

TECHNICAL SPECIFICATIONS

WWTP Lagoon Decommission, Swale Development, and Sinkhole Remediation Jefferson County, West Virginia

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 **POTESTA**

PROJECT NARRATIVE

The Jefferson County Commission's (Owner) Wastewater Treatment Plant (WWTP) lagoon is located within the Bardane Industrial Park near Bardane, West Virginia. This lagoon, which has not been in use for an extended time, is located downstream of culverts that convey stormwater flow from approximately 306 acres of land from the south side of Industrial Boulevard and another 1.5 acres from the north side of Industrial Boulevard. This lagoon interferes with the flow of stormwater and a sinkhole developed just upstream (south) of the lagoon.

The Owner has submitted a "Revised; Lagoon Decommission Irrigation Lagoon & Sinkhole Remediation Plan for Bardane Industrial Park" to the West Virginia Department of Environmental Protection (WVDEP), which was approved.

Specifically, the scope of work includes decommissioning the existing lagoon by dewatering the lagoon to the existing 300-foot wide drainage easement just downstream, and then removing the berms of the lagoon. A stormwater drainage swale is to be constructed, from the culverts at Industrial Boulevard through the former lagoon area, to handle a 25-year storm event, to the drainage easement. This drainage swale will route stormwater away from the location of the existing sinkhole which will be remediated per the WVDEP's Sinkhole Mitigation Guide and graded so that sheet flow of stormwater (no concentrated flow) will result in the area of the remediated sinkhole.

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TECHNICAL SPECIFICATIONS

WWTP Lagoon Decommission, Swale Development, and Sinkhole Remediation

1.0 GENERAL

1.1 Site Location

The site is located on the north side of Industrial Boulevard, between the Randox Laboratories and the West Virginia State Police in the Bardane Industrial Park, near Bardane in Jefferson County, West Virginia.

1.2 Definitions

The following definitions shall be used throughout these specifications:

Addenda - Written or graphic instruments issued prior to the opening of Bids which clarify, correct or change the Contract Documents. Also called Addendum.

Agreement - The written Agreement between Owner and Contractor covering the Work to be performed. The term "Agreement" shall be synonymous with the term "Contract."

Bid - The offer or proposal of the Bidder submitted on the prescribed form setting forth the prices for the Work to be performed.

Bidder - Any person, firm, or corporation submitting a Bid for the Work.

Contract or *Contract Documents* - All legal and technical writings plus Drawings for the Construction including, but not limited to, Technical Specifications, Drawings, Contracts, contractor bid forms, bidding instructions, and written communications.

Contractor - Denotes the individual or organization who performs the Work. The Contractor shall provide all labor, materials, equipment, supervision, tools, services, and incidentals necessary to complete the contract in accordance with the Contract Documents.

Drawings - The approved documents or drawings, or exact reproductions of them, showing construction requirements for the project. The Drawings show the location, character, dimensions, and other details of the prescribed work including layouts, profiles, and cross sections; however, subsurface soil and geological data are excluded from this definition. The term "Drawings" shall be synonymous with the term "Plans."

Engineer - The person and/or company responsible for the project design. The Engineer will review, and monitor the work as requested by the Owner. All questions or changes which may affect the work shall be presented to the Engineer for review. For this project the Engineer is Potesta & Associates, Inc.

Owner - Denotes the individual or organization for whom the work is being performed. In the case of this project, the Owner is Jefferson County Commission. The Owner may delegate responsibilities to others in the performance of this work.

Shop Drawings - All drawings, diagrams, illustrations, brochures, schedules and other data which are prepared by the Contractor, a Subcontractor, manufacturer, supplier or distributor to substantiate the design, material or equipment for some portion of the Work.

Specifications - A part of the Contract Documents consisting of written descriptions of a technical nature of materials, equipment, construction systems, standards and workmanship, also referred to as Technical Specifications.

Subcontractor - An individual, firm or corporation having a direct contract with Contractor or with any other Subcontractor for the performance of a part of the Work.

Work - All materials, equipment, services, facilities and other related items necessary to produce the construction required by the Contract Documents and all supplies incorporated or to be incorporated in the Work.

1.3 Description of Problems

The Jefferson County Commission's Wastewater Treatment Plant lagoon is located within the Bardane Industrial Park near Bardane, West Virginia. This lagoon, which has not been in use for an extended time, is located downstream of culverts that convey stormwater flow from approximately 306 acres of land from the south side of Industrial Boulevard and another 1.5 acres from the north side of Industrial Boulevard. This lagoon interferes with the flow of stormwater and a sinkhole developed just upstream (south) of the lagoon.

1.4 Purpose

The purpose of this project is to decommission the lagoon by first dewatering the lagoon to the existing 300-foot wide drainage easement downstream of the lagoon and removing the berms of the lagoon. A stormwater drainage swale will be constructed from the culverts at Industrial Boulevard through the former lagoon, to handle a 25-year storm event, to the drainage easement. This drainage swale will route stormwater away from the location of an existing sinkhole which will be remediated per the WVDEP's Sinkhole Mitigation Guide and graded so that sheet flow of stormwater (no concentrated flow) will flow over this remediated sinkhole.

The Owner has presented a "Lagoon Decommission & Sinkhole Remediation Plan", subsequently amended, to the WVDEP, which was approved.

1.5 Subsurface Information

No subsurface exploration was completed for this project.

2.0 SCOPE OF WORK

2.1 General

The work covered by these Specifications includes dewatering and removing a WWTP lagoon, remediating a sinkhole and construction of a stormwater swale. Included are installation and maintenance of erosion and sedimentation control, earthwork, and regrading and revegetating disturbed areas, cleanup of the area upon completion of the work, and all other such operations as specified herein. The purchase and delivery of materials to the site will be the responsibility of the Contractor unless otherwise specified. No payment shall be made for stored materials.

2.2 Supervision

Except where the Contractor is an individual and gives his personal superintendence to the Work, the Contractor shall provide a competent superintendent satisfactory to the Owner (or their designated representative) on the work site at all times during working hours with full authority to act for the Contractor.

2.3 Environmental Control

The Contractor shall conduct all work to minimize the amount of dust, erosion, and damage to local flora and fauna. General site cleanup shall be performed upon the completion of work and/or on a daily basis as determined by the Owner. The project area shall be kept clean of all rubbish and debris resulting from the Work. All barrels, cans, drums, rubbish, waste, or other debris shall be disposed in an approved landfill or other appropriate location.

2.4 Site Plans

All of the Drawings in the List of Drawings are part of this Specification and are included separately.

2.5 Additional Specifications

Contractor shall conduct his activities in such a manner to comply with the following:

1. WVDEP - Division of Water and Waste Management (DWWM) Groundwater Protection Program's "Sinkhole Mitigation Guidance" document for a sinkhole with drainage area of less than 5 acres, found in Appendix A.
2. "Revised: Decommission Irrigation Lagoon & Sinkhole Remediation Plan for Bardane Industrial Park," dated March 22, 2018, found in Appendix B.

2.6 Proposed Construction Sequence

The proposed construction sequence (major steps only) for this project is outlined below. The Contractor may perform the construction in another sequence with the prior approval of the Owner.

1. Install stabilized construction entrance.
2. Clear & grub for E&S measures only and install perimeter E&S measures.
3. Dewater lagoon per "Revised: Decommission Irrigation Lagoon & Sinkhole Remediation Plan for Bardane Industrial Park," dated March 22, 2018, (Appendix B).
4. Build temporary stormwater runoff diversion dike through the existing lagoon. Stabilize this diversion dike prior to opening up the lagoon berms (the upstream opening last) to allow the stormwater runoff to be rerouted from the existing drainage swale and open sinkhole, through the constructed diversion so that the sinkhole area is bypassed, and to the downstream drainage conveyance.
5. Install diversion dikes upslope of sinkhole to route stormwater surface flow away from entering the sinkhole work area.
6. Remediate sinkhole per the WVDEP - DWWM Groundwater Protection Program's "Sinkhole Mitigation Guidance" document for a sinkhole with drainage area of less than 5 acres (Appendix A) and in accordance with the requirements contained in the Drawings and Specifications.
7. Clear & grub remainder of site.
8. Demolish & remove pump house and former irrigation/lagoon structures.
9. Grade swale, removing diversion dikes.
10. Stabilize land disturbance areas.
11. Remove E&S measures once stabilized.
12. Demobilization.

3.0 SITE ACCESS

Site access from the public roadway will be located at the construction entrance shown on the site plan drawings. If the Contractor requires additional rights-of-entry, it will be the Contractor's responsibility to obtain them. In the right-of-entry agreements between the Contractor and landowner, the landowner shall hold the Owner harmless from any injury or damages whatsoever resulting from the use of the property. The Contractor shall hold the Owner harmless for any damage to public or private property. All proposed routes of access shall be subject to the approval of the Owner. The Contractor shall be responsible for removing and replacing any fences necessary for access to the work areas, and providing any temporary fencing required, all at his own expense.

4.0 INTERPRETATIONS

The Contractor shall make interpretations of the surface and subsurface conditions which may affect methods or costs of the execution of work. All prospective Contractors shall obtain their own permission from the landowner for subsurface explorations, samplings, tests, etc. The Contractor herein agrees to make no claim for damage or compensation should the Contractor find conditions during the progress of the work different from those calculated or anticipated. The actual quantities may vary from those shown. The Contractor is responsible for verifying these quantities and bringing any discrepancies to the attention of the Owner a minimum of three days prior to the submittal of the bid.

5.0 UTILITIES AND OTHER OBSTRUCTIONS

It shall be the sole responsibility of the Contractor to contact West Virginia 811 (WV811), the Jefferson County Public Service District (JCPSD) and the Jefferson Utilities, Inc (JUI), 48 hours prior to excavation and, to locate and avoid all utilities, facilities and other structures and obstructions. For that purpose, the Contractor shall employ all necessary precautions and methods to insure avoidance of and damage to such conditions. In the event such damage does occur, the Contractor shall notify the affected utility owner and the Owner immediately, make or have made all necessary repairs, and bear the expense of repairs for the damage thereof and any resulting damage caused thereby. The Contractor is required to submit a list of all utilities contacted to the Owner before commencing work. If utility relocations not specifically covered by these documents are necessary, as determined by the Owner, the Contractor shall be reimbursed for the relocation per utility company invoice. The Contractor shall first submit a written cost estimate for all utility relocations required to the Owner for approval prior to performing or arranging for any utility relocations. The Owner will be the sole judge as to whether utility relocations are required.

Overhead and underground utilities, including storm water structures (culverts, ditches), are not shown on the Drawings. The utility locations should be field located by the contractor prior to the initiation of work.

If the Contractor encounters any underground utilities not previously identified and field located, the Contractor shall not disturb the utility and shall notify the Owner immediately for determination of subsequent actions.

6.0 EQUIPMENT RESPONSIBILITY

All equipment shall be in satisfactory operating condition and be capable of safely and efficiently performing the work required. Qualified operating personnel shall be provided by the Contractor for the operation of this equipment. The Contractor shall furnish and install, at the Contractor's own expense, all fuel, oil, grease, cables, repair parts, tools and all other miscellaneous supplies and parts necessary for the efficient operation of each unit. In the event that equipment required to complete the on-going work is inoperable the Contractor at his expense is required to repair or replace the inoperable equipment within 48 hours. Contractor is responsible for cleaning up all spilled fuels and oils. Contractor must provide appropriate secondary containment for all petroleum products and antifreeze temporarily stored at the site.

7.0 TRAFFIC MAINTENANCE

The Contractor shall maintain traffic in accordance with the West Virginia Division of Highways' Standard Specifications, Roads and Bridges, Supplemental Specifications latest revision, and the West Virginia Division of Highways' manual entitled Traffic Control for Street and Highway Construction and Maintenance Operations' latest revision. Traffic control is considered incidental to this project.

8.0 LIMITING ACCESS

The Contractor shall limit access to his work areas, including erecting and maintaining any temporary barriers and warning signs necessary to limit access to the construction areas.

Limiting and maintaining access, as specified, shall be considered incidental to the project.

9.0 PROJECT CONTROL

The Owner reserves the right to control and direct all facets of the project. However, such control does not relieve the Contractor of the sole responsibility for site safety and the proper completion of the services.

10.0 DAMAGES

The Contractor shall be responsible for all damage to public or private property or facility, regardless of location or character, which may be caused by moving, hauling or otherwise transporting equipment, materials, or workers to or from any part of the work site, whether by him or his subcontractors, or as a result of performing the Work. This will include any damage to the access road (paved or unpaved) leading to the construction site and damage to public or private utilities. The Contractor shall make satisfactory and acceptable arrangement with the owner of, or the agency or authority having jurisdiction over, the damaged property or facility concerning its repair or replacement or payment of costs incurred in connection with said damage. All things damaged in connection with the performance of the Contract shall be restored to their original condition or better as determined and approved by the Owner, and/or property owner.

Damages to personal property items (e.g., driveways, private utilities, culverts, and mailboxes) shall be repaired by the Contractor (at no cost to the Owner) as soon as possible.

11.0 PERMITS AND LICENSES

Obtaining the WVDEP National Pollutant Discharge Elimination System (NPDES) stormwater construction general permit and the highway occupancy permit from West Virginia Department of Highways, will be the responsibility of the Owner. The Contractor shall be responsible to comply with all conditions of the highway occupancy permit and the stormwater construction general permit including installation of BMPs, inspections, maintenance, documentation, and all other requirements.

12.0 MOBILIZATION AND DEMOBILIZATION

12.1 Description

This work shall consist of the performance of construction preparatory operations, including the movement of personnel and equipment to the project site, and the establishment of the Contractor's other facilities necessary to begin work on a substantial phase of the Contract. It shall also include all demobilization activities.

12.2 Materials

As required.

12.3 Mobilization

Upon receipt of notice to proceed, the Contractor shall initiate and complete measures necessary to commence the work. Mobilization shall also consist of delivering to the site and assembling in working order necessary equipment, materials, and supplies to be furnished by the Contractor to

complete the work. The Contractor will be responsible for securing a materials storage area, including a right-of-entry for use of that area if outside of the limits of construction.

12.4 Demobilization

Demobilization shall consist of the removal from the site of all the Contractor's equipment and materials after completion of the work and cleanup of the site. Work shall be done to the satisfaction of the Owner.

12.5 Method of Measurement

The method of measurement for determining the quantity of work done as described above will be on a lump sum basis.

12.6 Basis of Payment

The quantity of work done will be paid at the Contract lump sum price bid for this item. Price and payment shall be full compensation for doing all the work herein described in a workmanlike and acceptable manner, including the furnishing of all labor, materials, tools, equipment, supplies, and incidentals as necessary to complete the work. The amount shall not exceed 10 percent of the total amount bid for the project.

Partial payments for "Mobilization and Demobilization" will be as follows:

1. One-half of the amount bid will be released to the Contractor with the first estimate submitted not less than 15 days after the start of work at the project site.
2. The final one-half of the amount bid shall be released when demobilization is complete.

Nothing herein shall be construed to limit or preclude partial payments otherwise provided for by the Contract.

No deduction will be made, nor will any increase be made, in the lump sum mobilization and demobilization item amount regardless of decreases or increases in the final total Contract amount or for any other cause.

12.7 Pay Item

Item 12, Mobilization and Demobilization, per lump sum. Cannot be more than 10 percent of the total amount bid for the project.

13.0 QUALITY CONTROL

13.1 Description

This work shall consist of testing for verification that the materials supplied and the work performed are in accordance with these Specifications.

13.2 Materials

As required to procure samples and perform required testing.

13.3 Construction Materials

The Contractor shall furnish the services of his own testing laboratory or select an independent testing laboratory, as long as the laboratory is under the direct supervision of a Registered Professional Engineer. The laboratory must be approved by the Owner.

Testing for strength, slump, compaction, grain size analysis, aggregate, rock, soils, and nutrient and lime requirements, etc., shall be performed as required by these Specifications or as ordered by the Owner in writing. The Owner will determine the need, locations, extent, and time of any testing herein specified or in addition to that which is herein specified.

The Contractor shall be responsible to perform laboratory tests of the various fill materials (soils) to identify the Standard Proctor density. A copy of the soil laboratory testing summary sheet shall be supplied to the Owner's representative for review and approval prior to placement of all material. If, in the opinion of the Owner, the Proctor density has changed, a retest will be required.

The fill materials shall be compacted to 90 percent of their Standard Proctor density (ASTM D 698) unless otherwise required by these Specifications. Field density tests shall be performed by the Contractor or a qualified third party testing laboratory acceptable to the Owner in accordance with the Specifications. All Proctor tests shall be submitted to the Owner for approval prior to compacting the fill and after fill compaction to verify that the compaction criteria is obtained. Field density test results shall also be provided to the Owner as they are completed during the progress of the Work.

Only first-class materials conforming to the requirements of the Specifications shall be incorporated into the work. All materials shall be accepted by the Owner prior to use in this project. The Contractor shall furnish a written statement of the origin, composition, and manufacturer of any or all materials (manufactured, produced, or grown) that are to be used in the work. The sources of supply of each material used shall be approved by the Owner before delivery is started. If, at any time, sources previously approved fail to produce materials acceptable to the Owner, the Contractor shall furnish materials from other Owner-approved sources.

Whenever the Specifications require that a product be in accordance with federal or state regulations, ASTM designations or other association standards, the Contractor shall present a certification from

the manufacturer that the product complies therewith. When requested or specified, the Contractor shall also submit supporting test data to substantiate compliance.

13.4 Method of Measurement

Quality control and related requirements as specified herein will be paid at the Contract lump sum price bid for this item. The amount shall not exceed 3 percent of the total amount bid for the project.

13.5 Pay Item

Item 13, Quality Control, per lump sum. Cannot be more than 3 percent of the total amount bid for the project.

14.0 SITE PREPARATION

14.1 Description

Work in this Section shall be performed in accordance with the Drawings and as specified herein.

14.2 Materials

Temporary construction entrance materials, diversion dikes, erosion control matting and silt fence for erosion control as specified herein.

14.2.1 Silt Fence

- 14.2.1.1 Silt fence materials and installation shall meet all applicable requirements of Section 642.6.5 of the West Virginia Division of Highways Standard Specifications for Roads and Bridges, Adopted 2000.
- 14.2.1.2 Non-woven filter fabric shall be purchased in a continuous roll. Fabric shall contain ultraviolet ray inhibitors and stabilizers to provide a minimum of 6 months construction life at temperatures ranging from 1 to 120 degrees Fahrenheit. Preferred fabrics are Mirafi 100X, Exxon GTF, or approved equal.
- 14.2.1.3 Stakes shall consist of 2-inch by 2-inch oak or 2-inch by 4-inch pine and a minimum length of 5 feet. Fasteners shall be heavy duty 1-inch staples or tie wires.
- 14.2.1.4 If steel posts (standard "U" or "T" section) are used for silt fence construction they shall have a minimum weight of 1.33 pounds per linear foot and a minimum length of 5 feet.

14.2.1.5 “Envirofence,” “Geofab,” or approved equal are preferred prefabricated units.

14.2.2 Stabilized Construction Entrance

Stone for stabilized construction entrance shall be No. 1 coarse aggregate meeting the requirements of Section 703 of the West Virginia Division of Highways Standard Specifications for Roads and Bridges, Adopted 2010.

14.2.3 Erosion Control Matting

The erosion control matting for the grass lined channels with matting shall consist of North American Green – RollMax – EroNet S75 Erosion Control Blanket or an approved equal.

14.3 General Requirements

The Contractor shall conduct his operations in such a manner as to minimize soil erosion. The Contractor shall construct, as necessary, sediment and erosion control devices at the work areas prior to beginning any type of earth disturbance. The Contractor shall be responsible for cleaning sediment and erosion control structures of sediment that may accumulate during the work.

14.4 Clearing and Grubbing

All clearing and grubbing shall be approved by the Owner prior to commencement. The work areas within the limits of construction indicated on the Drawings shall be cleared and grubbed by removing all standing or felled trees, stumps, brush, trash and other objectionable matter to the satisfaction of the Owner. All materials from the required clearing and grubbing operations shall be removed from the site and burned or chipped for later use as mulch.

14.5 Erosion and Sedimentation Control

Care shall be taken in the areas adjacent to construction areas to minimize disturbance or removal of vegetation and trees. Erosion control shall be completed prior to the start of construction. The Contractor shall attempt to minimize the rate of runoff from the disturbed areas during the period of construction.

The Contractor shall comply with and conform his operations to all applicable federal, state, and local laws and regulations.

Silt fence, rock check dams and diversion dikes shall be as specified according to the WV Erosion & Sediment Control, Best Management Practices Manual, latest edition or Owner approved equal and as specified herein.

14.5.1 Silt Fence

The height of silt fence above original ground shall be 16 inches, minimum, and shall not exceed 36 inches. Filter fabric shall be purchased in a continuous roll and cut to length to minimize joints. When joints are unavoidable, the silt fence shall be joined together at a support post by twisting the fence ends or last post of each run around each other and securely sealed. A trench 4 inches by 4 inches shall be excavated on the uphill side of the posts. The fabric shall be fastened securely to the uphill side of the posts and extended into the trench. Do not staple fabric to trees. The 4-inch by 4-inch trench shall be backfilled and compacted atop the fabric to eliminate under-piping. The end of fabric runs shall be turned slightly uphill to prevent runoff from going around. Silt fence shall be installed along the contour of the land with no section exceeding 5 percent slope in 20 feet.

14.5.2 Stabilized Construction Entrance

Stabilized construction entrance shall be installed and maintained at locations shown on the Drawings or where required to avoid tracking of mud or sediments onto public roadways. The stabilized construction entrance shall be maintained by cleaning mud and sediments from the surface and/or adding new stone to the surface.

14.5.3 Erosion Control Matting

The erosion control matting to be placed in the drainage swale shall be three roll widths in width and centered along the centerline of the drainage swale. Erosion control matting shall be installed in accordance with the manufacturer's recommendations including anchoring and overlaps.

14.5.3 Removal

All erosion and sediment control devices installed for this Work shall be left in place until the vegetative cover served by that device reaches 80 percent cover. Silt fence and super silt fence shall be removed and taken to a permitted solid waste landfill for disposal.

Earthwork shall be in accordance with Section 15.0, Earthwork.

14.6 Method of Measurement

The method of measurement for determining the quantity of work done as described above for silt barriers (silt fence) will be measured per linear foot. The method of measurement for stabilized construction entrance shall be per entrance installed. Temporary diversion ditches and temporary diversion dike shall be measured per linear foot along the flow line of the ditch or dike. Clearing and grubbing, temporary access road construction and maintenance, and related activities shall be considered incidental to construction and no separate payment will be made for these items.

14.7 Basis of Payment

The quantity of work done will be paid at the contract price bid for these items. Price and payment shall be full compensation for doing all the work herein described in a workmanlike and acceptable manner, including the furnishing of all labor, materials, tools, equipment, supplies, and incidentals as necessary to complete the work.

14.8 Pay Items

Item 14.1, Silt Barriers, per linear foot.

Item 14.2, Construction Entrance, per item

Item 14.3, Diversion Ditches, per linear foot

Item 14.4, Diversion Dike, per linear foot

Item 14.5, Erosion Control Matting, per square yard

15.0 EARTHWORK

15.1 Description

The work to be performed under this Section shall be in accordance with the Drawings and as specified herein. The terms for earthwork used in the remainder of this Section imply unclassified excavation in native materials (soil and rock). The work under this Section shall include, but is not necessarily limited to, the following:

1. Earthwork for erosion and sedimentation control.
2. Earthwork for diversion ditches and diversion dike.
3. Earthwork for sinkhole remediation and drainage swale installation.
4. Final grading, shaping, and contouring drainage swale and area over remediated sinkhole.

Payment for earthwork required for erosion and sediment control, diversion ditches, and diversion dikes are included in the unit prices bid for those items, and no separate payment will be made for earthwork (excavation or fill) for the above items. Earthwork for regrading the lagoon will be paid under this item.

15.2 Material Definitions

As required.

15.3 Construction Methods

15.3.1 Excavation

Material excavation shall consist of the required removal of materials from the areas shown and the sloping and finishing of the areas to the required lines and grades as shown on the Drawings. The slopes may be varied only by permission of the Owner. Any excavation beyond planned grades will not be paid for unless prior authorization is obtained from the Engineer. Slopes shall be trimmed neatly to present a uniform surface, free from hollows and protrusions and loose or overhanging rocks. The tops of all slopes shall be rounded to form a smooth, uniform transition to the existing ground.

The reclamation approach described in these construction specifications is intended to provide a lasting, stable configuration. The Contractor is required to exercise care to avoid conditions which may result in unstable conditions during the construction process.

The Contractor must utilize material removal techniques, which are generally considered to be conducive to retaining slope stability. Additionally, disturbed slopes shall be brought to the design template as soon as practical and shall be protected in accordance with Section 19, "Revegetation."

15.3.2 Material Placement

Depositing and compacting fill in layers shall be started at the lowest point in the fill below grade, at the bottom of ravines and at the toe of the slope on side hill fills. Prior to fill placement, existing foundation for the embankment will be proof-rolled and all unsuitable material, as determined by the Owner, will be removed.

Excavated material shall be placed in successive layers not to exceed one (1) foot in thickness before compaction. The layers shall be constructed approximately horizontal. Each layer, before starting the next, shall be leveled and smoothed by means of power driven graders, dozers, or other suitable equipment with adequate weight, capacity, and power to do the work. Layers shall be extended across the entire fill at the level of deposition unless otherwise authorized by the Owner. Each layer, before starting the next, shall be compacted.

The Contractor shall select and segregate the soil material from the proposed excavations to place as the top 12 inches of backfill for the sewage lagoon area. The 12 inches at the top of the backfill will serve as the vegetative layer; therefore, the best soil material shall be used in this layer to promote vegetative growth.

Fill materials to be used in any area of an embankment shall be free from trash, debris, frozen soil, organic material or other foreign material.

Embankment fill and embankment subgrade materials shall be compacted to at least 90 percent of Standard Proctor maximum dry density (ASTM D 698) at a moisture content of not less than 3

percent below, nor greater than 5 percent above, optimum. Testing shall be at a frequency of one test per 250 cubic yards placed. Four compaction tests per lift shall serve as a minimum.

Fill material which does not contain sufficient moisture to be compacted to the requirements specified herein shall receive applications of water necessary for compaction. Water shall be applied with suitable sprinkling devices and shall be thoroughly incorporated into the material which is to be compacted. Embankment fill material which contains excess moisture shall be dried prior to compaction. Sufficient discing equipment shall be continuously available at the site and shall be used to add water or remove excess moisture from fill materials.

At the close of each day's work, or when work is to be stopped for a period of time, the entire surface of the compacted fill shall be sealed by a method approved by the Owner. If, after a prolonged rainfall, the top surface of the embankment is too wet and plastic to work properly, the top material shall be removed to expose firm material. Ruts in the surface of any layer shall be suitably filled or eliminated by grading before compaction. The disturbed areas will be revegetated according to Section 19, "Revegetation."

15.3.3 Sludge Mixing / Stabilization

Following dewatering of the lagoon, the Contractor shall be responsible for mixing borrow soil material with the sludge to bulk and reduce the moisture content. The sludge must be compacted to meet the criteria in Section 15.3.2. In the event that additional methods are required to achieve an optimum moisture content, the Contractor may propose the addition of hydrated lime or other admixtures to remove excessive moisture conditions. The Contractor shall propose and gain approval from the Owner and WVDEP, prior to using any admixtures.

All soil and sludge mixing shall be accomplished using the equipment such as a backhoe or excavator. Sludge and soil shall be mixed thoroughly to achieve a consistent mixture throughout. All sludge shall be mixed to ensure that there are no unmixed layers or zones. Mixing shall extend to the bottom of the lagoon to be evidenced by observation of natural soil horizons.

15.3.4 Blasting

The Contractor may perform blasting activities as described by this section in the areas that require excavation which cannot be excavated by using conventional excavation equipment. The Contractor shall exhaust all alternatives of excavation before performing blasting activities. The Contractor shall comply with all applicable rules and regulations by federal, state, and local jurisdictions when blasting is performed. The Contractor shall notify the Owner in writing at least 14 days prior to beginning drilling and blasting operations. The Contractor shall be responsible for all damages caused or resulting from his blasting activities.

15.4 Excavated Materials

All suitable material which is excavated during construction shall be retained for use as backfill. Unsuitable material shall be disposed at a location designated or directed by the Owner. Topsoil shall be temporarily stockpiled separately from the unclassified material in an area approved by the Owner. Material shall not be placed in areas where water is ponded. The stockpile(s) shall have side slopes no steeper than 2H:1V. Temporarily stockpiled material shall not be compacted. The stockpile(s) shall be shaped and maintained in such a manner that the top surface shall remain free of puddles and the side slopes shall not be unduly rutted. Temporary stockpiles shall be seeded in accordance with Section 19.0, Revegetation of this Specification. No material, used as backfill/regrading material or to be disposed shall be placed at slopes steeper than 2H:1V. Positive drainage shall be provided at all times.

After completion of construction, all suitable excess excavated material shall be used in regrading and recontouring the construction areas provided it will not interfere with the drainage of the areas, as directed by the Owner.

15.5 Water Handling

The Contractor must provide a system for diverting water around the work area(s) to the proper down-gradient drainage systems. This will improve working conditions and decrease the potential sediment load carried by the water as a result of excavation in the area.

The Contractor shall handle all surface and/or ground water so as not to damage adjacent property or pollute the streams and/or waterways. The Contractor's plan for diversion of ground water and/or surface water during construction shall be subject to approval by the Owner. The plan may be placed in operation upon approval. Nothing in this Section shall relieve the Contractor from full responsibility for the adequacy of the diversion and protective works.

Excavation areas shall be maintained so that they will drain properly at all times. The Contractor shall construct and maintain any and all necessary channels, flumes, pipes, sumps and/or other temporary diversion and protective works; shall furnish all materials required, therefore, shall furnish, install, maintain, and operate all necessary pumps and other equipment for removal of ground water and/or surface water from the work area. After having served their purpose, all of the above shall be removed from the work area.

15.6 Borrow Excavation

This work shall consist of using borrow areas as a source for items requiring soil and/or rock. All on-site and off-site borrow areas must be approved by the Owner. The Contractor is responsible to obtain right-of-entry agreements to include Owner with the right of inspection and holding the Owner harmless from any injury or damage whatsoever resulting from the Contractor's use of the property. The Owner is also responsible for obtaining an NPDES stormwater permit for all off-site borrow areas.

There will be no additional compensation for accessing, furnishing, clearing, grubbing, grading, restoring, fertilizing, seeding, and mulching of off-site borrow areas. The Contractor shall submit a site grading and operations plan to the Owner for review and approval. Highwalls shall not be allowed within borrow areas. Reclamation and revegetation of off-site borrow sites shall be considered incidental to the borrow operations and shall be included in the unit prices bid for Off-site Soil Borrow Material.

The Contractor shall submit a detailed plan for development and reclamation of the borrow area for approval prior to disturbance of the borrow area.

Erosion and sediment control shall be required for all borrow areas. Erosion and sediment control for off-site borrow areas shall be incidental to construction and no separate payment will be made for erosion and sediment control at borrow areas.

15.7 Riprap

Stone for riprap shall consist of fieldstone or rough shot rock as nearly rectangular in section as is practicable. The stone shall have a minimum weighted loss of 30 percent when subjected to five cycles of Sodium Sulfate Soundness Test, ASTM C88 as modified by AASHTO T104. All stone shall be well-graded and obtained from an Owner approved commercial quarry.

15.8 Method of Measurement

15.8.1 The method of measurement for excavation shall be by the cubic yard, which shall be the material excavated and placed as compacted and as herein described, measured in its original location and determined from contractor-produced (certified by registered professional surveyor) cross-sections by the method of average end areas. No separate payment will be made for sediment controls, ditch or berm, or any other incidental work referred to under "Unclassified Excavation."

15.8.2 The method of measurement for soil borrow material imported to the site required to achieve final grades shall be per cubic yard as determined by before and after contractor-produced (certified by registered professional surveyor) cross-sections at the borrow area.

15.9 Basis of Payment

This item shall be paid at the Contract unit price bid for unclassified excavation. Payment shall constitute full compensation for all materials, labor, equipment, and incidentals necessary to perform the work.

15.10 Pay Items

Item 15.1, Unclassified Excavation, of on-site material, per cubic yard.

Item 15.2, Unclassified Excavation, of off-site soil borrow material, per cubic yard.

16.0 LAGOON DEWATERING

16.1 Description

It is required that the lagoon be dewatered using a system of pumps and hoses to remove water from the lagoon in a controlled manner and direct water to the existing drainage swale downstream of the lagoon.

16.2 Materials

16.2.1 Pumps and Hoses

Pumps and hoses shall be provided by the Contractor at no separate cost to the Owner.

16.3 Construction Methods

The Contractor shall follow the “Revised; Lagoon Decommission Irrigation Lagoon & Sinkhole Remediation Plan for Bardane Industrial Park” (Appendix B).

1. The discharge shall be monitored continuously during discharge, at the discharge point at the storm water drainage swale, and at points downstream of the discharge, to ensure no flooding, erosion, or other issues occur.
2. The discharge shall begin at a lower rate (50 gallons per minute maximum) and be observed for 1 hour, with no occurrence of flooding or erosion issues, before increasing the discharge rate by no more than 50 gallons per minute. The maximum rate shall not exceed 500 gallons per minute.
3. The Contractor shall take all measures to ensure that the sediment from the pond is not discharged.
4. All materials and equipment required to perform the work shall be on site prior to the initiation of the work activities.
5. The work activities shall be managed in a manner that will provide for the maximum alleviation of impact to, and maximum protection of, aquatic life and human health.
6. The work activity, once initiated, shall be performed continuously, if necessary, until completed.
7. The Contractor shall notify Jefferson County which in turn shall notify Environmental Enforcement’s District field office, at (304) 822-7266, 24 hours prior to the initiation of any procedures. This will afford the Department with an opportunity to have personnel available to observe the activities. Jefferson County

shall further notify the Emergency Response Spill Alert System at 1 -800-642-3074, prior to, and upon conclusion, of any bypass event, or further, upon any spill incident.

The Contractor shall be responsible for all costs and penalties associated with damages incurred during dewatering of the lagoon and agrees to hold the Owner harmless for any damages.

16.4 Method of Measurement

There shall be no separate payment for lagoon dewatering. The lagoon dewatering shall be paid under Pay Item 14.0 "Site Preparation" of these Specifications as part of the lump sum item.

16.5 Basis of Payment

The lagoon dewatering shall be paid under Pay Item 14.0 "Site Preparation" of these Specifications. Any damages incurred during the Contractor's dewater operation shall be the sole responsibility of the Contractor.

17.0 SINKHOLE REMEDIATION

17.1 Description

This work of remediating the sinkhole shall not commence until the diversion dikes have been constructed and stabilized to direct stormwater flow from the sinkhole location. The sinkhole remediation shall be conducted in accordance with the WVDEP DWWP Groundwater Protection Program's "Sinkhole Mitigation Guidance" document for a sinkhole with drainage area of less than 5 acres, found in Appendix A and as required by the Specifications and Drawings.

17.2 Materials

Stone, filter fabric, and soil as specified herein.

17.3 Construction Methods

1. Remove and properly dispose of materials dumped in and around the sinkhole in accordance with applicable federal, state, and local laws.
2. Excavate loose material from the sinkhole and try to expose the solution void(s) in the bottom. Enlarge the sinkhole, as necessary, to allow for installation of the filter material.
3. Select stone that is approximately 1.5 times larger than the solution void(s). Place the stone into the void(s) forming a competent bridge. Stone used for the bridge layer should have rock strength equal to, at least, moderately hard (e.g., resistant to

abrasion or cutting by a knife blade but can be easily dented or broken by light blows with a hammer). Shale or similar soft and non-durable rock is not acceptable.

4. Place a layer of filter material over the bridge to a minimum thickness of 24 inches. Approximately 35 percent of the material should be larger than the opening between the bridge and the void(s). There should be no discernable large openings around the bridge. The material should be either gabion stone, stone for rip rap, or stone for special rock fill that conforms to West Virginia Department of Highways, Standard Specification Roads and Bridges, Section 704.
5. Place a layer of smaller size filter material over the previous layer to a minimum thickness of 10 inches. The size of the material should be $\frac{1}{4}$ to $\frac{1}{2}$ the size of that used in the previous layer. The material should be No. 57 aggregate, which conforms to West Virginia Department of Highways, Standard Specifications Roads and Bridges, Sections 703.1.1, 703.1.2, 703.1.3, 704.1.4, and 703.2.1. Unacceptable filter material consists of pea gravel or slags (steel, electromagnetic, or power plant).
6. Place a layer of sand-sized filter material over the previous layer at to a minimum thickness of 10 inches. The sand must be compatible in size with the previous layer to prevent piping. The material should be fine aggregate that conforms to West Virginia Department of Highways, Standard Specification Roads and Bridges, Sections 702.1.1, 702.1.2, and 702.1.3.
7. Engineering fabric conforming to AASHTO M 288 may be substituted for the stone and sand filter materials discussed in 5 and 6.
8. Backfill over the top filter layer or engineering fabric with soil material to the surface. This should be mineral soil with at least 12 percent fines. Reuse soil material excavated from the sinkhole as much as possible and place any available topsoil over the backfill. Overfill by about 5 percent to allow for settling.
9. Establish vegetation on the mitigated sinkhole and other disturbed areas of the site.

17.4 Method of Measurement

The method of measurement for sinkhole remediation will be on a lump sum basis.

17.5 Pay Item

Item 17.0, "Sinkhole Remediation" per lump sum.

18.0 DEMOLITION AND REMOVAL OF SEWAGE LAGOON STRUCTURES

18.1 Description

This work shall consist of the demolition, removal, and disposal of sewage lagoon structures at the locations shown on the Drawings and as directed by the Engineer. Included are:

1. Demolition, removal, and disposal of the inlet pipes, outlet concrete structure, irrigation pump house and all materials and utilities associated with these items. All piping shall be completely removed.
2. Demolition, removal, and disposal of the all lagoon fencing.

18.2 Materials

As required.

18.3 Construction Methods

18.3.1 Structure Demolition, Removal and Disposal

The structures to be demolished, removed and disposed are identified on the Drawings and/or described herein. These structures include the inlet pipe, outlet structure, irrigation pump house and materials associated with the structures. Note that material requiring removal and disposal may exist within the limits of construction that is not specifically called out on the Drawings.

Demolition of existing structures shall be performed using standard construction equipment wherever practical. Demolition operations shall be performed with the utmost care not to endanger life or property. The Contractor shall be responsible for analyzing all of the structures to be razed so that demolition operations are performed in a manner which results in a total and safe removal of the structures while maintaining the safety of construction laborers, equipment operators and vehicular traffic along public and private roads. Use of explosives shall not be permitted.

All salvageable material shall become the property of the Contractor, unless noted. Construction and demolition waste material shall be disposed of at an approved landfill.

The Contractor shall be responsible for any permits and fees required for disposal of the material at an approved landfill.

Concrete piers, foundations and other structures, shall be completely removed or cut to a minimum of 12 inches below the existing ground surface, and the holes shall be backfilled to the ground surface unless otherwise noted.

All areas disturbed shall be graded and dressed as directed by the engineer and revegetated in accordance with Technical Specifications Section 19.0, "Revegetation."

Any miscellaneous garbage or debris within the limits of construction will be removed and lawfully disposed of by the Contractor.

18.4 Method of Measurement

The method of measurement for demolishing, removal, and disposal of the sewage lagoon structures and debris as described herein will be on a lump sum basis. Included in the lump sum price shall be earthwork and demolition, removal, disposal of structures and equipment.

18.5 Pay Item

Item 18.0, "Demolition and Removal of Sewage Lagoon Structures," per lump sum. Cannot be more than 5 percent of the total amount bid for the project.

19.0 REVEGETATION

19.1 Description

This work shall cover all operations incidental to the establishment of vegetation within the limits of construction and all other areas disturbed by the Contractor. This work also includes the furnishing and the application of fertilizer, agricultural limestone, mulch and seed in accordance with these Specifications and as designated herein.

19.2 General Requirements

All areas disturbed by the Contractor shall be revegetated as specified herein.

All revegetation activities shall be conducted immediately following completion of final grade so as to utilize the fine soil material as a seedbed before this material is lost due to erosion from subsequent rainfall.

19.3 Materials

The materials to be used for revegetation shall conform to the applicable requirements of these Specifications.

19.3.1 Fertilizer

The commercial fertilizer to be used shall consist of a 10-20-10 or 10-20-20 grade of uniform composition and be furnished in standard containers. These containers, in accordance with applicable state and federal laws, must be clearly marked with the following information:

1. Weight,
2. Name of plant nutrients, and
3. Guaranteed nutrient percentages.

Fertilizer rates shall be formulated from soil test results. In the absence of soil testing, a rate of 600 pounds per acre will serve as a preferred minimum.

Fertilizer shall be applied immediately to all areas reaching final grade by one of the two following methods:

1. Apply and incorporate fertilizer during seedbed preparation, or
2. Apply fertilizer in hydroseeding mixture following seedbed preparation.

19.3.2 Limestone

The lime to be used will be an agricultural grade pulverized dolomitic limestone containing a minimum of 10 percent $MgCO_3$ and not less than 95 percent total carbonates. Fineness will be such that no less than 75 percent will pass through a No. 100 sieve and 100 percent will pass through a No. 10 sieve.

Lime rate shall be formulated from soil test results. Lime shall be applied such that a standard soil pH of 6.0 is achieved. In the absence of testing, the minimum lime addition rate shall be 3 tons per acre.

Lime shall be applied immediately to all areas reaching final grade by one of the two methods listed in Section 19.3.1, "Fertilizer."

19.3.3 Seed Mixtures

The variety of grass and legume seed furnished for the project shall bear a tag, in accordance with applicable State and Federal laws, with the following information listed:

1. Lot number.
2. Seed producer's name.

3. Percent purity.
4. Percent germination.
5. Date of germination testing.
6. Weed seed content (should be <0.25% by weight).

All leguminous seed shall be inoculated with the specified strain of rhizobia which shall be a pure culture of bacteria selected for maximum vitality. No rhizobia shall be used which has passed the expiration date on each package. The inoculate shall be applied at 5 times the recommended rate except when used in a hydroseeding mixture. When hydroseeding, the rate will be 10 times the recommended rate.

19.3.3.1 Temporary Seed Mixture

All stockpiles or other disturbed areas which will require further disturbance that will be delayed for a period of 3 weeks or longer shall be vegetated according to the following guidelines.

Variety of Seed	Spring 3/15-5/31	Summer 5/31-8/15	Fall 8/15-10/15	Winter 10/15-11/15
	lb/acre			
Annual Ryegrass (Lolium multiflorum)	20		20	
German Millet* (Setaria italica)		50		
Cereal Rye (Secale cereale)				90

* Do not use Japanese Millet.

All areas to be temporarily seeded which are to be redisturbed shall be fertilized with 600 pounds per acre of 10-20-10 or 10-20-20. All areas reaching final grade to be temporarily seeded shall be fertilized according to Section 19.3.1, "Fertilizer." Lime shall be applied according to Section 19.3.2, "Limestone." Mulch shall be applied according to Section 19.3.4, "Mulch."

19.3.3.2 Permanent Seed Mixture

Permanent vegetation shall be established on all areas reaching final grade or other areas not likely to be disturbed by further construction activities. Any areas which reach final grade between May 31 - August 15 or October 15 - November 15, shall be seeded with appropriate temporary seed mixture according to Section 19.3.3.1, "Temporary Seed Mixture." These areas shall then be reseeded with the appropriate permanent seed mixture, without Annual Ryegrass, during the next defined seeding

period according to this Section. The actual date of permanent seeding will require approval of the Engineer.

Lawn Mixture

Rate (lb/1000 sq ft)	Seed Variety	Minimum Specifications	
		% Purity	% Total Germination
0.45	Red Fescue (Pennlawn)	98	85
0.90	Kentucky Bluegrass	85	75
0.70	Merion Bluegrass	90	75
0.20	Annual Ryegrass*	95	85

* Use Annual Ryegrass only in mixtures seeded after August 1 and before May 15.

General Mixture⁻¹

Variety of Seed	Spring 3/15-5/31	Fall 8/15-10/15
	lb/acre	
Orchardgrass (Dactylis Glomerata)	15	15
Birdsfoot Trefoil ⁽¹⁾ (Lotus Corniculatus)	15	15
Red Clover (Trifolium Pratense)	10	10
Annual Ryegrass (Lolium Multiflorum)	15	15
Bicolor Lespedeza	1	1
Foxtail Millet or Hairy Vetch ⁽²⁾ (Vicia Villosa) or Winter Wheat	12 5 10	12 5 20

(1) *Herbaceous Legumes must be treated with the appropriate bacterium before seeding. On areas which are steeply sloping (steeper than 1.7:1) or slide prone substitute Crownvetch (Coronilla Varia) at 20 pounds/acre for Birdsfoot Trefoil.*

(2) *Use only if the area is shaded.*

19.3.4 Mulch

Mulching procedures shall take place immediately following seeding. Mulch material shall consist of straw, grass hay, wood cellulose fiber, or wood/bark chips.

19.3.4.1 Straw

Straw mulch shall include baled wheat or oats straw or baled grass hay. Straw mulch shall be dry and reasonably free of weed seeds, sticks or other foreign material. Straw mulch shall be applied at a rate of 2 tons per acre.

The straw mulch shall be anchored with 100 gallons per acre of asphalt emulsion, or 750 pounds per acre of wood cellulose fiber.

19.3.4.2 Wood Cellulose Fiber

Only wood cellulose fiber shall be used on slopes steeper than 2 horizontal to 1 vertical at a rate of 1,500 pounds per acre. Mulch for use with the hydraulic application of seed, fertilizer and lime shall consist of wood cellulose fiber. It shall be processed in such a manner that it will contain no growth or germination inhibiting factors and shall be dyed green. It shall be manufactured in such a manner that (1) after addition and agitation in slurry tanks with fertilizer, lime, seed, and water, the fibers in the material will become uniformly suspended to form a homogeneous slurry, and (2) the material, when hydraulically sprayed on the ground, will form a blotter-like ground cover impregnated uniformly with seed, will allow the absorption of moisture, and will allow rainfall to percolate to the underlying soil.

The wood cellulose fiber shall be supplied in packages having a gross weight not to exceed 100 pounds. Weight specifications of this material from suppliers, and for all applications, shall refer only to air dry weight of the fiber material. Air dry weight is based on the normal weight standard of the Technical Association of the Pulp and Paper Industry for Wood Cellulose and is considered equivalent to 10 percent moisture. Each package of the cellulose fiber shall be marked by the manufacturer to show the air-dry weight content.

19.3.4.3 Wood/Bark Chips

Wood/bark chips recovered from any clearing and grubbing operations may be used as mulch at a rate of 45 cubic yards per acre. Wood/bark chips from mills or whole-tree chipping operations can also be used. Chips should not be larger than d-inch thick or more than 6 square inches (2 inches x 3 inches) in area.

19.3.5 Water

Water for hydroseeding shall be reasonably free of injurious and other toxic substances harmful to plant life. The source of water is subject to the approval of the Owner.

19.4 Seedbed Preparation

The seedbed (cover soil layer) shall be prepared by “tracking in” with a dozer or scarifying by other approved methods. “Tracking in” shall take place by operating the equipment up and down the regraded slope such that the cleat marks are parallel to the final contours.

Rocks larger than approximately 6 inches in diameter, trash, weeds, cleared and grubbed material, and other debris that will interfere with seeding or maintenance shall be removed and disposed of as directed by the Owner. Maximum particle size for protective soil cover shall be limited to 2 inches.

Seedbed preparation shall be suspended when soil moisture conditions are not suitable for the preparation of a satisfactory seedbed, as determined by the Engineer.

Soil shall be friable, and reasonably free of subsoil and clay lumps. Soil shall also be reasonably free from brush, roots, weeds and other objectionable vegetation. Stones or similar objects larger than approximately 2 inches in any dimension, and litter or other materials unsuitable or harmful to plant growth shall not be in the soil.

19.5 Seeding

All seeding operations shall be performed immediately following seedbed preparation in such a manner that the seed is uniformly applied in the specified quantities on the designated areas.

Seedbed preparation and seeding shall take place progressively as various regraded areas are brought to final grade.

Seed application shall consist of approved hydroseeding methods where feasible. Any seed left in the hydroseeder overnight shall be reinoculated before that seed is applied. Other methods of seed application may be utilized for site-specific reasons if approved by the Owner.

Any area failing to establish a vegetative stand due to weather or adverse soil conditions shall be reseeded, relimed, refertilized and remulched as directed by the Owner.

19.6 Maintenance of Seeded Areas

The Contractor shall maintain all seeded and planted areas during construction and for the 1-year maintenance period. All areas shall be protected from any further equipment traffic and any damaged area shall be repaired and reseeded. Maintaining seeded areas shall consist of watering, refilling, refertilizing, reliming, reseeding and remulching erosion gullies and all bare areas.

19.7 Second Step Seeding

The second step seeding will take place during the first defined seeding period following the initial seeding and will coincide with the removal of the silt fence. The following shall be used as a guide for second step application:

1. For areas with less than a 50 percent stand or subject to severe erosion, apply the complete amount of seed, fertilizer, lime and mulch as specified above.
2. For area with over a 50 percent stand, apply one-half the original amount of seed, fertilizer, and lime as specified above. If erosion is a problem, apply one-half the original amount of mulch specified above.

In areas where silt fence is removed, the accumulated sediment will be removed or spread out prior to the application of second step seeding.

The Contractor will be responsible for complete removal of silt fence during the mandatory second step seeding. If large areas of disturbance still exist up gradient of silt fence it shall remain in place until acceptable vegetation has been established. Additional seeding beyond second step seeding may be required to achieve acceptable vegetative cover and shall be completed if so directed by the Owner, and shall be completed at no additional cost to the Owner.

19.8 Method of Measurement

The method of measurement for determining the quantity of work done as described above will be on a per acre basis (field measured) to the nearest tenth of an acre for seeding (including seedbed preparation, fertilizer, limestone, seed, mulch and water) for only those areas within the limits of construction as shown on the Drawings. There will be no additional compensation for accessing, furnishing, clearing, grubbing, grading, restoring, fertilizing, seeding, and mulching of on-site or off-site borrow areas.

19.9 Basis of Payment

Payment will be made at the Contract unit price bid for these items. Price and payment shall be full compensation for doing all the work herein described in a workmanlike and acceptable manner, including the furnishing of all labor, materials, tools, equipment, supplies, and incidentals as necessary to complete the work. Payment for seeding includes all seeding (i.e., first and second seeding). Payment for seeding is on a one-time basis only. No additional payment will be made for second or subsequent seedings. Temporary seeding is considered incidental to construction and no separate payment will be made.

19.10 Pay Item

Item 19.0, Seeding, per acre.

APPENDIX A

1

**West Virginia Department of Environmental Protection
Division of Water and Waste Management
Groundwater Protection Program**

Sinkhole Mitigation Guidance

August 8, 2005

Purpose:

These sinkhole mitigation designs serve to allow the filling of sinkholes while maintaining recharge to the aquifer, reducing potential contamination threats to groundwater, and eliminating safety hazards at sinkhole entries.

General:

Consideration should be given to the method used for removing contaminated materials from sinkholes and reducing or eliminating direct inflow of surface water into sinkholes. Land treatment methods that improve the filtration and infiltration of surface water before it enters the sinkhole should be used along with the mitigation of the sinkhole.

Before selecting a treatment option the following should be considered:

- Land use
- Existing and planned land treatment
- Sinkhole drainage area
- Dimensions of the sinkhole opening
- Safe outlet for diverted surface water
- Environmentally safe disposal of sinkhole "clean out" material
- Availability and quality of filter material
- Safety of equipment and operators and laborers during installation

Treatment selection should be based on the dimensions of the sinkhole drainage area and include direct sinkhole treatment with surface water control measures and filter strips. Whichever treatment option is chosen, it should avoid surface water ponding or the creation of high soil moisture conditions in excess of 72 hours.

Treatment designs apply to sinkholes with excavated depths of 5 to 25 feet and with drainage areas up to 15 acres. Excavations up to 5 feet are sufficient for most sinkholes. Sinkholes with excavation depths of greater than 25 feet or with uncontrolled drainage areas greater than 15 acres may require adjustments to the treatment measure(s) and/or surface water control measure(s). In these cases, geologic and engineering assistance must be obtained and a site-specific treatment design prepared.

Treatment for Sinkholes with Drainage Areas Less than 5 Acres

Treat the sinkhole using the mitigation design in Figure 1 of this guidance document. The treatment site should be inspected after periods of heavy precipitation because some material may run into adjacent sinkhole voids causing a surface depression. In this case, maintenance will include adding soil material at the surface. The existing land use or practice may continue over the treated sinkhole as long as the treatment is maintained.

Treatment for Sinkholes with Drainage Areas of 5 Acres or More and Having a Safe Outlet

The following additional treatment criteria are applicable to sinkholes with drainage areas of 5 acres or more where a safe outlet can be provided to divert surface water away from the sinkhole. A safe outlet is one that does not erode, divert surface water to another sinkhole or injection well, or cause flood damage to crops, property, buildings, or highways/roads.

Surface water control measures should be situated to reduce the internal drainage area around the sinkhole to less than 5 acres. The choice of surface water control measures is generally based on site-specific conditions.

Treatment for Sinkholes with Drainage Areas of 5 to 15 acres and Having No Safe Outlet

Treat the sinkhole using the mitigation design in Figure 2 of this guidance document. The site should be inspected after periods of heavy precipitation because some material may run into adjacent sinkhole voids causing a surface depression. In this case, maintenance will include adding soil material at the surface. The sinkhole should remain as unused land.

Vegetated Buffer Area

A vegetated buffer area should be installed around the sinkhole to improve runoff water quality by filtration and adsorption of contaminants. The vegetated buffer area should be installed within the sinkhole drainage area and should begin at the treated sinkhole.

The minimum width (in feet) of the vegetated buffer area is determined by multiplying the sinkhole drainage area (in acres) by seven. This width should provide beneficial filtering for some distance outside the sinkhole because surface water runoff may be temporarily held before reaching the treated sinkhole.

Appropriate vegetation should be used for the buffer area. Use native vegetation as much as possible. **DO NOT** use noxious plants or weeds. It is recommended that a plant nursery be consulted for the appropriate vegetation.

Acceptable Materials

Engineering fabric - must meet the applicable requirements of AASHTO M-288.

Aggregates – fine aggregates, gravel, or rock rip rap that conforms to the West Virginia Department of Highways, Standard Specifications for Roads and Bridges, Sections 702, 703, and 704.

Specifications

Use the following guidance for installing a mitigation design for sinkholes and sinkhole areas with drainage areas of less than 5 acres:

1. Remove and properly dispose of materials dumped in and around the sinkhole in accordance with applicable federal, state, and local laws.
2. Excavate loose material from the sinkhole and try to expose the solution void(s) in the bottom. Enlarge the sinkhole, as necessary, to allow for installation of the filter material.

3. Select stone that is approximately 1.5 times larger than the solution void(s). Place the stone into the void(s) forming a competent bridge. Stone used for the bridge should have rock strength equal to, at least, moderately hard (e.g., resistant to abrasion or cutting by a knife blade but can be easily dented or broken by light blows with a hammer). Shale or similar soft and non-durable rock is not acceptable.
4. Place a layer of filter material over the bridge to a minimum thickness of 24 inches. Approximately 35 percent of the material should be larger than the opening between the bridge and the void(s). There should be no discernable large openings around the bridge. The material should be either gabion stone, stone for rip rap, or stone for special rock fill that conforms to West Virginia Department of Highways, *Standard Specification Roads and Bridges*, Section 704.
5. Place a layer of smaller size filter material over the previous layer to a minimum thickness of 10 inches. The size of the material should be $\frac{1}{4}$ to $\frac{1}{2}$ the size of that used in the previous layer. The material should be No. 57 aggregate, which conforms to West Virginia Department of Highways, *Standard Specifications Roads and Bridges*, Sections 703.1.1, 703.1.2, 703.1.3, 704.1.4, and 703.2.1. Unacceptable filter material consists of pea gravel or slags (steel, electromagnetic, or power plant).
6. Place a layer of sand-sized filter material over the previous layer at to a minimum thickness of 10 inches. The sand must be compatible in size with the previous layer to prevent piping. The material should be fine aggregate that conforms to West Virginia Department of Highways, *Standard Specification Roads and Bridges*, Sections 702.1.1, 702.1.2, and 702.1.3.
7. Engineering fabric conforming to AASHTO M 288 may be substituted for the stone and sand filter materials discussed in 5 and 6.
8. Backfill over the top filter layer or engineering fabric with soil material to the surface. This should be mineral soil with at least 12 percent fines. Reuse soil material excavated from the sinkhole as much as possible and place any available topsoil over the backfill. Overfill by about 5 percent to allow for settling.

9. Establish vegetation on the mitigated sinkhole and other disturbed areas of the site.

Use the following guidance for installing a mitigation design for sinkholes and sinkhole areas with drainage areas of 5 to 15 acres:

1. Remove and properly dispose of materials dumped in and around the sinkhole.
2. Excavate loose material from the sinkhole.
3. Place a layer of filter material into the sinkhole, allowing the stone to fill the void(s) below the bottom of excavated sinkhole. The size should be $\frac{1}{4}$ to $\frac{1}{2}$ the size of the void(s). This material can be WVDOH gabion stone, rip rap stone, or special rock fill stone.
4. Place a layer of the same size filter material to a thickness of about $\frac{1}{4}$ TD (TD = total depth) above the sinkhole bottom.
5. Place a layer of smaller size filter material over the previous layer to a thickness of about $\frac{1}{4}$ D. Bring this layer to surface level. The size should be $\frac{1}{4}$ to $\frac{1}{2}$ the size of the previous layer. The material should be No. 57 aggregate, which conforms to West Virginia Department of Highways, *Standard Specification Roads and Bridges*, Sections 703.1.1, 703.1.2, 703.1.3, 703.2.1, and 704.1.4. Unacceptable stone consists of pea gravel or slags (steel, electrometallurgical, or power plant).
6. Shale or similar soft and non-durable rock is not acceptable.
7. Establish vegetation on the mitigated sinkhole and disturbed areas of the site.

Engineering Fabric Requirements for Subsurface Drainage

Engineering fabric used in the mitigation of sinkholes should meet the applicable requirements of AASTHO M 288, Section 7.2

Engineering Fabric Installation

Proper construction and installation techniques are essential to ensure that the intended function of the engineering fabric is fulfilled.

When sewn seams are necessary, the seam strength must be equal to or greater than 90 percent of the specified grab strength, as measured in accordance with ASTM D 4632.

When sewn seams are used for the seaming of the engineering fabric, the thread must be high strength polypropylene, or polyester. Nylon thread is unacceptable.

For Sinkhole Mitigation Design A, place the engineering fabric loosely, with no wrinkles or folds, and with no void spaces between the fabric and the bridge. Overlap successive sheets of engineering fabric a minimum of 12 inches, with the upstream sheet overlapping the downstream sheet.

Prior to covering, the engineering fabric should be inspected to ensure that it has not been damaged (*e.g.* holes, tears, rips) during installation. An engineer or the engineer's designated representative should conduct the inspection. The designated representative should be a certified field inspector.

Damaged fabric must be repaired immediately. Cover the damaged area with an engineered fabric patch that overlaps to 12 inches beyond the damaged area.

Any damaged engineering fabric that cannot be repaired shall be replaced as directed by the engineer.

Place material over the engineering fabric in such a manner as to avoid stretching and subsequently tearing the fabric. Do not drop stone and soil placement from a height greater than one meter. Do not allow stone with a mass of more than 100 kg to roll down the slope of the sinkhole.

Grading the sinkhole slope is not permitted if the grading will result in the movement of the stone directly above the engineering fabric.

Operation and Maintenance

The owner/operator is responsible for maintaining the mitigated sinkhole and sinkhole area. At a minimum, the following maintenance practices should be performed:

1. Mow grass and plantings as necessary to promote vigorous growth.
2. Inspect mitigation measures at least twice a year and after all major rain events. Repairs to the sinkhole mitigation measures should be made promptly were warranted.

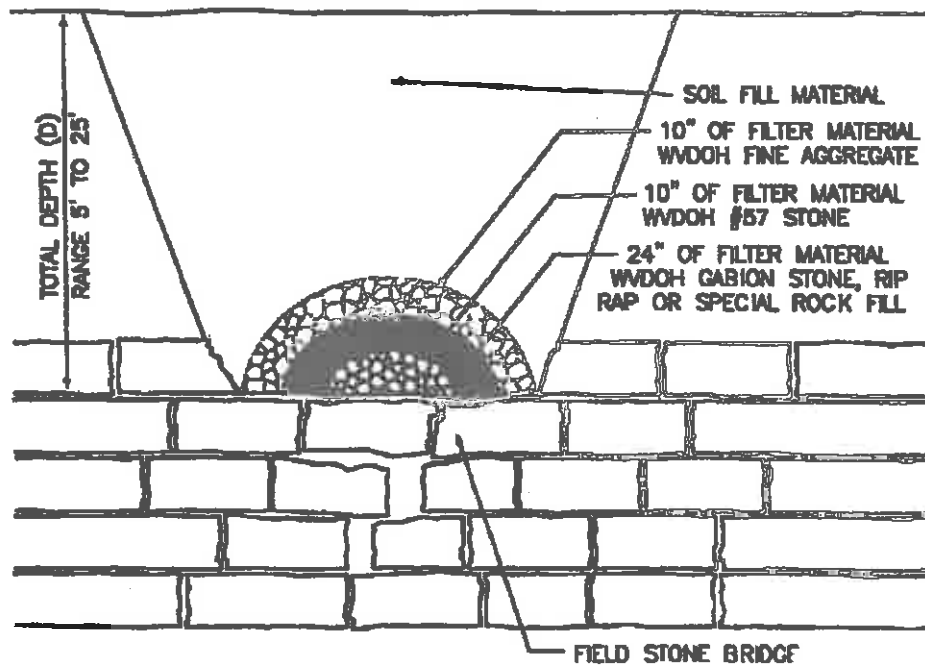
References:

USDA Natural Resources Conservation Center, January 2004. *Maryland Conservation Practice Standard, Sinkhole and Sinkhole Area Treatment, Code 725.*

West Virginia Department of *Highways, Standard Specifications Roads and Bridges*, 2000, Section 702, "Fine Aggregates", Section 703, "Coarse Aggregates", Section 704, "Stone and Crushed Aggregate", Section 715, "Miscellaneous Materials".

WEST VIRGINIA DEPARTMENT OF ENVIRONMENTAL PROTECTION
SINKHOLE MITIGATION GUIDANCE

FIGURE 1



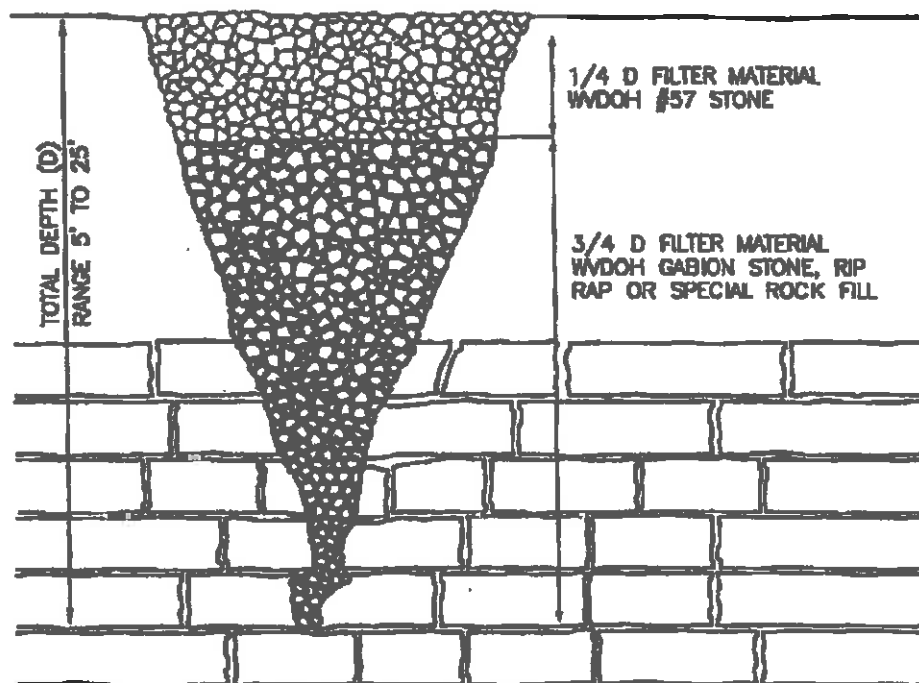
NOTE:
A NONWOVEN GEOTEXTILE MEETING AASHTO M288,
SECTIONS 7.1+7.2 MAY BE SUBSTITUTED FOR THE
WVDOT #57 STONE AND WVDOT FINE AGGREGATE

SINKHOLE MITIGATION

(DRAINAGE AREA LESS THAN 5 ACRES)

WEST VIRGINIA DEPARTMENT OF ENVIRONMENTAL PROTECTION
SINKHOLE MITIGATION GUIDANCE

FIGURE 2



SINKHOLE MITIGATION

(DRAINAGE AREA 5 TO 15 ACRES)

APPENDIX B



west virginia department of environmental protection

Division of Water and Waste Management
601 57th Street SE
Charleston, WV 25304
Phone: (304) 926-0495
Fax: (304) 926-0463

Austin Caperton, Cabinet Secretary
www.dep.wv.gov

March 22, 2018

Roger Goodwin, PE, CFM
Director & Chief County Engineer
Jefferson County Department of Engineering, Planning & Zoning
P.O. Box 716
116 East Washington Street, Suite 100
Charles Town, WV 25414

CERTIFIED RETURN RECEIPT REQUESTED

**Re: Revised: Decommission Irrigation Lagoon &
Sinkhole Remediation Plan for Bardane
Industrial Park**

Dear Mr. Goodwin:

This is in response to the revised request for the proposal received by this office on the 28th day of February, along with the initial request received on the 31th day of August 2017, for decommissioning the sewage irrigation lagoon and remediate the sinkhole on property owned by Jefferson County Commission. The revised plan includes a one-time temporary discharge of water from the Bardane Industrial Park Irrigation Lagoon. The revised plan has been reviewed.

The agency does not object to this remediation plan so long as the facility adheres to the following conditions:

1. The work shall be performed in accordance with the letter, and all attachments, as presented, in the correspondence, dated August 31, 2017, February 28, 2018, and March 21, 2018.
2. The sinkhole will be remediated in accordance with the applicable guidelines in the WVDEP Sinkhole Mitigation Guidance document.
3. The discharge shall be monitored continuously during discharge, at the discharge point at the storm water drainage swale, and at points downstream of the discharge, to ensure no flooding, erosion, or other issues occur.

Promoting a healthy environment.

4. The discharge shall begin at a lower rate (50 gallons per minute maximum) and be observed for 1 hour, with no occurrence of flooding or erosion issues, before increasing the discharge rate by no more than 50 gallons per minute. The maximum rate shall not exceed 500 gallons per minute.
5. Jefferson County shall take all measures to ensure that the sediment from the pond is not discharged.
6. All materials and equipment required to perform the work shall be on site prior to the initiation of the work activities.
7. The work activities shall be managed in a manner that will provide for the maximum alleviation of impact to, and maximum protection of, aquatic life and human health.
8. The work activity, once initiated, shall be performed continuously, if necessary, until completed.
9. Jefferson County shall notify Environmental Enforcement's District field office, at 304-822-7266, 24 hours prior to the initiation of any procedures. This will afford the Department with an opportunity to have personnel available to observe the activities. Jefferson County shall, further, notify the Emergency Response Spill Alert System at 1-800-642-3074, prior to, and upon conclusion, of any bypass event, or further, upon any spill incident.

Upon completion of the remediation, the entire disturbed area must be seeded and fertilized to establish a vegetative cover on the site.

While the Division is understanding of the need to perform this work, this correspondence shall not constitute an affirmative defense in any enforcement action brought against Jefferson County, Potesta & Associates, Inc., or any contractors used, for violations from the performance of the work activities.

If you have any questions, please feel free to contact Brian Bailey at (304) 926-0499 ext 1021.

Sincerely,



Scott G. Mandirola
Director

SGM/bdb

Roger Goodwin
March 28, 2018
Page 3

cc: Env. Insp. Supervisor
Env. Inspector (Jefferson County)
Connie Anderson, Supervisor, Groundwater and Stormwater Team
John Perkins, Supervisor, General Permits and Support Team
Yogesh Patel, Engineer Chief, Permitting, DWW
Bill Herold, Bureau for Public Health
K. Joe Knechtel, PE, Potesta & Associates, Inc.



Engineers and Environmental Consultants

15 South Braddock Street, Winchester, Virginia 22601 - (540) 450-0180; www.potesta.com

February 28, 2018

Mr. Yogesh Patel
Engineer Chief
West Virginia Department of Environmental Protection
Division of Water & Waste Management
601 57th Street, SE
Charleston, West Virginia 25304-2345

RE: Revised Request to Amend the Decommission Irrigation Lagoon and Sinkhole Remediation Plan for Bardane Industrial Park
Jefferson County Department of Engineering, Planning & Zoning
Potesta Project No. 0103-17-0430

Dear Mr. Patel:

Potesta & Associates, Inc. (POTESTA) on behalf of Jefferson County Department of Engineering, Planning & Zoning (JEFFERSON), is submitting this request to amend their "Decommission Irrigation Lagoon & Sinkhole Remediation Plan for Bardane Industrial Park" (Plan), of August 31, 2017 and approved by the West Virginia Department of Environmental Protection - Division of Water and Waste Management (DWWM) on October 6, 2017. This request follows your discussion with Ron Potesta and me on February 14, 2018.

JEFFERSON requests that the Plan be amended as follows:

- 1) Sample the lagoon water by taking composite samples from three locations within the lagoon and tested for the parameters below. Each composite sample will consist of three grab samples taken from three widening concentric circles of the lagoon water surface; central, mid-way, and perimeter of lagoon water surface. The results will be submitted to the DWWM for review and approval.

List of Parameters

Arsenic	Copper	Molybdenum	Potassium
Cadmium	Lead	Nickel	Selenium
Calcium	Magnesium	pH	Total Nitrogen
Chromium	Mercury	Phosphorous	Zinc

- 2) If the sample results meet the DWWM approval, the lagoon water will be dewatered by submersible pump at an initial rate of 50 to 75 gpm to the downstream stormwater

POTESTA & ASSOCIATES, INC.

Charleston, West Virginia • Morgantown, West Virginia • Winchester, Virginia

Mr. Yogesh Patel
February 28, 2018
Page 2

drainage swale. If no downstream impacts are observed, this rate will be slowly increased to shorten the overall time to dewater the lagoon. *The existing sinkhole is upstream of the lagoon; therefore, this release will not impact the sinkhole.*

The remainder of the Plan will remain as stated.

We trust that this information is sufficient to allow your review and approval for closure of the lagoon. Please do not hesitate to call if you have questions.

Sincerely,

POTESTA & ASSOCIATES, INC.



K. Joe Knechtel, PE
Senior Engineer

KJK/mh

cc: Mr. Joe Kent, JEFFERSON



Engineers and Environmental Consultants

15 South Braddock Street, Winchester, Virginia 22601 - (540) 450-0190; www.potesta.com

VIA EMAIL ONLY

March 21, 2018

Mr. Brian D. Bailey
West Virginia Department of Environmental Protection
Division of Water & Waste Management
601 57th Street, SE
Charleston, West Virginia 25304-2345

RE: Water Analysis Results
Jefferson County Commission Irrigation Lagoon
Bardane Industrial Park, Jefferson County, West Virginia
Potesta Project No. 0103-17-0430-400

Dear Mr. Bailey:

Potesta & Associates, Inc. (POTESTA) obtained water samples from the above-referenced lagoon in accordance with Revised Request to Amend the Decommission Irrigation Lagoon and Sinkhole Remediation Plan for Bardane Industrial Park, submitted to the West Virginia Department of Environmental Protection (WVDEP) February 28, 2018.

POTESTA visited the lagoon on March 5, 2018 to obtain samples. An aluminum jonboat was used to obtain samples. Each composite sample consisted of three grab samples taken from three widening concentric circles of the lagoon water surface; central, mid-way, and perimeter of lagoon water surface. Sample locations are shown on the attached sketch. The results are summarized below, and the laboratory results are attached.

Parameters	Composite Sample 1	Composite Sample 2	Composite Sample 3
Total Copper	ND	ND	ND
Total Lead	ND	ND	ND
Total Zinc	0.007 mg/l	0.005 mg/l	0.007 mg/l
Total Molybdenum	ND	ND	ND
pH	8.25 SU	8.28 SU	8.30 SU
Total Phosphorous	0.33 mg/l	0.19 mg/l	0.19 mg/l
Total Mercury	ND	ND	ND
Total Cadmium	ND	ND	ND
Total Chromium	ND	ND	ND
Total Arsenic	ND	ND	ND
Total Calcium	34.5 mg/l	34.0 mg/l	30.0 mg/l

POTESTA & ASSOCIATES, INC.

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Mr. Brian D. Bailey
March 21, 2018
Page 2

Parameters	Composite Sample 1	Composite Sample 2	Composite Sample 3
Total Magnesium	3.02 mg/l	2.94 mg/l	2.73 mg/l
Total Kjeldahl Nitrogen	0.78 mg/l	1.12 mg/l	0.90 mg/l
Total Nitrate as N	0.35 mg/l	2.20 mg/l	1.65 mg/l
Total Nitrite as N	ND	0.20 mg/l	ND
Total Nitrogen as N	1.13 mg/l	3.52 mg/l	2.65 mg/l
Total Nickel	ND	ND	ND
Total Selenium	ND	ND	ND
Total Potassium	12.7 mg/l	12.5 mg/l	11.4 mg/l

If you have any questions, please do not hesitate to call.

Sincerely,

POTESTA & ASSOCIATES, INC.

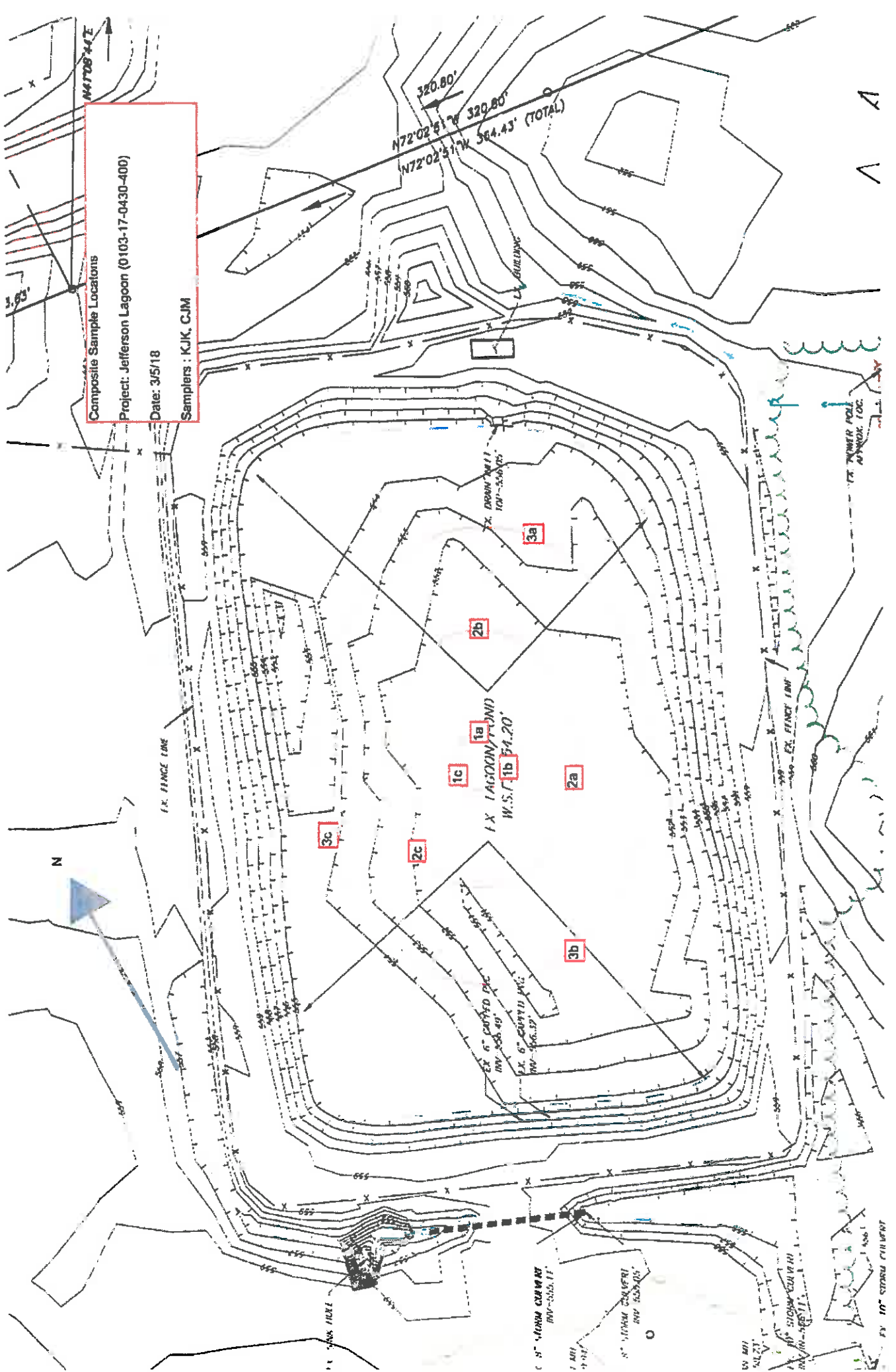


K. Joe Knechtel, PE
Branch Manager

KJK/mh

Attachment

Samplers : KJK, CJM





Bridgeport, WV 26330

TEL: 304-842-5285 FAX: 304-842-5351

reliancelabs@wvdsi.net
www.reliancelabs.net

25 Crimson Circle
Monticello, WV 26043

TEL: 304-596-2084 FAX: 304-596-2086

***PROJECT/REMARKS**[illegible]

RELINQUISHED BY:	DATE & TIME	RECEIVED BY:
------------------	-------------	--------------

PRINT	DATE	TIME	PRINT	DATE	TIME
Feb 6	3-7-8	8:30	Feb 6	3-7-8	8:30
PRINT	DATE	TIME	PRINT	DATE	TIME
Feb 6	3-7-8	8:30	Feb 6	3-7-8	8:30

RUSH STATUS

ADDITIONAL LABORATORY FEES MAY APPLY**

STATEMENT OF QUALITY: Should Reference Laboratories, Inc. be at fault and any dispute arise regarding analytical data generated by the laboratory, the extent of the liability to customers will be a duplicate analysis of the sample (providing adequate sample remains) as a refund of the analytical fee. In no event will Reference Laboratories, Inc. be liable for any consequential damages, including but not limited to direct, indirect, or consequential damages arising from such claims.

NOTE: Typical sample turn around for routine samples is 7 to 10 business days. This is not a guarantee that sample will be returned in this time frame, however. Non-routine samples may require a additional time.



Reliance Laboratories, Inc.
2044 Meadowbrook Road | P.O. Box 4657
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Martinsburg Laboratory
Ridgefield Business Center | 25 Crimson Circle
Martinsburg, WV 25403
Phone 304.596.2084 | Fax: 304.596.2086

Certifications: WV Department of Health # 00354 00443 | WV Department of Environmental Protection # 158 181
MD Department of Environment # 336 337 | US Environmental Protection Agency # WV00042, WV00801

LABORATORY REPORT SUMMARY

Client: C05625

POTESTA & ASSOCIATES, INC.
15 S. BRADDOCK ST.
WINCHESTER

VA 22601-

Monday, March 19, 2018

Total Number of Pages: 4
(Not Including C.O.C.)
Page 1 of 4

Lab ID	Sample ID	Sample ID 2	Sample Date
282335-2018-W	#1		3/5/2018
282336-2018-W	#2		3/5/2018
282339-2018-W	#3		3/5/2018

The enclosed results have been analyzed according to the referenced method and SOP. Any deviations to the method have been noted on the report. Unless otherwise noted, all results have been verified to meet quality control requirements of the method. All analysis performed by Reliance Laboratories, Bridgeport, WV unless otherwise noted. Parameters analyzed by Reliance Laboratories, Martinsburg, WV are noted with @ on laboratory report. This report may not be reproduced, except in full, without written approval of Reliance Laboratories, Inc.

Report Reviewed By:



Reliance Laboratories, Inc.
2044 Meadowbrook Road | P.O. Box 4657
Bridgeport, WV 26330
Phone: 304.842.5285 | Fax: 304.842.5351

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Ridgefield Business Center | 25 Crimson Circle
Martinsburg, WV 25403
Phone: 304.596.2084 | Fax: 304.596.2086

Certifications: WV Department of Health # 00354, 00443 | WV Department of Environmental Protection #: 158, 181
MD Department of Environment # 336, 337 | US Environmental Protection Agency #: WV00042, WV00901

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15 S. BRADDOCK ST.

Monday, March 19, 2018

Page 2 of 4

WINCHESTER, VA 22601-

Lab Number: 282335-2018-W Sample ID: #1

Parameter	Value	Units	Method	Date/Time Analyzed	Analyst	MDL	MRL
Analyte Group: Inorganics							
Total Copper	ND	mg/l	EPA 200.7 R4.4	3/14/2018	10:59 TH	0.005	0.05
Total Lead	ND	mg/l	EPA 200.7 R4.4	3/14/2018	10:59 TH	0.005	0.05
Total Zinc	J 0.007	mg/l	EPA 200.7 R4.4	3/14/2018	10:59 TH	0.002	0.05
Total Molybdenum	ND	mg/l	EPA 200.7 R4.4	3/14/2018	10:59 TH	0.01	0.05
Field pH@@	8.25	S.U.			JK		
Total Phosphorus	J 0.33	mg/l	SM4500PE-99	3/13/2018	12:03 TH	0.02	0.5
Total Mercury	ND	mg/l	EPA 245.1 R3.0	3/13/2018	10:50 TH	0.0001	0.001
Total Cadmium	ND	mg/l	EPA 200.7 R4.4	3/14/2018	10:59 TH	0.002	0.05
Total Chromium	ND	mg/l	EPA 200.7 R4.4	3/14/2018	10:59 TH	0.006	0.05
Total Arsenic	ND	mg/l	EPA 200.7 R4.4	3/14/2018	10:59 TH	0.007	0.05
Total Calcium	34.5	mg/l	EPA 200.7 R4.4	3/14/2018	10:59 TH	0.078	0.5
Total Magnesium	3.02	mg/l	EPA 200.7 R4.4	3/14/2018	10:59 TH	0.03	0.5
Total Kjeldahl Nitrogen	0.78	mg/l	SM4500NB-97	3/7/2018	10:00 JL	0.17	0.5
Total Nitrate as N@	J 0.35	mg/l	EPA 300.0 R2.1	3/6/2018	19:13 AA	0.06	0.5
Total Nitrite as N@	ND	mg/l	SM4500NO2B-00	3/6/2018	19:13 AA	0.014	0.1
Total Nitrogen as N@	1.13	mg/l	CALCULATED		AA		
Total Nickel	ND	mg/l	EPA 200.7 R4.4	3/14/2018	10:59 TH	0.006	0.05
Total Selenium	ND	mg/l	EPA 200.7 R4.4	3/14/2018	10:59 TH	0.004	0.05
Total Potassium	12.7	mg/l	EPA 200.7 R4.4	3/14/2018	10:59 TH	0.06	0.5

Remarks:

Date Sample Collected: 3/5/2018 10 29
Sample Submitted By: J. Knechle
Date Sample Received: 3/5/2018 13 55

Sample temp. upon receipt: 7.2 Deg C

MDL - Minimum Detectable Limit

MCL - Maximum Contaminant Level, USEPA Regulated

ND = Not Detected at the MDL or MRL

MRL - Minimum Reporting Limit

J = Reported value is an estimate because concentration is less than the MRL

*Method Code: STANDARD METHODS ONLINE ED; US EPA METHODS FOR THE CHEMICAL ANALYSIS OF WATER AND WASTES, Rev. 83; US EPA METHODS FOR THE DETERMINATION OF METALS IN ENVIRONMENTAL SAMPLES, May 1994; TEST METHODS FOR EVALUATING SOLID WASTE, SW-846, 3rd ED; USEPA Manual for Certification of Laboratories Analyzing Drinking Water, 6th ED. In accordance with EPA Regulations, all reports, including raw data and quality control data, are maintained by the laboratory for a minimum of 5 years.

@Parameter analyzed by Reliance Laboratories, Martinsburg, WV

@@Values supplied by client

NOTE 40CFR136 sets criteria for sample temperature and preservation. This sample fell outside of this criteria.

RLI 601



Reliance Laboratories, Inc.
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Martinsburg, WV 25403
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Certifications: WV Department of Health # 00354, 00443 | WV Department of Environmental Protection #: 158, 181
MD Department of Environment #: 336, 337 | US Environmental Protection Agency #: WV00042, WV00901

POTESTA & ASSOCIATES, INC.
15 S. BRADDOCK ST.

Monday, March 19, 2018
Page 3 of 4

WINCHESTER, VA 22601-

Lab Number: 282336-2018-W Sample ID: #2

Parameter	Value	Units	Method	Date/Time Analyzed	Analyst	MDL	MRL
Analyte Group: Inorganics							
Total Copper	ND	mg/l	EPA 200.7 R4.4	3/14/2018	11:01 TH	0.005	0.05
Total Lead	ND	mg/l	EPA 200.7 R4.4	3/14/2018	11:01 TH	0.005	0.05
Total Zinc	J 0.005	mg/l	EPA 200.7 R4.4	3/14/2018	11:01 TH	0.002	0.05
Total Molybdenum	ND	mg/l	EPA 200.7 R4.4	3/14/2018	11:01 TH	0.01	0.05
Field pH@@	8.28	S.U.			JK		
Total Phosphorus	J 0.19	mg/l	SM4500PE-99	3/13/2018	12:03 TH	0.02	0.5
Total Mercury	ND	mg/l	EPA 245.1 R3.0	3/13/2018	10:50 TH	0.0001	0.001
Total Cadmium	ND	mg/l	EPA 200.7 R4.4	3/14/2018	11:01 TH	0.002	0.05
Total Chromium	ND	mg/l	EPA 200.7 R4.4	3/14/2018	11:01 TH	0.006	0.05
Total Arsenic	ND	mg/l	EPA 200.7 R4.4	3/14/2018	11:01 TH	0.007	0.05
Total Calcium	34.0	mg/l	EPA 200.7 R4.4	3/14/2018	11:01 TH	0.078	0.5
Total Magnesium	2.94	mg/l	EPA 200.7 R4.4	3/14/2018	11:01 TH	0.03	0.5
Total Kjeldahl Nitrogen	1.12	mg/l	SM4500NB-97	3/12/2018	11:00 JL	0.17	0.5
Total Nitrate as N@	2.20	mg/l	EPA 300.0 R2.1	3/6/2018	19:29 AA	0.05	0.5
Total Nitrite as N@	0.20	mg/l	SM4500NO2B-00	3/6/2018	19:29 AA	0.014	0.1
Total Nitrogen as N@	3.52	mg/l	CALCULATED		AA		
Total Nickel	ND	mg/l	EPA 200.7 R4.4	3/14/2018	11:01 TH	0.006	0.05
Total Selenium	ND	mg/l	EPA 200.7 R4.4	3/14/2018	11:01 TH	0.004	0.05
Total Potassium	12.5	mg/l	EPA 200.7 R4.4	3/14/2018	11:01 TH	0.06	0.5

Remarks: @@Values supplied by client.

Date Sample Collected: 3/5/2018 10 33
Sample Submitted By: J. Knechtel
Date Sample Received: 3/5/2018 13 55
Sample temp. upon receipt: 7.2 Deg C
MDL - Minimum Detectable Limit
MCL - Maximum Contaminant Level, USEPA Regulated

ND = Not Detected at the MDL or MRL
MRL - Minimum Reporting Limit
J = Reported value is an estimate because concentration is less than the MRL

*Method Code: STANDARD METHODS ONLINE ED; US EPA METHODS FOR THE CHEMICAL ANALYSIS OF WATER AND WASTES, Rev. 83; US EPA METHODS FOR THE DETERMINATION OF METALS IN ENVIRONMENTAL SAMPLES, May 1994; TEST METHODS FOR EVALUATING SOLID WASTE, SW-846, 3rd ED; USEPA Manual for Certification of Laboratories Analyzing Drinking Water, 6th ED. In accordance with EPA Regulations, all reports, including raw data and quality control data, are maintained by the laboratory for a minimum of 5 years.

@Parameter analyzed by Reliance Laboratories, Martinsburg, WV

NOTE *MS and/or MSD recovery falls outside of acceptable quality control criteria for this analytical batch

NOTE: 40CFR136 sets criteria for sample temperature and preservation. This sample fell outside of this criteria



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 Martinsburg, WV 25403
 Phone: 304.596.2084 | Fax: 304.596.2086

Certifications: WV Department of Health # 00354 00443 | WV Department of Environmental Protection # 158 181
 MD Department of Environment # 336 337 | US Environmental Protection Agency # WV00042, WV00301

POTESTA & ASSOCIATES, INC.
 15 S. BRADDOCK ST.

Monday, March 19, 2018
 Page 4 of 4

WINCHESTER, VA 22601-

Lab Number: 282339-2018-W Sample ID: #3

Parameter	Value	Units	Method	Date/Time Analyzed	Analyst	MDL	MRL
Analyte Group: <u>Inorganics</u>							
Total Copper	ND	mg/l	EPA 200.7 R4.4	3/14/2018	11:18 TH	0.005	0.05
Total Lead	ND	mg/l	EPA 200.7 R4.4	3/14/2018	11:18 TH	0.005	0.05
Total Zinc	J 0.007	mg/l	EPA 200.7 R4.4	3/14/2018	11:18 TH	0.002	0.05
Total Molybdenum	ND	mg/l	EPA 200.7 R4.4	3/14/2018	11:18 TH	0.01	0.05
Field pH@@	8.3	S.U.			JK		
Total Phosphorus	J 0.19	mg/l	SM4500PE-99	3/13/2018	12:03 TH	0.02	0.5
Total Mercury	ND	mg/l	EPA 245.1 R3.0	3/13/2018	10:50 TH	0.0001	0.001
Total Cadmium	ND	mg/l	EPA 200.7 R4.4	3/14/2018	11:18 TH	0.002	0.05
Total Chromium	ND	mg/l	EPA 200.7 R4.4	3/14/2018	11:18 TH	0.006	0.05
Total Arsenic	ND	mg/l	EPA 200.7 R4.4	3/14/2018	11:18 TH	0.007	0.05
Total Calcium	30.0	mg/l	EPA 200.7 R4.4	3/14/2018	11:18 TH	0.078	0.5
Total Magnesium	2.73	mg/l	EPA 200.7 R4.4	3/14/2018	11:18 TH	0.03	0.5
Total Kjeldahl Nitrogen	0.90	mg/l	SM4500NB-97	3/12/2018	11:00 JL	0.17	0.5
Total Nitrate as N@	1.65	mg/l	EPA 300.0 R2.1	3/6/2018	19:46 AA	0.05	0.5
Total Nitrite as N@	ND	mg/l	SM4500NO2B-00	3/6/2018	19:46 AA	0.014	0.1
Total Nitrogen as N@	2.55	mg/l	CALCULATED		AA		
Total Nickel	ND	mg/l	EPA 200.7 R4.4	3/14/2018	11:18 TH	0.006	0.05
Total Selenium	ND	mg/l	EPA 200.7 R4.4	3/14/2018	11:18 TH	0.004	0.05
Total Potassium	11.4	mg/l	EPA 200.7 R4.4	3/14/2018	11:18 TH	0.06	0.5

Remarks: @@Values supplied by client.

Date Sample Collected: 3/5/2018 10:39
 Sample Submitted By: J. Knechtel
 Date Sample Received: 3/5/2018 13:55
 Sample temp. upon receipt: 7.2 Deg C
 MDL - Minimum Detectable Limit
 MCL - Maximum Contaminant Level, USEPA Regulated

ND = Not Detected at the MDL or MRL
 MRL - Minimum Reporting Limit
 J = Reported value is an estimate because concentration is less than the MRL

*Method Code: STANDARD METHODS ONLINE ED; US EPA METHODS FOR THE CHEMICAL ANALYSIS OF WATER AND WASTES, Rev. 83; US EPA METHODS FOR THE DETERMINATION OF METALS IN ENVIRONMENTAL SAMPLES, May 1994; TEST METHODS FOR EVALUATING SOLID WASTE, SW-846, 3rd ED; USEPA Manual for Certification of Laboratories Analyzing Drinking Water, 6th ED. In accordance with EPA Regulations, all reports, including raw data and quality control data, are maintained by the laboratory for a minimum of 5 years.

@Parameter analyzed by Reliance Laboratories, Martinsburg, WV

NOTE: MS and/or MSD recovery falls outside of acceptable quality control criteria for this analytical batch

NOTE: 40CFR136 sets criteria for sample temperature and preservation. This sample fell outside of this criteria

Bailey, Brian D

From: Joe Knechtel <JKKnechtel@potesta.com>
Sent: Wednesday, March 21, 2018 4:15 PM
To: Bailey, Brian D
Cc: Perkins, John M; Patel, Yogesh P; Melissa High; Joe Kent
Subject: RE: Bardane Industrial Park - Lagoon and Sinkhole Remediation Plan
Attachments: Bailey, Brian - Water Analysis Results (17-0430-400).pdf

Brian

Please find attached the sample results for the Jefferson Commission Lagoon for your evaluation. Please contact me if you have any questions. Thank you.

Joe

K. Joe Knechtel, P.E.
Potesta & Associates, Inc.
15 S. Braddock Street
Winchester, Virginia 22601
(540) 450 - 0180 - Phone
(540) 450 - 0182 - Fax
(540) 247 - 2950 - Cell

This electronic communication and its attachments contain confidential information. The recommendations and/or design data included herein are provided as a matter of convenience and should not be used for final design or ultimate decision making. Rely only on the final hardcopy materials bearing the consultant's original signature and seal. If you have received this information in error, please notify the sender immediately.

From: Bailey, Brian D <Brian.D.Bailey@wv.gov>
Sent: Thursday, March 15, 2018 10:28 AM
To: Joe Kent <jkent@jeffersoncountywv.org>; Joe Knechtel <JKKnechtel@potesta.com>
Cc: Perkins, John M <John.M.Perkins@wv.gov>; Patel, Yogesh P <Yogesh.P.Patel@wv.gov>
Subject: FW: Bardane Industrial Park - Lagoon and Sinkhole Remediation Plan

Joe and Joe,

After speaking with Yogesh, we do not object to the concept of your amended plan to dewater the Bardane Industrial Park Irrigation Lagoon.

Before we can make any amendments to the initial response letter, we would need to receive the requested water test results in your attached revised plan and evaluate them.

Please forward me the requested test results, and we will go from there.

Thanks,

Brian Bailey

WV DEP
DWWM – Permitting

601 57th Street SE
Charleston, WV 25304
Phone: 304-926-0499 ext 1021
Fax: 304-926-0497

From: Perkins, John M
Sent: Friday, March 09, 2018 10:55 AM
To: Bailey, Brian D <Brian.D.Bailey@wv.gov>
Subject: FW:

See if this is acceptable.

From: Anderson, Connie J
Sent: Friday, March 09, 2018 9:24 AM
To: Perkins, John M <John.M.Perkins@wv.gov>
Subject: FW:

John,
As the decommissioning of the lagoon is in your shop, I want to say that I have no issues with this amendment because the sinkhole will not receive any of the released water.
Thank you,
Connie

From: Patel, Yogesh P
Sent: Friday, March 09, 2018 9:02 AM
To: Anderson, Connie J <Connie.J.Anderson@wv.gov>
Subject:

Yogesh P. Patel, P.E.
Assistant Director
Division of Water and Waste Management
601 57th Street, S.E.
Charleston, WV 25304-2345
Phone (304)-926-0499 Ext. 1014
Fax (304)-926-0496
Yogesh.P.Patel@wv.gov

JEFFERSON COUNTY, WEST VIRGINIA
Department of Engineering, Planning & Zoning
Offices of

Engineering / Building Permits & Inspections / Floodplain Management

116 East Washington Street, Suite 100
P.O. Box 716
Charles Town, West Virginia 25414

Roger Goodwin, P.E., CFM
Director, Chief County Engineer & Building Official

Phone: (304) 728-3256
Fax: (304) 728-3953
rgoodwin@jeffersoncountywv.org

TO: West Virginia Department of Environmental Protection
Division of Water & Waste

FROM: Roger Goodwin, P.E., CFM
Director & Chief County Engineer

DATE: August 31, 2017

SUBJECT: **WWTP Lagoon Decommission & Sinkhole Remediation Plan**
Bardane Industrial Park, Jefferson County

WWTP and Lagoon Decommission Violation no. w17-19-026-mkk
Sinkhole UIC Permit Violation no. w17-19-025-mkk

The following is the proposed plan to decommission the waste water treatment plant effluent discharge storage lagoon and to remediate the sinkhole at the Bardane Industrial Park in Jefferson County (*see attached location map*), as required under the above noted West Virginia Department of Environmental Protection (WVDEP) violations:

1. The proposed plan is to decommission the lagoon by draining it, then removing a portion of north and south lagoon berms and drying out the lagoon. A new drainage swale can then be constructed from the upstream roadway culverts located at Industrial Boulevard, through the lagoon site, to a drainage swale that exists on an adjacent lot at the northern end of the lagoon. There is already a minimum 300 foot wide drainage easement (*see attached existing easement plat*) across this lot that extends to the downstream roadway culverts located at James Burr Boulevard.
2. It is understood that as part of the approval of the plan to drain the lagoon and construct a drainage swale, that we are required by the WVDEP to obtain one grab sample of the sludge/soil in the lagoon and have it tested for the following:

Arsenic	Total Nitrogen
Cadmium	Phosphorous
Chromium	Potassium
Copper	Calcium
Lead	Magnesium
Mercury	pH
Molybdenum	Percent solids (sludge only)
Nickel	Fecal Coliform (sludge only)
Selenium	Volatile Solids (sludge only)
Zinc	
Cyanide	

The results are to be submitted to the WVDEP for review.

3. The lagoon will be drained by pumping the water in the lagoon to the nearby Jefferson County Public Service District (JCPSD) pump station since the WVDEP will not allow the water in the lagoon to be discharged downstream into the stormwater drainage system.
4. Once the new drainage swale is in place, the sinkhole will then be remediated in accordance with applicable guidelines in the WVDEP's Sinkhole Mitigation Guidance document (*see attached guidelines*). Fill will then be placed over the sinkhole and in the drainage swale that currently runs to the sinkhole. The fill will be graded toward the new drainage swale so that the stormwater runoff sheet/surface flows to the new drainage swale and not into the sinkhole (*see attached aerial site map showing proposed drainage swale*).
5. All WVDEP permits required for the project will be obtained prior to beginning construction. All disturbed areas will be stabilized with seeding and mulch, erosion matting, check dams, etc., in accordance with the sediment and erosion control plan that is developed by the consulting engineer for this project.
6. Upon completion of all work, an inspection will be scheduled with the WVDEP.
7. A drainage easement plat will then be recorded at the county clerk's office for the new drainage swale that is constructed across the lot owned by the Jefferson County Commission (the parcel with the sinkhole and lagoon).

In summary, the overall intent of this plan is to carry the stormwater runoff from the upstream culverts at Industrial Boulevard directly to the downstream drainage and stormwater management system – thereby diverting the stormwater away from the sinkhole; which will eliminate the need for an Underground Injection Control (UIC) permit for the sinkhole.

Currently, there are approximately 307.77 acres draining to the sinkhole. When

the project is finished, we expect approximately only 1.5 acres of area will have stormwater runoff sheet flowing over the sinkhole to the new drainage swale. The other 306.27 acres will by-pass the sinkhole.

The following table is an estimated timeline for the generally anticipated steps to performing field surveying, engineering the project, bidding the work, funding the project and constructing the project. This plan/project will require a time extension on the "Rule Authorization" from the current October 1, 2017 deadline for obtaining a UIC permit for the sinkhole:

<u>WWTP Effluent Discharge Lagoon Decommission & Sinkhole Remediation Project</u> Bardane Industrial Park Jefferson County, WV August 31, 2017		
Project Timeline		
No.	Task	Weeks
1	Get Co. Commission approval to issue RFP to Engineering consultants	3
2	Draft RFP & scope of work	2
3	Advertise Request for Proposals from Consulting Engineers	2
4	Receive RFP's and review and get Co. Commission approval to hire	4
5	Engineering consultant performs field survey, engineers design, completes construction documents, plans & specifications, obtains state & federal permits, provides cost estimate.	12
6	Get Co. Commission funding allocation and approval to bid project.	4
7	Advertise for Bids from Contractors, pre-bid conference, receive bids	6
8	Review bids and make recommendation to County Commission	3
9	Award Bid & Issue Notice of Award	1
10	Legal review construction bonds, insurance documents; issue Notice to Proceed	4
11	Construction stakeout and perform construction work	10
12	WVDEP Inspection	2
13	Close out Project & Final Payment to Contractor	2
	Estimated Total Weeks	55

1

**West Virginia Department of Environmental Protection
Division of Water and Waste Management
Groundwater Protection Program**

Sinkhole Mitigation Guidance

August 8, 2005

Purpose:

These sinkhole mitigation designs serve to allow the filling of sinkholes while maintaining recharge to the aquifer, reducing potential contamination threats to groundwater, and eliminating safety hazards at sinkhole entries.

General:

Consideration should be given to the method used for removing contaminated materials from sinkholes and reducing or eliminating direct inflow of surface water into sinkholes. Land treatment methods that improve the filtration and infiltration of surface water before it enters the sinkhole should be used along with the mitigation of the sinkhole.

Before selecting a treatment option the following should be considered:

- Land use
- Existing and planned land treatment
- Sinkhole drainage area
- Dimensions of the sinkhole opening
- Safe outlet for diverted surface water
- Environmentally safe disposal of sinkhole “clean out” material
- Availability and quality of filter material
- Safety of equipment and operators and laborers during installation

Treatment selection should be based on the dimensions of the sinkhole drainage area and include direct sinkhole treatment with surface water control measures and filter strips. Whichever treatment option is chosen, it should avoid surface water ponding or the creation of high soil moisture conditions in excess of 72 hours.

Treatment designs apply to sinkholes with excavated depths of 5 to 25 feet and with drainage areas up to 15 acres. Excavations up to 5 feet are sufficient for most sinkholes. Sinkholes with excavation depths of greater than 25 feet or with uncontrolled drainage areas greater than 15 acres may require adjustments to the treatment measure(s) and/or surface water control measure(s). In these cases, geologic and engineering assistance must be obtained and a site-specific treatment design prepared.

Treatment for Sinkholes with Drainage Areas Less than 5 Acres

Treat the sinkhole using the mitigation design in Figure 1 of this guidance document. The treatment site should be inspected after periods of heavy precipitation because some material may run into adjacent sinkhole voids causing a surface depression. In this case, maintenance will include adding soil material at the surface. The existing land use or practice may continue over the treated sinkhole as long as the treatment is maintained.

Treatment for Sinkholes with Drainage Areas of 5 Acres or More and Having a Safe Outlet

The following additional treatment criteria are applicable to sinkholes with drainage areas of 5 acres or more where a safe outlet can be provided to divert surface water away from the sinkhole. A safe outlet is one that does not erode, divert surface water to another sinkhole or injection well, or cause flood damage to crops, property, buildings, or highways/roads.

Surface water control measures should be situated to reduce the internal drainage area around the sinkhole to less than 5 acres. The choice of surface water control measures is generally based on site-specific conditions.

Treatment for Sinkholes with Drainage Areas of 5 to 15 acres and Having No Safe Outlet

Treat the sinkhole using the mitigation design in Figure 2 of this guidance document. The site should be inspected after periods of heavy precipitation because some material may run into adjacent sinkhole voids causing a surface depression. In this case, maintenance will include adding soil material at the surface. The sinkhole should remain as unused land.

Vegetated Buffer Area

A vegetated buffer area should be installed around the sinkhole to improve runoff water quality by filtration and adsorption of contaminants. The vegetated buffer area should be installed within the sinkhole drainage area and should begin at the treated sinkhole.

The minimum width (in feet) of the vegetated buffer area is determined by multiplying the sinkhole drainage area (in acres) by seven. This width should provide beneficial filtering for some distance outside the sinkhole because surface water runoff may be temporarily held before reaching the treated sinkhole.

Appropriate vegetation should be used for the buffer area. Use native vegetation as much as possible. **DO NOT** use noxious plants or weeds. It is recommended that a plant nursery be consulted for the appropriate vegetation.

Acceptable Materials

Engineering fabric - must meet the applicable requirements of AASHTO M-288.

Aggregates – fine aggregates, gravel, or rock rip rap that conforms to the West Virginia Department of Highways, Standard Specifications for Roads and Bridges, Sections 702, 703, and 704.

Specifications

Use the following guidance for installing a mitigation design for sinkholes and sinkhole areas with drainage areas of less than 5 acres:

1. Remove and properly dispose of materials dumped in and around the sinkhole in accordance with applicable federal, state, and local laws.
2. Excavate loose material from the sinkhole and try to expose the solution void(s) in the bottom. Enlarge the sinkhole, as necessary, to allow for installation of the filter material.

3. Select stone that is approximately 1.5 times larger than the solution void(s). Place the stone into the void(s) forming a competent bridge. Stone used for the bridge should have rock strength equal to, at least, moderately hard (*e.g.*, resistant to abrasion or cutting by a knife blade but can be easily dented or broken by light blows with a hammer). Shale or similar soft and non-durable rock is not acceptable.
4. Place a layer of filter material over the bridge to a minimum thickness of 24 inches. Approximately 35 percent of the material should be larger than the opening between the bridge and the void(s). There should be no discernable large openings around the bridge. The material should be either gabion stone, stone for rip rap, or stone for special rock fill that conforms to West Virginia Department of Highways, *Standard Specification Roads and Bridges*, Section 704.
5. Place a layer of smaller size filter material over the previous layer to a minimum thickness of 10 inches. The size of the material should be $\frac{1}{4}$ to $\frac{1}{2}$ the size of that used in the previous layer. The material should be No. 57 aggregate, which conforms to West Virginia Department of Highways, *Standard Specifications Roads and Bridges*, Sections 703.1.1, 703.1.2, 703.1.3, 704.1.4, and 703.2.1. Unacceptable filter material consists of pea gravel or slags (steel, electromagnetic, or power plant).
6. Place a layer of sand-sized filter material over the previous layer at to a minimum thickness of 10 inches. The sand must be compatible in size with the previous layer to prevent piping. The material should be fine aggregate that conforms to West Virginia Department of Highways, *Standard Specification Roads and Bridges*, Sections 702.1.1, 702.1.2, and 702.1.3.
7. Engineering fabric conforming to AASHTO M 288 may be substituted for the stone and sand filter materials discussed in 5 and 6.
8. Backfill over the top filter layer or engineering fabric with soil material to the surface. This should be mineral soil with at least 12 percent fines. Reuse soil material excavated from the sinkhole as much as possible and place any available topsoil over the backfill. Overfill by about 5 percent to allow for settling.

9. Establish vegetation on the mitigated sinkhole and other disturbed areas of the site.

Use the following guidance for installing a mitigation design for sinkholes and sinkhole areas with drainage areas of 5 to 15 acres:

1. Remove and properly dispose of materials dumped in and around the sinkhole.
2. Excavate loose material from the sinkhole.
3. Place a layer of filter material into the sinkhole, allowing the stone to fill the void(s) below the bottom of excavated sinkhole. The size should be $\frac{1}{4}$ to $\frac{1}{2}$ the size of the void(s). This material can be WVDOH gabion stone, rip rap stone, or special rock fill stone.
4. Place a layer of the same size filter material to a thickness of about $\frac{3}{4}$ TD (TD = total depth) above the sinkhole bottom.
5. Place a layer of smaller size filter material over the previous layer to a thickness of about $\frac{1}{4}$ D. Bring this layer to surface level. The size should be $\frac{1}{4}$ to $\frac{1}{2}$ the size of the previous layer. The material should be No. 57 aggregate, which conforms to West Virginia Department of Highways, *Standard Specification Roads and Bridges*, Sections 703.1.1, 703.1.2, 703.1.3, 703.2.1, and 704.1.4. Unacceptable stone consists of pea gravel or slags (steel, electrometallurgical, or power plant).
6. Shale or similar soft and non-durable rock is not acceptable.
7. Establish vegetation on the mitigated sinkhole and disturbed areas of the site.

Engineering Fabric Requirements for Subsurface Drainage

Engineering fabric used in the mitigation of sinkholes should meet the applicable requirements of AASTHO M 288, Section 7.2

Engineering Fabric Installation

Proper construction and installation techniques are essential to ensure that the intended function of the engineering fabric is fulfilled.

When sewn seams are necessary, the seam strength must be equal to or greater than 90 percent of the specified grab strength, as measured in accordance with ASTM D 4632.

When sewn seams are used for the seaming of the engineering fabric, the thread must be high strength polypropylene, or polyester. Nylon thread is unacceptable.

For Sinkhole Mitigation Design A, place the engineering fabric loosely, with no wrinkles or folds, and with no void spaces between the fabric and the bridge. Overlap successive sheets of engineering fabric a minimum of 12 inches, with the upstream sheet overlapping the downstream sheet.

Prior to covering, the engineering fabric should be inspected to ensure that it has not been damaged (*e.g.* holes, tears, rips) during installation. An engineer or the engineer's designated representative should conduct the inspection. The designated representative should be a certified field inspector.

Damaged fabric must be repaired immediately. Cover the damaged area with an engineered fabric patch that overlaps to 12 inches beyond the damaged area.

Any damaged engineering fabric that cannot be repaired shall be replaced as directed by the engineer.

Place material over the engineering fabric in such a manner as to avoid stretching and subsequently tearing the fabric. Do not drop stone and soil placement from a height greater than one meter. Do not allow stone with a mass of more than 100 kg to roll down the slope of the sinkhole.

Grading the sinkhole slope is not permitted if the grading will result in the movement of the stone directly above the engineering fabric.

Operation and Maintenance

The owner/operator is responsible for maintaining the mitigated sinkhole and sinkhole area. At a minimum, the following maintenance practices should be performed:

1. Mow grass and plantings as necessary to promote vigorous growth.
2. Inspect mitigation measures at least twice a year and after all major rain events. Repairs to the sinkhole mitigation measures should be made promptly were warranted.

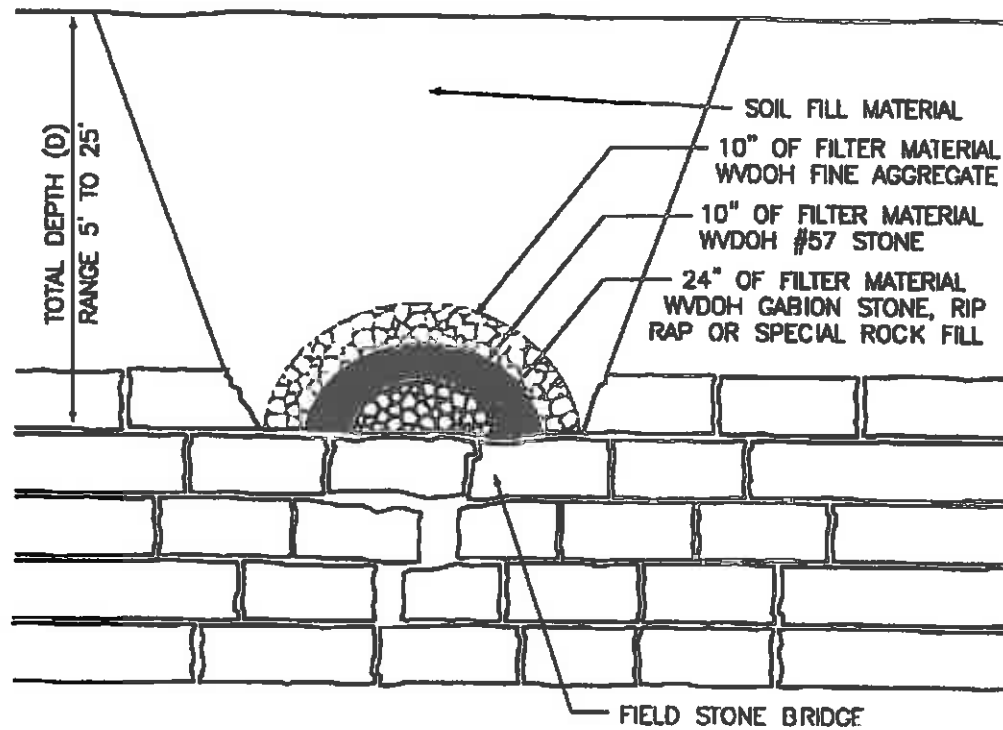
References:

USDA Natural Resources Conservation Center, January 2004. *Maryland Conservation Practice Standard, Sinkhole and Sinkhole Area Treatment, Code 725.*

West Virginia Department of *Highways, Standard Specifications Roads and Bridges*, 2000, Section 702, "Fine Aggregates", Section 703, "Coarse Aggregates", Section 704, "Stone and Crushed Aggregate", Section 715, "Miscellaneous Materials".

WEST VIRGINIA DEPARTMENT OF ENVIRONMENTAL PROTECTION
SINKHOLE MITIGATION GUIDANCE

FIGURE 1



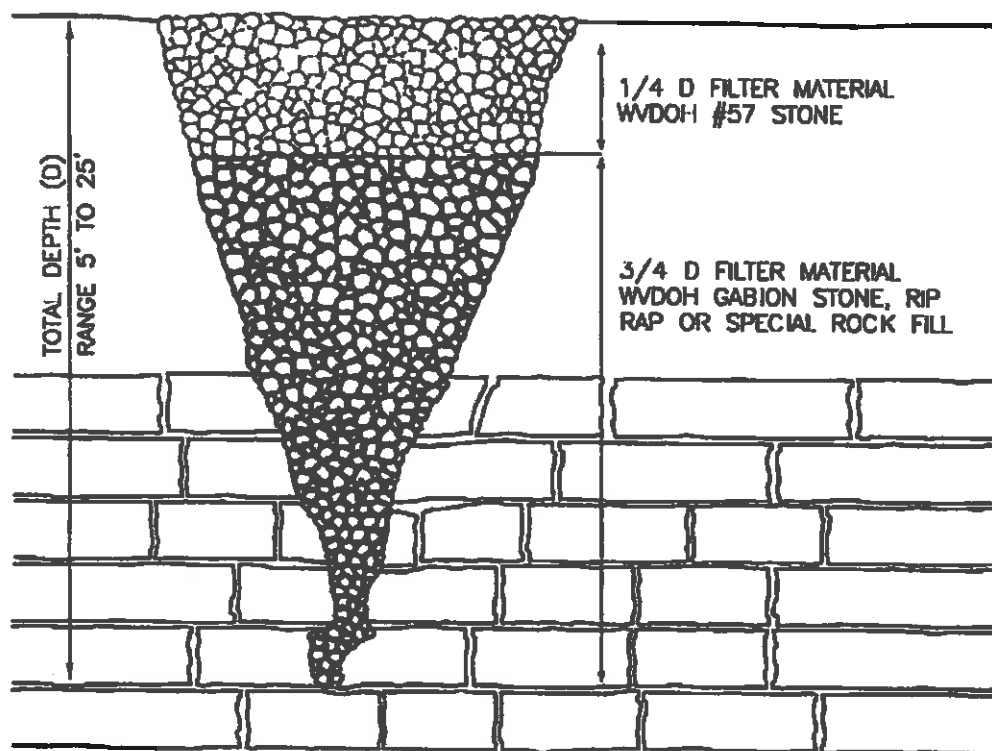
NOTE:
A NONWOVEN GEOTEXTILE MEETING AASHTO M288,
SECTIONS 7.1+7.2 MAY BE SUBSTITUTED FOR THE
WVDON #57 STONE AND WVDON FINE AGGREGATE

SINKHOLE MITIGATION

(DRAINAGE AREA LESS THAN 5 ACRES)

WEST VIRGINIA DEPARTMENT OF ENVIRONMENTAL PROTECTION
SINKHOLE MITIGATION GUIDANCE

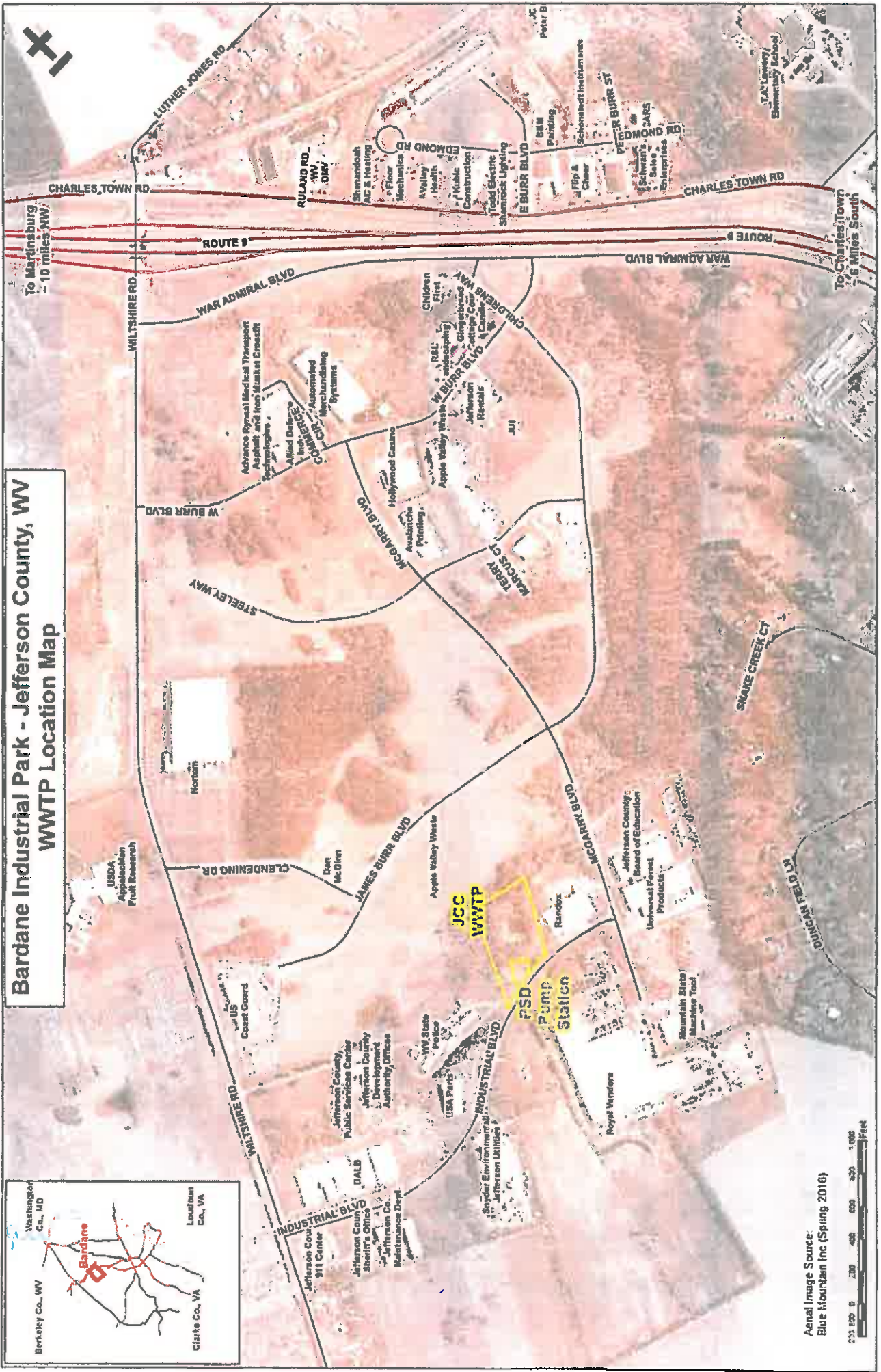
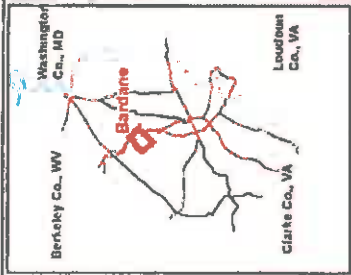
FIGURE 2



SINKHOLE MITIGATION

(DRAINAGE AREA 5 TO 15 ACRES)

Bardane Industrial Park - Jefferson County, WV WWTP Location Map



Aerial Image Source:
Blue Mountain Inc (Spring 2016)

