



**UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION III
1650 Arch Street
Philadelphia, Pennsylvania 19103-2029**

STATEMENT OF BASIS

FOR

**U. S. EPA UNDERGROUND INJECTION CONTROL (UIC) PROGRAM
DRAFT CLASS IID PERMIT NUMBER PAS2D701BALL**

FOR

**Penneco Environmental Solutions, LLC
6608 Route 22
Delmont, Pennsylvania 15626-0300**

FOR

A proposed project consisting of one Class II-D (produced fluid disposal) injection well, the Sedat #3A, used for the disposal of fluids produced with oil and gas production operations (hereinafter, "Injection Well", "Penneco Injection Well Sedat #3A", "Sedat #3A", or "the Facility"). The proposed injection well to be covered by this permit will be located in:

Plum Borough

**Allegheny County, Pennsylvania
Latitude 40° 31' 38.5" N Longitude -79° 42' 48.5" W**

Background: In 1989 Penneco Injection Well Sedat Well #3A was drilled to a depth of 4,320 feet and construction was completed resulting in a producing natural gas well, which produced through the Bradford Sandstone Formations. The well was hydraulically fractured at three depths and produced natural gas until 2015 when it was taken out of service due to low production. The well was plugged back to a depth of 1,940 feet, directly below the Murrysburg Sandstone injection zone, in accordance with Pennsylvania DEP regulations.

On March 9, 2016 Penneco Environmental Solutions, LLC ("Permittee") submitted to U.S. Environmental Protection Agency, Region III ("EPA") a UIC permit application for the operation of a brine disposal well. EPA sent a Notice of Deficiency (NOD) dated July 8, 2016 to Permittee requesting additional information. In response to the July 8, 2016 request, Permittee supplemented the original application with an initial response to the NOD dated September 10, 2016.. The Permittee's submittals dated March 9, 2016 and September 10, 2016 are collectively referred to in this Statement of Basis as the "Permit Application". Based on its review of the Permit Application, EPA has determined that the permit application is complete.

Pursuant to the federal Safe Drinking Water Act, 42 U.S.C. §§ 300f *et seq.*, and its implementing regulations, 40 CFR Parts 144-146, and § 147.1955, the EPA UIC Program is responsible for regulating, through the issuance of permits, the construction, operation, monitoring and closure of injection wells that place fluids underground for enhanced recovery of oil or natural gas or disposal. EPA intends to issue a UIC permit for Penneco Injection Well Sedat #3A, with conditions and terms as stated in the accompanying draft permit, unless information is received during the public comment period indicating that modifications to the draft Statement of Basis or the draft permit are warranted. The draft permit specifies conditions for construction, operation, monitoring, reporting, and plugging and abandonment, which are specified so as to protect and prevent the movement of fluids into Underground Sources of Drinking Water (USDW). The Permittee's UIC project and the draft permit conditions specific to this project are described below:

Area of Review: Pursuant to the applicable regulations, 40 C.F.R. §§ 144.3 and 146.6(b), the Area of Review "AOR" is "the area surrounding an injection well described according to the criteria set forth in § 146.06..." 40 C.F.R. §§ 144.3. Section 146.06 provides that the area of review for each injection well shall be determined according to either the zone of endangering influence ("ZEI") or by a fixed radius. The applicant must first research then develop a program for corrective action to address any wells which penetrate the injection zone and which may provide conduits for fluid migration. Penneco chose a one-quarter mile fixed-radius as the Area of Review around the proposed injection well. To determine whether the one-quarter mile fixed radius was acceptable, EPA conducted a zone of endangering influence (ZEI) calculation using geologic information pertinent to the injection zone as well as anticipated operational parameters provided to EPA by Penneco in its permit application. EPA determined, based on the ZEI calculation, that the one-quarter mile fixed radius Area of Review was acceptable. Permittee provided information on the well population within the ZEI by conducting reviews of Pennsylvania Department of Environmental Protection Bureau of Oil and Gas well records and conducting a field survey of the area. After extensive research of company, local, county and state well records five wells were identified that penetrate the injection zone within the Area of Review. All such wells have been thoroughly evaluated to document proper well construction and/or plugging and abandonment. The draft permit also requires Permittee to perform corrective action on any unplugged/abandoned wells that penetrate the injection zone within the Area of Review if they are identified at a future date.

Underground Sources of Drinking Water: A USDW is defined by the UIC regulations as "an aquifer or its portion" which, among other things, "contains a sufficient quantity of ground water to supply a public water system" and which also "[c]ontains fewer than 10,000 mg/l [milligrams per liter] total dissolved solids", and which is also "not an exempted aquifer" 40 C.F.R. § 144.3. The permittee has identified the lowermost USDW depth to be approximately 450 feet below surface elevation. Permittee has identified USDWs in the AOR in the Monongahela, Conemaugh, and Allegheny groups and notes that, based on two PA Geological Survey Water Resource Reports, "water quality is extremely poor beyond 500 feet in depth".

Well Construction: The Sedat #3A well has a 9 5/8 inch string of ground water protective surface casing running from 643 feet to the surface. This well construction exceeds the technical and generally accepted criteria of surface casing placement at no less than 50 feet below the lowermost USDW. See EPA, "Cementing Records Requirements in Direct Implementation Programs to Achieve Part II of Mechanical Integrity in Class II Injection Wells" (Jan. 27, 1999).

(https://www.epa.gov/sites/production/files/2015-08/documents/cementing_records_requirements_in_direct_implementation_programs_to_achieve_part_ii_of_mechanical_integrity_in_class_ii_injection_wells.pdf).

The permit application also indicates that the Sedat #3A well has 7 inch long string casing cemented from a depth of 1,948 feet to the surface as required by 40 C.F.R. § 147.1955(b)(5). Fluid will be injected via a 4 inch injection string set on a packer that is set above injection perforations and located at a depth of approximately 1,896 feet.

Injection and Confining Zones: Injection of fluids for disposal is limited by the permit to a 40 foot section of the Murrysville Sand Formation through a 4 inch injection string set on a packer at approximately 1,796 feet. This 4 inch tubing string is contained by a 7 inch cemented casing which has been perforated from 1,896 to 1,936 feet. The Murrysville Sand layer is 128 feet thick and lies between 1,822-1,950 feet at the wellsite. According to the applicant, the Murrysville Sand is a greenish-yellow to gray sandstone with occasional conglomeratic lenses and high porosity and permeability. This injection zone is separated from the lowermost USDW by an interval of approximately 1,400 feet, and is favorable for injection due to its highly permeable, porous structure that allows for the storage and accumulation of fluids under adequate confining conditions. Based on two porosity logs run for wells in the area of Sedat #3A, the average density porosity throughout the Murrysville Sand is approximately 24%. The applicant based their formation permeability value on a 2007 “Petrologic Study of the Murrysville Sandstone in NW PA” by Melissa Sager, which calculates permeability in the formation to have a range of 0.005 to 1,000 millidarcies (mD) with an average of around 100 millidarcies. Based on this study and a number of tests Penneco had conducted by HFrac Consulting Services, LLC, permeability at the Sedat #3A site is estimated to be 1.8mD.

According to the applicant, the driller’s log shows that the upper confining zone, located immediately above the injection zone, is comprised of the low permeability Riddlesburg Shale. The Riddlesburg Shale layer, a dark gray to greenish and grayish black laminated shale and siltstone layer with occasional sandstone and limestone beds, is approximately 80-90 feet thick in the Sedat #3A AOR.

The Riceville-Oswayo Shale, a dark gray to medium gray shale and siltstone layer, is the lower confining zone and is located directly beneath the Murrysville Sand. This layer is approximately 30 feet thick in the Sedat #3A AOR.

Maximum Injection Pressure: The maximum allowable surface injection pressure for the permitted operation will be 1,421 pounds/square inch (psi) at the surface which equates to a pressure of 2,332psi at a depth of 1,896 feet (the location of the top of the injection interval). These maximum pressures were developed based on an injection fluid specific gravity of 1.11 (**S.G. = 1.11**) and an injection depth of 1,896 feet. Injection pressure as well as annular pressure will be continuously monitored. The maximum injection pressure has been calculated to prevent the initiation of new or the propagation of existing fractures in the injection zone during operation of the Injection Well. EPA uses Instantaneous Shut-In Pressure (ISIP) as the basis for

determining maximum injection pressure limitations. ISIP represents the minimum downhole injection pressure required to hold cracks in rock open. This pressure limitation will meet the regulatory criteria of 40 CFR § 146.23(a). and the geologic properties derived from tests of the injection formation of the Sedat #3A Well.

Geologic and Seismic Review: The SDWA regulations for Class II wells do not require consideration of seismicity, unlike the SDWA regulations for Class I wells used for the injection of hazardous waste. See regulations for Class I hazardous waste injection wells at 40 C.F.R. §§ 146.62(b)(1) and 146.68(f). Nevertheless, EPA evaluated factors relevant to seismic activity such as the existence of any known faults and/or fractures and any history of, or potential for, seismic events in the area of the Injection Well as discussed below and addressed more fully in *“Region 3 framework for evaluating seismic potential associated with UIC Class II permits, September, 2013.”* EPA also established a maximum injection pressure in the draft permit designed to limit the potential for seismic events.

The permit provides that the Permittee shall inject through the Injection Well only into a formation which is free of known open faults or fractures within the Area of Review as required in 40 C.F.R. § 146.22. The Permittee submitted geologic information that indicates the absence of faults in the confining and injection zone. Although this does not conclusively demonstrate the absence of any faults in the area of the well, the probability of injection induced seismicity is low because permit conditions require the operator to operate the well at a pressure low enough so any existing fractures will not be activated.

Earthquake activity in Pennsylvania has been associated with the Precambrian, crystalline, igneous/metamorphic bedrock, sometimes referred to as “basement rock”, which is located below sedimentary bedrock. Earthquakes in Pennsylvania are commonly related to either faulting in the basement rock, or to faulting at a shallower depth caused by tectonic stresses that originated from the basement rock. The available geophysical and seismic information researched by the Permittee, as well as through EPA’s review of published information of seismicity in Pennsylvania, shows no evidence of faults that reach the land’s surface from basement rock.

The United States Geologic Survey (USGS) has not recorded any seismic activity that originated in Allegheny County, Pennsylvania (Search performed via <http://earthquake.usgs.gov/earthquakes/search/> on February 28, 2017). In addition, the National Academy of Sciences or National Research Counsel’s report, “Induced Seismicity Potential in Energy Technologies”, National Academy Press , 2013, indicates that oil and gas production in a reservoir can assist in preventing future impacts from seismicity due to injection because of the reduction in reservoir pore pressure during the years of gas production. Penneco identified in the Permit Application significant gas and oil production in the vicinity of the proposed Injection Well.

EPA developed the maximum injection pressure for the Injection Well using data submitted by Penneco in the permit application. Penneco provided to EPA fracture stimulation data obtained

by HFrac Consulting Services, LLC that included an instantaneous shut-in pressure (ISIP). The ISIP is the minimum pressure necessary to begin to reopen any fractures created during the fracture stimulation process and is significantly lower than the pressure required to fracture the rock. EPA limited in the draft permit the surface injection pressure and the bottom-hole injection pressure to a level lower than both the ISIP and the fracture pressure to prevent the initiation of new or the propagation of existing fractures.

Finally, a number of factors help to prevent injection wells from failing in a seismic event and contributing to the contamination of a USDW. Most deep injection wells, those that are classified as Class I or Class II injection wells, such as the Permittee's proposed Injection Well, are constructed to withstand significant amounts of pressure. The Penneco Injection Well Sedat #3A is constructed with multiple steel strings of casing that are cemented in place. Furthermore, the draft permit requires the Permittee to mechanically test the Injection Well to ensure integrity before operations begin and to continuously monitor the Sedat #3A Injection Well during operations to detect any potential mechanical integrity concerns. For the reasons above, the risk of seismic activity in Allegheny County as a result of the Sedat #3A Injection Well's operation would be very low.

Injection fluid: The permit limits this injection well to the disposal of produced fluids associated with oil and natural gas production activities with an expected maximum volume of 54,000 barrels per month. This is a proposed commercial disposal well, and disposal sources will be from oil and gas production facilities. This includes produced and flowback water from wells completed in natural gas and oil producing formations. To ensure that injection into this well adheres to permit requirements, the permit requires Permittee test the specific gravity of each truckload of fluid it receives for injection. Permittee also must test for total dissolved solids, pH, total organic carbon (TOC), and other parameters as stated in Part II, paragraph C.4 of the draft permit at the initiation of injection and every two years thereafter, and whenever the operator anticipates a change in the injection fluid (e.g., from different geologic formations, geographic regions, different customers, etc.). The parameters chosen for sampling reflect not only some of the typical constituents found in the injection fluid, but also in shallow ground water. Should a ground water contamination incident occur during the operation of the Injection Well, EPA will be able to compare samples collected from ground water with the injection fluid analysis to help determine whether operation of the Injection Well may be the cause for the contamination.

Testing, Monitoring and Reporting Requirements: The Permittee is required to conduct a two part mechanical integrity test (MIT) after completing construction of the well. The two part MIT consists of a pressure test to make sure the casing, tubing and packer in the well do not leak and a fluid movement test to make sure that the movement of fluid does not occur outside the injection zone. In addition to the monitoring described above, additional pressure testing of the casing, tubing and packer will occur every two years or whenever a rework on the well requires the tubing and packer to be released and reset. The Permittee will be responsible for monitoring injection pressure, annular pressure, flow rate and cumulative volume on a continuous basis and reporting this data to EPA on an annual basis. These tests as well as monitoring and cementing

records, will provide documentation as to the absence of fluid movement into or between USDWs and flow conditions that exist in the injection zone during operation, thus assuring that USDWs are protected.

In addition to MIT requirements, the Permittee has identified one well, Pennsylvania permit number 003-21210, which will serve as a monitoring well. The purpose of this well is to alert the Permittee of potential fluid movement. The Permittee notes in their application that the monitor well is 1,010' to the south west of Sedat #3A and has satisfactory spacing and placement to provide adequate sampling area.

Plugging and Abandonment: The facility has submitted a plugging and abandonment plan that will result in an environmentally protective well closure at the time of cessation of operations. Prior to EPA making any authorization to inject, the Permittee will also make a demonstration of financial responsibility that assures adequate resources will be maintained for well closure. These provisions should preclude the possibility of abandonment without proper closure.

Expiration Date: A final permit, when issued, will be in effect for ten years from the date of permit issuance. This proposed draft permit contains essentially the same conditions as a final permit unless information is supplied to EPA which would warrant alternative conditions or actions on this permit application.

Additional Information: Questions, comments and requests for additional information may be directed to:

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