the treatment system. In order to investigate the problem, dissolved metals analysis for both iron and aluminum may be necessary at certain sampling locations. For the dissolved iron and aluminum analyses, the water sample can be either filtered in the field and placed directly into a nitric acid preserved bottle (after filtering) or sent to the laboratory unpreserved (no nitric acid) for filtering. If the limestone pond is not working properly, it will allow dissolved metals to persist through the system and can be checked at the limestone pond outfall, which may not be concluded from a total metals analysis.

In addition to the standard laboratory analyses performed at least twice a year, other field analyses should be performed more frequently at the system outfall if possible to closely track the system operation to serve as indicators for maintenance. Field kits and meters can be used to easily measure parameters at the sites for such things as acidity, alkalinity, total iron, and pH. Since certain components of the treatment system may require somewhat frequent maintenance, as often as twice per year for flushing the limestone pond, it would be advantageous to simultaneously measure some of the parameters easily measured in the field such as acidity, alkalinity, and pH at the final outfall location. However, it is important to note that water quality measurements should not be collected for the final outfall during a flushing event from the limestone pond. Locations recommended for field testing of water quality (at a minimum pH, acidity, and alkalinity) during maintenance activities at the treatment system should include the following.

Water Quality and Flow Sampling Point:
2 – Outlet of French Drain Pipe near Miller Run (Final System Outfall)

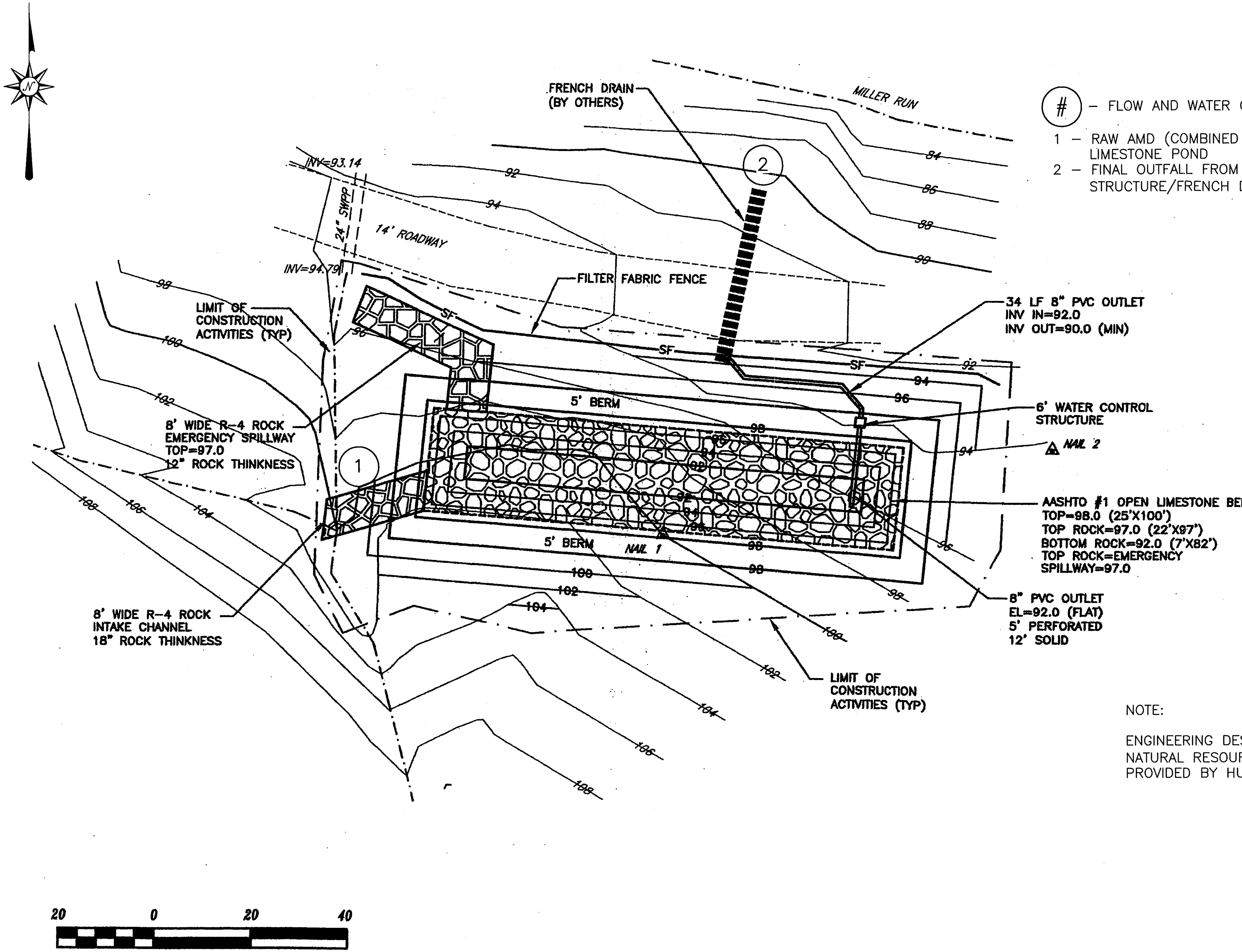
Maintenance Activities

<u>*Limestone Pond*</u>

This limestone pond may require frequent manual flushing using the inline structure. The inline structure is attached to a small segment of perforated pipe located at the bottom of the downstream end of the limestone pond. It is imperative to rely on monitoring of the final system outfall (outfall from French Drain) water quality and visual observations of accumulated material (metal precipitates) and debris on top of the limestone layer to determine when the limestone needs to be stirred. Debris accumulated on top of the limestone such as leaves and branches should be removed by hand or using rakes and shovels to prevent migration down into the limestone bed. The limestone pond should be flushed at least once every quarter for approximately 10 to 15 minutes by removing all of the stoplogs from the inline structure. After approximately 10 to 15 minutes, replace all of the removed stoplogs in the inline structure.

Finally, if after manually flushing the limestone pond the AMD is not being treated adequately (adequate treatment defined as having pH of 5.0 or greater and 50% or more dissolved Al removal) or if visual observations of the top layer of limestone indicate short-circuiting of water across the top of the limestone bed due to metal precipitates or debris accumulation on the surface, arrangements should be made to remove the debris as previously mentioned and stir up the top few feet of limestone. The top few feet of limestone should be stirred to loosen up accumulated aluminum precipitates with a piece of heavy equipment such as a backhoe, making sure to not damage the perforated piping network near the bottom downstream end of the pond.

The water level in the limestone pond may need to be lowered to perform the maintenance on the upper limestone portion of the bed by removing enough stoplogs in the inline structure to keep the water level below the layer to be stirred. The limestone bed may also show signs of reduced volume in certain areas due to the limited space available, level of acidity, and source location of the raw AMD. If these reduced volume areas are observed and treatment efficiency is compromised, then limestone (AASHTO #1) should be added to the limestone pond as needed to maintain the top of stone above the normal operating water surface elevation.



(#) – FLOW AND WATER CHEMISTRY SAMPLING POINTS

1 – RAW AMD (COMBINED SOURCES) IN ROCK–LINED CHANNEL INTO LIMESTONE POND
2 – FINAL OUTFALL FROM WATER LEVEL CONTROL STRUCTURE/FRENCH DRAIN

NOTE:

ENGINEERING DESIGN PLAN SHOWN WAS PREPARED BY NATURAL RESOURCES CONSERVATION SERVICE (NRCS) AND PROVIDED BY HUNTINGDON COUNTY CONSERVATION DISTRICT.

SKELLY and LOY Inc. ENGINEERS–ENVIRONMENTAL CONSULTANTS	06/22/11	FIGURE 4

OM&R SCHEMATIC PLAN

MILLER RUN #1 AMD REMEDIATION SYSTEM
CARBON TOWNSHIP
HUNTINGDON COUNTY, PA
PREPARED FOR:
HUNTINGDON COUNTY
CONSERVATION DISTRICT

R10–0471.001	SCALE: 1" = 20'

Miller Run #2 Treatment System

Site Description

GPS Coordinates for the Site = 40° 13' 47.1" N and -78° 10' 29.0" W
The Miller Run #2 treatment system is accessed off of S.R. 0913 at the outskirts of Barnettstown by turning onto T.R. 354 and then onto the State Game Lands No. 67 access road that runs along nearly the entire stretch of Miller Run. There are lockable gates at certain locations on the State Game Lands No. 67 access road.

The source of this discharge is an old surface mine on the State Game Lands No. 67 site that historically flowed down a channel from a mining area then through a culvert under the Game Lands access road and ultimately into Miller Run. This AMD discharge, which includes multiple seeps, is characterized as inconsistent with respect to flow rate and has historically ranged from a few gpm to nearly 100 gpm with an average of approximately 10 gpm. The passive treatment system (see Figure 5) was designed to treat the Miller Run #2 AMD discharge with an open limestone pond for alkalinity generation to remove the acidity and aluminum concentrations. The raw AMD discharge directly enters the limestone pond on the southwestern end, which contains approximately 380 tons of limestone in a 4-foot-deep layer with a perforated pipe within the bottom of the western end of the limestone bed. Based on an average flow of 10 gpm directed into the system and historic water chemistry data, it was calculated that the amount of limestone used in the limestone pond would produce enough alkalinity to raise the pH and precipitate nearly all of the dissolved aluminum in the AMD. The perforated pipe was specified for placement near the bottom and western end of the limestone layer and attached to an inline water level control structure to maintain the water level within the limestone bed, serve as the normal outfall structure, and manually flush the limestone bed. The outlet from the inline structure enters rip-rap outlet protection area at the upstream end of a culvert underneath the Game Lands access road, which outlets into the mainstem of Miller Run.

The limestone pond contains a perforated pipe within the limestone bed that connects to the inline structure that serves as both the normal outlet structure for AMD following contact with the limestone and a manual flushing device that helps to remove accumulated metal precipitates from the limestone void spaces. The outlet pipe from the inline structure is discharged into a culvert underneath of the State Game Lands access road. The limestone bed, which contains high calcium carbonate limestone (typically greater than 80% $CaCO_3$), dissolves when in contact with the AMD to impart alkalinity and neutralize acidity. The outfall of the culvert receiving the limestone pond effluent discharges the treated water into Miller Run.

When properly functioning, the passive treatment system is expected to reduce dissolved aluminum concentrations by 80% and remove all of the acidity in the final system outfall.

Operational Check-Up

In order to ensure the proper operation of the passive treatment system for the AMD discharge, water quality sampling and flow measurements at various locations within the system must be collected and monitored. The water quality sampling and flow measurement events must be conducted prior to any manual flushing event from the limestone pond due to their potential impact on the results. Water quality sampling and flow measurements should be collected at the final system outfall location (see Figure 5) at least once every six months to provide periodic snapshots of the operations and effectiveness of the system. Other identified sampling locations at the site should be monitored for flow and water chemistry as needed based on results of the regularly monitored location to troubleshoot problems, including the raw AMD where possible and outfall from each system component.

Flow rates must be measured at all locations, wherever possible especially where water (AMD) enters and leaves the passive treatment system. In addition, understanding flow rates of the limestone-containing pond may help to identify problems associated with hydraulic conductivity or permeability of the limestone bed. All locations identified as flow measurement locations for the passive treatment systems should be measured using the bucket and stopwatch approach or installation of weirs or through visual estimation if necessary. As indicated above, the flow measurements and water quality sampling should be conducted every six months at a minimum at the final system outfall.

Flow and Water Chemistry Sampling Points:

1 – Primary AMD Source (Northern Inflow to Limestone Pond)
*2 – Outlet of Inline Structure (Limestone Pond/Final System Outfall)

*This sampling location should be monitored every six months to monitor system performance and using the results of the water chemistry analyses to determine when sampling is needed at the additional locations.

Note: Some locations may require modification of the rock-lined channel by either installing a weir or pipe to provide a discrete location in each for measuring flow and collecting water samples. Otherwise, these locations might only be sampled for water chemistry.

Water quality sampling should include both field measurements and water samples collected and sent for analysis to an off-site independent laboratory. Water samples collected and sent to an off-site independent laboratory for analysis should be performed at least once every six months at the final system outfall and should include the following parameters for analysis.

- Total Iron
- Total Aluminum
- Total Manganese
- Total Alkalinity
- Hot Acidity
- pH

Normally, the primary sampling location (final system outfall) should be tested for the above parameters, but additional parameters are recommended should results from a sampling event indicate problems with the treatment system. In order to investigate the problem, dissolved metals analysis for both iron and aluminum may be necessary at certain sampling locations. For the dissolved iron and aluminum analyses, the water sample can be either filtered in the field and placed directly into a nitric acid preserved bottle (after filtering) or sent to the laboratory unpreserved (no nitric acid) for filtering. If the limestone pond is not working properly, it will allow dissolved metals to persist through the system and can be checked at the limestone pond outfall, which may not be concluded from a total metals analysis.

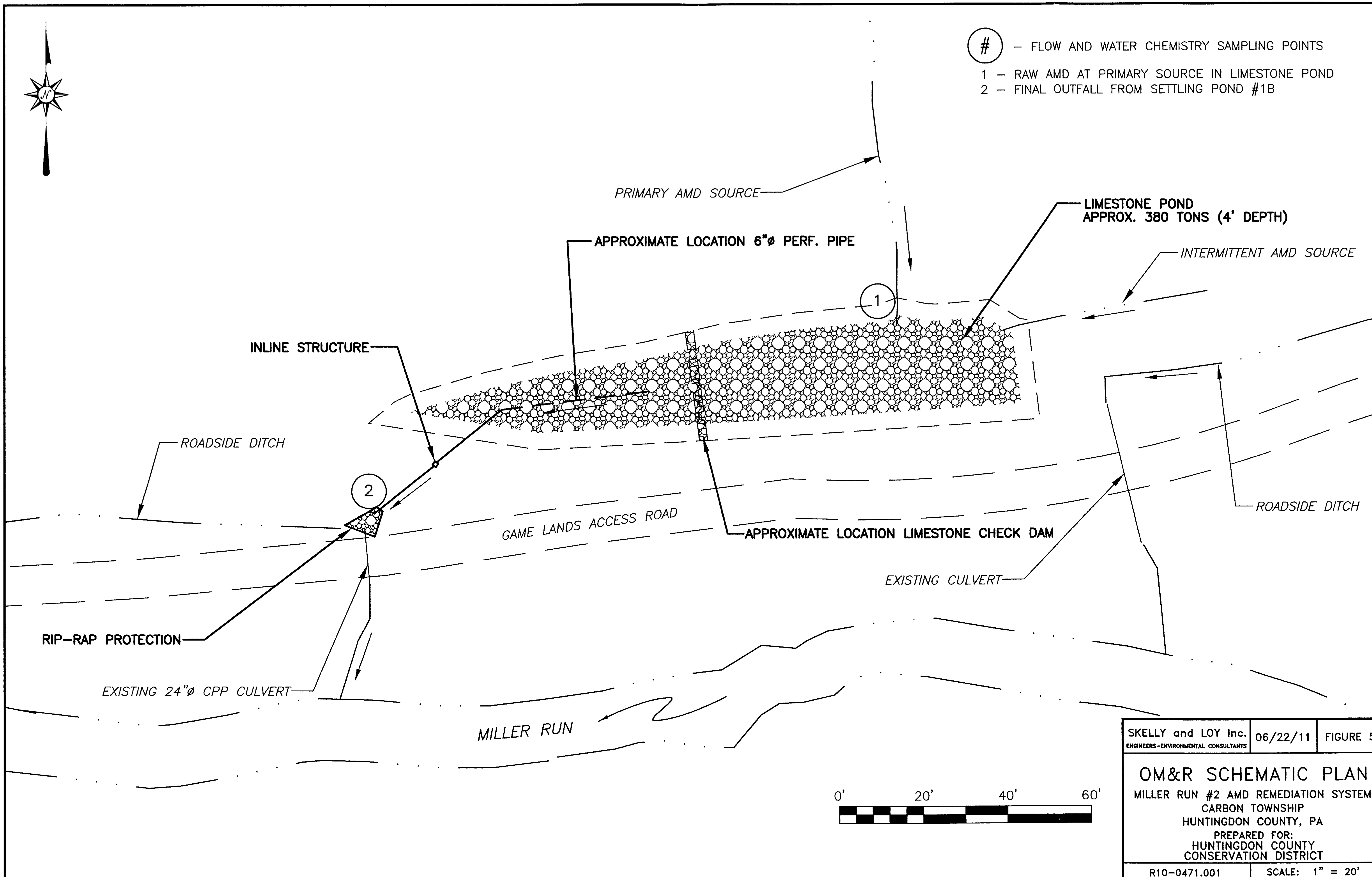
In addition to the standard laboratory analyses performed at least twice a year, other field analyses should be performed more frequently at the system outfall if possible to closely track the system operation to serve as indicators for maintenance. Field kits and meters can be used to easily measure parameters at the sites for such things as acidity, alkalinity, total iron, and pH. Since certain components of the treatment system may require somewhat frequent maintenance, as often as twice per year for flushing the limestone pond, it would be advantageous to simultaneously measure some of the parameters easily measured in the field such as acidity, alkalinity, and pH at the final outfall location. However, it is important to note that water quality measurements should not be collected for the final outfall during a flushing event from the limestone pond. Locations recommended for field testing of water quality (at a minimum pH, acidity, and alkalinity) during maintenance activities at the treatment system should include the following.

Water Quality and Flow Sampling Point:
2 – Outlet of Inline Structure (Limestone Pond/Final System Outfall)

Maintenance Activities

<u>Limestone Pond</u>
This limestone pond may require frequent manual flushing using the inline structure. The inline structure is attached to a small segment of perforated pipe located at the bottom of the downstream end of the limestone pond. It is imperative to rely on monitoring of the final system outfall (outfall from the inline structure) water quality and visual observations of accumulated material (metal precipitates) and debris on top of the limestone layer to determine when the limestone needs to be stirred. Debris accumulated on top of the limestone such as leaves and branches should be removed by hand or by using rakes and shovels to prevent migration down into the limestone bed. The limestone pond should be flushed at least once every quarter for approximately 10 to 15 minutes by removing all of the stoplogs from inline structure. After approximately 10 to 15 minutes, replace all of the removed stoplogs in the inline structure.

Finally, if after manually flushing the limestone pond the AMD is not being treated adequately (adequate treatment defined as having pH of 5.0 or greater and 50% or more dissolved Al removal) or if visual observations of the top layer of limestone indicate short-circuiting of water across the top of the limestone bed due to metal precipitates or debris accumulation on the surface, arrangements should be made to remove the debris as previously mentioned and stir up the top few feet of limestone. The top few feet of limestone should be stirred to loosen up accumulated aluminum precipitates with a piece of heavy equipment such as a backhoe, making sure to not damage the perforated piping network near the bottom downstream end of the pond. The water level in the limestone pond may need to be lowered to perform the maintenance on the upper limestone portion of the bed by removing enough stoplogs in the inline structure to keep the water level below the layer to be stirred. The limestone bed may also show signs of reduced volume in certain areas due to the limited space available, level of acidity, and source location of the raw AMD. If these reduced volume areas are observed and treatment efficiency is compromised, then limestone (AASHTO #1) should be added to the limestone pond as needed to maintain the top of stone above the normal operating water surface elevation.



– FLOW AND WATER CHEMISTRY SAMPLING POINTS
1 – RAW AMD AT PRIMARY SOURCE IN LIMESTONE POND
2 – FINAL OUTFALL FROM SETTLING POND #1B
PRIMARY AMD SOURCE
LIMESTONE POND
APPROX. 380 TONS (4' DEPTH)
APPROXIMATE LOCATION 6"ø PERF. PIPE
INTERMITTENT AMD SOURCE
1
INLINE STRUCTURE
ROADSIDE DITCH
2
GAME LANDS ACCESS ROAD
APPROXIMATE LOCATION LIMESTONE CHECK DAM
ROADSIDE DITCH
EXISTING CULVERT
RIP-RAP PROTECTION
EXISTING 24"ø CPP CULVERT
MILLER RUN
0'
20'
40'
60'
SKELLY and LOY Inc.
ENGINEERS-ENVIRONMENTAL CONSULTANTS
06/22/11
FIGURE 5
OM&R SCHEMATIC PLAN
MILLER RUN #2 AMD REMEDIATION SYSTEM
CARBON TOWNSHIP
HUNTINGDON COUNTY, PA
PREPARED FOR:
HUNTINGDON COUNTY
CONSERVATION DISTRICT
R10-0471.001
SCALE: 1" = 20'

Minersville Treatment System(s)

Site Description

GPS Coordinates for the Site = 40° 13' 3.4" N and -78° 10' 54.0" W
The Minersville treatment system(s) are accessed off of S.R. 0913 at the outskirts of Barnettstown by turning onto T.R. 354 and then onto the State Game Lands No. 67 access road that runs along nearly the entire stretch of Miller Run.

The source of the discharge(s) is an old underground mine on the site, which created two distinct sources for passive treatment. The primary AMD discharge (AMD Source #1) is characterized as fairly consistent with respect to flow rate and has historically averaged 90 gpm, while the smaller secondary discharge (AMD Source #2) has historically average less than 10 gpm. The passive treatment system (see Figure 6) was recently improved and designed to treat the AMD Source #1 discharge with an open limestone pond, referred to as a FeAlMn Bed, for alkalinity generation followed by a large small settling pond/wetland for detention of the treated water to capture the aluminum precipitates. The AMD Source #1 is captured in a high flow bypass structure (inlet box) with a valve and bypass pipe to divert the AMD around the treatment system. The AMD Source #1 directly enters the limestone pond, containing approximately 6,000 tons of limestone in a sloped bed ranging from 3.5 to 7 feet deep with one perforated pipe within the downstream end of the limestone bed. The FeAlMn Bed contains three up baffles and four down baffles made of HDPE. Based on an average flow of 90 gpm directed into the system and historic water chemistry data, it was calculated that the amount of limestone used in the limestone pond would produce enough alkalinity to raise the pH and precipitate the dissolved aluminum in the AMD. The perforated pipe was specified for placement near the western end of the recently added limestone layer and attached to an inline water level control structure to maintain the water level within the limestone bed, serve as the normal outfall structure, and manually flush the limestone bed. The outlet from the inline structure enters the downstream end of a rock-lined channel that empties into the Settling Pond/Wetland.

A manual valve and piping network within the original bottom limestone layer were also installed to allow periodic manual flushing of the limestone pond to the constructed mitigative wetland on the site as needed. The water is then directed out of the limestone pond through the inline structure and into a Settling Pond/Wetland where the aluminum precipitates are settled and retained. The Settling Pond/Wetland located on the east side of the Game Lands access road serves as the final polishing component of the passive treatment system, which provides the retention and capacity to settle and retain the remaining aluminum precipitates. The deeper settling pond portion of the pond is separated from the shallower wetland portion of the pond by a limestone barrier. A perforated riser pipe was specified as the final outlet structure in the Settling Pond/Wetland to allow the water to discharge from the settling pond under the Game Lands access road and into a ditch that empties into Miller Run.

The limestone pond contains a perforated pipe within the limestone bed that connects to the inline structure that serves as both the normal outlet structure for AMD following contact with the limestone and a manual flushing device that helps to remove accumulated metal precipitates from the limestone void spaces. The outlet pipe from the inline structure is discharged into a rock-lined channel immediately upstream of the Settling Pond/Wetland. The limestone bed, which contains high calcium carbonate limestone (typically greater than 80% $CaCO_3$), dissolves when in contact with the AMD to impart alkalinity and neutralize acidity. The Limestone Pond or FeAlMn Bed, which was converted from a Vertical Flow Pond by removing the compost layer, contains the original limestone layer, with an additional limestone layer along with up and down baffles installed vertically within the limestone bed to maximize contact time with the limestone and minimize short-circuiting. A second source of AMD, referred to as AMD Source #2, outlets through a standpipe within the rock-lined channel between the FeAlMn Bed and Settling Pond/Wetland. This AMD source receives alkaline treatment only from the excess alkalinity imparted to the AMD Source #1 water from the limestone in the FeAlMn Bed during mixing in the Settling Pond/Wetland.

When properly functioning, the passive treatment system is expected to reduce aluminum concentrations by 90%, iron concentrations by approximately 50%, and remove all of the acidity in the final system outfall.

A third source or seepage comes out of the ground on the outer western slope of the FeAlMn Bed and is directed into a Settling Pond to allow oxidation, precipitation, and settling of low iron levels within the water. No alkalinity treatment is provided for this seepage since the pH levels have historically not been a problem. Water from the Settling Pond outlets through a perforation within a PVC pipe elbow in the southwestern corner of the pond that directs the outfall under the Game Lands access road and into Shoup Run. A pipe and valve network was installed to allow draining of the Settling Pond into a Constructed Mitigative Wetland on the opposite (west) side of the Game Lands access road. The Constructed Mitigative Wetland, which also receives the flush pipe from the FeAlMn Bed valve system, outlets water directly into Miller Run from a principal spillway.

Operational Check-Up

In order to ensure the proper operation of the passive treatment system(s) for the AMD discharges, water quality sampling and flow measurements at various locations within the system must be collected and monitored. The water quality sampling and flow measurement events must be conducted prior to any manual flushing events from the different treatment system components, due to their potential impact on the results. Water quality sampling and flow measurements should be collected at the final system outfall locations (see Figure 6) at least once every six months to provide periodic snapshots of the operations and effectiveness of the system(s). Other identified sampling locations at the site should be monitored for flow and water chemistry as needed based on results of the regularly monitored locations to troubleshoot problems, including the raw AMD where possible and outfall from each system component.

Flow rates must be measured at all locations, wherever possible especially where water (AMD) enters and leaves the passive treatment system(s). However, the raw AMD discharge into the Limestone Pond/FeAlMn Bed will be difficult to measure flow because of the methods of introduction into the respective treatment pond. The high flow bypass structure, which is an inlet box that may also be used to direct the raw AMD source #1 away from the system for maintenance has the potential for flow measurement of the raw AMD that enters the treatment system. In addition, understanding flow rates of the limestone-containing pond may help to identify problems associated with hydraulic conductivity or permeability of the limestone bed. All locations identified as flow measurement locations for the passive treatment system(s) should be measured using the bucket and stopwatch approach or installation of weirs or through visual estimation if necessary. As indicated above, the flow measurements and water quality sampling should be conducted every six months at a minimum at the final system outfall(s).

Flow and Water Chemistry Sampling Points:

1 – Raw AMD Source #1
2 – Raw AMD Source #2 (Outlet Riser in Rock-Lined Channel)
3 – Outfall From Inline Water Level Control Structure (FeAlMn Bed Outfall)
*4 – Outfall From Riser Pipe Outlet Structure in Wetland (Settling Pond/Wetland Final System Outfall)
5 – Seepage Into Settling Pond (Adjacent to FeAlMn Bed Flush Valve)
*6 – Outlet Pipe from Seepage Settling Pond (In Ditch to Shoup Run)

*This sampling location should be monitored every six months to monitor system performance and using the results of the water chemistry analyses to determine when sampling is needed at the additional locations.

Note: Some locations may require modification of the rock-lined channel by either installing a weir or pipe to provide a discrete location in each for measuring flow and collecting water samples. Otherwise, these locations might only be sampled for water chemistry.

Water quality sampling should include both field measurements and water samples collected and sent for analysis to an off-site independent laboratory. Water samples collected and sent to an off-site independent laboratory for analysis should be performed at least once every six months at the final system outfalls and should include the following parameters for analysis.

- Total Iron
- Total Aluminum
- Total Manganese
- Total Alkalinity
- Hot Acidity
- pH

Normally, the primary sampling locations (final system outfalls) should be tested for the above parameters, but additional parameters are recommended should results from a sampling event indicate problems with the treatment system(s). In order to investigate the problem, dissolved metals analysis for both iron and aluminum may be necessary at certain sampling locations. For the dissolved iron and aluminum analyses, the water sample can be either filtered in the field and placed directly into a nitric acid preserved bottle (after filtering) or sent to the laboratory unpreserved (no nitric acid) for filtering. If the Limestone Pond/FeAlMn Bed is not working properly, it will allow dissolved metals to persist through the system and can be checked at different outfalls to determine the source of the problem, which may not be concluded from a total metals analysis.

In addition to the standard laboratory analyses performed at least twice a year, other field analyses should be performed more frequently at the system outfall if possible to closely track the system operation to serve as indicators for maintenance. Field kits and meters can be used to easily measure parameters at the site for such things as acidity, alkalinity, total iron, and pH. Since certain components of the treatment system may require somewhat frequent maintenance, as often as once per quarter for flushing the limestone pond, it would be advantageous to simultaneously measure some of the parameters easily measured in the field such as acidity, alkalinity, and pH at the final outfall location. However, it is important to note that water quality measurements should not be collected for the final outfall during a flushing event from the upstream limestone pond. Locations recommended for field testing of water quality (at a minimum pH, acidity, and alkalinity) during more frequent maintenance activities at the treatment system should include the following.

Water Quality and Flow Sampling Point:
3 – Outfall From Inline Water Level Control Structure (FeAlMn Bed Outfall)
4 – Outfall From Riser Pipe Outlet Structure in Wetland (Settling Pond/Wetland Final System Outfall)
6 – Outlet Pipe from Seepage Settling Pond (In Ditch to Shoup Run)

Maintenance Activities

<u>*Limestone Pond/FeAlMn Bed*</u>
This limestone pond may require frequent manual flushing using the inline structure or flush valve. The inline structure is attached to a small segment of perforated pipe located at the downstream end of the limestone pond, while the flush valve is attached to the original perforated pipe network in the bottom of the limestone bed. It is imperative to rely on monitoring of the inline structure (FeAlMn Bed) and final system outfalls (Settling Pond/Wetland) water quality and visual observations of accumulated material (metal precipitates) and debris on top of the limestone layer to determine when the limestone needs to be stirred. Debris accumulated on top of the limestone such as leaves and branches should be removed by hand or by using rakes and shovels to prevent migration down into the limestone bed. If the limestone bed cannot be stirred regularly, every one to two years at a minimum, then the limestone pond should be flushed at least once every six months for approximately 10 to 15 minutes by removing all of the stoplogs from the inline structure or operating the flush valve. After approximately 10 to 15 minutes, replace all of the removed stoplogs in the inline structure or close the flush valve.

Finally, if after manually flushing the limestone pond the AMD is not being treated adequately (adequate treatment defined as having pH of 5.0 or greater and 50% or more dissolved Al removal) or if visual observations of the top layer of limestone indicate short-circuiting of water across the top of the limestone bed due to metal precipitates or debris accumulation on the surface, arrangements should be made to remove the debris as previously mentioned and stir up the top few feet of limestone. The top few feet of limestone should be stirred to loosen up accumulated aluminum precipitates with a piece of heavy equipment such as a backhoe, making sure to not damage the perforated piping network and up and down HDPE baffles within the limestone. The location of down baffles is indicated by the presence of check-dam-type features on the surface of the limestone bed. The water level in the limestone pond may need to be lowered to perform the maintenance on the upper limestone portion of the bed by removing enough stoplogs in the inline structure to keep the water level below the layer to be stirred. The limestone bed may also show signs of reduced volume in certain areas due to the limited space available, level of acidity, and source location of the raw AMD. If these reduced volume areas are observed and treatment efficiency is compromised, then limestone (AASHTO #1) should be added to the limestone pond as needed to maintain the top of stone above the normal operating water surface elevation.

Settling Pond/Wetland

The settling pond/wetland receives the outfalls from the inline structure that continuously discharges water from the FeAlMn Bed and the rock-lined channel that receives the AMD Source #2 from the outlet riser. The combined stream of net acidic and net alkaline waters will encourage the precipitation of aluminum and iron as it enters the Settling Pond/Wetland. The Settling Pond and Wetland portions are separated by a barely visible limestone barrier. The deeper Settling Pond water flows directly into the shallow, vegetated wetland portion of the pond before final discharge through a riser pipe in the western end of the wetland. The primary outlet riser pipe must be checked regularly since it can become easily clogged with floating debris or wildlife. A rock-lined emergency spillway in the western berm is capable of handling all or just the excess flows from the pond in case of problems with the primary outlet. Each time a site visit is conducted for maintenance, which is recommended every two to three months at a minimum, the primary riser pipe outlet structure should be inspected for debris accumulation and removed as needed. The rock-lined emergency spillway should be inspected for accumulated debris and removed as necessary to allow water to readily flow over the spillway during high flows or problems with the primary riser outlet.

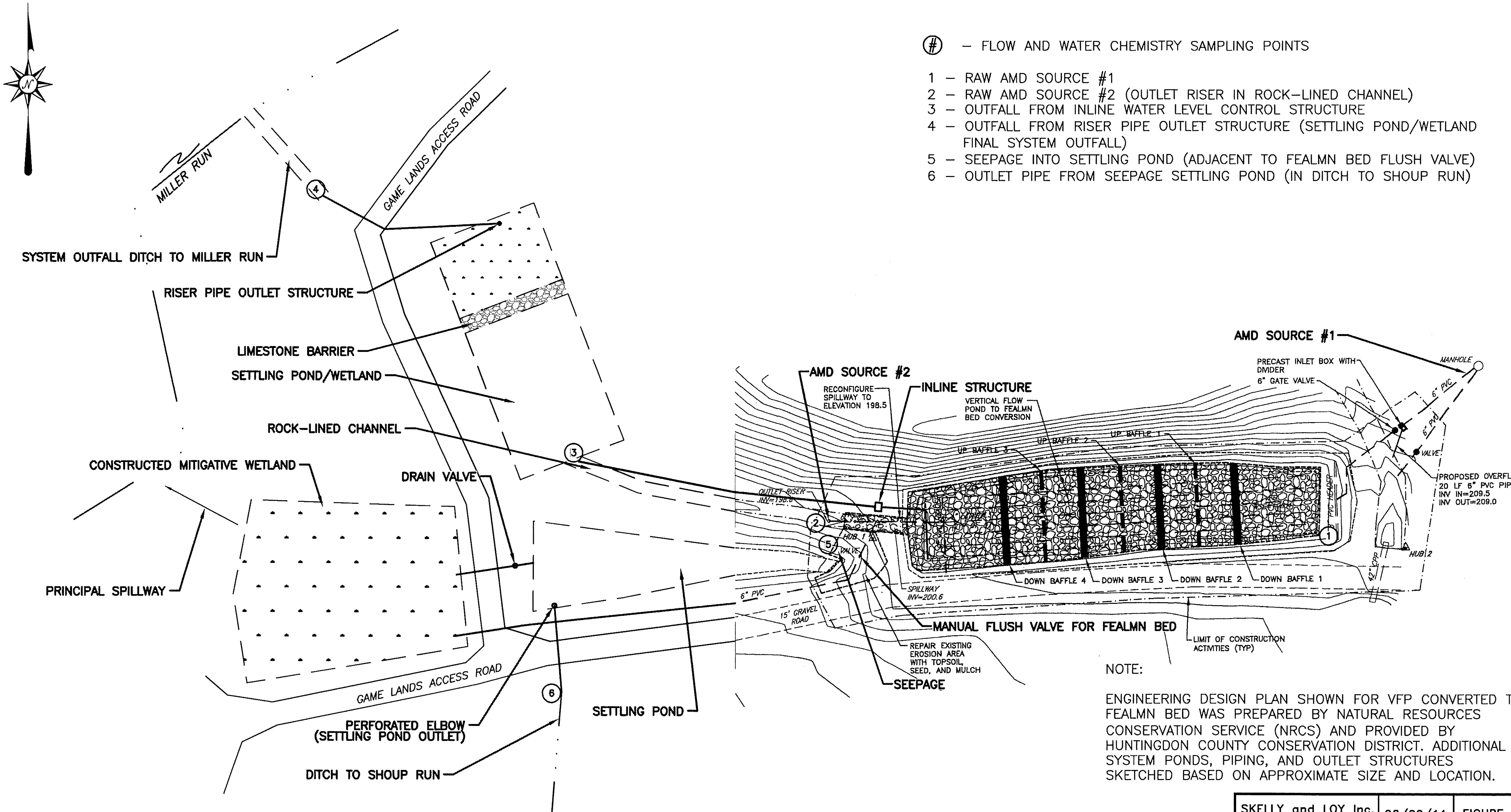
Sludge accumulation within Settling Pond #1 is dependent on the treatment efficiency of the FeAlMn Bed and flow rates entering the pond. However, every two years, the sludge levels in the bottom of the pond should be measured. Once the sludge levels accumulate to more than one foot at any location within the pond, steps should be taken to perform a sludge clean-out event. Depending on the method used for sludge cleanout, dewatering most or all of the water from the pond will be necessary by pumping water from the deeper Settling Pond as well as potentially routing the inflow from the FeAlMn Bed and AMD Source #2 outlet riser around the pond temporarily. Methods of sludge removal include the use of a vacuum truck, pumping and dewatering the sludge material in a geomembrane textile bag, or completely dewatering the pond and using heavy equipment with a bucket to remove the material and place it in a pile on the site for drying before hauling off-site. Upon removal of the sludge material, the inflow from the FeAlMn Bed and AMD Source #2 outlet riser may be directed back into the pond.

Settling Pond and Mitigative Wetland

This settling pond receives a small seepage that comes out of the ground near the manual flush valve for the FeAlMn Bed. The Settling Pond has a perforated PVC elbow fitting as its primary outlet structure that routes the water under the Game Lands access road and into a ditch that conveys the water to Shoup Run. Each time that a site visit is conducted for maintenance, which is every two to three months at a minimum for other components of the treatment system, the perforations in the PVC elbow fitting should be inspected for debris accumulation and removed as needed. It is recommended that this primary outlet structure be modified to limit clogging of the perforation and/or an emergency spillway be constructed for the Settling Pond. The pipe and valve system between the Settling Pond and Mitigative Wetland may be used to drain the settling pond for maintenance activities or provide a periodic water source to the Mitigative wetland during dry periods as needed.

Sludge accumulation within the Settling Pond is dependent on the seepage metal concentrations and flow rates entering the pond. However, every five years, the sludge levels in the bottom of the pond should be measured. Once the sludge levels accumulate to more than one foot at any location within the pond, steps should be taken to perform a sludge clean-out event. Depending on the method used for sludge cleanout, dewatering most or all of the water from the pond will be necessary by opening the drain valve and/or pumping water from the pond. Routing the seepage around the Settling Pond temporarily may be difficult, so it is recommended to perform the sludge removal during dry/low flow periods. Methods of sludge removal include the use of a vacuum truck, pumping and dewatering the sludge material in a geomembrane textile bag, or completely dewatering the pond and using heavy equipment with a bucket to remove the material and place it in a pile on the site for drying before hauling off-site.

The Mitigative Wetland is anticipated to have minimal maintenance requirements. The only potential sources of water into the Mitigative Wetland are surface runoff, manual flush valve outlet from FeAlMn Bed, and drain valve from the seepage Settling Pond, where the only uncontrolled source is the surface runoff. However, it is recommended, particularly during dry periods, that water from the seepage settling pond be periodically routed through the drain valve into the wetland to maintain adequate vegetation. The principal spillway should be inspected once a year for debris accumulation and removed as needed.



(#) – FLOW AND WATER CHEMISTRY SAMPLING POINTS

1 – RAW AMD SOURCE #1
2 – RAW AMD SOURCE #2 (OUTLET RISER IN ROCK–LINED CHANNEL)
3 – OUTFALL FROM INLINE WATER LEVEL CONTROL STRUCTURE
4 – OUTFALL FROM RISER PIPE OUTLET STRUCTURE (SETTLING POND/WETLAND FINAL SYSTEM OUTFALL)
5 – SEEPAGE INTO SETTLING POND (ADJACENT TO FEALMN BED FLUSH VALVE)
6 – OUTLET PIPE FROM SEEPAGE SETTLING POND (IN DITCH TO SHOUP RUN)

NOTE:

ENGINEERING DESIGN PLAN SHOWN FOR VFP CONVERTED TO FEALMN BED WAS PREPARED BY NATURAL RESOURCES CONSERVATION SERVICE (NRCS) AND PROVIDED BY HUNTINGDON COUNTY CONSERVATION DISTRICT. ADDITIONAL SYSTEM PONDS, PIPING, AND OUTLET STRUCTURES SKETCHED BASED ON APPROXIMATE SIZE AND LOCATION.

SKELLY and LOY Inc. ENGINEERS–ENVIRONMENTAL CONSULTANTS	06/22/11	FIGURE 6

OM&R SCHEMATIC PLAN

MINERSVILLE AMD REMEDIATION SYSTEM
CARBON TOWNSHIP
HUNTINGDON COUNTY, PA
PREPARED FOR:
HUNTINGDON COUNTY
CONSERVATION DISTRICT

R10–0471.001	SCALE: 1" = 40'

Limestone Sand Dosing Sites

Site Desciption

GPS Coordinates for the Hartman Run Site = 40° 13' 0.95" N and -78° 8' 55.8" W
GPS Coordinates for the Miller Run Site = 40° 14' 6.3" N and -78° 9' 50.7" W
GPS Coordinates for the Kennedy Run Site = 40° 14' 21.6" N and -78° 9' 50.7" W
The Miller Run and Kennedy Run limestone sand dosing sites are accessed off of S.R. 0913 at the outskirts of Barnettstown by turning onto T.R. 354 and then onto the State Game Lands No. 67 access road that runs along nearly the entire stretch of Miller Run. There are lockable gates at certain locations on the State Game Lands No. 67 access road. The Hartman Run limestone sand dosing site is located on a sportsman association access road that is accessed from S.R. 3017 (Broad Street) just north of Broad Top City.

SRWA and HCCD have established three limestone sand dosing sites in the headwaters of three of the main tributaries to Shoup Run that have historically been acidic in nature due to the vast coal mining in the area. The Miller Run and Kennedy Run limestone sand dosing sites are both located on State Game Lands No. 67 with stockpiles of the limestone sand material located in close proximity to the main stream channel. The Hartman Run limestone sand dosing site went through an actual engineering design and construction process to create limestone rip-rap lined segments of both the mainstem of Hartman Run and a small tributary for placement of stockpiled limestone sand directly into the stream channels to provide alkalinity in nearly the entire stretch of Hartman Run. Figure 7 shows the schematic of the Hartman Run limestone sand dosing site. Since no engineering design or construction was performed at the Miller Run and Kennedy Run sites, no schematics were created for these simplistic sites consisting of simply the stockpiled limestone sand material and approximate location within the respective stream channel where the sand is typically placed using equipment.

Because of the vast improvements in water quality to Miller Run as a result of the passive treatment systems and Dirt and Gravel Road BMPs, the frequency of dosing limestone sand directly into the headwaters of Miller Run has typically been not necessary. The limestone sand stockpile storage area is located in a clear flat location adjacent to the stream channel and just upstream of the confluence with Kennedy Run. Kennedy Run, a small tributary with its confluence near the headwaters of Miller Run, also requires only infrequent dosing of limestone sand directly into the main stream channel adjacent to an old timber road crossing over the stream near the headwaters. Limestone sand is stockpiled and stored at the Kennedy Run dosing site. Both sites are accessed from the Game Lands access road. The Hartman Run dosing site is located within a power line crossing area over the stream at the headwaters and is accessed from a sportsman association access road that leads down to the site. A large stockpile area was created and is currently used to store limestone sand material for use in the dosing operation.

The limestone sand is added into the stream channels at each of the three sites using a piece of equipment such as a backhoe or Bobcat. Placement of the limestone sand directly into the stream channels allows dissolution and transport of the calcium carbonate in the limestone sand to impart alkalinity and increase pH in the streams.

Operational Check-Up

In order to ensure the addition of the limestone sand at each of the three dosing sites within the Shoup Run watershed, water quality sampling at the mouth within the stream channels must be collected and monitored. Water quality sampling should be collected at the mouths of the three limestone sand dosing tributaries (see Figures 1 and 7) at least once every six months to provide indications on frequency of limestone sand dosing within each of the three respective streams.

As indicated above, the water quality sampling should be conducted every six months at a minimum at the tributary mouth locations. Additional water chemistry data may be important for determining the dosing location either in the mainstem or tributary channel at the Hartman Run limestone sand dosing site.

Water Chemistry Sampling Points:

> 1 – Mainstem of Hartman Run Upstream of Rock-Lined Channel Limestone Sand Dosing Area
> 2 – Tributary to Hartman Run Upstream of Rock-Lined Channel Limestone Sand Dosing Area
> *3 – Mouth of Hartman Run
> *4 – Mouth of Miller Run
> *5 – Mouth of Kennedy Run
>
> *Monitoring the mouth of each Shoup Run tributary (Hartman, Kennedy, and Miller Runs) should provide a basis for determining the need for limestone sand dosing at the headwaters location in each stream.
>
> Note: Some locations may require modification of the rock-lined channel by either installing a weir or pipe to provide a discrete location in each for measuring flow and collecting water samples. Otherwise, these locations might only be sampled for water chemistry.

Water quality sampling should include both field measurements and water samples collected and sent for analysis to an off-site independent laboratory. Water samples collected and sent to an off-site independent laboratory for analysis should be performed at least once every six months at the tributary mouth locations indicated above and should include the following parameters for analysis.

- Total Iron
- Total Aluminum
- Total Manganese
- Total Alkalinity
- Hot Acidity
- pH

In addition to the standard laboratory analyses performed at least twice a year, other field analyses should be performed more frequently at the tributary mouth locations if possible to closely determine the need for limestone sand dosing. Field kits and meters can be used to easily measure parameters at the sites for such things as acidity, alkalinity, total iron, and pH. Locations recommended for field testing of water quality (at a minimum pH, acidity, and alkalinity) during more frequent maintenance activities at the five nearby treatment systems should include the following.

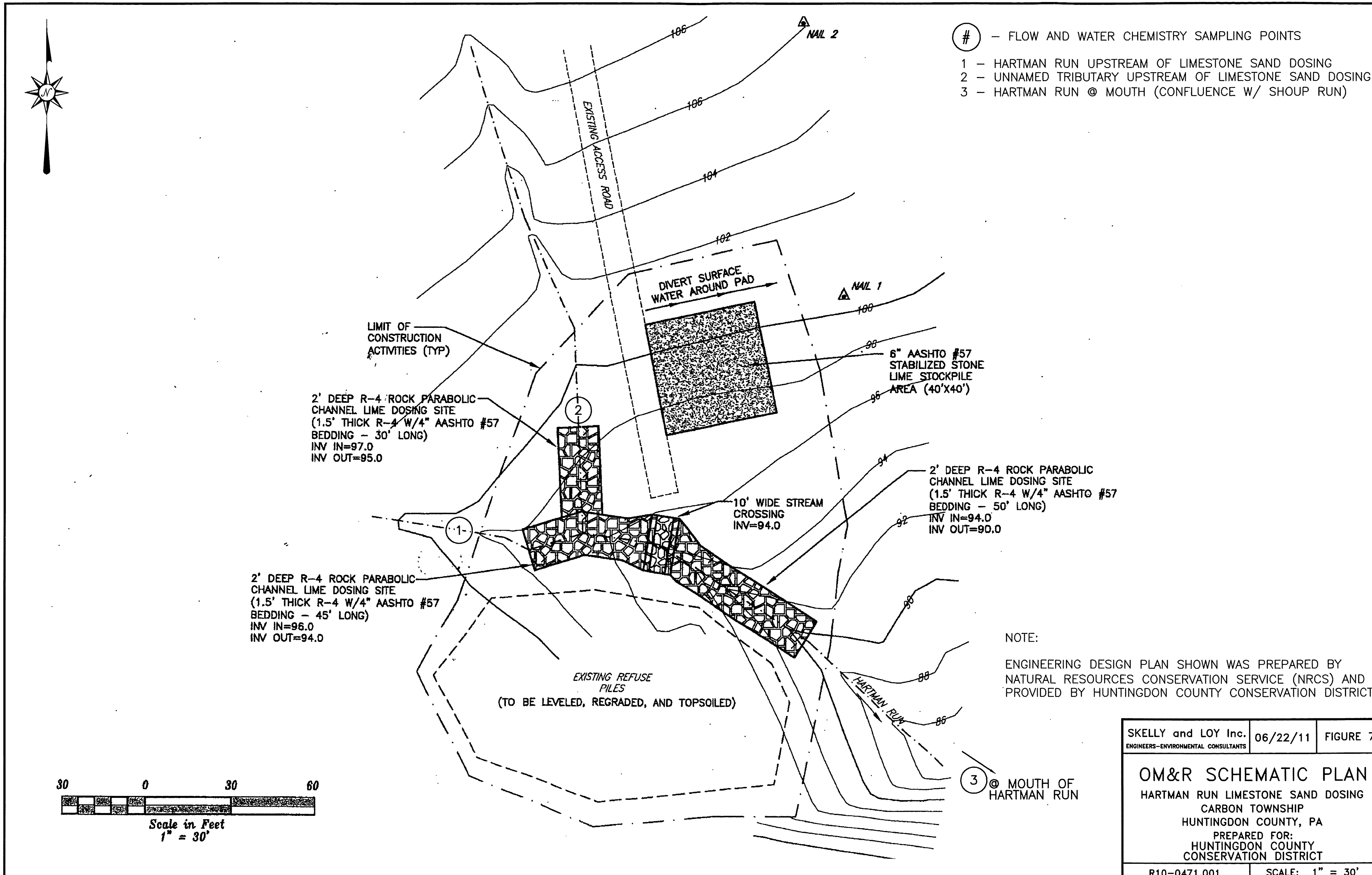
Water Quality Sampling Points:

3 – Mouth of Hartman Run
4 – Mouth of Miller Run
5 – Mouth of Kennedy

Maintenance Activities

The rock-lined channel in both the mainstem of Hartman Run and at the mouth of the unnamed tributary should be periodically inspected to ensure that the rip-rap lining thickness is maintained and washed out areas replaced as needed for use in the limestone sand dosing process. Limestone sand from the adjacent stockpile should be placed in the 45-foot-long segment of rock-lined channel in the mainstem of Hartman Run and 30-foot segment of rock-lined channel at the mouth of the unnamed tributary to add alkalinity to the stream as deemed necessary by SRWA and HCCD personnel based on water quality/chemistry data at the mouth of Hartman Run. The limestone sand should be loosely placed (not compacted) across the entire width of stream channel, within the extent of the rip-rap lining, and not exceed the top of bank within the stream channel. Additional limestone sand should be replaced at the stockpile location as needed or based on available funding.

The placement of limestone sand in the headwaters of Miller Run and Kennedy Run, located in close proximity to each other, is accomplished by placement of the stockpiled limestone sand directly into the mainstem of the streams as needed. Limestone sand from the stockpile at each site should be placed in the adjacent mainstem of Miller Run and Kennedy Run to add alkalinity as deemed necessary by SRWA and HCCD personnel based on water quality/chemistry data at the mouth of each stream. The limestone sand should be loosely placed (not compacted) across the entire width of stream channel and not exceed the top of bank within the stream channel. Additional limestone sand should be replaced at the stockpile location as needed or based on available funding.



– FLOW AND WATER CHEMISTRY SAMPLING POINTS
1 – HARTMAN RUN UPSTREAM OF LIMESTONE SAND DOSING
2 – UNNAMED TRIBUTARY UPSTREAM OF LIMESTONE SAND DOSING
3 – HARTMAN RUN @ MOUTH (CONFLUENCE W/ SHOUP RUN)
N
NAIL 2
NAIL 1
106
106
104
102
100
98
96
94
92
90
88
86
EXISTING ACCESS ROAD
DIVERT SURFACE WATER AROUND PAD
LIMIT OF CONSTRUCTION ACTIVITIES (TYP)
6" AASHTO #57 STABILIZED STONE LIME STOCKPILE AREA (40'X40')
2' DEEP R-4 ROCK PARABOLIC CHANNEL LIME DOSING SITE (1.5' THICK R-4 W/4" AASHTO #57 BEDDING – 30' LONG) INV IN=97.0 INV OUT=95.0
10' WIDE STREAM CROSSING INV=94.0
2' DEEP R-4 ROCK PARABOLIC CHANNEL LIME DOSING SITE (1.5' THICK R-4 W/4" AASHTO #57 BEDDING – 50' LONG) INV IN=94.0 INV OUT=90.0
2' DEEP R-4 ROCK PARABOLIC CHANNEL LIME DOSING SITE (1.5' THICK R-4 W/4" AASHTO #57 BEDDING – 45' LONG) INV IN=96.0 INV OUT=94.0
1
2
3 @ MOUTH OF HARTMAN RUN
EXISTING REFUSE PILES
(TO BE LEVELED, REGRADED, AND TOPSOILED)
HARTMAN RUN
NOTE:
ENGINEERING DESIGN PLAN SHOWN WAS PREPARED BY NATURAL RESOURCES CONSERVATION SERVICE (NRCS) AND PROVIDED BY HUNTINGDON COUNTY CONSERVATION DISTRICT.
30 0 30 60
Scale in Feet
1" = 30'
SKELLY and LOY Inc.
ENGINEERS–ENVIRONMENTAL CONSULTANTS
06/22/11
FIGURE 7
OM&R SCHEMATIC PLAN
HARTMAN RUN LIMESTONE SAND DOSING
CARBON TOWNSHIP
HUNTINGDON COUNTY, PA
PREPARED FOR:
HUNTINGDON COUNTY CONSERVATION DISTRICT
R10-0471.001
SCALE: 1" = 30'

General Site Maintenance Recommendations

In addition to the maintenance needs for each pond of the five passive AMD treatment systems, other components do require some basic inspection and infrequent maintenance work. These items include the rock-lined and/or grass-lined emergency spillways for each pond, rip-rap outlet protections at many pipe outfalls, rock-lined channel lining, and the condition of the access road, which should be inspected every six months at a minimum and after major rainfall events. The culverts under the access road at each of the treatment system sites should be inspected during each site visit and after major rainfall events to make sure they are flowing freely and kept clear of debris.

All constructed berms/embankments involved with the treatment ponds should be inspected at least twice a year to monitor for potential failure caused by either excessive flows or areas of surface erosion. Any areas experiencing significant erosion should be immediately regraded and stabilized with seed and mulch.

Replacement of Treatment Components/Materials

The treatment cells containing limestone are designed to provide adequate treatment for approximately 20 to 25 years. After 20 to 25 years of operation, the limestone contents of the treatment cells must be replenished. However, care must be taken to avoid damaging the piping networks in the bottom of the limestone beds. For the five limestone-containing ponds, this is simply a matter of dumping more high calcium carbonate limestone (>80% $CaCO_3$) in and perhaps mixing the fresh stone into the existing stone with a backhoe or excavator. Once the contents of the treatment cells have been replenished, they should provide adequate treatment for another 20 to 25 years. The limestone bed at the five passive treatment system sites may also show signs of reduced volume in certain areas due to the limited space available, level of acidity, and source location of the raw AMD. If these reduced volume areas are observed and treatment efficiency appears compromised based on outfall water quality, then high calcium carbonate limestone (AASHTO #1) should be added to the limestone pond as needed to maintain the top of stone above the normal operating water surface elevation.

The limestone sand at each of the three dosing sites should be replenished as needed based on usage and available funding. Stockpiles of limestone sand should be placed at the existing stock pile locations at each site, which also includes the stockpile location at the Benedict treatment system along the access road.