Appendix D
Investigations and Analysis Report

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This report describes the investigations that the project team completed to develop the Watershed Project Plan and Programmatic Environmental Assessment (Plan-PEA). It provides supporting information for the planning processes and decisions made, consistent with the PR&G and related environmental review requirements. These included the formulation, evaluation, analysis, and selection of a recommended program alternative to address water quality concerns associated with mushroom composting (MC) operations in southern Chester County watersheds. This report is organized in the following order:

1. Project Formulation
2. Preplanning and Initial Data Collection
3. Practice Improvements and Engineering Feasibility
4. Analysis of Program Alternatives
5. Economics and Cost Allocation

Items of a routine nature are not included; however, citations are included throughout the Plan-PEA for appropriate manuals, handbooks, research, and other references. Resource areas not discussed or described below are addressed in the main body of the Plan-PEA.

D-1.0 PROJECT FORMULATION

The Chester County Conservation District (CCCD) has developed a close working relationship with the Natural Resources Conservation Service (NRCS) in the project area by executing Environmental Quality Incentives Program (EQIP) and Regional Conservation Partnership Program (RCPP) contracts. These past and ongoing program efforts were central to conception of the program proposed by the NRCS and CCCD. Additional stakeholders such as the American Mushroom Institute (AMI)[1], MC operators, and other industry representatives assisted with collecting data to understand watershed resource concerns, problems, and opportunities for improving MC operations.

D-2.0 PREPLANNING / INITIAL DATA COLLECTION

D-2.1 Project Kickoff Meeting

A kickoff meeting was held to review the project scope, define participant roles and responsibilities, and initiate data gathering. Data obtained at the meeting was used to define project objectives, draft a purpose and need statement, and develop the plan of work and public participation plan for the Plan-PEA.

As shown in Appendix C, the NRCS and CCCD delineated the project area based on the concentration of mushroom farms in southern Chester County watersheds.

D-2.2 Mushroom Compost Site Visits & Operator Interviews

The project team selected four representative existing MC operations to conduct site visits, field reconnaissance surveys, and collect site-specific data. The sites were representative of a typical future project site within the watershed and were selected based on their availability for study and the variability in their composting processes. They were also consistent with the makeup of MC operators in the project area (i.e., three [3] passive composting sites and one [1] active composting site). Three treatment systems (i.e., one or multiple combined practices) were selected and analyzed for each of the passive composting

[1] MC haulers and operators are members of the AMI.

sites; two treatment systems were selected and evaluated at the active composting site. Conservation system designs were developed in accordance with site conditions and constraints, and a detailed cost estimate was prepared for each design. Additional details are summarized below in Section D3.2.

The site visits were conducted by project team engineers and scientists in June 2021 and included interviews with the MC operators. Along with initial data collection for the project area, the information obtained from the MC operators supported future decision-making for the project. These activities are briefly summarized below.

D-2.2.1 Leachate Sampling and Characterization

In addition to visual site inspections, the project team collected leachate samples from MC sites and water quality samples at and downstream of MC sites. The purpose of the sampling was twofold: (1) to substantiate the resource concern as the driver for the program; and (2) to baseline constituents of concern for designing conservation practices and evaluating their consistency with the program objectives. The leachate sampling results confirmed the constituents of concern associated with MC operations. They also provided baseline concentrations of these contaminants for use in designing effective conservation practices. The water quality sampling indicated that passively composted MC sites were associated with higher concentrations of contaminants (e.g., salt and nutrients) as compared to actively composted MC sites.

D-2.2.2 Resource Inventories and Data Collection

The activities described below were conducted to gather data about individual resource concerns determined relevant based on regulatory compliance requirements and stakeholder interviews. This initial inventory ranged from site-specific to the larger project area and shaped the baseline environment conditions for subsequent evaluations, including the Plan-PEA.

D-2.2.2.1 Potential for Habitat Survey

Three endangered and threatened species with potential to occur in the project area were identified: the Indiana bat (*Myotis sodalis*), northern long-eared bat (*Myotis septentrionalis*), and bog turtle *(Glyptemys muhlenbergii*). The field reconnaissance surveys of the representative MC sites assisted in determining the level of regulatory consultation that may be required of a cost-share applicant, including potential mitigation measures. Onsite observations concluded that habitat for the identified bat species (i.e., wooded areas) was limited on and around the MC sites; however, potential suitable habitat for the bog turtle may require additional surveys at some sites. It was therefore recommended that a Phase I Bog Turtle Investigation be conducted for all sites within 300 feet of wetlands as part of the application process.

D-2.2.2.2 Phase 1A Cultural Resources Investigation

The project team consulted PA-SHARE, and other archival sources, to determine the presence of historic properties and the probability of encountering archaeological sites in the project area. Based on this review, a Phase 1A investigation report was produced that detailed the location of historic properties listed, eligible for listing, or potentially eligible for listing, in the National Register of Historic Places (NRHP). The report supported the creation of a programmatic agreement for incorporation into the Plan-PEA, as appropriate. In accordance with 36CFR§800.4(b)(2), a programmatic agreement between the NRCS, Pennsylvania State Historic Preservation Office (PA SHPO), and Chester County Conservation District (i.e., the main sponsoring local organization [SLO] has been executed. Per consultation with federally recognized Native American Tribes having ancestral ties or ceded lands in the project area,

Tribes having expressed interest in the project were invited to participate in the development of the programmatic agreement and sign as concurring parties.

D-2.3 Identified Data Sources

D-2.3.1 Hydrology

The project team made observations regarding hydrologic conditions at the four representative sites in 2021. All observed sites were on private property and routinely used for agricultural purposes (i.e., disturbed or maintained site conditions). Other main sources of data accessed or obtained to define the hydrology associated with the project area included:

- Chesapeake Bay Program (CBP) – Chesapeake TMDL
- Chester County Water Resources Authority (CCWRA) – Chesapeake Bay Program
- CCWRA – Watersheds: An Integrated Water Resources Plan for Chester County, Pennsylvania and its Watersheds
- CCWRA – Chester County, Pennsylvania Water Resources Compendium
- Federal Emergency Management Administration (FEMA) – National Flood Hazard Layer (NFHL) Viewer
- National Oceanic and Atmospheric Administration (NOAA) – Climate at a Glance: County Time Series
- Partnership for the Delaware Estuary (PDE) – What is the Delaware Estuary Program?
- PADEP – Pennsylvania Climate Impacts Assessment 2021
- US Fish and Wildlife Service (USFWS) – Wetlands Mapper

D-2.3.2 Water Resources

The project team collected and analyzed leachate and other surface water samples at the representative sites to better understand the relationship between MC operations and water quality concerns in the project area. They also noted the location and condition of surface waters and drainage features in the proximity of the MC operations. Other main sources of data accessed or obtained to evaluate water quality in the project area included:

- Chesapeake Bay Program (CBP) – Chesapeake TMDL
- CCWRA – Chester County Water Conditions 2020; Online Water Maps Gallery - Interactive Maps; Special Protection Waters / Protected Stream Uses; Chester County, Pennsylvania Water Resources Compendium
- FONDRIEST Environmental, Inc. – Conductivity, Salinity & Total Dissolved Solids
- Kaplan, L.A., et al. 2013. Impact on Water Quality of High and Low Density Applications of Spent Mushroom Substrate to Agricultural Lands
- Pennsylvania Department of Environmental Protection (PADEP) – 2022 Pennsylvania Integrated Water Quality Report; Sources of Groundwater Contamination and Prioritization Document; Water Quality; Pennsylvania's Phase 3 Watershed Implementation Plan

- US Environmental Protection Agency (USEPA) – Overview of Total Maximum Daily Loads (TMDLs)
- US Geological Service (USGS) – Stream Conditions Biological and Chemical Monitoring Networks

The main sources of data accessed or obtained to evaluate water use associated with the project area included:

- Mushroom Farm Environmental Management Plans, as available
- CCWRA – Watersheds: An Integrated Water Resources Plan for Chester County, Pennsylvania and its Watersheds
- Delaware River Basin Commission (DRBC) – National Wild and Scenic Rivers in the DRB
- National Park Service (NPS) – Interactive Map of NPS Wild and Scenic Rivers
- Natural Resources Conservation Service (NRCS) – Critical Conservation Areas
- Pennsylvania Department of Conservation and Natural Resources (PA DCNR) – Rivers Conservation

D-2.3.3 Geology and Soils

The main sources of data accessed or obtained for geology and soil conditions related to the proposed action and alternatives included:

- Natural Resources Conservation Service (NRCS) – Conservation Practice Standards & Support Documents; Web Soil Survey

D-2.3.4 Land Use, including Real Property Rights and Zoning

The main sources of data accessed or obtained to evaluate land use in the project area included:

- Chester County Planning Commission (CCPC) – Landscapes3: Chester County Comprehensive Plan
- USGS – National Land Cover Database

Land use was field verified during the site visits and reconnaissance surveys. The proposed conservation systems would be sited on land already owned and operated by the applicant; therefore, real property rights would be in place for the duration of prospective cost-agreements.

D-2.3.5 Biological Resources

Other main sources of data accessed or obtained to evaluate the biology of the project area included:

- NOAA – Essential Fish Habitat Mapper
- Pennsylvania Code (PAC) – Subchapter B. CLASSIFIED PLANTS
- Pennsylvania Natural Heritage Program (PNHP) – Chester County Threatened and Endangered Species; Chester County Natural Heritage Inventory Update 2015; PA Conservation Explorer - Conservation Planning
- USFWS – Information for Planning and Consultation (IPaC)

D-2.3.6 Cultural Resources

The main sources of data accessed or obtained to evaluate cultural resources in the project area included the:

- U.S. Department of Housing and Urban Development, Office of Environment and Energy – Tribal Directory Assessment Tool (TDAT)
- Pennsylvania Department of Transportation – One Map (Pennsylvania Native American Areas of Interest)
- Pennsylvania Historic and Museum Commission's (PA SHPO) - Pennsylvania's Historic and Archaeological Resource Exchange (PA-SHARE)

D-2.3.7 Socioeconomics

The main sources of data accessed or obtained to characterize and evaluate the socioeconomic conditions of the project area included:

- Agency for Toxic Substances and Disease Registry (ATSDR) – Places and Health: CDC/ATSDR Social Vulnerability Index
- Agricultural and Community Development Services (ACDS). 2022. Chester County Agricultural Economic Development Strategic Plan
- American Mushroom Institute – The Economic and Fiscal Impacts of the Mushroom Industry
- Chester County Agricultural Development Council (CCADC) – Agricultural Information Sheet: Mushrooms in Chester County – General Facts
- PADEP – Environmental Justice Areas Viewer
- Pennsylvania Department of Labor and Industry (PA DL&I) – Chester County Profile. Preliminary Data
- US Census Bureau (USCB) – 2016-2020 American Community Survey 5-Year Estimates; Annual Estimates of the Resident Population for Minor Civil Divisions in Pennsylvania; Population Estimates, Pennsylvania
- US Department of Agriculture (USDA) – 2017 Census of Agriculture - County Data

D-2.4 Early Project Scoping

Early project scoping was conducted to identify watershed resource concerns in project area watersheds. These concerns were considered in formulating and evaluating alternatives that would meet the primary program objectives, as defined in consultation with the SLO. Using a variety of multi-media communications such as mailings, emails, and announcements (e.g., on-air radio, posts to websites and information boards, and targeted emails using organization-specific contact lists), the project team conducted public meetings with interested MC operators, government agency representatives, private professional services consultants, watershed residents, and other individuals and groups with a stake or interest in the project. These stakeholders assisted the project team by validating existing data, identifying additional data, and, in general, understanding resource concerns and constraints related to the proposed action and alternatives. With sufficient data and understanding, interdisciplinary teams were assigned to collate and analyze the data to help with project formulation.

D-3.0 PRACTICE IMPROVEMENTS & ENGINEERING FEASIBILITY

D-3.1 Conservation Practice Standards

NRCS conservation practice standards are established at a national level and set the minimum level of acceptable quality for planning, designing, installing, operating, and maintaining conservation practices. Conservation plans include practices that meet such standards and specifications as documented in the NRCS Field Office Technical Guide (FOTG) and the National Handbook of Conservation Practices (NHCP). These standards provide detailed information for the design of practices in a manner consistent with local conditions and resource concerns. Commonly, suites of conservation practices are planned and installed together as part of a conservation management system designed to enhance soil, water, and related natural resources for sustainable use.

Based on review and evaluation of the NRCS Pennsylvania-based conservation practices, 40 were identified as being relevant to MC operations in the project area. As shown in Table D-1, these conservation practices could be configured or combined to constitute one or more conservation systems. The design, construction, and operation of such systems would result in more efficient and resilient MC operations. They would also require or provide an opportunity to incorporate environmental protection measures by design. Overall, the resultant conservation systems would produce the localized water quality benefits sought by the program.

Table D-1. Mushroom Compost Programmatic Conservation Practices

No.	Conservation Practice	Core Practice	CPPE Water Quality Score [1/]	CPPE Air Quality Score [2/]	Cumulative CPPE Score [3/]
560	Access Road		18	1	2
371	Air Filtration and Scrubbing		17	0	18
591	Amendments for Treatment of Agricultural Waste		36	12	13
317	Composting Facility	X	18	8	7
656	Constructed Wetland		29	22	0
342	Critical Area Planting		63	9	5
362	Diversion		36	11	0
382	Fence		18	3	1
393	Filter Strip		34	19	2
410	Grade Stabilization Structure		14	2	0
412	Grassed Waterway		48	10	1
355	Groundwater Testing		0	0	0
561	Heavy Use Protection Area	X	15	5	2
422	Hedgerow Planting		3	7	31
468	Lined Waterway or Outlet		23	7	0
353	Monitoring Well		0	0	0
484	Mulching		34	5	5
590	Nutrient Management		43	20	12
500	Obstruction Removal		3	0	0
520	Pond Sealing or Lining – Compacted Soil Treatment		24	9	0

No.	Conservation Practice	Core Practice	CPPE Water Quality Score [1/]	CPPE Air Quality Score [2/]	Cumulative CPPE Score [3/]
521	Pond Sealing or Lining – Geomembrane or Geosynthetic Clay Liner		24	9	0
522	Pond Sealing or Lining – Concrete		24	9	0
533	Pumping Plant		28	0	4
391	Riparian Forest Buffer	X	98	25	5
390	Riparian Herbaceous Cover		78	25	3
558	Roof Runoff Structure		21	9	0
367	Roofs and Covers	X	15	1	13
350	Sediment Basin		15	11	0
336	Soil Carbon Amendment		25	4	4
442	Sprinkler System	X	42	15	4
570	Stormwater Runoff Control		17	6	0
578	Stream Crossing		14	2	0
587	Structure for Water Control		23	1	0
606	Subsurface Drain		37	6	0
600	Terrace		27	4	0
620	Underground Outlet		12	-3	0
635	Vegetated Treatment Area		24	9	3
360	Waste Facility Closure		11	4	5
633	Waste Recycling		22	10	5
632	Waste Separation Facility		29	12	9
313	Waste Storage Facility	X	16	13	-4
634	Waste Transfer		5	12	-4
629	Waste Treatment	X	31	12	8
359	Waste Treatment Lagoon		17	15	-3
638	Water and Sediment Control Basin		7	0	0
351	Well Decommissioning		10	8	0
380	Windbreak/Shelterbelt Establishment		86	6	14

Sources: FOTG | PA, Section 4 - Practice Standards and Supporting Documents and Conservation Practice Physical Effects (CPPE) (2024)

[1/] Conservation Practice Physical Effect (CPPE) considering water quality resource concerns: Nutrients Transported to Surface Water, Nutrients Transported to Ground Water, Pathogens and Chemicals from Manure, Bio-solids or Compost Applications Transported to Surface Water, Pathogens and Chemicals from Manure, Bio-solids or Compost Applications Transported to Ground Water, Sediment Transported to Surface Water, Sediment Transported to Ground Water, Pesticides Transported to Surface Water, Pesticides Transported to Ground Water, Salts Transported to Surface Water, and Salts Transported to Ground Water

[2/] CPPE considering air quality resource concerns: Emissions of Particulate Matter (PM) and PM Precursors, Emissions of Greenhouse Gasses – GHGs, Emissions of Ozone Precursors, Objectionable Odor, and Emissions of Airborne Reactive Nitrogen

[3/] CPPE considering all resource concerns

Some conservation practices were not included in the proposed program addressing the water quality effects of mushroom composting operations. These practices were initially evaluated but eliminated from consideration as being ill-equipped to accomplish the identified program objectives. Table D-2 lists the practices that were not selected for inclusion.

Table D-2. Mushroom Compost Conservation Practices Evaluated but Dismissed from Program Consideration

Conservation Practice Standard (CPS)	CPS Code	Justification [1/]
Access Control	472	MC operations generally do not have livestock.
Agrichemical Handling Facility	309	Conditions where practice applies not expected to occur on MC operations.
Alley Cropping	311	Not appropriate for farmstead land use.
Amending Soil Properties with Gypsum Products	333	Practice purpose does not align with purpose of the project.
Anaerobic Digester	366	Practice is not used in the industry to treat runoff water.
Animal Mortality Facility	316	MC operations generally do not have livestock.
Aquaculture Ponds	397	MC operations generally do not have livestock.
Aquatic Organism Passage	396	Practice purpose does not align with purpose of the project.
Bivalve Aquaculture Gear and Biofouling Control	400	MC operations generally do not have livestock.
Brush Management	314	Not appropriate for farmstead land use.
Channel Bed Stabilization	584	Practice purpose does not align with purpose of the project.
Clearing & Snagging	326	Practice purpose does not align with purpose of the project.
Combustion System Improvement	372	Practice purpose does not align with purpose of the project.
Conservation Cover	327	Not likely to be used by industry around facilities due to potential for habitat for pests (e.g. rodents).
Conservation Crop Rotation	328	Not appropriate for farmstead land use.
Contour Buffer Strips	332	Not appropriate for farmstead land use.
Contour Farming	330	Not appropriate for farmstead land use.
Contour Orchard and Other Perennial Crops	331	Not appropriate for farmstead land use.
Controlled Traffic Farming	334	Not appropriate for farmstead land use.
Cover Crop	340	Not appropriate for farmstead land use.
Cross Wind Ridges	588	Not appropriate for farmstead land use.
Cross Wind Trap Strips	589C	Not appropriate for farmstead land use.
Dam	402	Not appropriate for farmstead land use.
Deep Tillage	324	Practice purpose does not align with purpose of the project.
Denitrifying Bioreactor	605	Practice purpose does not align with purpose of the project.
Dike or Levee	356	Practice does not apply to sites where a diversion, grade stabilization structure, terrace, or water and sediment control basin are more

Conservation Practice Standard (CPS)	CPS Code	Justification [1/]
		appropriate. It is expected that these other practices will be more appropriate on MC operations.
Drainage Water Management	554	Practice purpose does not align with purpose of the project.
Dry Hydrant	432	Practice purpose does not align with purpose of the project.
Dust Management for Pen Surfaces	375	MC operations generally do not have livestock.
Early Successional Habitat Development/Mgt.	647	The resource concern addressed by this practice is habitat creation not water quality.
Emergency Animal Mortality Management	368	MC operations generally do not have livestock.
Energy Efficient Agricultural Operation	374	Not appropriate for farmstead land use.
Energy Efficient Building Envelope	672	The resource concern addressed by this practice is energy efficiency not water quality.
Energy Efficient Lighting System	670	The resource concern addressed by this practice is energy efficiency not water quality.
Feed Management	592	MC operations generally do not have livestock.
Field Border	386	Not appropriate for farmstead land use.
Field Operations Emissions Reduction	376	Not appropriate for farmstead land use.
Firebreak	394	The resource concern addressed by this practice is plant health and wildfire prevention, not water quality.
Fish Raceway or Tank	398	MC operations generally do not have livestock.
Fishpond Management	399	MC operations generally do not have livestock.
Forage Harvest Management	511	Not appropriate for farmstead land use.
Forest Farming	379	Not appropriate for farmstead land use.
Forest Stand Improvement	666	Not appropriate for farmstead land use.
Forest Trails and Landings	655	Not appropriate for farmstead land use.
Fuel Break	383	The resource concern addressed by this practice is plant health and wildfire prevention, not water quality.
Grazing Land Mechanical Treatment	548	Not appropriate for farmstead land use.
Herbaceous Weed Treatment	315	While this practice may be used to control invasive, noxious, and prohibited plants, most area for this project will require establishment of grass rather than have existing hay/pasture that needs weed control.
High Tunnel System	325	Not appropriate for farmstead land use.
Irrigation and Drainage Tailwater Recovery	447	Wastewater applied to vegetated treatment areas shall be applied at rates so as to not cause tailwater.
Irrigation Pipeline	430	This practice is not applicable to wastewater irrigation.
Irrigation Reservoir	436	The resource concern addressed by this practice is plant health through irrigation, not water quality.

Conservation Practice Standard (CPS)	CPS Code	Justification [1/]
Irrigation System, Microirrigation	441	Using a microirrigation system for wastewater is not practicable as the wastewater will clog the microirrigation ports and nozzles.
Irrigation Water Management	449	The resource concern addressed by this practice is plant health through irrigation, not water quality.
Land Reclamation, Abandoned Mined Land	543	Not appropriate for farmstead land use.
Livestock Pipeline	516	MC operations generally do not have livestock.
Livestock Shelter Structure	576	MC operations generally do not have livestock.
Mine Shaft & Adit Closing	457	Not appropriate for farmstead land use.
On-Farm Secondary Containment Facility	319	The practice is for containment of oil and petroleum products.
Open Channel	582	This practice is not commonly used in Pennsylvania. If clean water, a grassed waterway is preferred. If wastewater, a closed conduit is typically used.
Pasture and Hay Planting	512	Not appropriate for farmstead land use.
Pest Management Conservation System	595	The resource concern addressed by this practice is plant health and air quality, not water quality.
Pond	378	Other more appropriate conservation practices are recommended instead of a pond. For clean water storage, a CPS 638 Water and Sediment Control Basin is suggested and wastewater utilizes a CPS 313 Waste Storage Facility lined with a CPS 521 Pond Sealing or Lining - Geomembrane or Geosynthetic Clay Liner.
Prescribed Burning	338	Not appropriate for farmstead land use.
Prescribed Grazing	528	Mushroom composts typically do not have animals that would be grazing CPS 635 Vegetated Treatment Areas.
Range Planting	550	Not appropriate for farmstead land use.
Residue and Tillage Management, No Till	329	Not appropriate for farmstead land use.
Residue and Tillage Management, Reduced Till	345	Not appropriate for farmstead land use.
Restoration and Management of Rare or Declining Habitats	643	The resource concern addressed by this practice is threatened and endangered plant species health, not water quality.
Road/Trail/Landing Closure and Treatment	654	Not appropriate for farmstead land use.
Rock Wall Terrace	555	Not appropriate for farmstead land use.
Row Arrangement	557	Not appropriate for farmstead land use.
Shallow Water Development and Management	646	The resource concern addressed by this practice is wildlife habitat, not water quality.
Short Term Storage of Animal Waste and Byproducts	318	MC operations generally do not have livestock.
Silvopasture	381	Not appropriate for farmstead land use.

Conservation Practice Standard (CPS)	CPS Code	Justification [1/]
Sinkhole Treatment	527	Most of Chester County is not underlain by karst geology.
Spring Development	574	The resource concern addressed by this practice is water quantity and quality for animal usage.
Stream Habitat Improvement and Management	395	The resource concern addressed by this practice is improving the ecological function of a stream habitat, not water quality.
Streambank and Shoreline Protection	580	The resource concern addressed by this practice is streambank erosion, not water quality.
Stripcropping	585	Not appropriate for farmstead land use.
Structures for Wildlife	649	The resource concern addressed by this practice is wildlife habitat, not water quality.
Surface Drainage, Field Ditch	607	Not commonly used in Pennsylvania, do not anticipate using for this program as all drainage water collected will be using CPS 606 Subsurface Drain, collected in a conduit.
Surface Drainage, Main or Lateral	608	Not commonly used in Pennsylvania, do not anticipate using for this program as all drainage water collected will be using CPS 606 Subsurface Drain, collected in a conduit.
Surface Roughening	609	Not appropriate for farmstead land use.
Trails and Walkways	575	As there are not livestock generally involved with these facilities, CPS 560 Access Roads is more appropriate than CSP 575.
Tree/Shrub Establishment	612	While this practice is used to establish woody vegetation that can be used to improve water quality, more appropriate practices include CPS 422 Hedgerow Planting, CPS 380 Windbreak/ Shelterbelt Establishment, and CPS 391 Riparian Forest Buffer.
Tree/Shrub Pruning	660	The resource concern addressed by this practice is plant health, not water quality.
Tree/Shrub Site Preparation	490	While this practice could be used to prepare a site for planting of woody vegetation, similar preparation is already accounted for in the payment scenario for CPS 422 Hedgerow Planting, CPS 380 Windbreak/ Shelterbelt Establishment, and CPS 391 Riparian Forest Buffer.
Upland Wildlife Habitat Management	645	The resource concern addressed by this practice is wildlife habitat, not water quality.
Water Well	642	This practice does not apply to wells constructed for domestic or public water supply and monitoring wells, injection wells, temporary test wells, or piezometers.
Watering Facility	614	The resource concern addressed by this practice is livestock or wildlife water availability, not water quality.
Waterspreading	640	Not appropriate for farmstead land use.
Wetland Creation	658	Not appropriate for wastewater; should use CPS 656 Constructed Wetland instead.
Wetland Enhancement	659	Not appropriate for farmstead land use.
Wetland Restoration	657	Not appropriate for farmstead land use.
Wetland Wildlife Habitat Management	644	The resource concern addressed by this practice is wildlife habitat, not water quality.

Conservation Practice Standard (CPS)	CPS Code	Justification [1/]
Wildlife Habitat Planting	420	The resource concern addressed by this practice is wildlife habitat, not water quality.
Woody Residue Treatment	384	The purposes of this practice does not include water quality.

[1] Not appropriate for the farmstead land use determined from RMS Planning Tool – FY25 National.xls

D-3.1.1 Resource Effects of Conservation Practices

Conservation practice standards and state-specific conservation practice specifications include considerations that are designed to minimize potentially adverse impacts on affected resources. Typical effects of implementing conservation practices are summarized in each State's Conservation Practice Physical Effects (CPPE) document, contained in Section V of the FOTG.

The CPPE for these standards include effects and rationale statements developed in the context of field or conservation management unit application (i.e., the site level). They indicate the type and level of impacts (both positive and negative) on affected resources that would be likely to occur from a designed conservation practice in operation. The numeric CPPE ratings range from positive (i.e., improvement) to negative (i.e., worsening) in determining an evaluated level of impact (Table D-3). The CPPE ratings were determined at the individual practice level (i.e., an approved NRCS conservation practice standard) and link to a wide range of possible effects on natural resources and agricultural management objectives. As such, the CPPE are useful indicators for evaluating the potential effects of the proposed action and alternatives. [2]

Table D-3. CPPE Indicators

CPPE No.	Range of Possible Effects	Evaluated Level of Impact
5	improve	Substantial
4		Moderate to Substantial
3		Moderate Improvement
2		Slight to Moderate
1		Slight
0	No Effect	
-1	worsen	Slight
-2		Slight to Moderate
-3		Moderate
-4		Moderate to Substantial
-5		Substantial

[2] At a minimum, all NRCS CPPEs include the following information: (1) **Practice Setting**: describes the conservation practice as typically employed and its representative setting; (2) **Baseline Setting**: describes planning situation conditions on which to base the conservation practice effect; (3) **Effect**: qualifies (i.e., type and magnitude) the conservation practice effect on a resource concern assuming its full functionality; and (4) **Rationale:** explains how the conservation practice produces an effect.

CPPE No.	Range of Possible Effects	Evaluated Level of Impact

Source: NRCS 2024

Because the CPPEs are developed in the field once a conservation practice is fully operational, effects on resources, whether positive or negative, would be localized. By extension, effects may be of a lesser degree when considered on a larger scale. For example, in a watershed context, resource effects would be determined by the many individual practices taking place across space and time (i.e., cumulative effects). However, the design and location flexibility of the program provides the opportunity to produce synergistic effects within the project area. These additive effects are evident when considering all CPPE-identified resource concerns that could result from the program. That is, the CPPE cumulative rating for the programmatic conservation practices totals +165 indicating the more substantive, positive effects that could accrue at the watershed level.

D-3.2 Design and Engineering Feasibility

With the programmatic conservation practices identified and vetted by stakeholders, the project team conducted a feasibility assessment of the proposed action. The conceptual site design plans, engineering calculations, and detailed cost data developed for conservation practices at the representative project sites were used for this purpose. In other words, these work products were evaluated for conformance with applicable, conservation practice-specific criteria and standards identified by the NRCS for Pennsylvania. Figure D-1 and Figure D-2 show sample conceptual site plans developed by the project team.

The preparation of the conceptual site design and engineering data/documents considered both site and user constraints in the project area. They also met the applicable NRCS conservation practice specifications and demonstrated various options for effectively siting and operating conservation system(s) under the program. The practice scenarios, along with early project scoping, also led to the formulation of two programmatic alternatives that met the purpose and need of the proposed program. These included: Alternative 1 – Passive MC Operations Only (Future with Limited Federal Investment [FWLFI]); and Alternative 2 – All MC Operations (Future with Full Federal Investment [FWFFI]).

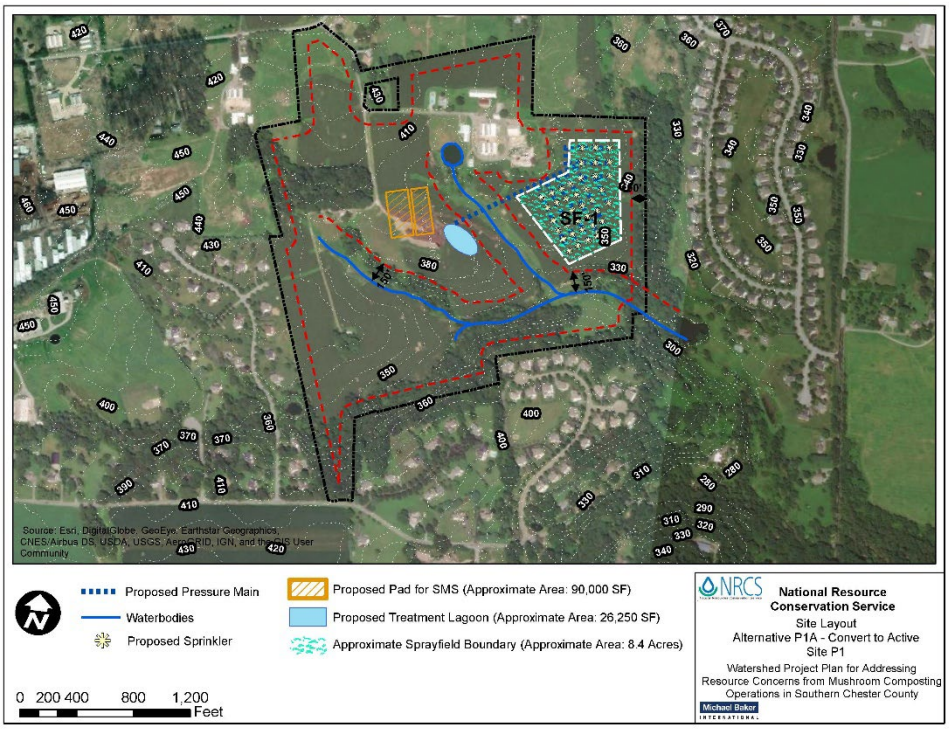

Figure D-1. Conceptual site plan to collect and treat mushroom compost leachate on evaluated site P1.

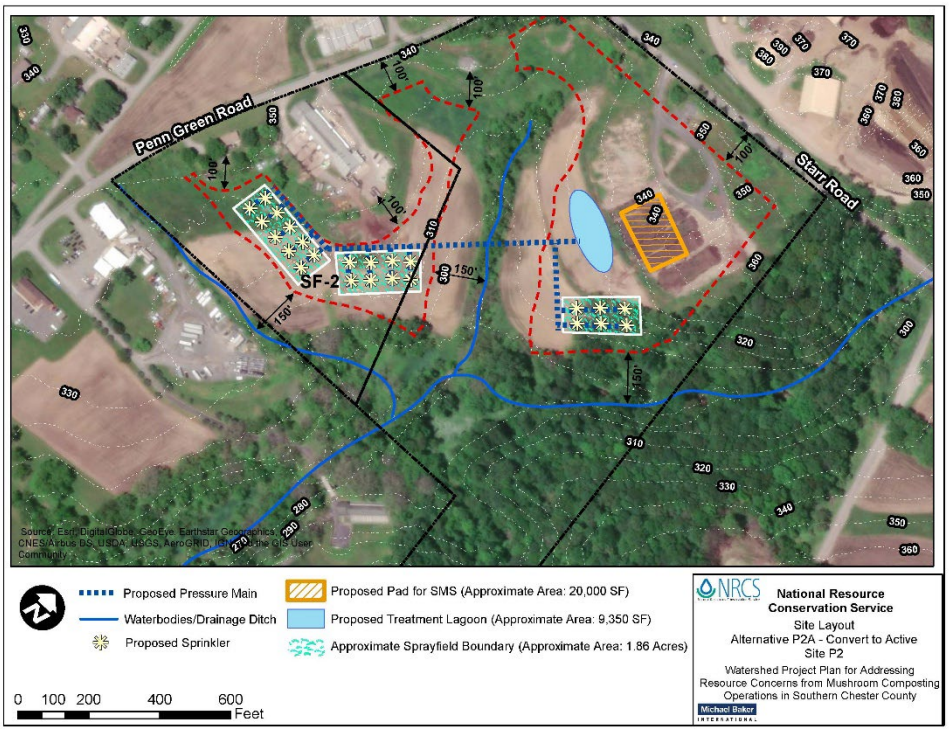

Figure D-2. Conceptual site plan to collect and treat mushroom compost leachate on evaluated site P2.

D-4.0 ANALYSIS OF PROGRAM ALTERNATIVES

Once the programmatic conservation practices were determined to be feasible based on conditions in the project area, further analyses were conducted to evaluate the identified program alternatives. The project team developed two decision-making tools for this purpose, as described below.

- Application Ranking Template. A rating system for applicants built around four basic evaluation factors or categories, each containing multiple program-specific scoring elements (see Table D-4).
- Alternative Ranking Template. A rating system for program administration to identify and fund conservation system(s) in the project area that produce the most water quality benefits (see Table D-5).

Table D-4. Application Ranking Matrix Scoring Elements

Category	Scoring Elements	Maximum Element Score	Maximum Category Score
Water Quality Improvement Factors	Potential Nutrient Load Reduction based on conservation practice and Material Volume	15	45 (47%)
	Compost Volume Reduction	15	
	Location within Watershed	5	
	Watershed Sensitivity	5	
	Receiving Water Sensitivity	5	
Other Ecosystem Services Factors	Air Quality Score based on conservation practice and Material Volume	5	10 (11%)
	Environmental Justice Score	5	
Constraints & Compliance Potential	Design Constraints (Space & Topographical)	5	10 (11%)
	Resource Constraints (Cultural or Historic)	5	
Relative Cost Factors	Unit Construction Cost	20	30 (32%)
	Maintenance Burden/Cost	10	
	Total Maximum Possible Score:		**95**

Table D-5. Conservation System Evaluation/Ranking Results

Site ID	Proposed Control	Water Quality Score (0-45)	Eco Services Score (0-10)	Constraints Score (0-10)	Cost Score (0-30)	Total Score (#)	Rank (#)	Points above min	Ranked	Result
P3D	Gasifier from Passive	39	8	8	8	63.6	1	23.6	100%	Highly Ranked
P3B	Convert to Active with Roof	30	7	7	15	59.8	2	19.8	84%	
P1B	Convert to Active with Roof	33	6	6	15	59.7	3	19.7	83%	
P1D	Add Roof from Active	22	4	7	27	58.9	4	18.9	80%	
P3E	Add Roof from Active	18	6	8	26	57.8	5	17.8	75%	Moderately Ranked
A1A	Gasifier from Active	29	7	7	14	57.7	6	17.7	75%	
P1A	Convert to Active	28	4	5	19	55.5	7	15.5	66%	
P3A	Convert to Active	23	5	8	18	54.4	8	14.4	61%	
P2A	Convert to Active	19	2	8	17	45.7	9	5.7	24%	
P2C	Do Nothing	0	0	10	30	40.0	10	0.0	0%	Not Recommended
P3C	Do Nothing	0	0	10	30	40.0	10	0.0	0%	
A1B	Do Nothing	0	0	10	30	40.0	10	0.0	0%	
P1C	Do Nothing	0	0	10	30	40.0	10	0.0	0%	
P2B	Gasifier from Passive	27	3	9	N/A	39.4	14	-0.6	-3%	

D-5.0 ECONOMICS AND COST ALLOCATION

D-5.1 Introduction

An economic analysis was conducted in conformance with the requirements of the National Watershed Program Manual, the Principles, Requirements, and Interagency Guidelines for Water Resource Projects (PR&G), the National Resource Economics Handbook Part 611 – Water Resource Handbook for Economics, and the procedures applicable to monetary economic analysis contained in Chapter 2 of Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies (P&G). The cost allocation was determined based on PL 83-566 and guidance

provided in the National Watershed Program Manual (USDA-NRCS 2014). PL 83-566 allows for the NRCS to pay 100 percent of the costs for engineering and NRCS project administration. NRCS may also offer cost-share assistance for construction similar practices and measures under existing NRCS programs. This rate is 75 percent unless the applicant self-certifies as historically underserved (the rate is then 90 percent). The Sponsors are responsible for 100 percent of real property acquisition.

All costs allocated to this project are for the purpose of watershed protection using land treatment practices. The economic analysis was limited to data collected under the scope of this project or that which was readily available from other reputable online sources. In practice, the actual costs would reflect currently unknown, future market conditions for demonstrable conservation practices as proposed by cost-share applicants and subject to approval by the NRCS delegate.

D-5.2 Calculation of Average Program Benefits and Costs

D-5.2.1 Rationale

The unique and programmatic nature of the proposed action and alternatives made it difficult to obtain readily available, relevant, and reliable data for calculating benefits and costs. For example, material and labor costs associated with constructing and operating the conservation practices at the currently unknown site level were based on market conditions at the time of inquiry. The actual costs will be determined by future program participation and market conditions at the time of solicitation. Data required to calculate the damage reduction benefits under the proposed program alternatives were similarly difficult to obtain and validate as accurate. Therefore, based on the SLO's objective to address water quality concerns associated with MC sites in the project area, the average damage reduction benefits of each program alternative were quantified in terms of nutrient/sediment management.

D-5.2.2 Methodology

D-5.2.2.1 Benefits Determination

The effective onsite control, detention, and treatment of wastewater generated at MC sites is the core management objective of the program. Given the beneficial effects generated by requiring adherence to the NRCS conservation practice standards, a quantitative analysis was conducted focusing on three of the most common constituents of concern associated with MC operations – nutrients (nitrogen and phosphorus) and sediment. The average program damage reduction benefits were quantified as the [$/lbs. reduced of nutrients/sediments] under each program alternative, as described below and summarized in Table D-6.

The quantitative analysis used proxy values from a 2019 valuation study to associate the removal of these contaminants with a resultant water quality improvement. Readily available, relevant data was used for project sites within the Chesapeake Bay Watershed. This data was also assumed to be relevant for the Delaware River Watershed.

Data used in these calculations included: (1) concentrations of nutrients in MC based on water quality samples obtained for the representative sites; (2) volumes of sediment based on MC practices and operational tempos at the representative sites. The willingness-to-pay study's results were used as proxy rates for damage reduction benefit for each contaminant. The resultant values were then converted to 2024 dollars.

These data were brought together to estimate the quantity of nutrient/sediment removal that would take place post-construction of the conservation practices at the representative sites on an annual basis. Since

the conservation practices could be organized to represent the evaluated program alternatives, these monetized damage reduction benefits were used to analyze benefits and costs for the purposes of the Plan-PEA. In other words, a demonstrable reduction of these main contaminants would be prerequisite to achieving the program objectives. Considering the CPPE rankings for the same programmatic conservation practices, the project team presumes that the totality of damage reduction benefits achieved under the program alternatives would be much higher in practice (Table D-6).

This conservativism is also supported by noting that only the sediment removal benefits were monetized for the conservation practices under Alternative 2; it was presumed nutrient management practices were already in place due to existing, *active* MC operations. Also, damage reduction benefits for a proposed gasification facility under Alternative 2 were excluded from the calculations due to uncertainty, both in terms of potential suitable sites/applicants and the currently unknown, future regulatory environment for the resultant air emissions.

Table D-6. Nutrient/Sediment Reduction (N/P/S) Benefits by Program Alternative [1/]

Program Alternative	lbs. reduced per year (N)	$ lbs. reduced per year (N)	lbs. reduced per year (P)	$ lbs. reduced per year (P)	lbs. reduced per year (S)	$ lbs. reduced per year (S)	$ lbs. reduced per year (N/P/S)
Alternative 1	22,148	$ 441,198	641	$ 155,003	1,739,086	$ 856,815	**$ 1,453,016**
Alternative 2	67,036	$ 1,335,368	27,233	$ 6,585,672	3,075,680	$ 1,515,330	**$ 9,436,370**

[1/] N – Nitrogen; P – Phosphorus; S – Sediment; lbs. – pounds

D-5.2.2.2 Costs Determination

Site specific cost estimates were prepared for each treatment system design (see Section D-3.2, above). These estimates were then averaged and extrapolated to determine approximate system costs. To determine the site-specific costs, unit prices for implementing standard conservation practices at representative sites in the project area under current market conditions were obtained. It was presumed these data best represent a typical, future program year. It was further assumed that the practices selected for each site are representative of the proposed action and include variations of the same practice.

Feedback provided by the SLO informed the estimated number of systems that would likely be installed through the program. There are eight active and nine passive mushroom composters in the watershed (three composting operations utilize both methods, so there are 14 total mushroom composters). Based upon operator input received during early project scoping, the project team projects a 30% program participation rate. Additionally, one operator expressed interest in pursuing gasification as a waste treatment solution and passive operators were mostly interested in MC runoff collection and treatment practices. In the latter case, the collected runoff could either be treated or reused as a required input of the mushroom composting process. Early project scoping and subsequent communications with prospective applicants also indicated that some proposed improvements would utilize more than one system (e.g. collecting and treating some runoff while roofing others or providing a cover over the runoff storage pond). The individual system cost and presumed number of installations are shown in Table D-7.

Table D-7. Estimated Mushroom Compost Treatment System Installation Costs

Treatment System	Unit	No.	System Cost [1/]	Total Cost
Mushroom Compost Leachate/Runoff Collection, Storage, & Treatment (Irrigated on a Vegetated Treatment Area)	No.	4	$812,500	$3,250,000
Mushroom Compost Leachate/Runoff Prevention (Roof)	No.	3	$833,333	$2,500,000
Mushroom Compost Treatment (Gasifier)	No.	1	$4,000,000	$4,000,000

[1/] System costs include construction costs to install the system, including required secondary and erosion and sedimentation control practices; permitting and design costs not included.

Operation, maintenance, and replacement (OM&R) costs were calculated by multiplying the estimated construction cost of each individual conservation practice by an average OM&R factor. The resultant individual conservation practice O&MR costs were added together to determine an OM&R cost of the identified conservation systems and annualized over the program evaluation period.

The total program cost was determined by assuming 15 percent of construction cost would be necessary to provide technical assistance and 16 percent of this cost would be necessary for project administration (including permitting and operation, maintenance, and replacement costs).

The cost estimates were annualized for an inaugural program period of 10 years using a discount rate of 3.00 percent. This would allow for programming the necessary funds and administering cost-share agreements. However, the benefits accrued under a cost-share agreement would not likely be realized until program years 6-10; the preceding program years include time for proposal preparation, review and approval, construction, and verification. Therefore, benefit estimates were calculated for the latter 5 years of each agreed upon cost-share agreement. This aligns with the anticipated timeframe for programmatic cost-share reimbursements to applicants with verified operational improvements.

D-5.3 Recommended Program Alternative

Alternative 2 – All MC Operations (FWFFI) is recommended as the preferred alternative. This alternative would provide flexibility to effectively administer a program under PL 83-566 and evaluate its performance. Based on the operational and environmental data collected by the project team (Table D-8), Alternative 2 (encompassing of Alternative 1) would be the most effective in accomplishing the program objectives. All conservation systems evaluated under Alternative 2 demonstrate value in addressing water quality concerns associated with MC sites, and most are relatively easy to implement in 3 years or less.

Table D-8. Alternatives Ranking Matrix

Program Offerings	Average Score (#)	Improvement (%)
Passive Only	59.6	79%
All Composters	57.9	69%
Active Only	55.2	55%
Do Nothing	45	0%

Table D-9 summarizes the net economic program costs and benefits of Alternative 2 (FWFFI).

Table D-9. Recommended Alternative – Estimated Program Benefits and Costs [1/ 2/ 3/]

Category	Cost or Benefit
Construction ($)	10.0M
Engineering ($)	1.5M
Program Administration ($)	1.0M
Real Property Acquisition ($)	0
Relocation ($)	0
Permitting ($)	0.2M
Total ($):	**12.7M**
Annualized Program Cost ($)	1.50M
Annualized O&M/Replacement Program Cost ($)	0.03M
Total ($):	**1.53M**
Annualized Damage Reduction Benefits ($)	**9.4M**
Benefit-Cost Ratio	**6.26**

Prepared December 2024

[1/] Price base: 2024 dollars; cost estimates rounded.

[2/] Amortization based on 10-year program at 3.00% rate.

[3/] Annual O&M/R outlays assume a 10-year program duration.

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