PARSONS

OLD OUTFALL 002 REMEDIAL OPTIONS PLAN

CHEMOURS FAYETTEVILLE WORKS
RCRA PERMIT NO. NCD047368642-R2-M3

Prepared for:

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Chemours PN 504552
Parsons PN 449338

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FIGURES

ACRONYMS

Acronym	Definition / Description
CO	Consent Order
ECBT	Empty bed contact time
EQ	Equalization
GAC	Granular activated carbon
gpm	Gallons per minute
HFPO-DA	Hexafluoropropylene oxide dimer acid (aka GenX)
IOX	Ion exchange
µS/cm	Microsiemens per centimeter
µm	Micrometers
mg/L	Milligrams per liter
NCDEQ	North Carolina Department of Environmental Quality
NWP	Nationwide Permit
PFAS	Per - and polyfluoroalkyl substances
PFMOAA	Perfluoro-2-methoxyacetic acid
RAP	Remedial Action Plan
Site	Fayetteville Works Facility
USEPA	United States Environmental Protection Agency

1.0 INTRODUCTION

On February 25, 2019, the North Carolina Superior Court for Bladen County entered a Consent Order (CO) among The Chemours Company FC, LLC (Chemours) and the State of NC and Cape Fear River Watch to address discharges of perfluoroalkyl and polyfluoroalkyl substances (PFAS) at the Chemours Fayetteville Works (the Site). Among other things, the CO requires Chemours to develop a remedial plan for reducing PFAS loading from Old Outfall 002 at the Site to the Cape Fear River.

1.1 Site Description and Background

The Site is a 2,777-acre manufacturing facility located near Fayetteville, NC in Bladen County (Figure 1). Since 1996, several stages of environmental investigations have been conducted at the site under NCDEQ oversight.

Studies conducted at the Site indicate that groundwater containing PFAS constituents from historic PFAS deposition is discharging to a channel on the property referred to as the Old Outfall 002 (Figure 2). The channel historically was utilized to discharge process wastewater but was abandoned by the prior site owner when the current Outfall 002 was constructed in 2012. There is currently no active process wastewater discharge from the Site into this former outfall. Water in this channel ultimately discharges to the Cape Fear River.

1.2 Objectives

Pursuant to paragraph 12.e of the CO, Chemours is required to submit a plan within 90 days of entry of the CO that analyzes the following remedial options:

(1) capturing the dry weather flow at Location B (as shown in Attachment A of the CO) of Old Outfall 002 and treating the water prior to discharge; and

(2) an alternative equivalent remediation method.

The treatment system for water collected at Location B is required to meet discharge standards set by DEQ and in addition be at least 99% effective in controlling the indicator parameters (i.e., GenX (hexafluoropropylene oxide dimer acid [HFPO-DA]) and perfluoro-2-methoxyacetic acid (PFMOAA)).

Upon approval by the North Carolina Department of Environmental Quality (NCDEQ) and Cape Fear River Watch, Chemours is required to implement one of the options by September 30, 2020. This Plan is intended to present the currently available options in order to meet this 90-day plan requirement.

2.0 TREATMENT AND CONTROL OPTIONS

2.1 Option 1 – Capture and Treat

Paragraph 12.e.i of the CO requires Chemours to evaluate a plan in which the dry weather flow in Old Outfall 002 is captured and then treated at the Location B (Figure 3). Based on current estimates, the dry weather flow at this location is approximately 500 to 1,000 gallons per minute (gpm). Additional flow studies are being designed to better define the flow rate. The treatment system is expected to be designed to treat flows in the range of 500 to 1,000 gpm based on current flow estimates.

2.1.1 Isotherm Studies

If the plan for capturing flow at Location B is selected, a treatment system must be implemented to treat the captured flow. Parsons is currently conducting studies to compare the efficacy of ion exchange (IOX) to granular activated carbon (GAC) for removal of PFAS compounds from Old Outfall 002 water. These studies include GAC isotherm studies on authentic sample volume from the lower reaches of Old Outfall 002 to gain adsorptive performance information within the anticipated influent matrix. This information is intended to demonstrate the potential benefits and limitations of using GAC to treat individual PFAS compounds. The studies are expected to be completed by late May 2019.

Typical GAC utilization rates required to attain prescribed target treated PFAS concentrations for select compounds will be estimated based on the isotherm model results. The isotherm model results for other compounds will be used to provide effluent characterization estimates for a range of target constituents identified in the CO. By using authentic test volume, all isotherm model results for individual compounds implicitly reflect matrix background effects as well as potential competitive adsorption effects due to the presence of other PFAS / sorbable constituents.

Parsons is also testing various IOX resins for treatment of PFAS constituents through bench-scale isotherm testing. The resins were selected based on previous studies performed by the Cape Fear Public Utility Authority. IOX will be compared to similar studies performed with GAC. Parsons will follow up with bench-scale column testing of IOX if the isotherm studies show it to be superior to GAC in performance and cost effectiveness. If completed, IOX column tests will be compared to similar studies performed with GAC.

2.1.2 Permitting

Based on the preliminary design, the following permits are anticipated to be needed to complete this effort:

- NPDES Permit (NCDEQ)
- Wetlands / 404 Permit (U.S. Corp of Engineers)
- Building Permit (Bladen County)
- Land Disturbance Permit (Bladen County)

2.1.3 Flow Projections

Flow projections are based on the measured dry weather flow in the Old Outfall 002 channel. Since the dry weather flow is not anticipated to fluctuate significantly, the treatment system is expected to be designed to treat flows in the range of 500 to 1,000 gpm. This estimate is based on flow measurements conducted at different locations in the Old Outfall 002 channel using a salt dilution gauging. The measurement methodology is summarized below:

Volumetric flow rates along the length of the Old Outfall 002 channel were assessed at five locations using salt dilution gauging. Flow velocity gauging measurements were collected as an independent assessment of volumetric flow rates at the location designated OLDOF-2, where the Old Outfall 002 passes through a culvert. This location is just downstream of the proposed capture point (Location B).

Assessment began at the mouth of the channel and progressed sequentially upstream towards location OLDOF-5 (headwaters). The flow of streams was measured by dosing the stream with a known concentration of a tracer compound chosen to be sodium chloride. Chloride concentrations were maintained throughout the assessment below 230 milligrams per liter (mg/L), the United States Environmental Protection Agency (USEPA) acute freshwater aquatic life criteria and the North Carolina 15A NCAC 02B Water Quality Standards for Surface Waters (USEPA, 2019; NCDEQ, 2019).

Salt solution with a known concentration was dosed into the flowing stream as a near-instantaneous slug. The metered salt solution then mixes with the stream flow. Electrical conductivity (units of microsiemens per centimeter (µS/cm)) was measured using a conductivity probe in both the stock salt solution and at a well-mixed point downstream of the salt injection point. Using the known stock solution concentration and the recorded passage of the salt-wave across the downstream measurement point, the flow rate of the stream was calculated. Salt is a suitable tracer since it can be easily and accurately measured in the field and it can be used at concentrations that do not impact aquatic life. The following implementation steps were generally followed at each location:

- Select gauging location. A location along the stream suitable for the measurements was selected based on visual observations. Generally, deep pools and obstructions were avoided and a flowing, linear channel section that is 10-20 times the width of the stream was selected (moving water helps increase mixing of the stock solution).
- Calibrate conductivity probe. The conductivity probe was calibrated using calibration solutions ranging in concentrations from 10 mg/L to 100,000 mg/L.
- Record background stream conductivity. Background stream conductivity was recorded along the length of the stream and a background stream sample was collected for independent laboratory verification of background stream concentrations.
- Prepare stock solution. Stock solution was prepared by mixing a known volume of water from the stream with previously prepared sodium chloride packets of measured mass. Conductivity of the stock solution was measured to verify adequate mixing of salt mass at stream temperatures and a sample of the stock solution was collected.
- Begin dosing stream with stock solution. The stock solution was dosed instantaneously as a slug.

- Measure stock solution and stream concentrations. The conductivity of the stream was recorded continuously, every 1 second, at a single downstream location 10-20 times the width of the stream. Measurements were recorded until the stream conductivity reached background values recorded earlier.

Further field studies (ex., Parshall Flume) to confirm the flowrate will likely be implemented in the coming weeks prior to the development of a detailed design.

2.1.4 Capture Structure

In order to collect the base flow while allowing stormwater to bypass the system, a concrete diversion and overflow structure along with a sump will be constructed to capture the base flow from the channel at Location B. Submersible pumps will be installed in the sump to transfer the water from Location B to a treatment plant constructed in the upland area to the north (Figure 3). In order to allow for variations in the base flow, the capture system will be designed to capture and pump up to the base flow (500 to 1,000 gpm). The dam will be equipped with a spillway to allow flows greater than base flow (i.e., stormwater) to bypass the system and continue downstream.

This system is relatively straightforward to design and construct and should require limited maintenance. However, because construction will occur within the creek, a Section 404 permit must be obtained from the US Army Corp of Engineers. Also, as part of the permitting process, both the creek and the surrounding area will require wetland mitigation.

2.1.5 Wetlands

To comply with required wetlands permitting at Old Outfall 002, we investigated the use of a Nationwide Permit (NWP #38) in lieu of an individual permit. NWP #38 was established to address the cleanup of hazardous and toxic waste sites. This permit may be applicable to the Fayetteville site. In anticipation of this, Parsons has already mapped wetlands in the area and is reviewing impacts to potential cultural resources.

In order to determine the applicability of NWP #38, Parsons had discussions with officials at the Wilmington, NC branch of the US Army Corps of Engineers. For the instream structure at Old Outfall 002, there was a discussion of possible implications of a structure in the stream bed. The creation of an instream weir protected by articulating mats and rip-rap was discussed. The advantage of the articulating mats would include: armoring the weir from stormwater events, the reduced potential for head-cuts from the river, and impact minimization from backwater flooding from the Cape Fear River. According to the Corps, since this instream structure would be substantial, would be semi-permanent,[1] and would likely be present after the current NWPs expire, it is likely that an Individual Permit would be required. Chemours is working with the Corps to determine if a permit can be issued in the timeframe established by the CO.

2.1.6 Proposed Treatment System

Parsons' preliminary evaluation indicates that the treatment system for captured groundwater would consist of the following unit processes:

[1] The CO requires that following the completion of groundwater remediation, Chemours shall remove any dam placed within Old Outfall 002 and restore the channel to its condition prior to the installation of the dam.

- Equalization (EQ)
- Chemical precipitation and settling (if required)
- Filtration
- PFAS adsorption
    - GAC
    - IOX – if required
- Clear well
- Sludge holding and dewatering (if required)

The unit treatment processes are described below.

EQ. The EQ system will be designed to attenuate variations in influent flow rates and target constituent concentrations. Sizing for the EQ system for the Old Outfall 002 treatment system will preliminarily consider variations in measured flow rates and target constituent concentrations in the stream flow to achieve a desired level of attenuation that will be determined during the design process. The EQ system will include the necessary tankage to provide the desired level of hydraulic retention plus associated equipment and instruments/controls including such elements as transfer pumps, level control, and interlocks with downstream processes.

Chemical Precipitation / Clarification (If Required). Chemical precipitation will be implemented to remove target (if applicable) and nuisance constituents (e.g., iron), if necessary, to prevent fouling downstream in the PFAS adsorption process. Testing is underway to determine if this treatment step will be required. This unit treatment process, if implemented, will preliminarily consist of the following steps:

- Aeration to oxidize soluble iron
- Chemical addition including pH adjustment and, if necessary, coagulant
- Flocculation (assisted with polymer addition)
- Settling

Iron oxidation will take place in a dedicated process vessel fitted with an aeration diffusion grid supplied by rotary-type blowers and supplemented with pH adjustment chemicals including caustic (e.g., sodium hydroxide) and acid (e.g., sulfuric acid) metering and chemical coagulant solution addition. The flow will proceed to a lamella clarifier to facilitate removal of precipitated iron solids. Treated flow will proceed to filtration; settled solids will be transferred by an underflow sludge pump to a sludge holding tank.

Filtration. Treated flow from the lamella clarifier will undergo filtration to prevent suspended/fugitive solids from fouling the downstream PFAS adsorption process. The type of filter (e.g., pressurized versus gravity) and media will be evaluated during the design process. The filtration system would be equipped with differential pressure monitoring to trigger filter backwash. Backwash flow would be directed to the head of the equalization system.

PFAS Adsorption. PFAS removal will be accomplished using GAC adsorption followed, if warranted based on treatment testing results, by IOX. Based on related GAC adsorption studies, the treatment objectives described in Section 1.2, and estimated influent

conditions based on the results from sampling at Location B in June 2018, up to 500,000 pounds of GAC will be required per year. Utilization estimates will be refined upon receipt of influent sampling results performed in March 2019 and once focused isotherm studies performed using authentic water from Lower Old Outfall 002 are completed (anticipated to be completed in early June 2019).

It is anticipated that skid-based contactor systems (e.g., Calgon Mod12) would be utilized. To maximize GAC utilization, installation and operation of two or more sets of dual contactor systems operated in series (i.e., effluent from first set proceeds through the second set, and so on) will be considered. The carbon units within each set would be operated in lead-lag fashion. The schedule and criteria for replacement of GAC for each set of contactors will be developed during the construction and startup phase.

Post-Adsorption Filtration. Treated flow from the adsorption treatment process will undergo filtration to further reduce solids in the treated effluent and prevent suspended/fugitive solids from building up in the downstream clear well, if warranted based on pilot testing operation. The type of filter (e.g., pressurized versus gravity) and media will be evaluated during the design process. The filtration system would be equipped with differential pressure monitoring to trigger filter backwash.

Clear Well. The system will preliminarily include a treated water clear well. The clear well will allow treated water to be held and returned to the head of the plant in the event the treated water does not meet discharge criteria.

Sludge Holding and Dewatering (If Required). If a chemical precipitation system is required, then sludge holding and dewatering will also be required. It is anticipated the sludge solids would undergo thickening either in a gravity settler or by other means. The thickened solids would then be dewatered. The thickening and dewatering technologies and associated equipment (e.g., thickened sludge transfer pumps, polymer addition) will be evaluated during the design phase. Liquid removed during thickening and dewatering will be transferred back to the EQ system. Dewatered solids cake would be managed / disposed in a manner which takes into account the potential association of PFAS constituents with the sludge solids.

System Interlocks. In addition to local controls, interlocks will be instituted among various processes to prevent conditions such as overflows and out-of-spec discharges, which would be determined based on real-time instrument readings. For example, influent pumps will automatically shut down if the level in the EQ system exceeds a high-level set point, and transfer pumps will automatically shut off if tank levels drop below low-level set points.

2.1.7 Proposed Pilot Scale Treatment System

CO paragraph 12.e also requires that Chemours complete pilot scale testing of the proposed treatment equipment to determine its control efficiency for all PFAS constituents identified in the Old Outfall 002 water. The pilot testing must be completed by September 30, 2019, be supported by three months of sampling data, and be submitted to NCDEQ for review and approval.

The proposed pilot scale treatment system will be constructed within the plant site since there are currently no facilities (power, water, etc.) at the proposed full-scale capture and treatment location. Water will be collected from the proposed capture location and trucked to the plant site, stored in tanks and pumped through the system. Treated water will then be transported off-site for disposal with other process wastewaters. Solids

residuals, if applicable, will be managed / disposed consistent with state and location regulations taking into consideration potential association of PFAS constituents with the solids residue.

The treatment system will be sized to treat approximately 0.25 – 0.5 gpm and will consist of similar components to the full-scale system described above. The pilot scale system will be operated initially without an iron removal component and at native pH. These systems will be added later if required or warranted based on technical efficacy or operability concerns (e.g., iron fouling in PFAS adsorption process). The overall system will preliminarily consist of the following components:

- An equalization (raw water holding) tank(s), sufficient to provide up to four (4) days of storage capacity.
- Transfer pump(s), including:
  - Centrifugal (submerged or dry-mounted) or peristaltic pump to transfer water through PFAS adsorption process (bypass pre-treatment)
  - Centrifugal pump to transfer water through chemical precipitation pre-treatment, followed by transfer using the aforementioned pump through filtration and PFAS adsorption.
- Filtration, using cartridge-type filters to remove fugitive solids; may be utilized ahead of PFAS adsorption without preceding chemical precipitation step.
- PFAS Adsorption, using 3- or 4-inch diameter HDPE or PVC tubing; up to three (3) columns would be installed in series each providing approximately 7 minutes of empty bed contact time (EBCT).
- Post Adsorption Filtration, as required using cartridge-type filters under pressure or gravity-type bag/media filter.
- Clearwell (treated water) storage tank, sized similarly to equalization (raw water storage) tank.

2.1.8 Preliminary Schedule

A preliminary schedule for the project is provided below in Table (1). This schedule assumes that permits will be issued in a timely manner by the DEQ, the U.S. Corp of Engineers and local permitting authorities (i.e., building and land disturbance permits).

Table 1 - Preliminary Schedule

Project Milestone	*Anticipated Target Complete Date*
Treatability Testing	June 2019
NPDES Permit Application	June 2019
Wetlands / 404 Permit Application	July 2019
Basis of Design	July 2019

Table 1 - Preliminary Schedule	
Project Milestone	*Anticipated Target Complete Date*
Pilot Study Construction	May 2019
Pilot Study Report	September 30, 2019
Detailed Design	February 2020
Procurement	On-going
Construction Completion	August 2020
Startup and Commissioning	September 30, 2020

2.2 Option 2 – Regenesis PlumeStop™

As an alternative remediation method required by CO paragraph 12.e, Chemours is also evaluating using PlumeStop™ to reduce PFAS flowing out Old Outfall 002. PlumeStop™ is an innovative groundwater remediation technology designed to sequester groundwater contaminants via sorption. It is composed of very fine particles (1 to 2 micrometers [µm]) of activated carbon suspended in water. The material is held in suspension through the use of proprietary organic polymers that allow easy injection and dispersion into the subsurface. As the polymer breaks down, the carbon coats the solid material in the aquifer matrix creating a passive, subsurface carbon adsorption filter. PlumeStop™ has been successfully applied to remediate other contaminants including larger PFAS molecules; additional testing is required to determine its effectiveness in treating HFPO-DA and PFMOAA. Chemours has initiated bench scale and pilot scale studies to assess the effectiveness of the remedial method. The material could be installed as a continuous barrier or combined with a cut-off wall (slurry wall) and arranged as a funnel and gate.

A combination of laboratory (bench scale) and pilot scale studies will be used to assess the efficacy of PlumeStop™ at the site. A phased approach is proposed in order to facilitate data collection and minimize assumptions. In phase 1, bench scale testing will be conducted alongside a pilot scale wall to be installed in the Perched Zone beneath the Site. The first step in this process is the collection of samples and installation of piezometers and monitoring wells required to gather the necessary performance data. Chemours installed the performance verification testing wells in April 2019 and conducted an initial round of sampling to establish baseline conditions.

2.2.1 Bench Scale Treatability Testing

PlumeStop™ has been demonstrated to effectively bind PFAS compounds and similar species in a range of conditions. Parsons will confirm that the specific indicator constituents (HFPO-DA and PFMOAA) will bind effectively and that competitive sorption will not reduce the effectiveness of the PlumeStop™. Therefore, the overall objective of the laboratory testing is to determine the efficacy of PlumeStop™ as a remediation

option to treat HFPO-DA and PFMOAA, as well as other fluorinated compounds and VOCs present in groundwater at the subject site. Specifically, the intent of the testing is to perform an isotherm with the bulk aquifer components to determine the dose-response of PlumeStop™ for the target compounds as well as other non-target species within the aquifer matrix. This testing will provide the Regenesis technical services team with site-specific dosing information to aid in a field design and to be used in a model to predict the anticipated performance of PlumeStop™ at the site.

The intent of the treatability study is to determine the dose-response of PlumeStop™ for the target contaminants present in the samples by performing an isotherm measurement, rather than to demonstrate complete removal of the contaminants. Six loadings of PlumeStop™ will be used in the isotherm bench test, ranging from approximately 500 mg/L to 50,000 mg/L. Three of the six treated samples will be prepared in duplicate for reproducibility verification. In addition to the PlumeStop™ treated samples, two control samples and one method control blank will also be analyzed. The control samples will contain site soil and groundwater with no added PlumeStop™. The method control blanks will consist of deionized water and are analyte-free. They are carried through the entire process and are meant to trace any artificial sources of contamination from the procedures.

All samples will be prepared in 4-liter high density polyethylene bottles for the sorption batch study. Each bottle will contain 4,000 milliliters of contaminated groundwater from the site in addition to 0.4 kilograms of site soil. The designated amount of PlumeStop™ for each treatment level will be added to the reaction vessel, (or de-ionized water for the controls) and the samples will be mixed by inversion and kept at room temperature for 48 hours. At this time, a settling reagent will be added. This settling reagent is a mix of salts formulated and tested to decrease the time needed for PlumeStop™ to destabilize and settle out of the aqueous phase. If PlumeStop™ is not removed prior to sample extraction, any contaminants adsorbed onto PlumeStop can be extracted during the analytical sample preparation step and will lead to biased-high results. Additionally, spiked surrogates will have low recoveries due to sorption onto PlumeStop™. After approximately an additional 72 hours, aliquots of the samples will be centrifuged if PlumeStop™ has not been completely removed, and PlumeStop™-free groundwater component will be sent for PFAS and VOC analysis.

2.2.2 Proposed Pilot Scale Testing

In order to collect performance data, several monitoring wells and piezometers must be installed. The pre-pilot study drilling project includes the installation of 2 soil borings (to map out the location of the perched zone clay), 6 monitoring wells, and 4 piezometers. The proposed boring and pilot study location is shown on Figure 4.

The next step in the pilot test involves the injection of the Regenesis PlumeStop™ into the subsurface to construct an initial 75-foot long by 20-foot wide barrier in the perched zone (Phase 1). Three rows of injection points (20 points each) will be used to construct the wall with an estimated vertical treatment interval of 5.5 feet (approximately 16.5 to 22 feet below ground surface). Phase 1 will be used to determine the effectiveness of the material. Based on a preliminary design, the following injection rates are proposed.

Injection of the phase 1 pilot barrier began on May 8th and will be completed in mid-May. Monthly groundwater samples will be collected from perched zone wells MW-38 through

MW-43 for three months following the injections to monitor the performance of the barrier. The groundwater samples will be analyzed for HFPO-DA and PFMOAA. A report describing the results of the bench and pilot scale testing will be submitted to NCDEQ by September 30, 2019.

Phase 2 of the pilot study (if required) will involve the installation of a second treatment barrier. Phase 2 will be designed based on the results of Phase 1 and will be used to refine the required application rates required for full scale implementation.

2.2.3 Permitting

This option will require obtaining an injection permit from NCDEQ. There are no other known permitting requirements for this option.

2.3 Option 3 – Hydraulic Control

Chemours is also considering a third possible approach. Under this third approach, a system to cut off groundwater flow from the manufacturing area to the south toward the Old Outfall 002 channel would be designed and installed. Reducing flow from this area would ultimately reduce the mass of PFAS discharging to Old Outfall 002. There are at present two options for obtaining hydraulic control:

- Cut-off wall (e.g., slurry wall) with upgradient trench
- Groundwater extraction from vertical or horizontal well(s)

The hydraulic control system would be installed in the upgradient area north of the Old Outfall 002 channel as shown on Figure 5. In the first option, a slurry wall would be installed and keyed into the clay confining unit below the Surficial Aquifer. A groundwater extraction system would be installed just upgradient of the wall. Groundwater would be extracted at a rate sufficient to prevent flow over the wall. The extracted groundwater would be treated with carbon. Treated groundwater could be discharged to the Cape Fear River or re-injected into the aquifer through injection wells located upgradient of the wall.

Hydraulic control could also be maintained through a series of horizontal or vertical extraction points. Extracted water would be treated and discharged in a similar manner as the first option.

The slurry wall would likely result in significantly lower flow rates and thus lower operational costs for the treatment plant as compared to hydraulic control by pumping alone. Re-injection of the treated effluent will require a non-discharge permit from NCDEQ; discharge to the Cape Fear River will require an NPDES permit similar to Option 1.

3.0 COMPARISON OF ALTERNATIVES

A complete analysis of each alternative is not practical until the two pilot studies have been completed. The pilot studies for Options 1 and 2 will be completed by September 30, 2019 as required by the CO. In addition, Chemours will want to incorporate any comments and feedback on this report from NCDEQ and Cape Fear River Watch into its selection of a proposed option. At this time, as part of the evaluation process, the screening guidelines for conducting feasibility studies as established by the United States Environmental Protection Agency (USEPA 1988) were preliminarily considered to compare the options. The remedial alternatives were preliminarily screened based on the following criteria:

- Technical Implementability
- Effectiveness
- Administrative Feasibility
- Cost

3.1 Technical Implementability

Technical implementability considers whether there are technical limitations that would preclude a technology from further consideration. Examples of these limitations are geologic or hydrogeologic conditions (e.g., a formation may not be amenable to effectively applying technologies requiring injections), depth of impact, type of constituents or the presence of limiting constituents (e.g., metals or conditions toxic to bacteria). At this time, there are no known technical limitations precluding any of the proposed remedial alternatives (although such limitations could be identified during the pilot studies for options 1 and 2). The impacted groundwater is relatively shallow and accessible. The geology and hydrogeology at the Site do not present obstacles to any of the proposed treatment options. The technology is readily available to install a slurry wall at the required depths.

3.2 Effectiveness

The alternatives were assessed based on four effectiveness criteria:

- Ability to meet remedial goals
- Protection of human health and the environment
- Whether the technology is proven or is an emerging technology
- Reliability

The application of GAC and IOX adsorption to remove the constituents from water in an ex-situ treatment system are proven, reliable technologies that can meet the remediation goals and are protective of human health and the environment.

The hydraulic control option is also a proven technology with reliability comparable to the capture and treat option. Hydraulic control would also be protective of human health and the environment (removing PFAS before it could reach the Old Outfall 002 channel). Capturing the groundwater before it reaches the channel will lower the surface water concentrations in the Old Outfall 002 channel. However, the time required to reach 99% removal under this option cannot be determined without additional data collection and modeling. Chemours is evaluating this option and determining the data needs.

The use of PlumeStop™ to sequester these constituents is still an emerging technology and the pilot study is required before a complete judgement can be rendered with regard to these criteria.

3.3 Administrative Feasibility

The evaluation of administrative feasibility covers such items as the ability to obtain permits, the availability of resources (e.g., space, power, backfill, or other utilities), and the availability of contractors or other suppliers required to perform the work. There are no known administrative limitations with the hydraulic control option. There are potential administrative limitations to capturing and treating the water (a number of permits are required from Federal, State, and Local agencies). The application of PlumeStop™ has no known administrative concerns.

3.4 Cost

Once the pilot studies are complete, costs will be considered in evaluating among those of the options that are found to meet the other selection criteria, discussed above. At this point, the design of each option has not progressed to the point where costs can be accurately calculated for the options.

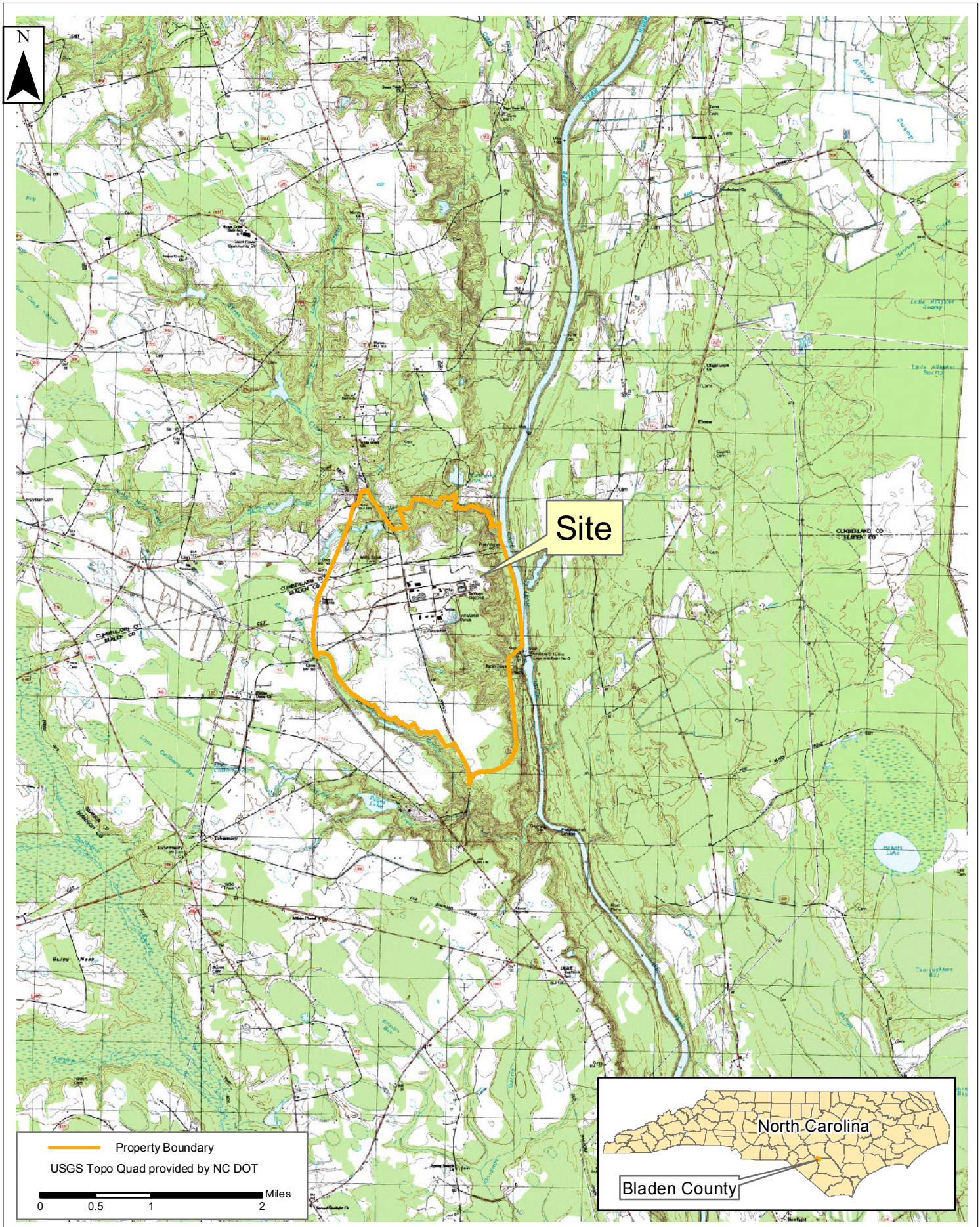
3.5 Summary

All three options appear to be technically and administratively feasible, assuming that all necessary approvals and permits are received in a timely fashion. Capturing and treating the water is anticipated to be effective at removing PFAS constituents. Additional studies are needed to estimate the effectiveness and time required to reach the remedial goals for the two alternative options.

4.0 REFFERENCES

USEPA 1988. Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA. EPA/540/G-89/004. OSWER Directive 9355.3-01.

FIGURES



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Site Location Map
Old Outfall 002 Remedial Options Plan
Chemours Fayetteville Works
Fayetteville, North Carolina

Drawn:	Date:	File Project Number:
C. Oneal	1/29/2018	450768
Revision: 1	Figure Number: 1	

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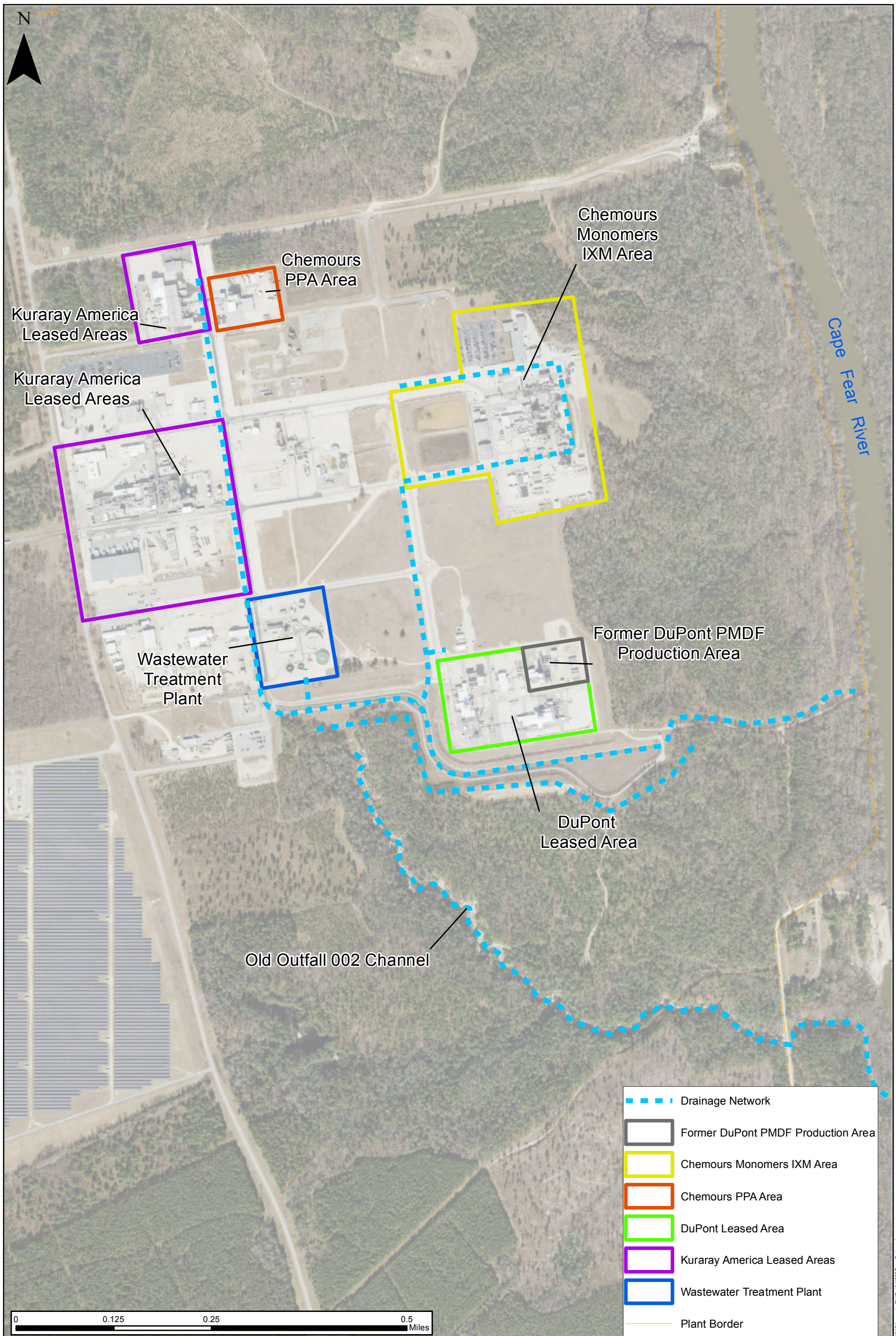

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Site Layout Map Old Outfall 002 Remedial Options
Fayetteville Works Facility
Fayetteville, North Carolina

Drawn:	Date:	File Project Number:
C. Oneal	5/20/2019	449338.01050
Revision: 1	Figure Number: 2	

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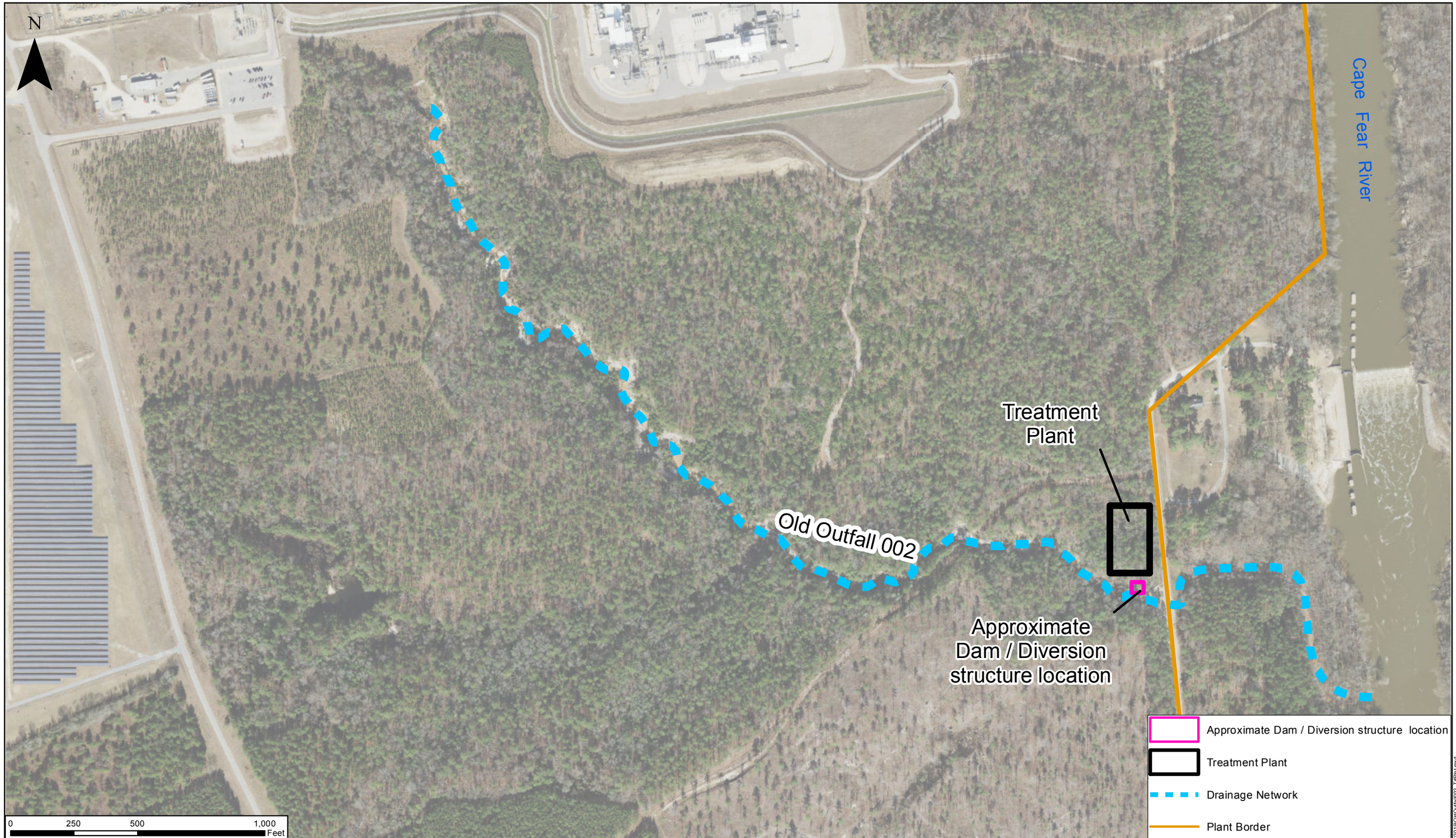

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Old Outfall 002 Capture and Treatment Area
Old Outfall 002 Remedial Options Plan
Fayetteville Works Facility
Fayetteville, North Carolina

Drawn: C. Oneal	Date: 4/8/2019	File Project Number: 449338.01050
Revision: 1	Figure Number: 3	
Name: OldOutfall002_TrtPlnt		

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Regenesis PlumeStop Performance Verification Testing
Old Outfall 002 Remedial Options Plan
Fayetteville Works Facility
Fayetteville, North Carolina

Drawn: C. Oneal	Date: 5/15/2019	File Project Number: 449338.01050
Revision: 1	Figure Number: 4	
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Proposed Hydraulic Control Option
Old Outfall 002 Remedial Options
Fayetteville Works Facility
Fayetteville, North Carolina

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