CAMBRIA AMD TASK FORCE
PASSIVE TREATMENT SYSTEM EVALUATION

COLD STREAM
VERTICAL FLOW PASSIVE TREATMENT SYSTEMS
FINAL REPORT

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<u>PROJECT NO</u>: AMD 14(0850)102.1

<u>PROJECT NAME</u>: Cold Stream

<u>PROJECT LOCATION</u>: Rush Township, Centre County

<u>RECEIVING STREAM</u>: UNT (Site A Only) to Cold Stream to Moshannon Creek to West Branch Susquehanna River

<u>COLD STREAM CH 93 PROTECTED WATER USE</u>: Basin, source to US 322 at Philipsburg – HQ CWF
Basin, US 322 to mouth at Moshannon Creek - CWF

PROJECT GOALS

Cold Stream Dam is a popular recreational facility located in the town of Philipsburg. The dam and its water supply source, Cold Stream, are both heavily used trout stocked fisheries. In the 1970's Scarlift Project 70 constructed a dike and channel system along the eastern flank of Cold Stream, as far as topography would allow, to intercept and divert contaminated drainage from abandoned mines for a length of almost two miles downstream and around Cold Stream Dam. This project improved water quality and allowed for the trout stocked fishery in Cold Stream and Cold Stream Dam. The headwaters of Cold Stream support reproducing brook trout populations. The first significant degradation of Cold Stream occurs at the confluence of an unnamed tributary (UNT) conveying AMD from the Glass City area. This tributary is on the opposite side of Cold Stream and approximately one mile upstream from the Project 70 channel which was unable to intercept this discharge. The Wood Duck Chapter of Trout Unlimited has initiated an effort to address the Glass City UNT and a few other remaining sources of AMD that were beyond the scope of Scarlift Project 70. The Wood Duck Chapter submitted an application for assistance from BAMR's Set Aside Program which proposed an extension of the Scarlift Project 70 dike and channel system. For the same issues of topography and geology which limited the extent of the original project, BAMR decided against the proposal to extend the Scarlift Project 70 dike and channel system. BAMR instead agreed to address the Glass City discharges through the Cold Stream passive treatment project with the goal of improving water quality in the one mile section of Cold Stream beyond the extent of the Project 70 channel and for further improvement of water quality in the two stream miles and Cold Stream Dam below.

PROJECT DESCRIPTION

The Cold Stream project is located approximately 1.25 miles south of the town of Phillipsburg near the village of Glass City on the eastern side of SR 350 near the intersection of T-600. The Cold Stream project consists of two separate passive treatment systems designated as Site A and Site B. Each system contains two vertical flow successive alkalinity producing (SAP) units in series.

<u>SITE A</u>

Site A is the larger of the two systems covering a total area of approximately 4 acres. The system is located at the intersection of SR 350 and T-600 just off the eastern edge of SR 350 and along the northern edge of T-600. Site A is surrounded entirely by a chain link fence with an entrance gate along the edge of T-600. This system treats a collapsed deep mine entry discharge, which is the largest source of mine drainage within the Glass City area, and related coal outcrop seeps. These discharges are located along a roadside ditch on the opposite side of T-600 from the system. The discharges are collected by the roadside ditch and directed to a central point where they are piped under T-600 to the treatment system. Site A consists of an initial Stabilization Pond followed by SAP 1, a Sedimentation Pond, an Aerobic Wetland, and SAP 2 as the final system unit. A small seep (approximately 1 to 3 gpm) that was too low in elevation to be directed into the beginning of the system is piped into the Aerobic Wetland prior to the SAP 2 final treatment unit. The final treated system effluent from Site A discharges directly into the Glass City UNT.

SITE B

Site B is located approximately ½ mile south of Site A along the side of a forested ridge above Cold Stream approximately 100 feet higher in elevation than Site A. Site B is accessed via a dirt haul road located directly across T-600 from the entrance to Site A. Site B covers an area of approximately 2.25 acres. This system treats a single collapsed deep mine entry discharge which is located on a steep hillside approximately 25 feet higher in elevation from the first unit of the system. The discharge is conveyed by a steep riprap ditch downslope to the system. A chain link safety fence runs along the top of the slope above the discharge. Site B consists of an initial Stabilization Pond, Aerobic Wetland 1, SAP 1, a Sedimentation Pond, Aerobic Wetland 2, SAP 2 and a Sedimentation Pond as the system final unit. The final treated system effluent from Site B discharges into the woods and down over the forested ridge slope towards Cold Stream which is approximately 500 feet away and 120 feet lower in elevation.

PROJECT INFORMATION

- Project was a DEP BAMR design. Project Designer: Dan Sammarco. Design Completion Date: April 7, 1997.
- Contractor: Kukurin Contracting, Inc., RD 2, Route 286, Export, PA 15632
- Construction Engineer: Steve Helsel
- Inspector Supervisor: Duane Scully
- Project Inspector: Paul Paranich
- Final Inspection: September 24, 1998
- Engineer's Estimate: $400,000.00
- Low Bid: $309,939.00
- Final Construction Cost: $394,071.97

PROJECT DESIGN INFORMATION

No project design information exists in Cambria Office files. The Cambria Office Design File contains only as-bid drawings and contract.

SYSTEM MONITORING

Flushing Schedule: Every month

Water Sampling Schedule: Every Other Month

- SIS Monitoring Points Link
- Site A Monitoring Map Link
- Site B Monitoring Map Link
- Stream Monitoring Map Link

The Post-Construction Averages and Charts included in the following sections are presented with caution as to the reliability of the SIS data from which they were derived. In the raw data obtained from SIS, observed extreme outliers and spikes suggest incorrect data. Some of these occurrences were eliminated when found to be obvious errors. However remaining data extremes still tend to skew any analysis and it is difficult to determine whether there is still incorrect data remaining or if these patterns are in fact representative of the true conditions at these sites.

Representative Water Quality

------------------------------------- Site A System Water Quality Averages ---------------------------------

	Flow gpm	pH	Fe Total mg/l	Fe Ferrous mg/l	Acidity mg/l	Alkalinity mg/l	Al mg/l	Mn mg/l	SO_4 mg/l
Pre-Construction	48	2.6	52.1		465.7	0	24.5	1.3	
Post-Const Influent	105	2.6	62.5	2.4	489	0	32.6	2	377.7
Post-Const Effluent		6.9	13.1	5.3	12.1	161	4.1	2	435.2

Flows Less Than 200 GPM (Outliers Eliminated): Average 44 gpm

Site A System Influent Charts, Monitoring Point AIN

- Site A System Influent Charted Flow Chart Link
- Site A System Influent Charted Flow Less Than 200 GPM Chart Link
- Site A System Influent Metals Chart Link Site A System Influent Metals From 2003 to Present Chart Link
- Site A System Influent Hot Acidity Chart Link Site A System Influent Hot Acidity From 2003 to Present Chart Link
- Site A System Influent pH Chart Link Site A System Influent pH From 2003 to Present Chart Link
- Site A System Influent Sulfate Chart Link Site A System Influent Sulfate From 2003 to Present Chart Link

Site A System Effluent Charts, Monitoring Point AOUT (SAP2 Effluent)

- Site A System Effluent Metals Chart Link Site A System Effluent Metals From 2003 to Present Chart Link
- Site A System Effluent Hot Acidity From 2004 to Present Chart Link
- Site A System Effluent pH Chart Link Site A System Effluent pH From 2003 to Present Chart Link
- Site A System Effluent Sulfate Chart Link Site A System Effluent Sulfate From 2003 to Present Chart Link

------------------------------------- **Site B System Water Quality Averages** --------------------------------

	Flow gpm	pH	Fe Total mg/l	Fe Ferrous mg/l	Acidity mg/l	Alkalinity mg/l	Al mg/l	Mn mg/l	SO_4 mg/l
Pre-Construction	12	2.6	49		362.5	0	23.3	2.3	
Post-Const Influent	11.6	2.5	70.7	2.4	568.2	0	36.1	3.1	467.5
Post-Const Effluent		4.9	12.3	5.6	76.7	73.8	4.7	1.6	393.8

Flows Less Than 30 GPM (Outliers Eliminated): Average 7 gpm

- Site B System Influent Charted Flow Chart Link
- Site B System Influent Charted Flow Less Than 30 GPM Chart Link

SYSTEM PERFORMANCE EVALUATION

Site A

The raw water influent to the Cold Stream Site A system has exhibited an erratic pattern with some severely high spikes. Recorded flow has ranged from zero to 1,370 gpm with an average of 105 gpm. Site A Flow Chart. Even with high outliers eliminated, recorded flows of less than 200 gpm still exhibit this erratic pattern with a range between zero to 162 gpm and average of 44 gpm. Site A Flow < 200 GPM Chart. This erratic nature of the Site A raw water influent to the system is most likely explained by the arrangement for raw water collection. The discharges for Site A are located along a roadside ditch on the opposite side of the road from the system. The discharges are collected by the roadside ditch and directed to a central point where they are piped through a 24 inch smooth bore corrugated plastic culvert under the road to the treatment system. Intercepted surface water is most likely responsible for the erratic pattern of recorded flow for Site A.

- Road Culvert Inlet End: Photo
- Roadside Ditch Looking East: Photo
- Roadside Ditch Looking West: Photo

All monitoring of Site A has been routinely done on a system in-and-out basis, i.e. samples have only been collected and analyzed for the raw water in and final effluent out for the system as a whole. No sampling of the individual components within the system has been performed. The system final effluent comes from SAP2, the last unit in the system, and discharges directly to the Glass City UNT. When observed over the full time period that the Site A system has been in operation, water quality for the system final effluent indicates decreasing trends in the concentration of all parameters.

- Site A System Final Effluent Metals: Chart Site A System Final Effluent Alkalinity: Chart

- Site A System Final Effluent Hot Acidity: Chart   Site A System Final Effluent pH: Chart
- Site A System Final Effluent Sulfate: Chart

However, around 2002 to 2003 there appears to be some anomaly where system effluent water quality parameters began to exhibit reverse trends when viewed from only this time forward. This time period, around 2002 to2003, also coincides with an interval where little to no water sampling was performed and includes a period of 12 months where no samples were collected at all. Throughout all of this same time period flushing of both SAP1 and SAP2 continued on a monthly basis. This point of reversal in system effluent water quality trends may either indicate the approximate beginning of system failure or may be the consequence of the lack of monitoring information during this same period.

- Site A System Final Effluent 2003 to Present Metals: Chart
- Site A System Final Effluent 2003 to Present Alkalinity: Chart
- Site A System Final Effluent 2004 to Present Hot Acidity: Chart
- Site A System Final Effluent 2003 to Present pH: Chart
- Site A System Final Effluent 2003 to Present Sulfate: Chart

Site B

As with Site A, the raw water influent to the Cold Stream Site B system has exhibited an erratic pattern but on a lesser scale than with the Site A system. Recorded flow has ranged from zero to 90 gpm with an average of 12 gpm. Site B Flow Chart. Even with high outliers eliminated, recorded flows of less than 30 gpm still exhibit this erratic pattern with a range between zero to 25 gpm and average of 7 gpm. Site B Flow < 30 GPM Chart. Site B system influent comes from two PVC drain pipes installed in a sealed deep mine entry. This erratic flow pattern must therefore be truly characteristic for the influent to the Site B system.

- Site B Influent (Monitoring Point BIN): Photo
- Site B Influent Pipes: Photo   Close-Up Photo

All monitoring of Site B has been routinely done on a system in-and-out basis, i.e. samples have only been collected and analyzed for the raw water in and final effluent out for the system as a whole. No sampling of the individual components within the system has been performed. The system final effluent comes from a final sedimentation pond, the last unit in the system, and discharges through an 18 inch smooth bore corrugated plastic pipe culvert under the access road and into the woods.

- Site B Effluent Pipe Inlet: Photo
- Site B Effluent Pipe Outlet (Monitoring Point BOUT): Photo

The Cold Stream Site B system appears to have begun to fail shortly after completion of construction. Final system effluent shows increasing trends in metals and acidity and decreasing trends in alkalinity and ph from the very beginning of monitoring and continuing to present.

- Site B System Final Effluent Metals: Chart   Site B System Final Effluent Alkalinity: Chart
- Site B System Final Effluent Hot Acidity: Chart   Site A System Final Effluent pH: Chart
- Site A System Final Effluent Sulfate: Chart

Stream Monitoring

The Cold Stream project was completed in 1998. A pre-construction macroinvertebrate survey was conducted in 1995 and post-construction surveys were conducted in 2000, 2002, 2004, 2005 and 2008. Stream samples were collected pre-construction in 1994 and 1995, and post-construction in 2000, 2002, 2005, and 2008. No water quality data was found for the 2004 post-construction macroinvertebrate survey. No monitoring point upstream of the influence of effluent from the Site B system was established until 2008. In reference to the following analysis for both water quality and macroinvertebrate surveys, it should be noted that during the 2008 stream monitoring no flow or extremely little flow was discharging from either of the Site A or Site B systems. From observation of the stream water quality and macroinvertebrate analysis, it might also be noted that some sort of impairment, both in water quality and biology, appears to take place downstream of Tomtit Run.

Water sample analysis indicates obvious improvement in Cold Stream since completion of the project. In general metals have decreased while alkalinity and pH have increased downstream of the project. Since completion of the project, the upstream to downstream profiles for all water quality parameters remain rather flat with very low concentrations and very little variation throughout any individual sampling profile. Throughout the entire stream profile total iron has remained very low at less the 0.15 mg/l and varied by only 0.10 mg/l. Manganese has remained extremely low at less the 0.03 mg/l. No aluminum has been present in any stream samples taken since April 13, 1995. Alkalinity runs around 12 mg/l and pH around 7 again with little variation throughout any individual sampling profile.

- Stream Samples Total Iron: Chart
- Stream Samples Aluminum: Chart
- Stream Samples Manganese: Chart
- Stream Samples Alkalinity: Chart
- Stream Samples pH: Chart

Macroinvertebrate surveys perhaps indicate even more dramatic stream improvement since the initial pre-construction survey in 1995. The 2008 survey was the first to be analyzed by the ICE (Instream Comprehensive Evaluation) Metrics Index. The results of this evaluation showed no impairment at any of the Cold Steam monitoring points. The lowest scoring monitoring point from this evaluation was CS3, downstream of Tomtit Run, however this score still ranked as "Unimpaired."

- EPT (Mayfly, Stonefly and Caddisfly) Index: Chart
- EPT (Mayfly, Stonefly and Caddisfly) Total Insects: Chart
- Total Taxa: Chart
- Total Insects: Chart

SUMMARY OF CURRENT PROJECT STATUS

Research of monitoring information for the Cold Stream project began with review of SIS and project files maintained at the Cambria Office. As this review proceeded inconsistencies between SIS and file information and missing and incorrect data in SIS began to become apparent. Most notable with respect to the current task for analysis of the two Cold Steam systems was the discovery that in the 10 years since the project has been completed, only 2 full sets of samples have ever been taken that provide sample analysis throughout each system. All monitoring of the Cold Stream project has been routinely done on a system in-and-out basis, i.e. samples have only been collected and analyzed for the raw water in and final effluent out for both systems. This lack of monitoring data throughout each of the two systems reduces any analysis to near conjecture. Information from Brent Means and Art Rose conclude that Site A SAP 1 removes little to no acidity and needs rehabilitated. The concern is that Site A SAP 2 is currently doing all the work and eventually will fail also. The present load on Site A SAP 2 is unknown and evaluation of the status of its operation is presently impossible due to lack of monitoring information. Site B appears to be in complete failure. Analysis of where Site B problems exist and to what extent is presently impossible due to lack of monitoring information. Any type of time frame that would track when and where problems occurred within each of the two systems, whether it would now be of value or not, is impossible due to lack of monitoring information.

Site A

- Site A raw water influent to the system includes surface runoff from a roadside ditch and may explain extreme spikes in raw water flow measurements to the system.
- The raw water plywood weir at Monitoring Point AIN leaks around and possibly beneath the weir. Photo 1 Photo 2
- The water level control box for the effluent from SAP1 is a 10 foot deep box. This box is rusted and leaking to the outside through the side panels and inside between stop logs. The discharge pipe from this same level control box is submerged in the adjacent sedimentation pond and does not provide aeration or flow measurement capability. Photo 1 Photo 2
- At the Sedimentation Pond following SAP1 a plywood weir was placed in the principle spillway leading to the adjacent Aerobic Wetland. This weir was installed and used for a study of the effectiveness of SAP flushing conducted by Dr. Art Rose. Sediment has accumulated in the spillway behind this weir and caused the water level in this sedimentation pond to rise to the level of the emergency spillway which shows evidence of flow. It is surmised that the sediment accumulation behind this weir has come from the flushing events which are conducted

monthly. The principle spillway is located at the corner of the pond on the same side as the discharge pipe from SAP1 and this accumulation of sediment in the principle spillway may also signal a case of short-circuiting in the sedimentation pond. Photo 1 Photo 2

- The water level control box for the final system effluent from SAP2 is a 10 foot deep box. This box is rusted and leaking to the outside through the side panels and inside between stop logs. The discharge pipe from this same level control box was buried underground to appease a nearby resident who had complained about hydrogen sulfide smell coming from the system. Further complaints resulted in the compost being removed from SAP 2. It is questioned whether this pipe still needs to be buried since the compost was removed from SAP 2. Obviously no flow measurement is possible for the system final effluent from SAP2. This same pipe is used for flushing and presumably diminishes flushing efficiency.

<u>Site B</u>

- Site B has experienced considerable ATV use and vandalism. Almost every exposed pipe has been broken. ATV trails and litter are present throughout the site.
- The water level control box for the effluent from SAP1 is a 10 foot deep box. This box is rusted and leaking to the outside through the side panels and inside between stop logs.
- The water level control box for the effluent from SAP2 is a 10 foot deep box. This box has been filled with rocks and no longer functions. The discharge pipe from this same level control box is submerged in the adjacent sedimentation pond and does not provide aeration or flow measurement capability.
- Many of Site B cells are only minimally full of water with extensive freeboard that has liner on steep internal slopes presenting safety hazards.
- From field observations it appears that cell leakage throughout the system may be a problem, however the present condition of flow conveyance facilities between cells may attribute to this observation.
- The downslope course of the Site B final system effluent was tracked through the woods and any surface evidence found to dissipate shortly after discharge from the system. No point source impact location on Cold Stream for the Site B system effluent can be determined. Possibly for this reason, no stream monitoring point upstream of the Site B system had been established. The Task Force team established such a monitoring point at considerable distance upstream with the perception that any Site B influence on Cold Stream would be non-point or base flow. Two stream sampling events and a stream survey were conducted including this point during the Task Force review. However no flow from the Site B system was present for any of these events.

RECOMMENDATIONS

It is proposed that a revised and expanded monitoring program for the Cold Stream Project be planned and implemented with the goal of obtaining accurate data from all locations necessary to allow for a reliable analysis. Taking into consideration the erratic nature of the flow at both Site A and Site B, a monitoring period of one year with sampling and flow measurement conducted monthly is proposed in order to capture data from the range of flow events that is expected.

<u>Site A</u>

Site A should be conditioned to the minimal extent that reliable monitoring may be conducted. Examples would be replacing leaking level control boxes, and installing competent weirs or other flow measurement devices. Flow measurement capabilities should be established for raw water influent, SAP effluent, system final effluent and anywhere between cells where possible. Monthly monitoring should be conducted for raw water influent, SAP 1 influent and effluent, secondary discharge pipe into Aerobic Wetland and SAP 2 influent and effluent. Quarterly monitoring between all units throughout the system should be conducted. The following is a list of work items that would be required at Site A:

1. Replace the system influent raw water weir at Monitoring Point AIN. Something more permanent and durable than the existing plywood weir might be suggested.
2. Replace the water level control box for the effluent from SAP1. A suggested alternative would be to replace the existing level control box with a wye on this pipe leading up to a new short level control box of only about 3 or 4 foot depth that would still allow control of the SAP water level. Install a valve downstream of the new box on the run of the bottom pipe after the wye. The effluent pipe from the new level control box will now be

higher and allow for aeration, sampling and flow measurement from the end of this pipe. Some sort of conveyance ditch would also be required to direct the level control box effluent downslope into the adjacent sedimentation pond. This ditch could be curved and directed to intercept the end of the lower flushing pipe so that the ditch conveys both the normal SAP effluent and flush water. The SAP water level will be adjustable by the new short box within the range of the design water column. If the SAP water level is required to be lowered beyond this, for maintenance as example, the water can be lowered to the required level by the new valve downstream of the box. Flushing would be able to be conducted using the new valve instead of pulling stop-logs from a 10 foot deep box. Our BD crew has already installed such devices and knows the arrangement.

3. At SAP1 this would also be a good time to drain and autopsy this unit to inspect the compost and limestone layers. Test pits would need to be dug to inspect the limestone. Clean-out of the perforated pipe underdrain collection system could also be done at this time.
4. Clean out the accumulated sediment in the principle spillway of the Sedimentation Pond downstream of SAP1 to drop the water level in this pond below the elevation of the emergency spillway.
5. Replace the water level control box for the effluent from SAP2 using the same scenario proposed at SAP1. This would result in the system final effluent from SAP2 now being elevated and exposed to allow for aeration, sampling and flow measurement from the end of the level control box effluent pipe. A ditch would again be required to direct this flow downslope to the Glass City UNT. At this location a chain link fence separates the system from the Glass City UNT. A section of this fence may need to be temporarily removed to install the ditch and flushing pipe unless these can be worked under the fence. If a section of the fence is removed, installation of a gate at this location would be desirable.

Site B

In consideration of the magnitude and uncertainty of the problems associated with the Site B system, either a scaled-down rework or complete elimination of the entire system is proposed. The preference would be for a scaled-down rework plan utilizing any existing facilities if possible or their condition permits. Also in consideration of the problem with vandalism at Site B, any rework plan should include simple facilities with limited appurtenances and as limited surface presence as possible i.e. no exposed pipes, valves or boxes. Examples of facilities that may be considered would be Low pH Iron Oxidation, Wetlands and Open Limestone Channels. If their condition permits, materials from the existing units such as compost, limestone and maybe liner could be used in the new facilities as wetland substrate, channel lining, etc.

If this proposal for the Site B system is acceptable, it is suggested that no conditioning of the existing system be undertaken for further monitoring. Such work would most likely be eliminated in any rework plan. Simple monitoring of the Site B raw water discharge at BIN for the same one year monitoring period as described previously is proposed. This one year set of raw water data and flow would then be analyzed for a rework plan of Site B.

Cold Stream

Stream monitoring at all established monitoring points should be conducted monthly in conjunction with system monitoring for the proposed one year period. At least one additional macroinvertebrate survey should be conducted during this same period. Due to the lack of any monitoring point upstream of the Site B system, analysis of any impact on Cold Stream due to the Site B system is impossible using existing data. The proposed expanded set of stream monitoring data would be used to evaluate such impact, if any, and would then be considered in determining the scope and worth of any Site B rework plan.

ATTACHMENTS

- Project Location Map: Map Link
- As-Built Drawing: Drawing Link
- Full Water Quality Data Spreadsheet: Spreadsheet Link
- Macros: N Br Cucumber Run Upstream & Downstream No. of Taxa / No. of Insects Charted: Chart Link
- Macros: Cucumber Run at Cucumber Falls No. of Taxa / No. of Insects Charted: Chart Link
- Full Stream Surveys Data: Stream Surveys Link
- Construction Photos: Photos Link Note: Opens as web page. Click Browse Menu and select Full Screen. Then use mouse to navigate through photos.
- Ohiopyle State Park Map: Map Link
- Ohiopyle State Park Recreational Guide: Guide Link